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Editorial

Higher education is about promoting excellence in more ways than one: at individual level , it is an instrument of upward mobility through cultivation of excellence ; for national economy , excellence of work force is a prerequisite of sustained growth ; and for human kind , excellence is a must for extending the frontiers of knowledge and cultivation of values .Deepening of excellence requires simultaneous and multidimensional effort at improving the quality of higher education: generous support for individuals and institutions who work at the highest level and on the frontiers of knowledge in keeping with our context.

Higher education in India suffers from quality deficit in various respects .Very few Indian institutions have global recognition in terms of being centers of excellence in their field. It is essential that these islands of excellence be nourished and if possible expanded .The toughest challenge of excellence lies in improving the quality of teaching – learning in majority of non elite universities and colleges which continue to admit but found to do injustice to an overwhelming proportion of our talented students.

Since colleges enroll the vast majority of students in higher education, promoting a culture of excellence requires recognizing colleges as sites of creation and not just dissemination of ideas .Research capacities need to be encouraged and supported in taking up research including generation of innovative teaching–learning material .Further more an institution/university's contribution to knowledge is reflected in the publications it has made in the field of research and the number of Research degrees awarded.

Concurrent with the national attention towards expansion in higher education and for providing for equity, it is also necessary to ensure that quality and excellence are sustained and upgraded in all the institutions of Higher Education to match up to international levels.

In this context with immense pleasure, we are presenting the special issue of our interdisciplinary/multidisciplinary journal "Journal of Current Studies" before the academic community to commemorate the silver jubilee year. It is encouraging that the Journal is now receiving both higher quality and greater volume of

manuscript submissions. Being a multidisciplinary Journal, this special issue includes a broad range of papers representing various disciplines such as Chemistry, Physics, Economics, English, Commerce, Environmental science, Zoology and Biotechnology. Altogether Ninteen regular research papers and one article on educational philosophy are included in the current volume which represents the vol.no.3, issue no.1.july2013.

Looking forward to the future we can assure that the journal will continue to deliver the best of recent developments in different disciplines and publish good quality findings of high significance and relevance. On this occasion, we extend our sincere appreciaton of the college Management and the Principal, to the valued contributors and readers for their continued interest in JCS. Last but not the least, let us all gratefully acknowledge the magnanimity, benevolence and the constant encouragement of the College Manager, Principal who provide the full financial support to this endeavour.

We acknowledge the help, encouragement and criticism from various quarters. We admit all the short comings and commit ourselves to continous evaluation and improvement.

With warm regards   **Dr. M.G. Ramesh Babu**
                                                                       Chief Editor

Contents

MODIFICATION OF NATURAL RUBBER BY EPOXY RESIN

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Abstract

This paper investigates the effect of addition of epoxy resin (DGEBA) to NR prior to compounding and curing. Both commercial and synthesized epoxy resins have been employed. Only small amounts of the resin were added (1-4 %). There is a considerable improvement in the age resistance of NR vis-à-vis tensile strength and tear strength. The oil resistance of NR is also seen to improve on addition of the resin. Although there is no improvement in thermal degradation properties, the overall effect of addition of epoxy resin on the properties of NR has been positive.

1. Introduction

Natural rubber (NR) is a low cost material with excellent physical properties such as resilience, high tensile strength, superior resistance to tear and abrasion, tack and self adhesion. However, being highly unsaturated, it is easily attacked by heat, oxygen, ozone and chemicals leading to degradation of polymer chains and deterioration of properties (1). It is not resistant to petroleum based oils and fuels as it contains no polar groups. This has also limited its applications at high temperature and in hydrocarbon environments. Attempts have been made to improve the ageing characteristics of NR by blending with rubbers that are inherently resistant to ageing (2, 3). Alternatively, natural rubber vulcanizates can be given better aging resistance by a suitable choice of vulcanization systems and the use of antioxidants, antiozonants and waxes (4). Different types of coatings are also sometimes given for rubber products to improve age resistance (5).

The mechanical properties of crosslinked natural rubber undergo a marked change on heating with deterioration in elasticity and strength. The behavior of rubber when exposed to high temperatures is strongly influenced by the presence or absence of oxygen. More than half of the total change observed on ageing can be attributed to oxidation processes (6). Reaction with oxygen causes chain scission and further crosslinking. After oxidation a vulcanizate softens or stiffens depending on whether chain scission or crosslinking is more extensive (7, 8).

Blending with different thermoset resins has been employed as a means for curing rubber

as well as modifying the properties (9, 10). Epoxy resins are one of the most versatile materials used in industrial applications .They have excellent mechanical and chemical properties and fairly good temperature resistance (11, 12). Dr. Hani (13) has investigated a new composite material using natural rubber with epoxy resin, the natural rubber being used as a matrix material and epoxy resin and carbon powder as the reinforcement. This study investigates blending of epoxy resins with natural rubber for improvement of thermal ageing and oil resistance properties. Epoxy resins used for the present study consisted of commercial resin and samples synthesized in the laboratory.

2. Experimental

2.1 Raw materials

Bisphenol A (LR, M.W=228.29, 97% assay, MP=154-157°C) and epichlorohydrin (LR, M.W=92053, 98% assay, BP=114-118oC) were supplied by Research Laboratory, Mumbai, India. Benzene (M.W=78, 98% assay) and caustic soda (M.W=40, 97.05% assay) were obtained from E. Merck India Ltd, Mumbai. Commercial grade Epoxy Resin 103, and the room temperature amine hardener 301(Polyamine) were supplied by M/S Sharon Engineering Enterprises, Cochin.

Natural rubber (ISNR5) was obtained from Rubber Research Institute of India, Kottayam.

Zinc oxide was obtained by M/S Meta Zinc Limited, Mumbai. Stearic acid was supplied by M/S Godrej Soaps Pvt Ltd, Mumbai. Mercapto

benzo thiazol sulphenamide (MBTS) was supplied by M/S Bayer Chemicals, Mumbai. Tetramethyl thiuram monosulphide (TMT) was obtained from M/S Polyolefine Industries, Mumbai. Sulphur was supplied by M/S Standard Chemicals Co. Pvt. Ltd. Chennai.

2.2 Preparation of epoxy resin (DGEBA) (14)

Bisphenol A (1mole) was dissolved in a mixture of an excess of epichlorohydrin (6 moles) and 50cc water in a one litre three necked flask. The flask was equipped with a mechanical stirrer, thermometer and a Liebig's condenser. The mixture was heated gently (95-100°C) over a water bath till the epichlorohydrin began to boil. Heating was stopped and caustic soda (2 moles) was added two pellets at a time down the condenser. The reaction was allowed to subside before more alkali was added. When all the caustic soda pellets had been added, the reaction mixture was heated for 45 minutes. Heating was stopped as the reaction mixture turned viscous. The excess epichlorohydrin was removed by vacuum distillation. The remaining mixture was extracted with benzene to precipitate sodium chloride which was removed by filtration under vacuum. The filtrate was distilled in vacuum to remove benzene and dried in vacuum for about 3 hours. The resin formed was a pale yellow viscous and glassy liquid. The properties of the resin thus synthesized were compared with those of the commercial epoxy resin.

2.3 Characterization

Both synthsised resin and the commercial grade resin were subjected to the following characterization test.

Epoxide equivalent (Weight per epoxide)

The epoxy content of liquid resins is expressed as weight per epoxide (wpe) or epoxide equivalent which is defined as the weight of the resin containing one gram equivalent of epoxide. The epoxy content can also be expressed as equivalents / Kg of the resin. A common method of analysis of epoxide content of liquid resins involves the opening of the epoxy ring by a hydrogen halide (hydrohalogenation). Weight per epoxide values of the synthesized and commercial epoxy resins were determined by the pyridinium chloride method as per ASTM D 1652-73.

0.1 to 0.2 g of the epoxy resin was mixed with 2ml HCl in 25ml pyridine. The mixture was heated to reflux on a water bath for 45 minutes. The solution was cooled to room temperature and the unreacted acid present in it was estimated by back titration with standard NaOH solution (0.1N) using phenolphthalein indicator. A blank experiment was also carried out under the same reaction conditions.

Epoxide equivalent = N x V/w, where N is the strength of the alkali, V the volume of the alkali used up and w the weight of the resin. Epoxide equivalent is obtained as eq/Kg from which wpe value of the resin can be calculated.

2.3 Compounding and moulding of NR

Mixes were prepared on a laboratory size two roll mill (16x33cm) at a friction ratio of 1:1.25. The mixing was done according to ASTM D 3184-89. The epoxy resin was incorporated into the gum rubber while compounding on the two roll mill. Before addition, the epoxy resin was mixed with 10% by weight of a room temperature amine hardener. The resin was added prior to adding accelerator and sulphur to the n rubber compound. The formulations of the mixes are given in Table 1.

Cure characteristics of the mixes were determined at 150°C using Rubber Processing Analyser RPA 2000 supplied by Alpha Technologies, USA as per ASTM standard, D 2084-01. Vulcanization to optimum cure time was then carried out in an electrically heated hydraulic press at 150°C. The moldings were cooled quickly in water at end of the curing cycle and stored in a cool dark place for 24 hours prior to physical testing.

2.4 Physical testing of vulcanizates

The vulcanizates were tested for different mechanical properties according to relevant ASTM standards.

a) Tensile tests: The tensile properties (ASTM D 412) were determined using dumb-bell shaped specimens. Tear tests (ASTM D 624) were done using Type C un-nicked test pieces with a 90° angle and tab ends. Both samples were punched out from vulcanized sheets. The measurements were carried

out on a Shimadzu (Model AG1) Universal Testing Machine (10 KN) with a grip separation of 40mm, at a crosshead speed of 500mm/min.

b) Hardness: The hardness of the sample (Shore A) was determined using Zwick 3114 Hardness Tester according to ASTM D-2240

2.5 Ageing tests

Ageing tests were carried out on cured rubber samples for 72 hours in accordance with ASTM 573-04 using an air oven at 70°C. Tensile properties and tear resistance of the samples were determined after 24 hours of conditioning at room temperature.

2.6 Oil swelling studies

Oil resistance of the samples was estimated using methods outlined in ASTM D 471:98. Test specimens of circular shape (diameter 20 mm and thickness 2 ± 0.1 mm) punched out from tensile sheets were immersed in hydraulic oil for 3 days at room temperature and the percentage weight of oil absorbed was calculated from measurement of the swollen weight.

2.7 Soxhlet extraction

Known weights of different samples of vulcanized rubber were packed in Wattman 1 filter paper and extracted in a Soxhlet apparatus using acetone as solvent and the loss of weight (%) was noted

2.8 Thermogravimetric analysis

Thermogravimetric analysis was carried out using a TA Instruments Model TGA Q50 analyzer at a heating rate of 20°C in nitrogen atmosphere. Thermograms were recorded from room temperature

to 800°C. The onset of degradation, the temperature at maximum degradation and residual weight in percentage were noted.

2.9 Crosslink density

Swelling studies on the vulcanizates were done using toluene and crosslink densities calculated. A test sample of 10 mm diameter and 2 mm thickness was punched out from the central portion of the vulcanizate. It was accurately weighed and immersed in toluene in a closed vessel for 24 hours. The swollen sample was taken out and weighed. The sample was kept in vacuum air for complete drying (removal of solvent) and the dry sample weighed. The volume fraction of the rubber V_r can be calculated from the relation

$$V_r = \frac{(D-FT)\rho_r^{-1}}{(D-FT)\rho_r^{-1} + A_0\rho_s^{-1s}}$$

where, F = weight fraction of the insoluble components. It is the ratio of the sum of the weights of components like ZnO, fillers etc. which are insoluble in the solvent and total weight of all components as per the compounding recipe.

ρ_r = density of rubber (g/cc)

ρ_s = density of the solvent

A_o = weight of the solvent absorbed (W-D)

Crosslink density is found out using Flory-Rehner equation (15).

$$CLD = \frac{-\left[\ln(1-V_r) + \chi V_r^2\right]}{2\rho_r V_s (V_r)^{1/3s}}$$

where,

V_s = molar volume of the solvent

χ = interaction parameter of the rubber with the solvent

3. Results and Discussion

The FTIR spectra of the synthesized epoxy resin and the commercial sample were compared. The C-H stretching in epoxies is at 2960- 2990 cm^{-1}. Symmetrical stretching or breathing frequency is observed at 1231cm-1 and this is characteristic of the epoxy ring. The bands at 913 cm^{-1} (asymmetric ring stretching in which C-C stretches during contraction of C-O bond), 827 cm^{-1} and 757 cm^{-1} are typical of epoxy group. Both samples showed these characteristic features.

The epoxide equivalents of commercial and synthesized epoxy resins were determined as 5.33 and 5.52 Eq/Kg respectively. The synthesized resin has greater epoxy content than the commercial sample.

Cure characteristics of the vulcanizates are shown in Table 2. Curing studies indicate that for each mix cure time decreases with resin content up to 2% but increases beyond that value (Fig.1). The initial decrease in cure time indicates that the incorporation of resin promotes the cure reaction of NR. This can be due to interpenetration between the resin and the rubber molecular chains. Scorch time decreases with resin content. This is attributable to the heat of mixing resulting in premature curing of the compound. Minimum torque increases with resin content and maximum torque increases upto 2% and subsequently decreases slightly. The influence of resin content

on the torque values point to interaction between the rubber and resin.

Fig.2 shows the variation of tensile strength on addition of various percentages of resins, both commercial and synthesized, to the rubber. Both resins show a maximum tensile strength at 3%. Any interpenetrating effect between the rubber and the resin is likely to be maximum at this percentage. Presumably the dispersion of the resin is not effective at higher percentages resulting in filler like behavior.

Tear strength (Fig.5) also increases with resin content upto 3%. The improved tear strength also points to interpenetration. The marginal improvement in tensile modulus (Figs.3) on addition of resin is also indicative of some extent of interpenetration. Although initially there is a stiffening of the rubber chains resulting in an improvement in modulus, the trend reverses on adding higher percentages. Hardness (Fig.6) also shows improvement upto 2% of the resin.

Elongation at break is governed by the extent of crosslinks present at the time of rupture after all interpenetration has been cleared. The presence of the resin and interpenetration negatively influence crosslinking between rubber chains to some extent. Hence the increase in elongation at break on addition of the resin (Fig.4).

Fig.8 shows the variation in weight loss on extraction with acetone. There is only a moderate increase in weight loss with resin content on extraction. The low extractability of the resin from the rubber proves that the resin has either

undergone crosslinking between its own chains or taken part in interactions with the rubber chains. On close examination of the curves of Fig.8 it is seen that upto 2% resin, the curves are rather flat. Beyond 3% the curves become steeper indicating higher weight losses on extraction. Hence it is possible to suppose that in this range the resin is more extractible being dispersed less effectively in the rubber matrix.

Figs. 9 and 10 depict the variation of retention of tensile and tear strengths of different samples after ageing at 70°C for 72 hours. In the absence of the resin the percentage retention of tensile strength after 72 hours of ageing is only about 55 % (Fig.9). On addition of resin this value increases steadily until at about 4% it is almost 100-115% of the original tensile strength. Similarly in the case of tear strength there is a steady improvement in tear strength retention with resin content. The prolonged ageing process may help to make the crosslinking reaction of resin and/or chemical interaction between the rubber and the resin to go to completion. Hence the improvement in these two properties on ageing.

Fig. 11 shows that the addition of resin dramatically reduces the percentage mass of oil absorbed over a 72 hour period. Here again a 20-30% decrease is possible with only just 2% of resin. The presence of the resin in the crosslinked condition has made the rubber less penetrable for oil. Moreover, the polar nature of the resin reduces the interaction between the rubber chains and oil.

Fig.12 shows the variation of crosslink density of NR vulcanizates with resin content. Crosslink density increases with resin content upto 1-2% and after that at higher percentages, it falls. The increase in crosslink density is attributable to possible chemical interactions between the rubber and resin as well as interpenetrating effects. Poor dispersion of the resin may be the reason for the lowered crosslink density at higher percentages.

Thermogravimetric data of NR vulcanizates are given in Table 3. From the table it can be seen that the onset of degradation temperature, temperature at maximum degradation, temperature at 50% degradation and residue content are all similar.

Table 1. NR formulation for varying resin content

Sample	NR (phr)	Resin (%)	ZnO (phr)	St.acid (phr)	MBTS (phr)	TMT (phr)	S (phr)
1	100	0	4	2	0.8	0.2	2.5
2	100	1	4	2	0.8	0.2	2.5
3	100	2	4	2	0.8	0.2	2.5
4	100	3	4	2	0.8	0.2	2.5
5	100	4	4	2	0.8	0.2	2.5

Table 2. Cure characteristics

Properties	NR 0%	NR+com.EPR				NR+syn.EPR			
		1%	2%	3%	4%	1%	2%	3%	4%
Scorch time(min)	3.21	1.07	0.83	0.79	0.84	1.58	0.95	0.80	0.65
Cure time(min)	5.6	2.88	3.29	5.74	12.1	3.39	2.26	2.26	2.78
Min.torque(dNm)	0.013	0.02	0.019	0.03	0.033	0.016	0.04	0.055	0.072
Max.torque(dNm)	2.661	2.791	2.467	2.203	2.105	2.857	3.011	2.756	2.295

Table 3. Characteristics of thermograms of NR vulcanizates

Sample	Onset degradation temperature ($^{\circ}$C)	Temperature at 50% degradation ($^{\circ}$C)	Temperature at maximum degradation ($^{\circ}$C)	Rate of degradation at maximum degradation (%/$^{\circ}$C)	Residue (%)
NR	312.72	388.99	384.23	1.55	4.297
NR+EPR(com)	313.98	385.76	380.76	1.598	4.494
NR+EPR (syn)	318.49	394.37	391.63	1.485	5.024
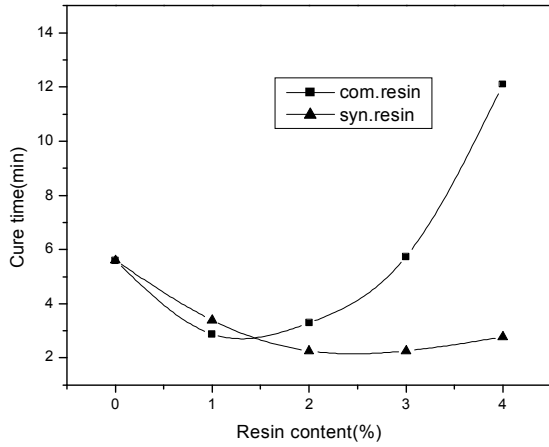
Figure 1: Variation of cure time with resin content

Figure 2: Variation of tensile strength with resin content

Figure 3 Variation of 300% modulus with resin content

Figure 4 Variation of elongation at break with resin

Figure 5 Variation of tear strength with resin content
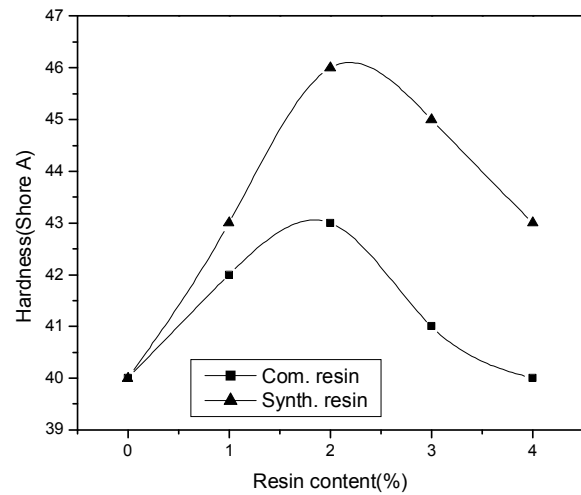
Figure 6 Variation of hardness with resin content
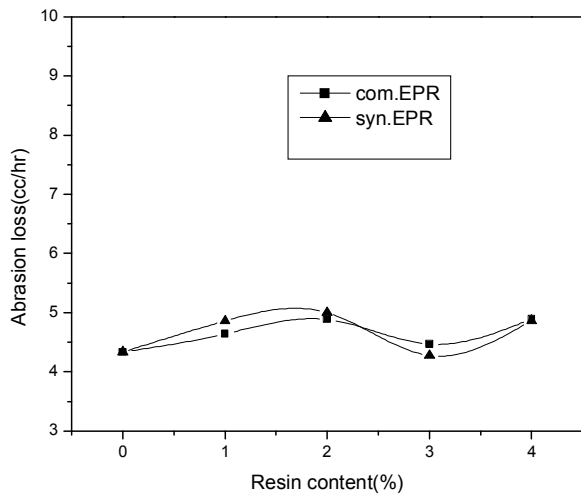
Figure 7 Variation of abrasion loss with resin content
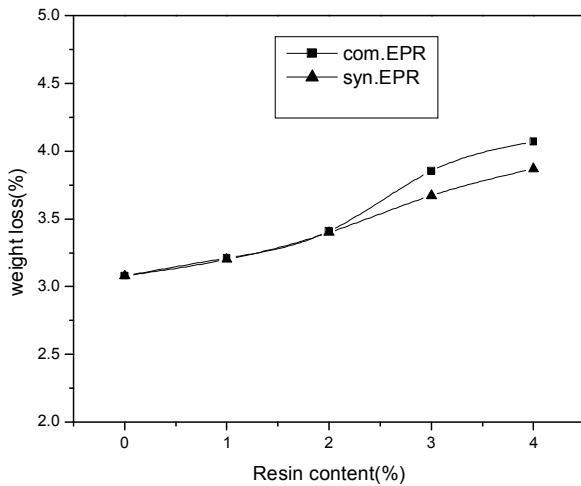
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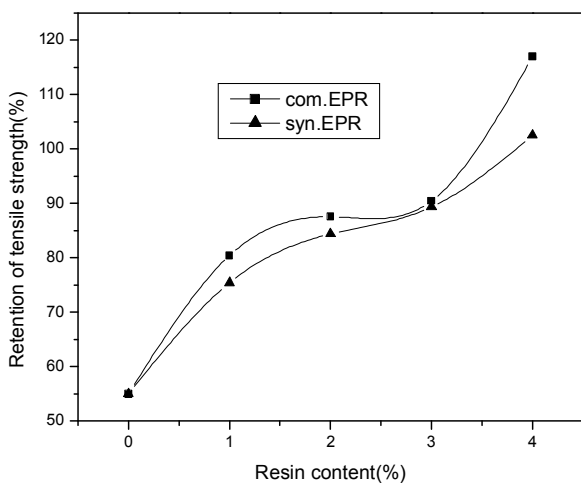
Figure 9. Variation of retention of tensile strength on ageing at 70°C for 72 hrs
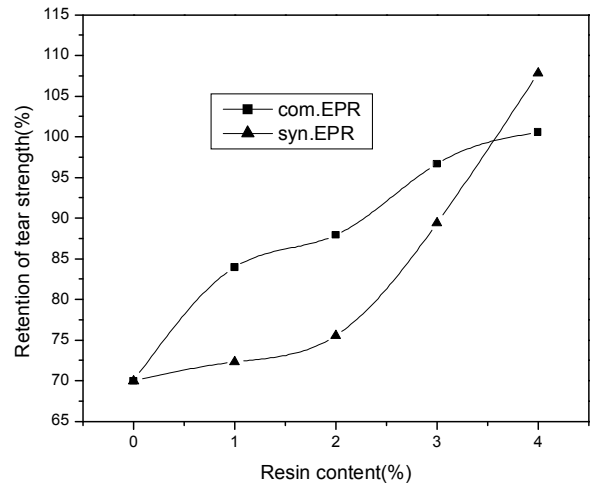
Figure 10. Variation of retention of tear strength on ageing at 70°C for 72 hrs
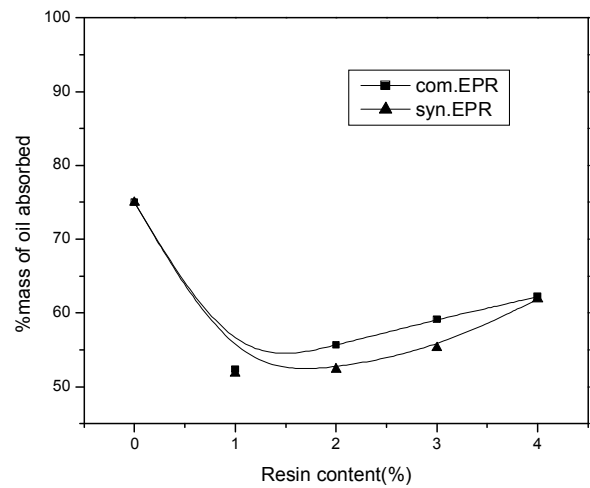
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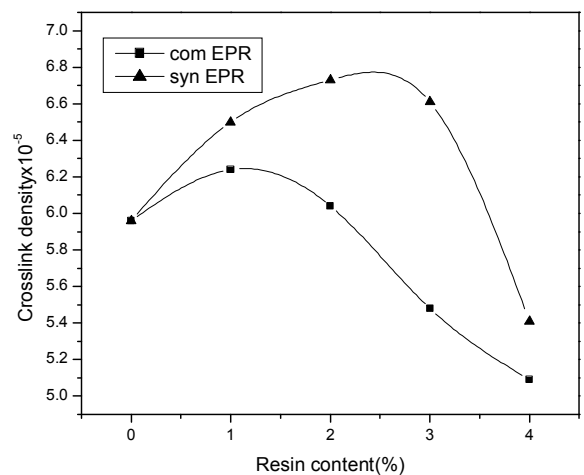
Figure 12. Variation of crosslink density with resin content

4. Conclusions

There is improvement in tensile strength and tear strength of NR on addition of epoxy resin, both commercial and synthesized. The age resistance of NR shows a clear improvement on addition of resins from the view point of tensile strength and tear strength after ageing. The blending with the resin has considerably improved the oil resistance of NR. There is only a moderate increase of weight loss on extraction with acetone after adding various percentages of resin which indicates that most of the resin has been chemically incorporated into the rubber matrix. The thermal degradation characteristics of NR modified by epoxy resin show only a moderate improvement on addition of resin.

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CONFORMATIONAL ANALYSIS OF BIPYRIDINE, PYRYLPYRIDINE, THIOPHYLPYRIDINE AND FURYLPYRINE-A QUANTUM MECHANICAL APPROACH

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Abstract

Bipyridine, pyrylpyridine, thiophylpyridine and furylpyrine are composite molecules having two subsystems connected together by single bond. The constituting subsystems can rotate freely around the single bond linking together. The energies of different conformers of these molecules are calculated using Hartree Fock theory. For bipyridine and furyl pyridine the most stable state is when the tortsionl angle is 180^0. For pyrylpyridine and thiophylpyridine the most stable state is when the torsional angle is 0^0, with the torsional angle 180^0 differing very slightly in energy. In all cases torsional angle 90^0 corresponds to transition state.

Keywords: *Activation energy, Computational Chemistry, Torsionangle, Atrop Isomers*

Introduction

Groups bonded by only a sigma bond can undergo rotation about that bond with respect to each other. The temporary molecular shapes that result from the rotation of groups about single bonds are called conformations of a molecule (conformational isomers). An analysis of the energy changes associated with the molecule undergoing rotation about single bond is called conformal analysis. There are compounds that have such a large rotational barrier between conformers and some of the conformers are stereo isomers. Conformational isomers that are stable isolable compounds are called Atrop isomers. For e.g.: biphenyl, bipyrryls, etc.

Computational chemistry [1] simulates chemical structures and reactions numerically, based in full or in part on the fundamental laws of physics. It allows chemist to study chemical phenomena by running calculations on computers rather than by examining reactions and compounds experimentally.

Some methods can be used to model not only stable molecules but also short lived, unstable intermediates and even transition states [2]. In this way, they can provide information about molecules and reactions which is impossible to obtain through observations. Computational chemistry is therefore both an independent research area and a vital adjunct to experimental studies [3].

In the present work, we study the conformational analysis of bicyclic aromatic compounds containing nitrogen or oxygen in the ring using ab initio method; in particular we

analyse bipyridine, pyrylpyridine, thiophylpyridine and furylpyrine.

Computational Aspects

All calculations were performed using Gaussian 03 [4]. We use the Hartree Fock model and 6-31G(d)basis set. The structures for the rotational barrier were optimised with respect to all coordinates except for the torsional angle defined by the concerned atoms. The keyword) Opt= ModRedundant Freq is used for this [5]. Activation energy is calculated by subtracting the zero point energies of reactants from the zero point energies of transition state in the output.

Results and Discussion

The optimized structures for the transition state and stable minima are given in the following figures.
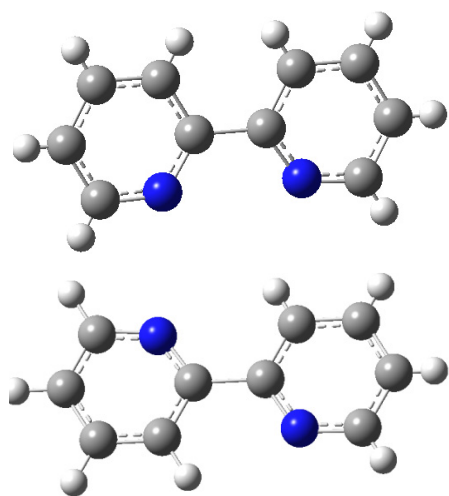
Fig. 1 biphenyl (torsional angle 0^0- unstable) and biphenyl (torsional angle 180^0- stable)
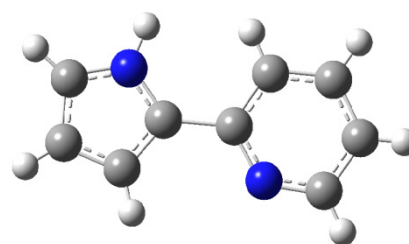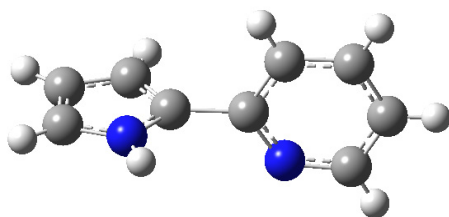
Fig. 2 pyrylpyridine (torsional angle 90^0- unstable) and pyrylpyridine (torsional angle 180^0- stable)
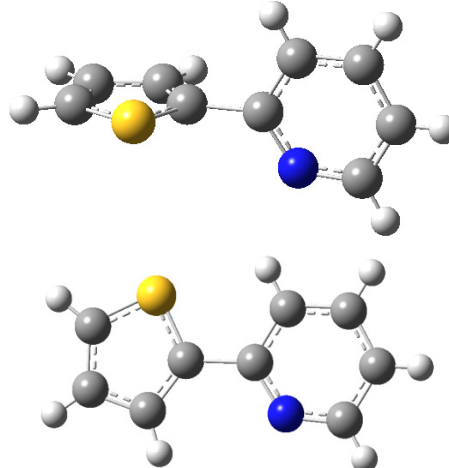
Fig. 3 thiophylpyridine (torsional angle 90^0- unstable) and thiophylpyridine (torsional angle 180^0- stable)
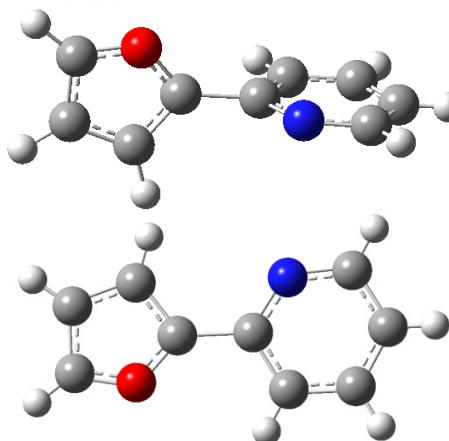
Fig. 4 furylylpyridine (torsional angle 90^0- unstable) and furylylpyridine (torsional angle 180^0- stable)

The results of the energy calculations for different torsional angles of the molecules bipyridine, pyrylpyridine, thiophylpyridine and furylpyrine are summarized in the following table.

Table 1 Energies of bipyridine, pyrylpyridine, thiophylpyridine and furylpyrine at various torsional angles.

Angle degrees	Energy-bipyridine Kcal/mole	Energy-pyrylpyridine Kcal/mole	Energy-thiophylpyridine Kcal/mole	Energy-furylpyridine Kcal/mole
0	-308882.4476	-285118.3301	-500024.2786	-297548.6222
30	-308883.8909	-285116.9498	-500023.6879	-297548.9895
60	-308883.3261	-285112.9336	-500021.4288	-297548.9330
90	-308883.1278	-285109.4195	-500019.6037	-297544.7033
120	-308884.6589	-285111.0510	-500021.1151	-297547.0442
150	-308885.0240	-285113.3728	-500023.3114	-297550.8093
180	-308890.7935	-285113.6866	-500023.9154	-297552.1583
210	-308885.0240	-285113.3728	-500023.3114	-297550.8093
240	-308884.6589	-285111.0510	-500021.1151	-297547.0442
270	-308883.1278	-285109.4195	-500019.6037	-297544.7033
300	-308883.3261	-285112.9336	-500021.4288	-297548.9330
330	-308883.8909	-285116.9498	-500023.6879	-297548.9895
360	-308882.4476	-285118.3301	-500024.2786	-297548.6222

The energy profiles of the molecules bipyridine, pyrylpyridine, thiophylpyridine and furylpyrine are given in the following figures.
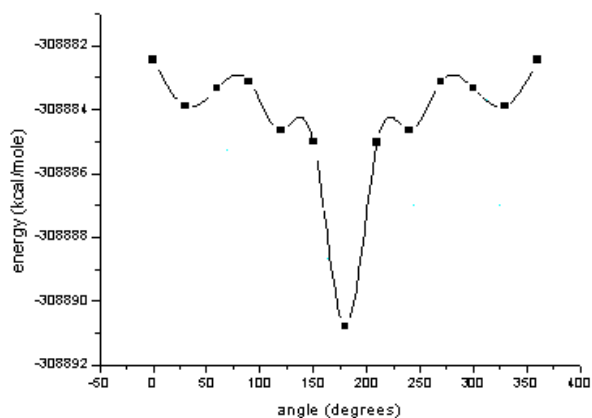
Fig. 5 Energy profile of bipyridine
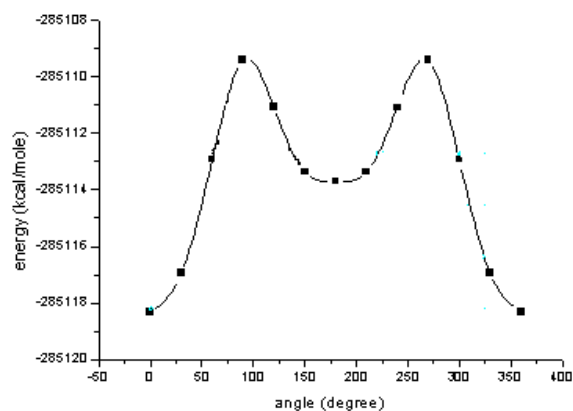
Fig. 6 Energy profile of pyrylpyridine
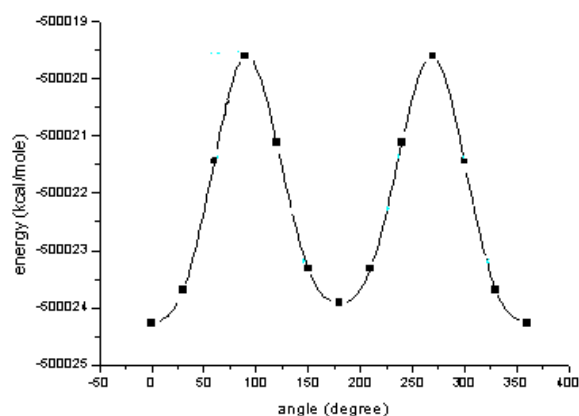
Fig. 7 Energy profile of thiophylpyridine
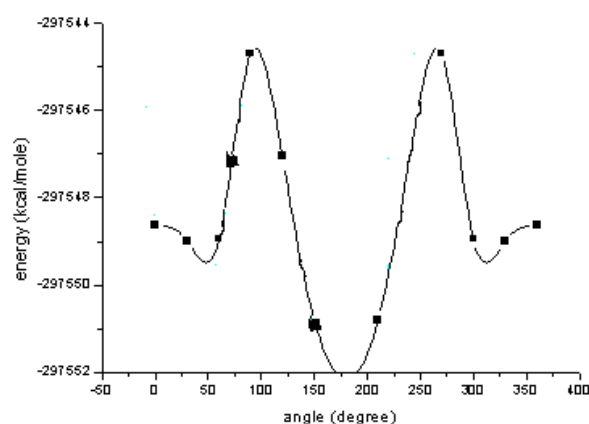
Fig. 8 Energy profile of furylpyridine

For bipyridine and furyl pyridine the most stable state is when the tortsionl angle is 180^0. There is a strong stabilization of the coplanar nitrogen *anti* conformation. For pyrylpyridine and thiophylpyridine the most stable state is when the torsional angle is 0^0, with the torsional angle 180^0 differing very slightly in energy. In all cases torsional angle 90^0 corresponds to transition state. This is confirmed by the appearance of only one imaginary frequency.

The rotational energy barrier for bipyridine is only 6.1346 kcals per mole. In the case of pyryl pyridine the energy needed to cross the barrier starting from 0^0 is 8.9106 kcals and from 180^0 is

4.6435 kcals. For thiophyl pyridine the corresponding values are 4.6749 kcals and 2.3117 kcals. For furyl pyridine the most stable state is that of torsional angle 180^0. To cross over the transition state at least 7.455 kcals of energy is needed.

Conclusion

In this work we calculated the energy values of bipyridine, pyrylpyridine, thiophylpyridine and furylpyrine at various torsional angles using ab initio method. We located the transition states and minima and calculated the activation energies for rotation.

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SYNTHESIS AND CHARATERIZATIOM OF POLYPYRROLE AND POLYPYRROLE COATED NYLON-6 FIBER

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Abstract

Pyrrole was polymerized in the presence of anhydrous ferric chloride as oxidant and p-toluene sulphonic acid as dopant. Polypyrrole coated Nylon fibers were prepared by polymerizing pyrrole in the presence of Nylon fibers. The reaction conditions were optimized to get a uniform coating of polypyrrole on Nylon. The resultant polypyrrole(PPy) and polypyrrole-coated Nylon fiber(F-PPy) were characterized using Infrared spectroscopy(IR), Scanning electron microscopy(SEM) and X-ray diffraction (XRD). DC conductivity of PPy and F-PPy was determined by a two probe method. The thermal stability of PPy, virgin Nylon fiber(F_v) and F-PPy was studied using thermogravimetric analysis (TGA). Differential scanning calorimetry (DSC) was used to determine the glass transition temperature(T_g) of PPy, Fv and F-PPy.The PPy coated fiber finds application as a strain sensor.

Key words*: Polypyrrole, Nylon fiber.*

1. Introduction

The intrinsically conducting polymers, which are organic polymers that possess the electronic, magnetic, electrical and optical properties of a metal have been attracting the attention of countless of group of researchers all over the world because of their potential application in modern technology. These characteristics turn conducting polymers into the category of so-called ' synthetic metals'. Outstanding properties in one area alone, for example, conductivity, is not necessarily a guarantee of practical utility. The unique properties of conducting polymers stem from: (1) the possibility of fine tuning the conductivity by adjusting the amount of dopant incorporated within the polymer, ie., by proper doping, the conductivity of these materials can be varied from insulator to semi conducting and then to metallic range. (2) doping/dedoping reversibility, ie., if doping is achieved by an oxidant, treatment with a reducing agent gives back the neutral polymer, the insulator and vice versa. (3) the optical absorption characteristics in UV-visible and near IR spectra as well as its electromagnetic absorption characteristics. These unique properties have led to the existence of wide and diversified applications for conducting polymers, such as antistatic coating, conductive adhesives, electromagnetic shielding, printed circuit boards, artificial nerves, aircraft

structures, molecular electronics, electrical displays, sensors, rechargeable batteries, electromechanical actuators , etc.[1-3]. Advantages of conducting polymer based devices compared to conventional semiconductor materials are: low weight, low cost, flexibility, colour change during oxidation/reduction and ability to cover large surface areas. The main disadvantage of conducting polymers is its poor processability. Without processability, the appreciation for conducting polymer would be limited one. Incorporation of conducting polymer into a host polymer substrate, forming a blend, composite or interpenetrated bulk network has been used as an approach to combine electrical conductivities with desirable mechanical strength of polymers [4].

Amongst the conducting polymers, polypyrrole(PPy) is one of the most studied one because of its high electrical conductivity, environmental stability and ease of synthesis[1]. Chemical polymerization of pyrrole is simple and fast process for the preparation of PPy. The most widely used oxidants for chemical oxidative polymerization of pyrrole are ammonium persulphate (APS) and ferric chloride ($FeCl_3$). Iron (III) chloride has been found to be the best chemical oxidant and water is the best solvent for chemical polymerisation with respect to desirable conductivity characteristics [5]. The overall stoichiometry resulting from chemical polymerisation of PPy with ferric chloride oxidant is shown in Fig.1.
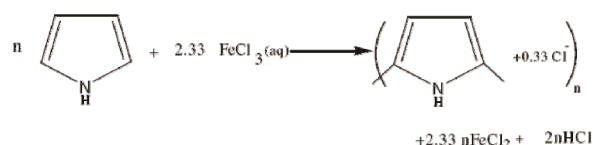
Figure 1 Chemical polymerization of pyrrole

The optimum initial mole ratio of Fe (III)/Pyrrole for polymerisation by aqueous iron(III) chloride solution has been found to be 2.25 or 2.33[6]. However, as any other conjugated conducting polymer, PPy lacks processability, flexibility and strength. This can be improved either by forming copolymers of polypyrrole or by forming polypyrrole composites or blends with suitable, commercially available polymers.Composites of PPy with many polymers such as poly(methyl methacrylate), poly(vinyl carboxyethylether),poly(ethylene terephthalate)(PET) fabrics, natural and synthetic rubbers, chlorinated polyethylene etc. have been reported[7-11].

