IMPACT OF DRUMSTICK (*Moringa oleifera* Lam.) SUPPLEMENT ON NUTRITIONAL STATUS OF SCHOOL CHILDREN

by

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THESIS

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DECLARATION

I hereby declare that this thesis entitled **"Impact of drumstick (*Moringa Oleifera* Lam.) supplement on the nutritional status of school children"** is a bonafide record of research 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 **"Impact of drumstick (*Moringa Oleifera* Lam.) Supplement on the Nutritional Status of School Children"** is a record of research work done independently by **Ms. Stephy. Das,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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LIST OF ABBREVATION

g	-	gram
mg	-	milli gram
µg	-	micro gram
et al.	-	and others
ie,	-	That is
Fig	-	Figure
kcal/ 100g	-	kilo calories per 100 gram
%	-	Per cent
EG	-	Experimental Group
CG	-	Control Group
ICMR	-	Indian Council of Medical Research
LDL	-	Low Density Lipoprotein
NFHS	-	National Family Health Survey
NNMB	-	National Nutrition Monitoring Bureau
WHO	-	World Health Organization
NIN	-	National Institute of Nutrition
MUAC	-	Mid Upper Arm Circumferences
UNICEF	-	United Nations Children's Fund
RDA	-	Recommended Dietary Allowances

Introduction

1. INTRODUCTION

As today's children are the citizens of tomorrow, their survival, protection and development are the pre-requisite for the future development of humanity. National Family Health Survey(NFHS)-3, (2006) studies found that the present scenario of health and nutritional status of the school age children in India is very unsatisfactory and vulnerable. Anaemia and other micronutrient deficiencies are common among Indian school children. These deficiencies led to problems of eye sight and poor working capacity and poor school performance.

The high prevalence of malnutrition among the school children especially in the coastal areas might lead to unsatisfactory classroom performance and multiple health problems. Though various supplementary feeding programmes are being implemented in the country, our children are still malnourished especially with reference to vitamin A and iron. Moreover the consumption of leafy vegetables among the coastal group is much low. It is in this context, the supplementation of leafy vegetables in processed form to the children as the supplementary food become significant (Lutter and Rivera , 2003).

The plant food can be health promoting beyond its traditional nutritional value and is gaining acceptance among consumers and health professionals. India's flora comprises of 6000 species of plants used for consumption, *M. oleifera* is one such inexpensive yet nutritious tree vegetable and consumption of which can prevent macro and micronutrient malnutrition. *M. oleifera* is termed as poor man's luxury due to their unassuming way of production, response to basic health needs, their wide range of choices and essential cheapness. The severity of micronutrient malnutrition widely prevalent in India can be easily reduced, if the consumption of *M. oleifera* is actively promoted especially among the low income groups of population. It is one of the "micronutrient wealth of India", no other source of food including animal food can compare with these in micronutrient composition especially β-carotene and iron (Tewari, 2007).

Dietary surveys conducted among fifty respondents revealed that consumption of green leafy vegetable is much below the recommended dietary

alowances of 100 g/day. Incorporation of green leafy vegetables in the diet will help to prevent micronutrient deficiencies.

M. oleifera is a predominant sources of micronutrient for poor people but their contribution to alleviate deficiencies is greatly under appreciated. One of the Strategy to minimize micronutrient deficiency is supplementation. It is cheap and promotes intake a whole range of micronutrients rather than singling out and tackling just one. It also fosters community and individual involvement, and can help to stimulate local food economy (Goyal *et al*., 2007).

Supplementary feeding is the provision of nutritious rations to targeted individuals that supplement the energy and nutrients missing from the diet of those with higher nutritional needs or those who are moderately malnourished (WHO, 2009). Supplementary feeding eliminates hunger, it act as a safety net to improve livelihood, protect vulnerable children, improve social interaction during meal time and improve nutrition by using quality foods (Ghassemi, 2003). Feeding may also improve social behavior, through increased interaction with the world, improved emotional state, and lowered anxiety. Increased social interaction may in turn, enhance cognitive functioning and learning ability (Bisla *et al*., 2012).

Moringa soup supplement is inexpensive and studies proved that they prevent micronutrient malnutrition and their consumption can be effected on a sustainable basis if children and their parents were convinced of the necessity for including them in diet through nutrition education. Hence, the present study of "Impact of drumstick *(M. oleifera*) supplement on the nutritional status of school children" was attempted with the objective.

1) To study the impact of drumstick (*M. oleifera*) on the nutritional status of the primary school children in the coastal areas of Alappuzha district.

2) To assess the impact of the supplementary feeding three months after supplementation among children.

Review of Literature

2. REVIEW OF LITERATURE

Literature available on different aspects related to the present study entitled "Impact of drumstick (*Moringa oleifera* Lam.) supplement on the nutritional status of school children" is reviewed under following headings.

2.1 Effect of supplementation in children

2.2 Moringa supplements for preventing malnutrition

2.3 Nutritional composition of moringa

2.4 Macronutrients and micronutrients from moringa

2.5 Phytochemicals and Antioxidants in moringa

2.1. EFFECT OF SUPPLEMENTATION IN CHILDREN

Bhutta *et al*. (2012) reported that supplementary feeding is helping to eliminate hunger for millions of children around the globe and is contributing to their education, nutrition, health and future productivity as adults. Supplementary feeding is a safety net that has proved effective in protecting vulnerable school children while providing nutrition, education, and gender equity benefits, along with a wide range of socio-economic gains.

Roy *et al*. (2010) found that when putting food on the family table today takes priority over a child's potential for tomorrow, school feeding programmes allow parents the choice of sending children to supplementary feeding also allows valuable income to be freed up to invest productively in ways that benefit the entire family. Supplementary feeding reduce hunger among school children so that hunger is not an obstacle to their development.

According to Beaton (2008), the aim of supplementary feeding is to provide the maximum effect as a safety net to improve livelihoods and invest in human capital through nutrition, health and education. Interventions are mutually reinforcing,
making the goal of breaking the intergenerational cycle of hunger which is a real possibility.

UNICEF (2009) reported that supplementary feeding also serves as a platform for other developmental outcomes such as: reinforcing and developing local economies through the purchase of local goods and services; reducing gender and social inequities by encouraging families to send girls and other vulnerable children to school; establishing basic infrastructure to allow governments to implement their own school feeding, while employing environmentally-friendly technologies and practices; ensuring safe learning environments to improve social interaction and cohesion during meal times.

Supplementary feeding is a unique and robust safety-net intervention driven by the interdependency between various outcomes, and combines short,mid and long-term benefits from nutrition, education and value transfer (Ghassemi, 2003).

In an efficacy trial in micronutrients added to Supplementary feeding promoted by government and UNICEF given to 6-12 month infants increase ferritin concentration from 19 % to 55% (Lartey *et al*., 2001).

Feeding may also improve social behavior, through increased interaction with the world, improved emotional state, and lowered anxiety. Increased social interaction may in turn, enhance cognitive functioning and learning ability (Thirumani and Uma, 2005).

In an impact study conducted on NNAPP programme revealed that education programme on nutrition among parents enable them to bring about remarkable improvement in their children's livelihood (Bhuvaneshwari, 2007)

A feeding trial conducted over period of 6 months using malted weaning foods based on low cost, locally available foods on infants and they found to be taller and heavier than their counter parts (Chandrasekhar *et al* ., 2008)

A comparison between initial and final measurements of pre school children revealed significant increase in height, weight and upper arm circumference (Sreelekshmi, 1995). A Longitudinal study in four Indian villages to investigate the effects of child supplementation, the group that received the supplement as

young children maintained most of the original gains in height and weight showed increased physical capacity and had better performance on various cognitive and behavioral test (Beaton, 2006).

In Orissa, providing breakfast to primary school students significantly increased attendance and arithmetic scores. The children who benefited most were those who were wasted, stunted, or previously malnourished (Meyers *et al* ., 2008).

The respondents showed a shift from moderate to high level of pretest knowledge after nutrition education and there was a reduction in the number of respondents who remained in low score level (Suresh, 2001).

Soup fortified with micronutrients provided to 350 schools, Fe status significantly falling from 49 per cent to 28 per cent in 6 to 7 year old children (Kruger and Badenhorst, 2006).

Vitamin A deficiency is a major public health problem affecting an estimated 190 million preschool-age children, mostly from the World Health Organization (WHO) regions of Africa and South-East Asia (Oliveira *et al*., 2008).

According to Martins *et al*. (2007), infants and children have increased vitamin A requirements to promote rapid growth and to help combat infections. Inadequate intakes of vitamin A at this age could lead to vitamin A deficiency, which, when severe, may cause visual impairment (night blindness) or increase the risk of illness and mortality from childhood infections such as measles and those causing diarrhoea.

Vitamin A deficiency is a public health problem, vitamin A supplementation is recommended in infants and children 6–59 months of age as a public health intervention to reduce child morbidity and mortality. Many countries have integrated strategies to deliver vitamin A supplements to infants and children in their national health policies (WHO, 2008).

Provision of high doses of vitamin A every 6 months until the age of 5 years was based on the principle that a single, large dose of vitamin A is well absorbed

and stored in the liver, and then mobilized, as needed, over an extended period of time (West and Sommer, 1987). A dose of 100 000 International Units (IU) in infants 6–11 months of age and 200 000 IU in children 12–59 months of age is considered to provide adequate protection for 4–6 months, with the exact interval depending on the vitamin A content of the diet and the rate of utilization by the body (Swaminathan *et al*., 1970).

Yip (2004) observed that iron deficiency anemia is still the most prevalent nutrition problem worldwide. Young children are a particularly vulnerable group and the prevalence of anemia in this population category in Southeast Asia is 50–70 per cent. Imdad *et al*. (2010) found that one of the causes of nutritional anemia is that the amount of iron absorbed is insufficient to meet the body's requirements. This insufficiency may be due to both inadequate iron intake from food and to low bioavailability.

Villamor and Fawsi (2005) found that children consume less food than do adults and their diet often consists of foods with a low iron content and in which the bioavailability of iron is poor. Anemia during childhood may lead to impaired motor development, decreased growth and appetite, reduced learning capacity, and reduced cognitive performance, and is also associated with poorer performance of the immune system. Therefore, an adequate supply of iron to all tissues during this critical period of development is essential.

