NUTRITIONAL STATUS AND VITAMIN A PROFILE OF LACTOVEGETARIANS

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DECLARATION

I hereby declare that this thesis entitled "**Nutritional status and vitamin A profile of lactovegetarians**" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title, of any other university or society.

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CERTIFICATE

Certified that this thesis entitled "**Nutritional status and vitamin A profile of lactovegetarians**" is a record of research work done independently by Ms. Gayathri, V. (2000-16-02) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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EXTERNAL EXAMINER

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CONTENTS

LIST OF TABLES

LIST OF TABLES CONTINUED

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

1. INTRODUCTION

According to biblical records mankind's first diet was of plant origin. But man has changed his habit according to his taste and life style. But the popularity and acceptance of vegetarian regime has been increased tremendously in the past two decades with a growing number of studies linking eating meat to a greater risk of heart disease and other degenerative disorders.

But poorly planned vegetarian diets, like inadequately formulated omnivores diet, can lead to nutritional deficiencies (American Dietetic Association, 1981). One of the essential micronutrients, the status of which is basically influenced by food habits (like vegetarianism and non vegetarianism) is vitamin A (Gopalan *et al.*, 2002).

Vitamin A is an essential nutrient found in considerable amount in foods of animal origin such as egg, fish, milk and liver. Vitamin A is not found in plants, but several plant foods including green leafy vegetables and fruits contain a substance called carotene, precursor of vitamin A. As far as dietary sources of vitamin A are concerned, the vegetarians get only provitamin A carotenoids while the omnivores get true vitamin A. Of the carotenoids β-carotene is the most effective source of vitamin A (Johnson *et al.*, 1995) which can be converted to two molecules of retinol while other carotenoids can yield only one molecule of retinol. The absorption of β-carotene is not as efficient as that of vitamin A and only a part of the absorbed carotene is converted to retinol. The carotene absorption depends on a number of factors, such as the dietary source, digestibility of the food, level of carotene intake, protein and fat content of the diet (Vijayaraghavan and Nayak, 1995). They further opined that animal source of vitamin A are unfortunately expensive and not within the reach of the rural poor, who constitute the bulk of Indian population and on the

contrary vegetarian diets which is relatively inexpensive provides provitamin A carotenoids.

The prevalence of vitamin A deficiency is more than the critical limits in most of the states and it is relatively higher in southern and eastern parts of the country. According to rough estimates, every year thirty to forty thousand children are becoming victims of preventable blindness. In Kerala 0.3 per cent of pre schoolers are affected by vitamin A deficiency (NIN, 1997). Inadequate dietary intake of vitamin A or its precursor β-carotene, is the most important contributory factor for the incidence of vitamin A deficiency. Lack of awareness, low purchasing power and prevalence of infectious diseases and worm infestation are said to be crucial factors that precipitate vitamin A deficiency which are also responsible for the prevalence of poor nutritional status.

In this context, it is of interest to study the vitamin A profile of the people who follow different dietary habits, *viz.*, vegetarians and non vegetarians along with the effect of diet on the nutritional status of the population. Thus the present study is an attempt to find out the vitamin A profile and nutritional status of the lactovegetarians as influenced by the composition of their diet with special reference to vegetables and fruits in comparison with omnivores.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

An ideal diet is one that promotes optimal health and longevity. Throughout history, human societies have developed varieties of dietary pattern based on available food, plants and animals that successfully supported growth and reproduction. As economies changed from scarcity to abundance, principal diet related diseases have shifted from nutrient deficiencies to chronic diseases related to dietary excesses. This shift has led to increasing scientific consensus that eating more plant foods but fewer animal foods would best promote health (Nestle, 1999).

According to Lima and Nell (1999) vegetarianisms is the abstienence from meat, fish and fowl. It encompasses a wide variety of eating patterns involving different degrees of animal food avoidance. The main types of vegetarianisms are lacto-vegetarianism, ovo-vegetarianism, lacto-ovo-vegetarianism and total vegetarianism. Lacto-vegetarians are persons who use milk and other dairy products in addition to plant foods and it lacks the benefit of iron, which can be fulfilled with effective dietary supplementation (Andrew, 2000).

2.1 NUTRIENT COMPOSITION OF VEGETARIAN AND OMNIVORES DIETS

A survey conducted by Leblanc *et al.* (2000) among 145 subjects (94 classical vegetarians, 34 Hindu lactovegetarians and 14 macrobiotics) in Franc revealed that the energy consumption of lactovegetarians females (1804 Kcal/d) was higher than that of pure vegetarians (1675 Kcal/d): their fat consumption was also higher (81 g/d) than pure vegetarians (61 g/d). The mean protein intake was 58 g/d for lactovegetarians and 50 g/d for classical vegetarians. Their vitamin C consumption was also higher (127.4 mg/d) than classical vegetarians (109 mg/d).

According to Krajcovicova-Kudlackova *et al.* (2000) who studied the nutritional status of lactovegetarians in comparison with omnivores, found

that, the mean values of iron, calcium and zinc of both groups were within the physiological range; but was significantly lower in vegetarians while the levels of vitamin E, C and β-carotene were significantly higher for vegetarians which according to the investigators represents a reduced risk of free radical disease. They also reported a higher content of linoleic and alpha-linolcic acids in lactovegetarians.

A study conducted by Woo *et al.* (1998) among elderly Chinese vegetarians and omnivores women (mean age of 81 years) revealed the fact that total energy, fat, protein, iron thiamine, riboflavin and niacin were lower in lactovegetarians while carbohydrate, calcium, potassium, retinol and ascorbic acid intakes were higher. While Harman and Parnell (1998) found a significantly higher intake of vitamin C and a lower energy derived from total and saturated fat among vegetarians.

According to Messina and Messina (1996) calcium and folic acid intake of lacto-vegetarian women were found to be close to recommended levels as compared to non-vegetarian diets.

The study conducted by Krajcovicova-Kudlackova *et al.* (1997) among lactovegetarians and omnivores to evaluate the nutritional status revealed that lactovegetarians had low iron and haemoglobin levels. A lower levels of cholesterol and significantly higher threshold values for essential anti oxidants *viz.*, vitamin C, vitamin E, β-carotene and vitamin A were observed by them among lactovegetarians when compared with omnivores.

Wilkins *et al.* (1996) analysed several vegetarian diets for energy, macronutrients, vitamins and minerals with few exceptions and found the values of all nutrients measured above the RDA. Results indicated that it is possible to obtain a nutritionally outstanding diet from plant foods. The study also revealed that vegetarian diets are adequate for all age groups and for those in different physiological conditions.

According to Finley *et al.* (1985) dietary iron intake of vegetarians was closer to that of RDA. However, according to the diet survey conducted by Drake *et al.* (1998) on 34 lacto-ovo-vegetarians the diet of vegetarians were found to be rich of carotenoids while dietary supplements are needed to meet iron recommendations.

A study conducted among 4746 adolescents (vegetarians and omnivores) by Perry *et al.* (2002) revealed that vegetarian adolescents were significantly more likely than non vegetarians to meet the 'Healthy People 2000' objectives. This was particularly noteworthy with respect to the intake of total fat (70 % Vs 48 %), saturated fat (65 % Vs 39 %), daily servings of vegetables (26 % Vs 14 %) and five or more servings of fruits and vegetables (39 % Vs 28 %). They also reported that vegetarians were less likely to eat fast food or drink soda and fruit drink regularly; they consume less vitamin B_{12}, more caffeine and iron when compared with omnivores.

According to Barr and Broughton (2000) who studied 90 current vegetarians, 35 past vegetarians and 68 current non vegetarians found that dietary intakes of vegetarians and current non vegetarians were consistent with current recommendations for macronutrient composition. Compared to current non vegetarians, current vegetarians had lower intakes of protein, saturated fat, cholesterol, niacin, vitamin B_{12} and D and higher fibre intakes.

The fibre intake was more than double that of non-vegetarians and iron intake was also significantly higher (Trespidi and Pinelli, 2001).

Remer *et al.* (1999) studied the iodine intake of lactovegetarians with that of omnivores. Their findings indicated that iodine intake was higher among non vegetarians (35.2 mg/d) than vegetarians (15.6 mg/d).

Nieman (1999) had concluded that there is not any detrimental effect of a vegetarian diet on physical performance capacity since plant food can

supply essential and non-essential amino acid and energy for male as well as female athletes.

Carlo (1995) found that vegan and vegetarian women had enough amount of protein in their body even before they become pregnant. However, Specker (1994) is of the opinion that a vegetarian diet is inadequate to meet calcium and vitamin B_{12} requirement during pregnancy which results in maternal bone demineralization but Sanders (1994) is of the view that vegetarian mothers do not show any higher incidence of complications of pregnancy but there are some links between vegetarians and low birth weight babies and earlier labour.

Carter *et al.* (1987) has enlightened the potential benefits of a vegetarian diet in pregnancy which includes adequate folate status at conception and a possible reduced risk of pre-eclampsia.

2.2 HEALTH AND NUTRITIONAL STATUS OF VEGETARIANS

Robinson and Barasi (2001) studied changes in body composition of selected subjects after six months on a self selected vegetarian diet which revealed that waist and hip circumference, weight, height ratio, biceps and triceps skin fold thickness and body fat all decreased compared to base line.

According to Horning and Sanchez (2001) vegetarians are reported to have a unique plasma amino acid profile; with higher level of arginine and glycine and lower levels of lysine and valine when compared to omnivores.

Key *et al.* (1999) opined that western vegetarians have a lower plasma total cholesterol (0.5 m mol/d) when compared to omnivores.

According to Johnson *et al.* (1995) plasma concentration of β-carotene was significantly higher in vegetarians than in non vegetarians. Plasma retinoid concentrations were not different between the two groups. They concluded that dietary and supplemental β-carotene, increased

plasma β-carotene concentration, but had no effect on plasma retinoid concentration.

According to Malter *et al.* (1989) among the vitamins they tested, only the level of carotene was significantly higher in vegetarians than in omnivores. The levels of vitamin A (retinol), vitamin K and vitamin E were not elevated.

Study conducted by Rauma (1995) revealed that vegetarians had significantly higher blood concentration of β-carotene, vitamin C and vitamin E.

According to Ballew *et al.* (2001) serum retinol concentration were greater with greater age, BMI, serum lipids and use of supplements containing vitamin A. In adults male sex, serum lipids, alcohol consumption and age were positively associated with serum retinol concentration. Household income was not found to be associated with serum concentration in children.

According to the study conducted by Tee *et al* (1995) the mean concentration of β-carotene of female subjects were higher than those of male subjects.

Another study conducted by Stephensen and Gildengorin (2000) revealed that mean serum retinol was lowest in subjects aged <10 g and increased with age. Concentrations were higher in males than in females.

According to Rauma (1995) the antioxidant levels in vegetarians show that a vegetarian diet maintains higher antioxidant vitamin status as compared to omnivores diet.

2.3 DISEASE INCIDENCE / PREVENTION AND VEGETARIANISM

Vimalakumari and Nandini (2001) are of the opinion that plant foods, in addition to supplying essential nutrients for the survival, also has a variety of bio-active substances like phytochemicals and antioxidants

(like β-carotene, vitamin E etc.) which help in protecting people from various diseases like heart diseases and cancer (Chellammal, 2001).

Bub *et al.* (2000) indicated that due to the antioxidant property of carotenoids it prevents cardiovascular diseases and cancer. He also found that consumption of carotenoid rich vegetables significantly increased selected carotenoids.

According to Brockmans *et al.* (2000) consumption of fruits and vegetables, rich in carotenoids improves the vitamin A status and decreased risk of heart disease. They are of the opinion that chronic vitamin A deficiency during pregnancy impairs growth and development of liver, heart and it may lead to coronary heart disease among new born infants.

Vitamin A as an antioxidant scavengers of free radicals, it protects LDL from oxidation. According to Gale (2001) high antioxidant status may help to prevent the initiation and progression of early atherosclerotic lesions in men.

Xu *et al.* (1992) are of the opinion that β-carotene can neutralize free radicals due to its antioxidant property. It can quench singlet oxygen, a reactive molecule that is generated in the skin by exposure to U.V. light and can induce pre-cancerous changes in the cells.

Paglia (1996) also opined that a vegetarian diet may be one of the best preventive measures against ulcer and certain cancers.

Speak *et al.* (1998) have found that carotenoids (β-carotene) possess antiaging and antiulcer properties.

Yang *et al.* (1996) studied that fresh dark green leafy vegetables were high in β-carotene and oxygenated carotenoids or xanthophylls, primarily lutein, whereas lycopene and carotene were not prominent and canthaxanthin was not existent in these vegetables. These analysis

suggest that consumption of carotenoids such as lutein in addition β-carotene may be associated with a low risk of cancers.

According to Neill and Thurnham (1998) high intake of fruits and vegetables gives protection against cancer. Ocke *et al.* (1997) found that low stable intake vegetables fruit and β-carotene experienced more than two fold increased relative risk of lung cancer than those with high stable intakes.

According to Pool-zobel *et al.* (1997) supplementation of diet with tomato, carrot or spinach products resulted in the significant decrease in endogenous level of stand breaks in lymphocyte DNA. Oxidative base damage was significantly reduced during the carrot juice intervention and it supports the hypothesis that carotenoid containing plant products exert a cancer protective effect via a decrease in oxidative other damage to DNA in humans.

Usharani *et al.* (2001) opined that β-carotene and vitamin C levels are significantly lower in all types of cancer patients. The β-carotene level in breast and rectum cancer subjects were less than half (22.4 mg/dl) while in stomach cancer patients the levels were nearly one third.

According to Mc Eligot *et al.* (1999) plasma carotenoid response can be an indicator of long term vegetable intake for women at risk of breast cancer recurrence.

Rock *et al.* (1997) have also ascertained that a high vegetable diet may reduce risk of breast cancer and may improve prognosis after the diagnosis of breast cancer.

Several studies have indicated that retinoids and carotenoids especially β-carotene can reverse pre cancerous oral lesions (Tanka, 1995 and Scully, 1995). Cell culture experiments shown that in animal models β-carotene can prevent cancer development (Krinsky, 1993 and Gerster, 1995). In accordance with its role as a controller of epithelial differentiation,

retinoic acid is found to prevent conversion of normal cells to carcinogenic cell (Krinsky, 1993). Pool-Zobel *et al.* (1997) have opined that carotenoid containing plant products exert a cancer protective effect. Vanpoppel (1996) also observed that a diet rich in β-carotene is associated with a reduced risk of cancer at a number of common sites, such as lung and stomach. Rijken *et al.* (1999) is of the opinion that increased vegetable consumption especially those rich in carotene reduces the risk of colo-rectal cancer mortality. Yang *et al.* (1996) observed that consumption of carotenoids such as lutein in addition to β-carotene is associated with low risk of cancers.

According to Hangen *et al.* (1993) fasting and vegetable intake over a period of one month had a positive impact on nutritional status on patients with rheumatoid arthritis.

Among study carried out by Kjaeldsen-Kragh *et al.* (1991) revealed that fact that fasting followed by one year of a vegetarian diet reduced and improved the rheumatoid arthritis condition.

According to Muller *et al.* (2001) all the 34 studies on fasting followed by vegetable rich diet in rheumatoid arthritis showed a statistically and clinically significant beneficial long-term effect.

A study conducted by Jibani *et al.* (1991) revealed that a predominantly vegetarian diet had an important beneficial effect on diabetic nephropathy without the need for a heavily restricted total protein intake.

According to Nicholson *et al.* (1999) the use of a low-fat vegetarian diet in patients with NIDDM was associated with significant reductions in fasting serum glucose concentration and body weight in the absence of recommendation for exercise.

According to Kapil (2002) a vegetarian diet especially a high fibre diet has a role in the treatment of diabetes because it shows the absorption

of glucose from the small intestine. If post prandial blood glucose levels are elevated, incorporating soluble viscous fibres in the diet will minimise this abnormal glucose spike.

Mc Eligot *et al.* (1999) reported that a change in plasma carotenoid concentration is found to be associated with change in BMI and change in plasma cholesterol and the plasma carotenoid response which results in low risk of heart attack can be used as an indicator of long term high vegetable intake.

Fawzi *et al.* (1995) found a strong inverse association between dietary intakes of vitamin A and risk of diarrhoea or risk of fever.

According to Mitra *et al.* (1998) serum retinol levels were found to be lower in children with diarrhoea than those without diarrhoea. However another study conducted in India by Ramakrishnan *et al.* (1995), among children (under five years of age) showed that the incidence of diarrhoea was not affected by a weekly dose 8333 IU of vitamin A for one year. Low serum retinol levels have been observed in children with a history of respiratory diseases by Bloem *et al.* (1990) and Quinlan and Hayani (1996). However, Pandey *et al.* (1991) found that standard vitamin A supplementation with two lakh IU every four months for one year reduced the rate of incidence of pneumonia. In India supplementation with a single, double or triple dose of two lakhs IU of vitamin A was found to have no influence on the incidence of respiratory illness in children under five years of age (Vijayaraghavan *et al.*, 1990 and Ramakrishnan *et al.*, 1995).

Tanumihardjo *et al.* (1996) had reported that vitamin A deficiency is commonly observed in children infected with *Ascaris lumbricoides*. Jalal *et al.* (1998) found that vitamin A status improved significantly in children who are heavily infected with *Ascaris lumbricoides* and who were dewormed and supplemented with β-carotene rich foods.

Semba *et al.* (1994) are of the opinion that low vitamin A levels are common among AIDS patients. In New York city 27 per cent of a group of hospitalized AIDS patients were identified with vitamin A depletion by Karter *et al.* (1995). Semba *et al.* (1993) has also observed that HIV infected adults with concomitant vitamin A deficiency have a 6.3 fold higher risk of death than non deficient patients. Semba *et al.* (1994) further found that the risk of mother to child transmission of HIV was more than four times lower in women with high serum retinol level. A study on children born to HIV infected women from South Africa done by Coutsoudis *et al.* (1995) recorded that although there was no reduction in overall morbidity, the incidence of all diarrhoeas was reduced by 29 per cent in the vitamin A supplemented group.

2.4 VEGETARIAN DIET AS A SOURCE OF VITAMIN A

The role of vitamin A / carotene in disease condition has been discussed in detail through the above references cited. Several studies have been carried out highlighting other functions of vitamin A / β-carotene in human nutrition.

Vitamin A is an essential micronutrient for visual system, growth and development, maintenance of epithelial cellular integrity, immune function and reproduction (Vijayaraghavan *et al*, 1990).

Olson (1991) has reported that vitamin A is essential for normal growth and development and its deficiency results in the loss of appetite followed by loss of weight resulting in stunted growth.

Murray (1996) had further reported that vitamin A is essential for normal growth, formation of tooth enamel, for proper spacing of teeth and for the formation of bones and soft tissues.

Involvement of vitamin A in reproduction both in males and females has been reported by several workers. According to Esklid and Hansson (1994) vitamin A helps in spermatogenesis in males. Wellik and De Luca

(1995) have stated that in females it is essential for normal pregnancy and lactation. Bates (1993) had reported that deficiency of vitamin A during pregnancy leads to foetal malformation and that low birth weight babies were marginally deficient in vitamin A.

Brockmans *et al.* (2000) opined that chronic vitamin A deficiency during pregnancy impairs growth and development of liver, heart and it may lead to coronary heart diseases of newborn infants.

According to Karter *et al.* (1995), vitamin A enhances and stimulates immune process, increased antibody response and induction of anti-tumor activity. Immunity is said to be related to its action on T-cells as reported by Israel *et al.* (1991) and Wang and Ballow (1993).

According to Semba *et al.* (1993) low serum vitamin A levels are found to have detrimental effects on immunity in human beings. A study conducted by Coutsoudis *et al.* (1992) revealed that three doses of vitamin A upto two lakhs IU for infants resulted in an increase in total lymphocyte counts and immunoglobulin levels. Semba *et al.* (1996) have declared that 73 per cent of children with bacterial meningitis had low serum retinol level.

Vitamin A is found to have some association with other nutrients, with respect to their absorption and utilisation.

Shobaki *et al.* (1997) found that addition of carotene enhanced the absorption of amino acid absorption and this effect was maximum in the case of methionine.

According to Blacklay *et al.* (1991) vitamin A is involved in the regulation of iron transport to the liver.

Vitamin A deficiency and anaemia often co-exist and three are significant associations between serum retinol and biochemical indicators of iron status. As indicated in intervention trials in VAD endemic areas, a direct association between vitamin A supplementation and increased blood

haemoglobin levels are observed (Suhano *et al.*, 1993). However the mechanism by which vitamin A influences iron metabolism are still unclear (Anton, 1995).

Another study conducted by During *et al.* (2000) had pointed out that β-carotene activity and iron concentration in the small intestinal mucosa were enhanced with increasing dietary iron and copper deficiency.

Layrisse *et al.* (2000) studied interaction of vitamin A or β-carotene with iron absorption in 104 human subjects. The results indicated that the presence of vitamin A increased iron absorption upto three times in the case of rice, 2.4 times in the case of wheat and 1.8 times in the case of corn. β-carotene increased absorption almost three times for the three next cereals tested. This information suggest that vitamin A and β-carotene forms a complex with iron keep it soluble in intestinal lumen and preventing the inhibitory role of phylates and polephenols on iron absorption.

Absorption study conducted by Garcia-Casal *et al.* (1998) revealed that the presence of vitamin A increased iron absorption upto two fold rice, 0.8 fold wheat and 1.4 fold corn. They further found that vitamin A did not significantly increase iron uptake under the experimental conditions employed but β-carotene had a significant increase. β-carotene enhanced iron uptake and helps to overcome the inhibition by potent inhibitors of iron absorption.

Tanumihardjo (2002) studied the effects of vitamin A and iron supplementation on the vitamin A status and iron status of pregnant Indonesian women. There was a significant impact increase in subjects who took iron and vitamin A supplementation than those who took vitamin A alone.

Another study concluded by Schmidt *et al.* (2001) established the fact that supplementation of vitamin A in conjunction with iron to women during pregnancy enhances the vitamin A status of their infants.

According to Rajalakshmi *et al.* (2001) cooking at elevated temperature in the presence of oxygen is said to cause conversion of all-trans carotene to its isomers with decrease in vitamin A activity. But cooking with lid is reported to be more effective in the retention of total carotenoids and beta carotene.

Kaur and Kapoor (2001) found that vegetables blanched by microwave methods were found to be superior over those blanched by HTST and LTLT methods. The retention of total carotenoids and better texture were also found in microwave method.

Effect of different blanching and drying methods on the stability of total carotenoids in carrots blanching was studied by Sharma *et al.* (2000). The data revealed that total carotenoids decreased by 9.9 to 10.6 per cent during blanching. Loss of total carotenoids was higher in unblanched carrots as compared to blanched and cabinet dried ones. Also caotenoid degradation was fastest in water blanched samples and least in steam blanched samples. Of the carotenoids β-carotene degraded fastest while lutin degraded slowest during storage.

Another study conducted by Vanhet *et al.* (1998) revealed the fact that processing of vegetables by mechanical homogenization or heat treatment has the potential of increasing the bioavailability of carotenoids.

Mosha *et al.* (1997) found that traditional processing practices of sundrying and storage in ventilated containers resulted in a significant decrease in the concentration of total carotenoids β-carotene and α-carotene in all the vegetables. They also reported that conventional blanching and cooking resulted in a significant increase in the concentration of carotenoids in cowpea, peanut and pumpkin leaves while

in amaranthus and sweet potato greens thermal processing brought about a significant decrease in the concentration of carotenoids.

According to Mc Eligot *et al.* (1999) serum concentration of α-carotene was significantly higher in the vegetable juice group than inn the raw or cooked vegetable group due to its bioavailability.

Absorption of β-carotene is not as efficient as that of vitamin A and only a part of the absorbed carotene is converted to retinol. The carotene absorption depends on a number of factors, such as the dietary source, digestability of the food, level of carotene intake, protein and fat content of the diet. They also opined that carotenoids are absorbed much more effectively from only solution like red palm oil than plant foods (Reddy and Vijayaraghavan, 1995).

Kattuga and Easwaran (1999) observed a positive correlation between intake of vitamin A and serum retinol levels and administration of β-carotene (300 μg/day for 30 days) produces a significant increase in serum retinol level.

Xu *et al.* (1992) found that a low fat diet leads to a condition where little bile reaches the intestine, leading to lost of vitamin A and carotene through faces.

According to Hollander (1981) the efficiency of dispersion and absorption of vitamin A and β-Carotene is affected by the presence of fat in the diet.

According to Hu *et al.* (2000) different fats have different effects on intestinal β-carotene absorption. They found that in female subjects, the ingestion of β-carotene with meal rich in sunflower oil had lower appearance of β-carotene in blood when compared to those subjects who had meal rich in beef tallow.

According to Vijayalakshmi and Mercy (2000) fat and proteins will improve absorption of vitamin A if provided with the same meal and vitamin A deficiency its often associated with protein in the case of protein – calorie malnutrition.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The study under focus was undertaken to find out the vitamin A profile of lactovegetarians as influenced by the composition of the diet with special reference to vegetables and fruits in comparison with omnivores.

The Plan of Study

3.1 Locale of the study

3.2 Selection of subjects

3.3 Conduct of the study

3.3.1 Conduct of diet survey

3.3.2 Conduct of food weighment survey

3.3.3 Computation of food use frequency score

3.3.4 Computation of dietary score for frequency of consumption of carotene / vitamin A rich foods (Vitamin A score)

3.4 Assessment of vitamin A status

3.5 Assessment of nutritional status

3.5.1 Clinical Examination

3.5.2 Anthropometry

3.5.3 Adequacy of diet with respect to different food groups and nutrients

3.6 Statistical analysis of data

3.1 LOCALE OF THE STUDY

The study was conducted at Vellayani campus of College of Agriculture, Kerala Agricultural University.

3.2 SELECTION OF SUBJECTS

Thirty female students of College of Agriculture, Vellayani in the age group of 18 – 22 years formed the subjects of the study. Care was taken to select an equal number of subjects who were lacto vegetarians and omnivores (15 each). A lacto-vegetarian subject was selected on the basis that she has followed a vegetarian dietary pattern for the past ten years or more but consumes milk.

The non vegetarian subjects (omnivores) were selected on the basis that they are in the habit of consuming non-vegetarian foods such as milk / meat / egg / fish or a combination of these fleshy foods at least four or more times in a week, and had followed this dietary habit for the past ten years or more.

Apart from the age (18 – 22), sex (female) and dietary habit, the willingness of students (collected in writing) to cooperate with the work during the entire period of the study was taken as an important criterion in the selection of the subjects.

Those who were in the habit of consuming pharmaceutical supplements or medicines / drugs (Allopathic, Ayurvedic, Homeopathic or from any other systems of medicine) or using vitamin A containing creams for skin care were excluded, since the above substances may have direct or indirect influence on the vitamin A profile of the subjects.

Care was also taken to exclude those subjects who had skin and eye disorders. Those subjects who had any major illness or infection or worm infestation at the time of the study or during the preceeding three months of the date of start of the study were also excluded from the study.

Thus the subjects of the study consisted of thirty young healthy adult female students free of visible symptoms of vitamin A disorders, half of them being lacto vegetarians and the remaining being omnivores.

3.3 CONDUCT OF THE STUDY

3.3.1 Conduct of diet survey

The dietary history and current food consumption pattern of the subjects were studied through diet survey using a specially designed questionnaire (Appendix I). The data were collected from individual subjects through personal interview.

3.3.2 Conduct of food weighment survey

A seven-day weighment was conducted to assess the actual food consumption pattern of all the subjects following the method suggested by Thimmayamma and Rau (1996). From the weighment data, raw food equivalents were worked out; the actual per capita daily intake of foods from different food groups were found out and compared with Recommended Dietary Allowances suggested by ICMR (1991). Actual per capita daily intake of different nutrients were computed from the per capita raw weight food equivalents and compared with RDA for nutrients suggested by ICMR.

3.3.3 Computation of food use frequency score

From the dietary survey data, the food use frequency score was computed using the method suggested by Reaburn *et al.* (1979).

