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LACTATION — CURRENT CONCEPTS AND CONCERNS

The importance of breast feeding in infant nutrition, health and survival has long been recognized. The recognition that lactation may have profound effects on maternal nutrition and fertility is of more recent origin. It is now well established that over millennia, breast feeding has been the major determinant of infant growth, health and survival and the contraceptive effect of lactation has been the principal regulator of human fertility.

The first half of the present century witnessed a profound decline in breast feeding in industrialized countries, so that in the sixties most women in these countries were not breast feeding their infants; bottle feeding had become the convenient norm and the symbol of sophistication. Luckily the tradition of universal prolonged lactation remained essentially unaltered during this period in developing countries like India.

Research studies carried out in the sixties and seventies in developed and developing countries brought out unique advantages of breast feeding and showed that irrespective of the socio-economic status and standards of environmental hygiene, breast feeding is the best for the mother infant dyad. There was a global movement to promote breast feeding in areas where it had declined and protect it in areas where it is still widely prevalent.

In India the traditional practice of near universal breast feeding continues both in urban and in rural areas; however, some recent data indicate that there has been a reduction in the duration for which the infant is exclusively breast fed. Early introduction of supplements to infants could result in increased morbidity due to infections and consequent growth faltering, as well as faster return of fertility in the mother.

The present decade is witnessing marked changes in the life-style, nutritional status, morbidity profile, fertility pattern and contraceptives use in Indian women; some of these may directly or indirectly have an impact on breast feeding practices. There is increasing employment of women outside the home and consequent reduction in "demand feeding" and earlier introduction of supplements to the infant. Health education, appropriate contraceptive care and food supplements to lactating women could result in improvement in maternal nutritional status, more rapid return of fertility and faster advent of the next pregnancy if contraceptive care is not provided. With the advent of the HIV epidemic, conflicting advice from different agencies regarding breast feeding in seropositive women has raised some doubts in the minds of both professionals and the general public regarding the continued advocacy for breast feeding in all segments of population.

Currently efforts are underway to provide clear guidelines to medical and paramedical personnel on these issues and inform and empower women so that they

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understand the unique advantages of breast feeding and therefore strive to achieve near universal practice of breast feeding in spite of the pressures due to the rapidly changing socio-economic milieu and life-styles. The present write - up briefly reviews the current concepts and concerns on lactation - nutrition - infection - fertility interactions and the interventions required to sustain and support the beneficial trends and remedial steps to minimize if not eliminate adverse interactions.

Changing Trends in Lactation

Studies carried out in the fifties and sixties have shown that both in urban and rural areas in India breast feeding was nearly universal; there were no marked differences between states or between different income groups. Two major areas of concern were that colostrum feeding was uncommon, and in rural areas there was a delay in introduction of supplements. Efforts were therefore directed to inform women about the need to change these practices. In the seventies the debate among professionals regarding the energy needs for growth in infancy, led to conflicting advice regarding the appropriate time for introduction of supplements to breast fed infants, reaching the women especially the urban middle income group . Studies carried out in both the developed and developing countries have now clearly shown that breast milk alone is sufficient to meet all the nutrient, water and electrolyte needs of infants upto 6 months of age irrespective of maternal nutritional status and climatic conditions.

Data from the National Family Health Survey[1] indicate that breast feeding is nearly universal with over 98 per cent of infants being breast fed. There were no urban rural or interstate differences regarding initiation of lactation. This trend should be protected by emphasising the unique benefits conferred by breast feeding to infants belonging to all segments of the population.

Contrary to current recommendation that infants may be exclusively breast fed upto 6 months and that there is no need to introduce supplements and provide water earlier, only 50 per cent of infants were exclusively breast fed even in the 0-3 months age group; 22 per cent of infants received water and 23 per cent milk or other fluids. In urban areas only one third of infants were exclusively breast fed in the 0-3 months age group; in rural areas the figure was 55.4 per cent. There were substantial interstate differences also; in Punjab only 3.3 per cent were exclusively breast fed at 0-3 months age, while 70.5 per cent were exclusively breast fed in Andhra Pradesh. Too early introduction of supplements is likely to result in increased morbidity due to infections and hence should be discouraged.

It is essential that supplements preferably semisolids are introduced to breast fed infants at 6 months of age so that the nutrient requirement for growth is met; this message is being given as a part of health education in all maternal and child health (MCH) programmes. In spite of this, nearly a third of infants were not receiving additional nutrients either as semisolids or as other liquids even when they were 6-9 months of age. Delay in introduction of supplements was reported more often (nearly 30%) in rural than in urban (20%) areas. There were substantial differences between states; in Rajasthan only 9 per cent of those in the 6-9 months age group received semisolid supplements while nearly 70 per cent in Kerala were given semisolid supplements. In all major states except West Bengal, Kerala and Tamil Nadu, more than 50 per cent of infants in the 6-9 months age did not receive semisolid supplements. Delay in introduction of supplements will result in growth retardation and hence the need for timely introduction of supplements should be stressed as a part of MCH care especially in rural areas in states where delay in introduction of supplements is reported.