Ching *et al* (2000) in his study found that weekly consumption of iron-fortified candies significantly improved iron status. After the 12-week intervention, the hemoglobin concentration, corrected for baseline, was significantly higher in the fortified group than in the placebo group. The same was found among the anemic subjects.

2.2. MORINGA SUPPLEMENTS FOR PREVENTING MALNUTRITION

Umesh *et al*. (2004) reported that there have been several programmes to fight malnutrition in Senegal, India, Benin, Zimbawe, Nigeria and Ethiopia. Supplementary Feedings Programme(SFP) of the Integrated Child Development

scheme of India aims at the improvement in the nutritional status of the preschool children and is an ideal platform to introduce Dehydrated Drumstick Leaves (DDL) into the diets of this target group as a nutritional intervention. For these programmes moringa leaves are dried and powdered for conservation, concentration, consumption and lessening the cooking time. The dehydrated moringa leaves are the concentrated sources of micronutrients.

Daxini *et al.* (2003) conducted a study in India on 40 children of an anganwadi were supplemented with pre-tested DDL incorporated recipes 5-7 g DDL/100 g product). The recipes were highly feasible and acceptable to the children and ICDS authorities and also improved their nutritional status. In the developing countries like India, sources of vitamin A such as drumstick leaves are valuable in overcoming the problem of vitamin A deficiency. These findings also accentuate the importance of carotene on the vitamin A status, and underscore its equivalence to synthetic vitamin A when fed in the right amount (Nambiar and Kosambia, 2004).

Nambiar *et al*. (2005) indicated that moringa leaves are potential for combating both micro as well as macro-nutrient malnutrition. In Africa, 25 g of moringa powder is administrated to girl child to improve their nutrition.

Anwar *et al*. (2007) reported that *M. oleifera* leaf powder has been used to combat malnutrition, especially among infants and nursing mothers in developing countries. One rounded table spoon (8 g) of leaf powder will satisfy about 14 per cent of protein, 40 per cent of the calcium and 23 per cent of the iron and nearly all the vitamin A needed for a child aged 1-3. Six rounded spoonfulls (48 g) of leaf powder will satisfy nearly all of women's daily iron and calcium needs during pregnancy and lactation. In Africa, 25 g of moringa powder is administered to pregnant women daily to improve prenatal nutrition (Diatta, 2011).

According to Fuglie (2001), Moringa tree were used as a base for a nutrition programme. For a child aged 1-3, a 100 g serving of fresh cooked leaves would provide all his daily requirements of calcium, about 75 per cent of his iron and half

of his protien needs, as well as important amounts of pottassium, B complex vitamins, copper and all the essential amino acids. As little as 20 g of leaves would provide a child with all vitamins A and C he needs. Incorporating moringa seeds in baked foods may be exploited as a means of boosting nutrition in Africa and Asia where malnutrition is prevalent (Ogunsina *et al*., 2011).

2.3. NUTRITIONAL COMPOSITION OF MORINGA

Moringa is perhaps the most nutrient dense single food source on the plant. All of the parts of *M. oleifera.* can be used in a variety of ways as food.

According to Fuglie (2001), Moringa has gained popularity as a source of nutrition that can feed the needy and save lives as well. It is full of nutrients and vitamins and is good for humans as well as fodder for animals. Moringa leaves, pods, and roots contain large amounts of protein, amino acids, vitamins and minerals and provide valuable nutrition for populations in remote areas that may suffer from food shortages and lack of protein sources in their local environment.

Gruangchok *et al*. (2010) revealed that fresh *M. oleifera* leaves contain seven times more calcium than in milk, three times more iron than in spinach, three times more potassium than in banana, four times more vitamin A than in carrot and proteins form as much as in egg.

Mahaood *et al.* (2010) reported that micronutrient content is more concentrated in dried moringa leaves that is, ten times of vitamin A than carrot, seventeen times of calcium than milk, fifteen times of potassium than banana, twenty five times of iron than spinach, nine times of protein than yogurt, vitamin C forms half of that of oranges.

M. oleifera has been used as a traditional medicine around the world, for anemia, skin infections, blackheads, anxiety, bronchitis, catarrh, chest congestion, asthma, blood impurities, cholera, glandular swelling, headaches, conjunctivitis, cough, diarrhoea, eye and ear infections, fever, abnormal blood pressure, hysteria, pain in joints, pimples, psoriasis, respiratory disorders, scurvy, semen deficiency,

sore throat, sprain, tuberculosis, for intestinal worms, lactation, diabetes and pregnancy (Fuglie, 2001).

Singh *et al*. (2012) observed that the leaves possess remarkable nutritional and medicinal qualities. They contain high amount of vitamin C, which fights a host of illnesses including colds and flu; vitamin A, which acts as a shield against eye disease, skin disease, heart ailments, diarrhoea, and many other diseases; Calcium, which builds strong bones and teeth and helps prevent osteoporosis; Potassium, which is essential for the functioning of the brain and nerves, and Proteins, the basic building blocks of all our body cells.

Mishra *et al*. (2011) found that moringa leaves contain all of the essential amino acids in a good proportion, which are the building blocks of proteins. These leaves could be a great boon to the people who do not get protein from meat.

Manzoor *et al*. (2007) observed that moringa even contains argenine and histidine two amino acids especially important for infants, which are unable to make enough protein for their growth requirements. The micro-nutrient content is even more in dried leaves;[ten times vitamin A of carrots],[17 times calcium of milk],[15 times the potassium of banana],[25 times the iron of spinach],[9 times the protein of yogurt].

Iqbal *et al.* (2006) viewed that the moringa plant has been consumed by humans throughout the century in diverse culinary ways.

(Arabshahi *et al.,* 2007; Fahey, 2005) reported that almost all parts of the plant are used culturally for its nutritional value, purported medicinal properties and for taste and flavor as a vegetable and seed. The moringa leaves can be eaten fresh, cooked, or stored as a dried powder for many months reportedly without any major loss of its nutritional value.

Chumark *et al.* (2008); Danmalam *et al*., (2001); and Dahiru *et al*. (2006) reported that epidemiological studies have indicated that *M. oleifera* leaves are a

good source of nutrition and exhibit anti-tumor, anti-inflammatory, anti-ulcer, anti-atherosclerotic and anti-convulsant activities.

Lockett *et al*. (2000) revealed that the leaves, seeds, flowers, pods (fruit), bark and roots are all seen as a vegetable and each part is uniquely harvested and utilized. For example, fresh leaves are picked, shade dried, ground to a powder, and then stored for later as a food flavoring or additive. Dried or fresh leaves are also used in foods such as soups and porridges.

McBurney *et al*. (2004); and Lockett *et al*. (2000) found that moringa leaves being rich in nutrients, pregnant women and lactating mothers use the powdered leaves to enhance their child's or children's nourishment, especially in under developed countries suffering from malnutrition.

Smolin and Grosvenor (2007) observed that moringa leaves are a very rich source of nutrients and contain the essential vitamins A, C and E. Though not proven, it is has been considered by many to contain as much vitamin A as a carrot, vitamin C as an orange and vitamin E as a pomegranate. Leaves rich in biologically active carotenoids, tocopherols and vitamin C have health-promoting potential in maintaining a balanced diet and preventing free-radical damage that can initiate many illnesses.

Lako *et al*. (2007); Gomez-Conrado *et al*. (2004); and Sánchez-Machado *et al*. (2006) found that provitamins cannot be identified in the moringa leaves, they can be monitored after conversion to their respective vitamins within the body. The edible moringa leaves contain essential provitamins, including ascorbic acid, carotenoids and tocopherols. In addition to the provitamins, moringa leaves are also considered a rich source of minerals (Gupta *et al*., 1989), polyphenols (Bennett *et al*., 2003), flavonoids (Lako *et al*., 2007); alkaloids, and proteins (Solvia *et al*., 2005); (Sarwatt *et al*., 2002). These essential nutrients can help to decrease the nutritional deficit and combat many chronic inflammatory diseases.

According to Hartwell (1971), the leaves were used in traditional remedies for tumors (Faizi *et al*., 1998; Guevara *et al*., 1999) and extensively used as a

natural sleepaid, applied as a poultice to sores, rubbed on temples for headaches, and as a purgativecleanser (Fuglie, 1999). These applications address the use of *M. oleifera* leaves in the food industry, as a synergistic natural product applied to ethnic foods, and the medical industry, as a preventative for numerous diseases (Fahey, 2005; Miean and Muhamed, 2001; Middleton *et al*. 2000; and Lockett *et al*., 2000).

(Faizi *et al.*, 1998; Murakami *et al.*, 1998) revealed that a number of natural compounds have been isolated from *M. oleifera* leaves including fully acetylated glycosides bearing thiocarbamates, carbamates or nitrites.

Glycosides containing isothiocyanates, malonates and flavonoids have also been identified and isolated in the leaves of the moringa plant (Faizi *et al*., 1998; Bennett *et al*., 2003; Miean and Muhamed, 2001). In particular, quercetin and kaempferol glycosides are broken down to yield the natural antioxidant flavonoids, quercetin and kaempferol, indicating these glycosides can be efficiently hydrolyzed to their respective aglycones (Miean and Muhamed, 2001; Bennett *et al*., 2003). Many plant glycosides can be used as treatments for cancer or chronic conditions such as high cholesterol and atherosclerosis (Chumark *et al*., 2008; Ghasi *et al*., 2000; Murakami *et al*., 1998).

(Havsteen., 2002; Middleton *et al*., 2000; Morris and Zhang, 2006) found that a high intake of flavonoids has been linked with a reduced risk of cardiovascular disease, osteoporosis and other age-related degenerative diseases.

Prouilleta *et al*. (2004), much of the interest has recently been focused on using flavonoids anticancerous properties as well as using quercetin and kaempferol to fight osteoporosis. These identified bioactive compounds in the leaves of *M. oleifera* make this an excellent candidate for nutritional and pharmaceutical supplementation.

The World Health Organization (WHO) has been studying the use of *M. oleifera* for many decades as a low cost supplement enhancer in the poorest countries around the world. This organization has been promoting the use of this

the plant to help those countries suffering from malnutrition, which is one of the major causes of death worldwide.