3.3.4 Computation of dietary score for frequency of consumption of carotene/vitamin A rich foods

Using the dietary survey data the dietary score for frequency of consumption of carotene/vitamin A rich foods were computed using a modified version of the method suggested by Bamji *et al.* (1996).

3.4 ASSESSMENT OF VITAMIN A STATUS

The vitamin A status of the subjects were assessed by estimating their serum retinol and β-carotene levels using the method suggested by

Bassey *et al.* (1946) and by assessing vitamin A / carotene intake of the subjects from the data obtained from the weighment survey.

3.5 ASSESSMENT OF NUTRITIONAL STATUS

The nutritional status of all the subjects were assessed through clinical examination, anthropometry and data on actual food intake.

3.5.1 Clinical Examination – All the selected students were subjected to a clinical examination with the help of a trained clinical practitioner using a schedule suggested by Swaminathan (1974). This was done at the end of weighment survey period. The clinical profile of the subjects were scored based on the presence / absence of clinical symptoms of deficiency or excess of nutrients. The clinical profile with special reference to symptoms of vitamin A deficiency / excess of each subject was also scored.

3.5.2 Anthropometry – The nutritional status of the subjects were also evaluated based on anthropometry. Height, Weight, Triceps Skinfold Thickness (TST), Mid Upper Arm Circumference (MUAC), Waist Circumference (WC) and Hip Circumference (HC) of the subjects were measured twice during the study period with an interval of three months using standard procedures (Rao and Vijayaraghavan, 1996). The values of individual subjects were compared with reference standard values.

Using the height and weight data, Body Mass Index (BMI) was calculated and the energy status of the subjects were thus assessed. Utilising the measurements of hip and waist circumference the Waist-Hip Ratio (WHR) was worked out to assess the presence or absence of specific types of obesity.

The variation in the anthropometric data over the period of three months were also analysed to evaluate the sustainability with reference to the nutritional status of the subjects.

3.5.3 Adequacy of diet with respect to different food groups and nutrients

The food and nutrient intake of individual subjects were calculated using standard procedures from the food weighment survey data and the actual food and nutrient intake of individual subjects were compared with Recommended Dietary Allowances stipulated by ICMR (1991)

3.6 ANALYSIS OF THE DATA

The data collected from the above mentioned items of the conduct of the study were analysed to find out the variation in the food consumption pattern and nutritional status and vitamin A profile of lacto vegetarians with that of omnivores, using appropriate statistical tools.

RESULTS

4. RESULTS

The study entitled 'Nutritional status and vitamin A profile of lactovegetarians' was conducted on a sample of 30 subjects by comparing the nutritional status and vitamin A profile of lactovegetarians with that of omnivores. Personal details, food consumption pattern, frequency of use of various foods with special reference to those containing carotene and vitamin A, actual food intake, anthropometric and clinical profile as well as the serum β-carotene level of selected lactovegetarians and omnivores were measured and compared so as to enumerate the variation between the groups. The results obtained from the above assessments are presented under the following subheadings.

4.1 Personal characteristics of the subjects

4.2 Dietary history and basic dietary pattern of the subjects

4.3 Meal pattern of the subjects

4.4 Percapita supply and availability of foods from hostel diet

4.5 Food use frequency

4.6 Food and nutrient intake of subjects

4.7 Vitamin A\ β-carotene score

4.8 Serum Vitamin A and β-carotene level of subjects

4.9 Factors in food that hinder / favour utilisation of vitamin A/β-carotene

4.10 Nutritional status of the subjects

4.11 Nutritional status index (N.S.I.)

4.12 Clinical examination

4.1 PERSONAL CHARACTERISTICS OF THE SUBJECTS

Personal characteristics of the subjects such as age, socio-economic background, use of pharmaceuticals or cosmetics containing vitamin A and

history of incidence of major illness, infections or infestations were collected using a structured questionnaire (specially designed for the purpose) through personal interview. The subjects were all females falling within the age group of 18-22 years. As per the details shown in table 1 it was noticed that eight (53.33%) lactovegetarians and 13 (86.66%) omnivores were of 22 years of age while one subject (6.67%) each of both the groups were 21 years of age. Three lactovegetarians (20%) and one omnivore were 19 years old and the remaining 20% lactovegetarians were 18 years of age. However there was no significant difference between the two groups as far as their mean age was concerned.

Table 1 Age of subjects

Age in years	Lactovegetarians		Omnivores		Total	
	Number of subjects	%	Number of subjects	%	Number of subjects	%
22	8	53.33	13	86.66	21	70.00
21	1	6.67	1	6.67	2	6.67
19	3	20.00	1	6.67	4	13.33
18	3	20.00	-	-	3	10.00
Mean	20.53 ± 0.441		Mean	21.53 ± 0.26		

Socio-economic characteristics of the subjects when assessed revealed that 93.33 per cent of lactovegetarians and 66.67 per cent of omnivores belonged to Hindu religion while rest of the members were Christians. As vegetarianism is believed to have its roots in the caste system prevalent in India as well as in Kerala, the analysis of the data further revealed that 73.33 per cent of lactovegetarians belonged to forward communities of Kerala such as Brahmins (26.67 %) and Nairs (40 %) while 26.67 per cent belonged to other backward castes and one was an orthodox Christian (6.67 %). In the case of omnivores, 66.67 per cent were from forward castes and the rest belonged to other backward communities (33.33 %).

As income is found to have a direct bearing on food habits and daily meal pattern, the family income of the subjects when assessed showed that the annual income of lactovegetarians ranged from Rs. 50,000 to three lakhs per annum. It ranged from Rs. 20,000 to two lakhs fifty thousand per annum in the case of omnivores. The mean income of lactovegetarians was Rs. 1,92,666 and Rs. 73,600 for omnivores. Data when analysed and tabulated (Table 2) revealed that lactovegetarians had significantly higher annual income than omnivores ($t = 4.0063$ $p > 0.1$).

Table 2 Annual family income of the subjects

Annual income (Rs.)	Lactovegetarians	Omnivores	Total	Percentage (%)
< 50,000	0	7	7	23.33
50,001 - 100000	4	6	10	33.33
100001 - 150000	1	1	2	6.68
150001 - 200000	3	0	3	10.00
200001 - 250000	3	1	4	13.33
250001 - 300000	4	0	4	13.33
Total	15	15	30	100.00

Apart from income, when the family background of the subjects were reviewed it was found that the average family size of the entire population was 4.56. There was no conspicuous variation in the family size of lactovegetarians (4.60) and omnivores (4.53). Another interesting observation was that 66.67 per cent of the respondents among the lactovegetarians and 33.30 per cent of omnivores were children of first birth order in their family. All the subjects except one had two siblings each; while one subject from the omnivores group had five siblings. Another fact was that two of the lactovegetarian subjects were 'identical' twins.

Enquiry on the use of pharmaceutical supplements six months prior to the study revealed that five lactovegetarians (33.33%) and four (26.67%) omnivores had the habit of consuming supplements daily. The data further revealed that out of five lactovegetarians, four subjects (26.67%) were using allopathic

supplements (B-complex tablets for mouth ulcer) and one subject (6.67%) was using an ayurvedic medicine for arthritis. These supplements were prescribed by doctors. In the case of omnivores, two subjects (13.33%) were consuming calcium supplements and one subject (6.67%) was taking B-complex tablets (suggested by doctors) and another subject (6.67%) was using a homoeotonic (Alfavenamalt) to put on weight. One member of the omnivorous group reported that she was taking calcium tablets as an alternative to milk, since she is allergic to milk. This is found to be a self-selected remedial measure to overcome calcium deficiency. Another subject was using calcium supplement in order to strengthen her bones which was prescribed by her father. None of the subjects were using any creams or pharmaceutical supplements containing Vitamin A.

Out of the 30 subjects, 20 per cent of lactovegetarians reported that they had suffered from a bout of viral fever for two weeks during the last six month period. One subject (6.67%) of the omnivorous group reported that she suffers from common cold frequently. Two (13.33%) lactovegetarians and one (6.67%) of omnivore were found to be allergic to dust and milk respectively.

Only two subjects each from lactovegetarian (6.67%) and omnivore (6.67%) groups had reported that they were deworming once in six months and that Bebex (tablet) was used for deworming. Out of 30 subjects none of them had done it recently.

Thus the background informations collected from the subjects revealed that the experimental group consisted of healthy young adult female resident university students of middle and high income social strata; they were from nuclear families and majority belonged to first birth order.

4.2 DIETARY HISTORY AND BASIC DIETARY PATTERN OF THE SUBJECTS

The basic dietary habit and dietary history of the subjects (with reference to a period of six months prior to the study) when assessed through a specially designed questionnaire (given in Appendix I) brought out the following facts into the lime light.

Out of the 30 subjects, 15 were lactovegetarians and 15 were omnivores. All the omnivores were in the habit of consuming all types of animal foods such as meat, egg, fish and also milk.

All the omnivores subjects (100%) and eight lactovegetarian subjects (53.33%) had been following the above dietary habit since childhood. Two lactovegetarians (13.33%) had been following the habit for more than 10 years and 33.33 per cent were following this dietary pattern for more than nine years. This indicates that the above subjects had changed their dietary habit from a non-vegetarian style to a lactovegetarian pattern.

Enquiry on basic meal pattern of the subjects over the past six month period revealed that 80 per cent of lactovegetarians as well as omnivores generally had four meals a day and two subjects (13.33%) each from both the groups had their meal only three times a day and the rest (one (6.6%) each from both the groups) had only two meals a day.

Since all the subjects were residents of a hostel, though the meal pattern is uniform, the personality traits, family meal pattern, upbringing etc. may have an influence on the selection and consumption of items served in a meal over the days or within a day. Therefore specific interogations were done with individual members to ascertain their preferences, choices and habits in order to study their dietary back ground, which gives an insight to the dietary history. The dietary history mainly pertains to the family diet of those who are staying in the hostel for more than one year.

Such enquiry revealed the following facts.

All the subjects (100%) were found to be using rice as the staple food. Thirty per cent of lactovegetarians and 20 per cent of omnivores were in the habit of using fruits more than three times a week and the rest were consuming it only occasionally. Out of 30 subjects 96.67 per cent of lactovegetarians and 60 per cent of omnivores indicated a special preference for mango, while a similar number of omnivores preferred apples and oranges. Out of 30 subjects 26.67 per cent from

each of the groups reported an aversion towards egg fruit due to its unacceptable flavour.

Only one lactovegetarian subject had the habit of consuming fruit juice/vegetable juice at least once in a week. Fruits like pineapple, mango, grapes and vegetables like carrot and tomato were used for the preparation of juice by the above subject.

Forty per cent of lactovegetarians and 66.67 per cent of the omnivores exhibited a preference for eating salads at least once in a week (containing tomato, onion and cucumber). Carrot, the excellent source of β-carotene was preferred as raw salad only by 13.3 per cent of lactovegetarians and 46.67 per cent of omnivores.

Based on the family dietary pattern all the subjects reported that they were consuming vegetables, daily. Green leafy vegetables was found to be used once in a week by 46.67 per cent of omnivores and 26.67 per cent of lactovegetarians while 20 per cent from both groups mentioned that they consumed it four times a week. In the case of roots and tubers 13.3 per cent of lactovegetarians reported that they were in the habit of consuming it twice a week and 66.67 per cent of omnivores were using it thrice a week.

Fruits and some of the vegetables were found to be used in the raw form by both vegetarians and non vegetarians. Items such as cucumber, tomato, onion, carrot and cabbage were used by 20 per cent of lactovegetarians and 26.64 per cent of non-vegetarians in the raw form as salads.

About 33.33 per cent of both lactovegetarians and omnivores were consuming buttermilk regularly on payment basis. Rest of them had the habit of taking buttermilk before they came to the hostel and they would have it when they go home on holidays. None of the subjects had addiction to tea or coffee. Out of 30 subjects, 96.67 per cent were taking two glasses of tea per day. One among the lactovegetarians was consuming tea once a day since she is not much interested in drinking tea.

Among omnivores eighty per cent reported that they had the habit of consuming fish daily. Most of the omnivores (86.67%) reported that they prefer chicken than other meat because it contains less fat. They had the habit of eating chicken at least twice in a month Eighty per cent of omnivores had the habit of eating egg twice a week and the rest (20%) were consuming it occasionally.

The method of cooking generally resorted to at home was also reviewed since the method of cooking is reported to influence utilization of Vitamin A. As far as the method of cooking was concerned in the case of green leafy vegetables, other vegetables roots and tubers and milk, the most frequently used method by lactovegetarian subjects was boiling. Next to boiling was sauting. Frying was found to be used for processing roots and tubers by 13.33 per cent subjects. In the case of omnivores, the most frequently used method for cooking roots and tubers, egg and milk was boiling. In the case of green leafy vegetables and other vegetables, most frequently used method was sauting. Frying method was employed for cooking roots and tubers by 46.67 per cent; for meat by 40 per cent; for other vegetables by 33.33 per cent and for egg by 13.33 per cent of the subjects. The most common method employed for processing non vegetarian foods was found to be frying.

To understand the basic knowledge of the respondents relating to vitamin A/β-carotene, as an important nutrient certain questions were asked since knowledge has been reported to influence food habits. The information thus collected are detailed below:

* None of the subjects had participated in Vitamin A prophylaxis programme and 46.67% of lactovegetarians and 33.33% omnivores had no knowledge about National Vitamin A Prophylaxis Programme.

* All subjects (100%) opined that vitamin A deficiency would cause blindness.

* Out of 30 subjects, 33.33 per cent of lactovegetarians and 53.33 per cent of omnivores were aware that night blindness is the major sign of vitamin A

deficiency while three lactovegetarians (20%) and two omnivores (13.33%) said that Xeropthalmia is caused by Vitamin A deficiency. Only two per cent (6.67%) of omnivores mentioned that infection can cause vitamin A deficiency.

* About 40% of lactovegetarians and 60.67 per cent of omnivores opined that mango and papaya are rich sources of vitamin A while 33.33% of both the groups mentioned about green leafy vegetables as vitamin A rich food. Only 6.67 per cent lactovegetarians had knowledge about red palm oil, the richest source of Vitamin A of vegetable origin.

* Out of the 30 subjects, 33.33% from both groups identified bread and vanaspathy as foods fortified with vitamin A while 6.6% omnivores opined that milk is also fortified with Vitamin A.

* When asked about the factors affecting Vitamin A utilization, 40 per cent of lactovegetarians and 80% of omnivores opined that iron deficiency anaemia can lead to vitamin A deficiency.

* Only two lactovegetarians (13.3%) and three (20%) omnivores had known that hookworm infestation can cause vitamin A deficiency.

* Only 46% of lactovegetarians and 40% of omnivores had a positive opinion about their food habits. Rest of the lactovegetarians opined that their diet is lacking in protein. The omnivores were of the view that non-vegetarian foods are expensive and supplies more fat which may cause indigestion.

4.3 MEAL PATTERN OF THE SUBJECTS

As the subjects were residents of a college hostel, the diet schedule of the college hostel for a period of seven days was reviewed two times within a period of one month in order to study the meal pattern. It was interesting to note that among lactovegetarians 13.33 per cent were staying in the hostel for the last four years; 20 per cent for three years; 6.67 per cent for two years and the rest (60%) were staying from last year. In the case of omnivores 20 per cent were staying in the hostel for last six years; 13.33 per cent since three years; 46.67 per cent since two years and the rest 20 per cent were staying from last year onwards (Table 3).

Table 3 Years of residence in the hostel by the subjects

No. of years	Lactovegetarians		Omnivores		Total	
	Number	%	Number	%	Number	%
6	0	0.00	3	20.00	3	10.00
4	2	13.33	0	0.00	2	6.67
3	3	20.00	2	13.33	5	16.67
2	1	6.67	7	46.67	8	26.66
1	9	60.00	3	20.00	12	40.00
Total	15	100.00	15	100.00	30	100.00

The weekly diet schedule observed during two alternate weeks in a month are detailed in Tables 4 & 5.

Table 4 Meal pattern over a week

(I Phase)

Day	Meal	Menu
I Monday	Breakfast Lunch Evening tea Dinner	Tea/coffee, Puttu, Bengal gram (whole) curry Rice, pumpkin curry, brinjal saute/fish fry Tea/Coffee, mixture Rice, raw banana saute, beans thoran, rasam
II Tuesday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, Appam, carrot-potato curry Rice, onion flower thoran, brinjal saute/fish fry, sambar(with tomato, carrot, bringal and ladies finger) Tea/Coffee, plantain (Robusta, ripe) Rice, ladies finger - beans thoran/fish fry, tomato onion curry, rasam.
III Wednesday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, Uppuma, green-peas curry Rice, ladies finger thoran, raw banana saute/fish curry, buttermilk Tea/Coffee, banana bajji Rice, beans thoran, yam curry, rasam
IV Thursday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, Poori, Potato curry Rice, greengram with snake gourd thoran, carrot saute/fish fry, Theeyal (potato, ladies finger, cucumber) Tea/Coffee, bun Rice, tomato-onion salad/fish fry, rasam
V Friday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, bread, jam, butter/egg omelette Rice, pumpkin with green gram curry, curd/fish fry, vegetable curry (cucumber, potato, ashgourd, drumstick, yam) Tea/Coffee, parippu vada Rice, potato curry, cabbage thoran, rasam

VI Saturday	Breakfast Lunch Evening tea Dinner	Tea//Coffee, iddli coconut chutney Rice, fish curry/bitter gourd fry, ladies finger thoran, sambar (carrot, tomato, ashgourd, cucumber) Tea/Coffee, mixture Rice, cauliflower curry/fish fry, carrot-beans thoran, rasam
VII Sunday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, masala dosa, coconut chutney Rice, cabbage thoran, curd, beef curry, coconut chutney Tea/Coffee, banana chips Rice, beans thoran, raw banana sauat, rasam

Table 5 Meal pattern over a week
(II Phase)

Day	Meal	Menu
I Monday	Breakfast Lunch Evening tea Dinner	Tea/coffee, uppuma, plantain (robusta ripe) Rice, green gram thoran, raw banana thoran/fish fry, pulissery Tea/Coffee, black gram vada Rice, cowpea thoran, tomato onion salad, rasam
II Tuesday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, dosa, bengal gram (whole) curry Rice, green gram curry, bread fruit thoran / fish fry Tea/Coffee, mixture Rice, cucumber pachadi, scrambled egg/beans thoran, rasam
III Wednesday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, bread, jam, butter/egg omelette Rice, brinjal saute/fish fry, aviyal (raw banana, carrot, brinjal), sambar (with potato, tomato, carrot, cucumber) Tea/Coffee, banana (ripe) Rice, potato saute, ladies finger thoran, rasam
IV Thursday	Breakfast Lunch Evening tea	Tea/Coffee, Puri, vegetable curry (Green peas and potato) Rice, snake gourd green gram thoran, raw banana saute/fish fry, pumpkin with green gram curry Tea/Coffee, pineapple

	Dinner	Rice, carrot-beans saute, tomato-onion salad, rasam
V Friday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, appam, bengal gram (whole) curry Rice, red gram thoran, fish curry/tomato-onion salad, green gram curry Tea/Coffee, bread toast Rice, cabbage thoran/fish fry, aviyal, rasam
VI Saturday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, idli, sambar (carrot, cucumber, tomato) Rice, pumpkin-green gram curry, ladies finger pachadi, beans thoran/fish fry Tea/Coffee, parippu vada Rice, raw banana saute, beans thoran/fish fry, rasam
VII Sunday	Breakfast Lunch Evening tea Dinner	Tea/Coffee, masala dosa, coconut chutney Rice, cabbage, \ beef curry, cucumber curry, coconut chutney Tea/Coffee, black gram vada Rice gruel, green peas thoran, pappadam

Meal		Time
Breakfast	-	7.00 AM
Lunch	-	12.00 Noon
Evening tea	-	3.30 PM
Dinner	-	7.00 PM

The general meal pattern consisted of an early morning tea, followed by four square meals such as breakfast, lunch, evening tea with a snack and dinner. The menu for each meal varied over a wide range.

Though black tea was served early in the morning, none of the subjects were consuming it daily. Tea/coffee with milk served for a second time along with breakfast was consumed daily by all the subjects except one lactovegetarian.

The menu for breakfast varied from one day to another over a period of seven days starting with puttu and bengal gram curry followed by appam with vegetable curry (carrot, potato), uppuma with green peas curry, puri with potato curry, bread with jam and butter/egg omelette, idli with chutney, and dosa with chutney during the first week of observation (Table 4). In the second phase of seven days it was found that starting with uppuma with plantain, dosa with bengalgram curry, bread with jam and butter/egg omelette, puri and vegetable curry (carrot, potato) appam with bengal gram curry, idli with sambar, masala dosa with chutney were the dishes served for breakfast.

It was noticed that there was no variation in the items served for breakfast between vegetarians and non-vegetarians except when bread was served as the major item; while the nonvegetarians received egg omelette , the lactovegetarians were served with butter and jam. However the omnivores were also given the freedom to consume butter and jam along with bread and omelette.

As a routine the lunch consisted of rice with three vegetable dishes (one in a liquid form (curry) with gravy) and pappadam. The vegetable dishes as a rule comprised of a curry, thoran and saute. The vegetables used for the curry included pumpkin, brinjal, tomato, yam, ladies finger, potato and cucumber during the 1st phase and potato, tomato, ladies finger, carrot and pumpkin during the 2nd phase. Vegetables used for sauting/thoran were brinjal, onion flower, raw banana, snake gourd, ladies finger, carrot, bittergourd and cabbage during the 1st phase and bread fruit, red gram / green gram with snakegourd, cabbage, beans and green peas were served during the 2nd phase.

In the case of nonvegetarians one vegetable dish was replaced by fish curry/fish fry on a regular basis. Egg and curd are optional items which may be served on demand by the incumbents for which they have to pay additional amount over and above the regular mess bill. Curd is an item specially served on Sunday for lunch for both lactovegetarians and omnivores. In the case of omnivores beef was served on all Sundays.

Tomato-onion salad with curd and ladies finger pachadi were served in the 2nd phase for vegetarians instead of fish curry.

Evening tea consisted of tea/coffee served with baked or fried items like mixture, plantain, banana bajji, bun, parippuvada and banana chips during the 1st phase and blackgram dhal vada, mixture, parippu vada and fruits like banana, pineapple were served during the 2nd phase as snacks for evening tea.

The menu for dinner as a routine consisted of rice with two vegetable dishes and rasam. Instead of one vegetable dish, fish was served for non vegetarians three days during the 1st phase and two days during the 2nd phase. Vegetable curry consisted of yam, potato tomato and cauliflower served during dinner. In the second phase no curry was served during dinner. The inmate received only rasam alongwith a vegetable saute. Vegetables used for thoran/saute were beans/ladies finger/ cabbage/ carrot with beans/raw banana during the 1st phase and cowpea/beans/ladies finger/potato/carrot with beans/cabbage/raw banana/green peas during the 2nd phase.

Tomato onion salad was served two times during the 2nd phase and once during the 1st phase. Cucumber pachadi and scrambled egg was served once during the 2nd phase. Instead of rice, rice gruel was served once during the 2nd phase for dinner.

Being a hostel diet, though the general meal pattern follows a prescribed and structured norm, the inmates were free to consume extra items of food such as banana chips, potato chips, biscuits, chocolates, sipup, icecream, ripe banana, curd and buttermilk on payment of extra amount over and above the charges levied for the regular meals. These extra items consumed may bring about variations in the individual consumption pattern. The data revealed that omnivores consumed extra foods less frequently than lactovegetarians. These extra items were consumed either with major meals or in between meals.

Table 6 In between meal frequency of subjects

Item	Lactovegetarins (%)			Omnivores (%)		
	Daily	Weekly once	Weekly twice	Daily	Weekly once	Weekly twice
Potato chips	20.00	6.66	26.67	6.66	26.67	20
Sipup	-	6.66	26.67	-	-	-
Chocolates	-	20.00	6.66	-	13.33	6.66
Icecream	-	6.66	-	-	6.66	-
Groundnut	-	6.66	20.00	-	33.31	20.00
Soft drinks	-	-	20.00	-	-	-

Most frequently used items consumed in between the major meals was reported to be potato chips, which was used daily by 20 per cent of lactovegetarians and 6.66 per cent of omnivores; 6.66 per cent lactovegetarians and 26.67 per cent of omnivores used it once in a week; 26.61 per cent of lactovegetarians and 20 per cent of omnivores consumed it twice in a week. As shown in Table 6 about 27 per cent of lactovegetarians consumed sipup twice a week while 6.66 per cent had it once in a week. About 13 per cent of the omnivores reported that they consumed it occasionally. Twenty per cent of lactovegetarians and 13.33 per cent of omnivores were in the habit of consuming chocolates once in a week; 6.66 per cent from both the groups consumed it twice in a week while 33.3 per cent of omnivores consumed it occasionally. Ice cream was consumed by 6.66 per cent of subjects from both groups once in a week. About half of the omnivores and 13.33 per cent of lactovegetarians had the habit of eating ice cream only occasionally; 6.66 per cent of lactovegetarians and 33.31 per cent of omnivores consumed groundnuts once in a week and 20 per cent of lactovegetarians as well as omnivores consumed it twice in a week. Twenty per cent of lactovegetarians consumed soft drinks twice a week while 20 per cent of omnivores consumed it occasionally.

4.4 PERCAPITA SUPPLY AND AVAILABILITY OF FOODS FROM HOSTEL DIET

Percapita supply and availability of foods from the hostel diet was calculated in order to assess whether the hostel diet is adequate to meet the RDA; in other words, to see whether the hostel diet is balanced or not.

The data given in Table 7 revealed that the hostel diet is ill balanced; while it supplies an excess amount of cereals, roots as well as other vegetables (when compared with RDA) it seems to be deficient in all other foods. The deficiency or inadequacy of different food groups was found to vary over a wide range. The supply of leafy vegetables for each individual in the hostel is only 1.79 g against the RDA of 125 g. This is the most inadequate item of the hostel diet.

The pulse consumption by lactovegetarians was found to be 65 per cent less than the RDA (60 g) and that of omnivores was 53 per cent short of RDA (45 g) because their requirement is lower (45 g) than that of lactovegetarians (60 g). The fat/oil supply was found to meet only half of the RDA.

As far as the omnivores were concerned, the availability of non vegetarian foods especially fish was much above the requirement (210.3 g against the RDA of 30 g) while the availability of meat and egg was only half of the RDA. The RDA for milk for omnivores is less (100 ml) when compared to lactovegetarians (200 ml) and the percapita availability of milk and milk products was 134.83 ml which is enough to meet the RDA of omnivores but it was insufficient to meet the requirement of lactovegetarians. The lactovegetarians received only 67.41 ml/day.

In general the percapita availability of important food groups like leafy vegetables, pulses, fruits, oil, milk (for lactovegetarians), meat and egg and oil (for omnivores) were found to be inadequate whereas the supply of cereals, other vegetables, roots and tubers (for lactovegetarians and omnivores) and milk and milk products and fish (for omnivores) were found to be in excess. Hence the hostel diet is found to be an ill balanced once.

Table 7 Average percapita availability of foods supplied through the hostel diet

	Average percapita availability	Lactovegetarians		Omnivores	
		RDA*	% adequacy	RDA**	% adequacy
Cereals (g)	341.96	300 g	113.67	300 g	113.67
Pulses (g)	20.98	60 g	34.97	45 g	46.62
Leafy vegetables (g)	1.79	125 g	1.43	125 g	1.43
Roots and tubers (g)	83.48	50 g	166.96	50 g	166.96
Other vegetables	113.39	75 g	150.67	75 g	150.67
Fruits (g)	10.71	30 g	35.7	30 g	35.7
Milk (ml)	134.82	200 ml	67.41	100 ml	134
Fish (g)	63.09	0	0	30 g	210.3
Meat and egg (g)	15.48	0	0	30 g	51.6
Oil (g)	15.53	30 g	52.1	35 g	44.66

*RDA for vegetarians

** RDA for non-vegetarians

(ICMR, 1977)

4.5 FOOD USE FREQUENCY

The frequency of use of different foods in the general meal pattern was assessed through one month inventory survey and was averaged for one week (7 days) and the above details were used to calculate "food use frequency score" based on the modality suggested by Reaburn et al. (1979). The mean food use frequency score computed for lactovegetarians and omnivores are given in Table 8.