This work describes the preparation and characterization of PPy and PPy coated Nylon-6 fibers (F-PPy). Optimization of coating conditions are also discussed. Infrared spectroscopy (IR), Scanning electron microscopy (SEM) and X-ray diffraction (XRD) analysis are used to characterize the PPy and F-PPy. DC conductivity of PPy and F-PPy is determined by a two probe method.The thermogravimetric analysis of PPy, virgin Nylon fiber and PPy coated Nylon fiber are also presented. The Possibility of application of PPy coated fiber as a strain sensor is also explored.

2. Experimental

2.1 Materials

Nylon-6 fiber was obtained from SRF Ltd. , Chennai, India. Pyrrole and *p*-toluene sulphonic acid were supplied by Spectrochem Pvt. Ltd. , Mumbai. Anhydrous Iron(III) chloride was obtained from Merck Specialities Pvt. Ltd., Mumbai. Pyrrole monomer was purified by distillation and stored at 4 ^{0}C in the absence of light.

2.2 Preparation of Polypyrrole(PPy)

PPy was prepared by chemical oxidative polymerization of pyrrole using anhydrous ferric chloride as oxidant and *p*-toluene sulphonic acid as dopant in aqueous medium. Molar ratio of oxidant to monomer was 2.22 and dopant to monomer ratio was 0. 4. The reaction was carried out at 4 °C with continuous stirring for 4 hours. Precipitated PPy was filtered, washed with water till the filtrate became colorless, followed by a wash with methanol to remove unreacted pyrrole and then dried in air oven at 55 ^{0}C for 24 hours.

2.3 Preparation of PPy coated fiber (F-PPy)

Nylon-6 fibers, were soaked in pyrrole for 1 hour and subjected to *in-situ* polymerization of pyrrole using anhydrous ferric chloride as oxidant and *p*-toluene sulphonic acid as dopant in aqueous medium to get PPy coated Nylon fibers(F-PPy).The coated fibers were then filtered, washed with water till the filtrate became colorless, followed by a wash with methanol to remove unreacted pyrrole and then dried in air oven at 55 ^{0}C for 24 hours.

Before *in-situ* polymerization, the coating conditions are to be optimized in order to have uniform coating, maximum conductivity and appreciable mechanical strength. For this, the virgin fiber was soaked in pyrrole or oxidant prior to polymerization.

2.4 Fourier transform Infrared spectroscopy

FTIR spectrum of polypyrrole, virgin Nylon fiber and PPy coated fiber were taken using Thermo Nicolet Avatar 370 having spectral range of 4000 cm^{-1}-400 cm^{-1} and a resolution of 0.9 cm^{-1} and equipped with KBr beam splitter and DTGS Detector

2.5 Scanning Electron Microscopy (SEM)

Scanning electron microscopic images of PPy, virgin Nylon-6 fiber and F-PPy were obtained using a Cambridge Instruments S 360 stereo scanner-versionV02-01.

2.6 DC Electrical Conductivity

For electrical measurement of PPy, bulk sample in the form of pellets were prepared. DC conductivity of the pellet was measured by a two probe method using a Keithley2400 source-measure unit. In the case of fiber the surface resistance was measured using the same instrument. At least five different measurements were used to calculate conductivity values.

2.7 Thermogravimetric analysis (TGA)

Thermogravimetric analysis of PPy,virgin Nylon fiber and PPy coated Nylon fiber was performed to determine changes in weight in relation to change in temperature. TGA studies

were carried out on a Q 20, TA Instruments Thermogravimetric Analyzer (TGA) with a programmed heating of 20 ^{0}C/min from room temperature to 800 ^{0}C. The chamber was continuously swept with nitrogen at a rate of 90 ml/min. The temperature at maximum degradation was taken as the peak degradation temperature and the rate of degradation at the peak degradation temperature was recorded as the peak degradation rate. The weight percentage of the samples remaining at 800 ^{0}C was recorded as the residue.

2.8 X-ray diffraction analysis

X- ray diffractograms of PPy, virgin fiber and PPy coated fiber were recorded using a Bruker AXS D8 Advance Diffractometer using CuKα radiation (λ = 1.54 A^{o}) at 35kV and 25 mA with a smallest addressable increment of 0.001 ^{o}. XRD results were obtained in the range 2θ = 3° to 80° at a scan rate of 4°/ min.

2.9 Mechanical properties of fiber

The mechanical properties of the fiber was studied using a Shimadzu Universal Testing Machine (model AG-I) with a load cell capacity of 10kN. The gauge length between the grips at the start of each test was adjusted to 50mm. The fibers were held between the two grips and a crosshead speed of 50mm/min was applied. The strength was evaluated after each measurement automatically by the microprocessor and presented on a visual display. Average of at least six sample measurements were taken to represent each data point.

3. Results and Discussion

3.1 Optimization of reaction conditions - PPy coating on Nylon fiber

Impregnation of fiber with pyrrole monomer prior to polymerization gave more uniform coating compared to oxidant (FeCl$_3$) impregnation as is evident from fig. 2.
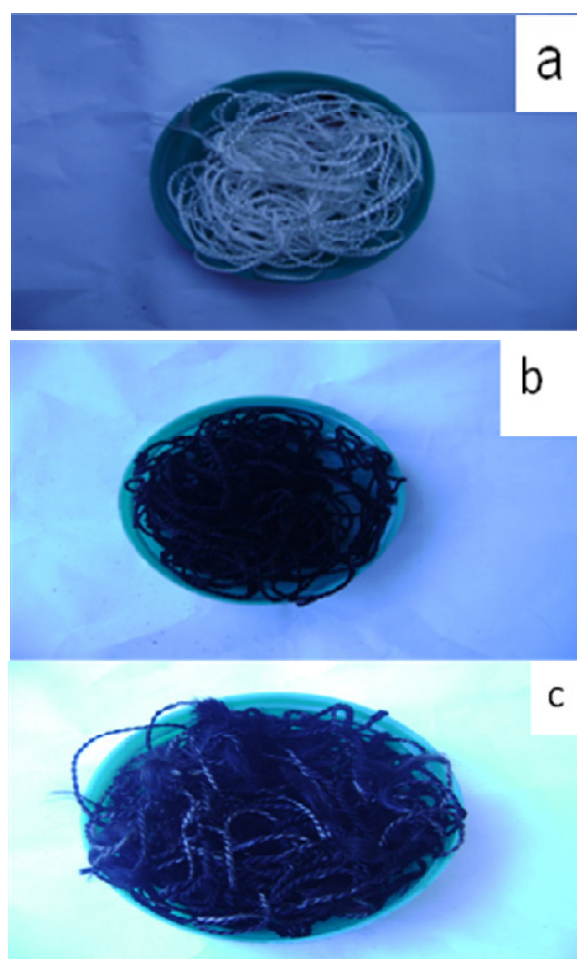
Fig. 2 (a) Virgin Nylon fiber (b) PPy coated Nylon fiber — monomer impregnated prior to polymerization (c) PPy coated Nylon fiber — oxidant impregnated prior to polymerization

3.2 Infrared spectroscopy

Fig. 3 shows the IR spectrum of PPy. The IR peak obtained at 3444 cm^{-1} is due to N-H stretching[12]. The band at 1534 cm^{-1}

corresponds to C=C stretching and that at 1440 cm^{-1} to C-C and C-N stretching: ie, typical PPy ring vibrations. The peak at 1293 cm^{-1} may be assigned to mixed bending and stretching vibrations associated with C-N links[13]. C=N stretching gives a band at 1151 cm^{-1}. In-plane deformation vibrations of C-H bond and N-H bond of pyrrole ring give rise to a peak at 1032 cm^{-1}.[14] IR peak at 853 cm^{-1} is due to C=H out of plane vibration indicating polymerization of pyrrole[15]. The band at 777 cm^{-1} may be assigned to N-H out of plane vibration. The band at 617cm^{-1} may be assigned to C-Cl vibrations[16]. Thus PPy obtained by the chemical polymerization method using FeCl$_3$ as oxidant is Cl$^-$ doped.
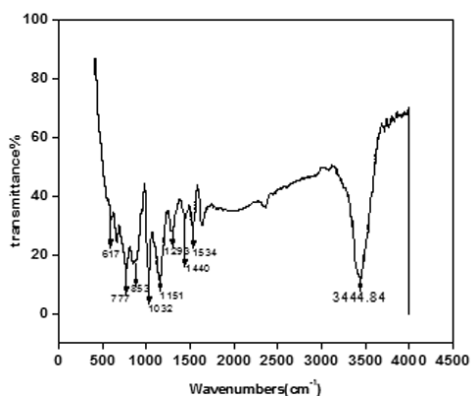
Fig.3 IR spectrum of PPy
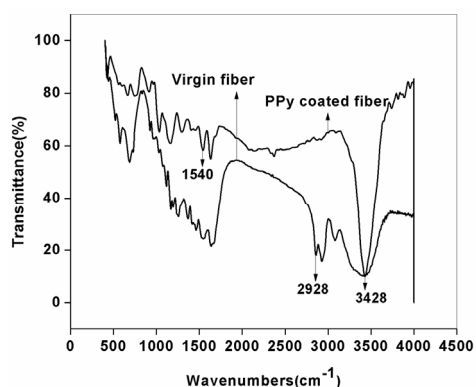
Fig. 4 IR spectrum of virgin Nylon fiber and PPy coated fiber

Comparison of IR spectrum of virgin Nylon fiber with PPy coated fiber (fig. 4) shows that the peak at 3428 cm^{-1} due to NH stretching in virgin fiber becomes more intense in PPy coated fiber as in the case of pristine PPy. Again, the peak at 2928cm^{-1} attributed to C-H stretching in virgin fiber disappears in PPy coated fiber. These two observations support the presence of a uniform coating of PPy on Nylon fiber. Peak at around 1534 cm^{-1} corresponds to C=C stretching in PPy. In the IR spectrum of coated fiber, there is an intense peak around 1540 cm^{-1} which is found to be less intense in virgin fiber.

3.3 Scanning electron microscopy

The granular morphology of PPy powder is visible in figure 5.The powder is composed of quasi spherical particles with diameter of about 250nm bonded to each other in irregular agglomerates. The agglomerates exhibit the typical three - dimensional and dendritic structure of PPy obtained by chemical polymerization in water.
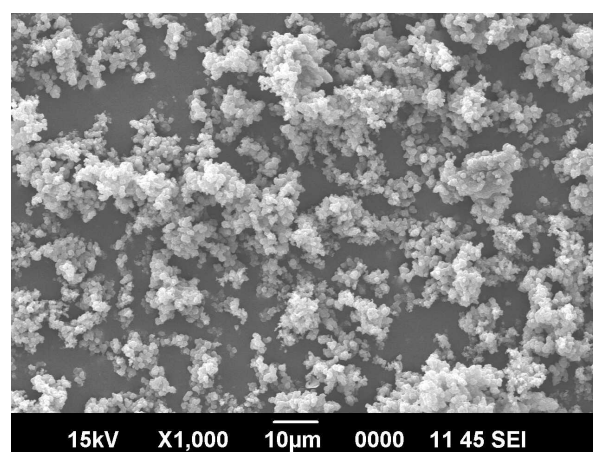
Fig. 5 Scanning electron micrograph of PPy.
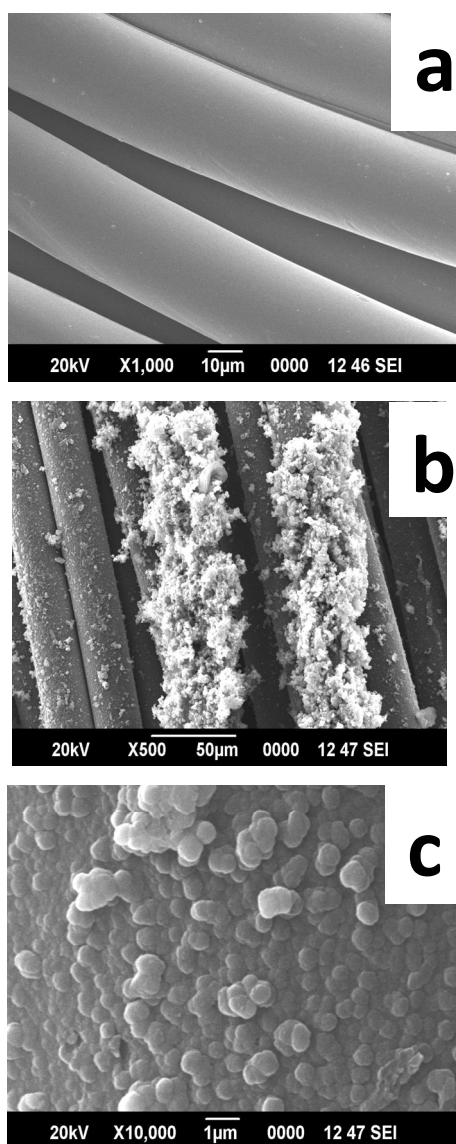
Fig. 6 Scanning electron micrographs of (a)virgin Nylon fiber, (b) PPy coated Nylon fiber and (c) PPy coated Nylon fiber at higher magnification

Figure 6(a) shows the smooth surface of uncoated Nylon-6 fiber. Fig. 6(b) and (c) show that PPy forms a dense coating of fused small hemispheres on Nylon fiber, fully encapsulating the fiber surface. During *in situ* polymerization, the individual fibers are coated with an even adherent polymer layer, directly grown on the fiber surface. This coherent coating of PPy on Nylon fiber results from the possible formation of chemical bonds between Nylon surface and the PPy molecules. The carbonyl groups on the Nylon backbones can provide a template for pyrrole monomers *via* hydrogen bonds, yielding a higher ordered and coherent PPy. Individual fibers do not stick to each other but remain well separated. The presence of a continuous PPy layer covering each fiber surface indicates that pyrrole could penetrate into the interstices between fibers and polymerization occurred inside the threads, not only at the surface of the fiber. The feature is expected to have positive consequences on the electrical properties of PPy coated fiber.

3.4 DC Conductivity

DC conductivity of 1.527×10^{-1} S cm^{-1} at room temperature is shown by the PPy sample prepared. PPy coated fiber obtained by dipping the fiber in monomer for 1h prior to *in situ* polymerization gives a surface resistance of 40Ω/cm.

3.5 Thermogravimetric analysis

Thermogravimetric analysis of pristine PPy is depicted in fig. 7. A first weight loss of 6.5% is due to loss of moisture. The second degradation, with a peak degradation occurring at 448 ^{0}C corresponds to degradation of PPy chain. Less than 30% weight loss occurs during this degradation. At 800 ^{0}C the residue weight is 55%. This indicates the high thermal stability of PPy.

Table 1 Thermal characteristics of the fiber

Thermal degradation parameters	Virgin fiber	PPy coated fiber
Onset degradation temperature (^{0}C)	376	338
Peak degradation temperature (^{0}C)	468	448
Peak degradation rate (%/^{0}C)	2.26	2.01
Weight loss at peak degradation temperature (%)	94.3	86
Temperature at 50% weight loss (^{0}C)	459	437
Weight remaining at 300^{0}C (%)	96.2	96.4
Weight remaining at 600^{0}C (%)	1	8.8
Residue at 800^{0}C(%)	0.2	6.7

Thermogravimetric analysis of pristine PPy is depicted in fig. 7. A first weight loss of 6.5% is due to loss of moisture. The second degradation, with a peak degradation occurring at 448 ^{0}C corresponds to degradation of PPy chain. Less than 30% weight loss occurs during this degradation. At 800 ^{0}C the residue weight is 55%. This indicates the high thermal stability of PPy.

Fig. 7 TG curve of PPy
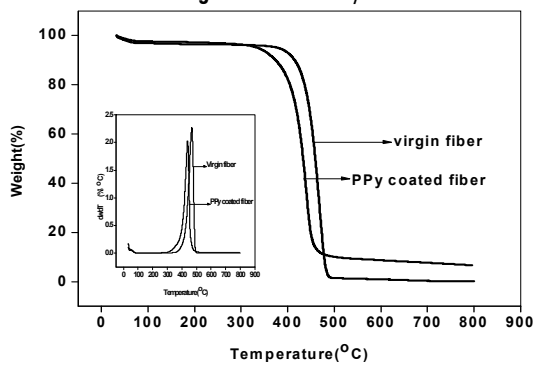
Fig. 8 TG curves of virgin fiber and PPy coated fiber (DTG curves in inset)

The thermal mass loss traces obtained with the TG analysis from virgin Nylon fiber and PPy coated Nylon fiber are reported in fig. 8. Inset represents the derivative thermograms. The thermal characteristics of the virgin and PPy coated fiber are presented in Table 1. The onset of thermal degradation of Nylon fiber occurs at about 376^{0}C whereas PPy coated fiber starts degrading at a lower temperature, at about 338^{0}C. It was pointed out by Wu *et al* .that [17] PPy coated fibers are less stable to heating than uncoatd fibers because of the breakdown of the PPy backbone. The peak degradation temperature is 448^{0}C for F-PPy which is also lower than that of virgin fiber. However, weight loss and rate of degradation at this temperature are lower for F-PPy. Residue weight is higher for F-PPy which may be due to the undegraded PPy.

3.6 X-ray diffraction analysis

X-ray diffraction patterns of PPy, virgin fiber and PPy coated fiber are depicted in fig. 9 and the XRD data of virgin fiber and PPy coated fiber are given in table 2.
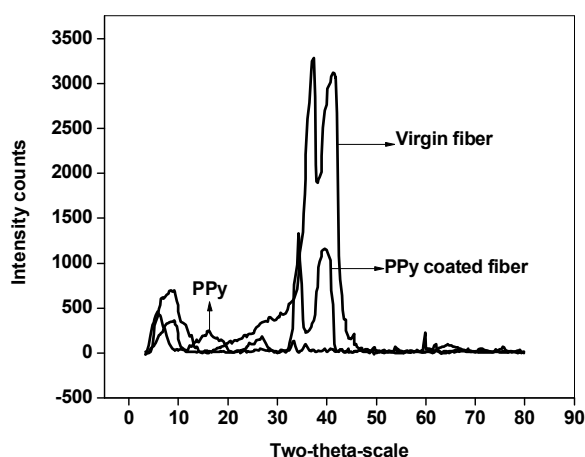
Fig.9 X-ray diffraction patterns of PPy, virgin fiber and PPy coated fiber

Table 2 XRD data of virgin fiber and PPy coated fiber

Fiber	$2\theta\ (\alpha_1)$	$2\theta\ (\alpha_2)$
Virgin	20.1	23.1
PPy coated	18.8	22.2

Broad peak of PPy at about $2\theta=27^{o}$ is characteristic peak of amorphous PPy and are due to the scattering from PPy chains at the interplanar spacing. Intensity of α_1 and α_2 peaks of the uncoated Nylon fibers reduces upon PPy coating due to decrease in the percentage of crystallinity of the fiber.

3. Poly Pyrrole Coated Fiber As Strain Sensor

Table 3 Mechanical properties of virgin fiber and PPy coated fiber

Fiber	Tensile strength(MPa)	Elongation at break (%)
Virgin	85.6	135.6
PPy coated	61.87	120

The mechanical properties of virgin fiber and PPy coated fiber are given in table 3. It is found that the Nylon fiber becomes stiffer on PPy coating due to less flexibility of PPy coating and decrease of free space for stretching. Tensile strength and elongation at break decrease significantly. Decrease of tensile strength may be

due to the hydrolysis of the fiber surface by the strong oxidant solution during *in situ* polymerization. However, the mechanical properties of the prepared PPy coated fiber are found to be satisfactory for normal service conditions.

Recently, it has been reported that conductivity of PPy-coated fabrics is also sensitive to strain, thus the conductive fabrics can be used to measure and control the movement of human body and construct wearable devices [18]. In comparison with most of the commercially available sensors, based usually on metal oxides and operated at high temperatures, the sensors based on conducting polymers have many improved characteristics. They have high sensitivities and short response time; especially these features are ensured at room temperature. Conducting polymers are easy to be synthesized through chemical or electrochemical processes, and their molecular chain structure can be modified conveniently by copolymerization or structural deviations. The possibility of the prepared PPy coated Nylon fiber possessing practically applicable mechanoelectrical property was also explored. As shown in fig. 10 F-PPy is found to exhibit monotonic increase in surface resistance with the elongation upto break point. Therefore it is proposed that PPy coated Nylon fiber can be used as a strain sensor for large deformation.
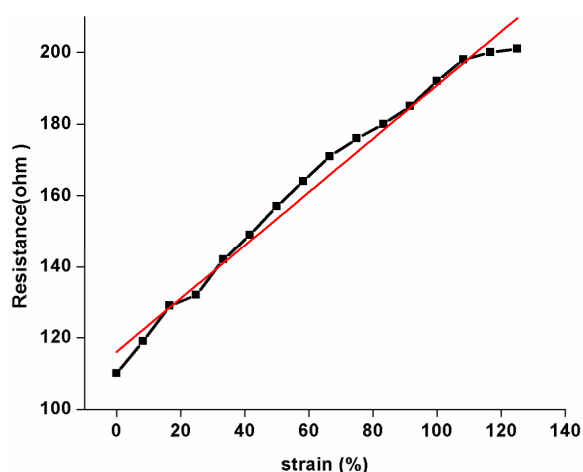
Fig.10 Electrical resistance changes of PPy coated Nylon fiber with elongation

3.5 Conclusions

Polypyrrole having DC electrical conductivity 1.527×10^{-1}S cm^{-1}was prepared by chemical oxidative polymerization. It was characterized by infrared spectroscopy, scanning electron microscopy, X-ray diffraction. It was found from thermogravimetric analysis that PPy is highly stable: maximum degradation occurring at 448 ^{0}C with a residue weight of 55% at 800^{0}C. Electrically conducting PPy coated Nylon fibers were prepared by *in situ* polymerization of pyrrole on Nylon fibers. Dipping the fiber in monomer for 1 hour prior to polymerization results in conducting fibers having higher conductivity compared to oxidant dipping. Comparison of IR spectrum of virgin Nylon fiber with PPy coated fiber indicated the presence of a uniform coating of PPy on Nylon fiber. SEM studies also revealed a dense uniform coating of PPy on Nylon fiber. The prepared PPy coated fiber finds application as a strain sensor.

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NONLINEAR OPTICAL PROPERTIES OF ZNO/POLYVINYLPYRROLIDONE NANOCOMPOSITE FILMS

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Abstract

Extensive studies have already been reported on the optical characteristics of ZnO/polymer nanocomposite films, using a variety of polymers including transparent polymers such as polystyrene, polymethyl methacrylate etc and many interesting results have been established regarding the non linear optical characteristics of these systems. Polyvinylpyrrolidone (PVP) is a water soluble polymer and though the structural and optical studies of ZnO/PVP nanocomposite films have already been investigated, there are no detailed reports on the nonlinear optical properties of ZnO/PVP nanocomposite films. The present work is an attempt to study in detail the non linear optical behaviour of ZnO/PVP nanocomposite films using Z scan technique. Transparent ZnO/PVP nanocomposite films were prepared from the ZnO incorporated PVP solution in water using spin coating technique. High-resolution transmission electron microscopy studies of synthesized ZnO show that the ZnO nanoparticles are of size around 10 nm. The ZnO/PVP nanocomposite films were structurally characterized by X-ray diffraction technique. These nanocomposite films offer prospects of application as efficient optical limiters to protect light sensitive devices from the possible damage on exposure to high intensity radiation.

Key words: *Nanocomposite, Nonlinearity, Z- scan technique, Optical limiting*

Introduction

Nanocomposites are a special class of materials having unique properties and wide application potential in diverse areas. [L. L. Becreft, C. K. Ober, 1999; . Y. J. He, 2004; D. G. Yu, J. H. An, 2004] Nanocomposite materials are multiphase solids where one of the phases has a dimension of less than 100 nm. These materials typically consist of an inorganic (host) solid containing an organic component or vice versa. Investigations into the nonlinear optical properties of nanocomposite films containing semiconductor nanoparticles have attracted considerable attention due to their practical applications in optical switching and optoelectronic devices [R.F. Haglund, L. Yang, R.H. Magruder III, J.E. Wittig, K. Becker, R.A. Zuhrl, 1993;.A. Hache, M. Bourgeois, 2000; Y. Hamanaka, K. Fukata, A. Nakamura, L.M. Liz-Marza´ n, P. Mulvaney 2004].

ZnO as one of the multifunctional inorganic nanoparticles has drawn increasing, attention in recent years due to its tunable electronic and optical properties and the potential

applications in many areas, such as field emission displays, solar cells and gas sensors [J. Hu, L.S. Li, W. Yang, 2001; H. Wu, X. Peng, A.P. Alivisators 1999 ; W. Lee, H.I. Yoo, J.K. Lee 2001]. With the advent of the widespread usage of optical detectors and sensors for scientific and industrial purposes, the need has rapidly arisen for optical limiting devices that protect the photosensitive components from intense optical radiation while remaining inactive for low intensity levels. Amongst the various nonlinear optical (NLO) materials investigated, direct band gap semiconductors, such as zinc oxide have attractive nonlinear properties that make them ideal candidates for NLO based devices.

Polymers are suitable host materials because they usually exhibit long-term stability and possess flexible reprocessability. The introduction of inorganic nanomaterials into polymer matrix has resulted in polymer nanostructured materials exhibiting multi-functional, high performance polymer characteristics beyond that of traditional polymer composites. In the present study, Polyvinylpyrrolidone (PVP) is chosen as the host polymer material because of its excellent solubility in ordinary solvents and chemical stability. PVP is water soluble, good film-forming and adhesive behavior on many solid substrates and its films exhibit good optical quality and mechanical strength [H.D.Wu, J.D.Wu, F.C.Chang , 2001; G.H.Ma, X.T.Zhang, C.C.Liu, C.F.Sun, Y.B.Huang

1997].Though the structural and optical studies of ZnO/PVP nanocomposite films have already been investigated, there are no reports on the nonlinear optical characteristics of ZnO/PVP nanocomposite films, in detail. The present work is an attempt to investigate the nonlinear optical properties of the spin-coated ZnO/PVP nanocomposite films using z-scan technique.

Experimental Procedure

Synthesis details

ZnO nanoparticles were synthesized using a simple chemical method at room temperature. 0.1M zinc acetate was dissolved in 100 ml methanol with magnetic stirring and then 0.2 M potassium hydroxide (KOH) was added. The mixture was stirred for ~2 hours and then washed and filtered. The filtrate was dried in an oven at 50° C for 5-6 hours. The white powder obtained was detected to be pure ZnO nanocrystals of average size ~10 nm by X-ray diffraction (XRD) analysis. The ZnO/PVP nanocomposite solution was prepared by adding 10 wt% of ZnO powder sample into the polymer solution (10% w/v) of PVP in water and stirring the mixture for two hours and then sonicating for ten minutes to ensure that the ZnO nanoparticles could be dispersed well. This solution was used to deposit thin films by spin coating on ultrasonically cleaned and optically flat glass substrates (Spin 150:- RPM-1000, time-1 minute).

Characterization

The morphology and size of the synthesized ZnO nanoparticles were estimated by transmission electron microscopic (TEM) studies. The micrographs were obtained using JEOL 3010 instrument with an ultrahigh resolution pole piece. X-ray diffraction patterns of ZnO, and ZnO/PVP nanocomposite were obtained on a Rigaku X-ray Diffractometer with Cu - Kα (1.5418 A°) radiation operating at 30 kV and 20 mA. The nonlinear optical properties of the ZnO/PVP nanocomposite films were studied using Z-scan technique. A Q-switched Nd: YAG laser with a pulse width of 7 ns at 532 nm was used in the experiment.tThe data was analyzed by using the procedure described by Sheik Bahae et al. [S. Bahae; A.A. Said; E.W. van Stryland. 1989].

Results and Discussion

Structural analysis

The XRD patterns of ZnO, and ZnO/PVP nanocomposite films are shown in figure1. All the diffraction peaks can be indexed to match the standard diffraction pattern of wurtzite ZnO. The diffraction peaks corresponding to (100), (002), (101), (102), (110), (103), and (112) planes indicate the hexagonal structure of zinc oxide. The average particle size is determined from the X-ray line broadening using the Scherrer equation, $\beta = k\lambda/d \cos\theta$, where β is the full width at half maximum (fwhm) in radians of the diffraction peak, λ is the X-ray wavelength, k is a

constant (0.89), θ is the Bragg angle of the peak and d is the average particle size. The particle size thus determined is found to be ~10 nm. The XRD pattern of the composite film consists of a broad non-crystalline peak of the polymer and sharp diffraction peaks of ZnO.
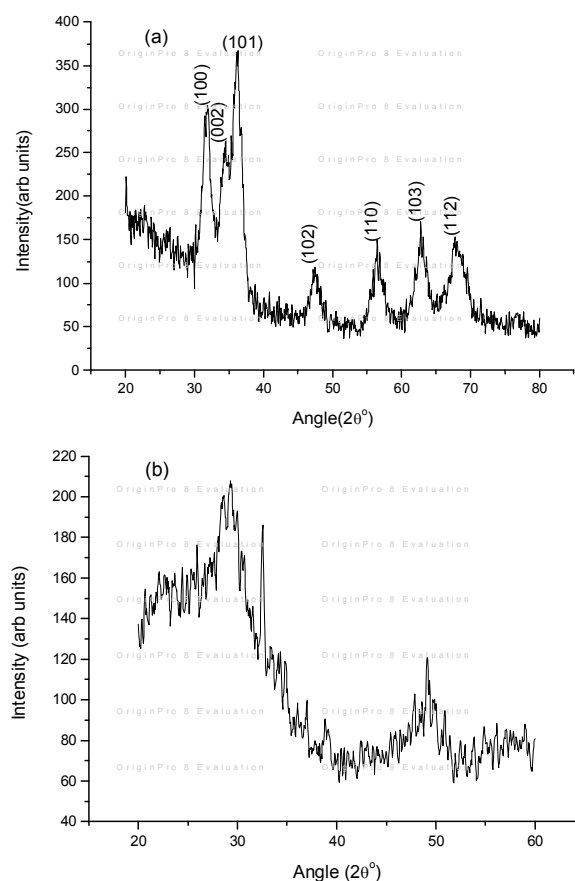
Figure 1 XRD pattern of a) ZnO powder and b) ZnO/PVP nanocomposite film

The TEM and High resolution TEM images of ZnO nanoparticles are shown in figure 2.

The morphology of ZnO is hexagonal. The average particle size determined from the XRD peaks using the Scherrer formula is found to be close to that obtained from TEM analysis.
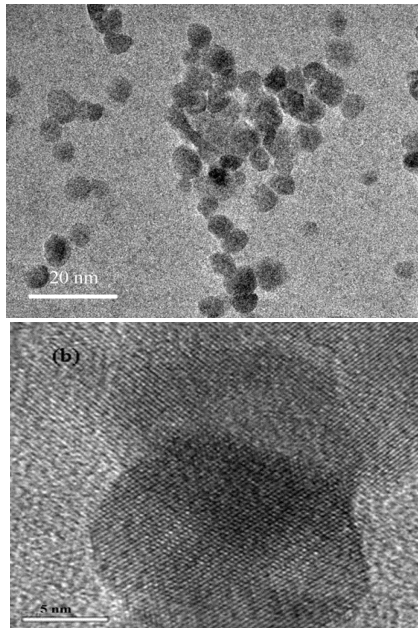
Figure 2 TEM (a) and HRTEM (b) images of ZnO nanoparticles

NLO studies

Nonlinear optical properties of ZnO/PVP nanocomposite films were investigated by the Z-scan technique. Figure 3(a) shows the nonlinear absorption of ZnO/PVP nanocomposite films at typical laser energy of 25 μJ for an irradiation wavelength of 532 nm. The open-aperture curve exhibits a normalized transmittance valley, indicating the presence of induced absorption. The observed nonlinearity is found to be of the third order, as it fits to a two photon absorption process (TPA). The corresponding net transmission is given by

$$T(z) = \frac{c}{q_0\sqrt{\pi}} \int_{-\infty}^{\infty} \ln(1 + q_0 e^{-t^2})dt \qquad (1)$$

where $q_0(z, r, t) = \beta I_0(t)L_{eff}$.

Here, $L_{eff} = 1 - e^{-\alpha L}/\alpha$, is the effective thickness with linear absorption coefficient α and nonlinear absorption coefficient β, L is the sample length and I_0 is the irradiance at focus [S. Bahae;

A.A. Said; E.W. van Stryland. 1989].The solid curve in figure 3(a) is the theoretical fit to the experimental data.

From the open aperture Z-scan curve it is found that, the ZnO/PVP nanocomposite films do exhibit induced absorption behaviour. The observed dip in the open aperture curve shows the transmittance limiting efficiency of the nanocomposite films, and the transmittance minimum is about 0.53, which highlights the better optical limiting efficiency of the films. Optical limiting (OL) devices protect light-sensitive sensors such as eye or CCD cameras, from possible damage caused by intense light exposure.
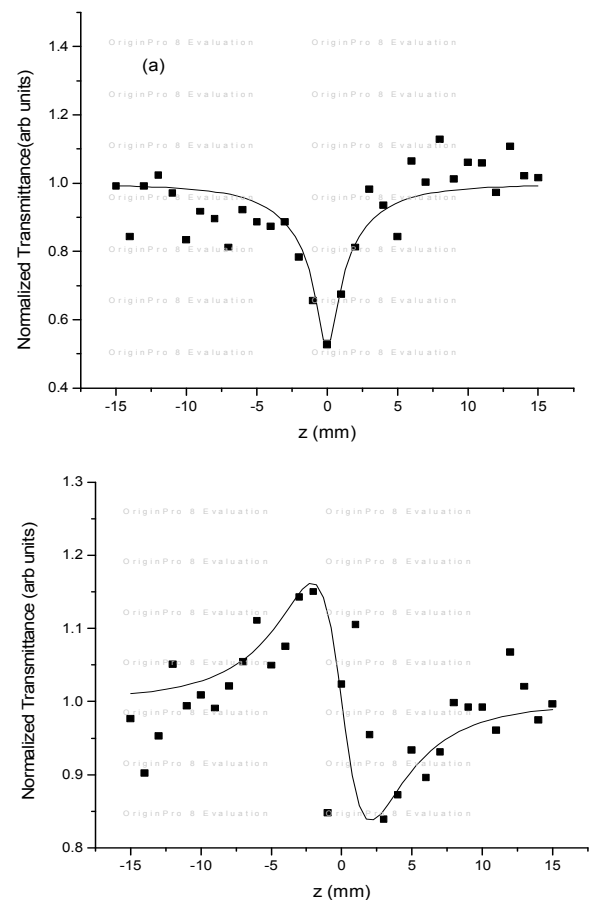
Figure 3 Open (a) and closed (b) aperture z scan curves of ZnO/PVP nanocomposite film

Figure 3(b) gives the closed aperture Z-scan trace of ZnO/PVP nanocomposite film for an irradiance wavelength of 532 nm from pulsed Nd: YAG laser of energy 25 μJ. The closed-aperture curve exhibits a peak to valley shape, indicating a negative value of the nonlinear refractive index n_2 [S. Waff, K. Park 1970]. For samples with appreciable refractive and absorptive nonlinearities, closed aperture measurements show contributions from both, i.e. the intensity-dependent changes in the transmission and the refractive index [S. Bahae; A.A. Said; E.W. van Stryland 1989]. By dividing the normalized closed aperture transmittance data by the corresponding normalized open-aperture data, one can eliminate the effect of nonlinear absorption and the resulting curves can be fitted with the theoretical equation for pure nonlinear refraction.

Conclusion

In the present work, ZnO nanoparticles and transparent, ZnO/PVP nanocomposite films have been grown using simple and reproducible methods. The technique employed in the present work for the synthesis of ZnO nanoparticles and ZnO/ PVP nanocomposite films is a convenient and economical way of realizing optical nanocomposite films suitable for industrial applications. The ZnO/PVP composite films with ZnO content of 10 wt % exhibit good nonlinear absorption nonlinearity. The lower transmittance of about 0.52 observed for the ZnO/PVP nanocomposite]behaviour. These films show a self-defocusing type (negative refractive index, n_2) optical films is ideal for the fabrication of efficient optical limiters in sensor protection applications.

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DIFFERENTIAL SCANNING CALORIMETRIC ANALYSIS OF CONDUCTING NATURAL RUBBER NANOPARTICLES REINFORCED NATURAL RUBBER COMPOSITES

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Abstract

Particle filled elastomeric composites have become attractive owing to their low cost and widespread industrial applications. The arrival of nanometer fillers to polymer materials is a promising channel for their property modification. Natural rubber composite is prepared by mixing the pristine natural rubber with conducting natural rubber powder. The DSC analysis shows that the Natural rubber nano composites exhibited excellent overall performance improvements due to the reinforcement effect.

Keywords: *Natural Rubber, Rubber Nanoparticles, Nanocomposites*

1. Introduction

Although intensively studied in the past decade, polymer composites based on micro and nano sized semiconductor organic particles still are in the focus of fundamental as well as industrial research. It has been shown that these organic polymer materials can be used for various technological applications such as organic batteries microelectronics, optoelectronics, coatings, sensors, biomedical, and information technology [1-6]. Depending on basic characteristics of selected polymer, added semiconductor can significantly enhance its optical, mechanical, magnetic, and/or thermal properties. Therefore, it is essential to examine and understand influence of incorporation of semiconductor particles on physical and chemical properties of polymer matrix [7]. Polymers have taken a vital position in all branches of science and technology. Industry and polymer materials are inter connected and inseparable. One of the most important candidates in the polymer industry is rubber material, which is a polymer of isoprene. An important sector of polymers, rubber materials is extensively used in the industrial and societal field due to the high and reversible deformability. Since the essential thermal stability of a pristine rubber is low, an additional reinforcing phase is necessary for practical use. [8]

Introduction of fillers into polymers leads to a wide range of interactions arising at the polymer-filler interface. Most of the applications of elastomers would be impossible without the reinforcing character of certain fillers, such as carbon blacks, carbon nano tubes, layered silicate clays which have favorably modify properties such as stiffness, tensile strength, heat distortion,

mould ability and other important properties Reinforcement of rubber by carbon black is merely due to its extensive interaction with the elastomers. The major factors that control these properties are the surface chemistry, nature, shape and size of particles, size distribution and specific surface area etc of the filler [9]. For many industrial applications, natural rubber is However, new materials have been implemented as rein forcers, whether for economical reasons or rather to impart some desirable characteristics. In this work, the possibility of replacement of carbon black by conducting natural rubber nanoparticles is suggested as reinforcing filler for natural rubber.

On the subject of possible management of composite materials in various technological areas, it is exceptionally important to achieve an overall insight of its properties, as well as to try to predict its stability in working conditions. The thermal degradation of polymers has been studied quite extensively using thermo gravimetric measurements. This paper comprise a detailed analysis of the influence of conducting natural rubber nanoparticles in thermal properties of the composite such as glass transition temperature, thermal stability and thermal degradation kinetics.

2. Experimental

2.1. Preparation of Natural rubber / Conducting Natural Rubber Nanoparticles composites

The Conducting Natural Rubber Nanoparticles (CNR nanoparticles) are prepared by doping the natural rubber solution with antimony pentachloride, a lewis acid using reflux boiling method. The precipitate obtained is filtered and dried under vacuum. The natural rubber /CNR nanoparticles composites is prepared by dry mill mixing technique using a two roll mixing mill so that composite with significant properties can be prepared by adjusting the ratio of the conducting component in the insulating matrix. The temperature of the rolls of the mill is kept at room temperature by the circulation of cold water. The various rubber chemicals and the cross linking agent are mixed with NR matrix and CNR nanoparticles using the roll mill. The amount of the filler is varied from 10% to 50%. The formulation of rubber chemical is shown in table 1.

Table.1. Formulation of NR/CNR nanoparticles composites

Formulation	Composition (phr)
Natural rubber	100
ZnO	5
Steric acid	2
MBTS*	1
CBS**	1.1
TMT***	0.2
Sulfur	2.5
CNR nanoparticles	10phr-50phr

* Mercaptobenzothiazyl disulphide
**N-cyclohexy-2-benzothiazolesulfenamide (CBS)
***Tetramethyl thiurium disulfide

In the case of elastomer composites the effects of fillers are quite erratic, since several factors such as distribution, dispersion and interface of the filler with the components of the composite may vary widely. However, the processing problems and cost efficiency for obtaining distinct homogeneous polymers are still

demanding concern for many potential applications. Because of this, there is a rising demand for dry mill mixing method compared to the solution processable composite in which the use of organic solvents come to pass problems. The compounded blends are compression molded at 433 K using a hot press and then cut into standard specimen. The tests of all characterization studies of vulcanized pristine NR and its composites are carried out according to the ASTM standards. Five specimens are measured for every case and the average values are taken.

2.2. Differential scanning Calorimetry (DSC)

The thermal measurement of each cured sample is performed with a Mettler-Toledo 822e instrument. Samples of about 7 mg are heated under a nitrogen atmosphere from 123 K to 373 K at a scanning rate of 10K /min, sample mass is determined by means of a Sartorius balance with an accuracy of 0.01 mg. Each thermogram is corrected for the asymmetry between the sample and the reference side in the DSC instrument by the subtraction of a blank curve, i.e. heat flow curves detected with empty crucibles, that are the same used in the sample measurement, and are subjected to the same temperature time profile. After this correction, specific heat capacity curve as a function of temperature is directly obtained from the heat flow curve divided by the heating rate and the sample mass. For each sample, the thermogram of the second heating run is adopted; care is taken in testing the reproducibility of the blank curves.