It is, however, noteworthy that the practice of prolonged breast feeding is still widely prevalent, 88 per cent of children in the age group 12-15 months and 67 per cent of children in the 20-23 months are breast fed. There were marked interstate variations in breast feeding at 20-23 months with West Bengal (84%) and Tamil Nadu (36%) at two ends of the spectrum.

The near universal initiation of breast feeding and the long duration of lactation need to be protected and promoted; efforts to reverse the tendency to introduce supplements too early in infancy have to be vigorously continued to ensure that infants do not unnecessarily get exposed to the risk of infections.

Lactation and Maternal Nutrition

Diet surveys indicate that most lactating women from the poorer segments of population subsist on diets which provide 1,200-1,800 Kcal/day; there is no increase in dietary intake during lactation. Successful prolonged breast feeding for 18-24 months is the traditional practice among the poorer segments of the Indian population. The estimated calorie expenditure in milk secretion varies

between 400-700 Kcal/day. The net energy thus available for a moderately active lactating mother is only 800-1100 Kcal/day[2]. Under normal circumstances such a large energy deficit is likely to result in weight loss of about 1.5-2.0 kg/ month.

In spite of continued low dietary intake, lactating women lose only about 1-2 kg of weight during the first year of lactation. With waning lactation, these women tend to regain their body weight over the next year or two, provided they do not become pregnant during this period[2]. Obviously adaptive changes have been evolved over millennia to ensure that lactation does not result in deterioration of maternal nutritional status. It would appear that because of these adaptive changes , the habitual dietary intake is just sufficient to maintain body weight in non-lactating women; and to prevent marked weight loss in spite of added expenditure of about 500 Kcal/day during the first year of lactation. It is also sufficient to cause a weight gain during the later months of lactation when energy loss in milk production decreases. But with the cessation of lactation it is again no more than adequate for maintenance of body weight.

An important concept regarding energy utilisation is that only a portion (maximum of 30-40%) of the total energy is converted into ATP or similar high energy compounds and is available for physical work or anabolic processes. It has been suggested that efficiency of utilisation might be higher when dietary intakes are lower. It is also possible that efficiency of energy utilisation may be modified by physiological changes known to occur during lactation . Ample data exist to indicate that plasma prolactin levels are higher and remain at the elevated level throughout the period of lactation in undernourished women. It is possible that elevated prolactin levels may have an anabolic role and result in more efficient utilisation of available nutrients by the mother. Obviously some ill understood but sensitive adaptive changes occur in lactating women on fixed energy intakes, so that the energy balance is maintained in spite of marked variations in energy expenditure.

Factors Associated with Deterioration of Maternal Nutritional Status

Dual stress of pregnancy and lactation

Among the traditional low income group of women,prolonged lactation for 20-30 months is common; contraceptive use is not widespread in these women. Under these circumstances about a third of all pregnancies occur in lactating women. Early advent of the next pregnancy is more common in working women and in those who introduce supplements to breast fed infants by the third or fourth month of lactation. A substantial number of these women continue to breast feed their infants during pregnancy and face the concurrent dual stress of pregnancy and lactation. Diet surveys undertaken among women who had conceived during lactation have shown that their food intake is essentially similar to that of non-pregnant women. Women who continued lactating during pregnancy had lower body weights, delivered infants of lower birth weight[3,4]; the elder sibling often showing growth retardation . These studies have demonstrated that a short interpregnancy interval and conception during lactation have an adverse effect on maternal and infant nutrition, birth weight and infant survival. Ensuring adequate contraceptive care at the appropriate time to lactating women might therefore constitute an important non-nutritional intervention for reducing the magnitude of maternal and infant undernutrition among the poorer segments of the population in India .

Reduction in dietary intake

Studies from Gambia[5] have demonstrated that a further fall in dietary intake below the habitual level — especially when coupled with increase in physical activity as in the preharvest season — resulted in deterioration in maternal nutritional status and lactational performance . In India a situation akin to this might be present in drought prone areas in the preharvest season or in women who are participating in food for work programmes in periods of drought. These situations and at risk women can readily be identified by the local *anganwadi* worker or the auxillary nurse midwife (ANM). These identified "at risk" women should be given adequate food supplements from the exiting food supplementation programmes.