United Nations Food and Agriculture reported that one in twelve people worldwide is malnourished, including 160 million children under the age of 5 (UNICEF. 2009)

2.4 MACRONUTRIENTS FROM MORINGA

Bamishaiye *et al.* (2011) revealed that the moringa leaves contained high amount of carbohydrates (55.14 %) in its early stage of malnutrition on dry weight basis.

Oduro *et al*. (2008) observed that 43.88 per cent of carbohydrates were found in fresh moringa leaves.

According to Ogbe and Affiku (2011), moringa leaves grown in Nigeria contain 63.11 per cent of carbohydrates.

Yameogo *et al*. (2011) observed that moringa leaves contained 10.6 per cent of carbohydrate for the cool mater and 38.6 per cent for the dry matter.

According to Promkum *et al*. (2010), the boiled moringa pods contain 60.5 g of carbohydrate.

ICMR, (2003) indicated that the fresh moringa leaves, immature pods and flowers contain 12.5 g, 3.7 g and 7.1 g of carbohydrates respectively per 100 g of edible portion.

Joshi and Jain (2011) reported that moringa pods contain 10.84 g per cent 100 g and 74.46 g/100 g of carbohydrates on fresh and dry weight basis respectively.

Moringa leaves in different agro climatic regions of Thailand contain 19.15-28.80 per cent of protein (Gruangchok *et al*., 2010). Moyo *et al*. (2011) observed that South Africa ecotype of dried moringa leaves contain 30.3 per cent of crude protein.

Table 1. Macronutrient contents in *Moringa oleifera*

(Per 100 g. fresh weight of edible portion)

Moringa	Carbohydrates (g)	Protein (g)	Fat (g)	Energy (g)
Leaves	12.5	6.7	1.7	92
Pods	3.7	2.5	0.1	26
Flower	7.1	3.6	0.8	50

Source: Nutritive Value of Indian Foods, 2004 & Fuglie, 2001

Moringa leaves contain 27.51 per cent of crude protein on dry weight basis (Oduro *et al*., 2008).

Mukunzi *et al*. (2011) in their study conducted at China and Rwanda revealed that moringa leaves grown in China contain 29.54 per cent of protein while those grown in Rwanda contain 25.24 per cent of protein.

According to Ogbe and Affiku (2011) moringa leaves in Nigeria contain 17.01 per cent of crude protein.

Bamishaiye *et al*. (2011) found that the moringa leaves has highest protein content (28.08 %) during their late stage of maturation.

According to Machado *et al*. (2004) all the edible parts of moringa showed te presence of Linoleic acid, Linolenic acid and Arachidonic acid.

The fresh moringa leaves in Nigeria contain 2011 per cent of crude fat and 1.69 per cent of fatty acids (Ogbe and Affiku, 2011). Moyo *et al*. (2011) reported that dried moringa leaves contain 6.5 g per 100g of fat. *Oduro et al.* (2008) stated that moringa leaves contain 2.23 per cent of fat on dried weight basis. According to Promkum *et al*. (2010) the boiled moringa pods contain 3.9 g of fat per 100 g of edible portion.

Machado *et al*. (2010) observed that moringa leaves, pods and flowers contains 4.96, 1.28 and 2.91 per cent of fat respectively on dry weight basis.

Joshi and Jain, (2011) reported that fresh moringa pods and dry pods powder contain 0.79 g per 100 g and 5.43 g per 100 g fat respectively.

Bamishaiye *et al.* (2011) indicated that dried moringa leaves contain 2.5 g per 100 g of fat.

Table 2. Amino acid content of *Moringa oleifera*

(Per 100 g fresh weight basis)

Amino acids	Leaves (g/16g N)	Pods (g/16g N)
Tryptophan	1.9	0.8
Methionine	2.0	1.4
Histidine	2.1	1.1
Threonine	1.9	3.9
Isoleucine	6.3	4.4
Leucine	9.3	6.5
Phenylalanine	6.4	4.3
Lysine	4.3	1.5
Valine	7.1	5.4

Source : Fuglie 2001

According to Machado *et al*. (2004) amino acids are the building blocks of protein. Moringa leaves and pods are rich in essential amino acid. It is very rare for a vegetable to contain all of these amino acids. The Moringa leaves could be a great boon to people who do not get protein from non vegetarian diet. Of the 20 amino acid required by our body, eleven of them are non essential and nine of them are essential. These vital amino acids are necessary for proper brain, muscle and

nervous function as well as providing the raw materials to allow the body to synthesize protein materials for further growth.

ICMR (2003) revealed that moringa oleifera tree contains all essential amino acids, which cannot be synthesized by the body and must be obtained from dietary sources to provide a solid basis for physical health. These vital amino acids are necessary for proper brain, muscle and nervous function as well as providing the raw materials to allow the body to synthesize protein materials for further growth.

Table 3. Micronutrient content of *Moringa oleifera*

(Per 100 g of fresh weight basis)

Moringa	Ca (mg)	P (mg)	Fe (mg)	Carotene (mcg)	Vit B1 (mg)	Vit B2 (mg)	Vit B5 (mg)	Vit C (mg)
Leaves	400	70	7	6780	0.06	0.05	0.8	220
Pods	30	110	5.3	110	0.05	0.07	0.02	120
Flower	51	90	-	-	-	-	-	-

Source : Nutritive value of Indian Foods, 2004

Nambiar and Kosambia (2005) found that the leaves of moringa leaves of moringa tree have one of the highest known contents of total carotene (40,000 µg/ 100 g) and beta carotene (19,000 µg/100 g). The ascorbic acid is a main compound in moringa; its content was 64.9 mg per 100 g and 53.8 mg per 100 g dry weight of raw and cooked pods respectively.

Brahma *et al*. (2009) found that the content of vitamin C in 100 g fresh tissues of moringa extract in fruits was 106.95 mg and seed was 62.11 mg. Kowsalya and Vidya (2004) observed that cabinet dried moringa leaves contain 591 mg of vitamin C, 0.14 m of vitamin B1 and 0.06 mg of vitamin B2 per 100 g of edible portion.

Yamego *et al*. (2011) found that moringa leaves contain 847.1 mg, 151.3 mg, 549.6 mg, 17.5 mg, 1.3 mg and 111.5 mg of calcium, magnesium, potassium, iron, zinc and phosphorous respectively per 100 g of cool mater. Similarly the dry matter of moringa leaves contain 2098.1 mg, 406.0 mg, 1922.0 mg, 28.3 mg, 5.4 mg and 351.1 mg of minerals respectively.

Joshi and Jain (2011) found that moringa pod powder (per 100 g) contain 6.66 mg of calcium, 31.50 mg of potassium, 1.25 mg of zinc, 1.07 mg of copper and 3.99 mg of manganese.

According to Moyo *et al*. (2011) the dried moringa leaves had the following mineral contents: calcium (3.65 %), phosphorous (0.3 %), magnesium (0.5 %), potassium (1.5 %), sodium (0.164 %), sulphur (0.63 %), zinc (13.03 mg/kg), copper (8.25 %), iron (490 mg/kg) and selenium (363 mg/kg).

Oduro *et al*. (2008) revealed that, dietary fibre is the edible part of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine.

It promotes beneficial physiological effects including laxation, lowers blood cholesterol level, blood glucose level and reduces the risk of colon cancer. Plant parts of *Moringa oleifera* are rich in dietary fibre.

Machado *et al*. (2004) observed that dried leaves contain 30.97 g per 100 g of fibre and dried pods contain 46.78 g per 100 g of fibre.

Joshi and Jain (2011) found that moringa pods contain 0.71 g per 100 g of fibre on fresh weight basis and 4.85 g per 100 g on dry weight basis.

According to Oduro *et al*. (2008) dried moringa leaves contain 19.25 per cent of crude fibre.

Table 4. Dietary fibre content in *Moringa oleifera*
(Per 100 g of edible portion)

Moringa	Dietary fibre
Fresh leaves	0.9
Dried leaves	30.97
Fresh pods	4.8
Dried pods	46.78

Source: Nutritive Value of Indian Foods, 2004; Fuglie, 2001; Machado *et al*., 2004

2.5 PHYTOCHEMICALS AND ANTIOXIDANTS IN MORINGA

M. oleifera is rich in various Phytochemicals (Antioxidants) like carotenoids, vitamins, minerals, amino acids, sterols, glycosides, alkaloids, flavanoids, moringine, moringinine, phytoestrogens, caffeoylquinine acids and phenolics in flowers, roots, fruits and seeds(Anvar *et al*.,2007). *M. oleifera* extract of both mature and tender leaves have potent antioxidant activity against free radicals, prevents oxidative damages.

Lalas and Tsaknis (2002) reported that the oil from dried moringa seeds showed higher antioxidant activity than butylated hydroxyl toluene and alphatocopherol.

The extract of the pods of *M. oleifera* is a good source of compounds with antioxidant properties, free radical scavenging activity and reducing power activity (Sharma *et al*., 2011).

Materials and Methods

3. MATERIALS AND METHODS

The study on "Impact of drumstick (*Moringa oleifera* Lam.) supplement on the nutritional status of school children" was under taken to ascertain the effect of moringa oleifera food supplement on the nutritional status of pre-school children in the coastal areas of Alappuzha district.

Materials and methods followed for the study are presented under the following headings.

3.1 Selection of area

3.2 Selection of respondents

3.3 Socio economic status of the respondents

3.4 Dietary habits of the respondents

3.5 Nutrition and health education to the subjects

3.6 Nutritional profile and general health status of the respondents

3.7 Selection of a standardized moringa soup supplement

3.8 Conduct of feeding experiment

3.9 Evaluation of feeding experiment

3.10 Statistical Analysis

3.1. SELECTION OF THE AREA

The area selected for the study was an Upper Primary School in Chennavely in Mararikulam sea coast of Alappuzha district. Chennavely is a small fisher folk village which comprises of 18 wards.

Basic criteria for selection of this village were:

(a) Children in the village were at higher risk of health related problems; especially about 90 per cent of children were anaemic.

(b) Children in this area had low cognitive development and had poor learning capacity.

(c) Most of the children suffer from micronutrient deficiencies.