3. Result and Discussion

Differential Scanning Calorimetry

Thermal analysis is becoming an increasingly useful tool in material characterization. The DSC thermogram of the pristine NR and NR composites are shown in figure 1.
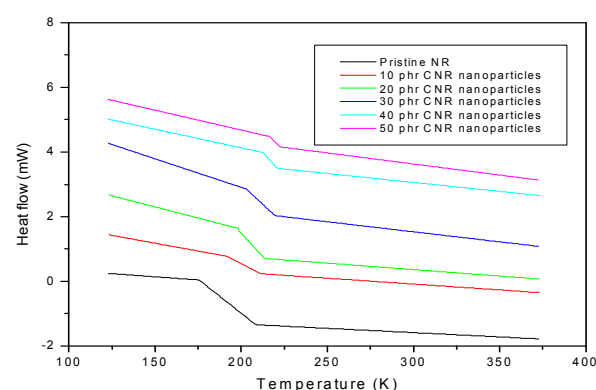
Fig.1. DSC thermogram of natural rubber/CNR nanoparticles composite systems.

From these DSC curves the thermal properties of specimens are analyzed. It can be seen that the glass transition temperature (Tg) of the NR increased with the addition of the CNR nanoparticles which due to the disorder in the macromolecular chains. It is reported that the molecular structure of NR is also affected by the activity of the macromolecular chains, [10] i.e. the fillers can obstruct the mobilization of the rubber macromolecular chains, and prevent macromolecular segments from obtaining ordered alignment. Moreover, the percentage of the pristine rubber matrix in the composites decreased because of the addition of further amorphous CNR nanoparticles. Therefore, the degree of crystalinity of the NR composite specimens decreased accordingly and the heat

absorption peaks in DSC curves weakened after the addition of the fillers.

Some studies indicated that the addition of fillers could absorb the basic accelerator species and may delay vulcanization. The molecular mobilization of rubber matrix in composites is affected due to the interactions between the fillers and rubber molecules, and the effects can see to be manifested in the DSC curves. During the heating process of the DSC analysis, the peaks of the heat absorption appeared around in the range of 209 K to 224 K. This indicates the improvement of thermal stability of the composite by the addition of CNR nanoparticles. The DSC data obtained are tabulated in table 2.

Table 2. DSC data of pristine NR and its composites

System	Onset (K)	Peak (K)	Heat of fusion(ΔH, J/g)
Pristine NR	176	210	54
10phr CNR nanoparticles	193	214	57
20phr CNR nanoparticles	198	216	85
30phr CNR nanoparticles	204	221	97
40phr CNR nanoparticles	214	223	101
50phr CNR nanoparticles	217	224	102

The specific heat is an important thermodynamic quantity, which characterizes the conformational and dynamical state of a polymeric system. Figure (2) shows the variation of experimental values of specific heat for natural rubber and natural rubber composites in the temperature region from 123 K to 373 K. It has been suggested that the transition is due to freezing to the segmental mobilities of the micro Brownian type which leads to a marked change of all kinds of properties.
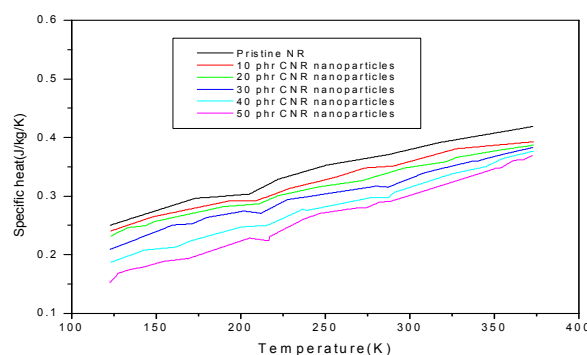
Fig.2. Specific heat-temperature curves of natural rubber/CNR nanoparticles composite systems.

For all the temperature studied pristine NR shows the maximum specific heat capacity. The addition of CNR nanoparticles to the natural rubber deteriorates its specific heat capacity. This is attributed to the increased amorphous nature of the composite by the addition of CNR nanoparticles. The rate of change of heat capacity for pristine natural rubber and its composites with CNR nanoparticles are shown in table 3. Thus the random structure of the material interferes with the movement of phonons and as a result specific heat decreases [11].

The heat capacity is also empirically correlated by a single equation represented by

$$C(T) = BT^n \text{-----------------------(1)}$$

The plus other higher order terms whose contributions are negligible in this range. This equation does not fit with the data for anomalies [12] This results are also in good agreement with the glass transition temperature determined by other methods. The behavioural pattern of heat capacity can be realized from Tarasov's theory [13]

In the region of Tg of natural rubber (205 K to 215 K) the difference of specific heat values

of the composite are more pronounced. As the temperature is further increased the specific heat rises linearly with temperature. It then shows a behavioral pattern which is independent of temperature. The rate of change of heat capacity before and after transition temperatures are shown in the table 3. It is clear from the figure 2, that each curve rises linearly with temperature and then shows a sudden shift at the temperature of Tg of natural rubber and its composites. As the temperature is further increased, the curve also increases which may be attributed to the increase of amplitude of vibration and the excitation of other internal modes with the increase in temperature [11].

Table 3. The rate of change of heat capacity of pristine NR and its composites

Sample	Rate of change of heat capacity (Jkg^{-1}K^{-1})	
	205 K	215 K
Pristine rubber	1.7256×10^{-3}	1.4665×10^{-3}
10 phr CNR nanoparticles	1.6914×10^{-3}	1.421×10^{-3}
20 phr CNR nanoparticles	1.6735×10^{-3}	$1.417\ 2 \times 10^{-3}$
30 phr CNR nanoparticles	1.6731×10^{-3}	1.4164×10^{-3}
40 phr CNR nanoparticles	1.6529×10^{-3}	1.4125×10^{-3}
50 phr CNR nanoparticles	1.5967×10^{-3}	1.3991×10^{-3}

4. Conclusion

The NR/CNR nano composites are fabricated with a two-roll mill. With the addition of the filler, the Tg of the resulting composites increased to some scope. The thermal stability of NR is also markedly improved by adding CNR nanoparticles. To conclude, the NR nano composites loaded with the CNR nanoparticles exhibited better overall performance due to the reinforcement effect. In addition, advanced rubber nano composites with improved

comprehensive performance have demonstrated the potential for expanded future industrial applications in bulk scenarios through a facile technique which improves the industrial processing, a requirement for high quality industrial-scale production.

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FOOD AND FEEDING HABITS OF *DASCYLLUS TRIMACULATUS* AT MINICOY ATOLL

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Abstract

In D. trimaculatus, the major food item was constituted by zooplankton with a preference for copepods. The other zooplankters are amphipods, mysis stage of prawn, zoea of crab and fish eggs. Other than these the crustacean remains, algae, coral pieces, and sand particles were observed. Algae was a prominent item of the gut in D. trimaculatus throughout the period and hence the seems to be an omnivore.

Key Words: *Dascyllus trimaculatus, Food and Feeding, Coral reef fishes, Atoll, Lakshadweep, Fish biology*

Introduction

The significance of the studies on food and feeding habits of a fish recognized by earlier workers in fishery biology is an accepted fact that this may affect its behaviour in respect to its habitat selection, growth, condition, breeding and even the population density. With due consideration to these aspects, the food and feeding habits of *Dascyllus trimaculatus* were studied. The stomach contents were analysed qualitatively to know the major food items and quantitatively to assess their relative abundance with respect to various months.

Hobson (1965) observed the diurnal and nocturnal activities of inshore fishes with emphasis to the food and feeding of pomacentrids. Lobel (1980) noted the herbivorous behaviour of damselfishes and their impacts in the coral reef community ecology.

Coughlin (1990) studied the feeding adaptations seen in reef fishes.

Many observations were made on the food and feeding of pomacentrids and they are: Hiatt and Strasburg (1960) in *Abudefduf vaigiensis, Chromis caerulea, A. dickii, A.glaucus, Plectroglyphidodon lacrymatus,* and *Stegastes nigricans;* Fishelson (1970) in *A. vaigiensis*; Low (1971) in *Pomacentrus flavicauda*; Allen (1972) in anemone fish; Emery (1973) in *A. vaigiensis*; Gerber and Marshall (1974) in *C. caerulea;* Allen (1975) in *A. sexfasciatus, A. curacao , C. cyanea P. lencozonus, A. dickii, P. flavicauda, P. bankanensis,* and *Amphiprion* spp; Sale (1976) in *P. wardi;* Hobson and Chess (1978) in *A. dickii, C. caerulea,* and *A.curacao*; Yamamoto (1979) in *A. dickii*, and *S. nigricans;* Gushima (1981) in *P. flavicauda;* Tribble and Nishikava (1982) in four species of *Chromis*; Ochi (1985) in *C. notata*; Allen (1991) in pomacentrids around the world;

Geletto and wood (1994) in S. *nigricans* and Letourner *et al*. (1997) in *S. nigricans*.

In Indian waters, studies on food and feeding habits of the reef fishes include works of Mohan *et al*. (1986) in *C. caeruleus*; Pillai *et al*. (1985) in *D. aruanus*; Mohan and Pillai (1988) in *Acanthurus triostegus*; Pillai and Madan (1990) in *A. glaucus*; Anand (1994) in reef fishes including individuals of Pomacentridae family; Vijayamma (1997) in ornamental fishes of the reefs including pomacentrids. No studies were done on the food and feeding aspects of *Dascyllus trimaculatus* in Indian waters were reported.

Material and methods

For the routine study of stomach contents 545 specimens of *D. trimaculatus* were collected for the year 1999-2001. All the samples for the study were collected after 45 minutes from the tide break. Soon after the collection they were bought to the laboratory and guts were collected. The gut condition was noted and was preserved in 10 % formaldehyde.

Monthly samples collected for two years were used to give qualitative and quantitative studies within the months of the two years.

Analysis of gut content

i) Qualitative analysis

Stomach of *D. trimaculatus* was cut open and the contents were washed into a petridish. The various components of the food items were observed under a binocular microscope. The feed were identified upto genus or family level, depending on the completeness of the organisms and the extent of digestion. In cases where the digestion had progressed to an advanced stage or where the food items were in a highly mutilated condition, the content was treated as 'digested matter'. Fragments of crustacean appendages and other body parts were grouped as crustacean remains.

ii) Quantitative analysis

Unlike other larger carnivorous fishes, the quantity of food of *D. trimaculatus* was very little as the size of the fish was small, which makes it difficult to determine the actual volume by displacement method. Therefore the Volumetric Points Method (Pillai, 1952) was employed. Since the occurrence method or volumetric method alone will not give a correct idea of the importance of the individual food items, both the methods were considered to prepare the 'Index of Preponderance' (Natarajan and Jhingaran, 1961), employing the formula

$$I = \frac{VO}{SumVO} \times 100$$

Where 'V' and 'O' are percentage volume and percentage occurrence of food items respectively along with 100, 80, 60, 40, 20, 10, and 0 points assigned respectively. Depending on the relative volume of the items, points were given for each. From these values, volume for each item was calculated. The percentage volume of each food item was found from the total volume of all

stomach contents in each month. Similarly, the percentage occurrence of different items was determined from the total number of occurrence of all items in each month. The 'Index of Preponderance' was taken to indicate the food preference of *D. trimaculatus*. The quantity difference observed among the food items in respect to months.

Results

i) Qualitative analysis of the gut content

The gut contents of *D. trimaculatus* showed that the fish was omnivorus. The food items of the fish could be broadly divided in to three groups. They were 1) zooplankton and animal remains 2) plant materials 3) coral and sand particles.

Among the zooplankton, copepods were the favourite food item for *D. trimaculatus*. Copepods were represented by *calanoids*. Amphipods ranked second among the zooplanktons. The other zooplankters were the mysis stage of prawns, zoea of crabs and eggs of fishes of other species were also found.

The crustacean remains included the broken appendages and fragments of the body parts of crustaceans. They were present in many of the stomach contents.

Plant materials observed were, partially digested filamentous macroalgae (Order: Chlorophycea; Family: Ulvacea and Cladophoracea) such as *Enteromorpha compressa*, *Chaetomorpha antennia*, *C. linoids*, *C. aerea*, and *Cladophora fascicularies*. These were dominant in the gut content. Bits of *Halimeda sp.* were also observed in some gut.

Small pieces of coral and sand particles were present in trace, which might have entered along with the food accidentally. These food items mentioned were present throughout the study and no new items were seen in respect to different months.

ii). Quantitative analysis of the gut content

Month-wise and year-wise analysis of food items

Zooplankton: As a single food item copepod gained the maximum index value of 69.97 and 67.36 during November 1999 and 2000 respectively, and was the prominent item throughout the years except in June 2000, June 2001, and July 2001. Minimum index value was observed in June for both years.

Among the zooplankton amphipods formed the second important food item. Maximum index value was 28.80 and 22.45, during January 2000, 2001 respectively. Minimum index of 10.81 and 9.62, was observed during April in 2000, 2001 respectively. This item was placed third during, April, October, and December in both the years. During May and June in the first year and March, November, June and July of the second year, this item was in the third and fourth place.

The mysis stage of prawn larvae as preferred to zoea in the gut contents of *D. trimaculatus*. Maximum index value was 14.55,

and 19.15 in March of 2000 and 2001 respectively and minimum index value was 00.02, and 0.17 during September 1999 and 2000 respectively. During the June and July of the study period, mysis stage was not observed for both years.

Zoea of crabs occurred in many guts though the volume percentage was less. It was absent during the months of June and July. Maximum index values, 0.66 and 1.05, were seen during the months of December 1999 and August 2001 respectively. Minimum index value of 0.02 and 0.08 was observed during the months of February 2000 and 2001 respectively.

Eggs of other fishes were present in the gut contents of *D. trimaculatus* in almost all the months except for March, June, and July of both the years. The maximum index was seen in September and the minimum during the month of January for both the years.

Plant materials: Filamentous algae, *Enteromorpha and Chaetomorpha*, were observed in many stomachs, and had a maximum index value of 30.00 and 43.18 during the month of June in the years 2000 and 2001 respectively. In the month of July 2001, this food item ranked first. In February and March of both the years the food item ranked fourth place and in rest of the months they were in second or third place. Minimum index value was observed in September for both the years.

Crustacean remains: This food item could be identified only by the part of the appendages, and

body segments, and was counted to a considerable amount. The highest index value observed was 15.00, in June 2000, and 15.45, February 2001. The minimum index of 0.76 was recorded during October in first year where as it was 0.33 in March for the second year. This food item was present throughout in all the months.

Coral remains and sand particles: This accidental item was also present throughout all the months in the two years of observation very insignificantly. In July 2001, the index value of this food item was 26.42. Minimum index value was 0.02 during the month of January for first year and during May for the second year. During December 1999, this was not observed.

Table 1. Month-wise quantitative analysis of the gut contents of *D. trimaculatus* during 1999 – 2001

Month	Copepods	Amphipods	Microalgae	Crustacean remains	Pprawn larvae (mysis stage)	Crab larvae (zoea stage)	Fish eggs	Coral remains and sand particles
Sep1999	67.85	20.27	0.20	10.74	00.02	0.11	0.63	0.18
Oct	60.98	16.20	20.42	0.76	0.51	0.37	0.62	0.14
Nov	69.97	15.90	12.23	0.99	0.22	0.06	0.17	0.46
Dec	55.24	17.03	25.09	0.77	1.14	0.66	0.06	0.00
Jan 2000	61.10	28.80	8.39	1.55	0.08	0.03	0.02	0.02
Feb	59.57	18.03	10.05	12.28	0.89	0.02	0.15	0.04
Mar	60.26	19.22	4.61	1.21	14.55	0.07	0.00	0.09
Apr	65.60	10.81	14.41	2.08	6.61	0.32	0.14	0.03
May	66.09	15.25	16.47	1.63	0.33	0.12	0.08	0.03
Jun	25.00	20.00	30.00	15.00	0.00	0.00	0.00	0.00
Jul	67.07	15.82	8.74	2.76	0.00	0.00	0.00	5.61
Aug	-	-	-	-	-	-	-	-
Sep	65.77	20.29	6.71	5.64	0.17	0.22	0.97	0.23
Oct	61.34	14.78	21.04	1.02	0.43	0.71	0.65	0.04
Nov	67.36	14.25	17.18	0.41	0.37	0.20	0.13	0.10
Dec	54.96	17.95	25.48	0.57	0.49	0.25	0.18	0.13
Jan 2001	61.43	22.45	14.09	1.63	0.24	0.08	0.01	0.07
Feb	54.93	17.00	12.15	15.45	0.20	0.10	0.10	0.09
Mar	57.28	13.88	9.16	0.33	19.15	0.11	0.00	0.10
Apr	53.85	9.62	22.45	4.41	8.44	0.61	0.30	0.33
May	66.53	16.44	15.17	1.13	0.51	0.11	0.09	0.02
Jun	15.63	12.98	43.18	4.05	0.00	0.00	0.00	24.16
Jul	22.16	10.23	36.65	4.55	0.00	0.00	0.00	26.42
Aug	62.22	15.51	9.74	9.74	1.28	1.05	0.27	0.20

Discussion

In *D. trimaculatus,* the major food item was constituted by zooplankton with a preference for copepods. The other zooplankters are amphipods, mysis stage of prawn, zoea of crab and fish eggs. Other than these the crustacean remains, algae, coral pieces, and sand particles were observed. Algae was a prominent item of the gut in *D. trimaculatus* throughout the period and hence the seems to be an omnivore in the present study. These observations are compared with the previous reports on the species belonging to the same genus and family as there is no extensive study on the food and feeding habits of *D.trimaculatus* were dealt in detail.

The preference towards zooplankton in the present study agrees with the studies of Hobson (1974) and Choat (1991) who reported the same for the genus *Dascyllus.* Hiatt and Strasburg (1960) reported copepodes, fish eggs and polychaete fragments as food for *D. aruanus.*

Pillai *et al.* (1985) reported that copepods, amphipods, filamentous algae and coralline materials are the food items of *D. aruanus.* The present work is in conformity with the food items reported by these authors. According to them, there was no selective feeding of plankton for this fish. But this is not in accordance to the present study as copepods is seen as the major food item throughout the present study period which indicates the preference for this feed.

Anand (1994) reported decapod larvae, shrimps, fish larvae, eggs, medusae, cirripede larvae, chaetognaths, megalopae, bryozoans, molluscan larvae and rarely green algae in the gut content of *D. aruanus.* This is not in full agreement with the present work. The difference in the area of collection and a short duration analysis and the differences of zooplankton occurrence of the region may be the reason for the variations between these two observations.

Zooplanktivore feeding habits in other pomacentrid species were observed in the genus *Chromis* by Emery (1973), Tribble and Nishikawa (1982), Choat, (1991); Mohan *et al.* (1986) and Noda *et al.* (1992). These works are also in conformity with zooplankton preference observed in the present study.

Goldman and Talbot (1976) reported *Pomacentrus* spp. as facultative omnivores. Choat (1991) observed pronounced tendencies towards herbivory in the genus *Pomacentrus.* Similarly, Anand (1994) reported omnivorus condition in genus *Chrysiptera* and *Abudefduf.* Vijayamma (1997) reported ominivores condition in *D. trimaculatus* and *D. reticulatus.* Letournneur *et al.* (1997) reported *Stegastes nigricans* as ominivores. All the above observations also support the omnivores feeding conditions of *D. trimaculatus* in the present study.

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ENZYMATIC DEHAIRING OF CATTLE HIDE BY CHRYSOSPORIUM KERATINOPHILUM

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Abstract

Many fungal species can utilize hair, hoof, nail, feather etc. as their sole carbon and nitrogen sources. The enzymatic degradation of keratin substrates by these fungi is focussed in detailing process of the animal skin. Among eight of the fungal strains tested, high enzyme yielding C.keratinophilum was selected for further activity on dehairing cattle hide. Optimal requirements for skin dehairing conditions by keratinase included time of reaction, reaction temperature, pH values and crude enzyme concentration. Experimental results revealed that optimal keratinase activity by standard assay of the selected fungal enzyme was exhibited at pH 9 for a contact time of 5 hr. at temperature 50 ºC. Enzymatic dehairing gives lengthier, stronger wool, which requires minimum washing afterwards. Hair gets removed along with epidermal layer and this makes the process of hair-loosening easier. The enzymatic dehairing is a more environmental friendly process. Exploiting this capacity of the fungal enzyme can be substituted in dehairing instead of traditional chemical process.

Key words: *Cattlehide, Dehairing, Chrysosporium keratinophilum, Leather, Solid state fermentation*

Introduction

Enzymes are vitally important to the existence of life. Current leather-processing procedures generate a considerable amount of chemical waste during all stages of processing and cause serious environmental pollution Ludvik J (2000). In the conventional pre-tanning process, depilation of animal hide is done by employing lime and sulphide. These two chemicals alone account for 70% of the total pollution in terms of biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS) and total suspended solids (TSS) Marsal A *et al* (1999). The alkaline nature of tannery effluents and the high sulphide content pollute ground water sources and cause serious health problems to the tannery workers and people living in the vicinity of leather-processing industries Ramasami T *et al*, (1999). A number of attempts have been made to find alternative methods for depilation of animal hide. The use of microbial enzymes, especially extracellular proteases have proved to be highly effective in depilating of animal hides Puvanakrishnan R, Dhar SC (1988) Though a

number of bacterial and fungal strains are known to grow on hides, only a few of them have been shown to produce extracellular proteases with depilatory activity Yates JR (1972) , Nilegaonkar SS *et al* 2007, In principle, the proteases having high depilatory properties with mild or no collagenolytic activity are considered to be the best proteases for depilating animal hide (Anbu P *et al* 2005), Friedrich J *et al* (2005), Giongo JL et al (2007) Macedo AJ *et al* (2005)There are diversified forms of enzymes which play dynamic roles in different areas. Proteases belong to a group of proteolytic enzymes that are obtained by microbial fermentations and are meant to use in leather industry for dehairing, bating and soaking purposes. Their major use is in detergent industry too where they are used for breaking proteinaceous matter caused by body secretions, food stuffs and blood stains. These enzymes are obtained from plants, animals and microbial sources. Animal and Microbial Proteases from Fungi and bacteria are used in the pretanning processes of leather manufacture.The use of pure proteolytic enzymes for the removal of hair from animal hides dates back to the early 1900s (Röhm O 1913) Until recently, most proteases used in enzymatic dehairing studies were bacterial in origin. Filamentous fungi, such as *Aspergillus*, have been the organism of choice for large scale production of bulk industrial enzymes, as the fungi can be grown on relatively inexpensive (agricultural waste) media and the fungi can secrete bulk quantities of enzymes (Bergquist PL,et al 2002). A proteolytic enzyme that had been isolated

from *Aspergillus tamarii* was used to dehair goat skins (Dayanandan A.,et.al 2003). Leather-making, is a by-product of the meat industry and reduces potential waste as well as contributing to economic growth Germann HP (1999). The challenges to develop an efficient enzymatic dehairing system for cattle hides initially the ease, low cost, and high yield of enzyme production—and a history of success with this enzyme for dehairing small skins led us to conduct this research. The results from this study will subsequently be applied to determine the effectiveness of the enzyme

Materials and Methods

Isolation of fungus from soil

Hair baiting technique was applied to isolate the fungus. Sterile petri dishes with SDA agar was used to grow the fungus isolated from the soil baited with hair. The fungus isolated from the soil was identified as *Chrysosporium sps*. by examining the external morphology and staining technique. It was then stored in SDA slants and kept at room temperature.

Effects of Different Solid Substrates

Different solid substrates like rice bran, wheat bran, wheat flour, ground nut cake and coconut cake were used to study their effect on alkaline protease production. Fermentation was carried out at room temperature. The best solid substrate achieved by this step was wheat bran and it was selected for subsequent experiments.

Solid state fermentation

Solid state fermentation of Chrysosporium was carried out in 250ml. Erlenmeyer flasks. 10gm. of wheat bran was taken in individual flasks and 20ml. Mineral Salt solution (MSS) was added. The flasks were plugged with cotton and autoclaved at 121 ºC for 15 minutes . Fungal spores from the slants were used as inoculum for SSF. The activity of the enzyme was assayed using the sample collected from the culture media.

Alkaline protease Assay

Enzyme extraction and estimation of moisture content were carried out and the alkaline protease activity was determined. (Lowry.et.al) The reaction mixture contained 0.5ml culture filtrate and 0.5ml Glycine - NaOH buffer of pH 9.0 The mixture was incubated for 10 minutes at room temperature. The culture filtrate with 0.5ml TCA was taken as the control. 1ml of 1% casein was added to this reaction mixture (2 ml) was incubated for 20 minutes at 50˚C. 4 ml of 5% TCA was added to both test and control mixtures to terminate the reaction.

After 1hr. of incubation at room temperature the solution was filtered through Whatmann No.1 filter paper. For colour development in both test and control, 1ml. of culture filtrate from each were mixed with 5ml of 0.4M Na2Co3 followed by the addition of 0.5 ml of folin's phenol reagent. Vortexed immediately and incubated for 20 minutes at room temperature. Optical density was taken at 660nm.

One unit of enzyme activity is defined as the amount of enzyme liberating one microgram of tyrosine per minute per ml. under the defined conditions.

Optimization of Fermentation process

Factors like selection of solid substrates, incubation temperature, incubation period and pH effecting the secretion of proteolytic enzyme under SSF were optimized

Results

Activity on different solid substrates by enzyme
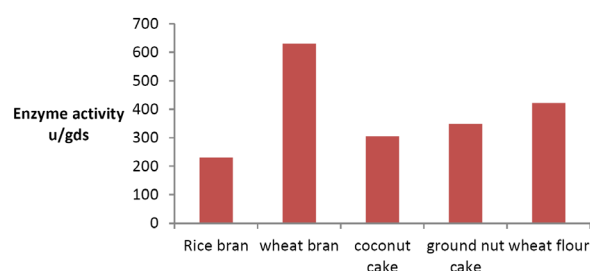
Among different solid substrates subjected for the experiment, wheat bran gave highest enzyme yield.

Effect of pH on Enzyme activity

The enzyme activity was assayed at different pH and the maximum activity was obtained at a pH 9.

pH on enzyme activity
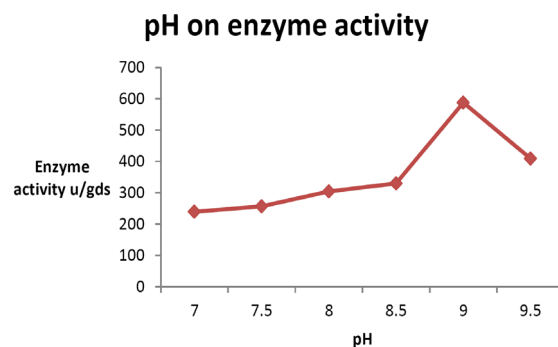
Effect of Temperature on Enzyme activity

4hrs.
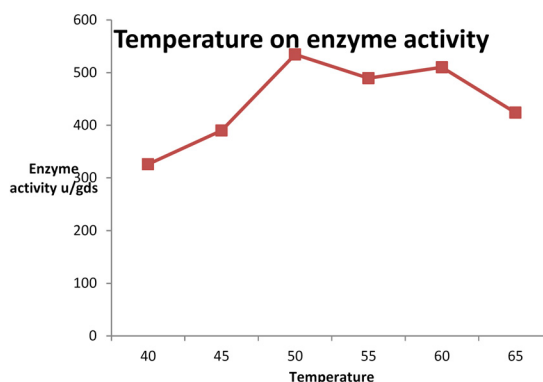
Application of enzyme in dehairing process

The dehairing efficacy of the enzymes is being assessed by applying the same on the Buffalo skin. The method adopted was dip method of enzymatic unhairing, the hides or skins were kept immersed in the enzyme solution at the required pH in sterilized petri dishes .Wet skin was selected and cut into two square pieces .They were washed thoroughly in soap water and tried. Two petri dishes were taken for the experimental set up. The sterilized skins were put into each plate. 20ml. of extracted enzyme was added to the first plate (experiment). 20 ml. of distilled water was added into the second plate. The skins were completely immersed in the enzyme. After every 2 hours interval the hairs were tried to remove from the skin using sterile forceps.

Dehairing at different time intervals

2 hrs. 4hrs.

6hrs.

8hrs.

Experimental results revealed that rice bran acted as the better substrate in growing the fungus. Optimal protease activity by standard assay of the selected fungal enzyme was exhibited at pH 9.0 for a contact time of 5 hr. at temperature 50 ºC. After 8 hrs. almost all the hairs of the skin were removed. The skin in the control setup didn't show any change.

Discussion

Enzymes are also important in reducing both energy consumption and combating environmental pollution. Enzymatic dehairing in tanneries has been envisaged as an alternative to sulphides (Beynon & Bond, 1989; Altschul et al., 1997). Alkaline proteases can be used which enables the swelling of hair roots, and the subsequent attack of protease on the hair follicle protein allowing easy removal of the hair (Gupta et al. 2002).The enzyme from *Chrysosporium keratinophilum* showed good dehairing capacity in the experiment. A large proportion of the known alkaline proteases are derived from microorganisms, especially Fungal strains Enzymatic unhairing accomplished by proteolytic enzymes is of great commercial importance contributing to more than 40% of the world's commercially produced enzymes. Approximately 50% of the enzymes produced is used for industrial process (Pepper et al., 1963). Further, proteolytic enzymes are more efficient in enzymatic dehairing rather than amylolytic enzymes (Puvankrishanan, 2003). The enzymes cause loosening of the hair, without damaging the fibrous collagen of dermis.Enzymatic dehairing has several advantages like significant reduction or even complete elimination of the use of sodium sulfide, total recovery of hair resulting good quality with good saleable value, and 3) creation of an ecologically conducive atmosphere for the workers.

Conclusion

The potential use of protease enzymes in leather processing eliminates the pollution causing chemicals such as sodium, lime and solvents. The study reports revealed that alkaline protease isolated from *Chrysosporium keratinophilum* has the potential to replace sodium sulfide in the dehairing process.

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PATTERN OF FOOD EXPENDITURE IN URBAN KERALA

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Abstract

The general process of economic liberalization and opening up of the economy initiated during the 1990s resulted in rural urban migration and boost the pace of urbanization. With increase in income and urbanization, demand for food not only increased but also changed with shifts in consumption patterns. The objective of the study was to assess the causality between consumption expenditure and food expenditure in Kerala. It focused on level and pattern of food expenditure of households in urban Kerala. The Primary data for the study were collected from 300 house holds belonging to three corporations in the state- Kochi, Thrissur and Kozhikode. A multi stage sampling procedure was adopted for selecting sample units. Secondary data were collected from census reports of various years, various issues of National Sample Survey Organization (NSSO) Publications, Economic Review of various years and Sarvekshana. The results of the study revealed that due to urbanization and increase in per capita income there was an increase in the pattern of food expenditure in favour of high value products. It was also observed that there was a gradual decline in the consumption of cereals which is the most important constituent of diet of Kerala people. The consumption of live stock products increased in the diets of the people across various parts of urban Kerala.

Keywords: Urbanisation, food expenditure, food consumption, MPCE

Introduction

The four decades since 1970 have witnessed rapid growth of global economy and a doubling of world population. It has been projected that 21st century will be the urban century with almost 60 percent of the world population living in urban areas by 2030; the highest share of population ever lived in urban areas. This rapid growth of urbanization along with rising proportion of population and its consequences are very important and its implications are significant. The general process of economic liberalization and opening up of the economy initiated during the 1990s resulted in rural urban migration and boost the pace of urbanization. With increase in income and urbanization, demand for food not only increases but also changes with shifts in consumption patterns. Consumers are diversifying their food basket and include more qualitative food items. The items such as milk, meat, egg, fish, fruits and vegetables and fatty oil have occupied an increasing share in the diets of all sections of population. Such changes in consumption pattern across regions necessitates studies which focus on the shift in food basket and food expenditure in urban areas.

The study was carried out to assess causality between consumption expenditure and food expenditure in Kerala. It focuses on level and pattern of food expenditure of households in urban Kerala. The main results of monthly consumer expenditure survey are presented with reference to per capita consumer expenditure in urban areas and distribution of expenditure under main heads namely food and non-food items. This analysis will help to ascertain the pattern of consumer

expenditure in the state of urban Kerala. The estimates are based on 300 urban sample households in Thrissur, Kochi and Calicut. Survey of household consumer expenditure provides the first and the foremost indicator of human living standard namely Monthly Per capita Consumption Expenditure (MPCE). It also brings to light variation in consumption of cereals, which is the most important constituent of diet of Kerala people.

Methodology

The study is based on both primary and secondary data. Secondary data used for the study were collected from census reports of various years, various issues of National Sample Survey Organization (NSSO) Publications, Economic Review of various years and Sarvekshana. The study is based on the quiquinnial survey of NSSO. The data from 27th round (1972-73) onwards was used for the present study. The Primary data for the study were collected from 300 households belonging to three corporations in the state- Kochi, Thrissur and Kozhikode. A multi stage sampling procedure was adopted for selecting sample units. The method of direct interview was also adopted to collect information from respondents. In order to determine the expenditure pattern in the three urban corporations, the consumption function was estimated.

For analyzing the food consumption pattern in the three corporations in Kerala, the ten items of food and seven items of non food are selected. The food items selected includes cereals, pulse and pulse products, milk and milk products, edible oils, meat, egg and fish, vegetables, fruits and nuts ,sugar, salt and spices, beverages etc. The nonfood items included pan, tobacco and intoxicants, fuel and light, medical, education,

clothing and foot wear, durable goods and miscellaneous goods and services.

Distribution of household and population by MPCE

A comparative picture of the monthly per capita consumption expenditure of the sample households revealed that the highest number of households was found in the MPCE class 2000-4000. It also shows that the lowest number of households belonged to the category greater than Rs.10000 (Table 1). Average household size in Thrissur was 3.67 while it was 3.82 and 3.47 in Kochi and Calicut respectively.

Table 1 Estimated households /population by MPCE class

MPCE class (Rs)	Thrissur			Kochi			Calicut		
	Households	Population	House hold size	Households	Population	House hold size	Households	Population	House hold size
<2000	5	20	4	5	27	5.4	6	25	4.17
2000-4000	58	225	3.88	43	177	4.12	46	184	4
4000-6000	20	64	3.2	35	133	3.8	36	103	2.86
6000-8000	10	35	3.5	6	20	3.33	6	19	3.17
8000-10000	4	15	3.75	8	19	2.38	4	12	3
>10000	3	8	2.67	3	6	2	2	4	2
Total	100	367	3.67	100	382	3.82	100	347	3.47

Source: Survey Data

Consumer expenditure comprises all expenditure incurred by the household on domestic account during the reference period. It includes expenditure on food and non food items. Monetary value of food articles consumed during thirty days is taken to represent consumer expenditure on food articles. For semi durable and durable goods the actual expenditure incurred towards purchase of the articles during the thirty day period is considered as consumer expenditure of the household. For other non food items also the monetary value of the articles during the thirty day period is taken as the consumer expenditure on the articles considered. Within some of these major groups of items there

are several commodities. Here consumption expenditure is calculated on the per capita basis.

Table 2 Percapita /household monthly consumer expenditure

	Food	Non food	Total
Monthly percapita expenditure RS (percent)			
Thrissur	1433.20 (35.66)	2586 (64.34)	4019.2
Kochi	1296.44 (31.20)	2858.66(68.80)	4155.1
Calicut	1314.92 (31.81)	2818.34 (68.19)	4133.26
Total	1348.09 (32.86)	2754.69 (67.14)	4102.78
Average monthly house hold consumer expenditure			
Thrissur	5259.85	9491.72	14751.57
Kochi	4952.39	10920.07	15872.46
Calicut	4562.79	9779.66	14342.45
Total	4925.01	10,064	14989.01

Source: Survey Data

Analysis of the household consumer expenditure on food and nonfood groups in urban corporations shows that the average monthly per capita expenditure (MPCE) worked out to Rs.4102.78. Out of this Rs.1348.09 (32.86 percent) was spent on food items and Rs. 2754.69(67.14 percent) on non food items. Average monthly consumer expenditure per family was estimated at Rs.14989.01.

Shares of various food and non food groups in total expenditure

The monthly Per capita Consumption Expenditure of broad groups of selected items is given in table 3. The consumption data were aggregated to Food and Non food groups. The food groups were then further aggregated to ten broad groups, viz. 1)Cereals, 2)Pulses and Pulse products, 3) Milk and milk products, 4) Edible oils, 5) Meat, fish and eggs, 6) vegetables 7)Fruits and nuts 8) Sugar 9) salt and spices and 10)Beverages. The Non food groups were aggregated in to seven categories. 1) Pan, tobacco, and intoxicants2) Fuel light 3) Medical 4) Education 5) Clothing &Footwear 6)

Durable Goods and 7) Miscellaneous goods and services.

Table 3 Percent distribution of broad groups of food items to total expenditure

Items	Thrissur	Kochi	Calicut	Combined MPCE
Cereals	6.98	5.51	5.50	5.99
Pulses & Pulse Products	2.10	1.73	1.88	1.90
Milk & Milk Products	5.28	4.59	5.08	4.97
Edible Oils	1.09	1.03	1.12	1.08
Meat, Egg & Fish	5.08	4.22	4.71	4.66
Vegetables	4.21	4.00	3.83	4.01
Fruits & Nuts	4.34	3.46	3.12	3.64
Sugar	1.26	0.89	0.96	1.03
Salt & Spices	1.326	1.32	1.57	1.40
Beverages etc.	4.00	4.45	4.05	4.18
Food sub Total	35.66	31.20	31.81	32.86

Source: Survey Data

Cereal continues to be the important constituent of a household's food basket; it occupies the highest share in the total budget. In the consumption food basket high-value foods such as milk, meat, fish and eggs are also receiving increasing importance. The table reveals that, out of every hundred rupees spent by households about Rs.33 was spent on food items and Rs.67 on non-food items. Further study revealed that among the food items cereals occupy the highest share (5.99 percent) followed by milk and milk products (4.97percent) and meat, egg and fish (4.66 percent). The expenditure on cereals forms 4.8 percent of the total consumption expenditure. The items which claimed relatively lower share were sugar (1.03 percent), edible oil (1.08 percent) and salt and spices (1.40 percent).

In the non-food group the share of miscellaneous category as a whole has been registering a progressive rise over other items with its share 22.79 percent in total expenditure. The category of education has also highest share of 17.54 percent in total expenditure. The salient fact

about educational expenditure that emerges is that tuition and other fees which form the major component of educational expenditure are commanding a progressively larger share of educational expenses. Durable goods formed 8.06 percent of total consumption expenditure. Per capita consumption of pan, tobacco and intoxicants has dropped substantially by about 1.05 percent and it occupies the lowest share in total expenditure.

Table 4 Proportion of expenditure of broad groups of food items to total expenditure for different MPCE classes in urban areas (percent)

Items	< 2000	2000-4000	4000-6000	6000-8000	8000-10000	> 10000	Total sample
cereals	9.82	7.71	5.44	4.30	3.14	2.78	5.99
pulses	3.00	2.47	1.70	1.34	1.13	0.74	1.90
milk	5.75	5.91	5.03	4.40	2.85	2.09	4.97
Oil	1.70	1.40	0.97	0.75	0.50	0.62	1.08
Vegetables	6.35	5.27	3.76	2.51	2.18	1.23	4.01
fruit	3.60	4.21	3.58	3.47	2.66	1.83	3.64
Meat, Egg, fish	6.76	5.29	4.72	4.57	2.23	2.75	4.66
Salt	2.61	1.82	1.30	0.89	0.68	0.52	1.40
sugar	1.85	1.40	0.89	0.65	0.56	0.32	1.03
beverages	6.08	5.23	4.04	3.19	2.25	1.45	4.18
Food	47.52	40.72	31.43	26.08	18.19	14.32	32.86

Source: Survey Data

The per capita annual consumption of different food and non food items by different expenditure groups and changes therein are presented in table 4. This has been observed that the various per capita expenditure classes are demonstrating a wide range of differences in per capita consumption expenditure. Therefore in order to obtain the estimation of differences in consumption pattern, the total per capita consumption expenditure classes have been converted in to six MPCE classes. The classes so constructed are up to 2000, 2000-4000, 4000-6000, 6000-8000, 8000-10000 and above 10000.

It is obvious from table 4 that both share of food and share of cereals fall appreciably with rise in MPCE level. Here the fall in the share of food is

steeper. The share of food falls from over 47.52 percent in the lowest MPCE class (Rs.0-2000) to fewer than 14.32 percent in the highest (Rs.10000+). The share of cereals also falls. Its share drops from 9.82 percent in the lowest MPCE class to a mere 2.78 percent in the highest MPCE classes. Over the years, the per capita consumption of vegetables, fruits, milk, meat, fish, and eggs has increased substantially in both higher and lower expenditure groups. The exposure to new food habits in urban area coupled with price variation could be the cause of higher consumption expenditure on these items in urban area. Thus, dietary shift in favour of high value products was prominent and pervasive. This structural shift has been quite significant even among the low expenditure groups who were quality conscious and paid higher prices for all these commodities.

It seems that there exist differences in the consumption patterns between various expenditure classes. These differences are sharply reflected in almost all the food items. It is found from table 4 that among food items the top five positions is occupied by cereals (5.99 percent), milk and milk products (4.97 percent), egg (4.66 percent), beverages (4.18 percent) and vegetables (4.01 percent). On the other side the bottom five positions are occupied by sugar (1.03 percent), edible oil (1.08 percent), salt (1.40 percent), pulses (1.90 percent) and fruits (3.64 percent). However items like salt presents some degree of homogeneity between different expenditure classes. This is mainly because salt is a minimum satiety.

Share of food and share of cereals in total expenditure

The share of cereals in total food expenditure is explained in the figure 1. Both share of food and share of cereals fall appreciably with rise in MPCE level. The share of food

declines from over 47.52 percent in the lowest MPCE class (0-2000) to under 14.32 percent in the highest (10000 +). Here the decline in the share of food is steeper. The share of cereals also drops from 9.82 percent in the lowest MPCE class to a mere 2.78 percent in the highest class.
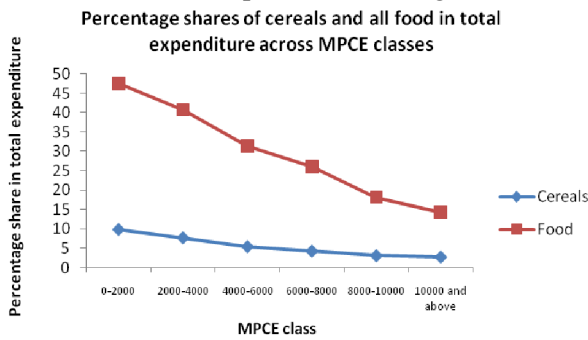
Figure 1

Consumption Function of urban sample house holds

In the above tables we discussed the expenditure pattern in three urban locations. There are different measures to discuss the extent of consumption expenditure and the most popular is estimation of consumption functions. Hence, the consumption function was estimated and the results are presented in table 5.

