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ROLE OF PYRETHROID IMPREGNATED MOSQUITO COILS/MATS IN REDUCING MAN-VECTOR CONTACT

Mortality and morbidity due to vector-borne diseases such as malaria, filariasis, dengue, Japanese encephalitis, *etc*, are the major cuases for the decrease in the Gross National Productivity (GNP) of many of the tropical countries[1,2]. Majority of the vector-borne disease control programmes rely heavily on indoor residual sprays with various insecticides belonging to organochlorine, organophosphorus, carbamates and synthetic pyrethroid groups. However, the efficacy of indoor residual spray is slowly diminishing because of exophilic behaviour and development of resistance in vectors and non acceptibility by the community. The present trend indicates that control methodology which can be used at the community and individual levels within the framework of the primary health care system, would be preferred over the conventional centrally organized control measures.

At present, the private pest control organizations and individuals are undertaking vector control with the insecticides available in the market which include organochlorine (OC), organophosphate (OP), carbamate and synthetic pyrethroids. Some of them such as Decis (an aerosol formulation of deltamethrin) are yet to be registered for public health use. At the individual level, people are using mats, coils and aerosol sprays and the market is flooded with such new products which offer promise. It is estimated that the consumption of mosquito coils/mats impregnated with allethrins in tropical and subtropical countries was over 12,500 million pieces per annum as of 1988 in which the Asian consumption was over 11,000 million pieces. South-East Asian countries consumed over 60 per cent of the world production of mosquito coils/mats[1]. Long-term consequences of such vector control practices may lead to the development of resistance in vectors. These may also be hazardous to the health of users and may lead to environmental pollution. Therefore, there is need to evaluate the efficacy and safety of products so that vector control can be ensured with reasonable safety to the people. In the present article an attempt has been made to review the available information on these aspects.

Bio-Potency Of Allethrins Impregnated Mosquito Coils/Mats Against Mosquitoes

Mosquito Coils

Knockdown and mortality in mosquitoes

Earlier OC compounds were used in mosquito coil impregnation on experimental basis. Smoke from coils impregnated with DDT at 7.4-13 per cent deterred over 90 per cent of *Anopheles gambiae* and *Mansonia uniformis*

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from entering experimental huts and exerted a strong repellent effect on *An. gambiae*, before and after feeding[3]. However, coils with 2 per cent DDT did not confer more protection than blank coils[4]. Similarly, a reduction of 30.5-37.8 per cent mosquito bites by burning coils containing 5 per cent DDT did not greatly improve sleeping comforts[5].

At present only synthetic pyrethroids belonging to the group allethrins are used in the coil/mat impregnation. Commonly used synthetic pyrethroids for this purpose are allethrin, d-allethrin, bioallethrin and esbiothrin. They are esters of chrysanthemic acid (CA), 2,2-dimethyl-3-(2,2-dimethylvinyl) cyclopropanecarboxylic acid with allethrolone and are the mixtures of 8 stereoisomers. They are more stable to heat than the natural pyrethrins. However, they are unstable to light and air and under alkaline conditions. The manner of use of mosquito coils, involves a burning tip temperature of about 800°C. Under this condition, organic matter including any active chemical agent such as allethrin added to the coil composition, would undergo pyrolysis. The resultant constituents of the smoke would thus determine both efficacy and safety of the product. However, allethrin vaporizes without decomposition when heated only upto 400°C[6-11]. Therefore, vaporization without pyrolysis seems to take place in the region of the coil following the area of combustion.