SELECTION OF RESPONDENTS

The respondents were purposively selected for ascertaining the conduct of the programme. The investigator initially approached the parish priest of St. Antony's church; he was the manager of the St. Antony's school in which the study was conducted. Through an informal discussion, the significance of the present trial was explained to the school authorities and parents and they were persuaded their children to attend a medical camp so as to identify children of having poor health, anaemia and micro-nutrient deficiencies. Subjects were identified through clinical examination by conducting two medical camps in the school with the help of a physician belonging to Alappuzha Medical College. During the camp, the blood samples were collected from the subjects for heamoglobin estimation. These camps were conducted before and after the supplementation programme.

Criteria for the selection of the subjects were:

1. Children in the age group 7-9 years
2. Children with the symptoms of under nutrition, anaemia, and micro-nutrient deficiencies.

Among 50 children from the medical camp, 30 were screened to have clinical symptoms and these 30 children were purposively selected for the feeding trial and used as experimental group (EG). Remaining 20 children were kept as control group (CG). Written consent of the subjects to participate in the study was also obtained.

3.3 ASSESSMENT OF SOCIO-ECONOMIC STATUS OF THE RESPONDENTS

The socio-economic level of the subjects such as social, economic, religious aspects and their family background in general have a very distinct part to play in determining the attitude, food consumption, health and behavioral pattern of the subjects. Meer *et al.* (2000) had opined that the socio-economic condition in which one lives is said to have a direct impact on food habits and nutritional status.

In order to elicit the information regarding personal and socio-economic back ground of the respondents and their families, details like age, religion, family type and size, educational status, occupation and monthly income of the family were ascertained using structured and pretested interview schedule.

3.4. DIETARY HABITS OF THE RESPONDENTS

According to Swaminathan (2003) diet survey constitute an essential for any complete study of nutritional status of individuals or groups, providing essential information on dietary habits, source of nutrients and nutrient intake. So a diet survey was conducted as part of the study.

The questionnaire consisted of questions regarding food habits, meal pattern, and frequency of use of various foods etc.

Interview method was used to conduct the diet survey. The dietary habits of the selected respondents were studied by conducting dietary survey by interview method using a suitably designed questionnaire.

3.4.1. Frequency of Use of Various Foods (Foods from Basic Food Groups)

The frequency of use of foods from various groups would give an indication to the adequacy of the daily diet pattern. Thus the frequency of use of foods from basic seven groups was ascertained. Food use frequency for different food items was measured on a six point scale on the basis of the frequency of use; scores were expressed as shown below.

Frequency	Score
Never	1
Occasionally	2
Once in a week	3
Twice in a week	4
Thrice in a week	5
Daily	6

3.4.2. Frequency of Use of Iron and Micro-Nutrient Rich Foods

Several studies have indicated that vegetables and fruits were absent in the diet of the children in coastal areas. Hence the consumption of those foods rich in iron and micro-nutrients was also studied.

Food use frequency for iron and micro-nutrient rich food groups was measured using an 8 point scale as shown below.

Frequency	Score
Never	1
Rarely	2
Occasionally	3
Fortnightly	4
Once in a week	5
Monthly	6
Weekly	7
Daily	8

The percentage of food score for each food used by participants as well as the preference score of the respondents for different food items were calculated separately using the formula suggested by Reaburn *et al*. (1979)

Percentage of total score for each food items

$$=\frac{R1S1+R2S2+R3S3+\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots RnSn}{n}$$

S1: Scale of rating given for frequency of a food item (i=1, 2,3…….6)

R1: Percentage of respondents coming under each frequency group (1,2,3……6)

The mean score was calculated using the formula given below

Mean score for each food group

$$=\frac{R1S1+ R2S2+R3S3+\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots RnSn}{100}$$

The percentage of participants using each food item was then computed

3.5. NUTRITION AND HEALTH EDUCATION TO THE SUBJECTS

The nutrition education programme was conducted for the children in both experimental and control group. The nutrition education programme was carried out by the method as suggested by Sheth *et al*. (2006).

According to Park and Park (2001) the aim of health education in nutrition is to guide people to choose optimum and balanced diets, which containing nutrients necessary for energy, growth and repair.

The respondents were given a brief introduction of the nutrition education programme. Children were exposed to nutrition and health education session with special reference to the nutritional significance of *Moringa oleifera* to alleviate their present anemia and micro-nutrient deficiencies. The education programme was evaluated with reference to gain in knowledge. The lecture cum discussion programme was well supplemented with slide show presentation depicting the importance of green leafy vegetables.

3.6. ASSESSMENT OF NUTRITIONAL PROFILE AND GENERAL HEALTH STATUS OF THE RESPONDENTS

Nutritional status is defined as the state of health enjoyed as a result of good nutrition. It is one of the critical indicators of health; therefore, regular nutritional assessment is important to maintain the health of participants (Kamath, 1986).

Assessment of nutritional status of a community is a major public health strategy to combat malnutrition, which aims to determine the type magnitude, distribution contributory factors and to identify the at risk group.

3.6.1. Anthropometric Measurements

Nutritional anthropometry is the measurements of human body at various ages and levels of the nutritional status of the respondents and this is based on the concept that an appropriate measurement should reflect morphological variation

Plate 1. Anthropometric Assessment of the respondents

occurring due to the significant functional and physiological change. The following anthropometric measurements were taken (Bamji et al., 2005). Nutritional anthropometry can be used to understand whether the person is underweight, normal weight, overweight or obese (Rao, 1996).

Various methods have been suggested to classify children into various nutritional grades using anthropometric measurements like weight, height and mid upper arm circumference (Rahmnath et al., 1993).

In this study, anthropometry, clinical examination and biochemical methods were made to assess the nutritional status of the respondents where height, weight, MUAC were calculated. Body mass index from weight and height measurements were calculated (Plate. 1).

3.6.1.1. Weight

Body weight is most widely used to sensitive and simplest reproducible anthropometric measurements. It indicates the body mass and is a composite of all body constituents like water, mineral, fat portion and bone. It reflects more recent nutrition (Srilakshmi, 2003)

For weighing, platform weighing balance was used as it is portable and is convenient to use in the field. The weighing scale was checked periodically for accuracy. The scale was adjusted to zero before each measurement. The subjects having minimum clothing were asked to stand on the platform of the scales, without touching anything and looking straight ahead. Each reading was taken twice to ensure correctness of the measurements.

3.6.1.2. Height

Height of the total length apart from nutritional and environmental factors. The extent of height deficit in relation to age as compared to region standard is regarded as a measure of the duration of malnutrition (Gopaldas, 2005).

Plate 2. Clinical Assessment of the respondents

To determine height, a stadiometer was used. The respondents were asked to remove their slippers and to stand with centre of the back touching the wall with feet paralleled and heels, buttocks, shoulder and back head touching the wall. The moving head piece of the stadiometer was lowered to reset flat on the top of the head and the measurements was taken. An average of the three measurements of height of the respondents was taken.

3.6.1.3. Mid Upper Arm Circumference

According to Sreelakshmi (2003) MUAC indicates the status of muscle development. This is also one of the anthropometric measurements used to measure obesity. In this study, this measurement was also taken for comparison with normal weight children and the standard suggested by Gnanasundaram et al., (1994).

3.6.2. Clinical Examination

Clinical examination is stated to be one of the most essential and the simplest methods used in the evaluation of nutritional status (Gupta and Tripathi, 2006). It is a part of nutritional assessment through which direct information of signs and symptoms of dietary deficiency could be obtained (Swaminathan, 1993).

The presence or absence of clinical deficiency symptoms, which is an index of nutritional status, was assessed by a qualified physician using a performa made for the purpose (Plate. 2).

3.6.3. Estimation of Haemoglobin

Biochemical assessment is another important tool for assessing the nutritional status of the subject.

There are several biochemical indicators of malnutrition specified for different nutritional deficiencies. According to Park (1997), haemoglobin level is

Plate 3. Feeding trial of the respondents

a useful index of the overall state of nutrition irrespective of its significance in anaemia. The heamoglobin content of the subject was estimated using cyannmet heamoglobin method.

3.7. SELECTION OF A STANDARDIZED MORINGA SOUP SUPPLEMENT

A standardized moringa soup supplement which was developed by Saranya (2012) in the department of Home Science was selected for supplementation for the respondents.

3.8. CONDUCT OF THE FEEDING EXPERIMENT

The best supplement was selected from the different combinations of the moringa soup supplement formulated by Saranya (2012) in the department of Home Science for the feeding trial in this study.

The efficiency of moringa food supplement among the subjects with anaemia, under nutrition and micronutrient deficiencies was tested by supplementary feeding

experiment of three months duration. The subjects in the experimental group were given moringa soup and control group were not provided with moringa soup. The 30 subjects in experimental group were given the supplement for five days in a week for total period of sixty working days (Plate. 3)

3.9. EVALUATION OF FEEDING TRIAL

The impact of the moringa soup supplement on the subjects with anaemia, under nutrition and micronutrient deficiencies was evaluated by carrying out clinical and biochemical investigation.

Clinical examination of the deficiency diseases of the subjects was carried out again after the 60 days period of feeding trial by the same expert from the Alappuzha Medical College.

Plate 4: Biochemical estimation of the respondents

Specially designed check list which was used at the beginning of the experiment for carrying out the clinical examination of the children was used again in order to evaluate the impact of feeding trial on the undernourished pre-school children. Clinical examination was done for both the subjects in the experimental group and control group. Presence or absence of clinical symptoms was assessed by giving score for each of the symptoms and by working out the total percentage scores.

Heamoglobin level was also estimated again in order to evaluate the effect of the feeding trial on Heamoglobin level (Plate. 4)

3.10. STATISTICAL ANALYSIS

The data collected were scored, coded, consolidated and subjected to statistical analysis and interpretations. The statistical procedures used in the present study were:-

(a) **Frequency**: It was calculated to find out the number of respondents in a particular cell.

(b) **Percentage** was used for simple comparison and was calculated by dividing the frequency of a particular cell by total number of respondents and multiplying by 100.

(c) **Mean Score**: Mean score was calculated by dividing the sum of observation by the total number of observations.

(d) **Paired T-test**: In order to compare observations in respect of each respondent before and after exposure to nutrition education, paired t-test was applied.

Results

4. RESULT

The result of the present study entitled "Impact of drumstick (*Moringa oleifera* Lam.) supplement on the nutritional status of school children" are presented under the following heads.