Table 5 Consumption Function of Urban sample house holds

Corporations	
Kochi	Y=2225+0.61y
Thrissur	Y=1816+0.74y
Calicut	Y=1755+0.71y

From table 5 it is seen that the regression coefficient ranges from 0.61 to 0.71. The maximum consumption is found to be in Thrissur and least in Kochi. However the difference between the three corporations is marginal only. The highest should be in Kochi, but it is relatively low due to the high volume of income. The estimated regressions, which is nothing but marginal propensity to consume is very realistic compared to the consumption habit of Keralites, which reassures the argument that Kerala is a consumer state.

Conclusion

As a result of globalization and opening up of the economy western culture are spreading to the entire parts of the economy. Due to increase in per capita income and urbanization the economic conditions among the households in urban areas are changed and this led to consumption expenditure in favour of high value products. Thus dietary diversification and demand for better quality food were clearly visible among sample households. It was also found that there was a gradual decline in the consumption of cereals. The relative importance of live stock products increased in the diets of the people across various parts of urban Kerala. The increasing demand of animal products like milk, meat, egg and fish comes from changes in the diets of majority of population and the factors driving these changes are population, income growth and urbanization. Therefore priority should be given to the production of cereals, vegetables, fruits and also live stock products. For this locally available resources should be more effectively utilized thus strengthening domestic production. In short government should take steps to improve production, reduce supply demand gap, and reduce price rise, thus making consumption basket more rational.

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A STUDY ON FOREIGN DIRECT INVESTMENT IN AVIATION SECTOR IN INDIA

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Abstract

Foreign direct investment is an investment made by a foreign individual or company in productive capacity of another country. It is the movement of capital across national frontiers in a way that grants the investor control over the acquired asset.

Key words: *FDI, DGCA, DIAL, IATA, ASSOCHAM*

When government of India announced in the year 1991 about her plans to allow FDI in India, it opened a Pandora's Box for us. Since then, our economy has been growing manifolds. FDI enables to bring foreign investment in India as a result of which, our country benefitted in many ways; namely-employment opportunities, better quality of life, better products, better education and higher per capita income. Since 1991, our economy is growing so rapidly that all the so called 'super powers "are keen on building strong relationship with our country. India was a country rich in resources, but the problem was their optimum utilisation.FDI has solved this problem. As a result, all the retail biggies are attracted towards India. India is giving tough competition to all developed countries, including China. So, wait for the day when our economy would be one of the strongest in the world.

The reform process has deregulated the economy and stimulated domestic and foreign investments, taking India firmly into the forefront of investment destinations. The government, keen to promote investment in the country, has radically simplified the nationalized policies, procedures and regulatory aspects. Foreign investment is welcome in almost all sectors, except those of strategic concern. Sectors such as automobiles, chemicals, food processing, oil and natural gas, petrochemicals, power, services, and telecommunications have attracted considerable investments. Today, in the changing investment climate, India offers exciting business opportunities in virtually every sector of the economy.

Foreign direct investment is an investment made by a foreign individual or company in productive capacity of another country. It is the movement of capital across national frontiers in a way that grants the investor control over the acquired asset.

FDI is a flow of entrepreneurial capital in the form of some mixture of managerial skills and financial lending. It directly increases the capital formation of the recipient country. FDI is the outcome of mutual interests of multi-national

firms and host countries. According to the International Monetary Fund (1977), FDI is," investment that is made to acquire a lasting interest in an enterprise operating in an economy other than that of the investor. The investor's purpose being to have an effective voice in the management of the enterprise". IMF definition of FDI treats both reinvested and other direct capital flows such as debt securities, trade credits and grants as part of FDI. This definition is accepted by most countries and also by UNCTAD for reporting FDI data.

Briefly speaking, economic benefits of FDI include Contribution to physical capital formation, contribution to human capital development, transfer of technology and know-how, expansion of market and expansion of trade. The technological changes that it brings about increase in factor productivity, change product and export composition, encourage research and development practice and add efficiency to local production

Revised FDI definition:

The RBI has recently revised data on FDI flows from the year 2000-01 onward by adopting a new definition of FDI. The revised definition includes three categories of capital flows under FDI:

1. Equity flows (equity in branches, shares in subsidiaries and other capital contributions),

2. Reinvested earnings (retained earnings of foreign subsidiaries and affiliates), and Inter-company debt transactions (inter-corporate

debt transactions between associated corporate entities).

There are, however, considerable variations among countries as far as their reporting system of FDI flows are concerned.

In brief one can summarize FDI is as "investment made by a foreign individual or company in productive capacity of another country. It is the movement of capital across national frontiers in a manner that grant the investor control over the acquired asset."

Significance of FDI

Developing countries, which invite FDI, can gain access to a wider global and better platform in the world economy. Economic growth – is one of the major sectors, which is enormously benefited from foreign direct investment. A remarkable inflow of FDI in various industrial units in India has boosted the economic life of country. Foreign Direct Investments have opened a wide spectrum of opportunities in the trading of goods and services in India both in terms of import and export production. Products of superior quality are manufactured by various industries in India due to greater amount of FDI inflows in the country. FDI apparently helps in the outsourcing of knowledge from India especially in the Information Technology sector. Developing countries by inviting FDI can introduce world-class technology and technical expertise and processes to their existing working process. Foreign expertise can be an important factor in

upgrading the existing technical processes. The civilian nuclear deal led to transfer of nuclear energy know-how between the USA and India. FDI increases the level of competition in the host country. Other companies will also have to improve on their processes and services in order to stay in the market. FDI enhanced the quality of products, services and regulates a particular sector. Linkages and spillover to domestic firms- Various foreign firms are now occupying a position in the Indian market through Joint Ventures and collaboration concerns. The maximum amount of the profits gained by the foreign firms through these joint ventures is spent on the Indian market. Employees of the country which is open to FDI get acquaint with globally valued skills. FDI has also ensured a number of employment opportunities by aiding the setting up of industrial units in various corners of India.

In this paper an attempt has been made to analyze the role of FDI in aviation sector.

India's civil aviation sector will be among the top five in the world in the next five years. "In the last six years we have been successful in bringing a revolution in India's civil aviation sector. Since 2004—05, we were considering our civil aviation sector as big, but at world level it was not much recognized. In just six years, India's civil aviation sector is ranked ninth in the world. "In the next five years, India's civil aviation sector will be among the top five in the world. The aviation industry contributed five per cent of the GDP, around Rs 291 crore in tax revenue, provided four million jobs and another

seven million jobs through tourism and related activities.

One of the fastest growing aviation industries in the world is Indian Aviation Industry. With the liberalization of the Indian aviation sector, a rapid revolution has undergone in Indian aviation industry. Primarily it was a government-owned industry, but now it is dominated by privately owned full service airlines and low cost carriers. Around 75 per cent share of the domestic aviation market is shared by private airlines. Earlier only few people could afford air travel, but now it can be afforded by a large number of people as it has become much cheaper because of stiff competition.

A wide range of services related to air transport such as passenger and cargo airlines, unscheduled service operators --- private jets and helicopters, airport management, and support services like Maintenance, Repairs and Overhaul (MRO), ground handling, in-flight catering, and training are being offered by Indian Aviation industry. Enormous benefit has reaped by the Aviation sector from the entry of private carriers, especially from those of the low fare ones.

Still the aviation sector contributes a small part of the travel and transportation services sector in India. The International Air Transport Association (IATA) released passenger and freight traffic forecasts projecting that in 2011 the air transport industry will handle 2.75 billion passengers (620 million more passengers than in 2006) and 36 million tonnes of international freight (7.5 million tonnes more than in 2006). In

the year 2006-07 about 96 million passengers were travelled by airlines annually, while nearly 6 billion passengers carried by the railways. In 2006-07 the airlines suffered losses of around USD 500 million and the situation is expected to decline in 2007-08. The reasons of these losses were high cost of operations, intense competition, and unsustainably low fares.

Due to the increasing costs aviation industry is facing the difficulty. India's aviation sector stands up to the crisis and races against its fastest growing global competitors. Enhancement in affordability and connectivity add to the expected improvement in both passengers and cargo traffic. Large public and private investments which are supported by government initiatives in air travel infrastructure are expected to pour in.

Indian civil aviation industry was started in the year 1912; it was the year when the first air flight between Karachi and Delhi was started by the Indian State Air Services in association with the UK based Imperial Airways. JRD Tata founded the first Indian airline -Tata Airline in 1932. Nine air transport companies were carrying both air cargo and passengers at the time of independence namely Tata Airlines, Indian National Airways, Air service of India, Deccan Airways, Ambica Airways, Bharat Airways, Orient Airways and Mistry Airways. Orient Airways shifted to Pakistan after partition.

In early 1948, Government of India established a joint sector company, Air India International Ltd in association with Air India (earlier Tata Airline) with a capital of Rs 2 crore. According to Air Corporations Act, 1953 the Government nationalized nine airline companies. Indian Airlines Corporation (IAC) was established to cater to domestic air travel passengers and Air India International (AI) for international air travel passengers. Existing airline companies were transferred its assets to these two corporations. According to this Act IAC and AI had a monopoly over the Indian skies. In 1994, Vayudoot, A third government-owned airline, which provided feeder services between smaller cities, was merged with IAC. Indian aviation industry was dominated by these government-owned airlines till the mid-1990s.

In the year 1990, open-sky policy was adopted by the government and it allowed air taxi- operators to decide their own flight schedules, cargo and passenger fares. The monopoly of IA and AI in the air transport services were ended by Indian Government, as a part of its open sky policies in the year 1994. Monopoly was ended by repealing the Air Corporations Act of 1953 and replacing it with the Air Corporations (Transfer of Undertaking and Repeal) Act, 1994. Now Private operators were permitted to provide air transport services.

By the year 1995, numerous private airlines had ventured into the aviation business and accounted for more than 10 percent of the domestic air traffic. These included Jet Airways Sahara, NEPC Airlines, East West Airlines, ModiLuft Airlines, Jagsons Airlines, Continental Aviation, and Damania Airways. But only Jet

Airways and Sahara managed to survive the competition. By this time, Indian Airlines began to lose market share to Jet Airways and Sahara. Today, Indian aviation industry is dominated by private airlines such as Deccan Airlines, GoAir, SpiceJet etc; these include low cost carriers who have made air travel affordable. In India Airline industry is plagued with several problems. Reasons are high aviation turbine fuel (ATF) prices, increasing labor costs and lack of skilled labor, rapid fleet expansion, and strong price competition among the players. Infrastructure constraint is one of the major challenges facing by Indian aviation industry. If Indian aviation industry has to continue its success story Airport infrastructure needs to be upgraded. In this direction some steps have already been taken. The future prospects of Indian aviation sector look bright.

Classification of Indian Aviation Industry

The players in aviation industry can be broadly categorized in three groups:

- ❖ Public players
- ❖ Private players
- ❖ start up players

There are three public players in Aviation industry: Air India, Indian Airlines and Alliance Air. The private players include Jet Airways, Air Sahara, Kingfisher Airlines, Spice Jet, Air Deccan and many more. Those who are planning to enter the markets are starts up players. Some of them are Omega Air, Magic Air, Premier Star Air and MDLR Airlines

Aviation Sector Boom

1) Foreign equity allowed: Without any Government approval, foreign equity up to 49 per cent and NRI (Non-Resident Indian) investment up to 100 per cent is allowable in domestic airlines.

2) Low entry barriers: Nowadays, to launch an airline venture capital of $10 million or less is enough. Private airlines are hiring foreign pilots, get expatriates or retired personnel from the Air Force or PSU airlines in senior management positions.

3) Attraction of foreign shores: Many private players like Jet and Sahara have gone international by starting operations, first to SAARC countries, and then to South-East Asia, the UK, and the US and many more domestic airlines too will be entitled to fly overseas by using unutilized bilateral entitlements to Indian carriers.

4) Rising income levels and demographic profile: As compared to the developed country standards, India's GDP (per capita) at $3,100 is still very low but as India is shining, at least in metro cities and urban centres, where IT and BPO industries have made the young generation prosperous. Demographically, In India people in age group of 20-50 among its 50 million strong middle class, has the highest percentage with high earning potential. It contributes the boost in domestic air travel, particularly from a low base of 18 million passengers.

5) Untapped potential of India's tourism: Presently India attracts 3.2 million tourists every year, while China gets 10 times the number. Due to the open sky policy Tourist arrivals in India are expected to grow exponentially.

6) Glamour of the airlines: An airline is as glamorous as the film-making industry. Today Airline tycoons, like J. R. D. Tata and Howard Hughes, Sir Richard Branson, Dr. Vijaya Mallya, have been idolized. Airlines have an aura of glamour around them, and high net worth individuals can always toy with the idea of owning an airline.

There is 170 per cent increase from present fleet strength of 158 aircraft as private and public sector airlines from India have placed orders in the last 6 months. As always, among the new entrants, a few may have visions of changing that world and others may be motivated only by money and the glamour of the airline sector. There is a need of support system of airports and their infrastructure, trained manpower such as pilots, cabin crew and maintenance engineers, passenger amenities such as hotels. Aviation Turbine Fuel (ATF) availability on a par with international prices, networks of travel agents and Internet penetration for the travelers for the aviation sector to work. More important, there has to be a rise in the per capita income to make air travel affordable.

1. Rush for domestic skies

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to the open sky policy Tourist arrivals in India are expected to grow exponentially.

2. Pre-requisites for survival

Low debt-equity ratio: Airline is a cyclical industry which has alternating short periods of growth and longer periods of recession. Due to the staying power of equity an airline gives the capital to stay afloat during periods of recession. Ideally the debt-equity ratio for new airlines should be less than or equal to 1.

Appropriate aircraft type: The most expensive assets of airlines are aircraft and it is having an average aircraft utilization higher than 11-12 hours per day is crucial for its survival.

Thus choosing an aircraft that is cost-effectively for the sectors identified, having sufficient number of pilots, as well as maintenance facilities and spare parts is vital.

Challenges for Aviation Industry

There are several challenges in front of aviation industry because of the growth in the aviation sector and capacity expansion by carriers. These include shortage of workers and professionals, safety concerns, declining income and the lack of accompanying capacity and infrastructure. Moreover, stiff competition and rising fuel costs are also negatively impacting the industry.

1. Shortage of trained Employee: There is a shortage of trained and skilled manpower in the aviation sector as a result of which there is cut-throat competition for employees which, in turn, is driving wages to unsustainable levels. Moreover, the industry is unable to retain talented employees.

2. Regional connectivity: To provide regional connectivity is one of the biggest challenges facing the aviation sector in India. The lack of airports is hampering the growth of regional connectivity.

3. Rising fuel prices: As fuel prices have risen, the inverse relationship between fuel prices and airline stock prices has been established. Moreover, it also led to increase in the air fares.

4. Declining yields: As more players are attracted towards Aviation industry because of increasing growth prospects it will lead to more competition. All this has resulted in lower returns for all operators.

5. Gaps in infrastructure: Airport and air traffic control (ATC) infrastructure is insufficient to support growth. While a initiate has been made to upgrade the infrastructure, the results will be visible only after some years.

6. High input costs: The input costs are also very high because of some of the reasons like Withholding tax on interest repayments on foreign currency loans for aircraft acquisition. Increasing manpower costs due to shortage of technical personnel.

Strengths:	Weakness:
❖ Growing tourism	❖ Under penetrated Market
❖ Rising income levels	❖ Untapped Air Cargo Market
❖ Liberal Environment	❖ Infrastructural constraints
❖ Modern Fleet	❖ Airport Infrastructure
❖ High Quality	❖ Airways Infrastructure
❖ Economic Growth	❖ National Carrier
❖ Political Stability	❖ Deep Pockets
	❖ High Cost Structure
	❖ Skilled Resources
Opportunities:	**Threats:**
❖ Expecting investments	❖ Shortage of trained Pilots
❖ Expected Market Size	❖ Shortage of Airports
❖ Market Growth	❖ High prices
❖ Geographic Location	❖ Middle East Aviation
❖ Lower Costs, Higher Quality	❖ Terrorism

Aviation - Brief Overview

India is poised to be among the top five aviation nations in the world in the next 10 years. Currently, India is the 9th largest civil aviation market, "Recent estimates suggest that domestic air traffic will touch 160-180 million passengers a year, in the next 10 years and the international traffic will exceed 80 million passengers a year,". The Indian Aviation Industry is exploring opportunities to improve connectivity and is also looking at enhancing the number of Indian carriers to various countries."One of the key achievements of India in the last decade has been to set-up an independent regulator for economic regulation of airports,".

Aviation - Market Size

According to data released by Directorate General Civil Aviation (DGCA), in the last decade, domestic air traffic has quadrupled from 13 million to 52 million and international traffic more than tripled to 38 million. A similar trend is observed in the cargo sector. The rapidly expanding aviation sector handles 2.5 billion passengers across the world in a year; moves 45 million tonnes of cargo through 920 airlines, using 4,200 airports and deploys 27,000 aircraft. Today, 87 foreign airlines fly to and from India and five Indian carriers fly to and from 40 countries. Passengers carried by domestic airlines during January-November 2011 were 55.03 million as against 46.81 million during the corresponding period of previous year thereby registering a growth of 17.6 per cent,

Trends: Aviation - Market Players

1) Consolidation in aviation sector: In aviation industries the rise in the number of alliances will help in promote the growth of aviation sector in India. Example of the Jet-Sahara merger is just the beginning. Indian aviation industry is looking forward to more consolidations.

2) The number of passengers traveling by air is on the rise: By 2025 passenger boarding expected to double and by the same time aircraft operations are expected to triple, the number of passengers traveling by air is on rise.

3) For the traveling public, price is paramount in choosing a carrier: Airfares are fully transparent to the public and travelers are choosing the lowest price option because of the Internet and round-the-clock search facility. Even business travelers, who have been less price-sensitive, are resisting fare increases. Travelers are not giving preference to brand but the only premiums

they are willing to pay for are time-of –day and direct flights.

4) Capacity is growing without much constraint: The new aircraft have been ordered by Indian carriers for delivery in the coming period, without clear plans to retire older planes. Significant numbers of regional jets are also adding by them. Kingfisher Airlines has already ordered 5 Airbus A380 aircrafts that will operate on international routes

5) Cost structures will continue to handicap legacy carriers as they compete with newer airlines, as well as with overseas carriers: Great threats are being posed by the low cost carriers to legacy carriers, as a result of which they are reshuffle, their pricing policies. Apart from this, they are also facing competition from overseas players.

6) Oil prices are not expected to fall: Aviation Turbine Fuel (ATF) prices have been increased by 3.5 per cent, in line with the rise in international oil prices. Because of this there is a marginal increase in airfares.

7) Outsourcing: Private airlines are famous to hire foreign pilots, get expatriates or retired personnel from the Air Force or PSU airlines, in senior management positions. Airlines are also famous to take on contract employees such as cabin crew, ticketing and check-in agents.

a. GVK Power & Infrastructure Ltd (GVK PIL) has acquired 108 million equity shares constituting 13.5 per cent in Mumbai International Airport Ltd (MIAL) from its Mauritius partner Bid Services Division for Rs 1,130 crore (US$ 215.28 million)

b. US-based electrical components company Eaton Corporation foresees plenty of opportunities for itself in India's unfolding civil and military aerospace story. "India is expected to emerge as one of the largest aviation markets in the world," as per Joe-Tao Zhou, APAC President, Aerospace Group, Eaton Corporation

c. GMR Infrastructure-led Delhi International Airport Ltd (DIAL) is set to approach the Government to expand the permitted land use for 250 acres. The company wants to lease out the land for non-airport related activities

d. SpiceJet has acquired a new fleet of Q400 aircraft from Bombardier and it will use these aircrafts in its new regional service. Under the deal, SpiceJet also has the option of ordering 15 more Q400 NextGen aircraft

• Airline operator Emirates plans to add new destinations in the US and Russia from Hyderabad via Dubai in the next few months. "Our market estimates are

that there are about 1,500 passengers flying to Dubai and Seattle each every month from Hyderabad," according to K P Venugopal, Emirates Sales Manager, Andhra Pradesh

- GippsAERO, the aircraft manufacturing division of Mahindra Aerospace, has signed an agreement with Rolls Royce to partner on engine technology for a new aircraft

- Air India will take delivery of its first Boeing 787 Dreamliner aircraft by the end of 2011, according to Dr Dinesh Keskar, President, Boeing India. Further, Boeing predicts that India will require 1,320 new aircrafts valued at US$ 150 billion over the next 20 years

- Air India Express has started operating direct flights from Muscat to three new destinations in Kerala, and have increase the number of flights from the Gulf to the country from October 31, 2011

- The ground-breaking ceremony of the new terminal at the Ibrahim Nasir International Airport was held on December 19, 2011. The project is being undertaken by a consortium led by GMR Group. Malaysian Airport is GMR's partner for the project which will be completed by 2014. The project is estimated to cost US$ 510 million

- The Turkish Airlines plans to expand its operations in India by 2012. "India is a very important market for us and we need to fly to at least five cities there," according to Temel Kotil, CEO, Turkish Airlines

CAPA expects India's carriers to place orders for up to 200 new aircraft this year, with a list price of US$ 11 - US$ 12billion. This will include about 125-150 narrow bodies, 30-50 regional aircraft and 10-15 wide bodies.

Problems:

For the Indian Civil Aviation Sector year 2011 has been one of unrest. The once lucrative sector has witnessed a large exodus of pilots and crew members leaving the country for greener pastures. As the country celebrates 100 years of aviation in India, large scale malpractices were detected at flying academies spread across the country where fake licenses were issued to pilots. The scam raised serious doubts about safety in the aviation industry. About 23 people were arrested which included pilots, senior employees of the aviation regulator Directorate General of Civil Aviation (DGCA) and middlemen involved in the scam.

Despite a 17 per cent growth in passenger traffic, India's civil aviation industry was hit by rising jet fuel prices and interest costs, which ate into the margins of carriers. High taxes on jet fuel and equally high airport charges were the major heads of cost for the Indian carriers, with the

global airlines' body **International Air Transport Association (IATA) estimating that fuel costs accounted for 45 per cent of the total costs, compared with 30 per cent for global carriers**.

The industry has accumulated losses of nearly Rs 15,000 crore in 2010-11, up from Rs 7,038 crore in 2009-10. Leading the pack is national carrier Air India followed by private sector carrier Kingfisher Airlines. The losses notched up these two giants played spoilsport for the Indian aviation sector in 2011.

The only reprieve was low-cost IndiGo that posted profits during the current tough times. It also announced a buy-order for 180 aircraft from European manufacturer Airbus worth as much as $15.6 billion, touted as the largest aircraft order in aviation history. In a bid to consolidate their position, Indian carriers undertook several steps to cut costs and rationalise their networks to match demand for air travel. While Jet Airways decided to move ahead with plans to have a single no-frills banner instead of running both JetLite and JetKonnect, Kingfisher decided to do away with its low fare segment, Kingfisher Red, and continue with its full-service brand. Flights of Air India and Kingfisher were also disrupted for a few days during the year as state-led oil companies stopped supplies demanding daily cash payments for lifting of jet fuel. Air India continued to reel under a huge debt with estimated debt now at Rs 43,777.01 crore towards

purchase of new aircraft and working capital loans. Air India suffered a loss of Rs 6,994 crore during 2010-11. The carrier's operations were hit by a nine-day strike by its pilots in April-May over the payment of salary and allowances. The strike disrupted its flight schedules. This apart, the Air India management faced three strikes, mainly due to late payment of salaries and the issue of the merger of Indian Airlines with Air India, which stranded thousands of passengers and pushed up its losses.

A group of ministers will consider a proposal also discuss the group of secretaries' recommendation to allow domestic carriers to import fuel directly rather than buying it from oil marketing companies. This will help airlines save at least a fourth of their expenses of Rs 10,000 crore on aviation turbine fuel. Airlines pay hefty sales tax ranging between 4% and 28% in different states on ATF, which can be avoided by importing fuel directly. The aviation minister had also said on Saturday that he would take up the issue of equity infusion into the struggling national carrier Air India with the finance minister after a section of pilots had gone on a strike to protest non-payment of salaries. Of the total debt of Rs 70,000 crore on the domestic aviation sector, Air India alone accounts for Rs 43,000 crore. Another committee of secretaries working on a turnaround plan for Air India has proposed infusion of Rs 30,000 crore into the carrier over the next decade. Access to funds is a critical issue for the aviation industry, with most domestic airlines registering

huge losses in the first half of the current fiscal. Industry Association ASSOCHAM estimates that the total losses for the whole year could rise to Rs 15,000 crore.

India's beleaguered aviation sector is experiencing severe turbulence as high jet fuel costs, fierce competition and losses threaten carriers' survival. The crisis engulfing Kingfisher Airlines, owned by billionaire liquor baron Vijay Mallya, has already sounded alarm bells, as it scraps scores of flights in a bid to stay financially viable. All of India's six main airlines -- barring budget carrier IndiGo -- announced steep losses in the quarter to September, due to falling passenger yields and high fuel costs. Jet Airways posted a loss of Rs 101.22 crore in the third quarter ending December 31, 2011, as higher fuel prices, lower fares and rupee depreciation continued to hurt the company. In the corresponding quarter last year, the company posted a net profit of Rs 118.23 crore. Total income increased to Rs 3,939.16 crore for the quarter under review as against Rs 3,473.38 crore recorded during the same quarter of 2010-11.

Jet Airways Q3 results			(in Rs crs)
	Q3		% growth
	2011-12	2010-11	
Net Profit	(101.22)	118.23	
Aircraft fuel expenses	1,753	1,097	60
Total expenditure	4,215	3,055	38
Total income	3,939.16	3,473.38	13

The Centre for Asia Pacific Aviation (CAPA) forecasts a $2.5-$3 billion loss for Indian airlines for the year ending March 2012. "The bloodbath has already started," referring to the sector's bad earnings. "Airlines are incurring cash losses and not even able to recover variable costs, which is a concern,". For an Indian airline, jet fuel is a huge variable cost -- up 41 per cent from a year earlier -- and constituting nearly half of operating costs. Fixed costs such as fuel taxes can be over five times the international average. India's rupee -- Asia's worst performing currency -- continues to depreciate against the dollar. Almost 70 per cent of an airline's costs such as maintenance, jet fuel, and spares, are dollar-denominated. On the surface, demographics make India, a country of 1.21 billion, an attractive story. India's passenger aviation sector is estimated to be growing at between 15 to 20 per cent each year, one of the world's fastest rates.

Air penetration in India is very low even as more Indians are flying than ever before. India has only three aircraft for every one million people compared to one aircraft per 50,000 people in the United States. But India's aviation sector, once the symbol of economic growth, grew too fast, adding expensive planes to their fleets too quickly.

According to PricewaterhouseCoopers India the industry will face problems until 'systemic and structural problems' such as poor infrastructure and high airport charges are dealt with. Most Indian airlines are unable to raise ticket prices due to intense competition. Only no-

frills IndiGo, has managed its costs nimbly, has been able to navigate the storm. Indigo placed one of the largest single orders of the Paris Air Show this year as it aims to boost its fleet size six-fold to 275 by 2025, from 46 currently. Consolidation of the overcrowded sector may also be in store. similar to buyouts in the past decade when Jet bought low-cost Sahara and Kingfisher purchased no-frills Air Deccan. Kingfisher recently axed Air Deccan, saying there was more money in premium passengers. India's six major airlines are Air India, which is state-owned, Jet Airlines and Kingfisher, plus budget carriers Indigo, Go and Spice Jet. Air India and Jet Airlines also have no-frills units.

In India, the government's open-sky policy has enticed many foreign aviation leaders to enter the market, spurring rapid industry expansion boosted by the growing population and increased demand for international travel and trade, as well as an increasing visiting friends and relatives) market. However, airlines must contend with insufficient infrastructure and challenging political bureaucracy in India. **"It is estimated that in the next decade, the Indian market will absorb approximately 316 commercial jets and need three times the number of airports that it has today, whilst at the same time, the country doesn't have enough skilled labour to maintain or to fly the aircraft,".** "Additionally, intense foreign competition prevents domestic carriers from international expansion, deeply affecting balance sheets. "India is amongst the world's most promising aviation markets and the region has

already taken steps to address some issues through the recent privatisation of airports." "Skilled aviation personnel in developed nations with stuttering economies may want to look East for opportunities, but the region is not without risk -- there is significant progress yet to be made in airport modernisation, aircraft maintenance, pilot training and air cargo services,". "It remains to be seen whether the Indian aviation industry can handle the region's relentless growth, with its West Asian, oil-rich neighbours all too keen to take on more capacity with new fleets of super-jumbos based in the Gulf and hundreds more on order. In India, the first step toward carrier consolidation is already complete. On June 1, 2011, the merger control provisions of the Competition Act, 2002, were brought into effect, allowing 'acquisitions of one or more enterprises by one or more persons or merger or amalgamation of enterprises. While this is a significant milestone, companies undertaking mergers or acquisitions must prepare for the challenges; with more competition in the aviation market, fares will soon be slashed and the resulting low margins will not cover all expenses and costs, which will create a situation where many domestic airlines will simply stop operating.

FDI in Aviation Sector

The Indian government has indicated that it will move speedily to save the country's deteriorating aviation industry by liberalizing rules on foreign investment. A draft cabinet note on foreign direct investment has put the FDI cap

for foreign airlines at 26 percent against 24 percent planned originally by the Civil Aviation Ministry to the Department of Industrial Policy and Promotion. Presently, foreign direct investment up to 49 percent is permissible in the aviation sector, but foreign airlines are not permissible to invest in a domestic airline company. The cabinet note said that the existing restrictions need to be removed. The government also intends to reorganize the state-owned Air India and bring in a strategic partner when it turns profitable.

IATA Director General and CEO Tony Tyler e has expressed doubts whether allowing foreign airlines to invest in Indian carriers would attract them enough to put in money now, when the domestic industry was in a financial mess. However, he strongly supported the need for further liberalisation of India's FDI policy in aviation as well as slashing of high taxes on jet fuel. "In today's difficult environment, generally speaking, many airlines are trying to keep their balance-sheets strong rather than investing in other airlines. .... Investing in loss-making business is obviously not a winning strategy," Almost all Indian carriers have suffered losses in the past two years. If investment by foreign airlines was allowed, "then investments from different kind of sources will arrive. ... Certainly, Indian laws are very restrictive on foreign investments in airlines."

If FDI policy was liberalised, "you will see foreign money coming into the aviation market, because it is a rapidly growing market. Therefore,

aviation-friendly policies are required, particularly lifting the dead weight of taxation," Describing India as a big aviation market, getting across the country by air was the best way. "We need good domestic air transport infrastructure to facilitate foreign investment." "globally, even in the bad days, fuel costs do not account for more than 30 per cent of the total costs of airlines (the world over). But in India, it is 45 per cent."

Terming high fuel prices in India as the "main problem" which was having "a significant drag" on Indian carriers "it handicaps the whole industry. It pushes costs up. So fares have to be increased to break even. Then you will have less traffic and less revenue. It is a horrible spiral of cost. It is penalising the industry." India's aviation industry free by expeditiously reducing taxes, especially those on jet fuel, instead of "micro-managing" the cash-strapped sector. The service tax on tickets and high taxes on jet fuel "should be reduced or eliminated". The Indian government to set the aviation industry free (from policy interventions like checking airfares). Concentrate on building infrastructure and the air navigation system. There is a lot the Indian government can do,".

Foreign Direct Investment (FDI) up to 49 per cent is now allowed in domestic airlines, but the policy currently bars foreign airlines from investing in them primarily on security grounds. While the DIPP feels that allowing foreign airlines to invest in domestic carriers would help them raise the much- needed equity, it does not find support among many Indian airlines which

feel that fledgling carriers would be susceptible to hostile takeovers as they were passing through a difficult financial situation. Besides Air India, domestic airlines like Kingfisher, Jet Airways and Spicejet have all reported losses due to high cost of operation and face severe liquidity crunch. Kingfisher Airlines is looking to raise working capital and wants the government to open up the domestic aviation sector for investment by foreign airlines only a foreign airline would be able to understand the problems of the sector.

But the opponents feel that a foreign carrier, with deep pockets, could play havoc with the domestic market. They could also artificially lower the price of air travel to kill domestic competition. Even the Federation of Indian Airlines (FIA), which has Kingfisher as a major member, had opposed the proposal to allow foreign carriers to invest in domestic airlines. It had quoted instances of similar laws barring investment by foreign airlines prevailing in several countries including the US and Canada.

The air transport (including air freight) in India has attracted foreign direct investment (FDI) worth US$ 423.31 million from April 2000 to September 2011, according to the data provided by Department of Industrial Policy and Promotion (DIPP). Private carriers are anticipated to post a combined profit of US$ 350–US$ 400 million for the financial year ending March 31, 2012, as per a report titled '2011-12 Aviation Industry Outlook' by Centre for Asia Pacific Aviation (CAPA) India. CAPA India expects domestic traffic growth of 17-18 per cent,

possibly as high as 20 per cent. International passenger numbers, which grew by about 10 per cent last year, are expected to increase towards the upper end of a 10-12 per cent range over the next 12 months.
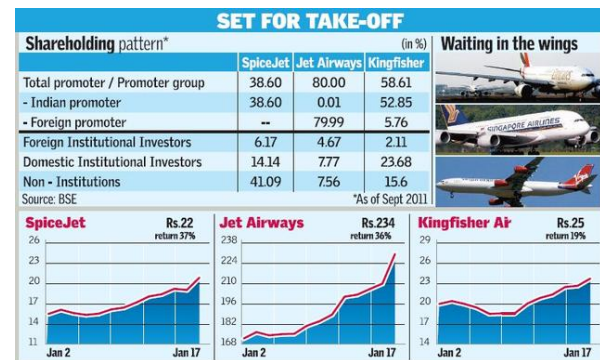
In a major relief to debt-laden airlines such as Kingfisher, the Civil Aviation Ministry has announced a "broad consensus" in the Government on allowing foreign airlines to pick up equity of up to 49 per cent in domestic scheduled airlines. The Cabinet will take a final call on the issue. Existing rules allow foreign investors, but not foreign airlines, to acquire up to 49 per cent equity in scheduled domestic airlines. It is now proposed that this distinction be done away with. Share prices of all the three listed airline companies took off. It also indicated that the Government is not averse to allowing foreign airlines pick up equity in Air India. It decided to immediately release Rs 150 crore to help the cash-strapped national carrier pay salaries and staff arrears.

"The Civil Aviation Ministry will prepare a Cabinet note for allowing foreign airlines to take 49 per cent stake in Indian carriers." The Department of Industrial Policy and Promotions

(DIPP) has put up a draft note for inter-ministerial consultation on FDI by foreign airlines. Though the DIPP note talks about only 26 per cent FDI, "a Committee of Secretaries has favoured higher FDI and we will work accordingly," Airlines such as Emirates and Singapore are also keenly watching the developments. All the major foreign airlines would be interested in picking up stake in Indian carriers. This is because the Indian market is growing at a very high rate. During the first 11 months of 2011, domestic passenger traffic grew by over 17 per cent. Indian carriers are divided over the move. While Kingfisher is believed to be in favour of such a move, Jet Airways is said to be against it on the grounds that with mounting losses, a foreign airline will be able to acquire a domestic airline cheap.

Estimation

The Government's open sky policy has attracted many foreign players to enter the market and the industry is growing in terms of both players and the number of aircrafts. Given the strong market fundamentals, it is expected that the civil aviation market will register a Compound Annual Growth Rate (CAGR) of more than 16 per cent during 2010-2013. Air traffic control (ATC) operations will start functioning as a new entity from April 2012. At present, the air navigation service comes under the Airports Authority of India (AAI), the state-owned airport operator. India has signed the bilateral Aviation Safety Agreement (BASA) with the USA.

The Government has taken various steps towards structural policy reforms and is coming out with new policies which are liberal and will encourage Public-Private Partnerships (PPP).

1. Government of India allows 100 per cent foreign direct investment (FDI) for green field airports, via the automatic route. Moreover, foreign investment up to 74 per cent is permissible through direct approvals while special permissions are required for 100 per cent investment

2. Private investors are allowed to set up general airports and captive airstrips while maintaining a distance of 150 kms from the existing ones. Complete tax exemption is also granted for 10 years

3. About 49 per cent FDI is allowed for investment in domestic scheduled passenger airlines and investment up to 100 per cent by Non-Resident Indians (NRI) via the automatic route. FDI up to 74 per cent is allowed for non-scheduled and cargo airlines

AAI has entered into Operation Management and Development Agreements (OMDA) with M/s. Delhi International Airport Ltd (DIAL) for Indira Gandhi International (IGI) Airport, Delhi with an objective to develop it into a world class airport. Phase-1 of the development of IGI airport has been completed with the construction of the new Integrated Terminal 3 (T3). It caters to additional 34 million passengers per annum and can operate as a hub. It is up to the airline to take these opportunities to operate

regular scheduled services from these airports and use it as regional hub.

The Indian aviation sector is a major economic driver for prosperity, development and employment. Massive investments in airport infrastructure have led to world class airports which have become the symbol of India's growth story. India is poised to emerge as the third largest aviation market in the world by the end of this decade. The sector with a growth of 18 per cent in domestic market is expected to generate approximately 2.6 million jobs in the next one decade. The Vision-2020 document prepared by Ministry of Civil Aviation is an assessment of the overall outlook of the aviation sector in 2020. The growth of aviation sector has potential to absorb upto US$ 120 billion of investment, according to the 2020 document. Fleet size of commercial airlines sector will be approximately 1,000 aircraft, domestic passenger numbers could reach 150-180 million, Helicopter fleet is expected to be 500, while the air cargo movement is expected to reach the level of 9 million MT. The sector is expected to have the potential to absorb 3 million jobs directly by 2020. The Vision 2020 announced by the Ministry of Civil Aviation also conceives of building infrastructure to support about 280 million customers.

For many, the decision to allow foreign airlines to take a 49 per cent equity stake in domestic carriers may seem cynically timed to benefit a company that is not just struggling to service debts of some Rs 7,000 crore, but is unable to meet statutory obligations as well. Even

if this judgment is accepted at face value, it still does not take away the basic merit of the Civil Aviation Ministry's in-principle decision. Currently, the Government permits foreign direct investment (FDI) of up to 49 per cent in scheduled local passenger airlines. The rider, though, is that foreign airlines per se cannot invest, either directly or indirectly. It means a Temasek Holdings can own 49 per cent in an Indian airline, whereas Singapore Airlines cannot, despite both being Singapore Government-promoted entities! The fact that this bizarre policy has been in existence since April 1997 — and crafted, in turn, to favour a few entrenched domestic players — is something that should not be lost sight of. If a policy is bad, it should go, regardless of the timing or motive behind the decision. This has, indeed, been the case with most reform measures, which while desirable in themselves, have nevertheless involved some element of stealth or rank opportunism.

The major beneficiaries of the latest Government move would undoubtedly be the huge debt-laden airlines, whose promoters are desperately seeking external capital infusion that will enable them to at least reopen credit lines with banks. The banks, too, would be no less keen to see payments resume on their loans already being considered as non-performing assets. More important are the consumers (and employees), who would certainly not lose if existing airlines continue to fly. They would further gain, if the new investor is someone who knows the business rather than a financial

institution with no long-term interest in the sector.

The ones that are likely to cry foul over opening up the Indian skies to foreign airlines are the existing efficiently-run domestic carriers. There is some justification in their viewing the move as providing easy exit options to extravagant promoters. The least the Government can do is to make it easy for them to fly to other countries, just as foreign airlines are being enabled to operate in India. Right now, the first preference to fly on international routes is extended to the state-owned Air India that does not even utilise its quotas. There is no reason for not awarding these straightaway to private Indian carriers. Equally, they should have the freedom to import aircraft fuel directly on their account (even if the actual ground handling till the final delivery point may be left to the oil companies) and avoid the huge sales tax incidence on it. It would help create a level-playing vis-à-vis foreign airlines.

The move to liberalise the norm has to be seen in the context of the financial troubles that most domestic airline companies are embroiled in, none more than Air India and Kingfisher. The thinking appears to be that easing the norm will enable these troubled airline operators to attract equity investment from foreign carriers. Though this is an infinitely better option than a bailout using public funds, the reality is that there might not be too many takers among foreign airline companies for this. The first reactions from some of them such as Lufthansa, Emirates and Singapore Airlines, purported to have been interested in investing in domestic carriers, only confirm this. They have all said that there is no immediate plan to invest in airline companies in India nor is it an important part of their future plans. Air Asia, a Malaysia-based low-cost operator, has gone a step forward and said that it would rather set up a subsidiary in India than invest in an existing carrier. Offering 49 per cent equity to foreign airlines is obviously no magic wand to ward off the problems the airline industry is enmeshed in. It might probably help one of the most troubled operators to seek a partner. If the government is keen to rescue the airline industry, there are other things that it could do. It could, for a start, rationalise taxes and duties on aviation turbine fuel, which are at ridiculously high levels. Soaring oil prices have made fuel expensive and the high taxes only add to the burden. Fuel being the biggest item of cost for airlines, any relief on that front will be welcome. Secondly, we need a regulator who will keep his eyes open for sharp anti-competitive practices such as cut-throat fare setting by some players forcing the others to join in a fatal race to the bottom. Thirdly, applications to fly short-haul international routes should be cleared quickly, especially where there is room to do so under bilateral agreements. It is quite possible that despite all such assistance there will still be some airline companies that cannot be rescued mainly due to mismanagement or faulty decisions made in the past. Though it might be tempting to go to their aid with financial assistance, it will be best to leave them to their devices.