Pyrethrin based mosquito coils were first tested against *Aedes aegypti* in Peet-Grady and room size chambers[12-14]. There was a decrease in the KD_{90} (time to knockdown 90% of mosquitoes) from 105 min to 20 min with increase in the concentration of pyrethrin from 0.1 to 0.5 per cent. For the same concentrations of pyrethroids, mortality after 3 h exposure followed by 24 h holding period increased from 88 to 100 per cent. Tests against free flying mosquitoes in a 28.3m³ room showed that exposure to smoke from the burning of 8 g coil containing 0.5 per cent pyrethrin for 1 h and 0.5 per cent allethrin for 2 h resulted in complete knockdown, but there was a high recovery after 24 h[15]. Slow knockdown effect of allethrin on *Culex pipiens pallens* was also reported[16]. Laboratory studies on the comparative efficacy of the four coil formulations against *Cx. quinquefasciatus, Ae. aegypti, An. balabacensis, Armigerus subalbatus* and *M. uniformis* showed that *Cx. quinquefasciatus* was the most tolerant in terms of immediate knockdown and 24 h mortality as compared to the other species[17].

Repellency and biting inhibition

Studies have shown that mosquitoes tend to disperse from the source of smoke emanating from pyrethrin coils, indicating repellency[13,15,18,19]. Burning coils impregnated with bioallethrin (or) Pyrethrins (5 g.ai/kg coil) in a Peet-Grady chamber resulted not only in rapid knockdown of *Ae. aegypti* but also in reduced blood feeding on human forearm[20] (Table.I). Blood feeding was also reduced after exposure to smoke containing pyrethrin[21]. Mosquito coil formulations with d-allethrin and d-transallethrin as active ingredients provided more than 70 per cent reduction in indoor mosquito landing/biting rate of *Cx. quinquefasciatus* on human subjects[1].

Table I. Knockdown (a) and feeding rate (b) of *Ae. aegypti* after exposure to smoke in a Peet-Grady chamber.

Treatment	50% knockdown time (min)			Percentage feeding
	Concentration			
	(0.25%)	(0.3%)	(0.5%)	
(a) Pyrethrins	10.3	10.0	8.3	-
Allethrins	12.3	9.4	8.9	-
Bioallethrin	8.55	5.9	5.5	-
(b) None	-	-	-	85
Blank Coil	-	-	-	61
Pyrethrins (0.5%)	-	-	-	2
Bioallethrin (0.5%)	-	-	-	2

Abstracted from Chadwick, 1970

This study further revealed that coils impregnated with synthetic pyrethroids provided 8 h protection over the entire burning period. From this study it is inferred that smoke from burning coils deters the mosquitoes from entering the room from outside. Mosquitoes already present in the room are either expelled, or their host finding behaviour is affected and a proportion of them are knocked down and killed. Laboratory and field studies conducted against *Ae. aegypti* and *An. gambiae* showed that burning coils impregnated with esbiothrin (75% S-bioallethrin + 25% other allethrin isomers) resulted in good knockdown and bite inhibition[22]. Trials conducted in verandah-trap huts (17.6 m³) with pyrethrum based coils containing 0.23-0.24 per cent pyrethrins demonstrated protection from biting of *An. gambiae* through expellency effect (39-92%), reduced

blood feeding (30-81%) and increased mortality in mosquitoes (19-27%)[23-25]. Field testing of coils impregnated with synthetic pyrethroids showed 70-93 per cent reduction in the biting activity of *An. farauti, An. koliensis* and *An. punctulatus*[26]. There was >90 per cent reduction in the number of mosquitoes including the principal malaria vector *An. culicifacies* entering human dwellings and cattle sheds due to smoke from burning ropes impregnated with deltamethrin and esbiothrin[27,28]. An experiment conducted in a 25 m^3 room using guineapig as host indicated that smoke from coils containing pyrethroids reduced biting of *Ae. aegypti* and *An stephensi* by 73.5-100 per cent. Similarly, man biting activity of *Ae. aegypti* was reduced when exposed to smoke from coil containing 0.2 per cent bioallethrin[29] (Table II). However, tests conducted in the field with mosquito coils containing 0.15 per cent esbiothrin showed only 52 per cent reduction in biting rates of *An. arabiensis* and a 73 per cent reduction in the biting of *Cx. quinquefasciatus*[30].

