Summary and conclusion

V. SUMMARY AND CONCLUSION

"Food is the life of beings – The foods that promote length of life, goodness, strength, health, happiness and cheerfulness and those that are sweet, soft, agreeable and nourishing are the favourites of Goodness" –

Bhagawad Gita (Chapter XX)

Good nutrition is the basic requirement for positive health, functional efficiency and productivity. Nutrition science provides abundant evidence on the importance of nutrition not only in promoting proper physical growth and development but also in ensuring adequate immunocompetence, cognitive development and work capacity. For a nation to be healthy, strong and productive, the health and nutritional status of its people must be good. According to WHO, today's emphasis is on "health expectancy" rather than "life expectancy".

Diet plays a crucial role in enhancing the health expectancy of an individual. The quality and quantity of nutrients in the diet appear to be an important consideration. In developing countries like India, various nutritional deficiency problems affect the lives of human being throughout their life cycle especially young children and women of reproductive age. It also alters immuno competence and increases the susceptibility to infection. Infection, in turn is a major precipitating factor causing acute nutritional deficiency disorders.

Improvement in supply and consumption of macro and micronutrients rich foods are important strategies to improve the nutritional status of the population especially younger generation. The young children and the youth of today are the nation's future and their health and nutritional well being should be promoted, by using the easily available nutrients especially micronutrients dense food items like Red palm oil.

Hence the present study was framed with the main objectives of ascertaining the acceptability of Red palm oil in selected South Indian recipes and also evaluating the effect of Red palm oil supplementation on nutritional status of the selected target groups. The present study consisted of three phases. In the first phase, household and market survey were conducted to identify the commonly consumed and frequently prepared food items in 200 rural families and 200 urban families and five famous eating outlets in Coimbatore city. In the second phase, acceptability trials, were carried out for the selected 70 recipes using different oils for comparison along with Red palm oil. In the third phase of supplementation studies, twelve variations of Red palm oil supplement, in the form of sweet ladoo were prepared on the basis of acceptability trial of 70 recipes and evaluated for the selection of the best combination for supplementation study through sensory evaluation. Supplementation studies were carried out in five Government and Government aided educational institutions. Total of 1554 girls (4-18 years) attending the above educational institutions were selected. Socio-economic survey and screening for anemia were carried out for the selected subjects. For supplementation studies, subsamples were identified and grouped according to ICMR (2002) age classification as pre school girls (4-6 years), school going girls (7-9 and 10-12 years) and adolescent girls (13-15 and 16-18 years). From each age group, 20 girls in experimental and 20 girls in control group were selected for in depth study.

In the beginning of the supplementation studies, twelve combinations of supplements were developed using roasted bengal gram, green gram dhal and soya flour (vigor) in different proportions. Each variety had four variations for effective incorporation of Red palm oil in it. Among 12 variations, roasted bengal gram based supplement was highly preferred by the panel members and the quantity for different age groups was fixed on basis of the panel members acceptance in total consumption of sweet ladoo.

Effect of Red palm oil supplement on nutritional status of the selected target groups was assessed by anthropometric measurements (Height and Weight), individual food and nutrient intake, clinical examination and bio-chemical estimation of haemoglobin, serum Total protein-Albumin and globulin and serum retinol level, before and after supplementation for the period of 90 days. Statistical analysis was used to find out the effect of Red palm oil supplementation on the selected study groups.

The salient findings of the present study were given below:

PHASE I

I. Identification of recipes for acceptability trials

- Seventy two percent of the rural and 86 percent of the urban families adopted to nuclear family system and rest of them were being in traditional joint family system. Majority of the rural (68 percent) and urban (72 percent) of families had one to four members in their families. It was interesting to note that all the homemakers had their education in different level and none of them were illiterates.

- Sixty seven percent of the rural and 47 percent of the urban homemakers were full time home makers. Twenty four percent and 41 percent were self employed and rest of them were gainfully employed in various Governmental and non-Governmental concerns and earned money. Based on HUDCO (2004), income classification, in rural areas, 32 percent, 46 percent and 22 percent of the selected families and in urban areas 24 percent, 58 percent and 18 percent were belonged to low, middle and high income groups respectively.