4.1 Personal characteristics of the participants

4.2 Socio economic characteristics of the participants

4.3 Food consumption practices with special reference to green leafy vegetables

4.4 Impact evaluation of nutrition education programme

4.5 Nutritional composition of standardized moringa supplement and its cost Effectiveness

4.6 Impact evaluation of feeding trial

4.1. PERSONAL CHARACTERISTICS OF THE PARTICIPANTS

Personal characteristics of selected fifty respondents with reference to age, caste, family size, family type, and educational status, were assessed.

4.1.1. Age of the Respondents

Table 5. Distribution of the respondents based on their age

Age	Experimental group (n=30)				Control group (n=20)			
	Male	Female	Total	Per cent	Male	Female	Total	Per cent
7yrs	1	4	5	17	1	3	4	20
8yrs	7	5	12	40	6	6	12	60
9yrs	7	6	13	43	1	3	4	20

Table 5, revealed that majority of the respondents (43 %) belonged to the age group nine years, 40 per cent of the respondents belonged to the age group 7 years and 17 per cent constituted those in the age group 7 years in the Experimental Group. Whereas, in the control group, majority of the respondents (60 %) belonged to the age group eight years, 20 per cent of the respondents belonged to the age group seven and nine years.

4.1.2. Religion of the Respondents

The religion wise distribution of the respondents as depicted in table 6, proved that majority (77%) of the respondents in the EG belonged to the Christian community and 23 per cent belonged to Hindu community and in the case of CG 60 per cent were from Christian community and in EG 40 per cent were from Hindu community.

4.1.3. Family Size

Table 6, indicates that majority ie, 67 per cent of the respondents in the EG and 65 per cent respondents in the CG belonged to category with five to seven members. 33 per cent of the respondents in the EG and 35 per cent of the respondents in the CG belonged to category with three to four members.

4.1.4. Type of Family Type

Table 6, depictes that majority of the respondent in the EG belonged to joint family (57 per cent) and in CG, 45 per cent belonged to joint family. 43 per cent of the respondents in the EG and 55 per cent of the respondents in the CG belonged nuclear family.

4.1.5. Sibling Size

Table 6, depicted that in the EG 60 per cent of the respondents belonged to category with one sibling. In the case of CG it was 40 per cent. 30 per cent of the respondents in the EG and 45 per cent of the respondents in the CG belonged to

category with two siblings. In the 10 per cent of the respondents belonged to category with four siblings, where as in CG it was 15 per cent.

Table 6. Distribution of respondents based on personal characteristics.

Variables	Category	EG (n=30)	Per cent	CG (n=20)	Per cent
Religion of the respondents	Christian	23	77	12	60
	Hindu	7	23	8	40
Family type	Nuclear	13	43	11	55
	Joint	17	57	9	45
Family size	3-4	10	33	7	35
	5-7	20	67	13	65
Sibling size	01	18	60	8	40
	02	9	30	9	45
	03	-	-	-	-
	04	3	10	3	15

4.2. SOCIO- ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Socio- economic characteristics of selected 50 respondents with reference to their monthly income, social participation, and educational status of the mother, mass media exposure and social participation of the mother were assessed.

4.2.1. Monthly Family Income of the Respondents

The table 7, reveales that a considerable percentage ie, 90 per cent of the respondents in the EG had a monthly income within the range of Rs < 1000; and in the case of CG it was 10 per cent. 95 per cent of the respondents in the EG and 5 per cent of the respondents in the CG had a monthly income within the range of Rs 1001- 5,000.

Table 7. Distribution of respondents based on their monthly family income

Income range (Rupees)	Category	No: of respondents	Per cent
<1000	EG CG	27 19	90 95
1001-5,000	EG CG	3 1	10 5

4.2.2. Educational Status of Respondents Mother's

Table 8. Distribution of respondents based on their mother's educational status

Variables	Category	EG(n=30)	Per cent	CG(n=20)	Per cent
Educational status	Upper Primary	8	27	6	30
	High School	14	47	10	50
	Pre-degree	4	13	3	15
	Degree	3	10	1	5
	PG and above	1	3	-	-

The educational status of the respondents mother's when assessed was seen to range from upper primary to post graduation. The educational status of the respondent's mothers reveales that 27 per cent in EG and 30 per cent in CG had

studied up to upper primary. Forty seven per cent in EG and 50 per cent in CG had studied up to High school. Thirteen per cent in EG and 15 per cent in CG had studied up to pre-degree. Ten per cent in EG and five per cent in CG had studied up to degree and three per cent of respondents in EG had studied up to PG level.

4.2.3. Mass Media Exposure

Table 9. Distribution of the respondents based on mass media exposure

Mass Media's	Category	Percentage of Participants					
		Daily	>two times per week	Two times per week	Once in a week	Once in a month	Never
News paper	EG CG	28 (93) 19 (95)	2 (7) 1 (5)	- -	- -	- -	- -
TV	EG CG	25 (83) 18 (90)	3(10) 2(10)	2 (7) -	- -	- -	- -
Radio	EG CG	21 (70) 4 (20)	3 (10) -	- -	4 (13) 6 (30)	- -	2(7) 10(50)
Computer	EG CG	30(100) 20(100)	- -	- -	-	- -	- -

Figures in parenthesis show percentages of respondents

It can be observed from table 9 that the participants are exposed to different types of media like radio, television, computer and newspaper. Table also revealed that television was watched by 83 per cent in EG and 90 per cent of respondents in CG. Radio was listened by 70 per cent in EG and 20 per cent of respondents in CG. On daily basis, Newspaper were read daily by 93 per cent of respondents in EG and 95 per cent respondents in CG and computer was used by all of the respondents in both EG and CG.

4.2.4. Social Participation

From table 10, it can be seen that with respect to social participation majority of the participants (72 per cent) functioned as members, while only 3 per cent functioned as office bearers of socio organization, and 25 per cent of the participants did not have membership in any of the social organizations.

Table 10. Percentage distribution of the social participation of respondent's mothers

Social Participation	Percentage of participation
As member	72
As office bearer	3
No member	25

4.3. FOOD CONSUMPTION PRACTICES WITH SPECIAL REFERENCE TO GREEN LEAFY VEGETABLES

4.3.1. Food Habits of the Respondents

Food habits of the respondents indicated that all of the respondents were non-vegetarians. From the result of table 11, it can be seen that majority of the respondents in EG (43 per cent) took home food while in CG it was 40 per cent. Thirty per cent respondents in EG and 20 per cent respondents in CG were found to dine outside, and 27 per cent respondents from EG and eight per cent respondents from CG were found to prefer both eating outside and home food .

Food consumption pattern of the respondents was assessed through diet survey. Details regarding food habits and frequency of use of the various foods items were collected and the results obtained are presented in table 11.

Table 11. Distribution of the respondents based on their food habits

	EG (n=30)		CG (n=20)	
	Number	Per cent	Number	Per cent
Eating outside	9	30	4	20
Home food	13	43	8	40
Both	8	27	8	40

4.3.2. Dietary Habits of the Respondents

Table 12. Distribution of respondents based on dietary habits

Characteristics	Category	No of respondents	Per cent
Habit of nibbling	EG	5	16.7
	CG	3	15
Choosy in food	EG	11	36.7
	CG	6	30
Skip meals	EG	14	46.7
	CG	8	40

Table 12, revealed that majority of the respondents in EG (36.6 per cent) were choosy in food, 46.7 per cent of the respondents skip their meals and 17 per cent of the respondent were having the habit of nibbling.

In the case of CG majority of the respondents (40 per cent) were having the habit of skipping their meals, 30 per cent were choosy in foods and 15 per cent were having the habit of nibbling.

4.3.3. Dietary Habits (Skipping Meals) of the Respondents

Dietary habits (skipping meals) of the respondents indicated that majority of respondents in EG (43 per cent) skip their breakfast and three per cent skip their lunch and in CG, 40 per cent respondents skip their breakfast and five per cent skip their supper.

Table 13. Distribution of respondents based on dietary habits (skipping meals)

Characteristics	Category	No of respondents	Per cent
Breakfast	EG CG	13 8	43.3 40
Lunch	EG CG	1 -	3.33 -
Supper	EG CG	- 1	- 5

4.3.4. Respondents Dislike Towards Food

Results of table 14, revealed that in EG majority of the respondents (36.6 per cent) disliked milk, 16.6 per cent disliked green leafy vegetables, 23.3 per cent disliked vegetables, 20 per cent disliked egg and 6.6 per cent disliked bakery product's and meat respectively.In CG, majority of the respondents dislike (70

percent) disliked vegetables, 20 per cent disliked green leafy vegetables, 15 per cent disliked milk and 10 per cent of the respondents disliked pulses.

Table 14. Distribution of the respondents based on the dislike towards food.

Characteristics	EG (n=30)	Per cent	CG (n=20)	Per cent
Vegetables	7	23.3	14	70
Milk	11	36.6	3	15
Egg	6	20	1	5
GLV	5	16.6	4	20
Pulses	-	-	2	10
Bakery	2	6.6	-	-
Meat	2	6.6	-	-

4.3.5. Frequency of Use of Various Food Items by the Respondents

Data collected based on the frequency use of various food items are presented in Table 15.

Cereals like parboiled rice was found to be consumed by all of the respondents in EG and CG on daily basis. It was noticed that most of the respondents (97 per cent) in EG and 75 per cent in CG consumed wheat flour only bi – weekly followed by monthly (3 per cent) in EG and 25 per cent in CG. Ragi was found to be consumed weekly by (37 per cent) respondents in EG and 35 per cent of respondents in CG. It may be noticed that most of the respondents (43 per cent) in EG and 35 per cent in CG consumed ragi only bi monthly followed by

Table 15. Percentage distribution of frequency use of food items

Food items	Group	Daily	Weekly	Monthly	Once in a week	Fortnightly	Rarely	Never
Cereals								
Parboiled rice	EG	30 (100)	-	-	-	-	-	-
	CG	20 (100)	-	-	-	-	-	-
Wheat flour	EG	-	29 (97)	1 (3)	-	-	-	-
	CG	-	15 (75)	5 (25)	-	-	-	-
Ragi	EG	-	11 (37)	13 (43)	5 (17)	1 (3)	-	-
	CG	-	7 (35)	7 (35)	6 (30)	-	-	-
Pulses								
Black gram dhal	EG	-	13 (43)	13 (43)	3 (10)	1 (3)	-	-
	CG	-	11 (55)	8 (40)	1(5)	-	-	-
Bengal gram	EG	-	13 (43)	9 (30)	6 (20)	2 (7)	-	-
	CG	-	11 (55)	4 (20)	4 (20)	1 (5)	-	-
Sprouted pulses	EG	-	12 (40)	10(33)	8 (27)	-	-	-
	CG	-	12 (60)	3 (15)	4 (20)	-	1 (5)	-
Leafy Vegetables								
Amaranth	EG	-	13 (43)	12 (40)	4 (13)	-	1 (3)	-
	CG	-	17 (85)	8 (40)	1 (5)	-	1(5)	-
Coriander leaves	EG	-	12(40)	10 (33)	8 (27)	-	-	-
	CG	-	6 (30)	6 (30)	6(30)	-	-	-
Drum stick leaves	EG	-	7(23)	12 (40)	8 (27)	2 (7)	1 (3)	-
	CG	-	8 (40)	8 (40)	8 (40)	1 (5)	-	-

Figures in parenthesis show percentages of respondents

(contd.....)