Women working outside home

Women's participation in economically productive activities outside the home is not a new phenomenon. Over the last few decades, socio-economic pressures,increasing urbanization and alterations in agricultural activities have resulted in urban and rural women seeking employment outside the home in nontraditional activities. Some recent studies[4,5] have shown that the dual stress of work in and outside the home has had an adverse effect on maternal nutritional status, reproductive performance, lactation and

infant health. It is, however, possible that employment outside the home might benefit working women and her family by increasing their purchasing power. Women from poorer segments of the population have to continue to work outside the home in order to ensure that there is no further deterioration in the purchasing power of the family. However, imaginative intervention programmes if effectively implemented might go a long way in reducing the physical work done at home and at work and help in improvement of maternal nutritional status. Non-nutritional strategies for preventing deterioration in the nutritional status of lactating women include facilities to reduce physical activity and energy output such as provision of biogas plants and water in the vicinity of the house.

Effect of Food Supplementation during Lactation

Lactating women had been considered a nutritionally vulnerable group because of the obvious nutrient loss in milk production; therefore they have been one of the target groups for all food supplementation programmes in India. Available data suggest that there is no substantial improvement in maternal nutritional status even in carefully supervised food supplementation studies in which there was substantial increase in maternal dietary intake[5]. Food supplementation did not result in any increase in quantity of milk secreted or improvement in quality of milk produced[4,5]. It has been suggested that the additional food intake might have been utilized for reversal of adaptive changes and hence there is no improvement in maternal body weight. Weight gain is one of the parameters widely used for evaluation of the food supplementation programmes. Data from Gambia[5] and elsewhere suggest that at least in lactating women, weight gain may not follow improvement in dietary intakes and so should not be used as a parameter to evaluate the success of food supplementation[4,6].

Studies from Gambia[5] have shown that food supplementation and improvement in maternal nutritional status results in faster return of fertility in lactating women . Studies in India have demonstrated that return of fertility is more rapid in lactating women with higher body weight[4,6]. These findings emphasizes the need for providing concurrent contraceptive care as a part of the programmes aimed to improve maternal nutritional status to ensure that early advent of the next pregnancy does not undo the benefits of the food supplementation.

Impact of ongoing food supplementation programmes

Many developing countries including India have initiated massive food supplementation programmes aimed at improvement of maternal and child nutritional status among poorer segments of the population. Very few of these programmes have been formally evaluated. However, there is an impression among professionals that by and large these programmes have not produced any significant improvement in maternal and child nutritional status. This might be due to the fact that administrative bottlenecks and logistic problems come in the way of food reaching the target women. Even if this was achieved, food sharing and food substitution are so common that the net increase in dietary intake may be no more than 100-150 k cal/day. There is also a growing awareness that unless coupled with health care, increasing food intake alone might not result in improved nutritional and health status of the individual. The Integrated Child Development Scheme attempts to achieve an integration of food supplementation, health care and health education.

Many developing countries including India are facing a resource crunch and therefore there might be a need for better targeting of the existing programmes. Efforts may have to be directed towards identifying individuals who need the supplements most (such as women who are pregnant and lactating, those in whom fall in dietary intake or increase in physical activity is occurring) and ensure that they receive adequate food supplements through these food supplementation programmes .

Effect of Maternal Nutrition on Lactation

Duration of lactation

Studies undertaken during the fifties in India showed that undernourished rural women successfully initiate lactation and continue to breast feed their offsprings for periods up to 24 months. Several global studies and studies from India have confirmed these observations. These data suggest that maternal undernutrition does not have any adverse effect either on initiation of lactation or duration of lactation[4]. Prolonged successful lactation appears to be nature's protective evolutionary step to look after the nutritional needs of the vulnerable young infant in communities where poverty and undernutrition are common.

Volume of breast milk

Studies conducted at the National Institute of Nutrition (NIN), Hyderabad, during the early sixties had shown that undernourished Indian women secrete 500-800 ml milk/ day. More recent studies using electronic balances for measurement of milk intake of infants have confirmed these findings[4]. Report from the developed countries indicate that milk intake of infants in these countries range from 600-1,000 ml/day but milk intake of infants born to undernourished women was lower. The data suggest that quantity of milk produced by undernourished women from developing countries is less than that of well nourished women from developed countries[7].

In recent years the concept that the infant modulates maternal milk yield has gained wide acceptance. Infants of undernourished women weigh less at birth and during infancy compared to infants born to well nourished women. The nutrient needs for these smaller infants are likely to be lower and this may at least be one of the reasons for the lower volume of milk ingested by these infants. Data from some of the WHO collaborative studies (unpublished data) have shown that when infants of similar birth weight and body weight were investigated, there were no significant differences in volumes of milk produced between undernourished and well nourished mothers, supporting the hypothesis that infant size is one of the determinants of the volume of breast milk produced.

