NFI BULLETIN
APRIL 1981
Bulletin of the Nutrition Foundation of India

Nutritional considerations in agricultural and rural development

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Agriculture is the backbone of the rural economy and hence agricultural advance and rural development are in most cases concurrent and interrelated events. They are both highly location-specific with reference to the packages of technology, services and public policies needed to sustain and stimulate them. Integration of nutritional consideration in agriculture and rural development is, therefore, likely to yield more speedy and reliable results than the many intervention and 'fire fighting operations' undertaken so far.

It is known that in rural areas there are seasonal changes in terms of incidences of malnutrition (Kamala S. Jaya Rao: *NFI Bulletin*, Jan 1981). Such high variability in both the qualitative and quantitative dimensions of the nutrition problem underlines the wisdom of examining possible solutions in the context of agricultural and rural development.

Nutritional dimensions in agriculture

Land use boards: Unfortunately, the institutional devices for imparting a nutritional dimension to crop planning do not exist in our country today. In order to help in restructuring land use patterns on scientific lines, it would be desirable to organize 'land use boards' with interdisciplinary expertise. Each board can cover a specific agro-ecological area. Such land use boards should assist farmers in optimizing the economic benefits from land and water through attention to the following major ingredients of scientific land use:

(a) Ecology: Land use based on ecological considerations will help to maximize the economic benefits from a given environment and minimize damage through man made as well as natural processes of desertification. Agro-meteorological research data will have to be integrated in crop planning models, so that contingency plans suited to different weather probabilities can be prepared.

(b) Economics: For reorienting land and water use on the basis of sound principles of economics, it is essential that production, storage, processing and marketing are viewed as a total system. The prevailing mismatch between these two areas of the production-consumption chain is harming both producers and consumers. For bridging the gap between potential and actual farm yields, it will be necessary to identify the precise constraints operating in each area and remove them. When postharvest technology is neglected, opportunities for the preparation of value-added products are lost. For example, food production statistics simply state that during 1978–79 India produced about 131 million tonnes of food-grains. This ignores the fact that the plants represented in these statistics produced over 400 million tonnes of dry matter, out of which grains constituted about 131 million tonnes. If the entire biomass is viewed as an asset and is utilized effectively, new avenues of income generation can be opened up. A part of biomass is currently used for feeding animals or as fuel. But by looking at the dry matter yield, part by part and by introducing techniques of preparing value-added material, we can enhance rural incomes.

(c) Energy: The energy needs of agriculture will have to be carefully worked out and an integrated energy supply system involving a suitable blend of renewable and non-renewable forms of energy will have to be introduced in each block. So far the pathway of productivity improvement has tended to rely heavily on a growing consumption of non-renewable forms of energy. We will have to reverse this process through the promotion of organic recycling techniques and through widespread use of biological source of fertilizer like *azolla*, blue green algae and symbiotic and non-symbiotic forms of nitrogen fixing organisms. Also, the current tendency to cultivate energy-rich crops like grain legumes and oilseeds under conditions of energy deprivation has to be corrected. Phosphorous conservation and recycling will be particularly important since phosphorous is a non-renewable resource. These steps will be facilitated if the farmers in each area organize 'renewable energy associations' and adopt a scientific energy conservation, generation and utilization methodology.

(d) Employment: Indian famines are famines of work than of food, since when work can be had and paid for food is always forthcoming. The situation today in the field of nutrition is one of providing the wherewithal to purchase food rather than the availa

bility of food in the market. All estimates of employment potential show that a majority of the people in India will have to depend upon agriculture, agroindustries and small scale industries as the major source of income until the end of this century.

Thus the state land use boards will have to develop a package of incentives and disincentives which can help to achieve the objectives of increasing income, employment and food production from the land, water and sunlight resources available in each district.

Such a board should have on it a nutrition scientist who could help in suggesting suitable crops which would help to meet the following needs:

- Providing some critical missing nutrients in the diet, like Vitamin A, Vitamin C, iron, etc;
- Preparation of homemade weaning foods;
- Developing a cereal-grain-legume combination so that all the essential amino acids can be provided in the diet;
- Developing suitable agriculture-cum-aquaculture techniques which could help in promoting dietary combinations, like rice-fish, potato-fish, etc;
- Promoting agroforestry systems of land management where appropriate botanical remedies for the specific nutritional maladies of the region are incorporated; and
- Introducing appropriate fodder legumes and shrubs which could provide the needed calories and proteins to farm animals, thereby enabling the introduction of larger quantities of animal food, like milk and milk products, eggs, etc, in the diet.