- Sixty eight percent of the selected families in rural areas and 63 percent of urban families were non-vegetarians and rest of them were vegetarians and

ova-vegetarians. All the selected homemakers prepared breakfast, lunch, tea and dinner regularly, using different types of oils and cooking methods.

- Data gathered from survey revealed that 90 percent of the families gave first preference to sunflower oil as their cooking oil and 85 percent of the families gave second preference to refined groundnut oil. These two oils were considered for comparison with Red palm oil used in sensory evaluation of the selected recipes.

PHASE II

Sensory evaluation of the recipes

- The results of the sensory evaluation showed that Red palm oil was equally acceptable as the other two oils namely refined groundnut oil and sunflower oil in various savoury preparations. There was a marked difference in flavour and colour due to inherent colour present in the oil which made the sweet items not acceptable by the panel members. Red palm oil was acceptable in terms of appearance, texture and taste but not in the aspects of colour and flavour.

- The sensory evaluation revealed that deep fried (sweet) items prepared in refined groundnut oil and sunflower oil were highly acceptable while sweets prepared in Red palm oil were also acceptable. In these preparations, flavour of Red palm oil was a little dominant and reduced the overall acceptability scores to some extent in the sensory evaluation. The other factors like appearance, crispness and taste did not show an appreciable difference between these three products prepared with three different oils. With repeated usage, people will get used to this difference in colour and flavour.

- Texture and appearance of deep fat fried savoury items using Red palm oil scored better than that of the same fried in sunflower oil and refined groundnut oil. In these preparations, colour of Red palm oil altered the colour of savouries

and turned yellowish brown colour. But, this change in colour, boosted the appearance of savouries and secured more scores. Thus, the Red palm oil lend itself, very well for the savoury preparations. Similarly, in shallow fat fried and in bakery items, sweet preparations with Red palm oil secured reduced scores because of the flavour of Red palm oil whereas in savoury preparation Red palm oil scored better than that of sunflower oil and refined groundnut oil. In these preparations, colour of Red palm oil enhanced the appearance of the products.

- With increasing health awareness, there is a continuous search for suitable oil having favourable impact on health and nutritional status. With this view in mind, Red palm oil is included in daily diet for improving health status of all age groups. It can be also used as a supplementary food for young children, youth and elderly people.

Phase III

Supplementation Studies

- Socio-economic survey was conducted for the selected 1554 families in the age group (4-18 years) to identify girls for supplementation studies. The data of the survey revealed that majority of the selected families belonged to nuclear family system, having 4 – 6 family members. It was heart warming to note that 87 percent of the parents of the selected 1554 girls were literate having different levels of education. Sixty eight percent, 23 percent and nine percent of the selected families belonged to low, middle and high income groups respectively.

- Information on the general food consumption pattern showed that 69 per cent were non-vegetarians in all the age groups whereas only 18 percent were vegetarians and 13 per cent were ova vegetarians. Majority of them spent 30-

40 percent of their total monthly income for purchasing different types of food items. Consumption of cereals and pulses were adequate to meet the RDA of ICMR. The per capita availability of vegetables, fruits, milk, egg and fleshy food was grossly inadequate. This might be due to low income (68 percent) poor purchasing power (46 percent) and lack of knowledge about protective foods like vegetables and fruits (57 percent). This, in turn resulted in poor intake of micronutrients like iron, calcium and retinol.

- It was heart warming to note that 80 percent of preschool girls and school going girls had their lunch in Chief Minister's Nutritious Noon Meal Program of Tamil nadu. For 15 percent of girls, their lunch was brought by their family members. Majority of the adolescent girls brought their lunch by their own. A meagre percent of the adolescent girls skipped their lunch due to short time duration for lunch and they were also particular to cut down their calorie content as they were conscious about their body weight.

- Twenty two per cent of the selected girls had three meals a day. Seventy two per cent of the girls had only two meals a day including lunch in school lunch programme and only 6 per cent had four meals consisted of breakfast,lunch, evening tea and dinner.