Table 8 Food use frequency scores

Food groups		Frequency score	
		Lactovegetarians	Omnivores
Cereals		100.00 %	100.00 %
Pulses		84.98 %	84.98 %
Vegetables	Leafy vegetables	96.68 %	90.00 %
	Roots and tubers	98.33 %	96.68 %
	Other vegetables	95.00 %	91.67 %
Fruits		62.22 %	53.33 %
Milk		100.00 %	100.00 %
Fats and oil		100.00 %	100.00 %
Sugar and jaggery		100.00 %	100.00 %
Fleshy foods	Meat	Nil	53.33 %
	Fish	Nil	91.12 %
	Egg	Nil	56.67 %

The data presented in the above table indicates that both lactovegetarians and omnivores secured a food use frequency score of 100 with respect to consumption of cereal, milk, nuts and oil seeds, fats and oils and sugar and jaggery, which reveals that these are basic foods (like rice) or accessory food adjuants (like oil, sugar or coconut) which were consumed daily irrespective of the food habit. The frequency of use of milk has received a score of 100 by both lactovegetarians and omnivores only because they consumed tea/coffee every day which was always served with milk.

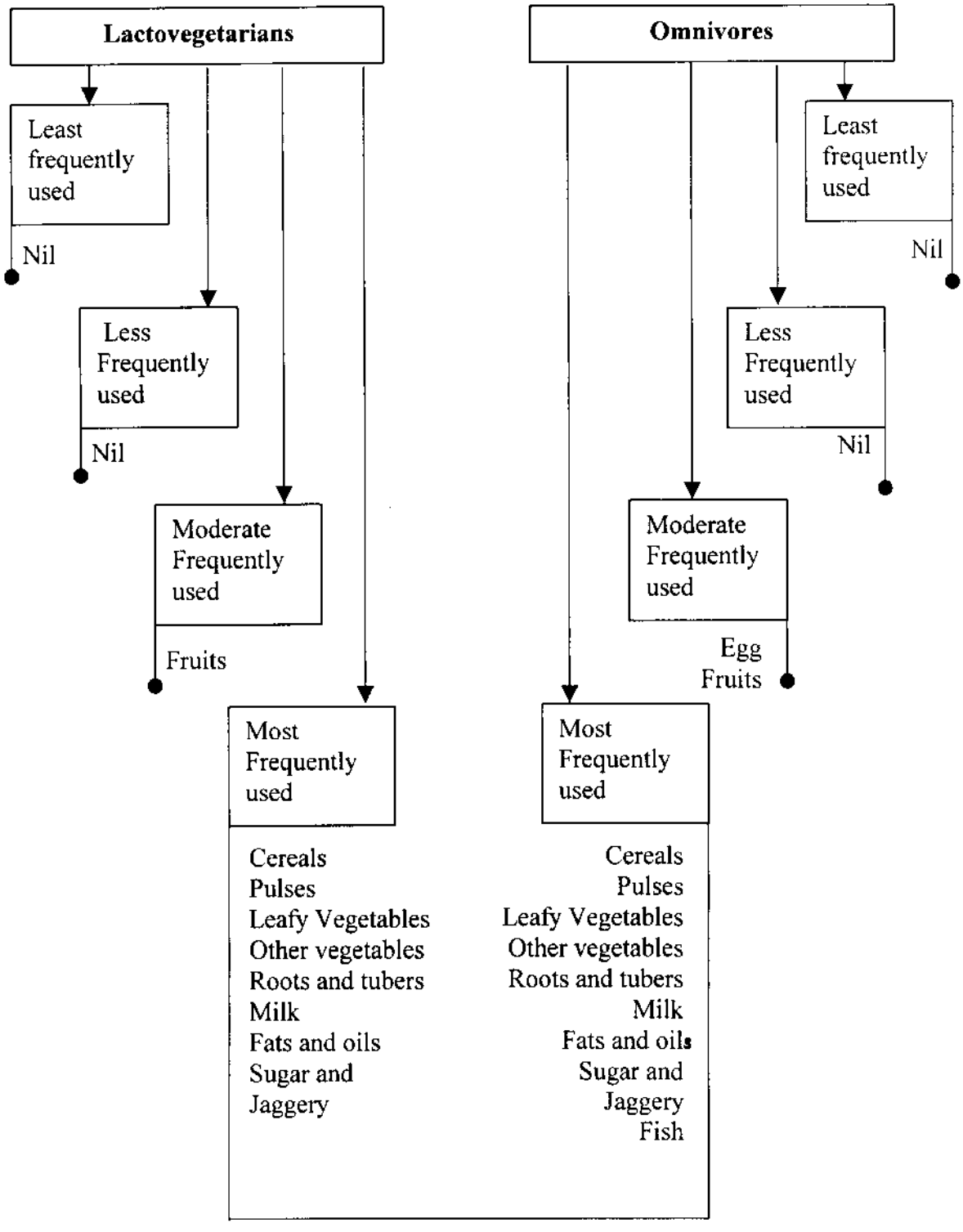
It was surprising to note that there was no profound variation in the frequency of use of vegetables by vegetarians and omnivores; the frequency ranged between 95 to 98 per cent in the case of vegetarians and between 90-96 per cent in the case of omnivores. The lack of disparity was also evident when frequency of use of the three groups of vegetables such as green leafy vegetables other vegetables and roots and tubers were compared between the two groups. In the case of green leafy vegetables, the frequency was 96.68 per cent for lactovegetarians while it was only 90 per cent for omnivores. The variation in the consumption of roots and tubers and other vegetables were about 2 percent and 4 per cent respectively higher among lactovegetarians when compared to omnivores.

Another important point which comes to the lime light from the above table is the frequency of use of pulses. Though pulses are reported to be "poor man's meat", and source of proteins for lactovegetarians, its frequency of use did not differ between omnivores and lactovegetarians (84.98 per cent for both groups). However a clearcut variation in frequency of use was noticed between the two groups with respect to consumption of fruits. The frequency score was 62.22 per cent for lactovegetarians while it was only 53.33 per cent for omnivores indicating a more frequent consumption of fruits by lactovegetarians over the omnivores.

Though fleshy foods were consumed only by omnivores, the frequency of consumption of the three common animal foods by them indicated that the frequency of consumption of fish was much higher (91.12%) than that of either egg (56.67%) or meat (53.33%). Though omnivores, the frequency of consumption of meat was found to be much lower than that of fish.

Based on the mean scores obtained for the different categories of foods consumed by the two groups of subjects the items of foods were further classified into four groups. Those which had scores in the range of 76-100, 51-75, 26-50 and less than 25 were segregated as "most frequently used", "moderately used", "less frequently used" and "least frequently used" foods respectively. The variation in frequency of use of different food groups by lactovegetarians and omnivores are shown in figure 1

Figure 1
Frequency of use
of different food groups



Both lactovegetarians and omnivores had scores ranging from 75-100 for cereals, pulses, leafy vegetables, roots and tubers, other vegetables, milk and milk products, fats and oils, sugar and jaggery, being the most frequently used ones. The omnivores also had fish over and above the foods mentioned above as "most frequently used" while both groups consumed fruits with "moderate frequency" (scores between 51-75 per cent). The omnivores also consumed egg and meat in the above frequency range. As the calculated food use frequency score of all the food groups consumed by the subjects (both lactovegetarians and omnivores) were above 50 per cent, it was observed that there were no food groups which could be categorised as "less frequently used" and "least frequently used" which points out the fact that the meals served in the hostel are more or less balanced. supplying foods from all the different food groups.

4.6 FOOD AND NUTRIENT INTAKE OF THE SUBJECTS

4.6.1 Actual Food Intake of the Respondents

The actual food intake of the subjects were calculated from the data collected through a weighment survey. The weighment survey was conducted for a period of seven days, following the method suggested by Thimmayamma and Rau (1996). The weight of all raw foods used, the weight of cooked foods (preparation) the quantity of each preparation consumed by each of the 30 subjects, were actually measured and recorded over a period of seven consecutive days. From this raw equivalents were calculated. By averaging the quantity of different foods consumed by each person, over a period of seven days the average percapita food intake of the individual subjects were arrived at. The average food intake of individual subjects are given in Appendix II(a) and II(b).

The average percapita intake of different foods by individual subjects belonging to lactovegetarian and omnivore groups are presented in Tables 9 to 17 and the details of consumption of foods belonging to different foods groups in comparison with RDA are explained below.

Table 9 Consumption of cereals and cereal products

Average amount consumed in g (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
50 – 100	2	13.33	-	-	2	6.67
101 – 150	-	-	2	13.33	2	6.67
151 – 200	7	46.67	3	20.00	10	33.33
201 - 250	1	6.67	6	40.00	7	23.33
251 – 300	4	26.67	2	13.33	6	20.00
301 - 350	1	6.66	2	13.34	3	10.00
Total	15	100.00	15	100.00	30	100.00

RDA – 300 g

The cereal consumption varied from 70 to 350 g against the RDA of 300 [Appendix II(a) and II(b)]. About 50 per cent of the lactovegetarians were found to consume 150 to 200 g per day on an average while 26.67 per cent consumed 250 to 300 g (Table 9). It was found that only 13.33 per cent lactovegerians and 6.67 percentage omnivores had an intake equal to RDA. There was wide variation in the consumption of cereals by omnivores *i.e.*, 40 per cent were consuming 200 to 250 g per day while 20 per cent were consuming only 151 to 200 g. Among the 30 subjects 33.33 per cent were found to consume 151 to 200 g of cereals.

Table 10 Consumption of pulses

Average amount consumed in g (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
<10	-	-	1	6.67	1	3.33
10 – 20	5	33.33	5	33.33	10	33.34
21 – 30	2	13.33	1	6.67	3	10.00
31 – 40	1	6.67	-	-	1	3.33
41 – 50	-	-	1	6.67	1	3.33
51 – 60	2	13.33	2	13.33	4	13.34
61 – 70	3	20.00	5	33.33	8	26.67
71 – 80	1	6.67	-	-	1	3.33
> 100	1	6.67	-	-	1	3.33
Total	15	100.00	15	100.00	30	100.00

RDA : Lactovegetarian – 60 g

Omnivores – 45 g

The pulse consumption varied from 9 to 138 g among the subjects against the RDA of 60 g and 45 g for lactovegetarians and omnivores respectively [Appendix II(a) and II(b)]. Among the subjects 33.33 per cent of both groups were consuming 10 to 20 g per day on an average. About 33.33 per cent omnivores and 20 per cent lactovegetarians were found consume 61 to 70 g (Table 10). One lactovegetarian was found to consume 138.72 g which is two times above the RDA. It was found that only one lactovegetarian (6.67 per cent) and one omnivore (6.67 per cent) had an intake almost equal to that of RDA.

Table 11 Consumption of green leafy vegetables

Average amount consumed in g (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
0 – 5	2	13.33	2	13.33	4	13.33
6 – 10	6	40.00	9	60.00	15	50.00
11 – 15	1	6.67	-	-	1	3.33
16 – 20	6	40.00	4	26.67	10	33.34
Total	15	100.00	15	100.00	30	100.00

RDA : 125 g

The consumption of green leafy vegetable was very low *i.e.*, in the range of 2 to 18 g against the RDA of 125 g [Appendix II(a) and II(b)]. It was found that 60 per cent of omnivores and 40 per cent of lactovegetarians were consuming only 6 to 10 g. About 40 per cent lactovegetarians and 26.67 per cent of omnivores were found to consume 16 to 20 g (Table 11) of leafy vegetables, which indicates that none of the subjects were taking leafy vegetables in required amounts.

Table 12 Consumption of roots and tubers

Average amount consumed in g	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
<50	12	80.00	11	73.33	23	76.67
>50	3	20.00	4	26.67	7	23.33
Total	15	100.00	15	100.00	30	100.00

RDA : 50 g

The recommended daily allowance for roots and tubers is 50 g. The root and tuber intake of the entire subjects ranged from 26.30g to 60.17 g [Appendix II(a) and II(b)]. In the present study 80 per cent of lactovegetarians and 73.33 per cent of omnivores were found to consume less than 50 g and only three (20 per cent) lactovegetarians and four (26.67 per cent) omnivores had an intake above 50 g (Table 12). One lactovegetarian (60 g) and one omnivore (68 g) were found to consume 10 g and 16 g respectively above the RDA (50 g).

Table 13 Consumption of other vegetables

Average amount consumed in g (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
<25	1	6.67	1	6.67	2	6.67
25 – 50	-	-	5	33.33	5	16.67
51 – 75	9	60.00	8	53.33	17	56.66
76 - 100	5	33.33	1	6.67	6	20.00
Total	15	100.00	15	100.00	30	100.00

RDA : 75 g

The consumption of other vegetables ranged from 16 to 94 g against the RDA of 75 g [Appendix II(a) and II(b)]. Out of 30 subjects 56.66 per cent (60 per cent lactovegetarians and 53.33 omnivores) were found to consume 51 to 75 g of other vegetables (Table 13). About 33.33 per cent lactovegetarians and 6.67 per cent of omnivores were found to have a higher intake of other vegetables above the recommended allowance but

one lactovegetarian and 40 per cent of omnivores were found to be deficient as compared to RDA. There were only two (13.33 per cent) lactovegetarians and one (6.67 per cent) omnivore who had an adequate intake.

Table 14 Consumption of fruits

Average amount consumed in g (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
5 – 10	1	6.67	5	33.33	6	20.00
11 – 15	3	20.00	1	6.67	4	13.33
16 – 20	1	6.67	1	6.67	2	6.67
21 – 25	-	-	1	6.67	1	3.33
26 – 30	2	13.33	-	-	2	6.67
31 – 35	-	-	2	13.33	2	6.67
36 – 40	2	13.33	1	6.66	3	10.00
>40	6	40.00	4	26.67	10	33.33
Total	15	100.00	15	100.00	30	100.00

RDA : 30 g

Consumption of fruits ranged form 5 to 83 g against the RDA of 30 [Appendix II(a) and II(b)]. It was found that 53.33 per cent of lactovegetarians and 46.96 per cent of omnivores were found to consume fruits above RDA. About 33.33 per cent omnivores were consuming only 5 to 10 g of fruits (Table 14). There were only two lactovegetarians (13.33 per cent) and three omnivores (20.00 per cent) who were found have

an adequate intake of fruits with respect to RDA. It was found that 33.33 per cent of the subjects were found to be consuming more than 40 g fruits per day on an average.

Table 15 Consumption of milk

Average amount consumed in ml (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
< 100	2	13.33	1	6.67	3	10.00
100 – 150	11	73.33	12	80.00	23	76.67
151 – 200	1	6.67	2	13.33	3	10.00
201 - 250	1	6.67	-	-	1	3.33
Total	15	100.00	15	100.00	30	100.00

RDA : Lactovegerarians - 200 ml

Omnivores – 100 ml

The RDA for milk in the case of lactovegetarians is reported to be 200 ml and that of omnivores as 100 ml by ICMR. It was found that the milk consumption ranged from 96.65 ml to 244.29 ml for lactovegetarians and 98.44 ml to 164.8 ml for omnivores [Appendix II(a) and II(b)]. About 73.33 per cent lactovegetarians and 80 per cent omnivores were consuming 100 to 150 ml milk per day while 6.67 per cent lactovegetarians and 13.33 per cent omnivores were found to consume 151 to 200 ml (Table 15). When compared to RDA none of the lactovegetarians had an adequate intake. Among omnivores two (13.33 per cent) subjects had an adequate intake.

As fleshy foods like fish, meat and egg were consumed by omnivores only the details relating to individual consumption by omnivores are given below.

Table 16 Consumption of fishes and other sea foods

Average amount consumed in g (range)	Omnivores	
	No.	%
<10	1	6.67
10 – 20	1	6.67
21 – 30	7	46.66
31 - 40	3	20.00
41 - 50	3	20.00
Total	15	100.00

RDA : 30 g

The consumption of fishes and other sea foods were in the range of 13.93 to 43 g against the RDA of 30 g [Appendix II(a) and II(b)]. Though it was found that 46.67 per cent of the omnivores were consuming 21 to 30 g of fish (Table 16) only four subjects (26.67 per cent) were having an adequate intake when compared to RDA. However three subjects (20.00 per cent) were found to have an intake above the RDA, while two subjects had a very low (below 15 g) intake when compared to RDA.

Table 17 Consumption of meat and poultry

Average amount consumed in g (range)	Lacto-vegetarians	
	No.	%
0 – 10	3	20.00
11 – 20	4	26.67
21 – 30	5	33.33
31 – 40	2	13.33
41 - 50	-	-
51 - 60	1	6.67
Total	15	100.00

RDA : 30 g

The consumption of meat and poultry was in the range of 4 to 52 g against the RDA of 30 g. Two subjects were found to have a zero intake during the period under report while only three (20 per cent) omnivores had an adequate intake according to RDA. Only one omnivore subject (6.67 per cent) had an intake above RDA of 52.49 g (Table 17).

4.6.2 Dietary Adequacy of Individual Subjects

The nutritional status of the subject were measured initially by a weighment survey. The data collected through the survey was utilized to calculate the percapita intake of different foods (classified into food groups) by the individual subjects categorized into two groups *i.e., viz.,* lactovegetarians and omnivores. The figures derived from this was further used to compute the percapita nutrient intake. The percapita food as well as nutrient intake was ultimately utilized to assess the adequacy of the diet consumed by the individual subjects by comparing it with recommended dietary allowance (RDA) for nutrients suggested by ICMR (1991).

The food intake data revealed that the diet consumed by more than 95 per cent of vegetarians and non–vegetarians were inadequate qualitatively and quantitatively. The diet consumed by 93 to 100 per cent of lactovegetarains were found to be inadequate in cereals, leafy vegetables, milk, fats and oils. Eighty six per cent of omnivores exhibited inadequacy in the consumption of cereal and other vegetables while 73 and 66 per cent respectively exhibited lower intake of roots and animal foods other than fish. The most inadequate dietary components of the diet in general were leafy vegetables and fats and oils since all the 30 subjects had a deficient intake of these two items.

The ill balance in consumption was further accentuated by the fact that with the deficiency of essential foods on one hand, excess consumption of pulses, legumes and fruits (by both omnivores and lactovegetarians) on the other hand would be observed from the data presented in Table 18. About 46.67 per cent of omnivores were found to consume an excess amount of pulses as well as fruits and 53.33 per cent of lactovegetarians were consuming fruits in excess when compared to RDA.

It was also noticed that 40 per cent of omnivores were taking fish in excess while an equal number of omnivores were consuming it inadequately. The meat and egg consumption was found to be inadequate among 66.67 per cent of omnivores while 13.33 were consuming it in excess quantity (Table 18)

Thus the individual food consumption when compared with RDA with respect to different food groups seems to be inadequate and ill balanced. Hence when evaluation of the nutritional status of subjects were done through diet survey, the results indicated that the nutritional status of the subjects would be poor based on their dietary intake.

Table 18 Adequacy of individual food intake

Food groups	Lactovegetarians						Omnivores							
	Adequate		Inadequate		Excess		Adequate		Inadequate		Excess		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Cereals and Cereal products	–		14	93.33	1	6.67	2	13.33	13	86.68	–		15	100.00
Pulses and legumes	1	6.67	10	66.67	4	26.67		–	8	53.33	7	46.67	15	100.00
Leafy vegetables	–	–	15	100.00	–	–	–	–	15	100.00	–	–	15	100.00
Roots and tubers	3	20.00	9	60.00	3	20.00	2	13.33	11	73.33	2	13.33	15	100.00
Other vegetables	1	6.67	9	60.00	5	33.33	1	6.67	13	86.67	1	6.67	15	100.00
Fruits	1	6.67	6	40.00	8	53.33	–	–	8	53.33	7	46.67	15	100.00
Fishes and other sea foods	–	–	–	-	–	–	3	20.00	6	40.00	6	40.00	15	100.00
Meat and egg	–	–	–	–		–	3	20.00	10	66.67	2	13.33	15	100.00
Milk and milk products	–	–	14	93.33	1	6.67	2	13.33	–	–	13	86.67	15	100.00
Fats and edible oil	–	–	15	100.00	–	–		–	15	100.00	–	–	15	100.00
Sugar and jaggery	15	100.00	–	–	–		15	100.00			–	–	15	100.00

4.6.3 Mean Food Intake of the Subjects

Mean food intake of the respondents studied is presented in Table 19. The data presented in the Table 19 reveals that hostel diets were insufficient to meet RDA for food groups such as for cereals, pulses and legumes, roots and tubers, leafy vegetables, other vegetables, milk and fats and oils in the case of both lactovegetarian and omnivores. However it was seen that the intake of fruits was sufficient to meet 114.7 per cent of RDA in the case of lactovegetarian and 93.89 per cent in the case of omnivores. The intake of roots and tubers and other vegetables were 90.03 per cent and 94.29 per cent respectively in the case of lactovegetarians which is higher than that consumed by omnivores (82.66 per cent and 70.26 per cent). Fats and oil consumption of lactovegetarians was 55.45 per cent of RDA which is slightly more than that of omnivores (47.43%). In the case of sugar and jaggery the consumption was adequate. Among the omnivores, consumption of fish (98.64%) was much more than the consumption of meat and poultry (69.30%). The consumption of other vegetables between the two groups seems to be highly significant (2.394**).

Table 19 Mean food intake of the subjects

	LACTOVEGETARIANS			OMNIVORES			
Food Groups	Average intake and SE	RDA	% of RDA met	Average in take and SE	RDA	% of RDA met	t-value
Cereals and cereal Products (g)	199.34 ± 17.15	300	66.45	208.15 ± 15.38	300	69.38	0.369
Pulses and legumes (g)	45.15 ±8.62	60	75.24	37.10 ±6.00	45	82.45	0.740
Leafy vegetables (g)	11.01 ±1.31	125	8.81	9.02 ±1.20	125	7.21	1.087
Roots and tubers (g)	45.02 ±2.17	50	90.03	41.33 ±2.95	50	82.66	0.974
Other vegetables (g)	70.72 ±4.53	75	94.29	52.70 ±3.83	75	70.26	2.934**
Fruits (g)	34.41 ±5.16	30	114.7	28.17 ±4.80	30	93.89	0.856
Fishes and other seafoods (g)	NA	30	NA	29.59 ±2.59	30	98.64	11.051**
Meat and egg (g)	NA	30	NA	20.79 ±3.46	30	69.30	5.802**
Milk and milk products (ml)	121.15 ±9.17	200	60.58	120.60 ±4.61	100	120.60	0.521
Fats and edible oil (g)	16.64 ±0.04	30	55.45	16.60 ±4.61	35	47.43	1.000035
Sugar and jaggery (g)	30 ±0	30	100	30 ±0.00	30	100	Not estimatable

** Significant at 1% level

4.6.4 Nutrient Intake of the Subjects

The nutrient intake of the subjects were calculated from the average intake of different food items derived from the weighment survey data, using the food composition tables. The details of nutrient intake of individual subjects are given in [appendix III(a) and III(b)]. The intake of different nutrients by the subjects belonging to the two groups in comparison with RDA are presented in Tables 20 to 30.

Table 20 Energy intake of the subjects

Energy intake in KCal (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
1200 – 1400	1	6.67	0	0	1	3.33
1401 – 1800	8	53.33	5	33.33	13	43.33
1801 – 2000	5	33.33	3	20.00	8	26.67
2001 – 2200	1	6.67	5	33.33	6	20.00
2201 - 2400	-	-	1	6.67	1	3.33
2401 – 2600	-	-	-	-	-	-
2601 - 2800	-	-	1	6.67	1	3.34
Total	15	100.00	15	100.00	30	100.00

RDA – 1875 KCal

The RDA for energy is 1875 KCal. About 53.33 per cent of lactovegetarians and 33.33 per cent of omnivores were found to have an energy intake 1400 to 1800 KCal which is lower than the RDA (Table 20). Only one lactovegetarian had an energy intake as low as 1271 KCal. Among the 30 subjects more than 40 per cent were found to consume 1400 to 1800 KCal of energy (Table 20). There were only five lactovegetarians who had an adequate energy intake when compared to RDA; while seven omnivores (46.67 per cent) and one lactovegetarian (6.67 per cent) had a higher intake above RDA (above 2000 Kcals).

Table 21 Protein intake of the subjects

Protein intake in g (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
10 – 20	2	13.33	1	6.67	3	10.00
21 – 30	9	60.00	7	46.66	17	56.67
31 – 40	3	20.00	7	46.67	8	26.67
41 – 50	1	6.67	-	-	1	6.66
Total	15	100.00	15	100.00	30	100.00

RDA – 50 g

The protein consumption of the subjects ranged from 17 to 48 g against the RDA of 50 g [Appendix III(a) and III(b)]. About 60 per cent of lactovegetarians and 46.66 per cent of omnivores (56.67 per cent out of 30 subjects) were found to consume 21 to 30 g protein (Table 21). Only one lactovegetarian subject had a protein intake in accordance with RDA while all the other subjects were found to have a deficit intake.

Table 22 Fat intake of the subjects

Fat intake in g (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
61 – 80	14	93.33	1	6.67	15	50.00
81 – 100	-	-	4	26.66	4	13.34
101 – 120	-	-	9	60.00	9	30.00
121 – 140	-	-	-	-	-	-
141 – 160	1	6.67	-	-	1	3.33
161 – 180	-	-	1	6.67	1	3.33
Total	15	100.00	15	100.00	30	100.00

RDA – 20 g

The consumption of fat was very high among the subjects. It varied from 74 to 174 g against the RDA of 20 [Appendix III(a) and III(b)]. All the subjects had an intake more than twice the amount of RDA. About 99 per cent of

lactovegetarians were found to consume 61 to 80 g of fat where as 60 per cent of omnivores consumed 100 to 120 g of fat per day on an average (Table 22). When lactovegetarians and omnivores were compared, omnivores had a higher intake than lactovegetarians. It was observed that 50 per cent of the subjects had an intake in the range of 61 to 80 g.

Table 23 Calcium intake of the subjects

Calcium intake in mg (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
<100	1	6.67	1	6.67	2	6.67
100 - 150	6	40.00	8	53.33	14	46.67
151 – 200	5	33.33	5	33.33	10	33.33
201 – 250	2	13.33	1	6.67	3	10.00
251 – 300	1	6.67	0	-	1	3.33
Total	15	100.00	15	100.00	30	100.00

RDA – 400 mg

The intake of calcium by all subjects were found to be less than 300 mg while the RDA is reported to be 400 mg. About 40 per cent lactovegetarians and 53.33 per cent omnivores were found to consume 100 to 150 mg per day on an average while 33.33 per cent of subjects from both the groups were consuming 151 to 200 mg of calcium (Table 23). Only one lactovegetarian subject had an intake of 265 mg (which is higher than that of others) while 6.67 per cent of subjects from both groups were found to consume less than 100 mg of calcium per day. Out of 30 subjects 46.67 per cent were found to consume calcium in the range of 100 to 150 mg but none of them had an adequate intake.

Table 24 Iron intake of the subjects

Iron intake in mg (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
<10	-	-	-	-	-	-
10 - 19	13	86.67	15	100.00	28	93.33
20 – 30	2	13.33	-	-	2	6.67
>30	-	-	-	-	-	-
Total	15	100.00	15	100.00	30	100.00

RDA – 30 mg

The consumption of iron was found to be in the range of 11 to 23 mg against the RDA of 30 [Appendix III(a) and III(b)]. All the subjects were found to be having a lower intake when compared to RDA. About 86.67 per cent lactovegetarians and all omnivores had an intake between 10 to 19 mg on an average (Table 24). Majority of the subjects (93.33 per cent) had the consumption in the range of 10-19 mg and none had an adequate intake.