Curry leaves	EG CG	30(100) 20(100)	- -	- -	- -	- -	- -	-
Other vegetables								
Cucumber	EG	-	13 (43)	13 (43)	-	2 (6)	2 (6)	-
	CG	-	9 (45)	11(55)	-	-	-	-
Ladies finger	EG	-	17(57)	6 (20)	6(20)	-	-	1 (3)
	CG	-	12 (60)	4(20)	4 (20)	-	-	-
Plantain green	EG	-	5 (17)	17 (57)	8 (27)	-	-	-
	CG	-	6 (33)	7(35)	7 (35)	-	-	-
Brinjal	EG	-	11 (37)	12(40)	5 (17)	1 (3)	-	-
	CG	-	11(55)	7(35)	1 (5)	-	-	-
Tomato	EG	28 (93)	2 (8)	-	-	-	-	-
	CG	8 (90)	2 (10)	-	-	-	-	-
Roots and tubers								
Onion big	EG	28 (93)	2 (7)	-	-	-	-	-
	CG	18(90)	2(10)	-	-	-	-	-
Carrot	EG	-	12 (40)	17 (57)	-	-	1(3)	-
	CG	-	8 (40)	12 (60)	-	-	-	-
Beet root	EG	-	12 (40)	12 (40)	4 (13)	1 (3)	1 (3)	-
	CG	-	7 (35)	11 (55)	2 (10)	1 (5)	-	-
Potato	EG	1 (3)	22 (73)	4(13)	2 (7)	1 (3)	-	-
	CG	-	15 (75)	2 (10)	3 (15)	-	-	-
Tapioca	EG	-	20 (67)	4(13)	2(6)	4(13)	-	-
	CG	-	15 (75)	2 (10)	3 (15)	-	-	-

Figures in parenthesis show percentages of respondents

(contd.....)

Fruits								
Mango	EG	-	4 (13)	24 (80)	1 (3)	-	-	1 (3)
	CG	-	5 (25)	14 (70)	1 (5)	-	-	-
Pine apple	EG	-	2 (6)	24 (80)	2 (6)	1 (3)	-	1 (3)
	CG	-	3 (15)	12 (60)	5 (25)	-	-	-
Orange	EG	-	3 (10)	20 (67)	4(13)	-	2(6)	-
	CG	-	3(15)	13 (65)	4 (20)	2 (7)	-	-
Jack fruit	EG	-	2 (7)	23 (76)	1 (3)	-	2(7)	-
	CG	-	1(5)	4(13.32)	1 (3)	-	-	-
Banana	EG	11 (37)	14 (47)	-	-	-	-	-
	CG	5 (25)	15 (75)	12(40)	1 (3)	-	-	-
Papaya	EG	2(6)	15 (50)	6 (30)	-	-	-	-
	CG	1(5)	13(65)					
Animal foods								
Egg	EG	-	29 (96)	-	-	-	-	-
	CG	-	20(100)	-	-	-	-	-
Meat	EG	1 (3)	26 (86)	3 (9)	-	-	-	1 (3)
	CG	-	20 (100)	-	-	-	-	-
Fish	EG	30 (100)	-	-	-	-	-	-
	CG	20 (100)	-					

Figures in parenthesis show percentages of respondents

once in a week (17 per cent) in EG and 30 per cent respondents in CG. While only three per cent consumed fortnightly.

Pulses like black gram dhal, bengal gram and sprouted pulses were found to be consumed by 43 per cent, 43 per cent and 40 per cent of the respondents respectively in EG and 55 per cent, 55 per cent and 60 per cent of the respondents respectively in CG on weekly basis. It may be noticed that monthly consumption was 43 per cent , 30 per cent and 33 per cent in EG respectively and 40 per cent , 20 per cent and 15 per cent respectively in CG.

It was found that 10 per cent, 20 per cent and 27 per cent of the respondents in EG and 5 per cent, 20 per cent and 20 per cent of the respondents in CG consumed pulses once in a week. Around 3 per cent in EG respondent consumed black gram dhal fortnightly, 7 per cent bengal gram in EG and 5 per cent in CG consumed sprouted pulses fortnightly.

Green leafy vegetables like amaranth and drumstick leaves were found to be consumed only by 43 per cent, and 23 per cent of respondents in EG and 85 per cent and 40 per cent respondents in CG respectively on weekly basis followed by 40 per cent respondents in EG and 40 per cent of respondents in CG consumed monthly. Around 13 per cent and 27 per cent of the respondents in EG and five per cent and 40 per cent of the respondents in CG consumed once in a week. Seven per cent of respondents in EG and 5 per cent of respondents in CG consumed drumstick leaves fortnightly. About 3 per cent of respondents in EG and 5 per cent of respondents in CG consumed amaranth rarely and 3 per cent of the respondents consumed drumstick rarely.

On assessing the frequency of use of other vegetables among the respondents, the most frequently used vegetables in their daily diet were found to be tomato (93 per cent) in EG and (90 per cent) in CG. The most frequently used vegetables in their weekly diet were found to be cucumber (43 per cent), ladies finger (57 per cent), plantain green (17 per cent) and brinjal (37 per cent) in EG. In CG consumption of cucumber was (45 per cent), ladies finger (60 per cent), plantain

green (33 per cent) and brinjal (55 per cent). Whereas, monthly consumption were found to be cucumber (43 per cent), ladies finger (20 per cent), plantain green (57 per cent) and brinjal (40 per cent) in EG. In the case of respondents in CG monthly consumption of cucumber were 55 per cent, ladies finger (20 per cent), plantain green (35 per cent) and brinjal (35 per cent). With regard to frequency use of ladies finger, plantain green and brinjal were consumed only once in a week.

In the case of respondents in EG fortnightly consumption of ladies finger 20 per cent, plantain green 27 per cent and brinjal 17 per cent. While in fortnightly CG consumption was ladies finger was 20 per cent, plantain green (35 per cent) and brinjal (5 per cent).

In the present study the results revealed from the table 11, that frequency use of roots and tubers are comparatively higher than green leafy vegetables. It was found that onion was most frequently used daily by 93 per cent of the respondents in EG and 90 per cent of respondents in CG. As far as the frequency of consumption of roots and tubers is considered, 40 per cent consumed carrot, 40 per cent consumed beetroot, 73 per cent consumed potato and 67 per cent consumed tapioca in EG. In CG, 40 per cent consumed carrot, 35 per cent consumed beetroot, 75 per cent consumed potato and tapioca on weekly basis.

Data pertaining to the frequency of use of fruits was also found to be low in the present study. Thirty six per cent of the respondents in EG and 25 per cent of the respondents in CG reported that they consumed banana daily in their diet. Thirteen per cent consumed mango, 6 per cent consumed pine apple, 10 per cent consumed orange, seven per cent consumed jack fruit and 50 per cent consumed papaya in EG weekly. In CG 25 per cent consumed mango, 15 per cent consumed pine apple and orange, 5 per cent consumed jackfruit and 65 per cent consumed papaya in CG weekly.

On assessing the frequency use of animal foods among the respondents, 96 per cent of the respondents in EG and all of the respondents in CG consumed egg weekly. Consumption of meat was 86 per cent in EG and all of the CG consumed

meat weekly. The present study revealed that all the respondents in both EG and CG consumed fish daily.

Based on the frequency of use of the green leafy vegetables by the respondents percentage total score for each food items were calculated separately using the formula suggested by Reaburn *et al*. (1979).

4.4. IMPACT EVALUATION OF NUTRITION EDUCATION PROGRAMME

4.4.1. Changes in Frequency of Use of Green Leafy Vegetables

Table 16. Frequency score of use of green leafy vegetables by the control group (n=20) before and after nutrition education

Green leafy Vegetables	Frequency			
	Before nutrition education		After nutrition education	
	Frequency score	Mean score	Frequency score	Mean score
Red Amaranthus	80.71	5.65	92.14	6.45
Coriander	66.42	4.65	74.28	5.2
Drumstick leaf	87.85	6.15	90.86	6.45
Curry leaf	100	7	100	7
Cabbage	77.85	5.45	84.28	5.9
Cauliflower	77.85	5.45	85	5.95

Summative evaluation was conducted to find out the change in green leafy vegetable consumption of the respondents after the participation in the nutrition

education programme. Pre and post education score of the frequency use of leafy vegetables consumption given in the table 16 revealed that there was an increase in the frequency of use of green leafy vegetables. From the table 16, it can be seen that curry leaves and coriander leaves were used by most of the respondents followed by red amaranthus, drumstick, cabbage and cauliflower. After the intervention it can be seen that consumption of use of all the other leafy vegetables increased.The frequency score revealed that there was progress in the consumption of leafy vegetables.

Table 17. Frequency score of use of green leafy vegetables by the experimental group (n=30) before and after nutrition education

Green leafy Vegetables	Frequency			
	Before nutrition education		After nutrition education	
	Frequency score	Mean score	Frequency score	Mean score
Red Amaranthus	74.25	5.19	97.04	6.79
Coriander	73.29	5.13	94	4.700
Drumstick leaf	67.54	4.72	100	7
Curry leaf	95	4.800	100	7
Cabbage	79.86	5.59	84.27	5.89
Cauliflower	75.63	5.29	86.6	4.310

Summative evaluation was conducted to find out the change in green leafy vegetable consumption of the respondents after the participation in the nutrition education programme. Pre and post education score of the frequency of use percentage of leafy vegetables consumption given in the table 17 revealed that there was an increase in the frequency of use of green leafy vegetables.