Table. II. Percentage of mosquitoes feeding on Guineapig and man during 30 min after exposure for 5 min to somke from impregnated coils in a room (25 m^3).

Species	Insecticide in coil	Burning time (minutes)	Percentage feeding Guineapig	Man
Ae. aegypti	Pyrethrins (0.26%)	7.5	9	NA
	Allethrin (0.4%)		18	NA
	Bioallethrin (0.2%)		8	6
	No coil (control)		75	52
An. stephensi	Pyrethrins (0.24%)	2.0	12	NA
	Allethrin (0.17%)		22	NA
	Bioallethrin (0.13%)		9	NA
	S-bioallethrin (0.1%)		0	NA
	No coil (control)		83	NA

NA: Data not available.
Abstracted from Chadwick, 1975

Mosquito Mats

Mats containing pyrethroid when heated are known to knockdown and kill the mosquitoes[31-34]. Several hours of biting inhibition and knockdown of *Ae. aegypti* were reported by heating mats impregnated with allethrin, bioallethrin and S-bioallethrin[32] (Tables III and IV). Burning mats impregnated with bioallethrin resulte ' in better knockdown and mortality among exposed mosquitoes[32]. This study also indicated that there was no degradation of bioallethrin while heating the mat. A mat surface temperature between 80-115°C is needed to get better performance[34].

Table. III. Knockdown and kill of *Ae. aegypti* by vapour from laboratory prepared mats containing bioallethrin or S-bioallethrin.

Mat content	Dosage (mg)	KD_{50} (min)	KD_{95} (min)	% Kill
S-Bioallethrin	75	15.8	18.8	94
	19	22.4	25.5	70
Bioallethrin	38	20.5	27.0	45
	40	20.7	24.7	57

Abstracted from Chadwick and Lord, 1977.

Table. IV. Percentage of hungry female *Ae. aegypti* taking blood from a guineapig in 30 min following a 5 min exposure to vapour from heated mats in a room (25 m^3).

Mat content	% mosquitoes fed
S-bioallethrin (19 mg)	3
Bioallethrin (37.5 mg)	14
Bioallethrin (40 mg)	15
Allethrin (88 mg)	56

Abstracted from Chadwick and Lord, 1977.

Pyrethroids of the allethrin group such as d-allethrin and d-transallethrin due to their heat stability and volatility are considered suitable compounds for use in mosquito coils and mats[29,31,33]. These two allethrins with their respective dosages (*ie* d-allethrin 0.2 to 0.3% w/w and d-transallethrin 0.1 to 0.15% w/w) were the most commonly used active ingredients in mosquito coils and mats worldwide[1]. A commercial mat containing 88 mg allethrin was as effective as a mosquito coil containing 0.25 per cent allethrin. Mats with 40 mg bioallethrin or 19 mg S-bioallethrin will give equal or better action than allethrin[32].

Risk For Human Health And The Environment

Toxicological studies indicated that the allethrin group of compounds are metabolized in mammals rapidly and there are no reports of accumulation of these compounds in animal tissues. Since compounds belonging to the allethrin group are highly biodegradable and highly photolabile, there is no chance of accumulation of these compounds in the soil and in plants. Their

restricted use, mostly against household pests at very low concentration, results in little chance of their residues in food[33,35,36].

Allethrin is found to be toxic to aquatic organisms like fish (LC_{50}: 7.8-87 μg/lit) and stonefly (LC_{50} : 28 μg/lit), but has a low toxicity for other aquatic insect larvae and daphnia (LC_{50} : 5000->50,000 μg/lit). Honey-bees are also highly susceptible, LC_{50} values being 3.4-9.1 μg/bee. Toxicity is low for birds (LD_{50}: > 2000 mg/kg)[35] (Table V). The acute oral toxicity of allethrin group of compounds for rats and mice is moderate to low (210-4290 mg/kg)[35] (Table VI).