Table 25 β-Carotene intake of the subjects

Carotene intake in µg (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
3001 – 4000	14	83.33	14	83.33	28	93.34
4001 – 5000	-	-	1	6.67	1	3.33
5001 – 6000	-	-	-	-	-	-
6001 - 7000	1	6.67	-	-	1	33.33
Total	15	100.00	15	100.00	30	100.00

RDA – 2400 µg

All subjects were found to consume more than 3000 mg of β-carotene against the RDA of 2400 µg. The β-carotene intake ranged from 3100 to 6050 µg among subjects [Appendix III(a) and III(b)]. More than 83 per cent of subjects of both groups were found to be having an intake in the range of 3001 to 4000 µg (Table 25). Vitamin A intake of omnivores were found to be slightly lower when compared to lactovegetarians. Among the 30 subjects one lactovegetarian was found to be having the highest β- carotene intake of 6050 µg.

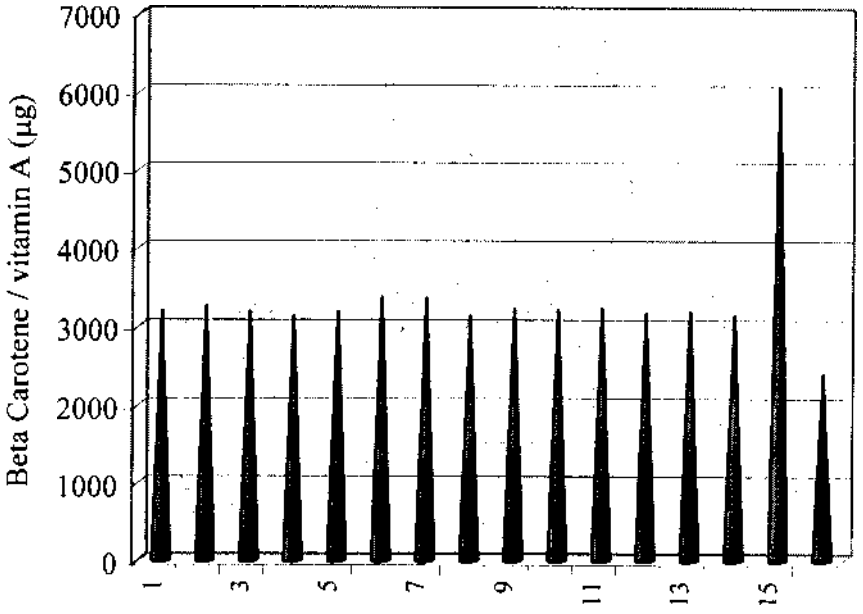


Fig. 2 Beta carotene intake of lactovegetarians

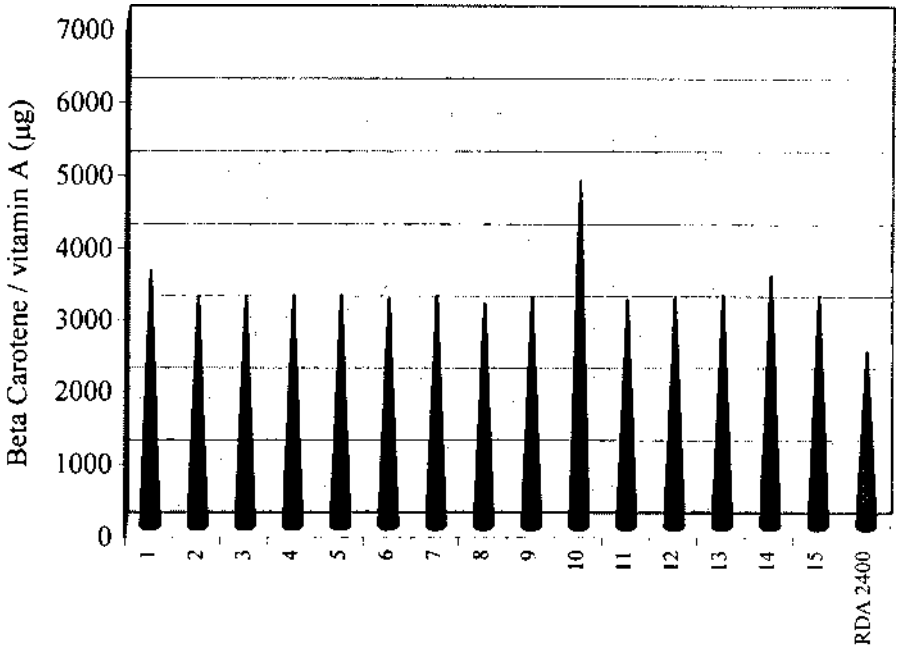


Fig. 3 Beta Carotene intake of omnivores

Table 26 Thiamine intake of the subjects

Thiamine intake in mg (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
0 – 0.50	3	20.00	2	13.33	5	16.67
0.6 – 1.00	12	80.00	13	86.67	25	83.33
> 1.00	-	-	-	-	-	-
Total	15	100.0	15	100.00	30	100.00

RDA – 0.9 mg

The consumption of thiamine was in the range of 0.45 to 1.00 mg against the RDA of 0.90. About 80 per cent of lactovegetarians and 86.67 per cent of omnivores (83.33 per cent out of 30 subjects) were found to consume 0.60 to 1.00 mg of thiamine (Table 26). There were only three subjects (20 per cent) form each group who had an adequate intake of thiamine in the light of recommended dietary allowance.

Table 27 Riboflavin intake of the subjects

Riboflavin intake in mg (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
0 – 0.20	-	-	1	6.67	1	3.33
0.21 – 0.40	12	80.00	13	86.67	25	83.33
0.41 – 0.60	3	20.00	1	6.66	4	13.34
Total	15	100.00	15	100.0	30	100.00

RDA – 1.1 mg

The intake of riboflavin of all the subjects were lower than the RDA (1.1 mg). Among the 30 subjects, 80 per cent of lactovegetarians and 86.67 per cent of omnivores (83.33 per cent out of 30 subjects) were found to consume 0.21 to 0.40 mg of riboflavin (Table 27) which would meet only 1/3 of their RDA.

Table 28 Niacin intake subjects

Niacin intake in mg (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
5 – 10	10	66.67	11	73.33	21	70.00
11 – 15	5	33.33	4	26.67	9	30.00
Total	15	100.00	15	100.00	30	100.00

RDA – 12 mg

In the case of niacin, 66.67 per cent of lactovegetarians and 73.33 per cent of omnivores (70 per cent out of 30 subjects) were found to consume only 5 of 10 mg of niacin against the RDA of 12 mg. About 33.33 per cent of lactovegetarians and 26.67 per cent of omnivores had their niacin intake in the range of 11 to 15 mg (Table 28). There was one lactovegetarian subject and two omnivores who had an adequate intake based on RDA [Appendix III(a) and III(b)].

Table 29 Ascorbic acid (vitamin C) intake of subjects

Vitamin C intake in mg (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
≤ 40	1	6.67	5	33.34	6	20.00
41 – 50	1	6.67	5	33.33	6	20.00
51 – 60	7	46.66	4	26.67	11	36.67
61 - 70	6	40.00	1	6.66	7	23.33
Total	15	100.00	15	100.00	30	100.00

RDA – 40 mg

The intake of ascorbic acid was found to be in the range of 27 to 69 mg against the RDA of 40 mg. All the subjects except one lactovegetarian (6.67 per cent) and five omnivores (33.33 per cent) (Table 29) had an intake above RDA. There was one lactovegetarian subject (6.67 per cent) and three omnivores (20 per cent) who had an adequate intake of Vitamin C.

Table 30 Fibre intake of the subjects

Fibre intake in mg (range)	Lacto-vegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
<2	-	-	-	-	-	-
2.1 – 4	8	53.33	2	13.33	10	33.33
4.1 – 6	6	40.00	13	86.67	19	63.34
61 - 8	1	6.67	-	-	1	3.33
Total	15	100.00	15	100.00	30	100.00

RDA – 40 mg

The intake of fibre was found to be very lower than the required optimum level of 40 g since the intake ranged from 2 to 6.65 g. Majority of the subjects (36.67 per cent) were found to consume fibre in the range of 51 to 60 g. About 40 per cent lactovegetarians and 86.67 per cent (Table 30) omnivores were found to consume 4.1 to 6 g of fibre and one lactovegetarian subject had the highest intake of 6.65 g which is much below the minimum amount of fibre required to maintain a healthy life.

4.6.5 Mean Nutrient Intake of the Subjects

The nutrient content of the diets of lactovegetarians and omnivores were calculated from their mean food intake using food composition table. The adequacy of the diets were assessed by comparing the nutrient intake with RDA. The nutrient intake of the diets consumed by lactovegetarians and omnivores are presented in Table 31. The above table reveals the fact that the diets of both lactovegetarians and omnivores are not adequate from nutritional point of view. The diet of lacto vegetarians were found to supply excess amount of β-carotene (141.42 per cent of RDA) and vitamin C (142.25 per cent of RDA). As far as the omnivores were concerned, the diet seems to be supply excess amount of calorie (105.51 per cent of RDA), carotene (137.12 per cent of RDA) and vitamin C (120.07 per cent of RDA) over and above the RDA. Though the intake of β-carotene and vitamin C were above normal for both groups, the lactovegetarians seems to consume higher amount of these vitamins than omnivores. The diets were found to be deficient with respect to three important nutrients namely protein,calcium and iron both among lactovegetarians and omnivores. Thiamin and niacin were seen

to be consumed in moderate amounts but there is an inadequacy of 15-20 per cent when compared to RDA among both groups. The most deficient nutrient seems to be riboflavin which is deficient to an extend of 70 per cent in both the cases.

Vegetarian dietaries are acclaimed for their fibre content but in the present study fibre seems to be one of the most deficient dietary constituent taken by the subjects and the mean consumption was found to be lower (4.33 ± 0.266) among lactovegetarians when compared to omnivores (4.84 ± 0.165).

Energy intake is an indicator of total adequacy of a balanced diet with special reference to major food components. In the present study the diets of lactovegetarians are found to be deficient by about 10% while the omnivores were consuming a diet which is adequate in calories but just about five per cent above RDA.

In general, the contents of Table 31 ascertains that nutrient intake of both vegetarians and non vegetarians are ill balanced. As far as the nutrient intake is taken into accounts, though much variation is not seen between the two groups, a positive and significant variation between lactovegetarians and omnivores are seen as far as their average intake of energy (2.676*) and ascorbic acid (2.403*) are concerned.

Table 31 Mean nutrient intake of the subjects

	LACTOVEGETARIANS			OMNIVORES		
Nutrients	Average intake SE	RDA**	% of RDA met	Average in take of SE	% of RDA met	t-value
Protein (g)	29.75 ± 1.78	50	59.49	29.25 ± 1.26	58.50	0.219
Energy (Kcl)	1723.63 ±47.75	1875	91.93	1978.27 ±78.57	105.51	2.676*
Calcium (mg)	160.89 ±12.48	400	40.22	141.85 +10.28	35.46	1.138
Iron (mg)	16.44 ±0.74	30	54.81	15.73 ±0.56	52.43	0.744
β-Carotene (μg)	3394.10 ±84.16	2400	141.42	3290.99 ±03.97	137.12	0.471
Thiamine (mg)	0.77 ±0.04	0.9	85.71	0.771 ±0.03	85.17	0.093
Riboflavin (mg)	0.33 ±0.02	1.1	30.00	0.34 ±0.02	31.04	0.440
Niacin (mg)	9.49 ±0.58	12	79.14	9.79 ±0.53	81.56	0.360
Vitamin-C (mg)	56.89 ±2.51	40	142.25	48.03 ±2.54	120.07	2.403*
Fibre (g)	4.33 ±0.26	40	10.83	4.84 ±0.17	12.11	1.60

*Significant at 5% level ** ICMR, 1991

4.6.6 Nutrient Adequacy of Individual Subjects

The adequacy of nutrient intake by the individual subjects as presented in Table 32 revealed that all the subjects were found to have an inadequate intake of protein, calcium, iron, riboflavin as well as fibre. About 33.33 per cent of lactovegetarians and 13.33 per cent of omnivores were found to have an adequate intake of energy while one lactovegetarian (6.67 per cent) and 53.33 per cent omnivores had an excess intake.

Another interesting observation was that all subjects were consuming carotene and fat in excess of their requirement. The vitamin C consumption of 93.33 per cent lactovegetarians and 73 per cent omnivores was found to be in excess while one lactovegetarian and two omnivores (13.33 per cent) had an inadequate intake. More than 80 per cent of the candidates in this study had a deficient intake of the two essential B complex vitamins namely thiamine and niacin while all the subjects had low intake of riboflavin. In general, there is not much difference in nutrient intake observed between the subjects belonging to the two groups.

Table 32 Adequacy of individual nutrient intake

Nutrient	Lactovegetarians						Omnivores							
	Adequate		Inadequate		Excess		Adequate		Inadequate		Excess		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Protein (g)	-	–	15	100.00	–	–	–	–	15	100.00	–	–	30	100.00
Fat (g)	–	–	–	–	15	100.00	–	–	–		15	100.00	30	100.00
Energy (KCal)	5	33.33	9	60.00	1	6.67	2	13.33	5	33.33	8	53.33	30	100.00
Calcium (mg)	-	–	15	100.00	-	–	–	–	15	100.00	–	–	30	100.00
Iron (mg)	–	–	15	100.00	–	-	–	–	15	100.00	–	–	30	100.00
Carotene (μg)	–	–	–	–	15	100.00	–	–	–	--	15	100.00	30	100.00
Thiamine (mg)	1	6.67	12	80.00	2	13.33	2	13.33	12	80.00	1	6.67	30	100.00
Riboflavin (mg)	–	–	15	100.00	–	–	--	--	15	100.00	–	–	30	100.00
Niacin (mg)	2	13.33	12	80.00	1	6.67	–	–	13	86.67	2	6.67	30	100.00
Vitamin C (mg)	–	–	1	6.67	14	93.33	2	13.33	2	13.3	11	73.33	30	100.00
Fibre (g)	–	–	15	100.00	–	--	--	–	15	100.00	–	–	30	100.00

4.7 VITAMIN A/β-CAROTENE SCORE

As the study primarily aims to assess the Vitamin A profile as well as the nutritional status of the selected subjects, the vitamin A intake had to be assessed. This was done by computing Vitamin A scores. All foods consumed by individual subjects (data collected from the 7 day weighment survey) were scored based on their β-carotene/vitamin A content as suggested by Bamji et al. (1996) and modified to suit the current study. In this context a score of `1' was given to an item that supplies less than 100/ µg of Vitamin A/β-carotene per 100 g of the substance and items containing every additional 100/ µg/100g was given an additional score of `1' point each. Thus a food item containing vitamin A/β-carotene in the range of 101-200/µg/100g would have a score of "2", while that supplying 201 to 300 µg would get a score of 3. Thus the minimum score was found to be `1' and the maximum score was 32, because in the present study the values for β-carotene content of different food items consumed by the subjects ranged from 100 to 3200 µg/100 g.

Based on the items of food consumed by the individual subjects (consolidated from the weighment survey data) vitamin A scores were worked out for each participant in the study. The average score for lactovegetarians and omnivores were also worked out from individual scores. The individual vitamin A/β-carotene scores are given in Table 33.

Table 33 Vitamin A scores of individual subjects

Sl.No.	Lactovegetarians	Sl.No.	Omnivores
1.	218	16.	209
2.	218	17.	158
3.	216	18.	160
4.	216	19.	159
5.	192	20.	190
6.	193	21.	219
7.	183	22.	170
8.	192	23.	101
9.	161	24.	167
10.	257	25.	160
11.	296	26.	172
12.	278	27.	213
13.	274	28.	206
14.	266	29.	186
15.	249	30.	194
	Mean = 227.27		Mean = 177.6

t = 3.823*

The data presented Table 33 revealed that the scores of the lactovegetarians ranged from 161 to 296 and from 101 to 219 among omnivores. When the lactovegetarians and the omnivores were classified in to groups based on the range of Vitamin A scores (Table 34) it was

Table 34 Distribution of Vitamin A scores among subjects

Vitamin A score	Lactovegetarians		Omnivores		Total	
	No.	%	No.	%	No.	%
100 -150	0	0.00	1	6.67	1	3.33
150 - 200	5	33.33	10	66.66	15	50.00
200 - 250	5	33.33	4	26.67	9	30.00
250 - 300	5	33.34	0	0.00	5	16.67
Total	15	100.00	15	100.00	30	100.00

seen that 10 out of 15 subjects (66.67%) among the omnivores had their vitamin A score in the range of 150-200 while 26.67% had it between 200-250 and only 1 person (6.67%) had it below 150. In the case of lactovegetarians 33.33% subjects had their vitamin A score in the range of 50-200 . 33.33% in the range of 200-250 and the rest in the range of 250-300. It was found that intake of vitamin A rich foods was higher for lactovegetarians than omnivores. Lactovegetarian subjects had a significantly higher mean score of 227.27 ± 0.06 than omnivores (177.60 ± 7.51) ($t = 3.8227$ $P > 0.1$)

4.8 SERUM VITAMIN A AND β-CAROTENE LEVEL OF SUBJECTS

Further β-carotene content of serum of individual subjects was measured chemically to find out the extent of absorption and utilisation of Vitamin A/ β-carotene from the foods consumed by the subjects. This will give a direct indication of vitamin A status of the incumbents. From the blood collected from 30 subjects serum vitamin A levels were analysed. It was revealed that serum vitamin A value of lactovegetarians ranged from 22.66 to 93.97µg/100ml and for omnivores it ranged from 21.70 to 95.64 µg/100ml. Among the subjects, four lactovegetarians (26.67%) and all omnivores (except one) had normal serum vitamin A value (50 µg/100ml) None of the subjects can be demarked as deficient.

According to Antia and Abraham (1997) if the value is less than 20 µg/100 ml a subject can be considered as deficient.

Since the study envisages to assess the vitamin A status of lactovegetarians and omnivores, the serum β-carotene content of the subjects were also measured. This was done because, for computing the vitamin A level of diet consumed by the subjects the nutritive value table published by ICMR (1991) was utilised where the vitamin A content of all the foods except animal foods (such as meat, poultry, milk and milk products) the value for Vitamin A is found to be expressed in terms of β-carotene.

Table 35 Serum β-carotene level of individual subjects

N=30

Sl. No.	Serum β-carotene (µg/100ml) Lacto vegetarians	Sl. No.	Serum β-carotene (µg/100ml) Omnivores
1.	149.301	16.	162.657
2.	91.107	17.	117.819
3.	96.831	18.	191.277
4.	89.676	19.	128.313
5.	93.015	20.	132.606
6.	106.371	21.	126.882
7.	83.952	22.	101.601
8.	88.722	23.	109.233
9.	99.693	24.	119.250
10.	187.938	25.	43.407
11.	90.153	26.	80.613
12.	47.223	27.	118.296
13.	94.446	28.	158.364
14.	45.315	29.	96.354
15.	161.226	30.	106.371
Mean	101.66 µg/100ml		119.54 µg/100ml

The β-carotene levels of the lactovegetarians and the omnivores are presented in Table 35. The data revealed that the serum β-carotene of lactovegetarians ranged from 45.32 µg/100ml to 187.94/µg/100ml and that of omnivores ranged from 43.41/ µg/100ml to 191.28/ µg/100ml. The mean value for lactovegetarians was found to be 101.66 ± 9.53/ µg/100ml and that of omnivores was 119.54 ± 8.76/ µg/100ml. It indicates that omnivores had a higher

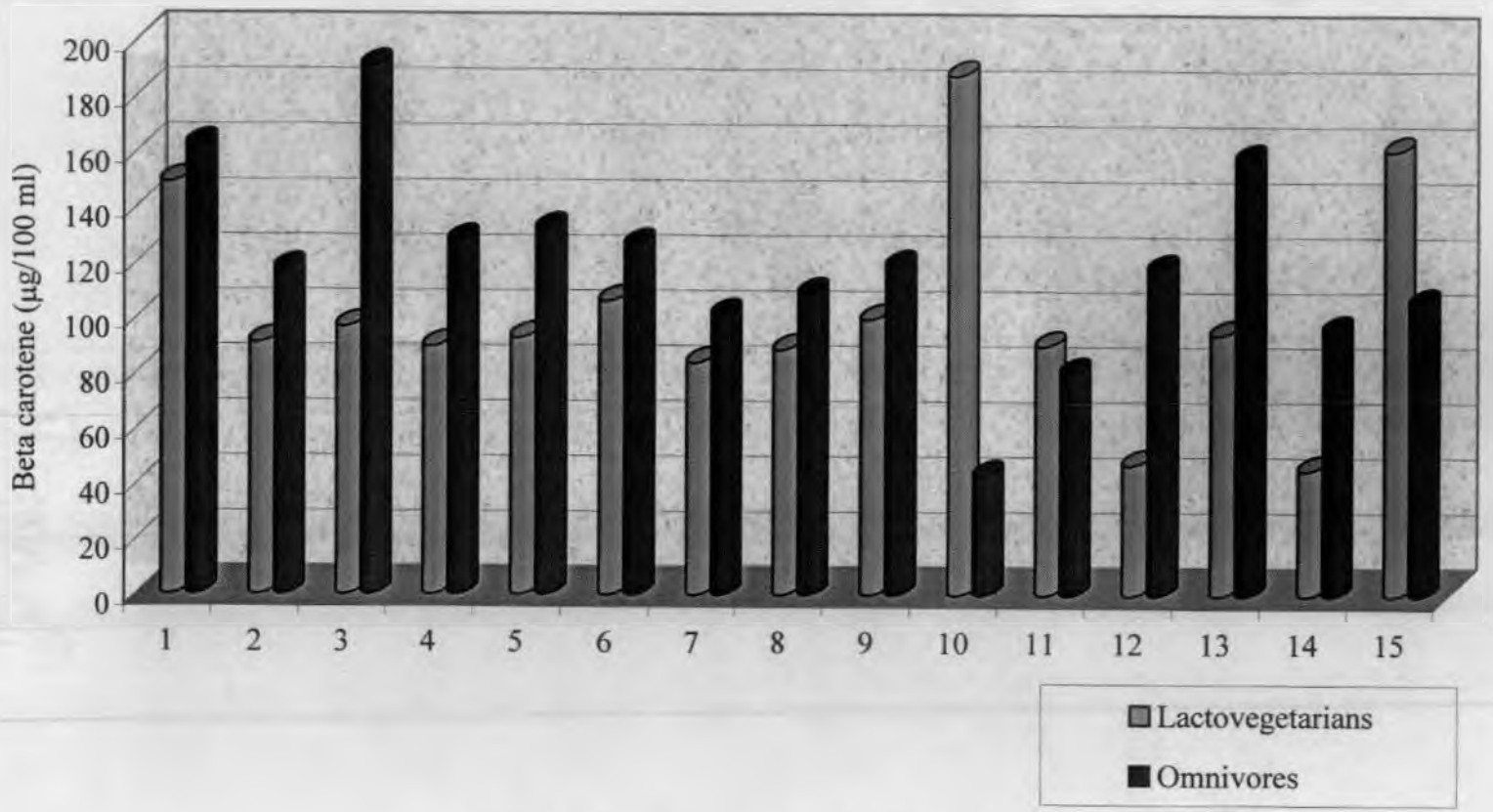


Fig. 4 Serum beta carotene level of subjects

β-carotene level than the lactovegetarians but the values were not significantly different when statistically analysed.

Table 36 Distribution of Vitamin A scores among subjects

µg/100ml	Lactovegetarians		Omnivores		Total	
	No	%	No	%	No	%
< 50	2	13.34	1	6.67	3	10.00
50-100	9	60.00	2	13.33	11	36.67
101-150	2	13.33	9	60.00	11	36.67
151-200	2	13.33	3	20.00	5	16.66
Total	15	100.00	15	100.00	30	100.00

The data shown in Table 36 when summarised indicates that majority (60%) of the lactovegetarian had serum β-carotene values between 50-100 µg/100ml while 60% of the omnivores had serum β-carotene level between 101-150 µg/100ml.

Acceptable levels of β-carotene indicating optimum nutritional status is reported to range between 50-250 ug/100 ml (Usharani *et al*, 2001). Among the subjects 6.67% omnivores and 13.34% lactovegetarians were found to have their β-carotene level below 50 µg/100 ml. The analysis of the data further revealed that out of total population of 30 subjects only three (10%) subjects had values below normal.

4.9 FACTORS IN FOOD THAT HINDER / FAVOUR UTILISATION OF VITAMIN A / β-CAROTENE

There are various factors in food which favour or hinder the absorption of vitamin A or β-carotene. The most important factor that helps the absorption and utilisation is fat since vitamin A is a fat soluble vitamin. As the fat intake of the incumbants especially the omnivores groups are high, that would facilitate the absorption of vitamin A or β-carotene from their diet. Protein and iron are the other factors associated with vitamin A utilisation. However in the present study

the intake of protein and iron are low since they are sufficient to meet only 52 per cent of RDA.

Fibre is a major factor which hinders the absorption of β-carotene but the average intake of fibre is only 4.33 g for lactovegetarins and 4.84 gram for omnivores against the RDA of 40 gram. Hence this factor may not decrease the absorption.

4.10 NUTRITIONAL STATUS OF SUBJECTS

Being the major objective of the study, the nutritional status of lactovegetarians and omnivores were assessed and compared in order to locate variations if any. The nutritional status of the subjects were primarily assessed through anthropometry and clinical evaluation, followed by dietary survey (weighment survey).

The height, weight, mid upper arm circumference (MUAC), triceps skin fold thickness (TST), circumference of waist (WC) and hip (HC) were the anthropometric parameters used to assess nutritional status. The above parameters of individual subjects were measured using standard techniques once before the conduct of weighment survey and was repeated after a lapse of three months. The details thus collected are presented in Tables 37 to 43.

Table 37 depicts the height of the subjects grouped into two categories namely lactovegetarians and omnivores.

The content of Table 37 depicts that the initial height of the subjects ranged between 149 cm to 165 cm among lactovegetarians and 149 cm to 170 cm among omnivores. As far as the height was concerned the lactovegetarians had a higher mean value of 155.80 cm ±1.48 than the omnivores 154.47 cm ±1.28 but no significant difference ($P < 0.05$) was observed between the groups.

The height of the subjects when measured once again after three months revealed the mean value of lactovegetarians and omnivores as 155.87 cm ±1.47 and 154.80 cm ±1.28 respectively. There was only an insignificant increase in the height of subjects when measured after a lapse of three months.

The initial weight of the subjects that is presented in Table 38, ranges form 43 kg to 58 kg among lactovegetarians and from 39 kg to 54 kg among omnivores. The mean value when computed revealed that lactovegetarians had a higher mean body weight (49.53 kg ± 1.28) than the omnivores (46.93 kg ± 1.24) indicating a variation between the groups of subjects. However the difference was found to be not significant.

The weight taken once again after three months revealed that the final weight of subjects ranged from 43 kg to 58 kg among lactovegetarians and from 39 kg to 54 kg among omnivores. However the mean weight of lactovegetarians and omnivores were 48.97 kg ± 1.26 and 47 kg ± 1.23 respectively. The initial and final weights of the subjects when compared revealed that the lactovegetarians had a lower mean weight, after three months (reduced from 49.53 kg to 48.97 kg.); but the omnivores showed a slight increase in their mean weight (46.93 kg increased to 47 kg). However the increase was found to be non significant ($P<0.05$).

The data collected on the height and weight of the individual subjects was used to findout whether the subjects have adequate weight for their height which is generally employed as an indicator of good stature and that of good nutritional status. The weight for height of the subjects are presented in Table 39.

The actual height and weight of individual subjects along with the mean value of the group to which they belong was compared with standard weight chart for height and age prescribed by LIC of India. The data when analysed revealed that only one subject among lactovegetarians had normal weight for height while three (out of 15) were having a value above the standard and the remaining had it below. In the case of omnivores, only one subject had 0.5 kg above standard weight for height and the rest had it below the required standard value.

The data also revealed that the mean standard weight for height of lactovegetarians was 52.63 ± 0.85 and that of omnivores was 52.13 ± 0.81. Though there seems to be a minor variation between the groups, when statistically tested the variation was found to be insignificant ($P < 0.05$).