Postharvest technology: It will be essential to promote relevant research in the area of postharvest technology. Especially, the whole area of grain drying and storage requires greater attention.

A majority of the farmers in our country have less than one hectare of land to cultivate. They have to meet their own food requirements and in addition should have some surplus produce for sale. An important method of obtaining supplementary income in such cases is the integration of animals in the farming system. It is necessary that suitable technologies are developed for preparing fortified feed material from all cellulosic wastes and from agricultural raw material. Fortification of straw with molasses and urea as well as microbiological enrichment of starchy material, like cassava, will have to receive much wider adoption.

The other area of relevance in terms of agricultural programmes is the addition of nutritional considerations in social forestry projects. Suitable trees which can provide fruits, nuts and foliage of interest from the nutrition viewpoint will have to be introduced in programmes such as 'A Tree for Every Child', 'Village Forestry', etc. There is a vast untapped potential in this field.

Nutritional considerations in rural development

Rural development in the ultimate analysis involves the provision of opportunities for the optimum utilization of the human resource in rural areas. Human resource development in its turn can take place only on the foundation of adequate nutrition. It is, therefore, necessary to base rural development programmes on the primary aim of providing opportunities for the human population to achieve optimum expression for their physical and mental potential. Such programmes should have the following four major components:

- Economic emancipation of the family with particular attention to provision of adequate employment

FOUNDATION NEWS

The Bulletin: The Foundation is gratified to find that the Bulletin has evoked a very favourable and enthusiastic response. Beginning with this issue the Bulletin will hereafter carry eight pages instead of four as hitherto.

The next (July) issue will carry a lead article on 'Nutrition in the Sixth Plan' by Dr M.S. Swaminathan, Member, Planning Commission. In addition to other articles, future issues will also carry a column highlighting the important nutrition programmes being supported by UNICEF in our country.

Scientific Advisory Committee

The Foundation has set up a Scientific Advisory Committee which will provide advice and general guidance to the Director General of the Foundation, with regard to the scientific programmes of the Foundation. The actual formulation of the detailed study-designs and monitoring of specific projects will continue to be the responsibility of the Task Forces specifically constituted by the Foundation for each project. The following scientists constitute the Scientific Advisory Committee:

Dr S.G. Srikantia, former Director, National Institute of Nutrition, Hyderabad; Dr K.T. Achayya, UN University Programme, CFTRI, Mysore; Dr Rajammal P. Devadass, Director, Sri Avinashilingam, Home Science College, Coimbatore; Dr S.N. Chaudhuri, Director, Child-in-Need Institute, Calcutta; Dr Shanti Ghosh, Consulting Pediatrician, New Delhi; Dr M.S. Gore, Director, Tata Institute of Social Sciences, Bombay; Dr Kamala S. Jaya Rao, Deputy Director, National Institute of Nutrition, Hyderabad; Dr P.G.K. Panikar, Centre for Development Studies, Trivandrum; Dr K Ramachandran, Head, Biostatistics Unit, AIIMS, New Delhi; Dr. B.N. Tandon, Head, Dept of Gastro enterology and Human Nutrition, AIIMS, New Delhi; Dr L. Ramachandran, Director, Gandhi Gram Institute, Madurai; Dr M.S. Rao, Prof. of Sociology, Delhi School of Economics, New Delhi.

Editorial Board

An editorial board for the Bulletin of the Nutrition Foundation has been set up.

Chairman: Dr C. Gopalan, Nutrition Foundation of India;

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opportunities to women who are largely engaged at present in unpaid and underpaid jobs, often characterized by physical drudgery;

- Education of children and adults;
- Provision of minimum needs, such as safe drinking water supply, health care, rural communication, etc; and
- Promotion of a small family norm through population and contraceptive education.

Experience with programmes such as Food for Work Programme of the Government of India and Employment Guarantee Scheme of the State Government of Maharashtra have provided useful insights into methodologies for nutrition improvement. For example, the Employment Guarantee Scheme of Maharashtra has revealed that there was predominance of females in 52 out of 87 selected works. The female participation was, on an average, 57 per cent in many rural works programmes. A similar observation has been made in several areas where the Food for Work Programme has been in progress. The fact that women will have additional income and in the case of Food for Work Programme .will also receive foodgrains directly, has an important implication from the point of view of nutrition of children. Detailed data will have to be gathered on this aspect.