- Among the girls attended their puberty, 85 percent of them had regular menstrual flow and rest of them had irregular menstrual cycle. It was interesting to note that only four percent of the selected girls adopted allopathic treatment for their menstrual problems. Eight to twelve percent of them following domestic remedial measures to overcome these problems. One third of the selected girls suffered from physical discomforts like stomach pain (36 percent), back pain (27 percent), body pain (21 percent), headache and vomiting (9 percent) and emotional disturbance (12 percent). Twenty four

percent of the selected girls had excessive bleeding and sometimes accompanied with irregular periods.

- Twenty percent of the selected subjects suffered from some of the common infectious diseases such as viral fever (18 percent), malaria (7 percent), jaundice (5 percent), mumps (4 percent) and typhoid (6 percent) in the past six months. These meager percentage prevalence was mainly due to their nutritious dietary pattern and effective involvement of health care centres in eradicating the infectious diseases among the public.

- It was also interesting to note that majority of the preschool girls (89 percent) were immunized for infectious diseases. Even school going girls and adolescent girls were properly immunized for various infectious diseases in the early stage of their life. Unfortunately eleven percent of the preschool girls had measles, diarrhoea and some kind of respiratory infections. It might be due to poor Vitamin A profile of the body.

- Mapping of girls for supplementation studies, anthropometric measurements, consumption of foods rich in beta-carotene/vitamin A and level of haemoglobin were recorded for 1554 girls and the data revealed that the selected girls were below the standard values of height and weight suggested by NCHS (Bamji et al 2003)

- The data gathered from the survey revealed that 12 percent of girls consumed Vitamin A and beta carotene rich foods like carrot, pumpkin, spinach and other dark green leafy vegetables, fruits like papaya, mango, weekly once or twice. Egg yolk, liver and butter occasionally. The mean intake of these foods were grossly inadequate when compared to RDA of ICMR (2002).

- Data on the screening of anemia among 1554 girls revealed that 42 percent of preschool girls (4-6 years), 28 percent of school going girls (7-12 years) and 27

percent of adolescents (13-15 years) and 31 percent of 16-18 years aged girls were healthy and non-anemic having normal haemoglobin level. Rest of them had various grades of anemia in their respective age groups. Majority of them were mildly anemic and less than 12 percent were severely anemic in condition.

- The mean increment in height recorded over a period of 90 days was 2.3 cm by the experimental group of preschool girls, 1.64 cm in school going girls of 7-9 years, 2.38 cm in 10-12 years, 1.33 cm in 13-15 years, and 1.83 cm in 16-18 years. Statistical analysis revealed that the mean increment in height of girls in the experimental group of all age groups was significant at one percent level, whereas in control group, mean height increment was not statistically significant. Comparisons in mean height increment of experimental and control group showed a significant difference during the study period. The same trend was noted in mean weight increment of experimental and control group of all age groups during the study period of 90 days.

- Statistical comparison within the experimental group and also with control group of all age groups were found to be highly significant at ($P<0.01$) level. The height and weight recorded by the girls of various age groups were found to be lower when compared with NCHS values suggested for various age groups, even at the end of the study period.

- Before supplementation, the diets of the both study groups were deficit in all food items including pulses, vegetables, green leafy vegetables and fruits. After supplementation with Red palm oil, the consumption of pulses, sugar and fats and oil had increased, due to supplementation of Red palm oil based sweet ladoo.

- Mean nutrient intake was deficient with respect to all the nutrient for girls, before supplementation. After supplementation, beta-carotene level was found to be high, because of beta-carotene rich Red palm oil supplementation. The same trend was observed in all the girls in experimental groups of all age groups.

- In experimental groups, girls aged between 4 and 6 years, the mean haemoglobin level increased from 11.02 g/dl to 11.99 g/dl (increment of 0.97g/dl), for the school going girls aged 7 to 9 years increment was 0.89g/dl, for 10-12 years it was found to be 0.59 g/dl. Adolescent girls aged 13 to 15 years, it was 0.74 g/dl and for 16 to 18 years, it was 0.91 g/dl. In the control groups, the mean increment in haemoglobin level of all age groups is ranged between 0.11 g/dl to 0.81 g/dl.