Composition of breast milk

Efforts to investigate the effect, if any, of maternal nutritional status on composition of breast milk began in the fifties. These studies showed that milk secreted by undernourished women had a somewhat lower fat content, protein levels were similar to those reported in well nourished women. In spite of these differences in composition, there were no significant differences in the calorie content of milk secreted by undernourished and well nourished women because in the former group the lactose content was higher[4]. Subsequent studies in India and global studies have confirmed these observations[4,7]. Most of the available data suggest that food supplementation to undernourished women does not have any significant impact on macro-nutrient composition of breast milk[4]. Available data suggest that the differences in the macro-nutrient composition of breast milk in undernourished women do not have any impact on infant growth and development. It is possible that nature has ensured that the calorie content of breast milk remains unaltered by maternal undernutrition, so that infant growth is safeguarded. It is also possible that infants can adapt and thrive even when the composition of their diet varies substantially. In this context it is worth recalling that infant food formulae in the forties and fifties had low fat, high protein and high sugar content. Infants fed on these grew well and have reached middle age without showing any abnormalities attributable to their diet during infancy.

Studies on mineral and trace element content of breast milk have shown that there are no significant differences between milk secreted by well nourished and undernourished mothers[4]. However, levels of almost all vitamins, appear to be lower in milk secreted by undernourished women[4]. Majority of undernourished women from the low income group in India show biochemical evidence of vitamin deficiencies. It is therefore hardly surprising to note that their breast milk contains lower concentration of these vitamins. The nutritional consequences of this on breast fed infants are still not clearly understood and need to be investigated.Supplementation of vitamins to the lactating women led to improvement in vitamin content of milk.

Infant Nutrition and Growth

It is now well accepted that breast feeding is the best form of infant feeding for all segments of the population in all countries. Breast milk provides appropriate nutrients in adequate quantities to ensure optimal growth in early infancy. Presence of anti-infective factors in breast milk and the fact that breast milk reaches the infant without any contamination ensures minimal morbidity due to infection in breast fed infants. Available global and Indian data[4] from all segments of the population suggest that up to 6 months of age solely breast fed infants grow as well as those who receive supplements. It would therefore appear that, contrary to the earlier theoretical predictions based on recommended dietary allowances during infancy, breast milk alone might be sufficient to support the growth of infants up to 6 months of age.

Appropriate time for introduction of supplements

Studies from India[4,8] have shown that solely breast fed infants grow well during the first three months of life; their growth during this period is comparable to that observed among infants born to well nourished mothers. Solely breast fed infants from low income groups double their birth weight by six months of age indicating that breast milk alone is adequate to support infant growth in early infancy.

However, after six months, growth faltering is common[8]. Delay in introduction of supplementary foods to infants beyond six months of age results in growth retardation as the infants do not get adequate nutrients to support growth.

It is essential that the current knowledge that breast milk alone is sufficient to meet the nutritional needs of most infants in the first six months of life is communicated to the all medical and paramedical personnel so that they in turn reassure women and counteract the existing tendency for too early introduction of supplements and its adverse consequences. Wherever possible, growth of infants should be monitored by monthly weighing. In communities where weighing is not possible, if a solely breast fed infant below six months of age is not thriving, or is crying due to hunger soon after breast feeds, the infant should be referred to the Primary Health Centre (PHC) for examination and appropriate advice . In the absence of any of these problems all women should be advised not to introduce supplements prior to 6 months of age because under the existing conditions of poor environmental sanitation such a practice is associated with increased risk of morbidity due to infection[4,8]. Women should also be made aware that too early introduction of supplements will also result in faster return of fertility.

Appropriate type of supplements

A variety of processed cereal-pulse based supplements are available in the market. They are widely used by the urban mothers belonging to middle and high income groups because they are convenient and are affordable . These segments of population should be informed about the need to give the infant vegetables and fruits in addition to these cereal pulse based supplements, so that the micronutrient requirements of the infants are met.

Recipes for a large variety of low cost infant food supplements prepared from locally available cereal, pulse, sugar and jaggery have been published by several institutions in India. However, community based studies have shown that very few women are able to prepare these special foods daily. Even when prepared these weaning foods become heavily contaminated with bacteria and if fed a few hours after preparation can cause diarrhoea[4]. It would therefore appear that giving freshly cooked unseasoned rice or wheat, pulse and vegetables from the family meal twice a day might be the most feasible method of introducing supplements to breast fed infants under the existing conditions in India. It is important that between 6 and 12 months of age the infant gets used to eating almost the whole range of adult food when it is freshly cooked. Studies from the NIN, Hyderabad, have shown that this practice was associated with a tripling of birth weight by the first year, relatively low morbidity due to infection and a reasonably long interpregnancy interval even in the absence of contraceptive care[4,8].