The need for an integrated approach to nutrition problems can hardly be overemphasized. The nutritional aims should form an integral part of agricultural and rural development. At present, they have tended to get operated on parallel or at any rate separate streams administered by totally different government departments or voluntary agencies. We now need a composite approach to rural development where employment, income generation, education and nutrition all become catalysts for each other. The starting point for such a Peoples' Nutrition Movement will be the organization of multidisciplinary land and water use planning groups in appropriate clusters of villages.

Vitamin A deficiency prevention programme

S.G. Srikantia

The Vitamin A deficiency problem

Vitamin A deficiency is one of the major public health problems in our country, and contributes to preventible blindness among young children.

The most rational approach to the control of prevention of Vitamin A deficiency is to ensure that diets provide adequate amounts of the Vitamin. This can be achieved by the use of inexpensive vegetable foods which are good sources of Carotene—provitamin A. The inclusion of such foods in diets calls for social evolution and is unlikely to occur as an isolated phenomenon within a short space of time. This can be achieved by the conventional method currently practiced. Administration of Vitamin A to high-risk groups through hospitals has to continue, although it has very limited coverage, and regularity of intake of Vitamin A supplements cannot be ensured. Additional, more effective short-term measures, therefore, appear to be necessary.

The liver can store large amounts of Vitamin A and release it for use when needed. Vitamin A deficiency could therefore, be prevented by a method by which hepatic stores of the Vitamin can be built up periodically. The National Institute of Nutrition, Hyderabad, examined this approach and based on their clinical, biochemical, experimental and field operational studies recommended that the oral administration of 2,00,000 IU of Vitamin A, dissolved in oil, once in six months to children between the ages of one to five years, be taken up as a national programme to control blindness due to Vitamin A deficiency. For reasons, as yet not well understood, the development of corneal lesions which lead to loss of vision is rarely seen in children beyond the age of five years; hence the decision to limit the programme to children below five years of age. This approach, is thus clearly aimed specifically at controlling blindness arising from Vitamin A deficiency.

Evaluation of the programme

The Government of India accepted this recommendation and a national programme was initiated during the Fourth Five Year Plan, with a financial outlay of four million rupees. The programme, started in 1971, was initially restricted to areas where the prevalence of Vitamin A deficiency was high and covered 1.6 million children in seven states. It has progressively increased, in 1979, to over 25 million children in all the states and union territories of the country.

Supplies of Vitamin A are made by the Department of Family Welfare of the Union Ministry of Health to the State Family Welfare Departments which are responsible for the programme implementation through their networks of primary health centres and subcentres. The auxiliary midwife and other paramedical workers distribute the Vitamin A—2,00,000 IU in two millitre of an orange flavoured syrup—once in six months, by home visits to all children between the ages of one to five years. Records of distribution are maintained.

An interim evaluation carried out in two states, Karnataka and Kerala, two years after the programme had been started, showed that the coverage was over 75 per cent of the expected number of children and that there was a reduction in the prevalence of conjunctival signs of Vitamin A deficiency to the extent of 75 per cent. This interim evaluation also confirmed the administrative feasibility of this approach within the existing health infrastructure.

Recently a more comprehensive impact evaluation of this massive dose programme had been undertaken. This covered eight states—Andhra Pradesh, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Rajasthan and West Bengal. Although base line data on the prevalence of signs of Vitamin A deficiency were not available in any of these states, evaluation was possible because of the development of a simple method which does not need such base line information. This method, developed by the National Institute of Nutrition, Hyderabad, makes use of the well-documented epidemiological observation, that the prevalence of Bitot spot—which is an objective sign of Vitamin A deficiency in children and is

age related—increases almost lineally with age. In communities where children receive Vitamin A, this age trend becomes indiscernible.

Findings of the evaluation study

A total of almost 70,000 children in 58 subcentres were covered for evaluation of the programme. The main findings were as follows:

- Programme effectiveness varied considerably from one state to another. Rajasthan and West Bengal appeared to have the most effective programmes, followed by Karnataka, Kerala and Orissa with Maharashtra and Andhra Pradesh with the least effective.
- The coverage of the target population was poor in most subcentres. A 50 per cent or more coverage was achieved in less than one-third of the areas. This poor coverage was an important reason for the lack of biological effectiveness.
- Maintenance of records of administration of the Vitamin was unsatisfactory in most centres and, as a result, it was impossible to compute the number of children who had received the massive doses regularly. Similarly, records of even the receipt and disposal of the Vitamin supplies were not kept satisfactorily.
- Among reasons for the poor coverage were: (a) irregular and short supply of the drug, (b) lack of preparedness of the community, (c) lack of supervision of distribution of the dose by the concerned personnel, (d) following a clinic approach instead of the recommended extension approach, and (e) upset in the work schedule of the auxiliary nurse midwife (ANM) by drafting her into family planning work. It was of interest to note that the ANM, who did not have the heavy family planning workload, could easily distribute the Vitamin A to all children expected to be covered by her.
- Knowledge of the functionaries of the programme was by and large satisfactory, although it could be improved. However, there was no effort made by them to educate the families about methods to prevent Vitamin A deficiency through dietary methods.