Table. V. Acute toxicity of allethrin for non-target organisms.

Organism	Parameter/Application	Toxicity
Fishes	96 h LC_{50}	7.8 - 80 μg/l
	48 h LC_{50}	19.0 - 87 μg/l
Arthropods	48 h LC_{50}	20.0 - 2000 μg/l
Daphnia pulex	3 h LC_{50}	5000 - >50,000 μg/l
Stonefly *(Pteronarcys californica)*	48 h LC_{50}	28 μg/l
Birds	LD_{50}	>2000 mg/kg
Honey bee	LD_{50} (contact)	3.4 μg/bee
(Apis mellifera)	LD_{50} (Oral)	4.6 - 9.1 μg/bee

Abstracted from WHO Environmental Health Criteria 87: 1989.

Table. VI. Acute oral toxicity of allethrin isomers.

Compound	Animal	LD_{50} (mg/kg body wt)
Allethrin	rat	720-2430
	mouse	480-1580
	rabbit	4290
Bioallethrin	rat	709-1041
	mouse	330-350
S-bioallethrin	rat	412-1290
	mouse	250-285
d-*cis* allethrin	mouse	210-270
Esbiothrin	rat	378-432

Abstracted from WHO Environmental Health Criteria 87: 1989.

Results of various toxicity studies on experimental animals summarized in Table VII show that these group of compounds did not produce serious effects in the experimental animals. Though allethrins have been used for many years, no toxic effects on human beings have been reported[35]. The air level of allethrins following conventional household aerosol spraying and mosquito coil burning and mat heating is not expected to exceed 0.5 mg/m^3. The results of short-term inhalation toxicity studies on experimental animals indicate that allethrins are weakly to moderately toxic with inhalation LC_{50} of > 1500 mg/m^3. Symptoms in experimental animals after short term exposure to vapour of S-bioallethrin and d-allethrin include excitation, salivation and trembling. There is no report of gene mutation, DNA damage and repair and chromosomal effects in experimental animals after exposure to allethrins[35].

Long-term studies indicated that rats when fed on diets containing 2000 mg/kg d-allethrin for over 2 years did not produce any abnormalities indicating that d-allethrin is not carcinogenic[37]. No embryotoxic and teratogenic effect of allethrin, bioallethrin and S-bioallethrin were found in rabbits, rats and mice even at relatively high doses[38-41]. No observed adverse effect levels were established for bioallethrin in a 90 days study and a 6 months study on dogs (1500 mg/kg diet and 200 mg/kg diet respectively, corresponding to 135 mg/kg and 6.1-7.2 mg/kg body weight respectively)[42]. In a 2 years study on rats, dietary administration of allethrin at 125 mg/kg, *ie* 5.9 and 6.6 mg/kg body weight per day for male and female rats did not produce any adverse effect[35]. Studies on the safety of coils showed that smoke from coils is safe for humans[11,35]. However, in actual use of mosquito coils and mats, the mild level of smoke generated is obviously inhaled by both adults and infants over the prolonged period. Therefore, effects of exposure to smoke from coils/mats on man need to be studied[43] and this warrants long-term studies on human subjects.

Conclusion

This review has clearly shown that the mosquito coils and mats could play a significant role in reducing man-vector contact. The high levels of knockdown and mortality in mosquitoes exposed to low doses of the so-called low toxicity insecticides like allethrins compare to high toxic OC, OP and carbamates implies that these group of compounds are effective for use at the community level without any organized vector control to reduce man-vector contact. The resultant low disease transmission can thus reduce the use of more toxic

Table. VII. Acute toxicity of allethrins on experimental animals.