From the table 17, it can be seen that curry leaves and coriander leaves were used by most of the respondents followed by red amaranthus, drumstick leaves, cabbage and cauliflower. After the intervention it can be seen that consumption of use of all the other leafy vegetables increased. The frequency score shows that there is progress in the consumption of leafy vegetables.

4.5 NUTRITIONAL COMPOSITION OF STANDARDIZED MORINGA SUPPLEMENT AND ITS COST EFFECTIVENESS

4.5.1. Nutrient Composition

Table 18. Nutrient composition of 100 gm moringa based soup mix

Energy(kcal)	429
Protein (g)	18
Carbohydrates (g)	56
Beta-carotene (μ)	3617
Vitamin C (mg)	34.4
Iron (mg)	0.024
Potassium (mg)	28.6
Sodium (mg)	328
Calcium (mg)	190

All the moringa parts have immense nutritional value such as vitamins, minerals and amino acids. The nutrient content of the standardized moringa based soup mix (100 g) were explained in table 18.

In the present study moringa based enriched soup mixes were formulated and the nutrients such as energy, proteins, carbohydrates, beta carotene, vitamin C, iron, calcium, potassium and sodium were present. The formulated soup was found to have energy content of 429 kcal, 18 g protein, 56 g carbohydrates, 3617 µ beta-carotene, 34.3 mg vitamin C, 0.024 mg iron, 28.6 mg potassium, 328 mg sodium, and 190 mg calcium (Saranya, 2012).

4.5.2. Combination of Moringa Based Soup Mix

Table 19. Standardized combination used for supplementation of 100 g moringa based soup mix

Ingredients	Per cent
Moringa leaf powder	10
Moringa stick pulp powder	30
Corn flour	15
Tomato flour	10
Soya flour	5
Milk powder	25
Onion powder	5

The developed standardized soup mix was made out of the combination, 10 per cent moringa leaf powder, 30 per cent moringa stick pulp powder, 15 per cent corn flour, 10 per cent tomato flour, 5 per cent soya flour, 25 per cent milk powder

and 5 per cent onion powder (Saranya, 2012). The combination used for the supplementation was depicted in table 19.

4.5.3. Cost of Production of Standardized Soup Mix

The cost of the developed standardized soup mix was calculated on the basis of the market value of ingredients used for the formulation of soup mix and the over head charges needed for processing each item.

In order to realize the economic feasibility of the developed soup mix, the cost was calculated by taking individual cost of the ingredients used with 10 per cent over head. The cost of 100g of moringa soup mix were calculated. Table 20 reveals details of cost effectiveness of the developed soup mix.

Table 20. Cost of the developed moringa soup supplement

Amount of soup mix	Amount (Rs)
100 gm	52
15gm(1 child)	7.8
27 Kg (30 respondents for 2 months)	14,040

4.6. IMPACT EVALUATION OF FEEDING TRIAL

Impact of supplementary feed on weight and height of the respondents of EG as well as CG were recorded before and three months after supplementation.

Mid upper arm circumference were also measured initially and after supplementation. Standard weight and heights of children of the EG and CG in the beginning of the feeding trial are presented in (Table 21 and 22).

Table 21. Distribution of respondents based on standard weight for age

Age	Standard Weight (Mean ± S.D)	Total (%) of respondents having standard weight for age	
		EG (n=30)	CG (n=20)
7 – 9 yrs (Boys)	25.4±2.6	10	23.3
7 -9 yrs (girls)	25.03±3.3	13.3	20

Source: NCHS Standard WHO, Geneva, 1983

Table 21, revealed that majority of respondents in both EG and CG were not having weight below the prescribed standard.

Table 22. Distribution of respondents based on standard height for age

Age	Standard height (Mean ± S.D)	Total (%) of respondents having standard height for age	
		EG (n=30)	CG (n=20)
7 – 9 yrs (Boys)	127±5.2	12	15
7 -9 yrs (girls)	126.4± 5.8	10	13

Source: NCHS Standard WHO, Geneva, 1983

Table 22, revealed that majority of respondents in both EG and CG were not having height below the prescribed standard.

4.6.1. Weight of the Experimental Group and Control Group Before and After Supplementation

From table 23, it can be seen that after three months of supplementation there was difference in the weight of the respondents. Statistically there was a significant difference in the weight before supplementation and weight after

supplementation at 1 % level of significance and no significant difference was found in control group.

Table 23. Weight of the experimental group (n=30) and control group (n=20) before and after supplementation

Parameters	Groups	Mean score	't' value
Weight before supplementation	Experimental	20.4	4.45**
Weight after supplementation		22.2	
Weight before supplementation	Control	21.70	1.37^{NS}
Weight after supplementation		21.78	

** Significant at 1 % level NS Not Significant

4.6.2. Height of the Experimental Group and Control Group Before and After Supplementation

Table 24. Height of the experimental group (n=30) and control group (n=20) before and after supplementation

Parameters	Groups	Mean score	't' value
Height before supplementation	Experimental	128.6	4.78**
Height after supplementation		129.1	
Height before supplementation	Control	127.9	1.45^{NS}
Height after supplementation		127.9	

**Significant at 1 % level NS Not Significant

From table 24, it can be observed that even though there was a slight increase in the mean score of height before and after the study, it was not that satisfactory.

Statistically there was a significant difference in the height before supplementation and height after supplementation at 1 % level of significance and no significant difference was found in control group.

4.6.3. Mid Upper Arm Circumferences of the Selected Respondents

Table 25. Distribution of respondents based on standard MUAC

Age of the respondents	Number (n=50)	Total (%) of respondents having standard mid upper arm circumference for age		
		Mean ± SD	EG (n=30)	CG (n=20)
7 years - 9 years	Boys	15±2	93	100
	Girls	16±2	62	77

Source : Gnanasundaram et al. 1994.

Table 25, revealed that majority of respondents in both EG and CG were having MUAC on prescribed standard.

Table 26. MUAC of the experimental group (n=30) and control group (n=20) before and after supplementation

Parameters	Groups	Mean score	't' value
MUAC before supplementation	Experimental	15.14	4.26**
MUAC after supplementation		15.26	
MUAC before supplementation	Control	15.22	1.83^{NS}
MUAC after supplementation		15.21	

**Significant at 1 % level NS Not Significant

From table 26, it can be seen that after three months of supplementation there was difference in the MUAC of the respondents.

Statistically there was a significant difference in the MUAC before supplementation and weight after supplementation at 1 % level of significance and no significant difference was found in control group.

4.6.4. Biochemical Assessment (Haemoglobin Level)

The biochemical assessment of nutritional status of the respondents was conducted by estimating the haemoglobin level.

Table 27 shows the distribution of respondents based on their haemoglobin level before supplementation.

Table 27. Haemoglobin level before supplementation

Haemoglobin level (gm/d)*	Percentage of respondents in EG (n=30)	Percentage of respondents in CG (n=20)
<7.9 (severe)	-	-
8.0-9.9 (Moderate)	-	-
10.0-10.9 (Mild)	50	100
11-11.9 (Non marginal)	43	-
>12 (Non marginal)	7	-

Source: NIN, 1984.

From table 28, it can be seen that after three months of supplementation there was difference in the Haemoglobin level of the respondents. Statistically there was a significant difference in the Haemoglobin level before supplementation and after

supplementation at 1 % level of significance and no significant difference was found in control group.

Table 28. Haemoglobin level of the experimental group (n=30) and control group (n=20) before and after supplementation

Parameters	Groups	Mean score	't' value
Hb before supplementation	Experimental	11.03	10.51**
Hb after supplementation		12.02	
Hb before supplementation	Control	10.13	0.78^{NS}
Hb after supplementation		10.08	

**Significant at 1 % level NS Not Significant

4.6.5. Clinical Examination

Examination of the respondents for the incidence of clinical signs and symptoms of deficiency diseases were depicted in table 29.

From table 29, it can be seen that after three months of supplementation there was decrease in the clinical symptoms of the respondents in the EG.

Decrease was found in the symptoms like lack of lusture, easy pluckability, bitot's spot, conjunctival xerosis, scarlet and raw tongue, mottled enamel, and spongy bleeding gums and no progress was found in control group.

Percentage of respondents suffered from Bitot's spot decreased from 26.66 per cent to 23.32 per cen. Percentge of respondents suffered from lack of lusture

reduced from 53.28 per cent to 46.62 per cent. In the case of mottled enamel, it was reduced from 19.98 per cent to 16.65 per cent.

Table 29. Distribution of respondents based on clinical symptoms before and after supplementation EG (n=30)

Clinical Symptoms	Before(%)	After(%)
Hair		
Lack of lusture	53.28	46.62
Easy Pluckability	39.96	36.63
Eye		
Bitot's Spot	26.66	23.32
Conjuctival Xerosis	9.99	3.33
Tongue		
Scarlet and raw tongue	16.66	13.32
Teeth		
Mottled enamel	19.98	16.65
Spongy bleeding gums	13.32	10

Discussion

5. DISCUSSION

The results of the study ' Impact of drumstick (*Moringa oleifera* Lam.) supplement on the nutritional status of school children" are presented under the following heads.

5.1 Personal characteristics of the participants

5.2 Socioeconomic characteristics of the participants

5.3 Food consumption practices with special reference to green leafy vegetables

5.4 Impact evaluation of nutrition education programme

5.5 Nutritional composition of standardized moringa supplement and its production cost.

5.6 Impact evaluation of feeding trial

5.1. PERSONAL CHARACTERISTICS OF THE PARTICIPANTS

In the present study socio economic and personal variables such as age, caste, family size, family type, and educational status, were taken.

The above mentioned informations were collected through direct interview with the subjects using an interview schedule and was statistically analysed in detail. The result revealed that majority of the respondents (43per cent) belonged to the age group nine years, 40 per cent of the respondents belonged to the age group 7 years and 17 per cent constituted those in the age group 7 years in the EG group. Whereas, in the CG, majority of the respondents (60per cent) belonged to the age group eight years, 20per cent of the respondents belonged to the age group seven and nine years. The study is supported by Gopalan (2013) who opined that child population is included in the total population of the country and child population comprises of 13.12 per cent of the total population of the county. Religion and caste are the oldest institution of the Indian society and has a great influence on the attitude and behaviour of an individual. Arora (1991) reported that caste is a unique institution of the Indian society. Hence, caste system of fifty families were analysed and it was observed that majority of the respondents in the

EG belonged to the Christian community and in the CG belonged to the Hindu community and in the case of CG 60 per cent were from Christian community and in EG 40 per cent were from Hindu community.