The mid upper arm circumference (MUAC) of lactovegetarians and omnivores measured twice within a period of three months are presented in Table 40. The initial values ranged between 20 cm to 30 cm among the entire population studied. The MUAC values ranged from 20 cm to 30 cm with a mean of 24.17 cm ± 0.541 and from 21 cm to 28 cm with a mean of 24.17 cm ± 0.609 among lactovegetarians and omnivores respectively. Though there are minor differences among individual subjects, there was no significant variation in the MUAC among lactovegetarian and omnivores based on statistical analysis of the data ($P < 0.05$).

After three months the mean mid upper arm circumference was 24.27 cm ± 0.61 for lactovegetarians and 24.03 cm ± 0.54 for omnivores which indicates a slight increase in both the groups. Again, the lactovegetarians were found to have a higher MUAC than omnivores. However the difference was not found to be significant.

When the individual values were compared with a reference (28.50 cm) value suggested by Jelliffe (1996), it was seen that all the subjects except one in the lactovegetarian group had MUAC value below the standard value of 28.5 cm.

The triceps skin fold thickness (TST) presented in Table 41 showed that its range varied from 14 mm to 28 mm among lactovegetarians and 13 mm to 26 mm among omnivores. The data revealed that the mean TST value of lactovegetarians (21.13 mm) was higher than that of omnivores (18.13 mm). However the difference between the two groups are not significant when analysed ($P < 0.05$).

The individual TST data when compared with the standard value revealed that 13 subjects (86.67%) among lactovegetarians and nine subjects among omnivores had values above the standard value of 16.5 mm.

The health status of the groups were further assessed using the data on waist and hip circumference of individual subjects. The waist and hip circumference of the subjects are presented in Table 42.

The waist circumference varied from 67 cm to 88 cm among lactovegetarians and 65 cm to 81 cm among omnivores. The lactovegetarians had a higher mean value (74.93 cm ± 1.48) than omnivores (72.40 cm ± 1.09).

The hip circumference varied from 80 cm to 99 cm for lactovegetarians and 83 cm to 94 cm for omnivores. Here again the lactovegetarians had a higher mean value of 90.87 cm ± 1.51 when compared to omnivores (88.4 ± 0.81) but the difference was not found to be significant ($P < 0.05$).

Another measurement taken after 3 months revealed that the mean waist circumference were 74.67 cm ± 1.51 and 71.87 cm ± 0.94 for lactovegetarians and omnivores respectively. The hip measurements taken after 3 months showed that the mean values were 90.50 cm ± 1.47 and 88.07 cm ± 0.90 for lactovegetarians and omnivores respectively (Table 43).

Relevant anthropometric data were utilized to develop certain approved indices inorder to assess health and nutritional status of the subjects to compare the lactovegetarians with omnivores. Thus BMI of the subjects were worked out using the actual weight and height of the subjects and the details are presented in Table 44.

Scrutiny of the data revealed that the BMI varied over a vide range from 16.76 to 23.49 and 17.31 to 22.07 with a mean value of 20.40 ± 0.41 and 19.51 ± 0.44 respectively for lactovegetarians and omnivores. The mean BMI values indicated that in general the lactovegetarians (20.40 ± 0.41) had higher BMI than omnivores (19.51 ± 0.44) but the difference was found to be statistically not significant ($P<0.05$).

When the BMI range of 18.5 to 25.0 is taken as cut off value compatible with optimum health, 60 per cent of lactovegetarians and 53.33 per cent of omnivores were found to be healthy based on their BMI. The data further revealed that 33.33 per cent had low weight while, 6.67 per cent had chronic energy deficiency (CED) of grade II among lactovegetarians. As far as omnivores are concerned 13.34 per cent had low weight (normal) 33.33 per cent had CED

grade I (mild). The BMI once again computed after 3 months indicated that the mean BMI were 20.15 ± 0.42 and 19.59 ± 0.44 for lactovegetarians and omnivores respectively. There was only an insignificant increase in BMI after three months. The data revealed that 60 per cent of the lactovegetarians and 53.33 per cent of omnivores were found to be healthy and the rest were below normal. The data also revealed that 33.33 per cent of lactovegetarians were found to be low weight (normal). Remaining lactovegetarians (6.67%) belonged to CED grade II (moderate). Out of 15 omnivores, 13.33 per cent were low weight (normal), 26.67 per cent were of CED grade I (mild) and the rest were CED grade II (moderate) (6.67%) and 58.33% were found to be normal.

The measurements of waist and hip circumference of individual subjects were used to workout Waist : Hip ratio (WHR) and was compared with standard measurements appropriate for good health. Such details are also given in Table 42. The WHR ranged between 0.74 to 0.91 among lactovegetarians and from 0.72 to 0.88 for omnivores with their mean value being 0.83 ± 0.012 and 0.87 ± 0.012 respectively. When compared to the standard value seven lactovegetarians (46.67%) and six omnivores (40%) had their WHR above normal and one subject (6.67%) of lactovegetarian group and five (33.33%) subjects among omnivores had normal values. All other subjects had values below normal.

The waist:hip ratio when computed once again after 3 months revealed the fact that the mean value of Waist : Hip ratio varied from 0.76 to 0.93 and 0.75 to 0.85 for lactovegetarians and omnivores respectively. (Table 43) When compared with the standard, four (26.67%) lactovegetarians and six omnivores (40%) had values above normal; three (20%) lactovegetarians and five (33.33%) omnivores (out of 15 subjects) had normal values and the remaining were below normal, when second sets of measurements were used for calculation of WHR. WHR is found to be higher in lactovegetarians than omnivores but the difference between the groups is not significant ($P < 0.05$).

Table 37 Height of subjects

N =30

Sl. No.	Height of lactovegetarians (cm)		Sl. No.	Height of omnivores (cm)	
	Initial	Final		Initial	Final
1.	162	162	16.	150	151
2.	151	152	17.	157	158
3.	150	150	18.	152	153
4.	165	165	19.	157	158
5.	153	153	20.	156	156
6.	153	153	21.	158	158
7.	149	149	22.	150	150
8.	153	153	23.	170	170
9.	165	165	24.	152	152
10.	153	153	25.	155	155
11.	160	160	26.	149	149
12.	162	162	27.	151	151
13.	150	150	28.	152	152
14.	161	161	29.	154	155
15.	150	150	30.	154	154
Mean	155.80 cm ± 1.48	155.87 cm ±1.47		154.47 cm ±1.28	154.80 cm ±1.28

Table 38 Weight of subjects

N=30

Sl.No.	Weight of lactovegetarians (kg)		Sl. No.	Weight of omnivores (kg)	
	Initial	Final		Initial	Final
1.	44.00	43.00	16.	43.00	44.00
2.	51.00	52.00	17.	50.00	50.00
3.	48.00	48.00	18.	41.00	41.50
4.	58.00	57.00	19.	53.00	53.00
5.	45.00	43.00	20.	51.00	51.00
6.	45.00	44.00	21.	54.00	54.00
7.	44.00	44.00	22.	45.00	47.00
8.	49.00	47.00	23.	51.00	51.00
9.	58.00	58.00	24.	51.00	50.00
10.	55.00	53.00	25.	46.00	47.00
11.	52.00	52.00	26.	39.00	39.00
12.	49.00	48.00	27.	48.00	47.00
13.	47.00	47.50	28.	40.00	40.00
14.	55.00	54.00	29.	42.00	40.50
15.	43.00	44.00	30.	50.00	50.00
Mean	49.53 kg ±1.28	48.97 kg ±1.26	Mean	46.93 kg ±1.24	47.00 kg ±1.23

Table 39 Weight for height of subjects

N=30

Sl. No.	LACTOVEGETARIANS				Sl. No.	OMNIVORES			
	Height (cm)	Weight (kg)	Standard* weight for height (kg)	Deviation (kg)		Height (cm)	Weight (kg)	Standard* weight for height (kg)	Deviation (kg)
1.	162	44	56.5	-12.5	16.	150	43	48.5	-5.5
2.	152	51	50.5	+0.5	17.	157	50	54.5	-4.5
3.	150	48	49.5	-1.5	18.	152	41	52.0	-11.0
4.	165	58	56.5	+1.5	19.	157	53	54.5	-1.5
5.	153	45	52	-7.0	20.	156	51	53.5	-2.5
6.	153	45	50.5	-5.5	21.	158	54	54.5	-0.5
7.	149	44	48.5	-4.5	22.	150	40	48.5	-8.5
8.	153	49	52	-3.0	23.	170	51	60.5	-9.5
9.	165	58	58	0.0	24.	152	51	50.5	+0.5
10.	153	55	52	+3.0	25.	155	46	50.5	-4.5
11.	160	52	53.5	-1.5	26.	149	39	48.5	-9.5
12.	162	49	56.5	-7.5	27.	151	48	50.5	-2.5
13.	150	47	48.5	-1.5	28.	152	40	50.5	-10.5
14.	161	55	56.5	-1.5	29.	156	42	54.5	-12.5
15.	150	43	48.5	-5.5	30.	152	50	50.5	-0.5
Mean	155.80 cm ± 1.48	49.53 cm ± 1.28	52.63 kg. ± 0.85	+5 -51.5	Mean	154.47 cm ±1.28	46.93 kg ±1.24	52.13 kg ± 0.81	+0.5 -83.5

* LIC of India

Table 40 Mid upper arm circumference of subjects (MUAC)

N=30

MUAC of lactovegetarians (cm)							MUAC of omnivores						
Sl. No.	Initial	* Reference standard value (cm)	Devi-ation	After 3 months	* Reference standard value (cm)	Devi-ation	Sl. No	Initial	* Reference standard value (cm)	Devi-ation	After 3 months	* Reference standard value (cm)	Devi-ation
1.	20.00		-8.50	19.50		-9.00	16.	23.50		-5.0	24.00		-4.50
2.	24.00		-4.50	24.50		-4.00	17.	24.50		-4.0	21.00		-7.50
3.	24.00		-4.50	29.00		+0.50	18.	21.00		-7.5	21.00		-7.50
4.	24.00		-4.50	24.00		-4.50	19.	27.00		-1.5	2.70		-1.50
5.	24.00		-4.50	23.00		-5.50	20.	25.50		-3.0	25.50		-3.00
6.	22.50		-6.00	22.50		-6.00	21.	28.00		-0.5	27.00		-1.50
7.	23.00		-5.50	23.00		-5.50	22.	23.00		-5.5	24.00		-4.50
8.	24.00	28.5	-4.50	24.50	28.50	-4.00	23.	24.00	28.50	-4.5	23.50	28.50	-5.00
9.	26.00		-2.50	26.00		-2.50	24.	28.00		-0.5	26.00		-2.50
10.	30.00		+1.50	29.00		+0.50	25.	22.00		-6.5	22.50		-6.00
11.	26.00		-2.50	26.00		-2.50	26.	21.00		-7.5	20.50		-8.00
12.	23.00		-5.50	23.00		-5.50	27.	27.00		-1.5	27.00		-1.50
13.	24.00		-4.50	24.00		-4.50	28.	22.00		-6.5	22.00		-6.50
14.	25.00		-3.50	24.00		-4.50	29.	22.00		-6.5	22.00		-6.50
15.	23.00		-5.50	23.00		-5.50	30.	24.00		-4.5	24.50		-4.00
Mean	24.17 ±0.54			24.27 ±0.61			Mean	24.17 ±0.61			24.03 ±0.54		

*Jelliffe (1996)

Table 41 Triceps skinfold thickness of subjects (TST) (average of initial and final measurements)

N=30

TST of lactovegetarians (mm)				TST of omnivores (mm)			
Sl. No.	TST (mm)	Standard value (mm)*	Deviation	Sl. No.	TST (mm)	Standard value (cm)*	Deviation
1.	14.00		-2.50	1.	16.00		-0.50
2.	21.00		+4.50	2.	19.00		+2.50
3.	22.00		+5.50	3.	15.00		-1.50
4.	23.00		+6.50	4.	25.00		+8.50
5.	23.00		+6.50	5.	14.00		-2.50
6.	2.2.00	16.50	+5.50	6.	22.00	16.50	+5.50
7.	20.00		+3.50	7.	13.00		-3.50
8.	18.00		+1.50	8.	17.00		+0.50
9.	19.00		+2.50	9.	26.00		+9.50
10.	28.00		+11.50	10.	23.00		+6.50
11.	21.00		+4.50	11.	17.00		+0.50
12.	22.00		+5.50	12.	17.00		+0.50
13.	24.00		+7.50	13.	14.00		-2.50
14.	21.00		+4.50	14.	15.00		-1.50
15.	19.00		-2.50	15.	19.00		+2.50
Mean	21.13 mm		+69.50 -5.00	Mean	18.13 mm		+36.50 -12.00

*Jelliffe (1996)

Table 42 Waist Hip ratio (WHR) of subjects (Initial)

N=30

WHR of lactovegetarians						WHR of omnivores					
Sl. No.	Waist (cm)	Hip (cm)	W/H Ratio	*Reference standard	Deviation	Sl. No.	Waist (cm)	Hip (cm)	W/H Ratio	*Reference standard	Deviation
1.	71	85	0.84	0.82	+0.02	16.	72	86	0.84	0.82	+0.02
2.	82	96	0.85	0.84	+0.01	17.	65	90	0.72	0.72	0.00
3.	88	98	0.89	0.90	-0.10	18.	68	83	0.82	0.78	+0.04
4.	80	96	0.83	0.84	-0.01	19.	81	92	0.88	0.89	-0.01
5.	67	89	0.75	0.78	-0.03	20.	75	89	0.84	0.83	+0.01
6.	69	80	0.86	0.88	-0.02	21.	78	93	0.84	0.84	0.00
7.	74	81	0.91	0.94	-0.03	22.	72	85	0.85	0.62	+0.003
8.	67	90	0.74	0.72	+0.02	23.	77	90	0.86	0.89	-0.03
9.	81	99	0.81	0.79	+0.01	24.	76	94	0.81	0.79	+0.02
10.	77	95	0.81	0.79	+0.02	25.	69	89	0.78	0.78	0.00
11.	76	96	0.79	0.79	0.00	26.	69	84	0.82	0.82	0.00
12.	74	86	0.86	0.88	-0.02	27.	72	89	0.81	0.83	-0.02
13.	70	92	0.76	0.78	-0.02	28.	68	83	0.82	0.82	0.00
14.	75	93	0.80	0.79	+0.02	29.	71	86	0.83	0.82	+0.01
15.	73	81	0.84	0.82	+0.002	30.	73	93	0.78	0.79	+0.01
Mean value	74.93 cm ±1.48	90.87 cm ±1.51					72.4 cm ±1.09	88.4 cm ±0.81			

*Sadikot (1996)

Table 43 Waist Hip ratio (WHR) of subjects (Final)

N=30

WHR of lactovegetarians						WHR of omnivores					
Sl.No.	Waist (cm)	Hip (cm)	W/H Ratio	Reference standard	Deviation	Sl. No.	Waist (cm)	Hip (cm)	W/H Ratio	Reference standard	Deviation
1.	67	86.00	0.78	0.78	0.00	16.	71.00	86	0.83	0.82	+0.01
2.	82	96.00	0.85	0.84	+0.01	17.	66.50	89	0.75	0.72	+0.03
3.	88	97.50	0.90	0.90	0.00	18.	66.00	82	0.80	0.81	-0.01
4.	80	96.00	0.83	0.84	-0.01	19.	77.00	91	0.85	0.83	-0.02
5.	67	88.00	0.76	0.72	+0.04	20.	75.00	88	0.85	0.83	+0.02
6.	69	81.00	0.85	0.88	-0.03	21.	77.50	92	0.84	0.84	0.00
7.	74	80.00	0.93	0.94	-0.01	22.	74.00	90	0.82	0.83	-0.01
8.	70	90.00	0.78	0.78	0.00	23.	76.00	89	0.85	0.83	+0.02
9.	81	99.00	0.82	0.80	+0.02	24.	74.00	93	0.79	0.79	0.00
10.	76	93.00	0.82	0.83	-0.01	25.	69.00	88	0.78	0.78	0.00
11.	76	95.50	0.10	0.79	-0.01	26.	68.00	83	0.82	0.82	0.00
12.	74	85.00	0.87	0.88	-0.01	27.	72.00	89	0.81	0.78	+0.03
13.	69	91.00	0.76	0.78	-0.02	28.	68.00	83	0.82	0.82	0.00
14.	75	92.50	0.81	0.83	-0.02	29.	71.00	85	0.84	0.82	+0.02
15.	72	87.00	0.83	0.82	+0.01	30.	73.00	93	0.78	0.79	-0.01
Mean value	74.67 cm ±1.51	90.50 cm ±1.47					71.87 cm ±0.94	88.07 cm ±0.90			

Sadikot (1996)

Table 44 Body Mass Index (BMI) of subjects

Sl. No.	BMI of lactovegetarians* Initial value□	Final value□	Sl. No.	BMI of omnivores* Initial value□	Final value□
1.	16.76 - CED - grade II (moderate)	16.38 - CED - grade II (moderate)	16	19.11 - Low weight (normal)	19.30 - Low weight (normal)
2.	22.36 - Normal	22.51 - Normal	17	20.28 - Normal	20.03 - Normal
3.	21.33 - Normal	21.33 - Normal	18	17.74 - CED grade I (mild)	17.73 - CED grade I (mild)
4.	21.30 - Normal	20.94 - Normal	19	21.54 - Normal	21.23 - Normal
5.	19.22 - low weight (normal)	18.37 - low weight (normal)	20	20.96 - Normal	20.96 - Normal
6.	19.22 - low weight (normal)	18.80 - low weight (normal)	21	21.63 - Normal	21.63 - Normal
7.	19.81 - low weight (normal)	19.82 - low weight (normal)	22	20.88 - Normal	20.89 - Normal
8.	20.93 - Normal	20.08 - Normal	23	17.65-CED grade I(mild)	17.65-CED grade I (mild)
9.	21.30 - Normal	21.30 - Normal	24	22.07 - Normal	21.64 - Normal
10.	23.50 - Normal	22.64 - Normal	25	19.56 - Low weight (normal)	19.56 - Low weight (normal)
11.	20.31 - Normal	20.31 - Normal	26	17.57-CED grade I(mild)	17.57-CED grade I (mild)
12.	18.70 - Low weight (normal)	18.29 - Low weight (normal)	27	21.05 - Normal	20.61 - Normal
13.	20.88 - Normal	21.11 - Normal	28	17.31-CED grade I(mild)	17.31-CED grade I (mild)
14.	21.21 - Normal	20.83 - Normal	29	17.71 - CED grade I (mild)	16.86 - CED grade II (moderate)
15.	19.11 - Low weight (normal)	19.56 - Low weight (normal)	30	21.08 - Normal	21.08 - Normal

* James (1988)
□ Presumptive diagnosis

4.11 NUTRITIONAL STATUS INDEX (N.S.I.)

The Nutritional status Index (NSI) of each of the subjects were calculated using the individual anthropometric data such as weight, height, waist circumference, Hip circumference and skinfold thickness. The NSI of the subjects are presented in Table 41. The NSI of the lactovegetarian ranged between 413.57 and 505.44 with a mean of 457.97, while that of the omnivores ranged from 401.72 to 477.07 (with a mean of 454.64)

Though there are individual variations in the NSI of individual subjects, there was no significant variation in the NSI of lactovegetarians and omnivores ($P < 0.05$).

Table : 45 N.S.I. of the subjects

Lactovegetarin		Omnivores	
Sl.No.	N.S.I.	Sl.No.	N.S.I.
1.	462.88	16.	463.60
2.	473.50	17.	401.72
3.	497.25	18.	453.77
4.	463.04	19.	488.34
5.	418.29	20.	465.12
6.	477.94	21.	466.21
7.	505.44	22.	470.45
8.	413.57	23.	477.07
9.	454.57	24.	449.82
10.	450.42	25.	433.20
11.	439.83	26.	454.11
12.	477.20	27.	448.89
13.	422.72	28.	454.06
14.	448.03	29.	459.71
15.	464.81	30.	433.07

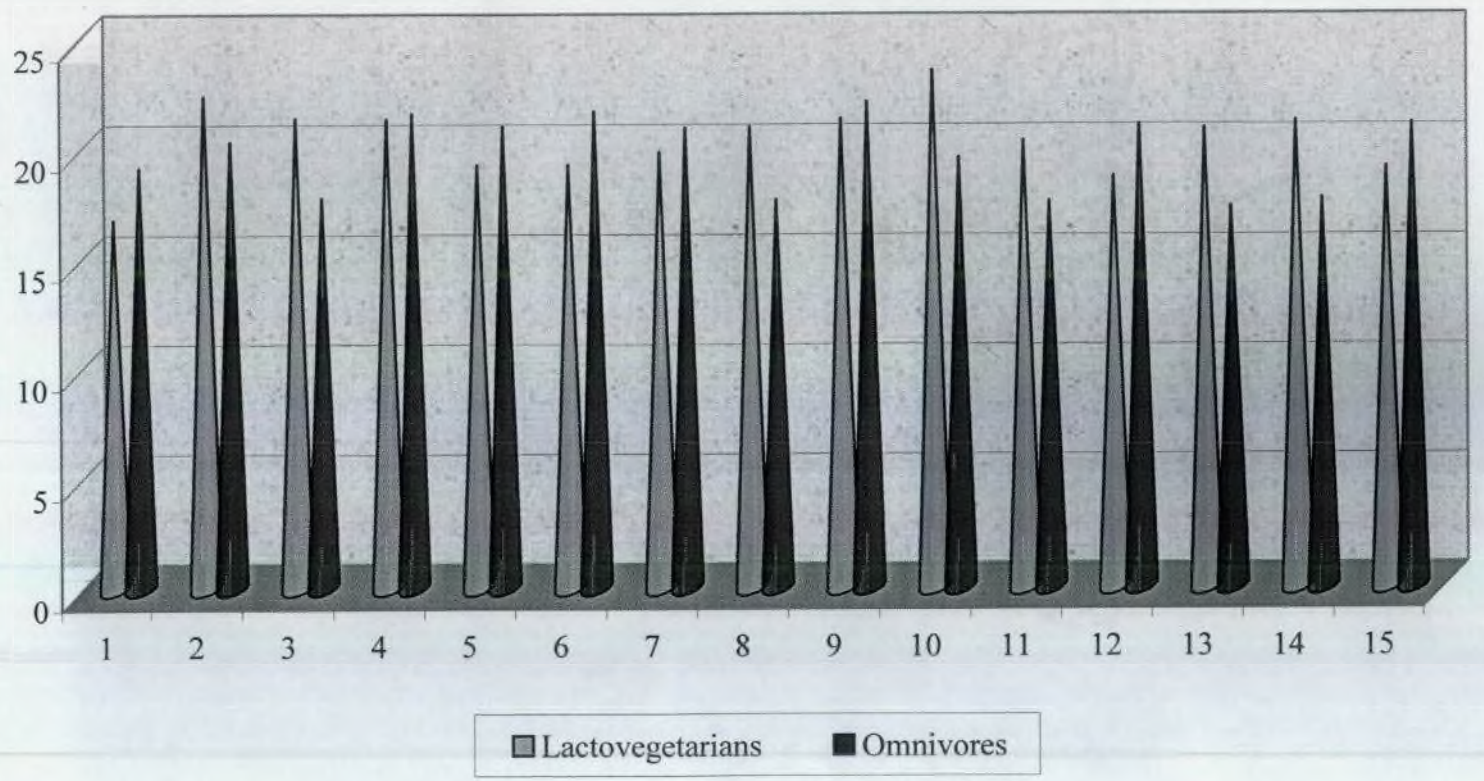


Fig. 4 Body mass index (BMI) of subjects

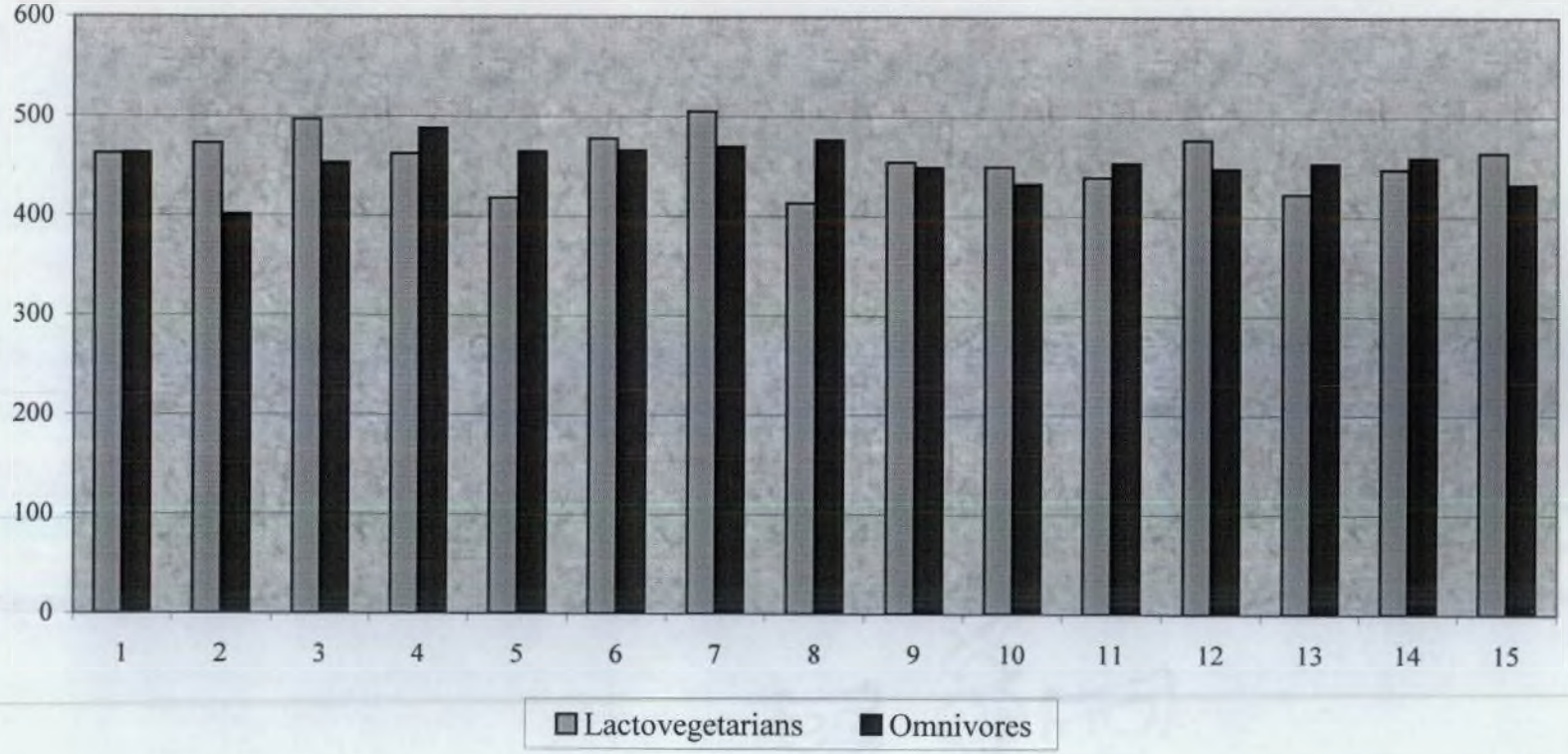


Fig. 5 NSI of subjects

4.12 CLINICAL EXAMINATION

Clinical examination of the subjects were conducted to assess the presence of nutritional deficiency disorders if any in general and with special reference to vitamin A. Clinical status of the subjects were assessed using the schedule suggested by N.A.C – I.C.M.R (Proforma given in appendix) and the clinical examination was conducted by a registered medical practitioner. Accordingly when this schedule is used for assessing the clinical status of individual subjects, a maximum total score of 65 would be obtained if all the deficiency are observed with the absolute deficiency symptoms and a minimum score of zero could be arrived at if none of the symptoms of deficiency are detected.