Delay in introduction of supplements beyond six months of age is associated with growth faltering and increased susceptibility to infection due to undernutrition. It is essential to ensure that health education messages advocating introduction of freshly cooked cereal, pulse and vegetable based semisolid supplements to infants by six months of age, reach and are followed by urban and rural women from low income groups in India .

HIV Infection and Breast Feeding

HIV infection has no adverse effect on lactation and lactation has no adverse effect on the course and outcome of HIV infection. Both HIV and antibodies to HIV are present in breast milk; presence of antibodies to HIV may provide some protection against transmission of HIV infection through breast milk. Research studies indicate that transmission of HIV through breast milk accounts for 1-3 per cent of all mother to infant transmissions. Isolation of HIV from breast milk and the reported instances of HIV transmission through breast milk have led to the public apprehension and debate about advantages of breast feeding in the era of the HIV pandemic. The concern has been heightened by the apparently conflicting recommendations of the advisory panels on breast feeding in seropositive women.

Breast feeding offers protection against a wide variety of infection and hence is crucial for survival for the high risk HIV infected neonates who might also be pre-term and have low birth weight. There are no tests by which HIV infected infants could be identified at birth. Unless all infants born to seropositive mothers are breast fed , HIV infected infants will be denied the benefit of breast feeding. The advantages of breast feeding by far out weigh the small potential risk of HIV infection through breast feeding. Therefore, in the Indian context, breast feeding by the biological mother is to be advocated in all infants born to seropositive women.

In India very few of the infected mothers can be detected because universal HIV testing is not possible.

Breast feeding is essential for infant survival and growth especially among the poorer segments of the population, because infant food formulae are neither affordable nor safe. Hence breast feeding by the biological mother should continue irrespective of the HIV infection status of the mother or infant, known or unknown. Promotion of breast feeding by all mothers will therefore continue to be the national policy[9].

Lactation and Fertility

Lactation prolongs post partum amenorrhoea and provides some protection against pregnancy. Suckling-induced endocrine changes result in relative infertility during lactation. It is estimated that in India universal and prolonged breast feeding prevents more pregnancies than all other reversible contraceptives currently in use. However, it should be clearly understood that lactation provides reliable and effective protection against pregnancy only during the first few months of lactation when the woman is solely breast feeding her offspring and is amenorrhocic. Increasing duration of lactation beyond six months , introduction of supplements to breast fed infants or return of menstruation should all be taken as indications that lactating women should seek contraceptive care to prevent too early advent of an unwanted pregnancy[3]. This advice should be given along with the health education message regarding the appropriate time for introduction of supplements to the breast fed infant, so that women understand the linkage between the infant feeding practice, morbidity in infants and return of fertility and refrain from starting supplements too early .

Effect of maternal nutritional status on lactational infertility

Available data from developed and developing countries indicate that lactational amenorrhoea is shorter among well nourished women from developed countries and among the socio-economically better-off segments of the population in developing countries. However, it has been suggested that the shorter duration of lactational amenorrhoea might, at least in part, be attributable to confounding variables such as the earlier introduction of supplements and schedule feeding among well nourished women, rather than a better nutritional status per se. In the last decade, two studies[3,5] have attempted to define the role of maternal nutritional status on duration of lactational amenorrhoea. One of these studies was undertaken among urban low income group women with similar breast feeding practices who did not receive any health and/or nutritional intervention. The mean durations of lactation and lactational amenorrhoea were significantly shorter in women whose body weights were over 55 kg[3]. The other evidence came from studies in Gambian women[5]; data from the study showed that prolactin levels were higher and the duration of lactational amenorrhoea was longer during the rainy season, when calorie intakes were lower. Food supplementation to lactating mothers resulted in a fall in prolactin levels and a reduction in the duration of lactational amenorrhoea. Average birth intervals were also shorter in women receiving supplements[5].

Obviously, under conditions of food scarcity and consequent undernutrition, nature and evolution have ensured a longer inter-birth interval so that the advent of the next pregnancy does not cause further deterioration in both maternal and infant nutritional status. Currently several programmes aimed at improving maternal nutritional status are underway It is essential to ensure that efforts to improve maternal nutritional status are linked to programmes aimed at providing contraceptive care , so that the advent of the next pregnancy does not undo the benefits of food supplementation. Contraceptives given to lactating women should be carefully chosen so that they do not have any adverse effect on lactation, the breast fed infant or the mother[3].