It would appear therefore that the massive dose programme has not been administered well, and this is the main reason for the overall poor impact. This aspect requires considerable strengthening all along the administrative line—from New Delhi to the auxiliary nurse midwife who distributes it to the child, if the benefits of this important intervention are to be realized. Unfortunately, with regard to most programmes in the health field, there is a vast gap between promise and performance. The story with regard to this programme appears to be no different.

Impact on nutritional blindness

Doubts have sometimes been voiced about the usefulness of this method in achieving its primary aim—preventing blindness due to Vitamin A deficiency. It has been asked whether a reduction in the prevalence of Bitot spots can be assumed to imply a reduction in blindness. This doubt has been raised, mainly because corneal lesions which lead to loss of vision are invariably seen in association with severe forms of protein-energy malnutrition and the massive dose provides Vitamin A without touching protein-energy deficiency. There are sound theoretical considerations and more importantly, epidemiological observations which support the conclusion that providing Vitamin A alone, even in the face of severe clinical forms of protein-energy deficiency, will protect the cornea. The most convincing way of resolving the doubt would of course be to determine at the community level, whether the massive dose brings down the rate of corneal involvement. Such a study poses enormous practical difficulties related to sample size, coverage logistics. However, realizing the need to provide an answer, the National Institute of Nutrition initiated about two years ago, a community-cum-hospital based study at Hyderabad.

Comments

It is important not to lose sight of one of the most important dimensions of the massive dose programme. This programme was conceived as a short-term measure to reduce the quantum of nutritional blindness until such time that the most rational and permanent solution takes over—improving the intake of Vitamin A through the habitual diet. Unless the short-term measure is coupled with concurrent energetic action to promote the long-term measure, interim measures will continue indefinitely—a most undesirable situation.

REVIEWS AND COMMENTS

Appropriate Supplementation of breast milk

There is now general agreement that breast feeding is the best way to feed infants and that every effort should be made to promote and protect this salutary practice. A question of practical importance however is, "What is the optimal time for the introduction of supplements to breast milk in the infant's diet?"

Waterlow and Thomson (Lancet: vo II, pp 238-242, 1979) had compared estimates of intakes of breast milk by babies with their requirements for energy and protein and concluded that, on an average, breast milk intakes of the order of 800 ml a day would stop meeting the infants' full energy needs by the age of two to three months. This would imply that supplementary foods should be introduced into the infant's diet by the third month.

Waterlow *et al* (J.C. Waterlow, Ann Ashworth and Mary Griffiths: Lancet: vol II, pp. 1176-79, 1980) have further discussed the duration for which breast milk alone can support optimal growth of the infant. These authors observe: "It seems justifiable to conclude that exclusive breast feeding for four to six months represents a physiologically possible target for some women."

The authors have then presented the results of 17 studies from different developing countries which show a fairly uniform pattern of a falling-off in growth rate of infants between three to four months, as compared to the UK standards. They however admit that the studies referred to suffer from several "shortcomings and possible sources of error"; and that "in some cases the numbers are quite small and the community studies may not be representative". (The Indian datas are based on a study carried out in a Bombay's sweeper colony on 32 infants in 1969.) Significantly, the authors also admit that they "do not know the relative contributions of inadequate food or infection as causes of this early

faltering".

Apart from the caution sounded by the authors with regard to the interpretation of the date assembled by them, there are important practical considerations which have a major bearing on the question of the optimal time for the introduction of supplementary foods in the infant's diet. Indeed, this question may not lend itself to a blanket recommendation. In communities living under ideal hygienic conditions, one may choose to err on the safe side and advise early introduction (three months) of supplementary foods as a measure of abundant caution. Such advice may also be justified because it is usually in such affluent communities that lactation performance is poor.