Using the above proforma when the clinical status of the subjects were evaluated only five (33.3%) lactovegetarians had deficiency symptoms such as dental caries (3), nasolabial seborrhoea (1), enlargement of thyroid (1) and vascularization of cornea (1). Out of the above subjects three lactovegetarians had one deficiency symptom each while one had two deficiency signs (dental caries and nasolabial seborrhea). Among omnivores five (33.33%) exhibited deficiency symptoms. Out of these five two each had vascularization of cornea and dental caries while one each had the problem of adipose tissue deficit, dryness and pigmentation of eye.

When the subjects were scored for their clinical status, it was seen that 66.67% of the subjects secured a score of '0' since they exhibited no symptoms of deficiency. Highest score of 3 out of 65 was secured by one omnivore while a score of 2/65 was secured by two subjects each of lactovegetarians and omnivores; 3 lactovegetarians and 3 omnivores had a score of one out of 65. All others had 'Zero' scores indicating their clinical condition as "healthy" (being free from nutritional deficiency diseases).

The data in general revealed that while the lactovegetarian subjects suffered from deficiencies of either B-complex/calcium/fluoride/iodine, reflected through the presence of nasolabial seborrhea, vascularization of corne, dental caries, enlargement of thyroid gland and pigmentation of eye (non-specific). The omnivores exhibited deficiencies of B-complex/calcium/fluoride/energy exhibited

by the presence of vascularization of cornea, dryness and pigmentation of eye, dental caries and problems of adipose tissue deficit. However as the incidence of deficiency disorders in both groups were varied and minimal, it is beyond the scope of study to compare the clinical picture of the subjects.

This study which comprised of an assessment of personal characteristics, dietary history, meal pattern, food and nutrient intake, serum retinol level, nutritional status index and clinical examination reveal the following facts.

The personal characteristics and basic dietary history of the subjects revealed that the subjects were healthy young adult female university students belonging to middle and high income families who were using neither supplements nor creams containing vitamin A. The current meal pattern of the subjects which was the hostel diet, is found to be more or less balanced supplying foods from all the different food groups. However the diet consumed by the lactovegetarians were found to be inadequate with respect to leafy vegetables, milk and milk products, pulses and legumes, cereals and cereal products. Though the vitamin A score of the lactovegetarians was found to be significantly higher than that of omnivores, the serum β-carotene or retinol levels of omnivores were found to be higher than that of lacto vegetarians. The clinical examination data also reveled that the incidence of symptoms and deficiency disorders in both groups were also minimal. The nutritional status of the subjects were also found to be satisfactory, and no significant difference was observed between lactovegetarians and omnivores. The study in general revealed that though all the subjects were healthy and had a good nutritional status, the serum vitamin A levels of omnivores was found to be better than that of lactovegetarians.

DISCUSSION

5. DISCUSSION

The results obtained after conduct of the study entitled "Nutritional status and vitamin A profile of lactovegetarians" are discussed in this chapter under the following headings.

5.1 Personal characteristics of the subjects

5.2 Dietary history and basic dietary pattern of the subjects

5.3 Meal pattern of the subjects

5.4 Food use frequency score

5.5 Vitamin A score

5.6 Percapita availability of foods from hostel diet

5.7 Mean food and nutrient intake of the subjects

5.8 Adequacy of individual food and nutrient consumption

5.9 Serum retinol / β-carotene level of subjects

5.10 Nutritional status of the subjects

5.1 PERSONAL CHARACTERISTICS OF THE SUBJECTS

Personal characteristics of the subjects were taken into account in this study since they may have an impact directly on food selection, preferences and consumption pattern and therefore indirectly on the nutritional status as well as on the vitamin A profile of the subjects.

One of the personal characteristics namely the dietary pattern of the subjects formed the corner stone in the selection of the subject for this study. Out of the 30 subjects, 15 were "lactovegetarians" as they were consuming milk as the only animal food and were following this dietary pattern for more than 10 years. The other half were designated as "omnivores" by virtue of their habit of consuming animal foods other than

milk in their daily diet over a specified period of time. This classification has been adapted on the basis of the connotation given by Lima and Nell (1999) and Andrew (2000). Major factors that influence nutritional status of an individual are socioeconomic factors and personal characteristics such as age, religion and income. According to Gosh (1989) social factors like religion, occupation, economics, education, beliefs and culture have important bearing on nutritional status.

Dietary habit of an individual, no doubt will be influenced by age. Since the longer one lives, one is apt to enter into a track which will lead to a constant habit. The age of the subjects ranged between 18-22 by virtue of the selection procedure as well as by the category of subjects selected for the study (college students). However 70 percent of the subjects in the two groups were 22 years of age and there was no significant variation in the age between the two groups. The age of the subjects were found to have no significant influence on the nutritioinal status but had a positive and significant correlation with serum vitamin A level ($r = 0.48^{**}$, $p > 0.1$). Ballew *et al.* (2001) had also found an increase in the serum retinol level with an increase in the age. In the present study also omnivores had higher mean age than the lactovegetarians and a higher serum retinol level too.

In a country like India which has a rich traditional cultural background, social environment existing in an area (a state, district, village, community or family) will have a profound influence on the food habit. Thimmayyamma and Rau (1996) had opined that dietary habits of individuals/families/communities vary according to regional customs, traditions and social factors. Vegetarianism is also reported to be interlaced with religious practices. Similarly in the current study it was conspicuous that Hindus and specially those belonging to upper caste had followed a vegetarian pattern of diet. According to Gosh (1989) religious

beliefs and culture have an impact on food consumption pattern and health status of individuals.

Religious practice again has its association with the principles of ahimsa and non-violence. These two features have been preached under Hinduism, Buddism and Jainism. As the later mentioned religions are not prevalent in Kerala, it is natural that more than 90 per cent of the lactovegetarian subjects were found to be from the Hindu community. However there was one lactovegetarian following Christianity. It is seen that she has opted for vegetarianism due to medical advice. She was suffering from arthritis for which she was advised to follow a vegetarian regime and hence she had shifted the dietary habit from an omnivore to lactovegetariansim. Muller *et al.* (2001), Hangen *et al.* (1993) and Kjaeldsen-Kragh *et al.* (1991) have all revealed the fact that fasting followed by vegetarian dietary pattern would reduce arthritis.

It is believed that vegetarianism has its roots in the caste system also which was prevalent in India. This trend has been seen in Kerala too. The reflection of this is seen in the current study also where 73.34 per cent of the lactovegetarians belonged to upper castes.

Food habits are reported to be directly correlated to economic status which is an important social factor. Kathleen and Julienne (1994) revealed that socio-economic status was worse among those adolescents with low food intake than among those with adequate intake. They opined that vitamin A intake was also lower among rural and periurban compared to urban adolescents (44 per cent, 47 per cent and 68 per cent of RDA respectively). The study endorsed the fact that the lactovegetarians in general had a significantly higher annual income than omnivores. But it was noticed that the serum retinol level of omnivores was higher than lactovegetarian subjects. The study conducted by Ballew *et al.* (2001) is also in tune with this result of the study i.e., there was no association between the household income and serum retinol level.

Vegetarianism is reported to have economic benefit over animal food based diet, which is found to be costly as suggested by Vijayaraghavan and Nayak (1995).

Another characteristic social factor namely the family size was found to have no influence on the dietary habits of the subjects. About 53.33 of both lactovegetarians and omnivores had a family size of four. Park and Park (1991) also reported that the average family size in India is 4.0.

In the modern era, people are highly conscious of their health status and physical fitness. Instead of making attempts to consume a balanced diet persistently as a means of maintaining ideal health, people resort to consumption of supplements in the form of tablets, tonics or capsules. Such supplements do provide essential nutrients but the practice of chemical or unnecessary clinical supplementation is liable to cause overloading of the system (overloading the kidneys, accumulation in soft tissues, deposition in the arterial walls etc). Moreover artificial supplementation is a costly alternative against consumption of natural foods that constitute an ideal diet. Consumption of supplements therefore would have an impact on the nutritional status of the subjects of this study too. Hence this enquiry revealed that 33 per cent of lactovegetarians and 26.67 per cent of omnivores had the habit of taking supplements other than vitamin A (prior to the study) in order to improve their nutritional status (to prevent deficiencies in the case of lactovegetarians). These supplements taken earlier was found to have no influence on the NSI and serum retinol status of these subjects. However Strauss (1999) had reported that children who were taking multivitamins had significantly higher serum β-carotene levels compared to those who did not take multivitamins.

Enquiry was also made to find out whether the lactovegetarian subjects who had consumed medicines for health problems such as arthritis prior to the study had any influence on the NSI or vitamin A

profile. It was seen that NSI of one subject who had taken medicines for arthritis was comparatively similar to that of other subjects but she had low serum retinol level of 90.153 μg /100 ml. Clinical picture showed that this subject had dental caries also. One of these omnivore subjects who had been taking B-complex tablets was generally weak. She had discolouration of skin, low adipose tissue quantity and dental caries. The serum β-carotene level of the above subject was however found to be lower (80.613 mg/100 ml) than others.

Another observation made was that those subjects who had viral fever (one lactovegetarian) and cold (one omnivore) were found to be having a low serum retinol level (88.77 μg/100 ml and 43.41 μg/100 ml respectively) even though they were found to be healthy otherwise.

5.2 DIETARY HISTORY AND BASIC DIETARY PATTERN

History of dietary pattern of the subjects were analysed through a specially designed questionnaire in order to assess the meal pattern as well as the food preferences exhibited by them in the past. As proclaimed by Gift *et al.* (1972) food habits of an individual are the characteristic repetitive acts that he or she performs under the impetus of the need to provide himself / herself with nourishment and simultaneously to meet an assortment of social and emotional goals. The basic informations collected revealed that all the omnivores had a non-vegetarian dietary pattern since childhood whereas only 53.33 per cent lactovegetarians had been following their habit from childhood. This denotes that the rest of the lactovegetarians had a non-vegetarian dietary pattern earlier. The data when analysed indicated that one subject who had changed her non-vegetarian habit to vegetarian dietary habit was found to have a better serum retinol level (161.26 μg/100 ml) level than her counterparts. This subject had changed her dietary habit due to an aversion towards meat and fish as well as by the influence of her father. Burton

(1978) had reported that parental attitudes and social factors are the predictors of adolescent food preference and dietary complexities.

When the meal pattern was analysed it was noticed that majority of the subjects in both the groups had the habit of taking four meals a day while two subjects (one from each group) had only two meals a day. Out of these two subjects, one lactovegetarian subject was found to have a lower serum β-carotene level (88.72 μg/100 ml) which can be associated with lesser food consumption consequent to lesser number of meals per day. This subject was also found to have an initial weight of 49 kg which was reduced to 45 kg after three months.

All the subjects were found to consume rice as the major staple. It was seen that more than 60 per cent of the subjects had a special preference for mango, apple and orange which are good sources of vitamin A, while about 26 per cent expressed an aversion towards egg fruit due to its unacceptable taste. Another interesting observation was that the one lactovegetarian subject who had the practice of consuming fruit juice/vegetable juice at least once in a week had only a normal serum level of 91.107 mg/100 ml as compared to others. It was seen that about 66.67 per cent of omnivores exhibited a preference for eating salad (tomato, onion, cucumber, carrot) at least once in a week whereas only 40 per cent lactovegetarians preferred it. About 46.67 per cent of omnivores also expressed a special preference for carrot which is an excellent source of β-carotene whereas only 13.30 per cent lactovegetarians had this preference. Analysis of dietary habits revealed that omnivores had a greater preference towards raw vegetables especially those rich in β-carotene in addition to animal foods. Eighty per cent of omnivores had the habit of consuming fish daily. Both these factors would have contributed to a better vitamin A status exhibited by the omnivores in this study when compared to a lactovegetarians. According to Barr and Broughton (2000) fruits (mango, orange etc.) and vegetables (especially green leafy and

carrots) contain a good amount of antioxidants, especially β-carotene and the preference for such vegetables and fruits to a higher degree by the omnivores could have led to a higher serum vitamin A level among omnivores.

5.3 MEAL PATTERN OF THE SUBJECTS

As the subjects are residents of a hostel run by an educational institution the meal pattern of the incumbents were found to be regulated by the structured and prescribed meal pattern of the institution. Though the day's diet comprised of four meals, only 85 per cent of the subjects had all the four square meals while the data indicated that others skip the meals at odd intervals. Devadas (1999) had the opinion that meal skipping and eating irregular meals are common during adolescence and is especially prevalent during middle and late adolescents. According to Elizabeth (1999) many adolescents skip major meals, and missing of breakfast (the brain's food) can adversely affect classroom performance. Out of the three subjects who skip meals, one lactovegetarian who skipped her meal more frequently had a low serum retinol level and have average intake of cereal, vegetable and other vegetable was not adequate to meet the RDA. Other two subjects had normal serum retinol level.

When the weekly meal pattern was analysed, the diets seem to have variety with reference to type of preparation, method of cooking used, as well as selection of foods that goes into the preparation. As far as the breakfast was concerned, it had variety spread over a wide range; each day of the week having an ideal combined where a cereal product is seen combined with a pulse or the cereal preparation is served with a pulse or nut (coconut) containing side dish. It is of significance to note that on three days out of seven days in a week, there were several items that will supply vitamin A and carotene (such as carrot, butter, jam, plantain, banana, tomato) in the breakfast itself. In the case of omnivores, egg, an excellent source of vitamin A was served in the place of butter and jam.

According to Swaminathan (1996) carrots, butter, curd, egg and banana are good sources of vitamin A. Therefore all such items except curd is found in the regular hostel diet consumed by the subject, which enhances the vitamin A score of the general diet.

The lunch comprises of rice with two to three vegetable dishes which would supply vitamins and minerals along with fibre and other nutrients. Instead of one vegetable dish, fish was served for omnivores. The meal at noon would also had a pulse served in the form of sambar or curry which serves as the major protein source for lactovegetarians. Beatrice (1999) also observed the presence of pulse curry (at noon) in her study relating hostel diets.

The evening tea seems to be rich in fat since it consists of tea or coffee always served with a fried snack such mixture, bajji, vada, banana chips or bread toast throughout the week except on two days, when they were found to receive a fruit or bun. This fruit being pineapple or plantain also contributes to the vitamin A/β-carotene level of the general diet.

The dinner seems to be lightest of the four meals generally consisting of rice and two vegetable dishes served with rasam. The dinner is observed to be highly inadequate on one day of the week, when rice is served with rasam and salad alone for the vegetarians.

Though the meal pattern is same, non-vegetarians were served with fish every day in the form of fish fry or fish curry except on Sundays when they would receive beef curry instead of one vegetable dish which is given to the vegetarians. This results in excess consumption of fish which confirms the observation recorded in the NNMB report of 1994, which reveals that the fish consumption in Kerala is very high. They have stated the average fish consumption of Thiruvananthapuram as 113 grams per day.

The dietary survey has also indicated that the vegetarians compared to omnivores were found to consume extra items such as potato chips, ice cream etc. But no significant variation in NSI or β-carotene levels could be observed between the lactovegetarians and omnivores who consumed such extra foods. This fact is endorsed by Elizabeth (1999) who remarked that eating of snack is higher among adolescents, which provides mostly empty calories that leads to micronutrient deficiency.

5.4 FOOD USE FREQUENCY SCORE

One method of assessing adequacy of a diet is through computation of food use frequency score. According to Fremes and Sabry (1976) a nutri-score plan would help to rate one's own diet and to discover the strong points and weeks spots in one's eating habits so as to strike a balance.

The food use frequency scores when computed from a diet inventory of the hostel over a period of month and averaged for one week indicated no major variation between the food use frequency of lactovegetrians and omnivores except in the case of fleshy foods and fruits. While comparing lactovegetarians with omnivores it is natural that the lactovegetarians would have a score of zero for animal foods since their diets are free of fleshy foods such as meat, fish and egg. Since, as remarked by Anderson (1982), the lactovegetarians are those who use milk and other dairy products in addition to plant foods; they exclude all meat, poultry, fish and egg.

Among the omnivores the scores for fish was quite high (91 per cent when compared to meat or egg (53 per cent 56 per cent respectively). This is so because fish is an inevitable item of Kerala dietaries and also because it is served either in the fried form or in the form of a curry. Hence it became one of the most frequently used item like vegetables. The score for meat and egg are low since meat is served only once (every Sunday) in a week while egg is served once or twice a week while fish is

part of every days diet especially as an item of lunch. The study conducted by Beatrice (1999) also had revealed that fish was used most frequently in all the three hostels she surveyed. Apart from fleshy foods a clear cut difference in the frequency score was observed in the case of fruits wherein the lactovegetarians had a higher score (62) than the omnivores (53). This variation could be attributed to the extra amount of fruits consumed by lactovegetarians over and above the fruits served as part of regular hostel diet. Beatrice (1999) had assigned a score of 44 per cent for fruits and reported that fruits and milk are items having moderate frequency of use. Frequency score for milk in the current evaluation seems to be an inflated one since milk as such is consumed only by 6.67 per cent lactovegetarians and 6.67 per cent omnivores. But it finds a place in the daily diet as a constituent of tea/coffee which is served daily twice and is universally consumed by all the subjects.

There is a general belief that pulses are an indispensable item of vegetarian dietaries and it is an item of low preference as far as the omnivores are concerned. But in the present study the score for pulse consumption between the groups did not differ, primarily because the pulse containing preparations such as sambar or a pulse-vegetable curry forms the major side dish served and consumed irrespectively by lactovegetarians and omnivores alike. This is in line with the observation of Krishnakumari (1981) who study the meal pattern of 11 women's hostels, and reported that pulse consumption of the subjects was more than adequate because pulse containing preparations was the major side dish served in the hostels. Moreover it is one of the vegetable curry or dishes which replaces the fleshy food based items, served for omnivores. Study conducted by Beatrice (1999) also confirms this finding and reveals the fact that cereals, pulses, vegetables, roots and tubers, fish, meat, egg, fat and oils, sugar and jaggery were most frequently used items of the agricultural college hostel.

The classification of food groups based on their scores into 'most frequently used' to 'least frequently used' based on the consumption pattern by lactovegetarians and omnivores had revealed the fact that both the groups did not have neither 'least frequently used' nor 'less frequently used' items which gives an indication that the hostel diet in general is a balanced one with adequate representation of foods from different food groups being repeated frequently.

5.5 VITAMIN A SCORE

The duel aim of the current study is to assess the vitamin A status and nutritional status of lactovegetarians and omnivores. As a first step the vitamin A status was assessed in two ways. Initially each individual was categorised based on their vitamin A score which was measured using the technique suggested by Bamji *et al.* (1996). The scores for individual subjects were computed on the basis of the intake of food materials containing vitamin A/β-carotene. The intake of vitamin A containing foods by the subjects were inturn derived from food weighment survey. Ten of the omnivores had a score ranging between 150-200 while ten of the lactovegetarians had it ranging from 200-300 which indicate that the lactovegetarians had a better vitamin A score than the omnivores. The variation between the groups with respect to vitamin A score seems to be highly significant ($t = 3.823^*$, $P > 0.01$). Rauma (1995) also had reported that vegetarians had significantly higher intakes of β-carotene and dietary vitamin A, and hence their vitamin A score may also be higher. This can be attributed to the intake of vegetables especially other vegetables, roots and tubers (especially carrot) and fruits such as plantain, pineapple and tomato. The consumption of items such as jam could also elevate the vitamin A score.

This fact is further clarified by the average food consumption pattern of the two groups of subjects. The average consumption of fruits, roots and tubers, leafy vegetables and other vegetables which are good sources

of vitamin A are higher among lactovegetarians. However the difference seems to be nullified by the consumption of fish, meat and egg by the omnivores. It is also observed that the consumption of milk being equal among the two groups, there is no chance of this item influencing the scores. It was seen that the vitamin A score was not found to have any association with the serum β-carotene/retinol level of the subjects.

When the individual vitamin A score was compared with their respective serum β-carotene level, no significant association could be traced. For example, a lactovegetarian with a score of 161 had a serum β-carotene level of 99 mμg/100 ml while another candidate with a score of 266 had a value of 45.316 mμg/100 ml of blood. This leads to the conclusion that having a high vitamin A score by itself does not guarantee a high level of serum β-carotene. This is so because though there are foods containing good amount of vitamin A, the quantity of that food consumed may be too low to bring about an elevation in the serum β-carotene level. The variation in the bioavailability of β-carotene from the food could be another factor which might influence the association between vitamin A score and the serum β-carotene levels. The bioavailability is influenced by several factors such as dietary source, digestibility of food, protein and fat content of the diet as reported by Reddy and Vijayaraghavan (1995).

While the vitamin A score gives only a quantitative indication of the vitamin A content of food materials included in the diet that supplied vitamin A/β-carotene, the serum level reflects the quantity of vitamin A / β-carotene that is available to the body from the food through the process of digestion absorption and utilization. Hence there is no point in comparing these two variables.

5.6 PERCAPITA AVAILABILITY OF FOODS FROM HOSTEL DIET

The diet schedule of the hostel for a week when scrutinized twice in a month with respect to the inclusion of various foods gave a general picture of balance and adequacy. This was further confirmed from the food use frequency score (Table 8). The above two parameters gave a general view that the diet served in the hostel is balanced with respect to quality. To confirm the adequacy and balance, the percapita availability of foods to the entire inmates of the hostel as well as percapita availability of foods to the selected 30 subjects, when evaluated gave a contradictory picture. As revealed in Table 8 it was seen that none of the food groups are served in adequate amounts to the inmates except other vegetables roots and tubers and fish. These three items which are adequately served also seems to off-set the balance of the diet because they are served in excess.

The most deficient item seems to be green leafy vegetables which seems to be deficient to an extent of 98 per cent. Inadequacy is also observed with respect to fruits (60-65 per cent), pulses (50-60 per cent), oil (45-50 per cent), milk (33 per cent – only for lactovegetarians), meat (50 per cent only for lactovegetarians) in the descending order.

About the hostel diet in general, Beatrice (1999) had reported that the percapita supply of cereals, pulses, fruits and fleshy fruits were adequate according to RDA while in the present study the hostel diet seems to be inadequate in the supply of fruits leafy vegetables and fleshy foods. However, NNMB reports (1994) are in tune with the current findings that the consumption of pulses (30 per cent), leafy vegetables (70 per cent) and fruits were inadequate with respect to their subjects from Thiruvananthapuram.

5.7 MEAN FOOD AND NUTRIENT INTAKE OF THE SUBJECTS

From the percapita food intake, the mean food intake of the lactovegetarians and omnivores were computed and compared with respect to consumption of different food groups that constitute a balanced diet based on RDA. Accordingly, it was seen that, the diet of lactovegetarians as well as omnivores were ill balanced being inadequate primarily in leafy vegetables, fats and oils followed by 66-70 per cent deficiency in the consumption of cereals. Leafy vegetables seems to be the most limiting dietary factor capable of meeting only 7-8 per cent of the RDA. This could be one reason for inadequate consumption of important minerals such as calcium and iron by the subjects. The calcium and iron consumption are met respectively only up to 35 to 40 per cent 52 to 54 per cent of RDA. According to Perry (2002) a vegetable rich diet improve vitamin status especially that of iron. However the vegetable intake in general is seen to be compensated by a good intake of roots and tubers and 'other vegetables' by lactovegetarians; the adequacy being 90 to 94 per cent. Though the intake of roots and 'other vegetables' are found to be inadequate by about 10 per cent and 'other vegetables' by six per cent, the consumption of the above items by the omnivores is found to be inadequate to an extend of 18 per cent and 13 per cent respectively. The inadequacy with respect to the consumption of other vegetables between the two groups seems to be highly significant (2.934**, P>1). It is a well known fact that omnivores in general consumed less vegetables than vegetarians and the above truth is reflected in the data gathered through the study.

Moreover the dietary schedule followed in the hostel that distinguishes between omnivores and lactovegetarians itself has made the stipulation that the lactovegetarians would receive an additional vegetable dish in the place of fish, meat or egg served in the form of fish fry/fish curry /beef curry/omlette. Rauma (2001) has also ascertained that

vegetarians consume more vegetables which helps to maintain a higher antioxidant (β-carotene) status in them when compared to omnivores.

Similar to vegetables there exists the basic conviction that the vegetarians would consume a greater amount of pulses to meet their protein needs which is met by the consumption of animal foods by the omnivores. Gopalan *et al.* (2002) opined that traditional vegetarian diets contain enough pulse, dhal and legumes in varying proportions which can compare favourably with PER of animals foods. In the present study the mean intake of pulses by lactovegetarins was just eight per cent above that of omnivores. However both the groups are found to consume 25 per cent (lactovegetarian) to 18 per cent (0mnivors) of pulses below RDA. This deficit intake is seen reflected in the mean protein intake also there is an inadequacy of 42 per cent with respect to protein among both the groups. It is surprising to note that RDA for protein met by the diet consumed by lactovegetarians and omnivores are to the same extent (about 59 per cent) though the omnivores were consuming pulses as well as fish meat and poultry which are ideal sources of good quality protein. However, findings of the present study are contradictory to the work reported by Kaur and Mann (1990) who had stated that the protein content of the non vegetarian diet was higher than that of vegetarian diet. Kathleen and Julienne (1994) have opined that adolescents from rural and periurban areas they surveyed, had low protein intake as compared to those in urban areas. This statement is true with the subjects of the study since the hostel is situated in a rural area which is also adjacent to a peri urban area; and their protein intake is 3 per cent below RDA. Though omnivores were also found to consume milk in excess (>20 per cent of RDA) the lactovegetarians were consuming 40 per cent less than RDA and were not consuming fleshy foods being vegetarians. Krajcovicova-Kudlackova *et al.* (1997) have also indicated that vegetarian children had significantly reduced intake of milk and dairy products than omnivores. B-complex vitamins and deficiency of riboflavin especially could be attributed to

inadequate intake of milk. Though the omnivores were consuming adequate amount of fish, they were found to consume other animal products 30 per cent below RDA. However it is gratifying to note that none of the subjects exhibited signs of protein deficiency when clinically examined.

Another inadequacy that is observed from the data on food intake is that of fats and oils. The fat requirement seems to be met only to 55 per cent in the case of lactovegetarians and 47 per cent in the case of omnivores though both the groups consume about 16.60 g of fat per capita per day. The variation in adequacy is attributable only to the requirement which is higher in the case of omnivores. This deficiency in fat consumption is seen reflected in the energy intake among lactovegetarians who were found to consume 10 per cent energy below the RDA. However, the omnivores were consuming slightly higher amount of calories than their requirement (> 5 per cent) which could be attributed to the fat supplied through fish (fried) and meat. A variation in consumption of invisible fat derived from other foods especially cereals could have contributed to the adequacy of calorie with special reference to omnivores. NNMB (1994) revealed that invisible fat in the food stuffs contributed significantly to total fat intake (visible + invisible fat) while it was nearly twice that of visible fat in most of the cities and in Thiruvananthapuram it was found to be six times that of visible fat. A similar situation is also noticed in this study.

Study conducted by Bederova *et al.* (2000) has also revealed that, vegetarians consume less fat than omnivores. Appleby *et al.* (1999) had further stated that omnivores had higher total and LDL cholesterol had further stated that levels than vegetarians which may be due to the presence of high content of fat (invisible) present in the animal foods.