SUMMARY

Surveys carried out in the country during the nineties indicate that universal initiation of lactation and prolonged breast feeding continue to be the rule in India both in urban and rural areas. There is a tendency for too early introduction of supplements to breast fed infants especially in urban areas; this practice may have adverse consequences such as increased morbidity in breast fed infants and faster return of fertility in the mother and hence need to be countered through health education. Advent of the HIV epidemic has provided one more reason to protect the existing practice of universal and prolonged breast feeding.

Available data suggest that lactation does not have an adverse effect on maternal nutrition in undernourished women subsisting on habitual low calorie diets. Chronic, mild and moderate maternal undernutrition does not have any adverse effect on initiation of lactation, duration of lactation, quantity and quality of milk secreted and the growth of the breast fed infant. However, further reduction in dietary intake, advent of the next pregnancy or increase

in energy expenditure result in deterioration in maternal nutritional status and lactational performance. Food supplements given to these women prevent these adverse consequences.

Lactation provides reliable protection against pregnancy in the first few months when the infant is solely breast fed; this effect is more marked in undernourished women. Improvement in maternal nutritional status is associated with faster return of fertility in lactating women; therefore efforts to improve maternal nutritional status should always be coupled with adequate provision for contraceptive care so that the too early advent of the next pregnancy does not result in deterioration in maternal nutritional status.

Early introduction of supplements to infants is likely to result in faster return of fertility in lactating women. Health education that solely breast fed infants grow and thrive normally during the first six months and in them the risk of infection is lower should be linked with advice that once supplements are introduced all lactating women should seek contraceptive care. Contraceptives should be chosen with care so that they have no effect on lactation, maternal or infant nutrition.

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This write-up, published on the occasion of the World Breast Feeding Week (August 1 to 7), has been contributed by Dr. P. Ramachandran, Advisor Health, Planning Commission, New Delhi.

ABSTRACTS

Some Research Projects Completed Recently

The role of ellagic acid in chemical carcinogenesis.

The study was carried out on NMRI inbred mice to evaluate the effect of ellagic acid (EA) on hepatic and pulmonary phase I and phase II drug metabolizing enzymes and antioxidant enzymes as also on lipid peroxidation in the liver and lung. The role of EA in modulating the binding of chemical carcinogens, ^{3}H-benzo(a)pyrene and ^{14}C-diethyl nitrosoamine with DNA *in vivo* and *in vitro* and its effect on binding of ^{3}H-benzo(a)pyrene and ^{14}C-diethyl nitrosoamine with DNA, mediated through peroxidative cooxidation of the carcinogens *in vitro* were also studied.

The effects of EA feeding at doses of 3,6 and 12 µg/ml drinking water for 8 weeks to male and female mice, on phase I and phase II drug metabolising enzymes were similar. EA did not change the activity of arylhydrocarbon hydroxylase (AHH) *in vivo* and *in vitro*. Feeding of EA to male mice for 8 weeks significantly decreased the hepatic cytochrome P-450, cytochrome b_5 and cytochrome c-reductase; the strongest effect was found at the dose of 12 µg/ml. On the other hand, AHH and cytochrome c-reductase activities in lungs increased on EA feeding. Hepatic UDP-glucoronyl transferase (UDPGT), glutathione-S-transferase (GST) and reduced glutathione (GSH) were significantly enhanced on EA feeding, and the effects appeared to be EA dose dependent. However, in lungs UDPGT and GSH levels were increased without any change in the GST activity. GST inhibition curve, obtained at different concentrations of EA in the 10,000 g hepatic supernatant using 1-chloro-2, 4 dinitrobenzene (CDNB) as substrate suggested two types of isoenzymes of GST (EA-binding and EA-nonbinding). Kinetic studies revealed that EA inhibited

GST activity non-competitively with respect to CDNB as a substrate.

EA feeding at a dose of 12 μg/ml inhibited the percentage inducibility of hepatic AHH by phenobarbitol from 25 to 6.5 per cent and the percentage inducibility of AHH by methylcholanthrene was decreased from 173 to 154 per cent. In the lungs, the percentage inducibility of AHH remained unaltered.

Addition of EA to liver microsomes of mice resulted in a steady increase in inhibition of NADPH-dependent lipid peroxidation upto 2mM concentration. The maximum of 70 per cent inhibition of ascorbate-dependent lipid peroxidation was achieved at 1mM concentration of EA. EA was found to be a stronger antioxidant than the known strong antioxidants like BHA, BHT, tocopherol and retinyl acetate. But the alizarin, quercetin, myricetin and purourogallin were found to be stronger inhibitors of *in vitro* lipid peroxidation compared to EA. Feeding of EA significantly increased the levels of reduced glutathione and glutathione reductase in the liver and lungs of male and female mice. However, there were no changes in the activities of catalase and superoxide dismutse. On the other hand, microsomes from liver and lungs of EA fed animals showed significantly suppressed NADPH- and ascorbate-dependent lipid peroxidation.