Practical considerations

On the other hand, in poor communities living under bad hygienic conditions with no access to safe water supply, the theoretical benefits of early supplementation, if any, may be more than offset by the inevitable earlier onset of diarrhoeal episodes, which are a major determinant of infant growth and nutrition in many developing countries. It is quite possible that under such circumstances the infants with early supplementation may arrive at their sixth month in a worse state of health and nutrition than infants not receiving such early supplementation. The balance of advantage in such circumstances may well lie in delaying the introduction of supplementary foods till the infant is six months old, beyond which point however, supplementation can definitely not be delayed.

Furthermore, the possible effects of early introduction of supplementary foods on the output of breast milk and on the duration of lactation also need consideration. Such effects, if any, may not seriously matter for the affluent communities but will be definitely deleterious for the poor for whom breast milk continues to be an important source of nutrients for the infant for about 18 months.

Unfortunately, there are few studies on poor communities living under unhygienic conditions, where the relative merits of early supplementation (three months), and late supplementation (six months) have been compared.

In this connection, a recent study carried out by Kristiansen and Nasher in Yemen 'A Pilot Study of Nutrition and Growth of South Yemeni Children'—unpublished report (personal communication) provides some interesting data, despite limitations with respect to sampling design which the authors themselves recognize and acknowledge. In this study, the authors have compared infants and young children in two villages in South Yemen (Laboos—250 children below three years, and Mahfed—150 children below three years). The communities in the two villages had nearly similar income levels and nearly equal access to health-care facilities. The sanitary conditions were somewhat different. Mahfed was apparently better off or a much higher proportion of the population in this village had toilet facilities and piped water supply available inside their houses, as compared to the population in Laboos. Eighty-eight per cent of infants below six months of age in Laboos, and 76 per cent of infants of the same age group in Mahfed were receiving breast milk.

The important point of difference between the two village communities was with respect to the use of commercial milk foods in early infancy. Thus, while in Laboos 46 per cent of the babies below six months were receiving bottle feeds of such commercial milk foods, as much as 82 per cent of infants of the same age group in Mahfed were receiving such feeds. The more extensive use of bottles and commercial milk foods in early infancy in Mahfed as compared to Laboos was clear. "Cow's milk product 'Dutch Baby' was sold all over. Dilution instructions were prescribed in English and were detailed with demands neither readable nor realizable by the village women."

The greater use of commercial milk foods in Mahfed was reflected in a greater prevalence of alimentary disorders in infants below six months of age (53 per cent in Mahfed as against 22 per cent in Laboos). Only four per cent of infants below six months of age, in Laboos, had haemoglobin levels below seven grams per cent as against 14 per cent in Mahfed. Fifty-six per cent of infants below six months of age had haemoglobin levels over 11 gm per cent in Laboos, as against 13 per cent in Mahfed. While the health status of 74 per cent of children in Laboos could be graded as 'good' and 26 per cent as 'intermediate' and 'poor' the corresponding figures for Mahfed were 51 per cent and 49 per cent respectively. Entamoeba histolytica, giardia and ascaris in faeces were present in six per cent of children in Laboos and 22 per cent in Mahfed (inspite of apparently better sanitary conditions in Mahfed). Even if due allowance is made for the lack of correct sampling design, these differences are apparently too large to be dismissed.

Type of supplementation

This study, coming as it does from Yemen, is of special significance as the import of commercial milk foods in the Gulf countries is at present very high; and their possible impact on infant nutrition in these countries has been viewed with concern.

As important as the question of the *optimal time* for the introduction of supplementary feeds is the question of the *type and nature* of the supplementary foods. In poor communities living under unhygienic conditions with no access to safe water supply, the use of freshly-cooked foods (which are also relatively much less expensive) may pose less risks of alimentary infections than commercial milk foods stored under unhygienic conditions, overdiluted with contaminated water, and fed from unclean bottles.

Recommendations with regard to the optimal time for the introduction of supplements and the type and nature of such supplements must, therefore, be based not just on theoretical estimates of breast milk output in relation to nutrient requirements but also on wider practical considerations—including particularly risks of infections, which condition and govern the absorption and utilization of nutrients, in different environments.

It has also to be impressed on the mothers that the introduction of supplementary foods does *not* imply that thereafter, the infant should be deliberately 'weaned' away from the breast. They have to be advised to continue breast feeding as long as possible.