The items that seems to be consumed adequately by the lactovegetarians are fruits, sugars and jaggery; the percapita mean

consumption of fruits being 34 g against an RDA of 30 g. It is of interest to note that fruits are supplied through the hostel diet only 2 to 3 times in a week which again is reflected in the food use frequency score of fruits (53-62 per cent) presented in Table 8. Vigilant observation of the food pattern of individual subjects revealed that the lactovegetarians are consuming fruits as 'extra' on 'payment basis' over and above what is generally served in the hostel. This extra consumption has only helped them to meet the requirement for fruits. This extra fruit consumption is seen to influence primarily their intake of vitamin C which is found to be 42 per cent above RDA in the case of lactovegetarians and >20 per cent in the case of omnivores. According to Gopalan *et al.* (2002) vegetarian foods especially leafy vegetables and fruits are rich sources of carotenoids and vitamin C. This could be another reason for enabling the subjects to consume adequate amounts of carotene which is found to be 37 and 41 per cent above RDA respectively for omnivores and lactovegetarians. This increased intake of fruits supplying adequate amount of β-carotene could be the reason for all the subjects to have an acceptable level of serum β-carotene as shown in Table 33, except two lactovegetarians and one omnivore who had values below 50 µg/100 ml. Food consumption data of these two individuals revealed that fruit intake of these subjects was also more than 45 g against the RDA of 30 g. One of these subjects who had a serum β-carotene of 43.41 µg/100 ml was found to suffer from common cold very frequently. However, consumption of higher quantities of fruit should have been reflected in the intake of fibre too. To the dismay of the investigator the fibre intake of both the groups are found to be least adequate meeting only 10-12 per cent of RDA. Observations on the meal pattern has revealed that the subjects were consuming fruits such as plantain after removing the fibrous portion completely. Moreover the consumption of fruits was mainly restricted to fruit juice which also might have reduced the fibre intake and cereals were provided in the refined form. Due to this the individual intake of both lactovegetarians and

omnivores as well as the mean intake of fibre seems to be inadequate (>85 per cent). But the fibre intake of lactovegetarians (10.83 per cent of RDA) was lower than omnivores (12.11 per cent of RDA). However the study conducted by Bar and Broughton (2000) revealed that vegetarian were found to consume more fibre than omnivores,

Though minor variation in percentage adequacy is observed between lactovegetarians and omnivores the variation is not significant between the groups except for vitamin C, energy and fat intake. Study conducted by Woo *et al.* (1998) found that total energy, fat, protein, thiamine, niacin intakes were lower in vegetarians than in non vegetarians, while carbohydrate calorie, calcium, potassium, retinol equivalent and ascorbic acid intake were higher.

Though the consumption of β-carotene and vitamin C are found to be in excess, they would not produce any toxic effects. Vitamin C being a water soluble vitamin will be lost through urine and the quantity consumed in excess may not have any deleterious effect. In the case of β-carotene, an essential fat soluble vitamin, the toxicity is generated only if consumed above 30,000 – 150000 mg per day. However, Nagai *et al.* (1999) from Japan found that eating pumpkin on a regular basis for two years may cause vitamin A poisoning and reverse effects are seen after six month of withdrawal of pumpkin. The consumption of β-carotene slightly above the RDA may help on the other hand to build up liver storage which could be made use of during lean periods of vitamin A consumption. These two vitamins are consumed in adequate amounts mainly because the subjects have a fairly good intake of vegetables and fruits, though the meal served in the hostel is deficient in green leafy vegetables.

As far as the mean nutrient intake of the subjects are concerned both lactovegetarians and omnivores have a ill balanced dietary intake. The diets consumed by the lactovegetarians are deficient both in energy and protein as well as in minerals such as calcium and iron which leads to the

conclusion that the lactovegetarians have a poor nutrient status as far as their nutritional intake is considered in light of recommended dietary allowances. Though not in energy, the omnivores also have a deficient intake of protein, calcium and iron which are the major nutrients required for maintenance and regulation of good nutritional status and health especially because the subjects are young adult/adolescent women. According to Prema (1999) the diet of adolescents she studied were lacking in protein, fat and fibre.

This deficient intake of nutrients could be attributed mainly to reduced intake of food in terms of quantity rather than that of quality. This fact was derived from the quantity of individual foods/preparations consumed by the subjects, evaluated through the weighment survey which was conducted for seven consecutive days. The diet served in the hostel in general had variety and is found to be having foods from all food groups. The food use frequency assessment and the values obtained for vitamin A score also endorses the adequacy of the hostel diet. Therefore the inadequacy observed in the nutrient intake points out to the deficient intake. Inadequate intake could be attributed to two facts; an adolescent or an young adult especially a women, tends to consume less food to maintain their body shape and figure or as a precaution to avoid obesity. According to Prema (1999) and Elizabeth (1999) adolescent girls were more conscious about over weight and they are engaged in fasting self induced vomiting or laxative were used to reduce weight. Obesity in general is considered as a social stigma especially by college university students. The second fact could be that being the inmates of a hostel, these girls might not be preferring the culinary practices as well as the dishes served in the hostel. In other terms they would prefer the taste of their home diet rather than the hostel diet. Moreover, those who have been staying in the hostel for several years (more than five years) might be finding the general meal pattern monotonous which might also lead to reduced food intake. This low intake might be the reason for more than 60

per cent of the subjects to have a body weight below normal. Food and Agricultural Origanisation (1995) had reported a study involving 22 healthy Nigerian adolescent girls who were residing in a hostel and it was seen that they had a low food and energy intake. Similar findings are noticed in this study also.

5.8 ADEQUACY OF INDIVIDUAL FOOD AND NUTRIENT CONSUMPTION

Nutritional status of individual subjects when assessed through weighment survey revealed that more than 80 per cent of the subjects had poor nutritional status based on the quantity of foods categorized into different groups and nutrients consumed by the subjects. Irrespective of being lactovegetarian or omnivore all subjects had negligible intake of leafy vegetables and low intake of fats. About 83 per cent to 90 per cent of the subjects had poor cereal intake while about 70 per cent had poor intake of milk and other vegetables.

Lower intake of cereals coupled with a deficient intake of fat could be the reason for more than 90 per cent of the subject to have low weight for height and low MUAC. More than 45 per cent of subjects were found to have low BMI also.

The reduced intake of these two energy constituents of the diet *viz.*, cereals and fat is also reflected by the low percapita calorie consumption as shown in Table 23. It was also observed that 60 per cent of lactovegetarians and 33 per cent of omnivores had inadequate energy consumption. Higher intake of roots and tubers along with the consumption of energy containing animal foods and excess intake of fish by the omnivores could be attributed as the reason for lesser percentage of individuals exhibiting calorie inadequacy among the omnivores.

Milk seems to be another item consumed to a lesser extend by 93 per cent of the lactovegetarian subjects. Lower intake of leafy vegetables as well as milk could be the reason for inadequate consumption of minerals

and vitamins. Since 100 per cent of the subjects were found to consume inadequate amount of calcium and iron, 80 – 100 per cent of subjects exhibited deficit intake of B-complex vitamins which can be theoretically attributed to reduced intake of the above two protective foods. The clinical evaluation of the subjects has also reinforced the fact that 33 per cent of the subjects are affected by deficiency of calcium and B-complex vitamins which can directly be connected to deficient intake of these regulatory foods.

The only factor which would be helping the subjects to maintain their nutritional status, though at a lower level, could be excess consumption of fruits and fish. The excess consumption of carotene and vitamin C especially by the vegetarians would have also might have contributed to the maintenance of moderately adequate nutritional status which was clear through clinical evaluation; since none of the subjects had specific symptoms of carotene, vitamin C and iron deficiency which are common among adolescents.

Though the nutritional status of the subjects in general had exhibited no direct association with the serum vitamin A levels it was observed that all the subjects had optimum vitamin A status when their serum β-carotene levels were examined which could be due to high intake of fruits and other vegetables by lactovegetarians and fish additionally by omnivores. The absence of iron deficiency anemia though the iron intake is poor, could be due to the favourable effect of vitamin A which is found in adequate amounts in the diet. A study conducted by Suhano *et al.* (1993) revealed that vitamin A supplementation has an effect on preventing iron deficiency anemia. The financial status of the subjects could also have a favourable effect inducing higher intake of fruits which were found to be the major source of carotene and vitamin C, since both lactovegetarians and omnivores belonged high income strata.

Though the carotene intake of all the subjects are high, the serum β-carotene levels of the omnivores were higher than that of lactovegetarians. This may be due to the variation in bioavailability. The higher fat intake and lower consumption of fibre along with moderate consumption of protein would have helped the subjects to have a optimum β-carotene level; since these factors favour absorption and utilization of β-carotene from the diet. The omnivores had an added advantage that they consume higher amount of protein which is of better quality than those derived from the plant foods consumed by lactovegetarians. Another factor could be that the plant source of vitamin A namely β-carotene needs to be converted to serum vitamin A in the case of lactovegetarians which involves loss due to the processes involved in bioconversion. As remarked by Murray (1996) the conversion of carotenoid to retinol takes 6-7 hours, the rate of absorption of vitamin A is more rapid than that of carotene. The fibre content which is a inseparable portion of the plant structure may also interfere with utilization. It may reduce the velocity as well as the quantum of conversion. In the case of omnivores conversion and transport of animal source of vitamin A into serum retinol/β-carotene is naturally enhanced by the presence of animal fat which is an integral part of animal tissues coupled with the absence of fibre. Hollander (1981) has endorsed the fact that the absorption of vitamin A and β-carotene is increased by the presence of fat in the diet. Lesser consumption of tea and also consumption of tea along with breakfast or snacks in the evening could have also favoured absorption of selected vitamins and minerals.

The poor nutritional status of the subjects in general can directly the assigned to the meal makeup of the general hostel diet which itself seems to be ill balanced with deficit supply of leafy vegetables, fruits and an excess supply of fish, fat and other vegetables. This basic defect is further aggravated and enlarged by the poor consumption pattern of individual subjects. The individual subjects are found to consume very little quantity

of individual items of food which is a cause of undernutrition rather than the cause of precipitation of grave symptoms of malnutrition.

5.9 SERUM RETINOL / β-CAROTENE LEVEL OF SUBJECTS

In this study the β-carotene values were estimated mainly because the intake of vitamin A from foods could be computed from the food composition tables only in terms of β-carotene units contained in the plant foods. As one of the major aim of the study was to compare the vitamin A status of lactovegetarians against that of omnivores, the β-carotene levels was found to be a better yard stick than retinol. The retinol levels of individual subjects varied over a wide range and no comparison could be struck between the serum levels of lactovegetarians versus omnivores. Though there was a minor variation in the mean β-carotene levels of lactovegetarians (101.66 μg/100 ml) and omnivores (119.54 μg/100 ml) the values did not differ significantly when subjected to statistical analysis. This indicates that being a lactovegetarian or omnivore had no influence on the serum levels when analysed on the basis of the hostel diet consumed by the subjects.

However, data presented in Table 33 indicates that the mean values of β-carotene are higher for omnivores when compared to lactovegetarians. This could be attributed to the better availability of vitamin A from animal foods as explained by Thurnham and Northrop-Clewes (1999). However, studies done by Johnson *et al.* (1995) among female adults found that the lactovegetarians subjects had higher β-carotene than omnivores. Malter *et al.* (1989) has reported that among the vitamins they tested, the level of carotene was significantly higher in vegetarians when compared to omnivores. More than the variation in the consumption of plant or animal foods, it is the diet as a whole as well as the quantity of the items consumed coupled with the bioavailability of vitamin A form the meal that influences the β-carotene levels. According

to Reddy and Vijayaraghavan (1995) the carotene absorption depends on a number of factors such as dietary source, digestibility of food, level of carotene intake, protein and fat content of the diet.

However, when the β-carotene levels of individuals were analysed a direct and significant positive relationship was observed between the serum level and the age of the incumbents ($r = 0.48^{**}$, $P>0.05$). A similar trend has been observed by Ballew (2001) when compared the β-carotene levels of children with that of adults. He found that the mean serum levels were lowest in subjects aged less than 10 years and it increased with age.

Another significant observation was that the serum β-carotene level was found to be associated with level of fat ($r = 0.64^{**}$, $P>0.05$) consumed. This could be due to the favourable influence of fat on absorption and utilisation of vitamin A, which is a fat soluble vitamin. Analysis of the diet schedule of the hostel revealed that the most frequently used method for cooking of vegetables was sauting. A similar trend has been reported by Hollander (1981) who reported that sauting of leafy vegetables with oil helps in retention of β-carotene. It was also noticed that the fried foods such as snacks, fish found a place in the daily diet of the hostel which also enhances the fat content.

Tanumihardjo *et al.* (1996) found that vitamin A deficiency was commonly observed in children infected with *Ascaris lumbricoides*. It has been reported that parasitic infections can reduce vitamin A absorption as much as 70 per cent. In the present study none of the subjects were reported to have hook worm infestation and only two subjects had the habit of deworming once in six months. Jalal *et al.* (1998) found that regular deworming will improve vitamin A status but in the present study those subjects who dewormed once in six months had a normal β-carotene level (less than 100 µg/100 ml) as compared to others.

5.10 NUTRITIONAL STATUS OF THE SUBJECTS

The nutritional status when evaluated through anthropometry, clinical examination and actual food intake survey revealed no significant difference between the lactovegetarians and omnivores. When height was taken into account, all the subjects except three of lactovegetarians and omnivores had a height above 151 cm which is declared as the height of a reference women. Though Keralites are reported to have a short stature, the current data gives no such indication. The height of females in the age group of 18–22 years even from the slum area of Thiruvananthapuram was found to have a height of 149.1 to 151.3 cm as reported by NNMB (1994). This gives an indication that though the subjects of this experiment and that of NNMB belong to totally different social as well as economic strata there seems to be no tangible variation in their height and 'stunting' was also not observed in these groups.

However, when the weight data was analysed, the lactovegetarians had a better mean weight than the omnivores. The mean weight of lactovegetarians though equal to a reference women there were nine subjects (60 per cent) who were below the value of 50 kg and six subjects (40 per cent) above that. In the case of omnivores, five subjects (33.33 per cent) were above 50 kg; eight (53.33 per cent) were below 50 kg and two subjects (13.33 per cent) were having a weight equal to 50 kg (weight of reference women). However the mean weight of females of Thiruvananthapuram city as registered by NNMB is only 44.3 kg. This also gives an indication that girls of this age from Thiruvananthapuram in general have lower body weight. Pant and Solanki (1989) had reported that height and weight of adolescents are found to be far below NCHS standard.

The data collected on the height and weight of the individual subjects when compared with standard weight for height revealed that all the subjects (except four lactovegetarians and one omnivore) had lower weight than the required standard value which proves that majority of the

subjects of the study, especially more subjects from the omnivores group have poor nutritional status.

Thus when anthropometry was used to evaluate the nutritional status of the subjects it was seen that majority (more than 80 per cent) of the subjects have adequate height. As far as the weight was concerned, 50 per cent of the subjects had weight below normal while 30 to 35 per cent in both the groups had excess weight. Weight being an important parameter that determines current nutritional status, low weight could be taken as an indicator of current short duration malnutrition while excess weight could be taken as a measure of excess calorie consumption or lack of sufficient physical exercise. When the dietary intake was evaluated in the light of anthropometric data, it was seen that all the subjects had an excess intake of fat mostly derived from invisible source. More over, the activity of the individual students are found to be varied and different depending on their work load. Hence these two contradicting factors would have influenced the energy intake and expenditure synergistically which would have affected their current weight status. It is seen that an equal number of subjects have low weight and excess weight, which can be attributed to both physical exercise and food intake of the individual subjects.

Since the weight and height of the individual subjects as well as their age are found to be highly variable, weight for height which is believed to be an age independent factor was further utilized to assess the nutritional status. Rao and Vijayaraghavan (1996) have opined that weight for height is a good prognostic indicator particularly in severe malnutrition and is also considered as a good index of current nutritional status. When the nutritional status of the subjects were analysed in the light of the above index, it was seen that 93 per cent of omnivores and 73 per cent lactovegetarians are malnourished. Pribi *et al.* (2001) had also reported that the weight for height of adolescents were less than standard value. In the present study there were only 13 per cent omnivores and 20

per cent lactovegetarians who had the index value above normal indicating excess weight for height. This indicates that the current dietary intake of the majority of the subjects are not adequate to meet their requirement. In this context it may be recalled that the diet per se served in the hostel itself is seemed to be ill balanced and the nutritional status exhibited by majority of the subjects points further to the fact that the individual subjects do not consume adequate amount of food served to them. The inadequacy in the diet and nutrient consumption is clearly picturised in the individual consumption data presented in Appendix II and III.

Apart from height and weight other anthropometric measurements of the subjects such as MUAC, TST, WHR and BMI were analysed. Mid upper arm circumference (MUAC) is used to indicate the status of muscle development. In the present study lactovegetarians were found have a higher MUAC than the omnivores but the difference was not found to be statistically significant. The study conducted by Woo *et al.* (1998) also is in tune with the present study. From the survey conducted by NNMB among females (18–22 years) of Kerala the MUAC is reported to be between 23.3 to 24.1 cm. In the present study also the mean value is found to be 24.17 which suggests that the mean value is below the standard value (28.5 cm).

As the MUAC of cent per cent of the omnivores and 14 (93.33 per cent) of lactovegetarians are found to be having a value below normal which indicates poor muscle development. This may be due to protein and calorie deficiency or due to insufficient exercise to these muscles. Dietary intake data endorses the fact that the majority of the subjects have poor protein intake as well as inadequate calorie intake. Being students, specially of post graduate level, these subjects have very little exercise to the muscle of the upper mid arm. Here again no significant variation between omnivores and lactovegetarians was observed which again

indicates that the dietary pattern has no influence on the MUAC of the subjects.

Measurement of triceps skin fold thickness (TST) helps to assess the amount of subcutaneous fat which inturn gives an indication of the calorie reserve in the body of an individual. According to Bargava and Kawatra (1999) the TST among middle income Indian women were 16.5 mm but in the present study the mean of lactovegetarians was 21.13 mm which is higher than that of omnivores (18.13 mm). The NNMB reports revealed that the fat fold thickness of females (18-22 years) from urban areas of Kerala is between 17.8 to 17.9 mm. Hence in the present study the mean TST of both lactovegetarians and omnivores were found to be above normal and the values are also higher than that reported by NNMB.

Further it was noticed that 13 (86.67 per cent) of lactovegetarians and nine (60 per cent) of omnivores had TST value above the standard value of 16.5 mm. Woo *et al.* (1998) also reported that lactovegetarians have a higher skin fold thickness than omnivores. High skin fold thickness is an indication of increased deposition of subcutaneous mass. This may again be due to high consumption of fat, energy or due to lack of exercise to these muscles (Triceps). However though the average fat consumption and calorie consumption were found to be significantly higher among omnivores when compared to lactovegetarians, the TST value of omnivores are found to be comparatively lower and the number of subjects who have lower TST than standard value are lower among omnivores. This contraindication further denotes that the variations exhibited between the individuals and groups cannot be attributed to their dietary pattern alone but to other genetic or physical activity and energy expenditure pattern. In this context it is noteworthy to mention that the differences exhibited by individuals are not significantly expressed when it comes to the group and hence no significant difference in TST was observed between the groups when the data was statistically analysed.

The waist–hip ratio of the subjects when compared to the WHR suggested by Sadikot (1996) revealed that 46.67 per cent each of lactovegetarians and omnivores were found to have a higher WHR while 53.33 per cent lactovegetarians and 26.67 per cent omnivores had value below standard. Here again no significant difference between the two groups were observed. The hip and waist circumference are indicative of musculature and extent of adipose tissue deposition as well as the nature of bone development. According to Tuomilehto *et al.* (1990) WHR is independently related to several cardiovascular risk factors. These are liable to be influenced by diet. According to the study conducted by Robinson and Barasi (2001) those subjects who consumed a self selected vegetarian diet had a lower waist–hip ratio when compared to omnivores. However in the current study there is no significant difference between the two groups having different dietary habits as far as waist–hip circumference or WHR is concerned.

To get a better picture of the nutritional status, the BMI was worked out which is reported to be a better index for measuring nutritional status especially among adults. As suggested by International Dietary Energy Consultative Group (IDECG), the BMI was used as a parameter in the study for detecting chronic energy deficiency (CED) and to measure nutritional status and calorie adequacy. This data revealed that about 60 – 65 per cent of the subjects in both the groups have normal nutritional status when measured with this yardsticks. Another fact which became clear through this evaluation is that 33.33 per cent of the omnivores have mild chronic energy deficiency (CED grade I – mild). Though the mean energy intake of omnivores are better than that of lactovegetarians, only one lactovegetarian had CED of a moderate type (grade II) but 33 per cent again had weight below normal, but no significant difference could be observed between the two. However, NNMB reports among urban slums revealed that chronic energy deficiency was slightly less in females than in males and in Thiruvananthapuram district it was noticed that 17 per

cent of adult females had CED. The normal range of BMI is 18.5 to 25.0. In the present study the mean BMI of lactovegetarians (20.40) was found to be slightly higher than that of omnivores (19.51). However the above values are within the normal range. Study conducted by Harman and Parnell (1998) among adult females revealed that BMI levels of both the omnivores and lactovegetarians are similar. Another study conducted by Key *et al.* (1999) revealed that vegetarians had a lower BMI when compared to omnivores, which is contradictory to the current study.

The anthropometric data further revealed that there is no significant difference between the nutritional status of the two groups of subjects based on height, weight, WHR as well as weight for height. This finding when viewed along with diet consumption data reveals that it is not the diet per se but the individual consumption which led both the group to have poor nutritional status based on the above parameters.

Clinical examination helps to assess level of health of individuals in relation to the food they consume (Park and Park, 1991). In the present study clinical examination of the subjects indicated the presence of mild forms of deficiency in 33.33 per cent of lactovegetarians as well as omnivores. The subjects exhibited mild forms of B-complex, calcium / fluoride deficiency which was common in both the omnivores and lactovegetarians noticed through symptoms such as nasolabial saborrhoea, vacularization of cornia, dryness and pigmentation of eye, dental caries while one omnivore exhibited the deficiency of adipose tissue through leanness and deficient weight for height. The dietary survey conducted has also revealed that the above subjects were found to have a poor intake of riboflavin, calcium, iron, while the consumption of carotene and calorie (except one omnivore) was found to be normal. Studies done by Specker (1994) and Barr and Broughton (2000) had pointed out that vegetarians had lower intake of vitamin B_{12}, calcium, protein, niacin etc. but in the present study both lactovegetarians and omnivores were found to have a

lower intake of the above nutrient. When weight of these subjects were analysed it was observed the above subjects had a normal weight except the one who had a deficit adipose tissue. The weight of that subject was found to be the lowest (39 kg) when compared to others.

Some of the symptoms such as dryness, pigmentation and vascularization of the eye were reported to be clinically non specific. None of the subjects exhibited any vitamin A deficiency symptoms. However, Taneja *et al.* (1978) had reported that occurrence of vitamin A deficiency and occurrence of B complex deficiency is higher among adolescents. They also stated that the incidence of nutritional deficiency diseases were higher among vegetarians than non vegetarian adolescents. One lactovegetarian showed the symptom of iodine deficiency too. This may be due to the fact that iodine intake of vegetarians are lower than that of omnivores as reported by Remer *et al.* (1999).

The study reveals that evaluation of nutritional status through clinical evaluation was also ineffective in identifying a difference in the nutritional status of lactovegetarians and omnivores.

On the whole, the nutritional status of the 70 per cent of the subjects based on clinical assessment seems to be satisfactory and others exhibited mild forms of deficiency and the cause of which may be the low food intake and specifically to negligible intake of green leafy vegetables and reduced intake of milk which are good sources of vitamins and minerals.

In short, it may be summarised that based on anthropometry the nutritional status of majority of the subjects (both lactovegetarians as well as omnivores) are poor, though the meal pattern of the hostel seems to be rich. This once again leads to the conclusion that the dietary pattern of the subjects, the composition of the hostel diet as well as the inadequate consumption of the available foods by the subjects have led to poor nutritional status.

It was surprising also to note that nutritional status of the subject had not influenced the β-carotene levels. In other words, if β-carotene levels are used as biochemical indicator for assessing nutritional status of lactovegetarians and omnivores, the results of the study indicated that there is no relationship between the two. It was also interesting to know that serum levels were influenced neither by β-carotene / vitamin A intake nor by the level of consumption of fruits and vegetables which are good sources of the above vitamin.

To conclude the study has brought out the following facts.

- ★ Nutritional status of 33 per cent of the lactovegetarians and omnivores are poor
- ★ The serum β-carotene levels of the subjects (86.67 per cent lactovegetarians and 93.33 per cent omnivores) are within the normal range corroborating with good health.
- ★ No significant variation between lactovegetarians and omnivores would be identified with respect to their nutritional status evaluated through anthropometry, diet survey and clinical evaluation
- ★ No significant difference between the lactovegetarians and the omnivores could be identified with respect to their serum retinon/β-carotene level on the basis of their dietary pattern nor on the basis of their nutritional status.
- ★ The nutritional status of the subjects were not found to be influenced by the meal pattern alone but by the per-capita consumption of foods and nutrients.
- ★ The β-carotene levels were found to be significantly influenced the quantity of fat consumed.
- ★ The age of the individual subjects was found to have a significant positive influence on the serum β-carotene levels.

★ An important observation that the lactovegetarians had lower β-carotene levels compared to omnivores and neither their diet history nor their period of stay in the hostel had any influence on the β-carotene levels.

The study in a nutshell revealed that there is no significant difference between the lactovegetarians and omnivores when their nutritional status and vitamin status were compared.

SUMMARY

6. SUMMARY

This study was conducted with an objective to assess the nutritional status and vitamin A profile of lactovegetarians in comparison with omnivores.

The subjects selected for the study were thirty female students of College of Agriculture, Vellayani. These subjects were selected primarily on the basis of their dietary pattern of past ten years. Thus 15 lactovegetarians (who were followers of a vegetarian dietary pattern but who were in the habit of consuming milk which is a food of animal origin) and 15 omnivores (who are in the habit of consuming non vegetarian foods at least four times a week or more) formed the subjects of the study.

While selecting the subjects care was taken to include only female students aged between 18 to 22 years. Few exclusion criteria were also followed in the selection of subjects. Those students who had skin and / or eye diseases, major illness/infection/infestation during the past three months and those were regular users of medicines, pharmaceutical supplements or creams containing vitamin A were excluded while selecting the subjects from the college hostel.

As the study envisaged to study the nutritional status and serum vitamin A profile of lactovegetarians in comparison with omnivores, assessment of nutritional status of subjects, their serum retinol and β–carotene levels, dietary habits, current dietary pattern, socio-personal characteristics actual food and nutrient intake and clinical status were evaluated.

Personal characteristics of the subjects when assessed confirmed that their age ranged between 18–22 years. Social background of the subjects when reviewed brought out the fact that 93.33 per cent of lactovegetarians and 66.67 per cent of omnivores were Hindus and the rest were Christians.

It was also observed that 66.67 per cent of the subjects of lactovegetarian as well as omnivores groups belonged to forward classes of Kerala. It was noted that the average family size of the subjects were 4.5.

As income has a direct bearing on food habits and daily meal pattern, the economic status of the subjects when enumerated brought forth the fact that all the subjects belonged to upper middle income strata. It was further observed that the lactovegetarians had a significantly higher annual income than the omnivores.

The knowledge of the subjects with respect to the sources, effects of deficiency and information about National Vitamin A Prophylaxis programme revealed that the subjects in general were not well informed about the role of vitamin A as a nutrient. However the omnivores comparatively had better knowledge than the lactovegetarians.

As part of the study the dietary history and basic dietary pattern of the subjects were assessed through a questionnaire. It revealed that all omnivores and eight (53.33 per cent) of the lactovegetarians had been following their respective dietary habit since childhood and the rest were found to have changed their habit. Further interrogation of the subjects brought out the fact that seven of the lactovegetarians (46.67 per cent) had shifted from an omnivores pattern to a vegetarian style since 10 years. The survey on dietary history also revealed that all the subjects were using rice as main staple food and that about 30 per cent of lactovegetarians and 20 per cent of omnivores were in the habit of consuming fruits more than three times in a week. Forty per cent of lactovegetarians and 66.67 per cent of omnivores reported a preference for salads though they were in the habit of taking salads only once in a week. Carrot, the excellent source of β–carotene was preferred only by 13.33 per cent of lactovegetarians and omnivores while 96.67 per cent of lactovegetarians and 60 per cent of omnivores indicated a special preference for mango, apples and oranges. Both the lactovegetarians and omnivores had the habit of consuming

vegetables daily. About 80 per cent of the omnivores reported that they eat fish daily. It was further noted that eighty per cent were in the habit consuming egg twice in a week and the rest were consuming it only occasionally. Though chicken was preferred by 86.67 per cent of omnivores due to its low fat content, it was consumed only once or twice in a month. The dietary history as revealed above is a reflection of their family diet pattern. But their current dietary pattern is controlled by the diet schedule of the hostel in which the subjects are residents since two to six years.