- The increase in mean haemoglobin level of experimental groups might be due to the supplementation of beta-carotene rich Red palm oil. Long term supplementation of Red palm oil supplement improve the haemoglobin level of the younger population much better.

- The mean serum total protein level for the experimental group of 4-6 years had increased from 5.88 to 7.26 g/dl, for 7-9 years, it was increased from 5.59 to 7.29 g/dl, for 10-12 years, it was 6.30 to 7.54 g/dl, for 13-15 years, it increased from 4.98 g/dl to 5.19 g/dl and 16-18 years, it increased from 4.51 to 7.48 g/dl. The mean increment of serum total protein of girls in the experimental groups of all age groups ranged between 1.25 g/dl and 2.96 g/dl. For control groups, it was found to be 0.04 to 0.24 g/dl after supplementation period.

- Statistical analysis of serum protein was done for the experimental groups showed recordable significant increment at ($P<0.01$) level in all age groups whereas in control group, the difference was insignificant. The same trend was

observed in serum albumin and globulin level of girls in experimental and control groups.

- There was a significant difference at ($P < 0.01$) level in the serum retinol level of the groups supplemented with Red palm oil pointing out the benefits of enhancing serum retinol level. Maximum increment of 30.75 mcg/dl was observed in the experimental group of girls aged 4 to 6 years. For the experimental group of 7-9 years, it was 26.19 mcg/dl, for 10-12 years it was 15.98 mcg/dl, for 13-15 years it was 22.97 mcg/dl, and for the 16-18 years it was 26.68 mcg/dl. The increase in serum retinol level of experimental group of all age groups were compared to control group and found to be significant at one percent level.

- Statistical analysis of serum retinol level between the initial and final values of the experimental groups of all age groups and between control groups revealed that there was a significant difference at ($P<0.01$) level. This might prove to be a very effective way of combating the wide spread micronutrient deficiencies especially vitamin A deficiency.

Hence, it is essential to include foods rich in beta-carotene and vitamin A constantly in their regular diet for healthy and desirable Vitamin A status of the body. The maintenance of Vitamin A stores in the body helps to meet the need for growth and development of the young children and youth and also for the preparation of future motherhood.

RECOMMENDATIONS

The following recommendations are emerged from this present study:

1. More research works are suggested to improve the nutrition and health status of the young children and the youth through nutrition education and

supplementation, since they are the nation's future and pillars to support and uplift the economic status of the country.

2. Create awareness among the public to include under-exploited, inexpensive foods of high nutritive value and are available right at the door steps of us, but are not put in optimal use. These ways, nutritional quality of our diet is improved through the judicious use of inexpensive nutritious foods like Red palm oil.

3. Elaborative studies be undertaken on role of fatty acids combinations and abundant antioxidants of beta-carotene and Vitamin E for the maintenance of health and prevention of degenerative diseases of population groups consuming different plant oils.

4. Concept of using Red palm oil in the daily diet may have far reaching the effects in the alleviation of micro nutrients deficiency especially VAD and hence needs popularization of Red palm oil in the society.

5. Take efforts to popularize Red palm oil among the public using publication, visual aids and media, making known of the nutritional significance and health benefits of Red palm oil to the consumers.

6. Explore possibilities of blending Red palm oil with other edible oils in ideal proportion, so as to shift the dietary polyunsaturated/saturated fatty acids and n-6 /n-3 ratio closer to recommended range to maintain good health.

7. The agricultural sector should concentrate more for the production and utilization of oil palm, which can be promoted by the health and welfare programmes.

Nutritional well being can be achieved only through a food based and not drug based approach. Pills and tablets can never be effective substitute for

balanced diets. We must resist the ongoing attempts of commercial exploitations of malnutrition of our people. Our attempts must be to achieve appropriate dietary diversification in order that diets of even poor household are balanced and of high nutritive value. A sound and sustained program of nutrition education may be helpful in modifying the future of young generation.

"Any investment towards improving the nutritional status of a Child is an investment for the health and wealth of the Nation"

(Devadas, 1987).