EA feeding at a dose of 12 μg/ml drinking water for 8 weeks to mice resulted in significant inhibition of ^{3}H-benzo(a)pyrene binding to lung DNA. In *in vitro* studies EA inhibited the binding of ^{3}H-benzo(a)pyrene and ^{14}C-NDEA with DNA, mediated by NADPH, ascorbate and linoleic acid-hematin systems.

It is thus concluded that EA not only act as an antioxidant but also enhances the GSH-dependent protective mechanisms. The overall consequences of these antioxidant activities might be beneficial and account for the anticarcinogenic activity of EA.

K.L. Khanduja
Department of Biophysics
Postgraduate Institute of Medical
Education and Research
Chandigarh.

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Production and immunological characterization of antibodies against estradiol-albumin and estradiol-albumin-DNA conjugates and their possible role in the pathogenesis of SLE.

The study was carried out to elucidate the possible role of estradiol in conjugation with DNA, in the pathogenesis of systemic lupus erythematosus (SLE). Commercially available calf thymus DNA was purified by repeated extraction with a mixture of chloroform and isoamyl alcohol. In order to obtain small size DNA fragments, this DNA was subjected to micrococcal nuclease digestion. DNA fragments (average size 200 bp) were covalently linked to bovine serum albumin (BSA) and estradiol-albumin by treatment with glutaraldehyde. The conjugates were separated from free DNA by gel exclusion chromatograpy and characterized by ultraviolet spectroscopy and thermal denaturation.

Antibodies were elicited in three rabbits immunized with estradiol-BSA, estradiol-BSA-DNA and DNA-BSA conjugates respectively, complexed with Freund's complete/ incomplete adjuvants. The conjugates induced high titre antibodies which were highly specific to their respective immunogens. These antibodies did not recognise native DNA (B-form), brominated DNA (Z-form) or poly (dc), poly (rG). The estradiol-BSA-DNA conjugate showed significant binding with sera from SLE patients known to have a high level of anti-native DNA antibodies. The results indicated the recognition of the unique conformation of estradiol-BSA-DNA conjugate by naturally occurring SLE anti-DNA autoantibodies. The recognition of β-estradiol by naturally occurring SLE autoantibodies was one of the important findings of the study.

Asif Ali
Department of Biochemistry
Faculty of Medicine
Aligarh Muslim University
Aligarh.

Publication:

Moinuddin and Ali, A. SLE and anti-DNA autoantibodies binding estradiol-albumin-DNA conjugate. *Lupus 3:* 43, 1994.

ICMR NEWS

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

Meetings of the Project Review Committees held at New Delhi:

Malaria, Filariasis and Kala-azar	August 8, 1995
Diarrhoeal Diseases	August 9, 1995

Participation of ICMR Scientists in Scientific Events:

Dr. G.V. Satyavati, Director-General, ICMR, co-chaired the meeting of the Joint Working Group of the Indo-US Vaccine Action Programme at New Delhi. She also participated in the Workshop on Multidisciplinary perspectives on introduction of new vaccines at New Delhi (July 17-20, 1995).

Dr. Kalyan Banerjee, Director, National Institute of Virology, Pune, participated in the meetings on (i) Emerging diseases and impending epidemics; and (ii) Standardisation for neutralising antibody for dengue at Salaya, Thailand (July 17-19 and 21-23, 1995 respectively).

Dr. V.P. Sharma, Director, Malaria Research Centre (MRC), Delhi, participated in the Joint WHO/Thailand International Assessment for Malaria at Bangkok (July 17-28, 1995).

Dr. U.C. Hegde, Dy. Director, Institute for Research in Reproduction, Bombay, participated in the VI International Congress of Reproductive Immunology at Washington D.C. (July 19-23, 1995).

Dr. Neena Valecha, Sr. Research Officer, MRC, Delhi, participated in the Clinical Tropical Pharmacology Workshop on Chemotherapy of Malaria at Bangkok (July 31 - August 11, 1995).

Dr. V.P. Sharma served as a Short-term WHO Consultant on Disease Vector Control in Sri Lanka (August 3-28, 1995).