To study the current meal pattern of the subjects, the dietary schedule of the college hostel for a period of seven days was reviewed two times within a period of one month. The general meal pattern consisted of an early morning tea, followed by four square meals. The daily diet, as well as the menu for each meal varied over a wide range. The most frequently included food groups in the diet were cereals, pulses, leafy vegetables, other vegetables, roots and tubers, milk, oil and sugar. In addition to this omnivores also consumed fish regularly. This observation leads to the fact that the hostel diet in general is a balanced one because of the use of a variety of essential foods. When the frequency of use of foods containing vitamin A / β–carotene by the subjects were computed it was seen that lactovegetarians had a significantly higher vitamin A score (227.27 ± 0.06) than omnivores (177.60 ± 7.51) which might be due to a higher mean intake of vegetables and fruits.

However when current meal pattern of the individual subjects were assessed through a seven day weighment survey, it was seen that the diet consumed by them are ill balanced. To be specific, the intake of the lactovegetarians were found to be inadequate with respect to leafy vegetables (<91.19 % RDA), fat (<44.54 % RDA), milk and milk products (<39.42 % RDA) and pulses (<24.76 % RDA) whereas intake of fruits, other vegetables and root and tubers were found to be first adequate

(>90 % of RDA). In the case of omnivores, leafyvegetables (<92.79 % RDA) other vegetables (<29.74 % RDA), other vegetables (<29.74 % RDA), meat and egg (<31.70 % RDA), cereal (<40.62 % RDA) fat (<52.57 % RDA) are found to be inadequate while the intake of pulses, roots and tubers, fruits fish, milk and milk products were found to be moderately adequate (supplying more than 80 per cent of RDA). A significant variation in the mean consumption of other vegetables (2.934**) was seen between the groups *i.e.*, the lactovegetarians (70.29) had a higher intake than the omnivores (70.29). Though more than 80 per cent of omnivores were consuming fish everyday, it was sufficient to meet only 98 per cent of their RDA. On the other hand, the individual consumption of vegetables and fruits revealed that all the subjects had a very low intake of leafy vegetables and fruits, while 50 per cent of lactovegetarians and 46.66 per cent of omnivores were consuming fruits adequately or at a rate higher than their RDA. All the subjects (except two lactovegetarians (13.33 per cent) and one omnivore (6.67 per cent)) were found to have adequate consumption of "other vegetables".

Mean nutrient intake of the subjects when computed revealed that both lactovegetarians and omnivores had an inadequate intake of protein (<40 % RDA), calcium (<60 % RDA), iron (<45 % RDA), riboflavin (<70 % RDA), niacin (<20 % RDA) and fibre (<99.17 % RDA). However the mean calorie intake of omnivores was found to be adequate (1978.27 Kcal) and slightly more than that of lactovegetarians (1723.63 Kcal) when compared to the RDA of 1875 Kcal.

As the primary aim of the study was to assess the nutritional status of lactovegetarians and omnivores, the nutritional status of the subjects were assessed through anthropometry, clinical examination and detailed diet (weighment) survey. Anthropometric measurements were taken twice within an interval of three months. There was no significant variation in the anthropometric measurements namely height, weight, triceps skin fold

thickness, mid upper arm circumference or the selected indices such as BMI, WHR between the omnivores and lactovegetarians. Time factor was also found to have no influence on the nutritional status of the two groups. However when the nutritional status index (NSI) was calculated from selected anthropometric measurements, the mean NSI of lactovegetarians was found to be higher than that of omnivores, though the difference was not statistically significant.

Clinical examination of the subjects indicated that the incidence of deficiency disorders in both groups were varied and minimal and it was noticed that 66.67 per cent of the subjects were absolutely free of deficiency disorders. Only 33.3 per cent of the subjects from both the groups had only mild deficiency signs related to nasolabial seborrhea, dental caries, vascularisation of cornea and pigmentation of eye. The nutritional status of the subjects revealed that all the subjects were found to be nutritionally healthy and only mild deficiency diseases were exhibited by 33.33 per cent (both lactovegetarians and omnivores) of the subjects.

Another aim of the study was to compare the serum retinol/β-carotene level of the subjects. It was seen that omnivores had a higher serum retinol as well as β-carotene level (119.54 μg/100 ml) than lactovegetarians (101.66 μg/100 ml) but the values were not significantly different when statistically analysed. The higher serum value among omnivores inspite of lower vitamin A score might be due to variation in the absorption and utilization which is higher for animal sources.

In short, the study revealed that the diet served in the hostel is an ill balanced one and there is no significant variation between lactovegetarians and omnivores with respect to their nutritional status. The nutritional stats was found to be influenced by the meal pattern and by the percapita consumption of foods and nutrients. The serum β-carotene level of 86.67 per cent lactovegetarians and 93.33 per cent

omnivores are within the normal range but mean value indicates that omnivores were having a better status than lactovegetarians. The β-carotene levels were influenced only by the quantity of fat consumed as well as age of the subjects. The lactovegetarians were found to have a higher income level, higher vitamin A score and better mean NSI when compared to omnivores. The salient finding of the study is that there is no significant difference between the lactovegetarians and omnivores when their nutritional status and vitamin A status were compared.

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NUTRITIONAL STATUS AND VITAMIN A PROFILE OF LACTOVEGETARIANS

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ABSTRACT

This study entitled 'Nutritional status and vitamin A profile of lactovegetarians' was conducted among female (18–22 year old) resident college students (15 lactovegetarians and 15 omnivores) inorder to assess the nutritional status and vitamin A profile of healthy lactovegetarians in comparison with omnivores.

To achieve the above goal, current dietary pattern, actual food and nutrient intake, clinical and nutritional status, serum retinol and β–carotene levels as well as the socio–personal characteristics of subjects were evaluated using standard techniques.

Among the subjects, 93.33 per cent lactovegetarians and 66.67 per cent omnivores were Hindus and the rest were Christians. All belonged to upper middle income strata. The lactovegetarians had a significantly higher income than omnivores. The dietary history of the subjects when assessed revealed that all omnivores and eight lactovegetarians had been following the same dietary pattern since childhood while the remaining had changed to vegetarianisms since 10 years or more. When the current meal pattern and actual food intake were assessed for a period of seven days through weighment it was found that the hostel diet is ill balanced and supplies inadequate amounts of pulses (65 per cent), leafy vegetables (98 per cent), fruits (65 per cent), oil (50 per cent), milk (lactovegetarians 32 per cent), meat and egg (omnivores 49 per cent). The percapita intake of protein, calcium, iron, riboflavin, niacin and fibre by the lactovegetarian and omnivores were inadequate when compared to RDA. However the mean calorie intake of omnivores was found to be higher and adequate than that of lactovegetarians.

Apart from dietary survey, the nutritional status of the subjects were further evaluated through anthropometry and clinical examination. The

anthropometric measurements (height, weight, TST, MUAC and selected indices like BMI and WHR) which was taken twice with an interval of three months revealed no significant variation between the two groups. However the mean NSI of lactovegetarians was found to be higher than that of the omnivores though the difference was not statistically significant. Clinical examination indicated that the incidence of deficiency disorders in both groups were minimal though varied and 66.67 per cent of the subjects were found to be absolutely free from deficiency disorders, while no significant variation between the groups were observed.

As one of the objective of the study was to compare vitamin A status of the subjects, it was seen that serum retinol A/β–carotene levels of omnivores were higher (119.54 µg/100 ml) than that of lactovegetarians (101.66 µg/ 100 ml) but the difference was not statistically significant. This slight variation could be due to increased absorption and utilisation of vitamin a from animal sources. A positive and significant correlation was observed between β–carotene level and the age and fat intake of the subjects. However vitamin A score computed from the food intake data revealed that lactovegetarians had significantly higher score (227.27 ± 0.06) than omnivores (177.60 ± 7.51) which is due to a higher intake of vegetables and fruits by lactovegetarians.

The salient finding of the study is that though the lactovegetarians had a higher income, higher vitamin A score and better NSI, there was no significant difference between the lactovegetarians and omnivores when their nutritional status as well as their vitamin A status were compared.

APPENDICES

APPENDIX I

Questionnaire to collect the general profile of the subjects (Socio-economic dietary habits and knowledge referring vitamin A)

(1) Name :
(2) Age :
(3) Address :
(4) Religion :
(5) Caste :
(6) Size of the family :
(7) Annual income :
(8) Birth order of the respondent :
(9) Spacing between the siblings and respondent :

(10) Basic dietary habit : (a) Vegetarian (b) Non-vegetarian (c) Lacto-vegetarian (d) Ovo-vegetarian (e) Lacto-ovo-vegetarian

(11) If non-vegetarian/ovo-vegetarian (please tick)

(a)Consuming meat, egg and fish (b) consuming meat, egg, fish and milk

(c)Consuming meat and fish only (d) Consuming meat, fish and milk only
(e) Consuming meat and milk only (f) Consuming egg and fish only

(g) Consuming egg, fish and milk only (h)Consuming egg and meat only
(i) Consuming fish only (j) Consuming egg only (k) Other (please specify)

(12) Have you been following this habit since childhood ? (a) Yes ☐ No ☐

(13) If no, how long since have you been following the current dietary habit ?

(14) Why the habit was changed ? (please give reasons)

(15) How many times do you take your meals daily?

(16) How many meals have you skipped in the past one week ?

Meal	Day1	Day2	Day3	Day4	Day5	Day6	Day7
Break fast							
Lunch							
Evening tea							
Dinner							

(17) Do you take fruits regularly ? (a) Yes ☐ (b) No ☐

If yes (a) How much ? (b) How often ?

(18) Which are the fruits you like most ?

(19) Which are the fruits you dislike most ?

(Please give reason for like & dislike)

(20) Do you take fruit juice regularly ? Yes ☐ No ☐

If yes (a) how many glasses ?

(b) how often ?

(c) which are the fruit juice you prefer most _____

(21) Do you take vegetable juice regularly ? Yes ☐ No ☐

If yes (a) how many glasses ?

(b) how often ?

(c) which are the vegetables you prefer most _____

(22) Do you have the habit of taking salads ? Yes ☐ No ☐

If yes (a) Please list the salad vegetables you consume most

(b) how often you consume them ?

(23) How often you consume the following vegetables : (Daily/4 days a week/thrice a week/5 days a week/6 days a week if other, please specify)

(a) Roots and tubers

(b) Green leafy vegetables

(c) Other vegetables

(24) Which vegetables you like most

(25) Which vegetables you dislike most ?

(26) Do you have the habit of taking milk regularly ? Yes ☐ No ☐

If yes (a) how many glasses milk ?

(b) how often ?

If no, why ?

(27) Do you know whether it is fortified with vitamin A ? Yes ☐ No ☐

If yes, please write the amount Do not know ☐

(28) Do you have the habit of taking butter milk regularly Yes ☐ No ☐

If yes (a) how many glasses milk ?

(b) how often ?

If no, why ?

(29) Do you have the habit of taking tea and coffee regularly ? Yes ☐ No ☐

If yes (a) how many glasses daily ?

(b) how often ?

If no, why ?

(30) Do you have the habit of taking egg regularly ? Yes ☐ No ☐

If yes (a) how many ?

(b) how often ?

If no, why ?

(31) Do you have the habit of taking fish regularly ? Yes ☐ No ☐

If yes (a) how much ?

(b) how often ?

If no, why ?

(32) Do you have the habit of taking meat regularly ? Yes ☐ No ☐

If yes (a) how much ?

(b) how often ?

If no, why ?

(33) Which meat you prefer most (a) Chicken (b) Beef (c) Mutton (d) Pork (e) Organ meat (f) if other please specify

(34) Which method of cooking is most frequently used for consuming the following items :

a) Green leafy vegetables (raw/salad/sauted/boiled/steamed)

b) Other vegetables (raw/salad/santed/boiled/fried)

c) Roots and tubers (raw/salad/sauted/boiled/fried)

d) Egg (raw/sauted/boiled/fry)

e) Meat (steamed/fried/sauted/boiled)

f) Milk (raw/boiled)

g) Fruits (raw/salad) if other please specify

(35) Do you have the habit of taking foods in between meals ? Yes ☐ No ☐

If yes, please answer the following ?

Nature of foods	Name	Frequency of use/daily/day							
		Nil	Once	Twice	Thrice	5 times or more	Once a week	Twice a week	Thrice a week
a) Confectionaries									
b) Fried items									
c) Nuts & oil seeds									
d) Sipups									
e) Chocolates									
f) Toffee									
g) Sweets									
h) icecream									
i) Cola									
j) Other drinks									
k) If other (please specify)									

(36) Are you in the habit of taking any pharmaceutical supplements/medicines

(a) Now Yes ☐ No ☐

(b) In last 3 months Yes ☐ No ☐

(37) If yes, state the category of the supplement (a) Ayurveda
(b) Allopathy (c) Homoeopathy (d) Other category (please specify)

(38) Name the supplement (1)

(2)

(3)

(39) Who prescribed the supplement ? (a) Self (b) Doctor (c) Friend

(d) Other (please specify)

(40) State the reason for taking the supplement (s) :

(41) Do you know the type of nutrients present in it ? Yes ☐ No ☐

If yes, please write the amount of vitamin A if present in it

(42) Are you using any creams that contain vitamin A ?

Yes ☐ No ☐

If yes, please specify the name of the cream and why it was used Do not know ☐

(43) Did you suffer from any illness or infections during the last 1 year ?

Yes ☐ No ☐

If yes, (a) give the name of illness (b) frequency of illness

(44 Are you suffering from worm infestation at present ?

Yes ☐ No ☐ Do not know ☐

(45) How frequently do you deworm ? (please specify)

(46) What is used for deworming ? (please specify)

(47) Have you done it recently? Yes ☐No☐ If yes, when ?

(48) Are you aware of vitamin A prophylaxis program ? Yes ☐ No ☐

(49) Have you even participated in it ? Yes ☐ No ☐

If yes, give details

(50) Do you know that vitamin A deficiency leads to preventable blindness ?

Yes☐No☐

(51) Do you known the signs and symptoms of vitamin A deficiency ?

Yes☐No☐

(52) Do you know that hook worm infestation causes vitamin A deficiency ?

Yes☐No☐

(53) Do you know that anaemia causes vitamin A deficiency ? Yes ☐No ☐

(54) Which foods do you consider as vitamin A rich food ?

(55) Why is vitamin A considered as an essential item in food? (functions)

(56) Do you know any food item that is fortified with vitamin A ?

If yes, please list Yes☐No☐

(57) Have you used them recently ? Yes ☐ No ☐

If yes, please list

If no, why ?

(58) What is your opinion about your dietary pattern ?

(59) What are the advantages and disadvantage of

(a) vegetarianism (b) Non-vegetarianism

APPENDIX II(a)

Mean food intake of lactovegetarians

Food groups	Subjects															RDA
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Cereals and cereal products (g)	208.63	320.86	268.86	179.66	274.93	261.85	267.11	77.10	186.73	169.52	177.61	153.93	159.04	193.04	91.19	300
Pulses (g)	33.59	16.66	21.07	15.05	18.76	12.19	13.62	52.20	76.87	62.03	138.72	64.52	70.25	54.49	27.67	60
Leafy vegetables (g)	18.88	10.45	16.17	16.17	16.17	16.17	16.17	2.14	4.29	7.43	7.43	7.43	7.43	7.43	11.43	125
Roots and tubers (g)	43.81	45.45	53.95	46.70	49.12	60.17	54.46	26.30	46.53	35.97	35.97	35.97	49.28	42.61	48.97	50
Other vegetables (g)	63.21	85.50	69.38	54.59	84.58	94.40	94.41	21.74	78.19	81.91	58.50	71.69	69.40	67.71	65.51	75
Fruits (g)	20.85	30.86	12.28	12.28	5.14	40.85	40.85	83.71	49.67	39.67	39.66	53.95	11.09	48.00	27.29	30
Fishes and other sea foods (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meat and poultry (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Milk (ml)	157.37	98.80	114.16	113.08	115.58	115.58	115.58	96.65	109.20	108.18	110.85	107.29	108.18	102.46	244.29	200
Fats and oils (g)	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	30
Sugar and jaggery (g)	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30

APPENDIX II (b)

Mean food intake of omnivores

Food groups	Subjects															RDA
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Cereals and cereal products(g)	202.46	306.52	206.65	225.14	260.73	263.19	305.16	151.51	109.72	214.70	104.65	206.13	172.44	158.77	234.51	300
Pulses (g)	9.34	10.42	20.92	22.58	19.75	18.07	13.39	13.37	66.32	50.50	61.68	54.19	63.83	69.89	62.28	45
Leafy vegetables (g)	7.29	7.29	7.29	16.17	16.17	7.29	16.17	16.17	2.14	7.43	7.43	7.43	7.43	2.14	7.43	125
Roots and tubers (g)	68.29	43.92	51.06	40.92	51.75	38.20	57.32	27.53	41.69	27.57	38.81	37.40	26.72	39.00	29.74	50
Other vegetables (g)	80.57	50.19	60.09	62.28	59.28	46.79	61.75	16.66	72.97	53.64	38.65	51.43	41.49	54.14	39.89	75
Fruits (g)	19.43	5.14	36.56	23.71	5.14	15.14	5.14	10.85	62.29	45.38	33.72	49.67	32.45	58.23	19.66	30
Fishes and other sea foods (g)	13.39	41.44	29.07	37.29	43.00	41.36	37.29	23.09	5.14	32.43	24.71	30.14	30.14	28.14	26.71	30
Meat and poultry (g)	0	30.32	0	20.30	23.16	20.30	23.16	23.16	4.29	52.49	22.50	12.86	12.86	31.07	35.36	30
Milk (ml)	115.59	137.02	111.31	115.59	115.59	121.31	115.59	98.44	106.75	154.52	102.18	106.75	121.04	122.47	164.80	100
Fats and oils (g)	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	16.60	35
Sugar and jaggery (g)	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30

APPENDIX III (a)

Nutrient intake of lactovegetarians

Nutrients	Subjects															RDA*
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Energy (KCal)	1670.37	2018.61	1829.13	1497.29	1849.27	1844.30	1879.06	1271.15	1740.63	1617.17	1891.66	1580.79	1597.94	1687.73	1879.28	1875
Protein (g)	25.66	29.37	27.42	20.42	26.82	29.53	31.13	29.42	37.51	29.25	48.58	30.87	28.82	34.08	17.30	50
Fat (g)	76.49	76.55	74.69	74.09	74.62	78.31	78.22	75.33	76.84	75.93	77.04	75.89	75.82	75.49	142.03	20
Calcium (mg)	140.11	118.03	116.76	91.75	114.85	128.52	133.38	228.64	193.26	160.71	265.33	158.46	163.10	235.33	165.13	400
Iron (mg)	13.88	18.08	16.62	11.72	16.55	16.52	16.98	14.14	20.60	16.88	23.69	15.89	15.62	16.99	12.49	30
Carotene / vitamin A (µg)	3190.28	3257.87	3179.47	3129.09	3179.68	3356.11	3349.14	3123.45	3214.02	3196.25	3219.32	3157.49	3183.09	3125.75	6050.57	2400
Thiamine (mg)	0.69	0.89	0.83	0.59	0.82	0.82	0.85	0.55	0.95	0.78	1.09	0.79	0.74	0.71	0.45	0.9
Riboflavin (mg)	0.31	0.35	0.29	0.24	0.29	0.41	0.42	0.24	0.40	0.33	0.47	0.34	0.32	0.29	0.24	1.1
Niacin (mg)	8.89	13.37	11.47	7.69	11.84	11.08	11.32	5.15	10.48	9.01	10.99	8.66	8.67	8.53	5.32	12
Ascorbic acid (mg)	57.03	52.39	51.16	45.88	55.12	65.53	55.17	30.76	67.34	70.06	62.46	57.16	54.22	60.14	69.10	40
Fibre (g)	3.59	3.22	3.52	2.91	3.72	3.69	3.85	4.69	6.65	5.21	5.71	5.22	4.75	4.64	3.61	40

*ICMR (1991)

APPENDIX III (b)

Nutrient intake of omnivores

Nutrients	Subjects															RDA*
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Energy (KCal)	1662.32	2296.72	1741.47	2034.28	2172.96	2167.47	2275.67	1674.35	1459.59	2625.75	1661.69	1899.83	1806.19	1995.12	2200.58	1875
Protein (g)	23.50	34.62	25.04	26.61	29.47	31.13	30.04	17.86	28.97	32.50	23.52	33.28	32.41	36.00	33.70	50
Fat (g)	81.79	112.46	86.48	110.25	112.80	112.03	110.60	103.15	77.29	174.48	107.37	93.09	93.88	117.06	115.22	20
Calcium (mg)	109.78	125.45	106.95	116.14	122.79	112.56	119.01	73.43	198.01	154.61	122.49	186.75	177.73	210.68	191.31	400
Iron (mg)	13.78	19.53	14.46	15.42	17.04	16.69	17.85	11.15	13.99	17.23	12.27	17.19	15.97	16.54	16.84	30
Carotene / vitamin A (µg)	3253.02	3171.40	3173.42	3178.57	3177.99	3136.05	3174.94	3067.71	3163.26	4764.71	3124.03	3151.02	3182.90	3465.16	3180.60	2400
Thiamine (mg)	0.66	0.98	0.70	0.77	0.83	0.84	0.87	0.52	0.64	0.81	0.60	0.84	0.80	0.79	0.86	0.9
Riboflavin (mg)	0.30	0.38	0.28	0.33	0.33	0.33	0.34	0.21	0.30	0.35	0.28	0.37	0.38	0.55	0.46	1.1
Niacin (mg)	8.99	13.31	9.36	10.03	11.36	10.95	12.79	6.99	6.46	10.57	6.16	10.35	9.35	8.91	11.22	12
Ascorbic acid (mg)	49.81	40.69	55.10	55.48	47.39	38.47	49.74	21.19	69.05	57.55	50.73	52.49	37.93	50.15	38.61	40
Fibre (g)	3.76	5.15	4.76	4.72	5.12	4.78	4.73	3.21	5.43	5.81	5.00	5.47	5.11	5.20	4.39	40

*ICMR (1991)

APPENDIX IV

Nutritional Assessment Schedule

(N.A.C. – I.C.M.R.)

1. Sex
2. Age
3. Height
4. Weight
5. Hip-width (intercristal)

I. General

6. Appearance
   - 0 Good
   - 1 Fair
   - 2 Poor
   - 3 Very poor

II Eyes

(A) Conjunctiva

7. Xerosis
   - 0 Absent, glistening and moist
   - 1 Slightly dry on exposure for a minute, lack of lustre
   - 2 Conjunctiva dry and wrinkled
   - 3 Conjunctiva very dry and Biot's Spots present
8. Pigmentation
   - 0 Normal colour
   - 1 Slight discolouration
   - 2 Moderate browning in patches
   - 3 Severe earthy discolouration
9. Discharge
   - 0 Absent
   - 1 Watery, excessive lachrymation
   - 2 Mucopurulent
   - 3 Purulent

(B) Cornea

10. Xerosis

0. Absent

1. Slight dryness and diminished sensibility

2. Haziness and diminished transparency

3. Ulceatation

11. Vascularization

0 Absent

1 Circumocorneal injection

2 Vascularization of cornea

(C) Lids

12. Excoriation

0 Absent

1 Slight excoriation

2 Blepharitis

13. Folliculosis

0 Absent

1 A few granules

2 Lids covered with extensive granules

3 Hypertrophy

14. Angular conjunctivitis

0 Absent

1 Present

(D) Functional

15. Night blindness

0 Absent

1 Present

N.B. – Exclude other eye diseases not associated with nutritional defects

III. Mouth

(A) Lips

16. Condition

0 Normal

1 Angular stomatitis, mild

2 Angular stomatitis, marked

(B) Tongue

17. Colour

0 Normal

1 Pale but coated

2 Red

3 Red and raw

18. Surface

0 Normal

1 Fissured

2 Ulcered

3 Glazed and atrophic

(C) Buccal mucosa

19. Condition

0 Normal

1 Stomatitis

(D) Gums

20. Condition

0 Normal

1 Bleeding and/or gingi vitis

2 Pyorrhoea

3 Retracted

(E) Teeth

21. Fluorosis

0 Absent

1 Chalky teeth

2 Pitting of teeth

3 Mottled and discoloured teeth

22. Caries

0 Absent

1 Slight

2 Marked

IV. Hair

23. Condition

0 Normal

1 Loss of lustre

2 Discoloured and dry

3 Sparse and brittle

V. Skin

(A) General

24. Appearance

0 Normal

1 Loss of lustre

2 Dry and rough or crazy pavements

3 Hyperkeratosis, phrynoderma

25. Elasticity

0 Normal

1 Diminished

2 Wrinkled skin

(B) Regional

26. Trunk

0 Normal

1 Collar-like pigmentation and dermatitis around the neck

27. Face

0 Normal

1 Nosolabial seborrhoea

2 Symmetrical sub-orbit pigmentation

3 Moon face

28. Perineum

0 Normal

1 Scrotal or puddendal dermatitis

29. Extremities

0 Normal

1 Symmetrical dermatitis with pigmentation of glove or stocking type

VI. Adipose Tissue (to be judged by the examination of the arm over the biceps)

30. Quantity

0 Normal

1 Deficient

VII Oedema

31. Distribution

0 Absent

1 Oedema on dependent parts

2 Oedema on face and dependent parts

3 General anasarca

VIII. Bones

32. Condition

0 Normal

1 Stigmata of past rickets

IX. Heart

33. Size

0 Normal

1 Apex just outside the nipple line

2 Enlarged

X. Alimentary system

34. Appetite

0 Normal

1 Anorexia

35. Stools

0 Normal evacuation

1 Diarrhoea

36. Liver

0 Not palpable

1 Palpable

37. Spleen

0 Not palpable

1 Palpable

XI. Nervous system

38. Calf tenderness

0 Absent

1 Present

39. Paresthesia

0 Absent

1 Present

Suggested guide for interpretation of clinical signs

Dietary obesity

- Excessive weight in relation to height or other skeletal indices
- Excessive skin folds
- Excessive abdominal girth in relation to chest girth

Under nutrition

- Lethargy, mental and physical
- Low weight in relation to height or skeletal indices
- Diminished skin folds
- Suggested skeletal prominences
- Loss of elasticity of skin

Protein calorie deficiency

- Muscle wasting
- Low body weight
- Psychomotor change
- Dyspigmentation of hair
- Easy pluckability of hair
- Thin, sparse hair
- Moon face
- Flaky paint dermatosis
- Diffuse depigmentation of skin

Thiamine deficiency

- Loss of ankle jerks
- Loss of knee jerks
- Sensory loss and motor weakness

- Calf muscle tenderness
- Cardiovascular dysfunction
- Oedema

Niacin deficiency

- Pellagrous dermatosis
- Scarlet and rawtongue
- Tongue fissuring
- Atrophic lingnal papillae
- Malar and supraorbital pigmentation

Vitamin C deficiency

- Spongy and bleeding gums
- Follicular hyperkeratosis, type-2
- Petechiae
- Echymoses
- Intramusular or subperiosteal haematoma
- Epiphyseal enlargement (painful)

Vitamin A deficiency

- Xerosis of skin
- Follicular hyperkeratosis, type I
- Xerosis conjunctive
- Keratomalacia
- Bitots spots

Riboflavin deficiency

- Angular stomatitis, angular scars, cheilosis
- Magenta tongue
- Central atrophy of lingular papillae
- Naso-labial dyssebacea
- Angular palpebritis
- Scrotal and vulval dermatosis
- Corneal vascularization

Vitamin –D deficiency

(1) Healed rickets (in children or adults)

Frontal and parietal bossing

Knock knees or bow-legs

Deformities of thorax

(2) Osteomalacia

Local or generalised skeletal deformities

Iron deficiency

Pallor of mucous membrane

Koilonychia

Atrophic lingual papillae

Iodine deficiency

Enlargement of thyroid

Excess of flurine (fluorosis)

Mottled dental enamel (difficult to distinguish in early stages from enamel hypoplasia).