Compound	Animal	Mode of testing	Dose	Result
Allethrin	Wistar rats ddY mice	Applied to shaved skin	2 - 5g/kg body wt	None died 8/16 died
Esbiothrin	New Zealand white rabbit	Applied to shaved skin	2 g/kg body wt	No death
d-allethrin	Rats	Exposed to mist for 2 h	260 mg/m³	Minimum toxicity
	Mice	Exposed to mist for 2 h	260 mg/m³	Minimum toxicity
S-bioallethrin	Rats	Exposed to mist for 3 h	24 mg/m³	Minimum toxicity
	Mice	Exposed to mist for 3 h	91 mg/m³	Minimum toxicity
Bioallethrin	Wistar rats	Exposed to atmospheric level (24 h)	500/1000 mg/m³	No adverse effects
Esbiothrin	Wistar rats	Exposed to respirable droplets (4 h)	LC_{50}:2630 mg/m³	No adverse effects
S-bioallethrin	Sprague Dawley rats/ ICR mice	Exposed to vapour from mosquito coil	8 h/day for 3 days	Extremely low acute inhalation toxicity

Abstracted from WHO Environmental Health Criteria 87: 1989.

insecticides to control the mosquito vectors and gives hope for developing self-help programmes in areas where people can afford to use them. However, lack of informations of the long-term effects of allethrins on human beings especially infants warrants more toxicological studies.

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This write-up has been contributed by Dr. D. Dominic Amalraj, Research Officer, Dr. P.K. Das, Dy. Director (Sr. Grade) and Dr. Vijai Dhanda, Director, Vector Control Research Centre, Pondicherry.

ABSTRACTS

Some Research Projects Completed Recently

Prevalence of Hepatitis C virus in acute and chronic liver diseases, blood donors and recipients

The study was conducted to determine the prevalence of antibodies to hepatitis C virus (HCV) in patients of acute and chronic liver diseases, blood donors and recipients of multiple blood transfusions using second generation anti- HCV ELISA. Only individuals who were serologically negative for hepatitis B virus (HBV) and hepatitis A virus (HAV) infection were studied. These included 100 patients of acute viral hepatitis (AVH), 12 of subacute hepatic failure (SAHF), 43 of acute hepatic failure (AHF), 70 of cirrhosis of the liver, 11 with chronic active hepatitis (CAH), 10 with hepatocellular carcinoma (HCC), 550 blood donors and 63 recipietns of multiple transfusions.

In 35 of the 100 AVH patients, the disease was due to sporadic NANB infection. Of these, three were positive for anti-HCV. Among 48 patients of AVH whose blood samples were taken only in the acute phase, 20 had NANB infection, but none was found to be positive for anti-HCV. In 52 patients tested serially upto 12 weeks, 15 were found to have NANB infection and three of these were positive for anti-HCV. Five of the 12 patients of SAHF and 23 of the 43 patients of AHF were found to have NANB infection but none of these were found to be anti-HCV positive. Nineteen of the 70 patients of cirrhosis of liver had NANB infection and 2 of these 19 were found to be positive for anti-HCV.

Six of the 11 patients of CAH and four of the 10 patients of HCC had NANB infection and of these, 2 patients each were found to be positive for anti-HCV.

Of the 550 blood donors, 494 did not show evidence of HAV and HBV and of these only 11 were positive for anti-HCVV. Of the 63 recipients of multiple blood transfusions, 46 did not show HAV and HBV infection. Of these, 24 were found to be positive for anti-HCV.

It is thus concluded that in patients of acute liver diseases, screening of HCV antibody should be done serially upto 12 weeks. Patients with cryptogenic chronic liver disease and recipients of multiple blood transfusions should be evaluated for HCV infection.

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1. Narang, A., Kar P. and Chakravarty, A. HCV infection in a north Indian hospital. *Indian J Gastroenterol 12:* 150, 1993.

Role of alpha and beta adrenergic agonists in stimulation of hypertrophy in cultured neonatal rat heart myocytes

The study was carried out to assess the role of norepinephrine and isoproterenol in the development of hypertrophy in cultured cardiac myocytes of the rat and to find out whether alpha and beta adrenergic antagonists can modulate or block this hypertrophic response. The action of norepinephrine and isoproterenol on the synthesis of contractile and noncontractile proteins in the cultured cardiac myocytes was also studied. Primary culture preparations of neonatal rat cardiac myocytes obtained from one to three day old rats were utilized for the study.