In India the government's open-sky policy has enticed many foreign aviation leaders to enter the market, spurring rapid industry expansion boosted by the growing population and increased demand for international travel and trade, as well as an increasing Visiting Friends and Relatives (VFR) market. "It is estimated that in the next decade, the Indian market will absorb approximately 316 commercial jets and need three times the number of airports that it has today, whilst at the same time, the country doesn't have enough skilled labour to maintain or to fly the aircraft.

Conclusion

As the fourth largest economy in the world in PPP terms, India is a preferred destination for foreign direct investments (FDI); India has strengths in information technology and other important areas such as auto components, apparels, chemicals, pharmaceuticals, jewellery and so on. Although India has always held promise for global investors, but its rigid FDI policies was a significant hindrance in this context. However, as a result of a series of ambitious and positive economic reforms aimed at deregulating the economy and stimulating foreign investment, India has positioned (projected) itself as one of the front-runners in Asia Pacific Region. India has a large pool of skilled managerial and technical expertise. The size of the middle-class population at 300 million exceeds the population of both the US and the EU, and represents a powerful consumer market. Due to the rise in income levels, disposable income is increasing which enhanced the number of flyers. Indian tourism is also in the growing stage as a result there has been an increase in the number of international and domestic passengers as well. It will lead to the growth in airlines industry. Although currently there are many challenges which are being faced by the Indian Aviation Industry but the growth prospect is very much high. Government has to take an initiative to improve the Airport infrastructure and to pour in some investments as well. Some steps are already being taken by the government for the development of Aviation Industry. Concluding we can say that apart from all the challenges Aviation Industry's future is very bright in India.

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GLOBALIZATION AND THE KERALA ECONOMY

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Abstract

The Government of India has been implementing the new economic policy based on globalization since 1999. However in Kerala, the economic reforms have been seriously implemented only after 2001. The present study focused on the impact of globalization on Kerala Economy based on selected economic parameters. The period before 2001 considered the pre-globalised period after 2001 treated as post globalised period. The study concluded that globalization and liberalization policies relatively produced a positive impact on Kerala Economy compared to the pre-globalization period.

Keywords: *Planned effort, Liberalised effort, Sectorial transition, Average annual growth rate*

The Government of India has been implementing the New-economic Policy based on globalisation since 1991. In Kerala, the economic reforms have been seriously implemented only after 2001, when the A.K. Antony Government assumed power. The Marxist-led LDF Government (1996-2001) was opposed to the globalisation policies. The LDF Government argued, "The implementation of economic reforms as such, without taking into consideration the industrial situation and the circumstances prevailing in Kerala had resulted in a serious crisis in the industrial sector and even some of the prestigious PSUs were on the verge of disinvestments. The Policy clearly stated that the domestic and foreign private investments in the State would be attracted subject to the existing laws governing it. Moreover, the industrial policy (1998) stated the need for a planned effort (not a liberalised effort) for industrial promotion and revival in the State. Therefore, globalisation and liberalisation policies were hardly implemented in Kerala before 2000-01.

On the other hand, the UDF Government in Kerala (2001-2006) has liberalised the industrial policy in 2001 for transforming the State into an attractive destination for industrial development, international trade and commerce, as evident from the following goals and steps of liberalisation:

(i) Creation and maintenance of an investment friendly climate

(ii) Deregulation of industrial sector

(iii) Industrial license is required for only 6 industries under compulsory licensing

(iv) Maximisation of private investment

(i) Elimination of all restrictive labour practices

(ii) Co-ordination of industry with the educational system

(iii) Re-engineering the Government's delivery mechanism

(iv) Introduction of Single Window Clearance Boards

(v) Special development of sunrise sectors including IT

(vi) Empowerment of the traditional sectors to face up to global challenges by appropriate productivity improvement, design changes, development and marketing.

(vii) Venture Capital Fund for financial assistance to new IT and high-tech ventures

(viii) Grant of 50% of the cost of project feasibility studies for medium and large scale industries

(ix) Priority in sanction and servicing of power

(x) Exemption from stamp duty/registration charge for purchase and sale of land/ built up space for IT projects

(xi) Exemption from the purview of the Pollution Control Act for IT projects

(xii) Moreover, the Government has tried to mobilise private investment funds from the non- resident Indians and from other global investors through the 'Global Investor Meet' (GIM) held in Kochi on 18th and 19th January 2003.

Pre and Post Globalisation Periods

Therefore, the present study forced to analyse the performance of Kerala Economy by categorizing the pre globalised period as before 2001 and the post globalised period after 2001.

Performance of the Kerala Economy During the Pre-Globalisation Period

1.1 Signs of slow down

The first phase of liberalization in India (or the pre globalisation period in Kerala) shows signs of slow down in the State in economic growth compared to the neighbouring states and

all India rate. The mean of yearly changes (4.6%) for Kerala is lower than Karnataka (8.7%) and Tamilnadu (6.8%) and all India (6.6%), as represented by table -1

Table 1 Year to year changes in simple growth rate of NDP at factor cost at 1993-94 prices.

(Per cent)

Year	Kerala	Karnataka	Tamilnadu	All India
1995-96	4.0	5.2	3.8	7.1
1996-97	4.0	9.3	6.0	7.5
1997-98	2.2	4.0	7.3	4.8
1998-99	6.2	12.9	6.8	6.8
1999-2000	6.9	7.6	7.1	--
Mean	4.6	8.7	5.8	6.6
Median	4.9	8.3	5.8	6.9

Source: K.K. Subrahmanian – Regional industrial growth under economic liberalization

1.2 Performance on the basis of sectoral growth rates

Performance of the Kerala economy during the pre globalisation period can be simply analysed with the help of sectoral growth rates of the economy. For this purpose, growth rates of primary, secondary and tertiary sectors are presented in Table-2, from 19 96-97 to 2000-01.

Table-2 Kerala Economy: Sectoral Growth rates (%)-Pre Globalisation Period

Year	Primary Sector	Secondary Sector	Tertiary Sector	Overall Growth rate
1996-97	3.0	-0.38	6.6	3.07
1997-98	-5.6	3.0	6.7	1.37
1998-99	2.5	9.0	8.7	6.71
1999-00	2.6	-0.2	11.7	4.70
2000-01	2.6	5.3	6.6	4.83

Source: Economic Review 2002, SPB, Kerala

It is clear that the growth rate of agriculture sector has declined to 2.6% from 3%, over the period. During 2001, the industrial sector made a growth rate of 5%, however the growth rates were unstable during the pre globalisation period. The growth of the service sector is also not satisfactory, as the rates are remaining the same

in 1996-97 and 2000-01. However, the economy made a marginal increment in overall growth rate by 0.6%, over the period.

Post Globalisation Period

We have already shown that the Kerala government has implemented Liberalisation and globalisation policies in Kerala only from the year 2001. The goals of Kerala Government with regard to liberalization were very clear from the various steps and policies undertaken during the last five years. Among the various liberalization policies, the IT policy should be specially mentioned. Kerala offers immense opportunity for investment in the IT industry. Government agencies have geared up to encourage new ventures in this sector. No state level clearances are required to set up IT projects. The government offers total venture support to investors.

Performance of the economy- Post Globalisation Period

Performance of the Kerala economy during the post globalisation period is analysed with the help of some selected parametres, as given below:

a) Rank position of the Best States in India

b) Per Capita Income

c) Sectoral Growth Rates-Post Globalisation Period

Rank position of the Best States in India:

By considering eight parameters, such as agriculture, industrial environment, consumer market, health, education, law and order, infrastructure, budget and prosperity, 'India Today' conducted a study among the States in India. The study envisaged that Kerala ranked

second in the position of Best States in India to live, during the post globalisation period. Kerala's position is next to Punjab, the well-developed State in India, during 2004 and 2005. Moreover Kerala is ahead of the neighbouring States like Tamil Nadu (4th), Karnataka (8th) and Andhra Pradesh (11th).

Per capita Income

The income parametre also depicts that Kerala made a moderate improvement during the period of globalisation. Kerala's per capita income has increased from Rs. 18,117 in 1999-00 to Rs. 24,492 in 2003-04. It is evident that per capita income of Kerala was the highest among the neighbouring States during the period. As per the information from the Economic Survey 2005-06, Kerala ranks 6th in per capita income among the Indian States.

Growth Performance of the Kerala Economy—Pre and Post Globalisation Periods (A Comparative Analysis)

Finally, we can comparatively analyse the performance of the Kerala economy during the pre and post globalisation periods. Annual average growth rates of the economy for the pre and post globalisation periods are estimated for this purpose and presented in the following table

Table -3 Growth Rates of the Kerala Economy-Pre and Post Globalisation Periods

Year-Pre	Growth rate-Pre	Year-Post	Growth rate-Post
19996-97	3.07	--	--
1997-98	1.37	2001-02	1.50
1998-99	6.71	2002-03	8.3
1999-00	4.70	2003-04(p)	7.4
2000-01	4.83	2004-05 (q)	9.2
	AAG-Pre=4.14		AAG-Post=6.6

Source: Economic Review 2005, SPB, Kerala

From the table, it is clear that Kerala economy has made a much better growth rate during the post globalisation period compared to the pre globalisation period. The average annual growth rate (AAG) was only 4.14% during the pre globalisation period. However, during the post globalisation period the economy registered an average growth rate of 6.6%. Therefore the Kerala economy has made an incremental growth rate of 2.5% during the post globalisation period compared to the pre globalisation period.

Conclusion

It may be concluded that globalization and liberalization policies relatively produced a positive impact on the Kerala economy. Further indicators such as export, poverty eradication, employment creation, sectoral transition etc. depict the same trend. Export from Cochin port has enhanced from -5.6 to 23.4% during the globalised period. Poverty ratio declined from 12.7 to 3.6. The number of total work seekers in the live register of Employment Exchanges in Kerala decreased from 42.15 lakhs in 2000 to 37.86 lakhs in 2005.

Sectoral transition is a landmark in the development of the Kerala economy because of two reasons: (i) Service sector has become the engine of growth in Kerala. (ii) Kerala Economy has reached the level of the standard of the well-developed OECD countries. Now, the sectoral contribution of the service sector in Kerala is more than 60 %.

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EXPORT OF SPICES FROM KERALA BEFORE AND AFTER GLOBALIZATION-AN ANALYTICAL STUDY

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Abstract

Kerala is regarded as the spices garden of the country. Black pepper of Kerala has acquired a wide fame across the world for its aroma and flavour. It is worthwhile to enquire that whether the globalisation process has benefited the spices export industry of Kerala. This is an attempt to study the trends in the export of major spices from Kerala during the pre and post globalisation periods.

Keywords: *Pre-Globalisation Period, Post-Globalisation Period, Trends in Exports, Export Destination*

According to the Food and Agricultural Organisation (FAO) estimates India and China are the leading producers of total spices in the world. During the year 2010 largest area in which spices were cultivated was in India. Nearly 26 per cent of the total area under spices cultivation in the world was in India. In India, Kerala is the leading producer and exporter of a number of spices such as pepper, cardamom, vanilla, nutmeg and mace and various kinds of value added spices.

Importance of the Study

Kerala is historically known for its spices plantations. The state has a rich and glorious past in the production and trade of many spices particularly black pepper. The history of the state is also closely linked with the trade of spices. Though, agriculture occupies a central role in the economy of Kerala, it accounts for only 30 per cent of the state's income. The state has only a low base in food production and is facing serious challenges (Economic Review, 2010). As a consequence of globalisation and trade liberalisation policies the imports of pepper to the country has increased considerably.

The global market scenario is going to become more competitive and there is also much possibility for the further liberalisation of the domestic market. In this context this study is an attempt to analyse the spices export potential of the state during the Pre and Post Globalisation Periods.

Objectives of the Study

The important objectives of the study are:

1. To assess the commercial significance of Kerala in the production and export of major spices in the country.

2. To examine the trends in the export of major spices including the value added spices from Kerala during the pre and post globalisation periods.

3. To observe the export destinations of Malabar Grade Black Pepper from Kerala

Methodology of the Study

This study has been carried out by using the secondary data. Various sources of the concerned secondary data were FAO, Spices Board India, Cochin Chamber of Commerce and Industry and the various issues of the Economic Review, published by Kerala State Planning Board. For this study a pre and post globalisation approach is used, based on the year of inception of the World Trade Organisation (WTO) in 1995.

Some Issues related to Globalisation Process

The essence of globalization is the increasing degree of openness in respect of international trade, international investment and international finance. It is a process of transformation of the world into a single integrated market. Therefore globalization process requires the reduction in import tariffs, substitution of quantitative restrictions with import tariffs, elimination of restrictions on the flow of goods and services, private investments and removal of exchange controls.

The collapse of Soviet Union in 1990 and the decline of socialism, process of globalization have decisively influenced the world economy. Globalization has several characteristics such as liberalization, privatization and deregulation which encourage free trade in order to create a single global economy. IMF, World Bank and WTO institutions and their policies were always enhanced trade liberalization and globalization

process. Privatization and liberalization policies facilitate the process of globalization of a country or a region.

India is a founder member of World Trade Organisation. As a member of WTO, India is required to meet certain obligations. By virtue of its membership of WTO, India became entitled to Most Favoured Nation (MFN) treatment from all the members of WTO. As per WTO article and trade agreements, India should also implement all concessions and obligations in the multilateral trade agreement and should ensure conformity of laws, regulations and administrative procedures with its obligations as provided in the articles and agreements.

Spices Export in Kerala

Various types of precious spices that are exported from Kerala are taking place mainly through Cochin Port. Pepper, cardamom, ginger and turmeric are the major spices exporting items of the state. Black pepper which is known as the 'black gold' is the king of spices. 'Malabar Grade-1 Black Pepper' has an inherent appreciation in the world market. In the case of pepper, black pepper, green pepper, pepper pinheads and sterilized pepper corns are the various exporting items. Other commercially significant spices that are exported through the Cochin Port include cardamom (Small), ginger, turmeric, items like ginger spent, turmeric spent etc. Various kinds of value added spices such as curry powders, spice mixtures, spice oils and oleoresins are also exported in significant quantities.

Export of Spices through Cochin Port

During 2009-2010 total export of various spices, including value added spices through Cochin Port (including air port and sea port) was 69534 tonnes valued Rs.1447.56 crores. In terms of quantity, the share of chilli powder was the highest (19 per cent), which was followed by black pepper (11 per cent), Turmeric powder (8 per cent), Pepper powder (7 per cent) and the share of curry powders was 6 per cent. In value terms also chilli powder was the leading item which registered around 9 per cent of the total export revenue, followed by pepper (8 per cent), pepper powder (5.5 per cent) and the export share of curry powders was 5 per cent. (See Table-1). During the year 2000-2001 total export of spices through these ports were 41493 tonnes valued at Rs.801.48 crores. Export of spices has shown an increase of 66.58 per cent in terms of quantity and 80.6 per cent in terms of value over the period 2000-2001 to 2009-2010.

Table-1 Spices Export Through Cochin Port (sea and air) during 2009-2010

(Quantity in Tonnes and Value in Rs.Lakhs)

Item	Quantity	Share in Per cent	Value	Share in Per cent
Black pepper	7771	11.18	11321.01	7.82
Green pepper(dehyd)	461	0.66	1332.06	0.92
Pepper powder	4910	7.06	8054.23	5.56
Pepper in brine	955	1.37	841.21	0.58
Cardamom (S)	811	1.17	6990.32	4.83
Cardamom(S)powder	40	0.06	278.06	0.19
Ginger(dry)	1111	1.60	1532.06	1.06
Ginger powder	1183	1.70	1437.69	0.99
Turmeric	371	0.53	328.02	0.23
Turmeric powder	5879	8.45	5098.98	3.52
Nutmeg	1134	1.63	3471.42	2.40
Nutmeg powder	393	0.57	1071.14	0.74
Cloves	35	0.05	119.02	0.08
Clove powder	19	0.03	5614	3.88
Vanilla	37	0.05	315.57	0.22
Curry powders	4442	6.39	7305.05	5.05
Chillies	539	0.78	461.21	0.32
Chilli powder	13472	19.37	12666.52	8.75
Other items	25971	37.35	76519.21	52.86
TOTAL	69534	100	144756.78	100.00

Source: Spices Board

Export of spices from Kerala during the Pre and Post Globalisation Periods

In order to study the trends in export quantity and export value six items were conserved for the study and these were pepper, cardamom, ginger, value added spices and the whole spices. Trends in exports, both in terms of quantity and value are analyzed on the basis of the data provided by the office of Cochin Chamber of Commerce and Industry. They annually publish the quantity of exports and its value of various spices that are exported by its members. The data available from their office is given in the Table-2

Table-2 Export of Spices from Kerala through Cochin Port Pre-Globalization Period

(Quantity in Tonnes)

Year	Pepper	Cardamom	Ginger	Turmeric	Other Spices	Total Export
1980-81	21885	509	3844	2261	190	28689
1981-82	20581	481	3441	1945	110	26558
1982-83	23403	441	2548	1700	116	28208
1983-84	27981	180	3695	1292	368	33516
1984-85	13891	508	5808	2236	217	22660
1985-86	49545	768	4249	2258	272	57092
1986-87	31900	233	1553	1665	315	35666
1987-88	44205	93	2171	1643	268	48380
1988-89	34706	112	3812	2024	382	41036
1989-90	32544	32	4146	1893	726	39341
1990-91	27675	67	2598	2130	1041	33511
1991-92	18909	142	5537	2305	647	27540
1992-93	20489	64	2921	2224	526	26224
1993-94	41729	227	2514	2688	532	47690
1994-95	33149	145	2522	2522	1102	38036
TOTAL	442592	4002	49955	30786	6812	534147
Average	29506.13	266.8	3330.33	2052.4	454.13	35609.8

Post-Globalization Period

Year	Pepper	Cardamom	Ginger	Turmeric	Other Spices	Total Export
1995-96	23116	164	2857	2646	4767	33550
1996-97	45495	43	4511	2593	5832	58474
1997-98	34303	90	7893	2707	645	45638
1998-99	32003	87	4228	2258	9687	48263
1999-00	40282	152	2509	2439	11684	57066
2000-01	19073	419	2536	2554	14367	38949
2001-02	20445	346	3113	3129	17184	44217
2002-03	15636	198	2462	3477	13583	35356
2003-04	13743	181	1469	3240	15179	33812
2004-05	10962	188	1712	2936	17299	33097
2005-06	12009	154	1455	2827	20647	37092
2006-07	22851	171	2144	3066	23802	52034
2007-08	28491	74	1652	3363	23266	56846
2008-09	24094	165	1480	3382	30955	60076
2009-10	16715	291	7601	1299	39112	65018
TOTAL	359218	2723	47622	41916	248009	699488
Average	23947.87	181.53	3174.8	2794.4	16533.93	46632.53

(Source: Cochin Chamber of Commerce and Industry)

In the beginning of 1980s the total export of spices from Kerala was around 28000 tonnes. During 2009-2010 it increased to more than 65000 tonnes. The average annual export of spices through Cochin Port during the pre globalization period was 35609 tonnes. This has increased to more than 46000 tonnes during the post globalization period.

The average annual export of pepper during the pre globalization period was 29506 tonnes. During the post globalization period it has decreased to 23948 tonnes, which has registered a decline of-18.8 per cent. In the case of cardamom the average annual export has decree sed from 267 tonnes to 182 tonnes. The average annual export quantity of ginger has also decreased from 3330 tonnes to 3175 tonnes during the post globalization period. In the case of turmeric the average annual export quantity has increased from 2052 to 2794 tonnes. On the other side the export of other spices has increased significantly during the post globalization period. These other spices include all types of value added spices such as crushed chillies, chilli powder, turmeric powder, curry powders , spice oils and oleoresins. In the pre globalization period the annual export quantity of other spices was only 454 tonnes, that has increased to around 16534 tonnes, registered an annual growth rate of 3542 per cent. The export of value added spices has increased considerably only since 1998-1999.

Export of Pepper from Kerala According to Destination

During the year 2009-10, the total export of pepper through Cochin Port was 16715.48 tonnes. The destination wise distribution of pepper export is described in Table-3

Table-3 Export of Pepper from Kerala According to Destination During 2009-2010

(Quantity in Tonnes)

Nation	Export Qty	Share in %
Africa	173.40	1.04
Australia	689.67	4.13
Bahrain	3.75	0.02
Belgium	407.45	2.44
Bulgaria	20.00	0.12
C.I.S	253.11	1.51
Canada	613.13	3.67
China	93.60	0.56
Croatia	16.00	0.10
Denmark	42.37	0.25
Finland	55.00	0.33
France	219.45	1.31
Germany	438.44	2.62
Greece	15.00	0.09
Holland	194.89	1.17
Hong Kong	98.39	0.59
Hungary	40.00	0.24
Iran	27.00	0.16
Israel	58.00	0.35
Italy	848.24	5.07
Japan	371.99	2.23
South Korea	16.90	0.10
Kuwait	7.13	0.04
Malaysia	137.00	0.82
Mexico	231.51	1.39
New Zealand	45.00	0.27
Norway	90.83	0.54
Philippines	53.72	0.32
Poland	87.74	0.52
Portugal	15.00	0.09
Qatar	4.55	0.03
Romania	14.00	0.08
Saudi Arabia	80.06	0.48
Singapore	304.25	1.82
Spain	253.58	1.52
Sri Lanka	1.14	0.01
Sweden	520.87	3.12
Taiwan	183.10	1.10
Thailand	82.50	0.49
Turkey	50.64	0.30
U.A.E	91.21	0.55
U.K	1036.84	6.20
U.S.A	8325.92	49.81
Vietnam	327.00	1.96
West Indies	60.00	0.36
Yugoslavia	16.00	0.10
GRAND TOTAL	16715..48	100.00

Source: Office of the Cochin Chamber of Commerce and Industry

Pepper export from Kerala, through Cochin Port find its way to nearly 50 markets all over the world. However, during 2009-10, pepper export to USA constituted around 50 per cent of the total export. Important other markets for Kerala pepper were U.K (6 per cent), Italy (5 per cent), Australia (4 per cent), Canada (4 per cent), Germany (4 per cent) and Sweden (3 per cent).

Zone wise Performance of Exports of Pepper from Kerala

A zone wise an analysis of export performance shows that American zone stands first in the case of import of pepper from Kerala. Fifty-five per cent of our total export of pepper was directed towards American zone. USA is the largest importer of this zone. Canada is the second largest importer. The European Union is the second important zone with a share of 26 per cent of our export quantity of pepper. The UK, Germany and France are the leading markets in this region for the black pepper of Kerala.

East Asia zone comes third in terms of import of pepper from Kerala, contributed to 9.5 per cent. Japan and Taiwan are the two important markets in this zone. See Table-4

Table-4 Zone wise export of pepper from Kerala

(Qty in Tonnes.)

Zone	Export Quantity	Share in per cent
America	9170.56	54. 86
European Union	4382.37	26. 22
CIS Countries	253.11	1. 51
East Asia	1585.96	9. 49
West Asia	354.22	2. 12
Africa	173.40	1. 04
Australia &Oceanic	734.67	4. 40
Others	61.19	0. 37
GRAND TOTAL	16715.48	100.00

Source: Office of the Cochin Chamber of Commerce and Industry

Recently Vietnam has emerged as the leading producer and exporter of pepper in the world. They have occupied a prominent position in the world pepper market especially since 2001. Their annual production of pepper is more than 1.10 lakh tonnes. Unfortunately we are losing our supremacy in the world pepper market year after year. The basic reason behind this is low productivity and descending production of pepper in the state. Only with the support of effective and quick measures from the concerned departments and the officials, the state can outstrip this inglorious position.

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MATERNAL HEALTH IN KERALA: A NOTE OF CONCERN

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Abstract

Even among society and economically backward people, this is progrence towards provide health care institutions. 75% of the delivery of SES 3 representing lower income were reported as caesarean. Percentage of women's reported delivery complications were higher among SESI, Govt Hospital reported higher rate of caesarean that private hospital. It was above 60% during the entire period under study.

Keywords: Maternal Health, Mortality, Morbidity, Social development index , Human development index

[A healthy community is the basic infrastructure of an economy without which an economically viable society can be built up].

The health status of any country to a great extent is directly related to the care given to the women and children. Maternal and child care is an integral part of primary health care provision. Improvement in women's health status is not possible unless basic and holistic health care are available at affordable cost within easy geographical reach.

Maternal health refers to the health of women during pregnancy, child birth and post partum period. It encompasses the health care dimensions of family planning, pre conception, prenatal and post natal care in order to reduce maternal morbidity and mortality. Pre-conception care can include education, health promotion, screening and other interventions among women of reproductive age to reduce risk factors that might affect future pregnancies. The goal of pre-natal care is to detect any potential complications of pregnancy early to prevent them if possible and to direct the women to appropriate specialist medical services as appropriate. However, present study included only health of women during pregnancy and child birth.

Problem Setting:

Kerala is well known for its uniqueness in health status. Kerala is ranked at the top in terms of human Development Index, Social Development Index, and gender development among the states in India. The state is often described as high health status at low cost and is reported to have lowest rural urban inequalities in public health status.

But, it was surprising to see the paradoxes in health sector that Kerala reported while claiming high health records in terms of health indicators like birth rate, death rate, infant mortality rate and life expectancy at birth. High

morbidity with low mortality, higher rates of mental, physical and sexual harassment towards women and children, higher rates of suicides, dowry death, accidents, violence, crimes inspite of higher human, gender and social development index were also received worldwide attention. Again, more importantly, kerala is also well known for having high literacy rate especially, women literacy, with low maternal health. Various studies have pointed out increasing birth complications, low birth weight babies inspite of higher rates of utilization of health care institutions during pregnancy delivery and post delivery period. Thus, the picture is not a bright one as other mortality indicators when it comes to maternal health in Kerala. Therefore It is the need of today to focus and study the dismal picture in maternal health. Hence present study was an attempt to find out the maternal health in Kerala and to examine the socio economic factors affecting maternal health in Kerala.

Methodology

Present study was based on both primary and secondary data. Secondary data were collected from the records of both private and public hospitals from two Districts : Thrissur and Ernakulam. Two private hospitals and two government hospital records were examined for this purpose. Primary data were collected from hundred households representing different Socio-Economic Strata to examine the socio economic impact on maternal health in Kerala. A sample

unit here is defined as those households where there was a delivery one year prior the survey.

Sampling frame work: Initially two districts viz. Thrissur and Ernakulam were selected .Two Taluks representing the above two districts were selected in the next stage. Again, two blocks representing two Taluks were selected. A list of sampling units were selected from the concerned Taluks and fifty households were selected from each Taluks randomly and classified into three Socio-Economic strata via: SES1,SES2 and SES 3. Education, Income, land ownership, housing pattern were the variables used for assigning ranks to each households. Then, assigning weights to these ranks ample unit were clarified in to three groups. Distribution of sample unit into three groups using the combined average of the household characteristic showed that 52% belonged to SES1representing high Socio-Economic Strata26%SES2 and 22%SES3repreenting low Socio-Economic Strata. Present study brought in to light following inferences.

Delivery characteristics

An important component of health care service of mother and babies are the provisions of proper medical care at the time of delivery. Child birth in hospital I an important behavioral variable which contributed to improved child survival in Kerala. Present survey revealed that 75% of the delivery of SES3 was in government hospitals. Nearly 60% of the deliveries of the

SES172 were in government hospital. It was really amazing to see the preference of people towards private institutions even among socially and economically backward group. Now a days, health facilities of government hospitals has improved. More funds were allotted for health care infrastructure in government hospital. But, even today, people's perception towards government institutions has not changed much. More attention should be diverted towards in this channel.

With regard to type of delivery, it was shocking to see that 75 % of the delivery of SES3 reported as caesarean as against 55 % 52 5 among ses1&2 respectively. This is another important area in this regard that should be given due importance seriously.

Respondents were asked to report in detail the complications during pregnancy and delivery. High fever, lower abdominal pain, vaginal discharge, excessive bleeding, dizziness, severe headache, low amniotic fluidwere the complications reported by the sample units during pregnancy. Percentage of women reported complications were higher among SES1 than SES 3. Seventy five percentage of them were asked bed rest during initial stages of pregnancy. Percentage of women reported complications during delivery was also higher among SES1 than other groups. It was also surprising to see that expense on delivery both in public and private hospital for caesarean reported only marginal difference.

To substantiate the inference drawn from primary data secondary collected from hospital records also analyzed and inferred that during the last five years from 2007-08, caesarean delivery in government hospitals were above 60 %. It increased from 60 to 67 % during 2010-11.

Table No.1: LSCS and Normal Delivery in Government Hospital

Year	Caesarean (%)	Normal (%)
2007-2008	60	40
2008-2009	66	34
2009-2010	62	38
2010-2011	67	33
2011-2012	64	36

Source: Hospital Records

Table No.2: LSCS and Normal Delivery in Private Hospital

Year	Caesarean (%)	Normal (%)
2007-2008	42	58
2008-2009	47	53
2009-2010	45	55
2010-2011	43	57
2011-2012	48	59

Source: Hospital Records

It was shocking to see that private hospital recorded lower caesarean rate than government hospital. Previous studies have reported higher rate of caesarean in private hospitals than government hospitals. Profit motive of hospital authorities was one of the major reasons pointed out by those studies. As against it, present study recorded higher rate of Caesarean delivery in government hospital than private hospitals. As per the present study, excessive bleeding was the major complication that occurred during delivery. Such complications were reported highly in government hospital than private hospital. (One reason given by the hospital authorities were that complicated cases were referred to government hospital from nearby hospitals which increased the rate of complications during delivery. Primitive labour, obstructed labour, prolonged

labour, were the problems reported during delivery. Again, such complications were higher among SES1 than among other groups. Study also revealed that there has been 11% to 25% decline in the total number of delivery in government hospitals and 6 to 9 % increase in total delivery during the study period and marginal increase in private hospitals. This indicates people preference towards private hospitals for health care needs.

Conclusion

Maternal health in terms of health of women during pregnancy and child birth found to be highly unsatisfactory as per the present study. Higher rate of utilization of private hospitals or maternal health even among lower income strata need to be studied. More than 60% of Caesarean type delivery is really unjustifiable as per WHO norms of a maximum of 15 percentage. More attention should be focused in this regard.

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ENTRY OF PRIVATE PLAYERS IN HEALTH INSURANCE SECTOR A STUDY WITH SPECIAL REFERENCE TO ERNAKULAM DISTRICT

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Abstract

The privatization of insurance sector envisages to improve the performance of the insurance sector in the country by increasing benefits from competition in terms of lowered cost and increased level of consumer satisfaction. However the implications of the entry of private insurance companies in health sector are not very clear. The recent policy changes will have been far reaching and would have major implications for the growth and development of the health sector. Unless privatization and development of health insurance is managed well, it may have negative impacts of health care especially to a large segment of the poor population in the country. If it is well managed then it can improve access to care and health status in the country very rapidly.

Keywords: *Health Insurance, Indictors, Popularrize, awareness affordable limit*

Introduction

The insurance sector plays a vital role in the economic development of a nation. It acts as a mobilizer of savings, financial intermediary, promoter of investment activities, stabilizer of financial markets and a risk manager. In turn economic development also facilitates the spread of insurance, both in terms of penetration and intensity. The new economic policy and liberalization process followed by the government of India since 1991 paved the way for privatization of insurance sector in the country. Health insurance which remained highly underdeveloped and less significant segment of the product portfolios of the nationalized insurance companies in India is now poised for a fundamental change in its approach and management. The scenario is all the more promising with the entry of private players into the insurance arena. There is also a possibility of insurance providers solely targeting the health insurance sector thereby triggering a boom.

The privatization of insurance sector envisages to improve the performance of the insurance sector in the country by increasing benefits from competition in terms of lowered cost and increased level of consumer satisfaction. However the implications of the entry of private insurance companies in health sector are not very clear. The recent policy changes will have been far reaching and would have major implications for the growth and development of the health sector. Unless privatization and development of health insurance is managed well, it may have negative impacts of health care especially to a large segment of the poor population in the country. If it is well managed then it can

improve access to care and health status in the country very rapidly.

Back Ground of the Problem

Over the last 60 years, India has achieved a lot in terms of health improvement. But still India is way behind many fast developing countries such as China, Vietnam and Sri Lanka in health indicators (Satia et. al. 1999). The quality and access of services in government funded health care system has always remained major concern. Hence, a very rapidly growing private health market has developed in India. This private sector bridges most of the gap between what government offers and what people need. However with proliferation of various health care technologies and general price rise, the cost of care has also became very expensive and unaffordable to large segment of population. The government and people have started exploring various health financing options to manage problems arising out of growing set of complexities of private sector growth, increasing cost of care and changing epidemiological pattern of diseases. Against this background, health insurance is increasingly being viewed as an important financing tool for improving the access to health services. The moral imperative that justifies strengthening of health insurance in India is the growing impoverishment of those with low resilience to absorb economic shocks caused by having to incur unplanned and lumpy expenditure for medical treatment. Irrespective of income class one episode of hospitalization is

estimated to account for 58 per cent of per capita annual expenditure pushing 2.2 per cent of the population below poverty line (World Bank, 2002). With 40 per cent of the hospitalized having had to borrow money or sell assets, during the decade 1986-1996, there was a doubling of persons unable to seek health care due to financial reasons (NSSO, 1998).

The network of health security schemes like ESIS, CGHS and community and employer based schemes is limited in India. With these schemes limited, only 15 per cent of population is covered under health insurance. In India, as part of liberalization process, the market for insurance business was thrown open for private players in 2000. As a result many new comers entered into the insurance market. The introduction of private players in the insurance sector has led to greater competition among all the players. As a result of this competition, the customers are presented with a plethora of choices in various categories. The customer service has improved and the private insurance players are increasingly eroding the market share of public sector insurance companies. During 2004- 05 & 2005-06, health insurance premium grew by 35 per cent, out of which 26 per cent growth for public sector general insurers and 74 per cent growth for private sector general insurers. In terms of market share, the public sector has declined from 82 per cent to 76 per cent during 2004-05 and 2005-06, while that of the private sector increased from 18 per cent to 24 per cent.

However, till date it is the public sector insurers who are commanding a major share of the Indian market. The private players, it needs to be noted, have taken the market share from existing clients and have not made much of the breakthrough either in bringing the new product or by bringing a set of new customers. This essentially means that the customer base of the public companies being eroded.

Statement of the Problem

The journey of insurance liberalization in India is now over 12 years old. Since 2000, fairly a good number of private insurance companies have entered the health insurance sector, breaking the monopoly of public sector insurance companies. Both public and private companies are offering a wide range of health insurance policies for the public. But even now there is only less popularity for health insurance products due to reasons like high price, inadequate marketing techniques and low level of awareness.

The Indian insurance industry and the general insurance segment in particular covers around 20 million persons under health insurance. Notwithstanding the shortcomings of health insurance policies offered by public sector companies and its clones from private general insurers, health insurance sector experienced a dramatic growth over the years, perhaps due to lack of alternative coverage. The number of persons covered under various health insurance products has grown from 6.9

lakhs in 1991-92 to 3.5 million in 1998-99 and around 17 million in 2005-06. Translating this in terms of penetration, it was 0.084 per cent in 1990-91, 0.49 per cent in 1999-2000, and 1.536 per cent in 2005-06. This indicates a low level of health insurance penetration, i.e. the share of health insurance premium to GDP. Low insurance penetration is pointer to the fact that spread of health insurance business has been relatively poorer in the country and large sections of insurable population is still isolated from the insurance coverage. This is being the reality, it is felt necessary to make a comparative analysis of the health insurance products and the level of satisfaction of the customers of both the public and private sector insurance companies with special reference to Ernakulam district.

Significance of the Study

Health insurance is a growing sector with considerable future potential. During the last few years, the premium from health insurance products in non-life companies has grown from Rs. 675 crores in 2001-02 to Rs. 3200 crores in 2006-07, almost 5 times its level 5 years back. The demand for health insurance covers has seen a healthy increase and today the sector is the fastest growing segment in the non-life insurance industry in India which grew it over around 30 per cent during the last few years. While this rate of growth appears to be very healthy, it is on a low base, and health insurance penetration in the country continues to be low. Thus there

can be no doubt that health insurance is a 'need', that requires to be addressed. This is where there is a role to develop more products, to address needs of more specific target groups and at the same time, to build awareness regarding health insurance and its potential to protect from such unforeseen health expenditure. Some recent estimates by re insurers and by consulting firms suggest that health insurance is likely to grow rapidly, cover 20 per cent of the population and constitute 12 per cent of total health market of the country, or over 30,000 crores by 2015. While the magnitude of such growth in health insurance is a matter of estimation, there is no doubt that there is a tremendous potential for the development of health insurance.

Objectives of the Study

The study has undertaken with the following specific objectives.

1. To make a comparative analysis of the level of satisfaction of the policy holders of public sector insurance companies with that of private sector insurance companies.

2. To study about the awareness of uninsured in Ernakulam district on various health insurance policies offered by both public sector and private sector insurance companies.

To offer suitable suggestions and recommendations to popularize health insurance products in the light of the present developments.

Methodology

Both primary and secondary data were used for the study.

Primary data: The area of study is Ernakulam district. Samples of 100 insured - 50 from public sector insurance companies and 50 from private sector insurance companies - and 100 uninsured people were selected at random from Ernakulam district. The subscribers are selected from Ernakulam district as it is being the central place and commercial capital of Kerala. Primary data were collected from 100 insured respondents and 100 uninsured respondents by way of a pre structured interview schedule. In the case of insured respondents, care was taken to obtain responses from customers who had received a claim from the insurers. An insurance policy, which is an intangible product, becomes tangible only when a claim arises.

Secondary data: Secondary data were collected from official websites of public and private sector insurance companies, IRDA, Tariff Advisory Committee, National Insurance Academy, Pune, Insurance Institute of India, etc., from marketing officers and agents of different insurance companies, and from different journals and periodicals published.

Findings

Following are the important findings of the study.

1. From the survey it is clear that private insurance companies are selling their policies to a more affluent, young and highly qualified customers. An average policy holder of a private insurance company is quite affluent and he is also more likely to be a salaried private employee or professional than a self employed businessman or government employee,   while   public   insurance companies have policy holders more or less uniformly spread across all occupation groups like private employee, self employed, government employee and even unemployed.

2. Another finding is that the major reason for discontinuing of earlier health insurance policies of public insurance companies by present private sector insurance companies' policy holders is inadequacy of benefits and delay in claim settlement, whereas it is due to high premium in the case of the present policy holders of private insurance companies. This points to the fact that the public   insurance   companies   should introduce new products with a view to meet differing needs of the different categories of people. Moreover, the private insurance companies should reconsider their high premium rates especially in a world of increasing competition.

3. It is found that among the respondents of both the   public and private insurance companies, major reason for taking health insurance policy is exorbitant hospital fee. Next major reason is tax benefit. It points to the fact that there is an urgent necessity to popularize health insurance products and thereby save the general public   from medical inflation.

4. Regarding the source of information, the major   finding   is   that   insurance agents/advisors are important source of information. Even advertisements and other medias of publicity comes only after the agents. This points to the fact that agents are influencing factor in popularizing health insurance products.

5. Another finding is that there was no prior cross checking of various health insurance policies by the majority of the policy holders. From the survey it is revealed that only 16 per cent had made any comparison before taking a policy. A person taking health insurance should be well aware of the terms and conditions of the   policy. He should make a comparison of the merits and demerits of various health insurance policies.

6. From the survey it is found that the agents are exercising a great influence on the policy purchasing decision of the policy holders. Majority of the respondents ie. 66 per cent were guided by agents in purchasing a particular policy. But the reality is that agents always push policies with the highest

premiums to pocket a higher commission.

7. Some of the respondents found it difficult to understand the wording of the policy. But it is very important in the case of health insurance policies. Most of the time the conditions and various points included in the insurance policy contracts are not negotiable and these are binding on the customers. There is no analysis on what is fair practice and what is unfair practice. The most important area of confusion is that of pre existing conditions. A number of cases of litigations are disagreement on these pre existing conditions. These problems arise because of lack of specification of number of areas and properly spelling out the conditions.

8. Another finding is that the sum insured of the majority respondents , i.e. 44 per cent, is in the category of Rs. 30000- 50000/-. There is only less demand for policies which are assuring huge sums. So there is a need for developing more policies of this range which cater to the needs of the general public.

9. One major finding is that insurance companies, both public and private, normally reject a claim only on genuine grounds. Primary data reveals that all of the respondents who made a claim, received the claim amount. But there is some difference of opinion with regard

to the time taken for claim settlement. Generally insurance companies promise to make claim settlement within 1 week or within a maximum of 10 days. But primary data reveals that majority claim settlements are within 10- 15 days.

10. There is less awareness about TPAs and only 29 per cent of the total respondents were dealing with TPAs. There is only less popularity to the system of TPAs and only 11 per cent were considering the system as helpful one. Their applicability to Indian situations needs to be examined carefully. TPAs need to work hard to gain the confidence of both the insurers and the insured.

11. Attitude of staff is one important factor especially in the present scenario of increased competition. But it is found that attitude of staff of private insurance companies are a bit more satisfactory compared to that of public insurance companies.

12. Regarding the satisfaction level of the customers, one major finding is that nobody is very much satisfied. Present customers are somewhat satisfied about their insurer's dealings. A separate analysis of the respondents of public and private insurance companies reveals that the satisfaction level is slightly better in the case of private insurance companies compared to public insurance companies. Moreover, the major reason

for dissatisfaction is poor service in the case of public insurance companies, but it is delay in claim settlement and dispute regarding claim amount which are equally leading to dissatisfaction in the case of private insurance companies.

13. Regarding suggestions of the policy holders to improve the present system of health insurance, majority opined in favour of reduction in premium. Another major suggestion is regarding the timely modified products catering to the needs of the different sections of the society.