ICMR AIDED SYMPOSIA/SEMINARS/WORKSHOPS/COURSES/CONFERENCES

Symposium/Seminar/Workshop/ Course/Conference	Date & Place	Contact Address
International Symposium on Human Stones, Free Radical and Trace Metals and VIII National Conference of Urolithiasis Society of India 1995.	September 14-16, 1995; (at Udaipur)	Dr. P.P. Singh, Organising Secretary, Department of Biochemistry, R.N.T. Medical College, Udaipur.
National Seminar on Public Health Aspects of Fixed Duration Treatment (FDT) in Leprosy.	September 22, 1995; (at Bombay)	Dr. C.R. Revankar, Organising Secretary, Bombay Leprosy Project, Vidnyon Bhawan, Sion-Chunabhatti, Bombay.
Symposium on Prevention and Control of Goitre Endemism in Tribal Population through Education and Mass Communication.	October 2-3, 1995: (at Bhopal)	Dr. D.K. Belsare, Director, Institute for Natural Resources and Human Environment, Bhopal.
Cytology Update - 1995.	October 14-15, 1995; (at Chandigarh)	Dr. A. Rajwanshi, Organising Secretary of Update, Department of Cytology and Gynaecologic Pathology, Postgraduate Institute of Medical Education and Research, Chandigarh.
XXVI Annual Conference of the Endocrine Society of India.	December 1-3, 1995; (at Ahmedabad)	Dr. J.M. Bhatavdekar, Organising Secretary, ESICON - 1995, Division of Molecular Endocrinology, The Gujarat Cancer Society, Ahmedabad.
International Symposium on Radiomodifiers in Human Health.	December 28-31, 1995; (at Manipal)	Prof. P. Uma Devi, Convenor, ISRHH, Department of Radiobiology, Kasturba Medical College, Manipal.

COUNCIL'S TRAINING PROGRAMMES

Reproductive Biology

At the Institute for Research in Reproduction, Bombay:

- Training Course on Techniques in Immunology, Cell Biology and Molecular Biology (November 2-25, 1995).
- Training Course on Techniques in Neuroendocrine Research (February 6-10, 1996).

Endocrinology

At the National Institute of Nutrition, Hyderabad:

- Annual Training Course on Endocrinological Techniques and their Application (August/September, 1995).

Nutrition

At the National Institute of Nutrition, Hyderabad:

- Annual Training Course in Nutrition (December 1, 1995 - February 28, 1996).

Oncology

At the Institute of Cytology and Preventive Oncology, New Delhi:

- Workshop on Molecular Biology of Viruses and Cancer alongwith Oligo DNA Synthesis and Polymerase Chain Reaction (September 18-22, 1995).

Occupational Health

At the National Institute of Occupational Health, Ahmedabad:

- Orientation Course on Occupational Health for Industrial Medical Officers (November 13-24, 1995).
- Training Course on Air Pollution Monitoring and Risk Assessment (December 13-19, 1995).

Medical Entomology

At the Vector Control Research Centre,Pondicherry:

- M.Sc. in Medical Entomology (From August 1995: for 2 years).

Laboratory Animal Technology

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

- Training Course for Laboratory Animal Supervisors (September 4 - November 30, 1995).

Haematology

At the Institute of Immunohaematology, Bombay:

- Training Course in Blood Group Serology and Blood Bank Methodology for Medical Officers (August 1 - September 29, 1995).
- Training Course in Blood Group Serology and Blood Bank Methodology for Technicians (August 1-31, 1995).
- Training Course in Advanced Haematology and Immunohaematology (September 11-29, 1995).

ICMR PUBLICATIONS

	Price (Rs.)
Nutritive Value of Indian Foods (1985), by C. Gopalan, B.V. Ramasastri and S.C. Balasubramaniam, Revised and Updated (1989), by B.S. Narasinga Rao, K.C. Pant and Y.G. Deosthale	21.00
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
Japanese Encephalitis in India (Revised Edition 1980)	5.00
Some Therapeutic Diets (Fourth Edition 1988, Reprinted 1992) by Swaran Pasricha	4.50
Nutrient Requirements & Recommended Dietary Allowances for Indians (1990, Reprinted 1994)	14.00
Fruits (1983, Reprinted 1992) by Indira Gopalan & M. Mohan Ram	7.00
Count What You Eat (1989, Reprinted 1991) by Swaran Pasricha	9.00
Diet & Diabetes (Second Edition 1993) by T.C. Raghuram, Swaran Pasricha & R.D. Sharma	18.00
Dietary Tips for the Elderly (1990, by Swaran Pasricha & B.V.S. Thimmayamma	3.50
Diet and Heart Disease (1994) by Ghafoorunissa and Kamala Krishnaswamy	26.00
*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

*10 per cent discount allowed to individuals. **25 per cent discount allowed to individuals.

These publications are available on prepayment of cost by cheque, bank draft or postal order (bank and postal charges will be extra) in favour of the Director-General, Indian Council of Medical Research, New Delhi. Money orders are not acceptable. All correspondence in this regard should be addressed to the Chief, Division of Publication and Information, Indian Council of Medical Research, Post Box No.4911, Ansari Nagar, New Delhi-110029 (India).

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