C. Gopalan

Malting as an aid in reduction of viscosity of cereal and legume based diets

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Weaning food formulations commercially produced in India and other parts of the world are essentially roller dried mixtures of grain ingredients fortified with vitamins, minerals and milk solids. As the ingredients are rich in starch and as they are cooked prior to drying they absorb plenty of water and are very thick in consistency when stirred up with water. This thick consistency or bulk of cooked starch limits the caloric intake when the food is served to young children. The desirability of reducing the viscosity of such foods to enhance the intake of calories, as complementary feeding, in addition to breast milk after the infant has reached four to six months of age, has been recognized. Both enzyme as well as processing treatment to modify the viscosity of the starch have been attempted in the advanced countries.

Balanced food and paste viscosity

Some traditional food processing operations like puffing and roasting as well as malting may be expected to modify the viscosity of the starch. Screening investigations at this laboratory indicated that such indeed was the case. Puffing or other forms of high temperature heat treatment was found to reduce the hot paste viscosity of the cereal or legume product. Maximum reduction in viscosity was however found through the process of malting which, in certain cases, effected 10 fold reduction in viscosity.

Based on these observations, a method has now been standardized for a balanced food formulation which has a low paste viscosity and could therefore be used for increasing the calorie intake of babies, as complementary to, and in addition to, breast feeding after four to six months of age. One such successful formulation is based on malted ragi and green gram. Ragi is a relatively inexpensive material with a high content of calcium while the green gram is known to be free from toxic, antigrowth and flatus producing factors. The combination of the cereal and legume also balances the amino acid profile in the formulation. After germination for one or two days the grains are dried, toasted to destroy unwanted enzymes but to preserve the o-amylase and dehusked using simple technologies developed for the purpose. The dehusked grain and flour are mixed in the proportion of 2:1 and the mix contains 13 per cent protein and has a PER of 2.4. The viscosity of this mix is far lower than that of the unmalted control grain mix and is also about one-third that of commercially prepared food formulations recommended for infants. As such it cooks to a free flowing slurry while the commercial weaning foods give a thick gel. For the same viscosity, the calorie density of the malted formulation can be at least double that of commercial weaning foods.

Systematic and long term feeding studies have been carried out with this malted weaning food on children ranging from six months to two years in a village, hospital, children's home and also in a labour creche and it has been found that this food is well tolerated by children and its growth promoting value is nearly as good as that of more expensive commercial weaning foods. Its advantages over commercial weaning foods are: (i) low bulk (higher caloric density); (ii) better digestibility; (iii) relatively lower cost (five rupees per kg compared to Rs 25 per kg) and (iv) most important, its adaptability to preparation at any scale. It can be prepared not only in remote villages or communities lacking sophisticated processing facilities, but can also be manufactured by a modern food industry.

Malting for reduction

Instead of ragi and green gram used in the present study, other available cereals and legumes could be suitably modified to produce similar products for use as infant foods. As the starch is already predigested partially during the germination process, it can be expected to have a better digestibility and could potentially be useful as food for convalescents and as geriatric food.

Taking advantage of the observation that considerable viscosity reduction can be achieved through malting, reduction in the viscosity of conventionally produced roller dried foods can be effected through introduction of a small quantity of malted ingredient into it. This idea has been tested out and found to be successful. Other food formulations based on roasted or puffed ingredients can also be suitably fortified with malt to effect viscosity reduction. For instance, a food formulation based on rice flakes, roasted chickpea and green gram which is nutritionally balanced and otherwise highly acceptable but which has a high viscosity on cooking has a lowered viscosity if a small proportion of malt ingredient is introduced into the formulation.

The present work has shown that foods formulated from malted grains or containing even a small proportion of a malt ingredient would have low paste viscosity (bulk) and high caloric density. This could be taken advantage of in the formulation of foods for infants in addition to breast milk after four to six months of age; and geriatric and specialized foods for convalescents.

It has now been established that the problem of protein-calorie malnutrition in children is not due primarily to protein deficiency in the diet as was formerly believed, but due to inadequate food intake. Protein deficiency is thus incidental to calorie inadequacy. It has also been established that cereal-legume based diets fed in amounts adequate to meet the calorie needs of the young child will also meet the protein needs, and that no special protein-rich formulations are necessary.

A major factor contributing to inadequate intake of cereal-legume based diets by young children is the 'bulk' or low calorie density of such diets. Simple procedures for reducing the bulk of cooked cereal diets, capable of application at the village-home level, can contribute greatly to the alienation of the problem. In this article, Dr Desikachar describes such a simple procedure developed by him at the Central Food Technological Research Institute, Mysore.