14. Survey among the uninsured people reveals that a majority, ie. 69 per cent are aware about various health insurance policies. So unawareness is not the major reason for less popularity of health insurance products. Moreover, the majority of the uninsured people revealed that high premium is the most important reason for not purchasing health insurance products. Only a minority is considering health insurance as a waste of money if claim is not forwarded .

15. Among the respondents who are unaware, majority opined that unawareness is due to lack of effective advertisement and publicity. Majority selected T.V. and radio as the best media for advertisement.

Suggestions

Following suggestions can be used to develop health insurance business.

1. First and foremost suggestion is that premium should be reduced to affordable limit. Present health insurance premiums are high and do not differentiate between people living in urban and rural areas, where the cost of medical care are different. Thus the present policies are less attractive to the poor and rural people. The tax subsidy provided to the health insurance premiums is also going largely to the rich who are the tax payers. So there is an urgent necessity to develop newer health insurance policies which are affordable to the poor.

2. Today, in the era of cut throat competition in the health insurance sector, it is hard for the organizations to survive with their traditional strategy selling. They need to be customer centric. Today's customer has a wide range of choices and he would opt for those which provide him not the better, but the best services. So to be customer centric and maintain a loyal customer base, It is a must that the insurance companies should focus on augmenting the quality of their services and being customer friendly not in words, but in practice. Use of IT will help to serve a larger customer base more efficiently, supplementing the distribution channels effectively and improving the customer service and customer relation management.

3. It is in the interest of the private players to expand their customer base by including the middle class and others instead of concentrating only on affluent customers, whereas public insurance companies have to empower its business development officers in pursuing innovative marketing strategies so as to steadily maintain their pre eminent position in the insurance sector. Since customer is the 'sovereign' in the insurance business, priority has to be accorded to customer care and customer service.

4. Unit linked health insurance products will have greater acceptability as customer awareness is increasing about customized, personalized and flexible products. Flexible products and new technology definitely bring down the cost of health insurance products.

5. Rural health insurance segment should be looked upon as an opportunity and as an obligation. A smaller bundle of innovative products in tune with rural needs and perception and an effective delivery system will allow health insurers to penetrate the rural markets.

6. It is time for TPAs to take corrective action to justify their role as health care facilitator failing which their survival may be at stake. They need to define service standards for every stage of interface with policy holders, be it enrolment, enquiry or hospitalization. Customer satisfaction

surveys need to be carried out at regular intervals to allow feedback on service deficiencies.

7. Accreditation of health providers is a critical requirement for enabling quality benchmarking of services and healthcare facilities, a necessary step towards uniformity health care charges. The introduction of a rating mechanism that is mandatory for participation in insurance schemes can fulfill this need.

8. Insurance companies should develop newer products to cater to the changing needs of the society. These may include policies covering disability income, mental diseases and old age health. Similarly expenses incurred on infertility treatment need to be covered. Medical expenses arising out of AIDS is an exclusion at present in all health insurance policies unlike in western societies.

9. Old age health care is a critical need of the society, more so in the absence of a comprehensive social security regime. Insurers restrict entry of new policy holders at an older age to avoid anti-selection against them. There is an urgent need for developing long term care insurance plans to the rapidly ageing population which cover physical or mental incapacity that prohibits the insured's activities of daily living. Likewise there is a pressing need for disability income insurance, which provides income benefit

to the insured when physical or mental incapacity prevents him/ her from being able to work.

10. While the traditional channel of agents would be the chief distribution channel, insurance companies should innovate and find new methods of delivering the products to customers. Corporate agency, brokerage, bancassurance, e- insurance, co-operative societies and panchayats are some of the channels which can be tapped by the insurer to reach the appropriate market segment.

11. There is a strong need to utilize the system of brokerage as a major distribution channel. Brokers are different from typical insurance agents. Even if they receive commission from a particular insurance company, they can still promote schemes of other insurance companies to the clients. Insurance brokers help companies as well as clients to choose the right product at right time and at the right price and these people can give non biased advices to the to their clients as against insurance agents who are usually tied up with a single company.

Conclusion

This study leads to the conclusion that present health insurance policies are affordable only by middle income and rich people. But the fact is that they are needed by the poor. Wider coverage is the urgent necessity in the case of health insurance products. Moreover there is no much difference in the level of satisfaction between the customers of public and private insurance companies. But the business activities of the private companies are limited in urban areas, where a fairly good market network of the public insurance companies already exists. On account of their urban based operational activity, the private insurance companies can neither increase the insurance base of the economy significantly nor lead to substantial employment generation. In short, the private players are adopting the same old products, the same old advertisements and the same old customer base. But the private players have played a great role in increasing the awareness level about health insurance products. They are using print and electronic media to popularize their products in the market. They have made the premium payments easier and they have call centre services that attend to the queries of the policy holders or future customers, leading to easy accessibility of information to the customers. This can lead to increased awareness among the customers regarding the various options available in the market.

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ANALYZING THE POLITICAL POTENTIALS OF POSTMODERNISM

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Abstract

The article focuses on the political dimensions of postmodernism. Postmodernism is overtly preoccupied with the transformation of reality into superficial, fragmentary, and changing images. It attempts to construct the real through language and various forms of representation. But on a closer analysis the political potentials and possibilities of postmodernism can be explored. Critics like Terry Eagleton acknowledge its radical political potential as it has lent a voice to the humiliated and reviled. Linda Hutcheon discloses the political aspects of postmodernism by showing how it complicates representation and history behind self-reflexive, metafictional, and discursive practices through her concept of 'historiographic metafiction'.

Keywords: *Postmodernism, representation, textuality, political.*

Introduction

Postmodernism can be understood as both a continuation and condemnation of modernism. It reduces reality to a textual level and employs parody, pastiche, and other stylistic strategies to foreground the textuality of the text and highlights the existence of the world as a linguistic construct. It has a tendency to read almost everything as a text. It rejects straightforward representation and belief in authentic originals. Reality for postmodernists is consciously constructed. It is very much involved with visual culture, images and the media.

The real in postmodern culture is replaced by the hyperreal, or by its image. Simulation becomes a form of (mis)representation that seeks to distance the real. This makes representation seem more real than the real it is meant to capture. Media images and metafiction complicate the referential value of representation. According to Jean Baudrillard simulation is opposed to mimetic representation and the relation between signs and referents becomes very unstable in the play of signs and images.

Postmodernists are aware of the reflexive nature of language and its power in constructing the world. Hence, they pay special attention to writing techniques and styles that foreground language and the unconventional/intertextual play of meanings as part of a larger concern with textuality. Steven Connor in "Postmodernism and Literature" states:

Rather than retreating from worldliness into the Word, postmodernism could continue to embrace the world, though on the condition that this world was known and shown to be made up of words. (69- 70)

The Issues of Representation

Postmodernists, while not necessarily abolishing the real, argue for the mediation and construction of the real through language and various forms of representation. Postmodernist fiction problematizes the representation of the world and makes it a matter of (de)construction through words. It complicates the relationship between being and representation. Postmodernists

transform the way we experience reality by highlighting the images we access, by showing how the real is disappearing or getting concealed by the hyperreal. We experience the real through its effects. The real is replaced by its copy in postmodern culture and the world is full of images, icons, signs, and texts. The image is made more important than the real it might refer to. As a result, many critics attacked postmodern culture for lacking in critical distance and being superficial.

Postmodernism was criticized for a lack of a historical sense in its interest in pastiche and formal experimentation. The mediation of experience, critics argue, effects a simulated reality and reduces external referents to simulations. The signifier, thus, takes precedence over the signified. Postmodernism has had its supporters and detractors because of its ambivalence toward and celebration of pluralism. Fredric Jameson relates postmodernism more to the present rather than the past or history. In line with a tendency of detractors of postmodern culture and art on grounds of simulacra rather than stable referents, he claims that it respects no authorities or traditions. He views it as tolerant of excess, lack of teleology, immediate gratification of desires, exhaustion of originality, erasure of historical past and as imitation of styles.

However, it should be noted that the postmodernism Jameson attacks is basically a cultural and historical period. Jameson in his well-known *Postmodernism, or The Cultural logic of Late Capitalism* presents postmodernism as a dominant cultural logic of multinational/consumer capitalism as the title hints. He argues that the global capitalist economy and commercialism effect a postmodern culture of lost subject, history,

and originality. He criticizes postmodernism, or rather the culture of postmodernity, for a lack of oppositional critique and a consumer culture of interchangeable commodities. Postmodernism for him is preoccupied with the transformation of reality into superficial, fragmentary, and changing images.

Terry Eagleton in *The Illusions of Postmodernism* acknowledges the 'illusions' of postmodernism and yet its radical potential. According to him, "The politics of postmodernism have been at once enrichment and evasion" (24). He points out the contradictions of postmodernism, including its radical and conservative nature and celebration of fluidity/difference despite a homogenizing impact. He contends:

At its most militant, postmodernism has lent a voice to the humiliated and reviled, and in doing so has threatened to shake the imperious self-identity of the system to its core. (24)

Historiographic Metafiction and Politics of Representation

The concept of Historiographic metafiction proposed by Linda Hutcheon is the most obvious of the postmodern paradoxical forms; one that is both self-consciously fictive and yet directly addressing historical issues, events and personages. Here Postmodernism turns out to be political in its act of representation and in its ambivalent nature. For Hutcheon, these distinctive forms of postmodern fiction are conscious of their status as fiction and the writing process. Rather, the end is to fictionalize history and distort borders between fiction and history since history can only be known through representation, narration, and discourses.

Hutcheon highlights the unavoidably textual nature of history in fiction. The gap between the textual and the real is bridged in her defense of postmodern fiction and its treatment of history. Her work falls within broader postmodern notions of our inability to know the real without mediation and interpretation, without trying to approach the truth from a specific perspective. Hutcheon shows that history is not a given but a mediated experience reaching us through texts by means of selection, organization, interpretation. History is real, she argues, but it shapes or relates to the present discursively. For Hutcheon, the ideological and the aesthetic, that is, 'the political and the self-reflexive', are turning out to be inseparable in postmodern fiction. According to her, historiographic metafiction foregrounds the problematic and complex relationship that has always existed between the formal concept of the text and the socio- political one of ideology. Hutcheon views postmodernism as simultaneously ironic and critical, complicit and subversive. She insists on the political aspects of postmodernism by showing how it complicates representation and history behind self-reflexive, metafictional, and discursive practices.

Postmodernism is not dehistoricized. It borrows from poststructuralism an interest in language and representation as the medium through which we experience the world. Hence, postmodernism rejects 'History' as absolute, uncontested and transcribes it into narrative, making it lose some of its localized referential aspects and fusing the local with the international.

In her essay 'Postmodernism' Hutcheon views:

What both postmodern historiographic theory and literature taught was that both history and fiction are equally 'discourses', that is, ways of speaking about the world that are constructed by human beings; both are systems of meaning by which we make sense of the past—and the present. The meaning of history is not therefore in the events but in the narrative that makes those past events into present historical 'facts.' (122)

In *The Politics of Postmodernism: Parody and History,* Hutcheon views that postmodernism is "a fundamentally contradictory enterprise" and that many of its works are "resolutely historical and inescapably political precisely because they are parodic" (180). Hutcheon maintains that using irony and play does not necessarily "exclude seriousness and purpose in postmodernist art" (186). In "Beginning to Theorize Postmodernism", Hutcheon dwells on the contradictory nature of postmodernism and its ambivalent treatment of history and politics. She continues to sample 'historiographic metafiction' as an example of this contradiction in that it is "intensely self-reflexive but refers to historical events and personages" (12). This form of fiction is characterized, as she argues, by "theoretical self-awareness of history and fiction as human constructs" (12). Hutcheon here defends postmodernism by arguing that it rethinks history in its textualized form, "as a human construct" since its "accessibility to us now is entirely conditioned by textuality" (21).

In *The Politics of Postmodernism*, Hutcheon continues to emphasize the contradictory nature of

postmodernism and to find the political potential of postmodernism. According to her:

> What postmodern theory and practice together suggest is that everything always was 'cultural' in this sense, that is, always mediated by representations. They suggest that notions of truth, reference, and the non-cultural real have not ceased to exist, as Baudrillard claims, but that they are no longer unproblematic issues, assumed to be self-evident and self-justifying. The postmodern is not a degeneration into 'hyperreality' in a technological world in Baudrillard's terms but a questioning of what reality can mean and how we can come to know it. (32)

Thus Hutcheon, in the study, focuses on the politics of postmodern representation; "the ideological values and interests that inform any representation" (7). Her model is a "paradoxical postmodernism of complicity and critique, of reflexivity and historicity" (11).

Conclusion

There is politics in the very act of representation as postmodernism 'denaturalizes' history and makes distinctions between the events and facts of the past and constructs them from their traces without denying them as events. The deliberate open-endedness, its 'both/and' thinking, and its resolute lack of resolution of postmodernism focuses on ex-centricity, marginality, and difference of the present age which gives it a political potential. Thus the postmodern condition re-opens political options that the culture of modernity has increasingly suppressed by its search for unity,

rationality, and non-contradiction. It acknowledges and even features precisely the inescapability of contradiction and shifts emphasis from rational resolution to negotiated contradiction in ways that have profoundly political implications.

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FINANCIAL INCLUSION-BANKING OF UNBANKED

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Abstract

Socio economic development of the rural poor is the pressing need of the day. The problem cannot be viewed in isolation. Financial inclusion of all citizens will surely help the nation in increasing the savings and stepping up in investment.

Keywords: *Financial Inclusion, Financial Services, Post liberlisation, Financial exclusion, Mobile Banking*

Introduction

Financial inclusion or inclusive financing is the delivery of financial services at affordable costs to sections of disadvantaged and low income segments of the society. In India, the focus of the financial inclusion at present is confined to ensuring a bare minimum access to savings bank account without frills to all. However, a sizeable section of the population, particularly the vulnerable groups, such as weaker sections and low income groups, mainly excluded from even the most basic opportunities and services provided by the financial sector. In a layman's sense financial inclusion is the process of bringing new customer into the premises of banks. An inclusive financial sector is defined as one that offers a range of financial services to the entire active population. More and more inclusiveness in growth is possible when all citizens are enabled to save and invest and thereby participating in growth efforts. The banks and other financial institutions have the responsibility for providing the financial accessibility to the weaker sections of the society.

Providing various financial services like loans, insurance, payments, remittances and financial advisory services to those who have no access to the formal financial structure of the country is the basic objective of financial inclusion. An open and efficient society is always characterized by the unrestrained access to public goods and services. As banking services are viewed as public goods, the availability of banking and payment services to the entire population without discrimination is inevitable. Financial inclusion is a critical component of the inclusive growth envisaged for the overall development of the country. The spread of banking facilities has been uneven in the country, throwing up challenges for achieving financial inclusion.

In the post – liberalization era, Indian public sector banks (PSBs) are facing a number of challenges in retaining and expanding their customer base. These challenges include finding an economically- viable solution for financial inclusion, innovation and customer relations.

The new age Indian customer has come to expect a lot more from banks than mere mechanisms to save. Customers are more knowledgeable, demanding, analytical and aware of their rights. Whether through approaching Reserve Bank of India (RBI), Banking Ombudsman, Right to Information

or Consumer Forums etc., modern day customers know their rights are not to be denied.

Financial Exclusion

It is just opposite of financial inclusion or inclusive finance. There are three types of exclusions.

a) People who do not have any access to a regulated financial system.

b) People who have limited access to bank and other financial services.

c) Individual who have inappropriate products.

Lack of banking habits, high transaction cost, lack of banking knowledge and insufficiency of knowledge on banking products prevents the unbanked people from knocking the door steps of banks.

The financially excluded sections largely comprise *marginal farmers, landless labourers, self employed and unorganized sector enterprises, migrants, ethnic minorities, socially excluded groups, senior citizens and women.*

Highlights of Financial Exclusion in India

- Half of the country is unbanked

- 55% of the population has deposit accounts.

- 9% of the masses have credit accounts.

- India has the highest number of households (145 million) excluded from banking.

- There was only one bank branch per 14,000 people.

- Only 20% of the population has any kind of life insurance.

- Just 18% had debit cards and less than 2% had credit cards.

Table-1 Highlights the accessibility of Financial Services to the population

Table-1 Percentage of Population Availing the Available Financial Services

Population having	
• Bank Account (Savings)	55%
• Life Insurance	20%
• Non Life Insurance	2%
• Credit Accounts	9%
• Debit Cards	18%
• Credit Cards	2%
Source: - Indian Journal of Finance – November-2012	

Table -2 states that there has been tremendous growth in the spread of banking network in the country since 1969. However despite this wide network of bank branches spread across the length and breadth of the country, the extend of financial exclusion in India is staggering.

Table-2 Bank Branches

Year	Rural	Semi urban	Urban & metropolitan	Total	Rural share (%)
1969	1833	3342	3087	8262	22
1970	3063	3718	3350	10,131	30
1975	6807	5598	6325	18,730	36
1980	15,105	8122	9192	32,419	47
1985	30,185	9816	11,384	51,385	59
1990	34,791	11,324	13,637	59,752	58
1995	33,004	13,341	16,022	62,367	53
2000	32,734	14,407	18,271	65,412	50
2005	32,082	15,403	20,870	68,355	47
2010	32,554	21,053	34,834	88,441	37
2011	33,813	23,236	36,750	93,799	36
2012	35,653	25,542	38,698	99,884	36

Source - **RBI**

Challenges before the Banks

Although steps have been taken by the banks to deliver the banking services and the credit facilities to the vast sections of the population belonging to the disadvantaged and low income groups, it is still a challenging task.

This is because of following reason,

1) Due to limited literacy, especially financial literacy, there is lack of awareness about the financial services and products.

2) The financial products are unsuitable for low income groups and the attitude of banks towards such customers is unfriendly and unempathetic.

3) The low income groups cannot fulfill KYC (Know Your Customer) norms due to lack of proper documents regarding identity, address, income proof etc.

4) Higher and nontransparent fees charged by the banking firms and crude terms and conditions.

5) Lack of communication due to language barriers.

Hence for a better financial inclusion or inclusive finance, it is necessary for banks to overcome the above mentioned obstacles in time.

RBI and Financial Inclusion

RBI has a crucial role for the effective implementation of financial inclusion practices. The Reserve Banks approach towards Financial Inclusion aims at connecting people with banking system and not just opening accounts. This includes meeting small credit needs of the people, giving them access to the payments system and providing remittance facilities. Since past couple of years the RBI has adopted so many strategies towards Financial Inclusion. From among this packages, a 100% financial inclusion drive targeting one district in each state for 100% financial Inclusion.

Government and Financial Inclusion

The initiatives taken by the Government of India as regards the Financial Inclusion are given below.

1) National Financial Inclusion Plan:-

   The Government has adopted a National Financial Inclusion Plan which has the objective of providing access to comprehensive financial services to at least 50% of 55.7 million financially excluded categories.

2) Setting up of special Funds:-

   The Government has established two funds with NABARD (National Bank for Agricultural and Rural Development) as under.

   a) Financial Inclusion (Promotion and Development) Fund. It is for meeting the cost of development and promotional efforts.

   b) Financial Inclusion Technology Fund for meeting the cost of technology adoption.

3) Pension:-

   Payment of Pension to Below Poverty Line (BPL) families through bank accounts is an important initiative done by the government.

4) Aadhar Plan:-

   Unique Identification Authority of India has taken up the project of providing unique identification numbers to all citizens. Now AEPS (Aadhar Enabled Payment System) is going to introduce in Banks and Financial Institution for an easy service.

5) Direct Cash Transfer :-

   It was implemented in 1st January 2013 in several districts across the country. At the end of 2013 it will extend to all districts. Through this scheme the money released by government will directly reaches to bank accounts of beneficiaries.

6) No Frills De-mat Account:-

The securities and Exchange Board of India (SEBI) has decided to introduce Basic Services De-mat Account (BSDA) with limited services and reduced cost for retail individual investors. However the value of securities held in that account should not exceed Rs-2 Lakhs.

New customer Experience

Modern device of mobile banking, ATM (Automated Teller Machine), Internet Banking and numerous other innovations have been incorporated to give customers easy access to banking. But no amount of technology or aggressive push can take away the importance of personal interactions in the banking sector. The bank employees make a difference for building customer loyalty. A good customer experience is an important weapon for Financial Inclusion.

A trained team can nurture customer relationships and build trust over a series of transactions. The customer will value such a relationship and the bank builds customer loyalty and also inclusive finance for *"banking the unbanked".*

Conclusion

Although, the Government has launched several subsidized programs for the benefit of the poor and co-operatives weaker section of the society could not be turned around. For the proper financial inclusion, easily accessible and affordable "credit plus services" should be provided to the vulnerable poor of the society. The rural financial system should be strengthened as a super market for various types of financial products in the rural India. Our future customers stay in rural areas and taking India to the next

level will not be possible without including them in the growth. "Financial Inclusion must not be a choice, but a challenge" to all credit delivery agencies and rural poor of India as well.

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STUDY OF HYDROGRAPHIC PARAMETERS OF DUG WELLS OF CHAZHUR PANCHYATH IN TRICHUR DISTRICT, KERALA STATE

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Abstract

The present investigation deals with a systematic monitoring of dug well water samples of Chazhur Panchayath for a period of 3 months from February to April 2013. 15 physicochemical parameters of the well waters from 18 wards of the studied area were analyzed to examine the suitability of water for drinking purpose. The results were compared with the standards prescribed by ISI, US Public Health Service and by Kerala State Pollution Control Board. Water samples analysed revealed that the various water quality parameters studied in the present investigation is within the desirable limit except in one. Water sample from ward no. 16 have some parameters more than desirable limit, but still within the permissible limit. Water from these sources can be used for drinking purpose in the absence of an alternate source.

Keywords: Chazhur Panchayath, hydrographic parameters, dug well, permissible limit, water quality standards.

Introduction

Today human activities are constantly adding industrial, domestic and agricultural wastes to ground water reservoirs at an alarming rate. Ground water contamination is generally irreversible, ie., once it is contaminated, it is difficult to restore the original water quality of the aquifer (1994). Excessive mineralization of ground water degrades water quality producing unobjectionable taste, odour and excessive hardness (1995). Although the soil mantle through which water passes acts as an absorbent retaining a large part of colloidal and soluble ions, with its cation exchange capacity, but ground water is not completely free from the menace of chronic pollution (1985).

Numerous activities including industrial production, agriculture, sewage discharge, commercial and residential activities contaminate ground water sources. The domestic sewage composed of fecal waste; kitchen and laundry wastes are the major sources of pollution for household wells (1979).

These are shallow excavations that range form a few square feet to many acres in area. They are commonly used to hold municipal

sewage, hospital wastes and a variety of wastes including industrial chemicals (1981).

Sanitary landfills are constructed by placing waste in excavations and covering the material with soil daily, so that garbage and other materials are not left exposed to produce odours, smoke, vermin and insects. Even though a land fill is covered, leachate almost certainly will be formed by the infiltration of rains (1970).Another cause of ground water pollution is the disposal of waste material directly on to the land surface. Examples include garbage sludge and domestic wastes. These wastes may occur as individual mounds or they may be spread over the land. If the waste contain soluble products they may be dissolved and infiltrated into the ground water (Haimes YY).

Another cause of ground water pollution is the effluent from septic tank, cesspools and privies. The close proximity, density of installations can create serious pollution problems, in creviced rock areas effluent may travel from long distances in fracture system and solution channels.

Animal feed lots covers relatively small area but provide huge volume of wastes. Feed wastes pollute ground water with large concentrations of nitrate and bacteria. A variety of water borne diseases like cholera, typhoid fever, bacterial dysentery, gastro enteritis, etc. are attributed to untreated or inadequately treated ground water containing toxic materials and pathogenic forms of bacteria and viruses.

Study area:

Area selected for the present study is 18 wards of Chazhur Panchayath, a rural area in Thrissur District, Kerala State. Water samples from dug wells in each ward have been collected for a period of 3 months from February 2013 to April 2013. Samples were collected using standard procedure.

Materials and Methods:

Water samples for the present investigations were collected from each of the 18 wards of the study area. Samples collected in precleaned polyethylene bottles were brought to the laboratory for various physicochemical analysis. All the reagents used were of AR grade. Water quality parameters viz. temperature, pH, electrical conductivity, TDS, acidity, alkalinity, total hardness, calcium, magnesium, chloride, free carbon dioxide, dissolved oxygen, BOD, COD and iron were analysed as per standard methods of APHA (2005) and by Vogel (1978).

Result and Discussion:

In the present investigation, a comparative study of 15 general parameters from 18 wards of Chazhur Panchayath were analysed. The results of the study are given in table I and compared with the standards prescribed by ISI, US Public Health Service and Kerala Pollution Control Board.

Odour

Odour is recognized as a quality factor affecting acceptability of drinking water and food prepared from it. Most organic and some inorganic chemicals contribute taste or odour. These chemicals may originate from industrial waste discharges, natural resources, such as decomposition of vegetable matter or from

associated microbial activity. In this study, water samples from 18 wards has no objectionable odour.

Temperature

Temperature of the water samples in the studied area ranged from 31.6 to 31.9. In general the temperature of the shallow ground water approximates that of the mean annual temperature of the air. The dominant factor controlling ground water temperature was found to be the geothermal gradient. Appreciable variation of the temperature existed only at greater depth (10 degree centigrade for every 60 meters). (2009)

P^H

P^H value is the logarithm of reciprocal of hydrogen ion activity, in moles/liter. In water, variations in PH value from 7 is mainly due to the hydrolysis of salts of strong bases and weak acids or vice versa. Dissolved gases such as CO_2, H_2S and NH_3 also affect PH of water. The overall pH range of natural water is generally between 6 and 8. P^H lower than 4 will produce sour taste and higher value above 8.5 bitter taste. P^H below 6.5 starts corrosion in pipes, there by releasing toxic metals such as Zn, Pb, Cd, Cu etc. P^H value is in the normal range for water from all the wards.

Total dissolved solids

Total dissolved solids is the term applied to the residue remaining in a weighed dish after the sample has been passed through a whatman no:1 filter paper and dried to constant mass at 103-105°C. Many dissolved substances are undesirable in water. Dissolved minerals, gases and organic constituents may produce displeasing colour, taste and odour. Some dissolved organic

chemicals may deplete the dissolved oxygen in the receiving water and some may be inert to biological oxidation, yet others have been identified as carcinogens. The ISI specified maximum limit is 500mg/l. There is a high value of 559 mg/l in ward 16. But this value is within the permissible limit of the value prescribed by KSPCB and USPH. In remaining wards this value comes within the desirable limit.

Acidity

It is a measure of effects of combination of compounds and condition in water. Acidity of water lowers dissolved CO_2 content there by reducing photosynthetic activity. Here acidity varies for each water samples. The highest value of acidity is 140 mg/l in ward 12 and the lowest value is 45 mg/l in ward 5.

Alkalinity

Alkalinity of water is due to the presence of carbonate and hydroxide ion. Alkalinity provides an idea about the salts present in water. Alkalinity of chemically treated water should be less than 126 mg/l. Excess alkalinity in water is harmful for irrigation which leads to soil damage and reduce crop yields. It is an important parameter involved in corrosion control. Here in this study the highest value is 180 mg/l in ward 1 and 18. Lowest value of alkalinity is 60 mg/l in ward 14.

Total hardness

Hardness is the measure of capacity of water to react with soap, hard water requiring considerably more soap to produce a lather. Hardness is mainly due to calcium and magnesium. Anions such as carbonates, sulphate

etc. contribute to hardness. The low and high value of hardness has disadvantages and advantages. Absolutely soft water is tasteless, corrosive and dissolve the metals. More cases of cardiovascular diseases are reported in soft water areas. Hard water is useful to the growth of children due to presence of calcium. Total hardness is in the range of 300mg/l and relaxation allowed is 600mg/l. In this study, water samples from all wards have hardness value within the desirable limit. The highest value of hardness is 270 mg/l in ward 16 and lowest value of hardness is 24mg/l in ward 14.

Calcium

Calcium is one of the most common constituent present in natural water ranging from zero to several hundred milligrams/ liter depending on the source and treatment of the water. It is an essential element for man. However high degree of consumption of calcium lead to some health problems. ISI specified maximum value of Ca is 75mg/l. In this study calcium level varies from 8mg/l - 130mg/l. The least value 8 mg/l is in the wards 8 and 14. The highest values are 124 mg/l and 130mg/l in ward 16 and 3 respectively.

Magnesium

Magnesium salts are important contributors to the hardness of water which breakdown when heated, forming scale in boilers. Chemical softening, reverse osmosis, electro dialysis etc reduces magnesium and associated hardness to acceptable levels. ISI specified maximum permissible value of Mg is 30 mg/l. In all values, except ward 16 this value is within the limit. In ward 16 this value is 35mg/l. According to the

value prescribed by KSPCB, the relaxation allowed value for mg is 100mg/l. So in ward 16 value is within the permissible limit.

Chloride

Chloride is one of the major inorganic anion in water. In potable water, the salty taste is produced by the chloride concentration is variable and dependent on the chemical composition. There is no known evidence that chlorides constitute any human health hazard. For this reason, chlorides are generally limited to 250mg/l in supplies intended for public use. High chloride content may harm metallic pipes and structure, as well as growing plants. Here in all wards chloride content is within the desirable limit, except in wards 3 and 16. In wards 3 and 16 this value is within the permissible limit. The highest value 639 mg/l is in the ward 3.

Free CO_2

CO_2 is a normal component of natural water. The present study reveals that carbon dioxide concentration was comparatively low in most the samples. Relatively higher concentration in dug wells can be attributed to the presence of decomposable organic matter in the bottom (2009). In this study value varies from 14 mg/l - 69mg/l. The least value is in ward 4 and highest value is in ward 17.

Iron

Iron is an essential element in human nutrition. Anaerobic ground water may contain Fe (II) at concentrations up to several milligrams/liter without discoloration or turbidity in the water. Taste is not usually noticeable at iron concentration below 0.3

mg/l, although turbidity and colours may develop in piped systems at levels above 0.05 to 0.1 mg/l. Long time consumption of drinking water with a high concentration of iron lead to liver diseases. Iron also promotes the growth of iron-bacteria. This gives a rusty appearance to the water. Colonies of these bacteria may also form a slime which causes problems in water closets, pipes, pumps and distribution system. In this study iron concentration varies from 0-0.6 mg/l. In ward 14, there is no iron in the water, But in ward 16 it is highest i.e, 0.6 mg/l. ISI prescribed limiting value of iron is 0.3 mg/l. 1 mg/l is the relaxation allowed value by KSPCB and USPH.
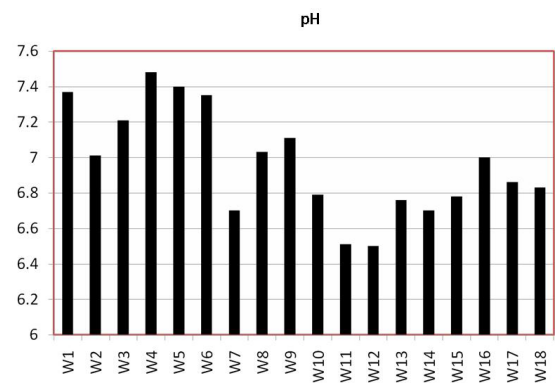
Electrical conductivity

Specific conductance yields a measure of water's capacity to convey an electric current. Here in all wards conductivity vary from 4.1 x 10-3 to 5.9 x 10-3 siemen When comparing all the 18 wards, the high value of conductance is in the ward 3. The high value is 5.9 x 10-3 and lowest value 4.1 x 10-3 in ward 18.
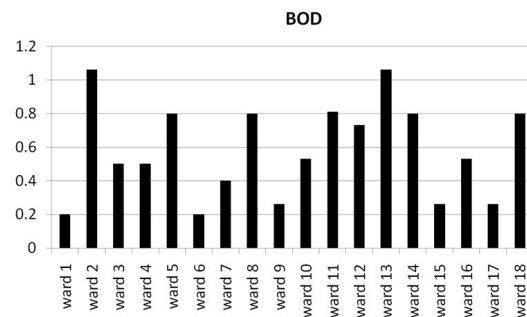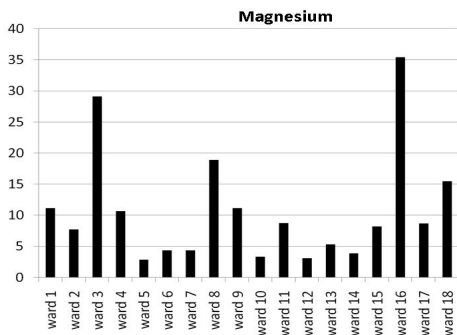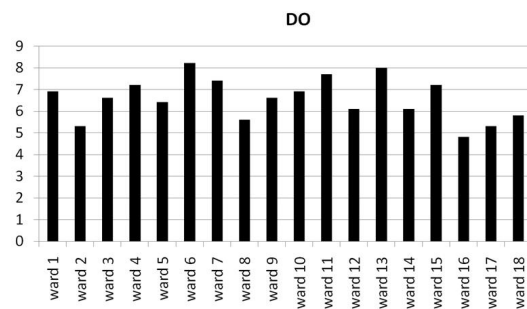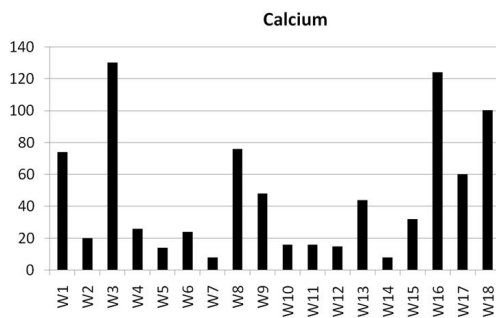
Dissolved Oxygen

The optimum value of good quality water has been 500 mg/l. of D.O. It is seen that D.O. range from 4.8 - 8.2 mg/l. The least value 4.8 mg/l in ward 16 and highest value 8.2 mg/l in ward 6. All the samples in the present study is within the optimal range. Its depletion is the most critical manifestation of pollution.

BOD

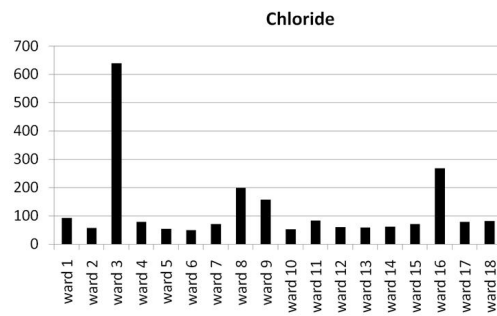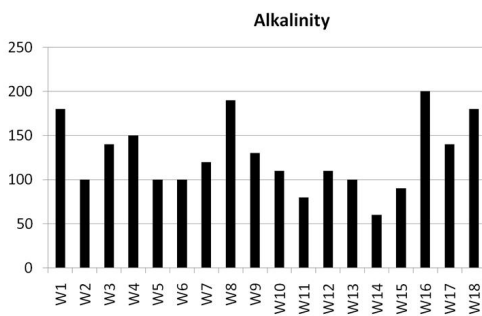It is the amount of oxygen consumed by micro organisms in stabilizing the organic matter. BOD depends on oxidisable organic matter present in samples. The 5 day BOD value is expressed in milligram for study. Highest BOD value is in the ward 2. The permissible limit for BOD as per WHO (1992) is 5 mg/l. The waters from all the samples from the study area have BOD values much less than the permissible limits.

Alkalinity

Free Carbon dioxide

Alkalinity

Chloride

Total Hardness

Iron

Calcium

DO

Magnesium

BOD

COD
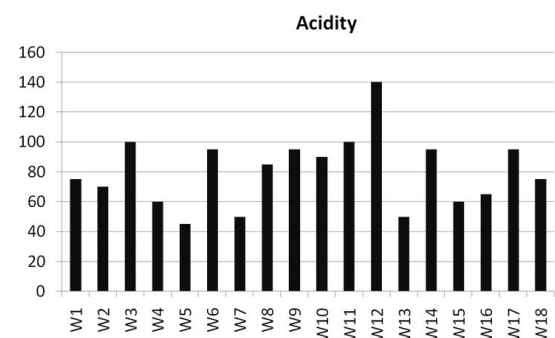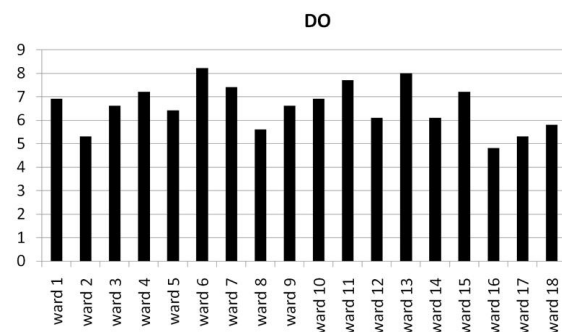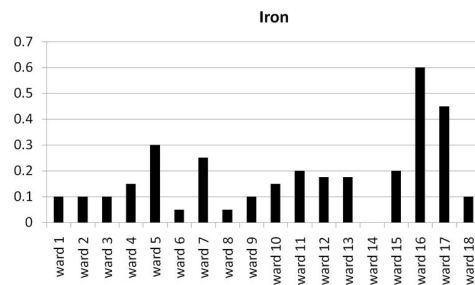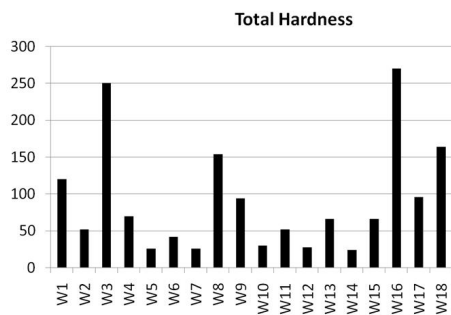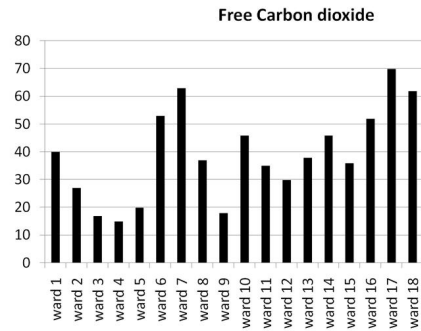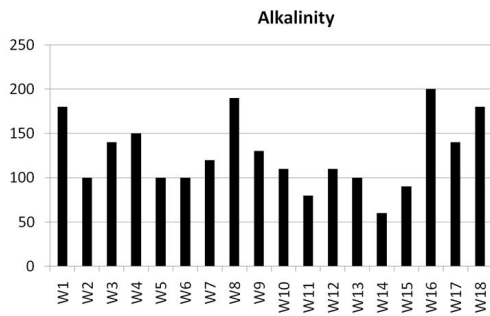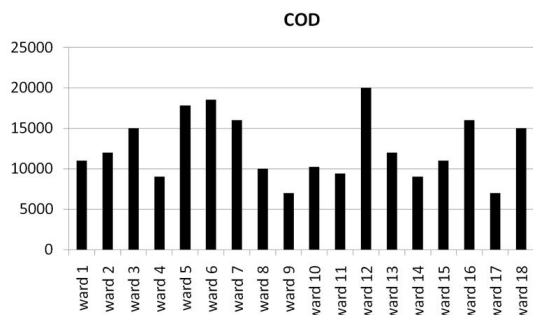
Conclusion

The ISI prescribed p^{H} value suitable for potable water is between 6.5-8.5. According to USPHS, this range is 7-8.5. The results of the present study shows that all the samples obey these range and the least pH value is 6.5 in ward 12 and highest value is 7.48 in ward 4.

The ISI specified maximum limit for TDS is 500mg/l. The USPHS and KSPCB prescribed value is also the same. In this study TDS level is highest for ward 16. The limit for total hardness prescribed by ISI is 300mg/l. Pollution Control Board also prescribe this limit, but USPHS limit is 200 mg/l. The total hardness value of water in all wards comes within the desirable limit.

The limit given for calcium by ISI, USPHS and KSPCB is 75 mg/l. The water from all wards satisfy this condition, except ward 3 and 16. The highest Ca values are 130mg/l and 124 mg/l in ward 3 and 16 respectively.

The limiting value for magnesium is 20 mg/l. The samples from all wards obey this limit, except ward 16. In ward 16 this value is 35mg/l.

The limiting value for chloride is 200 mg/l. Water from all wards is within this limit. But in the 3rd ward chloride content exceeds this limit. In ward 3 this value is 6.39 mg/l.

ISI recommended limit for iron is 0.3mg/l. And the relaxation allowed limit is 1.0mg/l. The USPHS limit is also the same. In ward 14, there is no iron content in water and in ward 16 iron content is 0.6 mg/l.

Therefore the present study concluded that of the 18 sources of water analyzed, almost all water sources are suitable for drinking purposes. The 17 sources of water have, all analyzed parameters within the desirable limit and water can be used for drinking. Only one source, i.e, water from the 16th ward, have some parameters more than desirable limit, but still within permissible limit. Water from these sources can be used for drinking purpose in the absence of an alternate source. There are no source of water with parameters more than permissible level.

Summary

Water is essential for the sustenance of all living organisms including plants, animals and man. It is essential to enforce water quality standards in the interest of public health. All developed countries strictly conform to water quality standards. Clean water is essential for healthy environment to support life systems on this planet. The taste of delicately balancing the ratio of available and exploitable water resources and sustaining their quality is most important for India as rainfall distributor is confined to 3-4 months in a year. Moreover, man-made global and local climatic distortions due to global warming, deforestation, loss of top soil, etc. have adverse effect on the monsoon pattern. The awareness, to the value of precious natural resource and the need for conceiving it for well being of mankind, among the common man is increasing.

Our ancient wisdom says that all water that falls from the sky should be divided into 12 parts, six parts must flow into the sea, four should go for the use of non human nature and only the remaining two are to be used by human beings. The latest advances in hydrology provide a scientific basis to our ancient wisdom fusion of traditional wisdom and modern technology to develop sustainable water conservation methods.