Norepinephrine (NE), an alpha and beta adrenoceptor agonists had a very potent effect in producing hypertrophy of cardiac myocytes at a concentration of 2μM, whereas isoproterenol (a beta adrenoceptor agonist) did not produce any such effect as measured by the total protein content. The protein content of the cells increased markedly with NE (199 pg/cell/day) whereas the increase was least with isoproterenol (35 pg/cell/day) as compared to control cultures (33 pg/cell/day). The increase in protein content with NE was both time and dose dependent with the maximum response occuring on day 11 with 2μM drug concentration.

Norepinephrine had a strong stimulatory effect on the synthesis of contractile proteins actin and myosin heavy chain in cultured cardiac myocytes while isoproterenol stimulated mainly the synthesis of noncontractile proteins.

The differential response with adrenoceptor agonists and studies with adrenoceptor antagonists (phentolamine and propranolol) indicated that the hypertrophic effect of NE was mediated by its stimulatory effect on alpha adrenergic receptors; phentolamine, an alpha adrenoceptor antagonist completely blocked the hypertrophic response of NE.

It is thus concluded that NE has a potent hypertrophic effect on the cultured cardiac myocytes and this is predominantly mediated by its stimulatory effect on alpha adrenoceptors. The present study will provide an excellent model to study the biological effects of various drugs and pharmacological preparations on living heart muscle cells.

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ICMR NEWS

The following meetings of various technical groups/ committees of the Council were held:

Meetings of the Project Review Committees (PRCs) held at New Delhi

PRC for Research in Non-Communicable Diseases	September 21, 1994
PRC on Leprosy	September 26, 1994
PRC on Tuberculosis	September 26, 1994
PRC on Viral Diseases	September 27, 1994
PRC on Microbial Diseases	September 27, 1994
PRC on Malaria, Filariasis and Kala-azar	September 28, 1994
PRC on Diarrhoeal Diseases	September 28, 1994
PRC on Biochemistry and Cellular & Molecular Biology	October 7, 1994

Annual Review and Expert Group meetings held at New Delhi:

Annual Review meeting on Traditional Remedies for Diabetes Mellitus	September 27, 1994
Annual Review meeting on Traditional Remedies for Bronchial Asthma	September 27, 1994
Expert Group on Total Diet Survey	October 4-5, 1994

Participation of ICMR Scientists in Scientific Events:

Dr. B.K. Sircar, Dy. Director, and Dr. S.K. Niyogi, Sr. Research Officer, National Institute of Cholera and Enteric Diseases (NICED), Calcutta, visited the International Centre for Diarrhoeal Diseases Research (ICDDR) at Dhaka for developing a collaborative research protocol on diarrhoeal diseases (September 15-30, 1994).

Dr. Uma Ganguly, Dy. Director, Dr. P.G. Sengupta and Dr. D. Sasmal, Asstt. Directors and Dr. M.K. Saha, Research Officer, NICED, Calcutta, participated in the VII Asian Conference on Diarrhoeal Diseases at Dhaka (September 17-19, 1994).

Dr. V. Kumaraswami, Asstt. Director, Tuberculosis Research Centre (TRC), Madras, participated in the Filariasis Field Trial Task Force of the WHO Special Programme for Research and Training in Tropical Diseases at Geneva (September 17-25, 1994).

Dr. Roshan, B. Colah, Sr. Research Officer, Institute of Immunohaematology (IIH), Bombay, visited Paris for discussion and planning of future work on the project Molecular Genetics of Major Haemoglobinopathies in India under the Indo-French Collaborative Programme (September 17 - October 5, 1994).