C. G.

Control of anaemia by fortification of common salt with iron

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Anaemia is one of the most important public health nutrition problems in India and in many other parts of the world. The prevalence of anaemia is relatively high among women of reproductive age—particularly pregnant women—and among pre school children. Results of a recent population survey among rural areas near Hyderabad indicate that 65 per cent of adult women, 75 per cent of pregnant women, 77 per cent of preschool children, and nearly 45 per cent of adult men are anaemic. Thus, contrary to earlier belief, anaemia is also high among men in rural areas. Similar datas have been reported among rural populations near Delhi and Calcutta. These observations emphasize that anaemia in rural India is much more widespread than hitherto believed, and stress the need to cover the entire population in any intervention programme designed to control anaemia.

Major cause of anaemia

Iron deficiency is the major cause of anaemia in our country, although folate deficiency contributes to some extent to anaemia among pregnant women and preschool children. The major cause of iron deficiency among our population is the poor absorption of iron from habitual diets which are predominantly based on cereals. Although these diets provide 20 to 30 mg of iron per day, absorption of iron from them as determined by the radioisotopic method is only one to five per cent because of the high phylate content of cereal diets. Hookworm infestation and frequent infectious episodes further aggravate iron deficiency in some segments of the population.

A rational approach to combat anaemia is to diversify and improve the diets of poor population groups to enhance iron absorption from their diets—a goal which cannot be achieved in the near future under the prevailing socioeconomic conditions in our country. An alternative approach is to increase dietary iron intake of the population through fortification of a suitable dietary item with iron.

Cereal products have been used widely as a vehicle for iron fortification in developed countries. Since they are not suitable in the Indian situation, the National Institute of Nutrition suggested common salt as a possible vehicle. Salt is consumed by all socioeconomic strata throughout the country and its daily consumption lies within a narrow range. Further, most of the edible salt in the country is produced in a limited number of centres which enables the fortification of most of the edible salt at manufacturing points.

Developing fortification programme

A major step in developing any fortification programme is the selection of a suitable iron compound compatible with the vehicle chosen. The compound chosen should be satisfactory, particularly when consumed with the habitual diet. Selection of a suitable iron compound for fortifying crude salt has, in fact, been a technological challenge.

Systematic studies carried out at the National Institute of Nutrition have resulted in the development of a formula for the fortification of salt with iron which is stable, with a good acceptability and a satisfactory iron bioavailability. According to this formula, crushed salt (40 to 50 mesh) is fortified with ferric orthophosphate (3.5 g per kg) and an absorption promoter, sodium acid sulphate (five grams per kg), to provide one milligram of iron per gram of salt. Further studies have shown that ferric phosphate in this formula can be replaced with ferrous sulphate (3,500 ppm) and orthophosphoric acid or sodium orthophosphate (2,800 ppm) bringing down the cost by nearly half.

The average salt consumption per adult in India is about 15 gm with a range of 10 to 20 gm. So, through iron fortified salt, an additional 15 mg of iron could be provided to the population. About three per cent of iron from this is absorbed by normal men when ingested with a cereal based diet. The technology of mixing the fortified salt on a large scale has also been standardized.

Next, the impact of the iron fortified salt on prevention of iron deficiency anaemia in the population was studied by community trials. Two studies were carried out—one among school children and other among rural population.

Study among school children: The first trial, which lasted for 18 months, was done among school children aged between five and 15 years who were inmates of four residential schools. These children, 1,080 boys and 564 girls, were divided into experimental and control groups. Their entire salt requirements were supplied either as fortified salt in the experiment schools or as unfortified crushed salt in the control schools. The study indicated that continued consumption of iron fortified salt was not associated with any untoward effects. Measurements of haemoglobin in these children in the beginning and at the end of the study indicated that haemoglobin levels had significantly increased and incidence of anaemia had decreased significantly in those receiving iron fortified salt at the end of one year, but not in the control children receiving the unfortified salt.

Rural population study

Multicentric field trials. The above trials were carried out on healthy children living in an urban school with access to adequate medical care. Majority of India's population live in rural areas where they are exposed to environmental factors like infection and infestation which also contriubte to anaemia. It was, therefore, necessary that the impact of iron fortified salt should be tested in such a population before it could be considered as a feasible public health approach to control anaemia.

A multicentric study coordinated by the National Institute of Nutrition was, therefore, carried out in different parts of the country with the active support of the Department of Food, Ministry of Agriculture, Government of India. This study was carried out in four centres—three of them were rural (Hyderabad, Delhi and Calcutta) and the other an

urban centre (Madras).