As a conclusion, the whole water system should be examined and then to develop an efficient, workable model to preserve and maintain that best quality of the water. Today the accelerated pace of development, rapid industrialization and population density have increased demand of water resources. Here we examined the quality of water from 18 wards of the Panchayath and compared with standard value. In almost all the water samples value comes within the permissible limit.

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STUDY OF IRON PROTEIN AND SUGAR CONTENT IN SOME LEAFY VEGETABLES

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Abstract

One of the primary requirements of the living organism is the food. In order to have a healthy life human being should consume the diet that provides enough calories, vitamins, minerals, proteins etc. In the present investigation, a study of iron, protein and sugar content in some leafy vegetables is carried out. There are several methods for the estimation of iron, protein and sugar. As they are present in minute quantity, calorimetric estimation is done. In the case of iron it is done by thiocynate method, while protein by biuret method and in the case of sugar DNS method is used. The leafy vegetables used are curry leaves, kozhupa, red amaranth, green amaranth, cabbage, muringa leaves, pumpkin leaves and pea leaves. Pumpkin leaves have large iron content. Protein content clearly indicates that curry leaves contain comparatively more protein. Almost all the vegetables leaves analyzed contain very minute quantity of sugar. Pea leaves contain more sugar than other leaves.

Keywords: *Iron, protein, sugar, leafy vegetables, colorimetry, absorbance*

Introduction:

In the planning of suitable diets for the individuals or the community, not only the quantity of food and its calorific value have to be considered, but of equally important is the quality of the food. Protein, lipid, carbohydrate are the proximate principles of food and are the main suppliers of calories. In addition to this, some inorganic components such as iron, magnesium, copper, iodine, etc are also required in suitable quantity to maintain healthy and disease free life. [7]

Iron

Iron is an essential mineral. It is a part of haemoglobin, second most abundant metal on earth. It is also a part of myoglobin, which helps muscle cells to store oxygen without enough iron. The function of iron includes DNA synthesis, energy production, oxygen transport and detoxification of aromatic components. It functions in the body as an integral part of many oxidation – reduction enzymes. It is also contained in several other biologically significant proteins like haemoglobin, myoglobin and

ferritin. Ferritin is concerned with the regulation of iron absorption and act as reserve iron.

The total iron content of the normal adult man is estimated to be about 4 -5 gm. The requirement of iron for a person varies with age and sex hormone. Human being absorbs ferrous iron rather than ferric iron. Most foods contain a small amount of iron but only 5 to 15 percent of this is absorbed. There are two types of iron in food. Heme and non heme iron. Heme iron has advantage that the absorption is not influenced by the composition of metal and may account for up to 25% of the iron absorbed from a diet rich in meat. The absorption of non-heme iron is variable and depends on other factors that promote or inhibit iron availability. Dietary iron intake can be increased in poor by increasing the dietary intake of habitual food or by enhancing the bio-availability of ingested iron. [5]

Protein

Proteins are the basis of many animal body structures. They also form the enzymes which catalyses chemical reactions throughout the body. Each molecule is composed of amino acids which are characterized by containing nitrogen and sometimes sulphur. (These components are responsible for the distinctive smell of burning protein, such as the keratin in hair). 20 amino acids can be found in the human body ,and about ten of these are essential and there for must be included in the diet .A diet that contains adequate

amount of amino acid is particularly important in some situations during early development and maturation , pregnancy lactation, or injury. A complete protein source contains all the essential amino acids, whereas an incomplete protein source lack one or more of the essential amino acids.

It is a common misconception that a vegetarian diet will be insufficient in essential proteins. Both vegetarians and vegans of any age and gender with a healthy diet ,can flourish throughout all stages of life, although the latter group typically need to pay more attention to their nutrition than the former. [7]

Biological value of protein defined as the percent of the absorbed protein nitrogen that is not excreted in urine. A high biological value there for indicates a high degree of utilization of the amino acids of the protein. Animal proteins like liver, meat, egg and milk protein have high biological value compared to vegetable proteins like those of cereals, pulses and vegetable. The biological value of mixture of protein is more than the average of their individual biological value. [2]

Carbohydrate

Carbohydrate may be classified as monosaccharides, disaccharides or poly saccharides or depending on the number of monomer (sugar) units they contain. They constitute a large part of food such as rice,

noodles, bread, and other grain based products. The spike in blood glucose level after ingestion of simple sugars is thought to be related to some of the heart and vascular disease which have became more frequent in recent times .Simple sugars form a great part of modern diet than formerly, perhaps leading to more cardiovascular disease.

Simple carbohydrates are absorbed quickly and therefore raise blood sugar level more rapidly than other nutrients. Rice, noodles, bread, and other grain based food are rich source of sugar. Excess consumption lead to diabetics. So if we take leafy vegetables like red amaranth, green amaranth, pumpkin leaf, pea leaf etc, it is providing enough amount of sugar and at the same time they are rich source of fiber, protein iron etc. [4]

Methodology

We know that one of the primary requirements of the living organism is the food. In order to have a healthy life human being should consume the diet that provides enough calorie, vitamins, minerals, protein etc.

Here, a study of iron, protein, and sugar content in some leafy vegetable is carried out. There are several methods for the estimation of iron, protein and sugar. As they are present in minute quantity, colorimetric estimation is done. In the case of iron it is done by thiocyanate method, while in protein biurret method and in the case of sugar DNS method is used. [2]

Leafy vegetables used are curry leaves, kozhupa, red amaranth, green amaranth, cabbage, muringa leaves, pumpkin leaves and pea leaves. Table 1

Table 1

Sample code	Common name	Botanical name
1	Curry Leaves	Murraya Koenigii
2	Cabbage	Brassica Oleracea
3	Muringa Leaves	Muringa Olifera
4	Red Amaranth	Amaranthus Oleraceus
5	Green Amaranth	Amaranthus Oleraceus
6	Kozhupa	Alternauthera sessilis
7	Pumpkin Leaves	Cucurbita maxima
8	Pea Leaves	Phaseolus aureus

Colorimetry is concerned with determination of concentration of a substance by measurement of a substance by measurement of relative absorption of light with respect to known concentration of the substance. It is based up on two fundamental laws of light absorption namely, Lambert's law and Beer's law. [3]

Colorimetric estimation of iron

Colorimetric estimation of ferric iron is generally carried out by the thiocyanate method. Ferric iron reacts with thiocyanate to give a series of intensely red coloured compounds, which remain in true solution. Ferrous iron does not give the colour. Depending up on which thiocyanate concentration, a series of complexes can be obtained. At very high thiocyanate concentration, the composition of the complex is $[Fe(SCN)_6]^{3-}$ .In the colorimetric determination a large excess of thiocyanate should be used. Since this increases the intensity and also the stability of the

colour. Strong acid (hydrochloric acid or nitric acid) of concentration (.05-.5M) should be present to suppress the hydrolysis of Fe^{3+} to Fe $(OH)_3$. [6]

To determine the concentration of iron in an unknown solution, a standard curve is first made by plotting absorbance of solutions against concentrations. For this, colour is developed in a number of solutions of known concentration by adding excess thiocyanate. Table 2. The absorbance of each solution is measured using photoelectric colorimeter. A plot of absorbance verses concentration would give a straight line passing through origin. Colour is developed in similar manner in a known volume of the unknown solution and its absorbance is also measured. [1] Table 3.

Colorimetric estimation of protein

Colorimetric estimation of protein is carried out by biuret method. Copper in alkaline solution reacts with peptide bond in protein producing a violet colour which is proportional to the amount of protein present.

To determine the concentration of protein in an unknown solution, a standard curve is first made by plotting absorbance of solutions against concentration. Table 4. A plot of absorbance versus concentration would give a straight line passing through the origin. Colour is developed and absorbance is measured in known volume of unknown solution also. [8] Table 5.

Colorimetric estimation of sugar

Colorimetric estimation of sugar is done by DNS method. Several reagents have been employed which assay sugar by their reducing properties. One such compound is 3,5- Di Nitro Salicylic acid (DNS) under alkaline condition to 3-amino-5-nitroslicylate, an orange yellow compound that has an absorption maxima at 540nm. Concentration of sugar in the given test solution can be determined as in the case of iron and protein. [8]

Results and discussion

To calculate the iron content of various samples, a standard curve was drawn by plotting concentration of standard solution against absorbance. A straight line graph is obtained. From the standard curve, the concentration corresponding to the measured absorbance of the unknown sample was determined. This value represents quantity of iron in1gm of dried vegetable leaf. Graph 1.
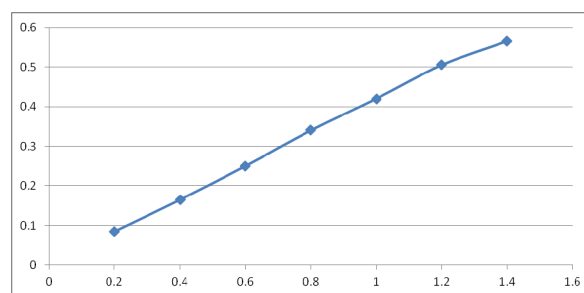

The analysis shows that pumpkin leaf contains more iron. Next comes the green amaranth. So these items should be included in our diet. The other leafy vegetables that contain iron are red amaranth, curry

leaves, kozhupa and so on. Thus curry leaf not only gives flavour but also contribute the iron content of the body.

To calculate the protein content of various samples, a standard curve was drawn by plotting concentration of standard solution against optical density at 540nm. A straight line graph is obtained. From the standard curve the concentration of protein in 1ml of test solution can be calculated, so protein in1gm of dried leaf sample can be calculated.
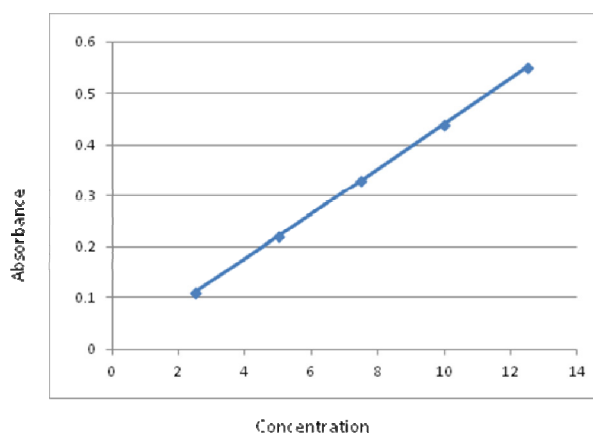
From the analysis it is clear that curry leaves are rich source of protein. Red amaranth, green amaranth and pea leaves also contain small quantity of protein. Muringa leaves also contain certain amount of protein. So not only the egg, meat etc are the rich source of protein, but also the vegetarian items can also increase the protein content.

To calculate the sugar content of various samples, a standard curve was drawn by plotting concentration of standard solution against optical density. Table 6. A straight line graph is obtained. From the standard curve the concentration of each test solution can be calculated.
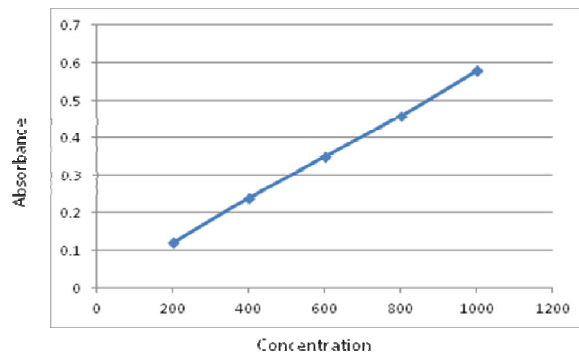
Analysis of sugar content in some leafy vegetables show that pea leaf contain large amount of sugar. Curry leaves and pumpkin leaves also have sugar content. For sugar patients most suitable leafy vegetables are kozhupa, green amaranth & muringa as they have least sugar content.

Conclusion

The iron content of the different varieties of amaranth grown in our locality is more or less same. Among the sample analyzed pumpkin leaves have large iron content. Green and red amaranth also contain requisite amount of iron. Similarly curry leaves and muringa leaves also contain relative amount of iron

On the other hand analysis of protein content clearly indicates that curry leaves contain comparatively more protein. Near to curry leaves red amaranth is also rich in protein. Kozhupa, green amaranth, muringa etc contain more or less same amount of protein.

Almost all the vegetable leaves analyzed contain very minute quantity of sugar. Among

them pea leaves comparatively contain more sugar than other leaves.

Summary

Anemia is concerned with increased parental mortality, increased child mortality, behavioral changes, and impair mental development, decreased work performance. So it is necessary to avoid anemia. Iron supply can be increased not only by choosing animal product rich in heme –iron, but also by choosing traditional iron rich plant food. It is essential to educate the public to change food habits and to eat more heme iron containing foods and eat non heme iron foods that enhance iron bioavailability. The public must be made aware of the value of consuming foods that enhance non heme iron bioavailability with meals and of not consuming those that inhibit non heme iron bioavailability. [5]

In addition to the iron content, public must also be aware of food items containing protein and various carbohydrates(sugar).

In the analysis of iron content of various leafy vegetables by thiocyanate method, it is clear that pumpkin leaves contain more iron and then comes the green amaranth. Curry leaves, red amaranth and muringa leaves also contain definite amount of iron. From all these leafy vegetables we will get required amount of iron. Thus by including this type of leafy vegetables in our daily food iron deficiency and disease caused by it can be controlled to a large extent.

From the analysis of protein content in the various leafy vegetables by biuret method, it can be seen that curry leaves contain large amount of protein. Other leafy vegetables that contain protein are red amaranth, muringa leaves, and green amaranth.

By using DNS method sugar content in various leafy vegetables has also been estimated. Pea leaf contain more sugar compared to other leaves. Kozhupa , green amaranth, muringa leaves etc contain very minute quantity of sugar. So even in case of diabetic patients these leaves can be used, as they provide necessary amount of iron and protein with out increasing sugar level. But it should be considered that iron, protein and sugar content in leaves may vary to some extent to the locality in which it is cultivated, the way of cultivation and the variety of the plant.

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A PREMONSOON STUDY OF PHYSICO-CHEMICAL ENVIRONMENT OF RIVER PERIYAR AT THREE DIFFERENT LOCATIONS

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Abstract

Present study is an assessment of the physico-chemical environment of River Periyar at Gothuruth Kadavu, Tharayil Kavala and Maliankara during the premonsoon period from February to April 2013. Here an attempt has been made to evaluate the pollution status of the studied locality. The water samples were analysed for 15 physicochemical parameters like temperature, pH, EC, TDS, acidity, alkalinity, total hardness, calcium, magnesium, chloride, free carbondioxide, dissolved oxygen, BOD, COD and iron. The study reveals that most of the studied parameters in the sampling sites are not in conformity with that of standard levels.

Keywords: Lower reaches, River Periyar, physicochemical parameters, water quality standards.

Introduction

The Periyar River other wise called the Poorna nadi, is the longest river of Kerala and also the largest in water discharge potential (Kerala Sate Gazetteer, 1986). The river which has a length of about 244 km and a catchment area of 5398 km^2; out of which a total of 5284 km^2 lies in the Kerala State and rest in the Tamil Nadu State. The river originates from the Sivagiri hills at an elevation of about 1830 m above mean sea level (msl) and flows through highly varied geological and geomorphic regions. The major channel supplying water and sediments to Periyar River are Muthirapuzha, Perinjankutty, Edamalayar and Mangalampuzha tributaries.

Population explosion and rise in demand for resources has lead to serious environmental problems in the river basins of Kerala, especially in the Periyar river basin. The Periyar River near Eloor – Kalamassery regions hosts many fertilizer and chemical industries. All these industries together discharge an amount of about 260 million m^3 of liquid wastes into the river channel, annually (Dineshkumar, 1997). Additionally, an amount of 113000 tonnes/year of urban wastes is also added in Periyar basin from various urban local bodies (CESS, 1999). The unscientific disposal of these wastes could enhance the level of pollution in the area. Analysis of secondary data from Agricultural Department, Government of Kerala reveals that an amount of 46000

tonnes/year of chemical fertilizers are applied for enhancing the productivity of the area. It is a fact that substantial part of these chemicals will also be reaching these river channels in one way or the other.

There are many environmental problems related to indiscriminate mining of sand. The river bank is cut deeply at many locations (particularly downstream stretches) for the passage of vehicles into the river bed. Incidents of river bank slumping, weakening of engineering structures, lowering of water table in wells adjacent to sand mining sites, etc., are common in the area (Padmalal et al., 2003). There are several reports of aggravated sea water ingression consequent to lowering of river channel in areas close to river mouth. All these impose added a stress to the physico-chemical and biological environment of the river ecosystem (Kondolf, 1994; Brown et al., 1998; Sheeba and Arun, 2003; Sreeja et al., 2003).

The present study is an attempt to assess the water quality along the lower reaches of River Periyar. An attempt has also been made to evaluate the pollution status of the area.

Study Area

The area selected for the present study includes 3 locations namely Gothuruth Kadavu, Tharayil Kavala and Maliankara, along the lower reaches of River Periyar. The area selected for the present study, the Periyar River lies between North latitude 9° 15' 50" – 10° 32' 53'' and East longitudes 76° 07' 32''.

Materials And Methods

Location

Water samples were collected from the lower reaches of Periyar River at three different areas. In order to study monthly variations samples were collected at the middle of three months namely February, March and April 2013. The three different areas include river near Kottapuram Bridge, River near Thozhuthungal Bhagavathy Temple, Tharayil Kavala and River near Maliankara Bridge. The samples were collected using standard procedural methods.

Sampling and Storage

Surface water samples were collected in pre-cleaned polythene containers. It was kept undisturbed until analysis. Standard procedures were adopted for the determination of physio-chemical parameters. Physical parameters includes colour, conductivity and temperature. Chemical parameters such as P^{H}, TDS, alkalinity, acidity, chlorine, total hardness and metals like Ca, Fe and Mg are determined. Samples for the determination of P^{H}, DO, BOD are kept in refrigerator and analysed as early as possible. The temperature of the sample is measured using sensitive thermometre at spot itself.

COMPARISON OF DIFFERENT PARAMETERS OF WATER SAMPLES

No.	PARAMETERS / LOCATION	RIVER NEAR KOTTAPURAM BRIDGE			RIVER NEAR THOZHUTHUNGAL TEMPLE			RIVER NEAR MALIANKARA BRIDGE		
	MONTHS	FEB	MARCH	APRIL	FEB	MARCH	APRIL	FEB	MARCH	APRIL
1.	Temperature (^{0}c)	31.2	31.8	32.1	31.2	31.7	32.1	31.3	31.6	32
2.	P^H	6.81	6.83	7.16	7.08	7.21	7.30	6.98	7.10	7.23
3.	Electrical conductivity (Siemen)	4.9×10^{-3}	5.6×10^{-3}	5.9×10^{-3}	4.8×10^{-3}	5.1×10^{-3}	5.9×10^{-3}	4.7×10^{-3}	5.9×10^{-3}	6.1×10^{-3}
4.	TDS	56.68	53.52	57.7	35.78	46.78	56.74	51.05	48.41	61.04
5.	Acidity (Mg / L)	75	135	55	90	130	75	70	135	90
6.	Alkalinity (Mg / L)	170	160	120	200	210	180	260	250	230
7.	Total Hardness	5000	5300	5480	5960	5720	5580	4940	4980	5040
8.	Calcium	760.75	670.65	780.78	850.85	570.57	860.86	900.9	1061.06	960.96
9.	Magnesium	1030.4	1125.26	1142.25	1241.89	1251.68	1147.09	981.79	952.58	991.50
10.	Chloride (Mg / L)	6858.6	6872.8	6887	6745	6801.8	6830.2	6901.2	6887	6887
11.	Free Co$_2$ (Mg / L)	3.495	3.695	1.697	3.495	2.397	1.997	3.495	2.397	3.096
12.	Iron (Mg / L)	1.6	0.2	0.3	1.6	0.3	0.4	0.4	0.8	0.7
13.	DO (Mg / L)	5.86	4.8	6.13	5.86	5.06	5.86	5.6	4.53	5.33
14.	BOD (Mg / L)	0.53	0.26	0.53	0.8	0.53	0.8	0.26	0.26	0.53
15.	COD (Mg / L)	7000	7600	8200	8800	8600	8200	6400	6200	7600

Result and Discussion

Water is a precious natural resource. It is the greatest gift of nature and a necessity of mankind. All living creatures depend on water in one way or another. The quality of drinking water is now the concern of scientist all over the world. Water should be obtained from a source that is free from pollution. All kinds of bacteria and microorganism should be absent. It should be colourless, odourless and have an agreeable taste.

The standard and observed values of physico-chemical parameters of experimental water samples are presented in the table. The quality of water samples varied with different places of collections because of differences in the sources or surroundings of these sources.

The present work is a monthly comparative study of Periyar River at three different locations along the lower reaches of Periyar. The discussion below focuses on the monthly variation of water quality parameters analysed.

Temperature

The temperature of sampling stations ranged between 31.2 to 32.1^{o}C. The temperature is a vital parameter for growth of organisms and plays an important role in the physicochemical and physiological behaviour of aquatic ecosystems. The mixing of inflowing river water and tidally influenced sea water plays an important role in the distribution of temperature. Processes like exchange of heat with atmosphere and any localised phenomenon are also likely to influence the distribution of temperature 1988.

P^H

P^H is a term used universally to express the intensity of the acid or alkaline condition of a solution. The observed P^H range suggested by the WHO is 7.0 - 8.5 for drinking water. The observed values are somewhat near to it, showing the neutral nature of river water. The pH is an important hydrological factor indicating the level of dissolved CO_2 in water, which in turn reflect the activity of phytoplankton at the level of DO in the water. High pH in surface waters is due to the photosynthetic activity.

Dissolved Oxygen

Dissolved Oxygen (DO) is essential to all forms of aquatic life including the organisms that break down man-made pollutants. DO is an important parameter in water quality assessment and reflects the physical and biological processes prevailing in water. The optimum value for good quality water has been 4 - 6 ml / l of DO. Along the entire study area level ranges from 4.5 - 5.86 - 6.13 mg/l. It varies with different seasons. The WHO standard of DO is >5.00 ml/l.

BOD

Bio-chemical Oxygen Demand is a measure of organic material contamination in water, specified in mg/l. BOD is the amount of dissolved Oxygen required for bio-chemical decomposition of organic compounds and the oxidation of certain inorganic materials (Eg. Iron, Sulphites). Typically the test for BOD is conducted over a five day period. BOD varies from 0.2 - 0.5 for Kottapuram from February - April. Then BOD varies from 0.5 - 0.8 for river near Temple and again between 0.26 - 0.53 mg/l at Maliankara. Typical natural waters have a BOD value ranging from 0.82 to 5 mg/l. BOD level above 6 mg/l will rob the water of needed oxygen for fish and other organisms 2009.

Total Dissolved Solids

The standard value proposed by WHO is 500 mg/l. The observed values are from 53.52 - 56.68 - 57.7 Kottapuram Kadavu. In the case of river near Temple. It is 35.78 - 46.78 - 56.74.

Then for Maliankara it is as 51.05 - 48.41 - 61.04. A rice in conductivity above permissible level indicates pollution. Thus with regard to TDS in the studied areas, the river is not much polluted.

Total Hardness

Hardness is the property of water which prevents lather formation with soap and increases the boiling points of water. The hardness mainly depend upon the amount of the calcium or magnesium salts or both. Anions such as carbonate, sulphates etc. contribute to hardness. The observed values range between 4940 - 5580 mg/l. Water containing hardness with concentration up to 60 mg/l is referred to as soft and those containing 120 to 180 mg/l as hard.

Free CO_2

Carbondioxide is a normal component of natural water. Carbondioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net eco system metabolism. The values for three areas are in the range between 1.69 - 3.69. Typically surface water contains less than 10 ppm free CO_2 while ground water may have much higher concentration. It lowers pH. Aquatic plant life, from phytoplankton to larger rooted plants, depends upon CO_2 and bicarbonates in water for growth. The significant factor is that when oxygen concentration falls through degradation of organic waste, the carbondioxide concentration rises. This increase in CO_2 makes it difficult for fish and other organism to use the limited amount of oxygen

present. The acceptable range of CO_2 for most finfish is less than 2 mg/l. The reading of the present study records that the water body under study is in trouble.

Acidity

It is a measure of effects of combination of compounds and condition in water. Acidity of water lowers dissolved CO_2 content there by reducing photo synthetic activity. The observed values are in the range between 55 – 130 mg/l. The permissible limit of BIS value is less than 1 mg/l.

Alkalinity

Alkalinity of water is due to the presence of carbonate and hydroxide ion. It gives an idea about the salts present in water. It is an important parameter involved in corrosion control. The observed values are in the range between 120 - 260 mg/l. The acceptable range for most finfish is 20 to 200 mg/l. For chemically treated water it shall be less than 120 mg/l. Acceptable limit by WHO is 120 mg/l.
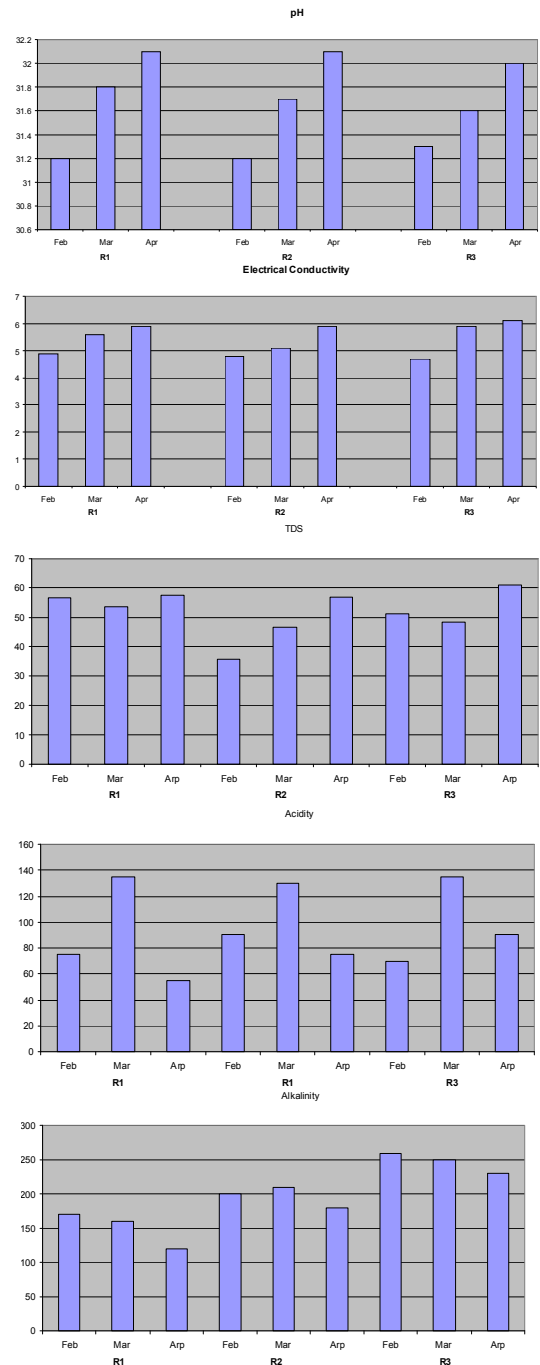
Electrical conductivity

EC is due to the ion present in water. A rise in conductivity indicate pollution. The experimental values range between 4.7 x 10.$^{-3}$ siemen - 6.1 x 10.$^{-3}$ siemen.
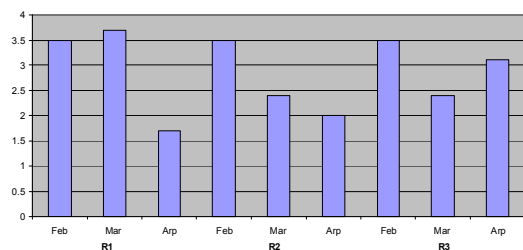
Iron

The observed values ranges from 1.6 - 0.3 mg/l for Kottapuram river in the three months. For river near temple the values are 1.6 - 0.3 - 0.4 mg/l. At Maliankara the values are in the range

0.4 - 0.8 - 0.7 mg/l. Concentration above 1 mg/l will impart a foul taste to the water. The maximum permissible range by US Public Health Service is 0.3 mg/l.

Total Hardness

Iron

Calcium

Dissolved Oxygen

Magnesium

BOD

Chloride

COD

Free Carbondiioxide
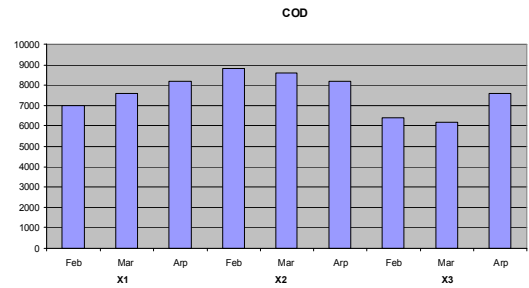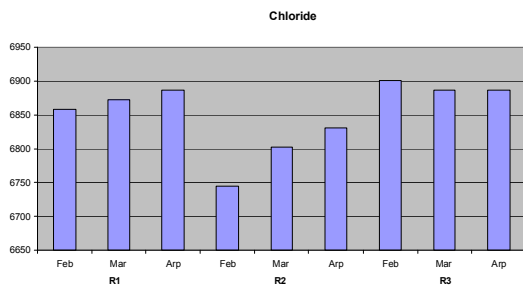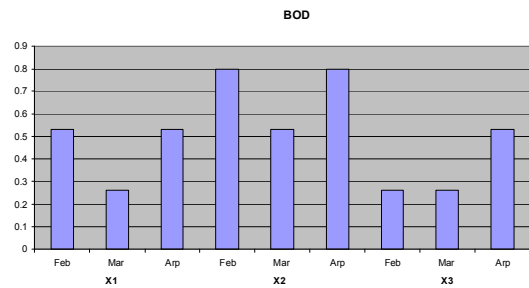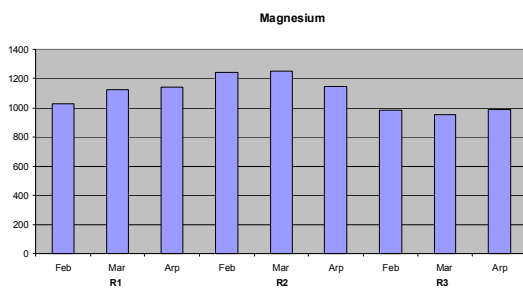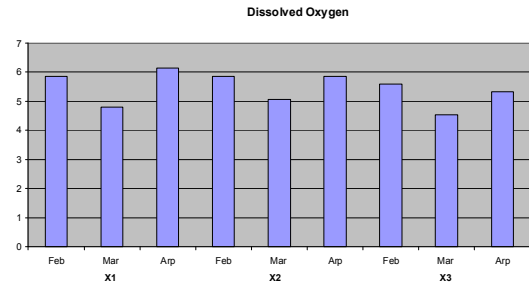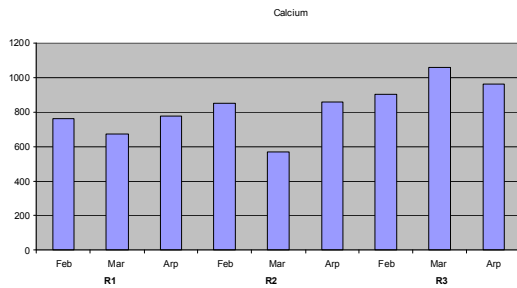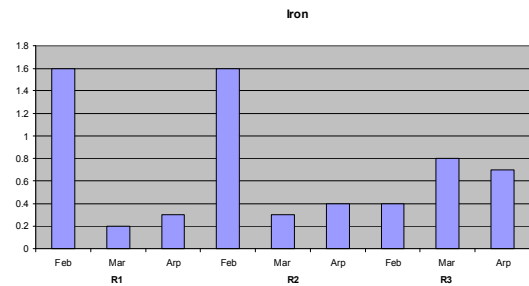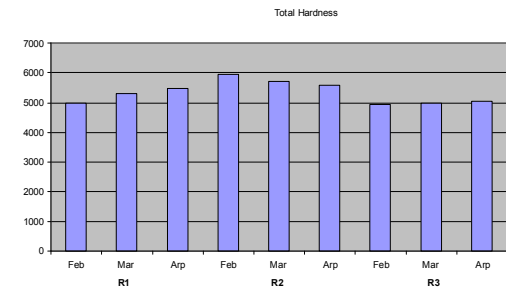
Conclusion

In the present investigation, a physico-chemical analysis of river Periyar at kottapuram, Tharayil kavala and Maliankara during the premonsoon period from February to April 2013 were carried out. The study revealed that with respect to certain parameters like Acidity, Alkalinity, Calcium, Magnesium, Total hardness,

Free co2,Iron,DO,BODand COD, significant variation could be seen with respect to monthly variation and study areas. But with respect to Temperature, PH and Electrical conductivity, there is no significant variation between the analysed areas as well as with monthly variation studies

Parametres like EC,TDS,BOD is low as compared with the standards whereas Acidity, Alkalinity, Hardness,chloride,Co2,DO,BOD and COD is not within the permissible limit. Temperature is close to the air temperature and pH showed an almost neutral trend. From this study it is revealed that the river is slowly but definitely get polluted

Clean water is increasingly scarce globally. Conserving water has become a prime environmental concern. It is an essential element for all living beings and is polluted very much in all countries. India is no exception to this phenomena. Due to increasing industrialization, urbanization and other developmental activities, most of our water bodies have polluted.(1999)It is to be conserved, protected and judiciously managed.

The present data thus showed that just like other Indian rivers, Periyar river along its lower reaches is much polluted and steps should be taken at the individual, industrial and administrational level, so that Periyar river water becomes palatable, potable, suitable for industrial and civic purposes as well as from the ecosystem point of view.

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EDUCATIONAL IMPLICATIONS OF BHAGAVADGITA

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Abstract

Srimad Bhagavadgita is a part of Srimad Bhagavad Puran - a great epic written in Sanskrit verse by the sage poet Ved Vysa. In the Gita, the essence of universal wisdom, the science of human nature, the philosophy of creation - the ultimate reality of the technique to attain that truth have been narrated by Krishna to his friend and devotee-Arjuna.

Keywords: *Virtuous knowledge, Sublimation of personality, importance of duty.*

Bhagavad Gita - means the song of the master ie of Krishna - Prince of Dwaraka, a Rajput royal line. This knowledge was imparted in a tense situation in the centre of the battle field, just when the Mahabharatha war was about to begin between the families of cousin brothers - the Kauravas and Pandavas. Krishna was the charioteer of one of the pandava princes - Arjuna. 'Gita' is a philosophical discourse of Srikrishna to persuade the reluctant Arjuna to fight against evil. It is compared in a familiar verse to the nectar like milk derived from the Upanishadic cows. (1)

All the Upanishads are the cows; the son of cowherd is the milker, Partha is the calf, men of purified intellect are the drinkers. The supreme nectar known as 'Gita' is the milk.

It forms a part of Bhishmaparva of Mahabharatha. The selection of battlefield for imparting teaching is quite appropriate. At first Arjuna is horrified at the thought that he has to fight with his relatives and friends and refuses to fight. Sreekrishna then proceeds to instruct him that it is his duty as a warrior as a righteous man to fight against evil and restore peace and order.

Our life is a battle field in the same manner. We have to fight at the physical level to protect our body from hunger, disease, vagaries of nature as well as from antisocial elements and machines of modern comfort. Our energy dissipates in gathering comforts of luxuries and protecting them. When our material wealth, power and honour which we earned with great effort are lost, we become miserable. During our journey of life we ride the raging waves of time, caught up in dualities, happiness - unhappiness, profit-loss, health-sickness, honour – dishonour, love - hate etc.

The Gita teaches one to be balanced & poised even under the influence of contradictory pulls & pressures. The most tragic situation arises when we toil hard at work, but we don't get the desired result. We may remain happy, successful and balanced in our life, if we practice the essence of Gita.

Symbolically our life is like the battle field of Mahabharatha. Our 5 major senses; & their

ramifications are the Pandavas. In totality body, mind, intellect, chitta & ego are the extensions of our experienced world. We are continuously struggling with the demoniac traits within & without. The chief warrior Arjuna is our mind, in conjunction with intellect & ego. Lord Krishna is pure consciousness - the cosmic intelligence who illumines our mind & intellect only when they are purified and cleansed after we surrender him with a prayer to become the charioteer of our life.(2)

The first and foremost of his mandates to Arjuna was

> **"klaibyam ma sma gamah partha**
> **naitat tvaiyyupapadyate**
> **Ksudram hrdaya daurbalyam**
> **Tyaktvo, Hshta parantapa"**

The man who fails to face a crisis is denounced as a doltor or as impotent.

In stinging reproachful words, Krishna is deliberately lashing out at the anxiety state neurosis in Arjuna. Krishna, who was silent so far, is now bursting forth into an eloquence in which every word is a chosen missile a pounding hammerstroke that casn flatten eney victim.

The word klaibyam means, the mental attitude of one who is neither masculine enough to feel a passionate courage and daring, nor womanly enough to feel the soft emotions of hesitation and despair. Emotionally therefor, Arjuna is behaving now as a contradiction, effeminately-manly and masculinely-effeminate, just like an eununch of the Indian royal courts who looks like a man but dresses as a women, talks like a man but feels like a women, physically strong but mentally weak.

So far Krishna was silent and the silents had a deep meaning. Arjuna, overwhelmed with compassion, had taken the decision not to fight and was all along mustering arguments in support of it. As a diplomat, Krishna knew that it would have been useless to contradict his friend earlier when he was inspired to argue eloquently in support of his own wrong estimate of things. But the tears in the eyes of Arjuna indicated that his inward confusion had reached a climax.

Soft words of sympathy could not have revived Arjuna's drooping mind to vigour. Thus Krishna rightly lashed out at his friend with these stinging arrows of ridicule dipped in the acid of satire. Krishna ends his word treatment with an appeal to Arjuna to 'Get up and act'.

When the touch of Lord's grace descends upon his devotees it is invariably felt by the seekers more as an avalanche than as a refreshing shower of Divine mercy. True to this great principle observed everywhere and experienced by every true seeker, in the Geeta too we find when the silent lord started speaking from charioteers seat, his words glamed and landed like lightning on Arjuna, to burn his wrong mental tendencies in the fire of shame.

More significant than this mandate was Madhusoodana's remaining firm as a rock under many a catastrophic circumstances. 'A champion of righteousness makes no distinction between friend and foe"; was the statement made by Sreekrishna. He proved himself an embodiment of that teaching.

The Krishna treatment of this patient of psychological derangement was certainly a specific cure, in as much as in the last chapter we

definitely hear Arjuna declaring that all his 'delusions have ended'. The rest of the story of how he became a rejuvenated warrior of tremendous strength and valour is quite well known to all students of this great classic.

In varying degrees every man is a victim of this 'Arjuna disease' and the 'Krishna cure' being specific is available to all of us at all times in the philosophy of Gita.

In Gita the surest means of acquiring wisdom is declared as follows.

"Sradhavamllabhate jnanam tatparah samyatendriyah

jnanam labdva param santimacerena dhigacchati"

The man who is full of faith, who is devoted to it, and who has subdued the senses obtains this knowledge, ere long he goes to the supreme peace.

The qualities that are necessary for an individual to be assured of the knowledge- Divine are being enumerated here as vividly as from the leaf of a science text book. Faith, devotion and self control are the three imperative necessities to be acquired ere we can hope to evolve to the diviner stature from our present mortal encumbrances. Krishna explains here that, having gained the right knowledge, the individual soon reaches the supreme peace.

All the 18 yogas contained in 18 chapters with 700 shlokas may be reduced to 4.

1. Karmayoga

2. Rajayoga

3. Bhaktiyoga

4. Jnanayoga

All the 4 yogas together stimulate life with spirituality. Since Srikrishna handles all the 4 yogas with equal importance he is called Yogeswara.

The Bhagavad Gita from beginning to end is a grand commentary on this sublime statement "Tat tvam Asi" ie "thou art that". You are not alien to God is the purpose of this sublime sentence.

The first 6 chapters elucidate the word in`thou` in the mahavakyam. The seeming limitation of the individual soul and how they could be overcome to the point of perfection are fully explained here. Chapters 7 to 12 forms second satkam. This deals with the word 'that'- indicating God or ultimate reality. The third satkam contains last 6 chapters. The predicate 'art' get explained here. The relationship between cosmic reality and individual soul is well established in this part.

"Parithranaya sadhunam vinasaya ca duskrtam

dharma samsthapanarthaya sambhavami yuge yuge"

For the protection of good, for the destruction of wicked and for the establishment of dharma, I am borne age after age.

It has been asserted that in Gita if one remembers the infinity at the time of departure from this world he definitely reaches God.

The secret of Gita is contained in focusing our mind on the supreme, in being devoted to him, making him our goal.

"Karmany evadhikaraste ma phalesu kada cana

ma karma phala hetur bhur ma te sangostvakarmani".

Seek to perform your duty but lay not claim its fruits. Be you not the producer of the fruits of karma, neither shall you lean towards inaction.

Your duty is to work, not to reap the fruits of work. Do not seek rewards, but do not love laziness either.

Todays confusions in society and man's helpless insignificance against the flood of events - inspite of all his achievements in science and mastery over matter are seen, because the Yogeswarah in him is lying neglected, uninvoked. Mere material production can, no doubt bring immediately a spectacular flood of wealth into the pockets of man, but not peace and joy into his heart. Prosperity without peace within is a calamity, gruesome and terrible.

Thus in the Upanishads of glorious Bhagavad Gita, in the science of eternal, in the scripture of yoga, in the dialogue between Srikrishna & Arjuna, the eighteenth discourse ends entitled, The yoga of liberation through renunciation. This is to renounce the false values of life in us is at once to rediscover the divine nature in each one of us which is the essential heritage of man.

The true meaning of Education

Thus we may accept according to the philosophy of Gita that true education is that which helps one to see the existence of God (ie Brahma) in the soul of an individual. Krishna-Arjun's Guru helps him to see the whole epitomized in one individual - ie God himself. Thus Krishna tries to help Arjuna to see the point that he (Arjuna) can't kill anyone's soul which resides in Brahma himself.