Dr. Dipika Mohanty, Director, IIH, Bombay, participated in a symposium on New Trends in Therapy for Haemoglobinopathies at Paris (September 19-22, 1994).

Dr. C.N. Paramasivan, Dy. Director (Sr. Grade), TRC, Madras, participated in the meeting on AIDS, Tuberculosis and other Mycobacterial Diseases, followed by the XIV IWGMT conference on the Genus Mycobacterium at Lisbon (September 20-21 and 22-24, 1994 respectively).

Dr. P. Yashodra, Research Officer, National Institute of Nutrition, Hyderabad, participated in the XIV World Congress of Gynaecology and Obstetrics at Montreal (September 24-30, 1994).

Dr. R. Prabhakar, Director, TRC, Madras, participated in a meeting to discuss the protocol of the WHO multicentric study of early bactericidal activity of antituberculous drugs in pulmonary tuberculosis at London (September 26-30, 1994).

Dr. R.S. Yadav, Sr. Research Officer, Malaria Research Centre, Delhi, participated in the VII International Congress of Parasitology at Izmir, Turkey (October 10-14, 1994)

ICMR AIDED SYMPOSIA/SEMINARS/WORKSHOPS/COURSES/CONFERENCES

Symposium/Seminar/Workshop/ Course/Conference	Date & Place	Contact Address
National Symposium-cum-Workshop on Oral Rehydration Therapy —Concepts, Clarifications and Commitments.	October 14-16, 1994; (at Bombay)	Dr. Meenakshi N. Mehta, Convenor, 9, Shaivali, C/3, BMC Colony, KAG Khan Road, Worli, Bombay.
XXII Annual Conference of the Indian Association of Preventive and Social Medicine.	October 17-18, 1994; (at Patiala)	Professor Surinder Singh, Organising Secretary of the Conference, Department of Socioal and Preventive Medicine, Government Medical Collge, Patiala.
Symposium on Advances in Neurotransmitter Receptors : Cellular and Molecular Mechanisms of Action of Chemicals	October 25-26, 1994; (at Lucknow)	Dr. P.K. Seth, Convenor of Symposium, Industrial Toxicology Research Centre, Lucknow.
Workshop on Growth Disorders of the Pigment Cell.	October 28-29, 1994; (at New Delhi)	Dr. Bhanu Iyengar, Director, Institute of Pathology, New Delhi.

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Symposium/Seminar/Workshop/ Course/Conference	Date & Place	Contact Address
MICON-International'94.	November 9-12, 1994; (at Mysore)	Dr. R. Shankaran, Chairperson of the Organising Committee, MICON-International'94. Defence Food Research Laboratory, Siddhartha Nagar, Mysore.
International Symposium on Gerontology and VII Conference of the Association of Gerontology (India).	November 14-16, 1994; (at New Delhi)	Dr. A.B. Dey, Organising Secretary of the Symposium, Room No.3096, Department of Medicine, All India Institute of Medical Sciences, New Delhi.
Brain Storming Session on Molecular Immunology.	December 9-10, 1994; (at Bhubaneswar)	Dr. B. Ravindran, Asstt. Director, Regional Medical Research Centre, Bhubaneswar.
Seminar on Genetic Epidemiology and XX Annual Conference of Indian Society of Human Genetics.	December 11-13, 1994; (at Hyderabad)	Dr. J.S. Murty, Professor and Head, Department of Genetics, Osmania University, Hyderabad.
III International Conference on DNA Fingerprinting.	December 13-16, 1994; (at Hyderabad)	Dr. Lalji Singh, Organising Secretary of the Conference, Centre for Cellular and Molecular Biology, Hyderbad.
XIX Conference of the Electron Microscope Society of India.	December 14-16, 1994; (at New Delhi)	Dr. S.K. Sharma, General Secretary, Electron Microscope Society of India, c/o National Physical Laboratory, New Delhi.
International Symposium on Atherosclerosis, Thrombosis and Transfusion Medicine.	December 15-20, 1994; (at Bombay)	Dr. D. Mohanty,Director, Institute of Immunohaematology, Parel, Bombay.
National Workshop on Biostatistics and Biometry.	December 16-18, 1994; (at Varanasi)	Dr. Manju Pandey, Convenor of Workshop, Department of Zoology, Banaras Hindu University, Varanasi.
Guha Research Conference 1994.	December 28-31, 1994; (at Rameswaram)	Dr. D. Balasubramaniam, Convenor of the Conference, Centre for Cellular and Molecular Biology, Hyderabad.
Symposium on Chromosomal and Molecular Basis of Genetic Analysis.	January 13-15, 1995; (at Varanasi)	Dr. R. Raman, Convenor, Chromosomal Symposium, Department of Zoology, Banaras Hindu University, Varanasi.
National Symposium on Modern Trends in Animal Health and Production Research and its Impact on Rural Development.	January 24-25, 1995; (at Hisar)	Dr. S.K. Mahipal, Organising Secretary of the Symposium, Department of Veterinary Public Health and Epidemiology, C.C.S. Haryana Agricultural University, Hisar.
IV National Workshop on Mycoplasmology.	January, 1995; (at Madras)	Dr. Usha Anand Rao, Organising Secretary of the Workshop, Department of Microbiology, Dr. A.L.M. Postgraduate Institute of Basic Medical Sciences, Madras.