Each rural centre covered several villages with a total population of about 6,000. These villages were surveyed initially for haemoglobin. In one set of villages (experimental) fortified salt was introduced and in another set (control) unfortified crushed salt. Salt required for all the centres was prepared on a large scale at Madras by the Department of Food and distributed in these villages house to house (Calcutta and Delhi) or sold through local shops (Hyderabad). After introducing the salt, haemoglobin survey was repeated every six months.

Analysis of data at the end of 12 months indicated that in all the centres, introduction of fortified salt had resulted in a significant improvement in haemoglobin and a reduction in the incidence of anaemia. The impact was quite striking in the Calcutta centre, where incidence of anaemia was high, i.e. 80 per cent or more. At the Calcutta centre, where hookworm infestation was quite high, iron fortified salt still showed a significant impact.

These extensive studies, laboratory, clinical and field have clearly demonstrated that iron fortified salt developed at the National Institute of Nutrition could be used to control anaemia in our population. Based on the results of these studies, it has been recommended to the Ministry of Food and Agriculture that fortification programme can be introduced on a national scale—initially in one region and then extended to other regions based on experience gained in one region. These recommendations are under active consideration of the Government.

Control of anaemia through iron fortification programme is a preventive approach but should cover the entire population and its effect can be felt only after a few years. Pregnant women who suffer from severe forms of anaemia which has to be corrected within a short period of 100 days or so, still require supplementation with therapeutic doses of iron to correct anaemia. However, if the fortification programme is in operation for several years even this problem of anaemia among pregnant women may be considerably reduced.

Need for a new family planning strategy

The figures for the growth rate of our population for the period 1971-1981, as revealed by the latest census (Census of India 1981, Series 1, Paper 1 1981: Registrar General and Census Commissioner for India), should cause serious concern. The overall dicennial growth rate during 1971-1981, for the country as a whole, was 24.75 per cent, as against 24.8 per cent during 1961-1971. While states like Tamil Nadu, Kerala and Orissa showed a significant decline in the population growth rates during 1971-1981 as compared to 1961-1971, others like Uttar Pradesh and Rajasthan actually registered a significant increase. Taking the country as a whole, the family planning programme had apparently made no significant impact on the population problem.

In an earlier publication (Survey on Infant and Child Mortality, 1979) the Registrar General of India reported that the birth rates in 1978 were 36.8 and 33 per thousand for rural and urban areas respectively, for populations with a monthly per capita expenditure of below Rs 50. As against this the figures were 19.2 and 17 per thousand for populations with a monthly per capita expenditure of over Rs 100. He also showed that for 52.4 per cent of the rural population and 27.4 per cent of the urban population, the per capita monthly expenditure level was below Rs 50. Only 3.8 per cent of the rural population and 20.7 per cent of the urban population had per capita monthly expenditure levels exceeding Rs 100.

The failure of our family planning programme is thus largely attributable to :

(a) the chronic administrative inefficiency of some states with a generally bad record in implementation of health and social welfare programmes,

(b) the generally poor impact of the programmes on the poorest sections of our population who, unfortunately today, constitute the vast bulk of our people.

If family planning programmes are viewed, not only from the demographic point of view but from the point of view of family health and nutrition, the failure to effectively reach the poorest sections who stand in special need of such a programme must be considered as the major weakness.

India has proclaimed its commitment to the goal—'Health for All by AD 2000'. Success in the family planning field is an essential requisite for the attainment of this goal. In order to achieve such success, our performance in this field during the next two decades must be vastly better than our performance during the last two decades. What is, therefore, urgently needed is a vigorous new strategy based on a dispassionate analysis of the factors underlying our past failures and shortcomings.

Our family planning programme so far, has relied very heavily on dissemination of contraceptive technological facilities and, to a certain extent, on education and information. The basic assumption has been that once contraceptive facilities are made freely available and the people are informed as to how they could be used, they will readily accept and adopt the programme. It must now be clear that this assumption is not justified and that the present strategy is inadequate. Unless the socioeconomic disincentives to family planning, inherent in the poverty situation are also vigorously attacked, the programme cannot make much headway. A brief outline of a strategy based on an effective functional integration of the following three components was recently presented (Medical Education and Health Care—New Challenges and Problems: Convocation Address, Benaras Hindu University 1981—C. Gopalan):

(a) Employment with guaranteed minimum wage throughout the year;

(b) compulsory health and nutrition insurance of children of the families and

(c) strict observance of a small family norm.

Such a new strategy is urgently called for.

C. Gopalan

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Designed and produced by Media Workshop and printed by Veerendra Printers.