The ideals of Education

We may analyze the ideals of education into 6 parts such as:

1. To develop virtuous knowledge

2. To develop & effect sublimation of personality

3. To coordinate between individual & social aim.

4. To develop the inner consciousness.

5. To develop intellectual & logical ability

6. To establish the importance of duty in life.

Now we shall understand how Gita refers to the above ideal education:

1. To develop virtuous knowledge

Our students like all suffer from ignorance of virtuous knowledge. In Gita Krishna remarks Arjun's ignorance & motivates him towards performing his duty. From this position we may take up the idea that the ideal of education should be to remove ignorance & to provide virtuous knowledge.

2. To develop & effect sublimation of personality

Everyone's personality is equipped with evil & virtuous traits. In otherwords Kauravas (Asuri) & pandavas (virtuous) exist in each of us.

Krishna awakens in Arjun the virtuous powers inherent in him & motivates him towards the right path. This is what exactly a Guru should do for his disciple. Thus the ideal of education should be to develop & sublimate the personality of the student.

3. To coordinate between individual & social aim

In the battle field Arjuna is lost between his individual freedom & social responsibility. His

individual freedom was to fight or not to fight. The social responsibility warranted his participation in the battle for punishing the evil doers for establishing peace in the land.

Krishna impresses upon him to sacrifice his individual freedom & take up the Gandeev for annihilating the wicked persons & their allies.

Thus we may say that according to Gita one of the chief ideals of education should be to affect a coordination between the individual and social aspect of things.

4. To develop intellectual & logical ability

Arjuna expressed his doubt regarding the utility of battle. His doubt is the root of preaching's of Gita. Krishna employs his intellectual & logical ability for removing Arjuna's doubt.

Thus the main purpose of philosophy of Gita is to develop the intellectual & logical ability of Arjun (common man) in order to make him enable to take his own decision in the face of alternatives. This should be our ideal of education also.

5. To develop inner consciousness

Arjuna desires to keep himself away from the dreadful battle field. Krishna does not want to force him against his will. Instead he (Krishna) take recourse to logical reasonings & tries to convince Arjun about his sacred self duty (Swadharma).

Ultimately on his own, Arjuna decides to fight against his opponents. Thus Krishna, his Guru & friend succeeds in awakening the inner

consciousness. This is exactly the ideal that we should follow in the field of education.

6. To establish the importance of duty

One can be happy only by establishing a balance between one's rights & duties. Krishna tells Arjuna that nothing is greater than performance of one's duty (Swadharma-palan). It is very necessary to emphasize this viewpoint before the students in these days. If our students develops this attitude towards life, then this very earth will become a heaven.

7. The curriculum

Gita refers to 2 types of knowledge - (1) knowledge about mundane affairs (Apara Vidya) - (II) knowledge about supreme self (Para Vidya).

In the knowledge about mundane affairs we may include all types of subjects in various disciplines of art, science, engineering etc. Within the spiritual realm come the knowledge about the soul (Atma), God (Brahma) - the being (Jeeva) and the world (Jagat).

Needless to add, these days in our educational system, the spiritual realm is greatly ignored. This has resulted in the predominance of acquisition of worldly wealth of various types. The knowledge spiritualism alone can give eternal peace to man. Hence in our educational system the spiritual aspects of man's life should also be given its due place along with subject related with worldly affairs.

8. The concept of moral education according to Gita

The performance of ones duty has been principally emphasized in Gita. It was towards

the fulfillment of this ideal that Arjuna takes the decision to fight in the battle field.

Krishna has impressed upon him that ones duty should be performed without taking into consideration its outcome and attachment for the same. It is extremely difficult to think of any higher moral ideal for a man than this.

Through practicing this ideal, a person will reach the peak of his development and he will overcome all worldly attachment. This is exactly what is needed in our youth these days. So if we impress upon them to practice the above ideal we shall be giving them the noblest moral education.

In chapter 18 - Lord Krishna sums up the conclusion of previous chapters & describes the attainment of salvation by the paths of karma; in chapters 1 through 6 & in Gjana yoga section which are chapters 13 to 18. The lord explains that while doing so one must offer without reservation everything to God. The knowledge revealed gets progressively more & more confidential than in all previous chapters. Thus this chapter is entitled "Final revelations of ultimate truth".

"Understand that knowledge by which one undivided, imperishable reality is seen within all diverse living entities is in the nature of goodness".

"Sarva bhutesu - yenaikam bhavam avyayam iksate

avaibhaktam vibhaktesu tajjanam viddhi sattvikam".

Being is seen in all existence is sattvie.

Though the forms constituted by the different body-mind-intellect equipments are all different in different living creatures, the sattvic knowledge recognizes all of them as the expressions of one and the same truth – which is the essence in all of them.

Just as an electrical engineer recognizes the same electricity flowing through all the bulbs, a goldsmith recognizes the one metal gold in all ornaments and every one of us is aware of the same cotton in all shirts, so also, the intellect that sees the screen upon which the play of life and throbs of existence are projected as the changeless one is the 'Knowledge' that is sattvik. (4)

Everything in this creation has comeout of empty space. This is "why lord Krishna says.,

Na cha matsthani bhutani'

Pashya me yogam aishvaram

bhuta-brnna chabhuta

-stho mamatma bhuta bhaianah"

You should have total faith that God present everywhere. Do not run after god. Do not be feverish to see God as a form

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A STUDY ON THE CHEMOPROTECTIVE AND RADIOPROTECTIVE ACTION OF CARUM COPTICUM LINN

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Abstract

The present study reports for the first time the chemoprotective and radioprotective activites of 70% methanolic extract of Carum copticum seed, against CTX (Cyclophosphomide), as well as γ - irradiation induced chemoprotective animal models. The administration of C. Copticum seeds extract (50mg/kg b. wt and 100 mg/kg b. wt) significantly reduced the CTX and γ radiation induced damage in a dose dependent manner.

The phytochemical screening of the plant showed the presence of terpenes and polyphenols. So in the present study it can be concluded that the radio-protective and chemoprotective activity of C. copticum is due to the presence of these compounds and its antioxidant effects.

Keywords: *Cancer, Radioprotective, Chemoprotective, Carrum copticum, Cyclophosphomide, CTX, γ radiation..*

Introduction

Cancer is a disorder in which several molecular changes are involved to initiate normal cells to form cancerous cells. According to an estimate in 2000, the global incidence of new cases of cancer is about 12 million. Cancer is one of the two leading causes of death in western countries, afflicting approximately one in every five individuals. In India the cancer registry data estimated that half a million cancer cases are reported per year in the country (Asanghvi, 1994). Over the years the number of cancer patients has increased significantly.

Cancer is an imprecise term used to describe an estimated 200 different malignant tumors, marked by uncontrolled growth and spread of abnormal cells. When the control over cell division in some cells is lost, they start dividing indiscriminately to form a mass cells. This new growth of abnormal cells is called neoplasm or tumor which may be benign or malignant (Kaushal, 1999).

The three important modalities for treating cancer are: Surgery, radiation and chemotherapy. The most commonly used modalities of cancer are chemotherapy and radiotherapy. But these therapies are not devoid of disturbing side effects. Hence, the search is still on to find novel drugs that can act as radioprotectors and chemoprotectors which will serve as powerful immune as well as

antioxidant enhancing drugs. Since different types of neoplasms have their own responses to the various modalities of therapy, a histological diagnosis is imperative in planning the appropriate management of malignant disease. Because of their different strategies each of these treatment is associated with specific risks and side effects (Benham etal, 1983.

One of the new areas of current interest in cancer research is the development of less toxic anti cancer drugs. In order to obtain better tumor control, the normal cells and tissues should be protected against the radiation injury and cytotoxic effects of chemotherapeutic agents. Thus the role of chemo-protective compounds in important in clinical cancer therapy.

Unlike in the advanced countries, one of the major challenges in cancer research in the developing countries is to develop cost effective and easily available drugs for cancer therapy. So investigations into the natural products and traditional medicine to explore the possibility of developing plant drugs local resources should be given priority. Plants have always been a common medicament either in the form of traditional preparations or pure active principles in India.

Carum copticum is a herb belonging to the family Apiaceae is cultivated throughout India, Baluchistan etc. It is commonly called as Bishop's weed and in Malayalam it is called

Ajwain. It has several beneficial effects on our body and in traditional Indian medicine the plant is used for various diseases including ulcer, tumors etc.

The seeds are considered to be powerful detoxifying agents (Mukherjee et al, 1967). The seeds are bitter and hot, carminative, diuretic, galactogogue, tonic, expectorant, cure weakness of limbs, and paralysis, chest pains, improves speech and eyesight, stimulate the intestine, good for ear boils, liver, spleen vomiting, dyspepsia, kidney troubles, inflammations (Unani) (Mahaskar,1935)

The essential oil of *Carum copticum* contains not less than 40-50% of Thymol brown as Ajwain-Ka-phol (Crude thymol) which is antihelmintic (Menon et al, 1947) Ajwain oil is shown to be toxic at different dilutions to pathogenic bacteria and is shown inhibitory to various microorganisms. It is also applied to retrieve rheumatoid and neuralgic pain. The seeds are also immune enhancing.

With all these wide spectrum of medicinal properties we propose to study its chemo protective and radio-protective studies in this work.

Materials & Methods

9% of seed extract, of *Carum copticum* (collected from Amala Ayurveda Hospital) was obtained by using 70% methonal and further evaporated, dried and dissolved in distilled water.

Test animals were the male Swiss Albino Mice between 22-27 g produced from the animal breeding station of college of veterinary and animal science- Mannuthy, Thrissur. Four groups of six animals each were formed for each of the radioprotective and chemoprotective experiment. The first group was not subjected to any sort of treatment in both the experiments.

The second group in both experiments served as control and with the animals in the radioprotective experiment being exposed to radiation at a dose of 600 rad/ animal using a cobalt-60 gamma source, while in the chemoprotective experiment, the second group test animals were exposed to cyclophosphamide.

The third and fourth group in both the experiments were in addition treated with *C. copticum* seed extract at a dose of 50 mg/kg body wt. and 100mg / kg body wt. respectively. Every fifth day the haemoglobin and haematological parameters were checked. At the 20th day the animals were sacrificed and the blood tissue parameters and bone marrow cellularity were checked.

Standard chemicals of analytical reagent grade were used. Estimation of super oxide dismutase activity was carried out by the method Mc Cord Beauchamp and Fridovich, 1969. Estimation of catalase was done by the method of Aebi, 1974, Glutathione was estimated using the method of Moron et.al,1979. Estimation of

glutathione peroxidase activity was done using the method of Hafemann et.al., 1974. Estimation of tissue lipid peroxidase was carried out by the reaction described by Ohkava etal, 1969. Creatinine was estimated using the method of Broa and Siroto 1980.

Total WBC count was carried out by Haemocytometer method, differential count and haemoglobin level was estimated using cyanmet haemoglobin method, by collecting blood at fifth day interval from the caudal vein into heparinised tubes. Bone marrow cellularity at the end of 20th day was carried out by flushing the bone marrow cells from both femur, into phosphate buffer saline containing 2% bovine calf serum. The number of bone marrow cells were determined using a haemocytometer and expressed as total live cells of $(X10^6)$ femur.

For histopathological study, the tissue of intestine were excised and permanent slides were prepared according to the standard methods. The results were at the end subjected to students test for statistical analysis of the data to determine the statistical significance between two values in the control and treated group.

Result and Discussion

The Present study reports for the first time the chemoprotective and radioprotective activities of *C. copticum* seeds against Cyclophosphamide (CTX) and r- radiation induced damage. The administration of 70 % methanolic extract

(50mg/kg body weight and 100mg/kg body weight) of *C. copticum* seeds significantly increased the Total WBC count and Haemoglobin levels compared with the control group (CTX alone or radiation alone). On the 20th day the animals were sacrificed the liver, kidney, blood and bone marrow were taken. The liver kidney and blood samples were subjected to biochemical analysis which revealed a significant increase in antioxidant enzyme levels in these groups (*C. copticum* treated groups) compared to control group. The bone marrow cellularity were also checked in which it was found to be coming closer to the normal levels in extract treated groups, compared with the control group. The liver and kidney marker enzyme levels are also coming closer to the normal levels in treated groups of animals. The histopathological studies also revealed the cytoprotective activity of *C. copticum* seeds against CTX and Radiation induced toxicities.

Initial activation reaction of CTX carried out by microsomal oxidation system in liver produces 4 hydroxy CTX, a cytotoxic metabolite, which diffuses from hepatocytes into plasma and distributed throughout the body. 4-hydroxy CTX is then further converted to some other cytotoxic metabolites and acrolein and phosphoramide mustard are among them (Berger, 1993) Grochow, 1996) Phosphoramide mustard is known to cause myelosuppression. In the present study the myelosuppression caused by CTX is

effectively prevented by *C. copticum* seed extract. The Extracted groups also showed enhanced levels of bone marrow cellularity, which indicate that *C. copticum* stimulate the haemaotopoitic system.

The metabolism of CTX in the body produces highly reactive electrophiles and the decreased value of GSH in CTX treated group is probably due to electrophilic burden on the cells and also due to the formation of acrolein, which is known to deplete GSH content and DNA alkylation (Mc Diamid et al, 1991) Treatment with C. copticum reduces the electrophilic burden and thereby increases the GSH levels. The increased levels of in vivo antioxidant systems revealed that extract also act as an antioxidant in vivo to reduce the toxicity induced by CTX.

The ability of ionizing radiations to kill cancer cells through the induction of cell damage makes this an important modality in the therapeutic approach against cancer in humans. But normal human tissues are not immune to the damaging effects of ionizing radiations. The degree of cell damage induced by radiations depends on numerous factors, including the radiation dose, its scheduled administration, the stage of the cell within the cell cycle, the levels of cellular antioxidant defense system and the availability of oxygen in the tissues (Weichselbaum et al, 1997)

The interaction of ionizing radiation with biological system results in the generation of

many highly reactive short-lived reactive oxygen species (ROS) mainly due to the hydrolysis of water. These ROS attack cellular macromolecules like DNA,RNA, proteins, membranes etc, causes its dysfunction and damage (Moller and Wallin, 1998) ROS increased the lipid peroxidation which in turn can alter the integrity of membrane structure leading to inactivation of membrane bound enzymes, loss of permeability of the membrane and decrease in membrane fluidity. Whole body irradiation increased the levels of lipid peroxidation both in serum and tissue. *C.copticum* treated animals showed a very low level of lipid peroxide levels comparable to normal levels. The in vivo antioxidant enzyme levels such as SOD Catalase, GSH and GPx levels are also coming closer to the normal value in *C.copticum* treated groups. One of the most important side effects of ionizing radiation is myelos suppression. In extract treated groups of animals an increase in total count and bone marrow cellularity were also observed which indicate the protective effect of *C.copticum* on radiation induced damage.

C. copticum contain several active ingredients. Of these terpenes and polyphenols are important. Many of these compounds show excellent antioxidant properties and they are good inhibitors of lipid peroxidation. Although the exact mechanism of action of *C. coptocum* is not clear, the combined action of above components makes it a good radio as well as chemoprotector.

Conclusion

The present study reports for the first time the chemoprotective and radioprotective activities of 70 % methanolic extract of *C. copticum* seeds againstCTX as well as r-irradiation induced chemoprotective and radio protective animal models. The administration of *C. copticum* seeds extract (50mg/k b.wt. and 100mg/kg b. wt.) significantly reduced the CTX and γ radiation induced damage in a dose dependent manner. The phytochemical screening of the plant showed the presence of terpenes and polyphenols. So in the present study it can be concluded that the radioprotective and chemoprotective activity of *C. copticum* is due to the presence of these compounds and its antioxidant effects.

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Acknowledgements
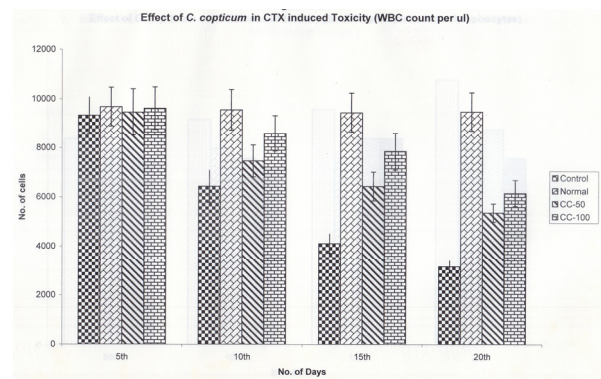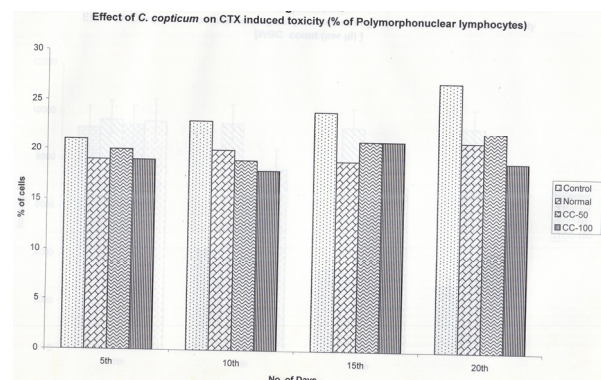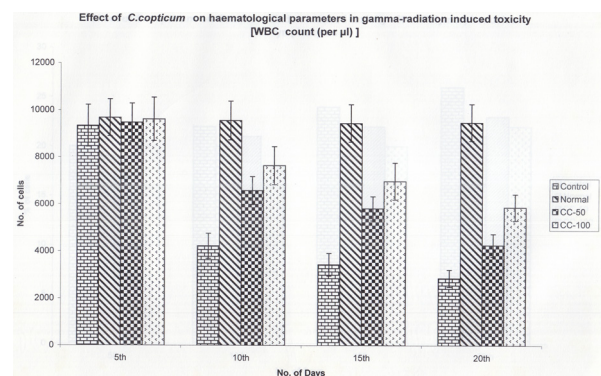
Figure : 1

Figure : 2

Figure : 3
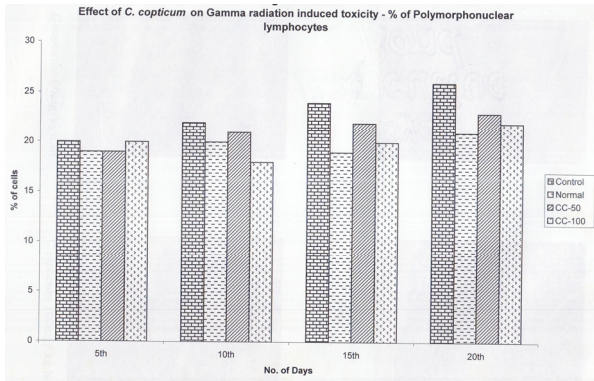
Figure : 4

Inhibitory effect of *C.copticum* on cyclophosphamide induced intestinal damage

Normal   Cyclophosphamide

C.copticum 50mg/kg b.wt   C.copticum 100mg/kg b.wt

Figure: 5

Inhibitory effect of *C.copticum* on γ-radiation induced intestinal damage

Normal   Radiation Alone

C.copticum 50mg/kg b.wt   C.copticum 100mg/kg b.wt

Figure: 6

Table 1
Effect of *C.copticm* on blood antioxidant levels in radiation treated mice

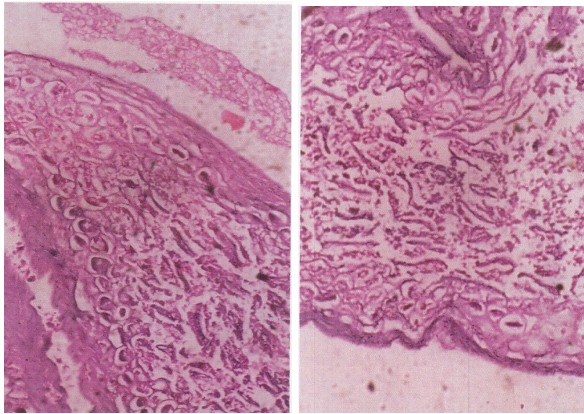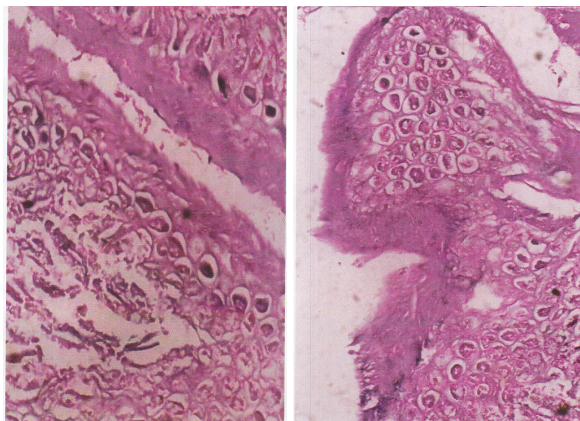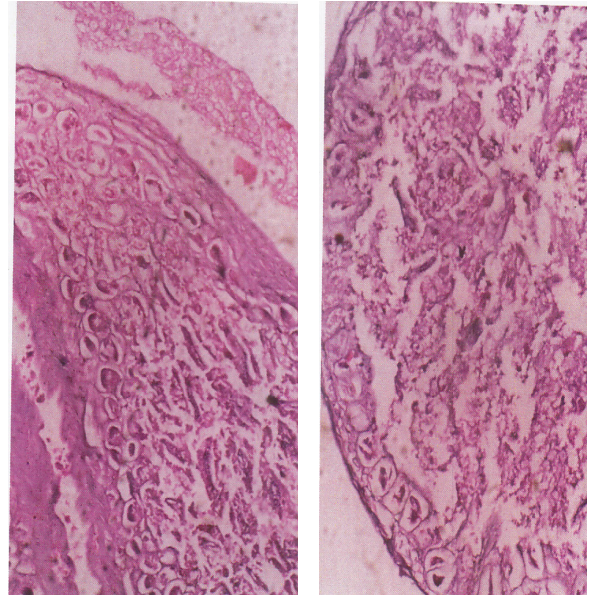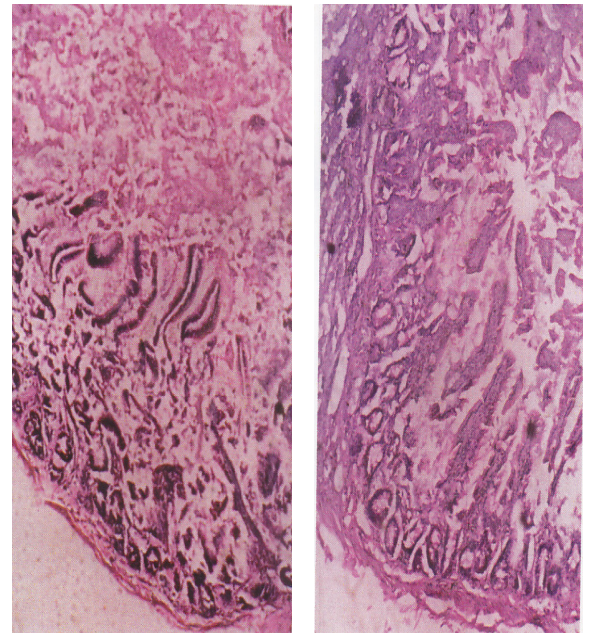|	SOD U/mg Hb	Catalase	GSH (nmol/ml)	GpX U/l of haemolysate
Control	532.2±45.26	224.76±36.2	24.18±5.28	982.58±138.51
Normal	1352.46±106.73**	330.41±75.58	32.51±8.49*	2435.21±389.29**
CC50mg/kg	1026.35±156.48*	422.82±84.36*	29.53±6.89**	1324.54±98.72**
CC 100 mg/kg	1574.37±220.46*	629.57±92.81**	34.84±5.64**	1921.68±35.56

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 2
Effect of *C.copticm* on liver antioxidant levels in radiation treated mice

	SOD U/mg protein	Cat U/mg protein	GSH (nmol/ml)	GpX nml/mg
Control	281.25±82.51	183.76±32.55	8.41±1.83	28.31±6.56
Normal	392.54±55.28**	363.25±83.2*	13.25±3.52	39.84±7.25*
CC50mg/kg	582.63±102.95**	324.51±52.86**	12.31±2.34*	33.86±7.19**
CC 100 mg/kg	853.94±95.86**	582.47±72.64**	15.48±1.98**	42.61±8.84**

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 3
Effect of *C.copticm* on kidney antioxidant levels in radiation treated mice

	SOD U/mg protein	Cat U/mg protein	GSH (nmol/mg)	GPx nmol/mg
Control	217.23±35.48	164.29±40.27	9.28±0.63	24.53±4.28
Normal	428.63±86.10*	489.61±56.20**	15.61±2.68	38.61±6.74*
CC50mg/kg	516.28±66.89**	325.47±62.5	11.31±1.19	29.82±3.64*
CC 100 mg/kg	796.82±113.64	427.34±81.35	16.82±1.28**	37.61±5.28

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 4
Effect of *C.copticm* on lipid peroxidation levels in radiation treated mice

	SERUM nmol/ml	LIVER nmol/mg	KIDNEY nmol/mg
Control	4.28±0.82	5.56±0.63	4.64±0.58
Normal	0.86±0.07	1.04±0.12*	0.97±0.14
CC50mg/kg	2.53±0.28**	3.51±0.69	3.18±0.79
CC 100 mg/kg	1.35±0.21	1.81±0.35	1.52±0.18*

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 5
Effect of *C.copticm* on lipid hemoglobin levels in radiation treated mice

	5th Day	10th Day	15th Day	20th Day
Control	15.25±1.62	13.48±0.89	12.61±0.91	7.82±0.52
Normal	17.19±0.94**	18.21±0.78**	17.63±26*	17.94±0.61**
CC50mg/kg	16.48±0.96**	14.21±1.36	13.68±1.42	10.11±0.87*
CC 100 mg/kg	17.11±0.88**	15.86±1.21	14.14±0.82**	11.43±0.76**

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 6
Effect of *C.copticm* on Alkaline phosphates and creatinine levels (serum) in radiation treated mice

	Creatinine (mg/dl)	Alkaline phosphates (U/L)
Control	0.96±0.12	92.47±8.51
Normal	0.64±0.1	38.1±5.61
CC50 mg/kg	0.89±0.16	80.09±4.15**
CC 100 mg/kg	0.72±0.15	58.4±8.26

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 7
Effect of *C.copticm* on blood antioxidant levels in Cyclophosphamide induced toxicity

	SOD U/mg Hb	ACT K/gm Hb	GSH nmol/ml	GPx nmol/ml
Control	614.2±67.4	246.48±41.68	25.28±6.41	869.41±92.52
Normal	1468.48±126.47**	329.51±20.82**	35.52±8.24*	2281.49+281.63
CC50 mg/kg	944.51±42.56**	267.14±32.89**	29.21±5.43*	1128.73±146.24
CC 100 mg/kg	1026.41±138.64*	2585.96±28.21**	30.54±6.44**	1744.34±189.56*

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 8
Effect of *C.copticm* on liver antioxidant levels in Cyclophosphamide induced toxicity

	SOD U/mg protein	CAT U/mg protein	GSH nmol/mg	GPx nmol/mg
Control	264.24±42.81	192.21±26.85	10.61±0.98	27.46±5.21
Normal	384.76±35.26**	381.54±54.82*	14.16±2.61	35.62±9.61
CC50 mg/kg	282.43±33.46**	256.79±29.41**	11.75±1.56	29.42±3.58**
CC 100 mg/kg	376.82±42.54**	324.45±48.54**	13.72±0.96**	32.81±5.27**

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 9
Effect of *C.copticm* on Kidney antioxidant levels in Cyclophosphamide induced toxicity

	SOD U/mg protein	CAT U/mg protein	GSH nmol/mg	GPx nmol/mg
Control	227.52±39.24	381.49±56.75	10.86±1.27	26.41±3.24
Normal	456.61±62.87**	184.86±20.64	14.21±0.98**	33.25±5.26
CC50 mg/kg	281.51±35.45**	225.71±27.62**	12.32±0.63**	28.44±3.27**
CC 100 mg/kg	355.63±42.18*	284.86±24.26**	13.56±0.78**	29.98±4.48

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 10
Effect of *C.copticm* on lipid peroxidation levels in Cyclophosphamide induced toxicity

	SERUM nmol/1	LIVER nmol/mg	KIDNEY nmol/mg
Control	3.42±0.57	4.21±0.76	3.28±0.61
Normal	0.98±0.15	0.99±0.12**	0.87±0.14
CC50 mg/kg	2.28±0.36*	3.58±0.94	2.61±0.54*
CC 100 mg/kg	1.36±0.19	1.59±0.34	1.89±0.24*

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 11
Effect of *C.copticm* on lipid haemoglobin levels in Cyclophosphamide induced toxicity (g/dl)

	5th	10th	15th	20th
Control	13.28±1.87	12.64±0.54	10.52±0.67	8.51±0.95
Normal	17.59±1.27**	17.68±1.29	16.56±1.28	16.98±0.86**
CC50 mg/kg	15.21±0.96**	13.52±0.68*	12.83±1.32	10.68±0.75**
CC 100 mg/kg	16.86±1.34**	15.21±1.58	14.28±1.52	12.53±1.36

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 12

Effect of *C.copticm* on Alkaline phosphatase and Creatinine levels (Serum) in Cyclophosphamide induced toxicity

	Creatinine (mg/dl)	Alkaline phosphatase (V/L)
Control	0.98±0.27	86.41±10.24
Normal	0.54±0.08**	42.81±14.28
CC50 mg/kg	0.74±0.11**	72.56±9.49**
CC 100 mg/kg	0.62±0.09**	48.52±7.61

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

Table 13

Effect of *C.copticm* on bone marrow cellularity in CTX and Radiation induced damage

Radio protection			
Control	Normal	CC50	CC 100
5.28±0.4	13.42±0.51	7.21±0.64	8.58±0.62
Chemo protection			
Control	Normal	CC50	CC 100
6.21±0.82	14.61±1.26	8.28±0.52	10.58±0.82

P<*0.05, **0.01. Values are mean ± S.D. of 6 animals in each group

A SURVEY OF GENERAL PAREMETERS OF TEMPLE PONDS IN & AROUND NORTH PARAVUR, ERNAKULAM, KERALA

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Abstract

Present study is assessment of the Physicochemical environment of temple ponds in an around North Paravur. On the basis of the present physicochemical analysis, it is revealed that the water samples of all the 10 ponds varies from one source to another. The results also suggest that all the studied parameters were well below the permissible limit suggested by WHO and ISI, except temperature. Thus the water samples in the studied temple ponds are potable and fit for domestic purposes. It also support biodiversity and it is further concluded that the overall water quality of the various temple ponds, remained within the safe limits as all of them are well protected and kept neat and clean.

Keywords: Physicochemical parameters, Water quality standards, Temple ponds

Introduction

Ground water, that is found under ground in the cracks and spaces in soil, sand and rock. Ground water is stored in space called aquifers. Surface water moves slowly through layers of soil, sand and rocks and get saturated in aquifers. Aquifers typically consist of gravel, sand stone, on fractured rocks like lime stone. These material is permeable because they have large connected spaces that allow water to flow through. The speed of ground water flow depends on the size of the space in the soil or rocks and how these spaces are connected.

Today human activities are constantly adding industrial, domestic and agricultural wastes to ground water reservoirs at an alarming rate. Ground water contamination is generally irreversible ie once it is contaminated, it is difficult to restore the original water quality of the aquifer (Gilbert J, 1994). Excessive mineralization of ground water degrades water quality producing unpleasant unobjectionable taste, odour and excessive hardness (David, K.W. 1995). Although the soil mantle through which water passes acts as an absorbent retaining a large part of colloidal and soluble ions, with its caption exchange capacity, but ground water is not completely free from the menace of chronic pollution (Regunath H.M., 1985)

A primary cause of ground water contamination are underground storage tanks containing toxic chemicals, septic systems, land fills, large industrial facilities, fertilizers, and oil spills. Leaking pits, ponds and lagoons in urban areas where waste water is 'treated' are also a

major source of ground water pollution. Water soluble substances that are dumped, spilled, spread or stored on the land surface eventually may infiltrate. Ground water may also become contaminated through the disposal of fluid waste into wells and in lime stone terrains, wastes seep through sink holes directly into aquifers. Infiltration of contaminated surface water has caused ground water contamination in several places. Irrigation tends to increase the mineral content of both surface and ground water. The degree of severity in such cases is related to hydrologic properties of the aquifer, the type and amount of wastes, disposal methods and climate. Another cause of ground water quality deterioration is excessive pumping out, which may cause the migration of more mineralized water from the surrounding strata into the well. The study of hydro- geochemical zones in a few places in India, indicate that the chemical composition of ground water is affected by use of fertilizers, and land use practice.

Ponds are common in Kerala. Ponds are widely used as source of drinking and domestic purpose, in many pasts of Kerala. Ponds helped to maintain the ecological balance as reservoirs of rainwater and collection points of ground water which feed springs and recharging ground water. It has been reported that kerala has approximately 995 tanks and ponds having more than 15000 mm3 summer storage. More than 50% of these water bodies are on the verge of extinction.

There has been a trend to reclaim these water bodies for developmental activities.

The temple ponds are generally considered as sacred and pure. But the above mentioned anthoropogenic activities exert an impact on the physicochemical characteristics of ground water in general. For the effective maintenance of water quality one needs continuous monitoring. So it has decided to assess and compare the water quality status of temple ponds to known how far it is pure and potable since we are considering them as sacred and the least polluted. Further more much of the available data on ground water quality are from urban and industrialized areas. Not only that ground water has long been considered as one of the purest forms of water available in nature and meets the overall demands of rural & semiurban people. Therefore it was decided to extend the studies to a suburban area of Ernakulam district in Kerala.

Description of study area:

North Paravur also Paravur Taluk formerly known as PARUR is a town, Municipality in Ernakulam district in Kerala State. It is an old and growing Municipality considered as the gateway to Malabar. Though considered a part of Kochi for all practical purposes, the town is 17Km away from Edappally in the city of Kochi. It is the northern suburb of Kochi city. The ancient seaport of India, Muziris is located in Pattam Village 3Km away from the town. The western part of Taluk is coastal

area with cultivations like prawn and pokkali rice. The eastern parts are fertile lands. The heavy industries of Kochi is located in Udyogamandal area of the Taluk. It is once famous for its traditional industries like coir, handlooms and agriculture. Now it is changing to a major suburb of Cochin, where people looking for jobs in the city. North Paravur is located at 8.78 N and 76 E.

It has an average elevation ie of 10m. It has in the flat delta region of the Periyar river and cut by several canals, which have resulted in the formation of many islands. The 'Kodungalloor Kayal' (backwater) and 'Varapuzha Kayal' (back water) are in this taluk.

Methodology

The present study envisages a survey of the physicochemical characteristics of temple ponds in and around N. Paravur, in Ernakulam district of Kerala state. (The water samples are collected from the temple ponds in and around the areas of N. Paravur . Sample I Sreekrishna Swami Temple Kannankulangara, Sample II Saraswathi Temple Mukambika, Sample III Devi Temple Thonnyakavu, Sample IV Mahadeva Temple Peruvaram, Sample V Thirumuppam Mahadeva Temple, Sample VI Sreenarayana Temple Moothakunnam, Sample VII Kottuvallikkad Alungal Bhagavathi Temple, Sample VIII Cherai Azhiyikkal Sreevaraha Temple, Sample IX Chettikkadu Bhuvaneswary Temple, Sample X Paruvakkal Bhagavathi Temple, Sample XI Sree

kurumba Temple Kodungallur. The temperatures of the samples will be measured using a sensitive thermometer at the spot itself.

Water samples were collected from each of the ten temple ponds during February 2013 to April 2013 at regular intervals of one month between 9.30 and 10.30 am. The samples were brought to the laboratory in precleaned polyethylene bottles for various Physicochemical analysis. All the reagents used were A.R. grade. Water quality Parameters like temperature, pH Electrical conductivity, dissolved oxygen, free CO_2, chloride and total hardness, were analysed as per the standard methods of APHA (2005) and by Vogel (2008). All necessary precautions were taken during physicochemical analysis.

Result and Discussion

The average values of various Physicochemical Parameters of the 10 pond waters are presented in table 1. Water temperature varied from 29.5 to 32.2 and has a close relation to the variation of atmospheric temperature as observed by Sunkad and Patil (2004). The electrical conductivity are very low except in the case of sample 2, (Kottuvallikkadu). Others are in a range of 0.18 micro siemens to 93.0 micro siemens. A rise in conductivity indicate pollution. Survana and Somashekar (1997) reported that EC usually decrease after rainfall following increase in inflow, culminating in dilution. In the present study, it is very low. Low ionic content in natural waters is

generally attributed to slow chemical weathering (Blakur et al , 1990). Dissolved Oxygen ranged from 4 to 14.56 mg/l lowest in sample 1 (Sreekrishna Temple) and higher in sample 5 (Sree Kurumba Temple). Free Co2 ranged from 5.99-47.5 mg/l. It is lowest in sample IV (Cherai) and highest in sample IX (Sree Kurumba Temple). The chloride content in the studied samples ranged from 0.012 to 0.106 mg/l. It is well below the permissible limit. Total hardness varied from 7-74mg/l. It is highest in sample 6 (Paruvakkal) and lowest in sample 7 (Thirumuppam). In the present study it is far below the standards prescribed by WHO and ISI.

Table 1 Comparison of different parameters of water samples

Sample	Temperature	Electrical conductance	pH	Dissolved Oxygen	Free CO$_2$	Chloride	Total Hardness
1	29.5	0.76	8.25	4.00	17.97	0.03261	54
2	31.5	0.93	8.15	5.44	11.98	0.04679	74
3	31.9	0.67	8.68	4.16	13.98	0.01701	36
4	31.2	0.42	8.93	6.24	5.99	0.01418	40
5	32.2	0.18	6.98	14.56	21.12	0.0155	7
6	31.9	0.57	7.56	14.24	14.08	0.106	11.6
7	31.6	1	7.16	13.12	15.84	0.03545	10
8	31.8	0.27	7.20	11.84	8.8	0.056	7.8
9	31.6	0.19	5.63	13.12	42.52	0.012	8
10	31.5	0.36	5.98	15.36	19.86	0.0411	10.8
11	31.7	0.81	6.31	10.08	22.88	0.055	20.4

Sample I Sreekrishna Swami Temple Kannankulangara, Sample II Saraswathi Temple Mukambika, Sample III Devi Temple Thonnyakavu, Sample IV Mahadeva Temple Peruvaram, Sample V Thirumuppam Mahadeva Temple, Sample VI Sreenarayana Temple Moothakunnam, SampleVII Kottuvallikkad Alungal Bhagavathi Temple, Sample VIII Cherai Azhiyikkal Sreevaraha Temple, Sample IX Chettikkadu Bhuvaneswary Temple, Sample X

Paruvakkal Bhagavathi Temple, Sample XI Sree kurumba Temple Kodungallur.

Result and Discussion

The average values of various Physico-chemical parameters of the samples are presented in table 1. Water temperature varies from 29.5 to 32.2C and has a close relation to the variation in atmospheric temperature as observed by Sunkad and Patil (2004). Water temperature is of enormous significance as it regulates various abiotic characteristics and biotic activities of an aquatic ecosystem which is recognized by many authors Ray J.G.et al (2008).

The electrical conductivity are comparatively low in all the samples and range from 0.18 micro siemens to 93.0 micro siemens. A rise in conductivity indicates pollution. EC in water is due to ionization of dissolved inorganic solids. EC is an excellent indicator of TDS, which is measure of salinity that affects the taste of potable water (WHO 1984). Suvarna and Somasekhar (1997) reported that EC usually decrease after rainfall following increase in inflow, culminating in dilution. Low ionic content in natural waters is generally attributed to slow chemical weathering (Blakar et al 1990).

Dissolved oxygen ranged from 4 to 14.56mg/litre, lowest in sample 1. (Sreekrishna temple) and higher in samples (Sree Kurumba Temple). The minimum limit of DO required for fresh waters as per ICMR (1975) and the ISI

(1991) standards is 5 to 6 mg/l. Only in two samples it is below 5 mg/l. In eight samples the recorded value of oxygen is above 6mg/l. The reduction in dissolved oxygen content in water bodies is due to high oxygen demanding wastes as also reported by Choudhary (1991).

Free CO_2 ranged from 5.99- 47.5 mg/l. It is lowest in sample IV (Cherai) and highest in sample IX. Typically surface waters contain less than 10mg/L of free CO_2, while ground water may have much higher concentration. The significant factor is that when O_2 concentration falls through degradation of organic wastes, the CO_2 concentration rises. The acceptable limit of CO_2 is 10mg/L for surface water and an increase in CO_2 above this level indicates increase in pollution load, Ramesh Babu et al 2012.

Total Hardness in the present study varied from 7-74 mg/L. It is highest in samples VI at lowest in sample VII. It is one of the most important properties of drinking water at is caused by metallic ions dissolved in water.

In all the studied samples total hardness varied from 7-74mg/L. It is highest in sample VI and lowest in sample VII and is well below the permissible limit of 500mg/L (WHO 1984). Chloride in excess imparts the salty taste to water and people who are not accustomed to high chlorides are subjected to laxative effect (Raviprakash & Krishanarao 1989). The WHO limit for Chloride in drinking water is 200-600mg/L. In the present investigation chloride content varied from 0.012 to 0.106 mg/L and is thus well below the permissible limit (2010).

Conclusion

On the basis of the present physicochemical analysis, it is revealed that the water samples of all the 10 ponds varies from one source to another. The results also suggest that all the studied parameters were well below the permissible limit suggested by WHO and ISI, except temperature. Thus the water samples in the studied temple ponds are potable and fit for domestic purposes. It also support biodiversity and it is further concluded that the overall water quality of the various temple ponds, remained within the safe limits as all of them are well protected and kept neat and clean.

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