COUNCIL'S TRAINING PROGRAMMES

Nutrition

At the National Institute of Nutrition, Hyderabad:

... Annual Training Course in Nutrition (December 1, 1994-February 28, 1995).

Occupational Health

At the National Institute of Occupational Health, Ahmedabad:

... Training Course on Air Pollution Monitoring and Risk Assessment (October 19-25, 1994).

... Training Course in Pesticide Residue Analysis (December 5-9, 1994).

Laboratory Animal Technology

At the Laboratory Animal Information Service Centre, National Institute of Nutrition, Hyderabad:

... Training Course for Laboratory Animal Supervisors (September 12- December10, 1994).

ICMR Publications

	Price Rs.
Growth & Physical Development of Indian Infants and Children (1972, Reprinted 1989)	10.00
Studies on Weaning & Supplementary Foods (1974, Reprinted 1986).	6.00
Studies on Pre-School Children (1974, Reprinted 1986).	6.00
A Manual of Nutrition (Second Edition 1974, Reprinted 1992).	4.50
Low Cost Nutritious Supplements (Second Edition 1975, Reprinted 1994).	4.00
Menus for Low Cost Balanced Diets and School Lunch Programmes Suitable for South India (Third Edition 1977, Reprinted 1991).	4.50
Menus for Low Cost Balanced Diets and School Lunch Programmes Suitable for North India (Second Edition 1977, Reprinted 1994).	4.50
Some Common Indian Recipes and their Nutritive Value (Fourth Edition 1977, Reprinted 1991) by Swaran Pasricha & L.M. Rebello.	10.00
Nutrition for Mother & Child (Third Edition 1978, Reprinted 1991) by P.S. Venkatachalam & L.M. Rebello.	9.00
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* Depressive Disease (1986) by A. Venkoba Rao.	58.00
** Medicinal Plants of India Vol.2 (1987).	136.00
**The Anophelines of India (Revised Edition 1984) by T. Ramachandra Rao.	150.00

Unpriced Publications

(for limited distribution)

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Collaborative Study on Blindness, 1971-74 (1987)

Endomyocardial Fibrosis in India (1983)

Epidemiological Survey of Endemic Goitre and Endemic Cretinism (1989)

Illegal Abortion in Rural Areas (1989)

Collaborative Study on Phenomenology and Natural History of Acute Psychosis (1989)

Melatonin (1991) by S. Parvathi Devi

Field Supplementation Trial in Pregnant Women with 60mg, 120mg and 180mg of iron with 500ug of Folic Acid (1992)

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