The present study that majority ie, 67 per cent of the respondents in the EG and 65 per cent respondents in the CG belonged to category with five to seven members. 33 per cent of the respondents in the EG and 35 per cent of the respondents in the CG belonged to category with three to four members. Similar reports were given by Sheethal (2011) and Krishnaroopa (2003). Kerala is a state with high literacy and people are exposed to the benefits of having small family. Regarding the family size, Park (1997) had reported that average family size in India is four.

It is observed that many researchers explained the concept of nuclear family and it is becoming more and more common in our society and joint family system is fast disappearing. Similar reports have been given by Krishnaroopa (2003), Renjini (2008) and Sheethal (2011) in their studies done in Thiruvananthapuram district. Joint family is declining these days especially in the city like Thiruvananthapuram where dwellers are mostly working class people migrated from different parts of Kerala. Nuclear family has become a prevalent norm Kerala as reported by Bulliyya *et al*. (2002). NFHS-2 Survey (2001) conducted in Kerala found that just over half of all households are of nuclear type. The present study depicted that majority of the respondent in the EG belonged to joint family (57 per cent) and in CG 45 per cent belonged to joint family. 43 per cent of the respondents in the EG and 55 per cent of the respondents in the CG belonged to nuclear family.

5.2 SOCIOECONOMIC CHARACTERISTICS OF THE PARTICIPANTS

Socio economic status, known as the key determinants of health status of any individuals as it affects the educational status, food consumption pattern and other life style behaviour factors (Ching, 2003). A recent research revealed that socio economic and demographic factors play an important role in the food consumption

pattern Rahman and Rao (2002). Children are one of the most important group of any society as they have an influential effect on the future socio economic and cultural status of the society.

Family income is considered as an important determinant, since it determines the family status and socio economic position in the society to which they belong. In the case of family income considerable percentage that is, 90 per cent of the respondents in the EG had a monthly income of Rs < 1000 ; and in the case of CG it was 10 per cent and 95 per cent of the respondents in the EG and 5 per cent of the respondents in the CG had a monthly income within the range of Rs 1001- 5,000. The study is in concurrence with the result of Bhuvaneshwari (2007), dietary intake was found to be markedly influenced by income level.

On assessing the social participation of the respondents mothers, it was found that majority of the participants (72 per cent) functioned as members, while only 3 per cent functioned as office bearers of socio organization, and 25 per cent of the participants did not have membership in any of the social organizations. The findings of the study found to be in concurrence with the studies of Sheethal (2011) and Bhuvaneshwari (2007).

Mass media play a significant role in the spread of new ideas among children. In Kerala majority of the families had their own television sets NFHS-2 (2001). The present study also reveales that television was watched by 83 per cent in EG and 90 per cent of respondents in CG. Radio was listened by 83 per cent in EG and 90 per cent of respondents in CG. On daily basis, Newspapers were read daily by 93 per cent of respondents in EG and 95 per cent respondents in CG and computer was used by all of the respondents in both EG and CG.

Educational status of the respondent's mothers in the present study revealed that 27 per cent in EG and 30 per cent in CG had studied up to upper primary. Forty seven per cent in EG and 50 per cent in CG had studied up to High school. Thirteen per cent in EG and 15 per cent in CG had studied up to pre-degree. Ten per cent in EG and 5 per cent in CG had studied up to degree and 3 per cent of

respondents in EG had studied up to PG level. This shows that present generation is better educated than the older generation. The findings of this study is in conformity with the studies reported by Razeena (2000), and Geetha (2008).

Education is life blood in any development activity and helps people to understand and practice the ideals preached. Literacy and educational attainments are the indicators of quantitative improvements in human resources and female literacy is said to hold the key to the coming generation of full genetic potentials pertaining to health and nutrition for family planning. Female literacy is also indicative of better nutritional status. However, information regarding the ways to improve the quality of life and to realize basic human rights including rights for better nutrition is not furnished through any educational programme (Sheela, 2004).

5.3. FOOD CONSUMPTION PRACTICES WITH SPECIAL REFERENCE TO GREEN LEAFY VEGETABLES

Food consumption practices have remained the subject of intense research over the last decade, not only because of their importance in children's growth and development, but also because of the increasing realization that eating habits in the early stages of life may be important determinants in the prevention of the so-called degenerative diseases.

According to Ghassemi, (2003) food habits of an individual are the characteristic repetitive acts that he performs under the impetus of the need to provide himself with nourishment and simultaneously to meet social and emotional goals.

The present study revealed the food habits, food preferences and frequency of use of various food items by the respondents. In the present study it was found that 100 per cent of the respondents were non- vegetarians. Similar results were observed by Sheethal (2011), Unnithan (2008), Reshmi (2007) and Krishnaroopa (2003) in their studies. Kerala being land near to the seas, the availability of sea

food is high and fish is comparatively cheaper than other animal foods. This could be the reason for the non vegetarian habit being more prevalent in Kerala.

5.3.1. Food Habits of the Respondents

Dietary habits of the people depend on the availability of food, which is observed to be influenced by the climate, socio-economic, cultural variables, environment, religion, superstitions and ignorance. Health related behaviours and belief formed during childhood and have been linked to patterns of behaviour in childhood. Dietary habits of childhood may be maintained into adult lives (Lien *et al*. 2001)

The present study revealed that majority of the respondents in EG (36.7 per cent) were choosy in food, 46.7 per cent of the respondents skip their meals and 17 per cent of the respondent were having the habit of nibbling. In the case of CG majority of the respondents (40 per cent) were having the habit of skipping their meals, 30 per cent were choosy in foods and 15 per cent were having the habit of nibbling. Mony (2003) opined that biological and physochological development changes during childhood period have a dynamic effect on the food preferences, food habits and eating behaviour of children.

The present study also revealed that majority of the respondents in EG (43 per cent) took home food and in CG it was 40 per cent. Thirty per cent respondents in EG and 20 per cent respondents in CG were found to dine outside, and 27 per cent respondents from EG and 8 per cent respondents from CG were found to prefer both eating outside and home food. Dietary habits (skipping meals) of the respondents indicated that majority of respondents in EG (43 per cent) skip their breakfast and three per cent skip their lunch and in CG, 40 per cent respondents skip their breakfast and five per cent skip their supper. This trend was also observed by Leena (2000).

Distribution of respondents based on dislike towards food revealed that in EG, majority of the respondents (36.6 per cent) dislike milk, 16.6 per cent dislike green leafy vegetable, 23.3 per cent dislike vegetables, 20 per cent dislike egg and

6.6 per cent each dislike bakery foods and meat. In CG majority of the respondents dislike (70 per cent) vegetables, 20 per cent dislike green leafy vegetables, 15 per cent dislike milk and 10 per cent of the respondents dislike pulses.

On assessing the frequency use of food items by the respondents it was found that cereals were consumed daily and weekly by both EG and CG. It can be inferred that cereals are the staple food of India and amongst these, rice is consumed daily by Keralites in spite of many changes. In addition to this, milk was most perpetually used foods in the dietaries of all respondents among both groups . Milk is used by the respondents to prepare coffee and tea. Similar results were obtained in studies done by Juna (1999) and Gayathri (2003). Coconut was used daily since it is an integral part of the gravy of dishes with vegetables or fish. These findings were found to be same for both EG and CG.

5.3.2. Frequency of Use of Green Leafy Vegetables

Leafy vegetables are rich sources of minerals like iron, calcium, potassium and magnesium, and vitamins like A, C, E and K and many of the B vitamins. When consumed regularly they can substantially improve micronutrient status of the Indian population. According to Gupta and Prakash (2009), green leafy vegetables also contain many helpful phytochemicals or phytofactors in scavenging the dreadful free radicals generated as metabolic by products in alleviating many serious diseases.

Dietary surveys conducted among different segments of the population revealed that consumption of green leafy vegetables is much lower than the recommended dietary allowance of 100g/day. National Nutrition Monitoring Bureau (2000) Survey of Kerala also revealed that consumption of green leafy vegetables was grossly inadequate particularly among preschool children. Data indicated that even low cost and locally available leafy vegetables like amaranth and drumstick were not consumed daily by most of the respondents. All of the respondents used curry leaves daily. 40 per cent in EG and 30 per cent of respondents from CG consume coriander leaves weekly. Curry leaves and coriander leaves are used for seasoning in most of the Kerala dishes and that may be reason for them being more acceptable. But it has to be noticed that curry leaves and

coriander leaves are consumed in very small quantities to improve the taste of the dishes, and hence not very important from the nutritional point of view.

Vitamin A rich leafy vegetables like amaranth, cabbage and drumstick leaves were locally available. Amaranth and drumstick leaves was found to be consumed only by 43 per cent, and 23 per cent of respondents in EG and 85 per cent and 40 per cent respondents in CG respectively on weekly basis.

It was evident from the results that cauliflower and cabbage were used by the respondents occasionally . Cauliflower is a vegetable grown in cold climate and is not easily available in local market. Also, the cost factor of cauliflower may be another reason for it being occasionally used by the respondents. However leafy vegetables are available but their consumption was also found to be low among the respondents.

Similar results have been reported in studies by Unnithan (2008), Ramlath (2007), and Humulka *et al*. (2000). A similar study by Kumari and Singh (2001) on school children also reported that green leafy vegetables are inadequate in children's diet.

The present study revealed that the frequency use of green leafy vegetables was also low. This can be improved by giving proper nutrition education. An awareness creation programme for women on nutrition through green leafy vegetable conducted by Hemalatha and Prakash (2002) also showed a definite increase in the frequency of consumption of green leafy vegetables.

5.4. IMPACT EVALUATION OF NUTRITION EDUCATION PROGRAMME

After the intervention programme, the leafy vegetable consumption of the respondents was assessed once again by diet survey. Change in green leafy vegetable consumption of the respondents was observed after the intervention programme. The result showed that the frequency of use of green leafy vegetables

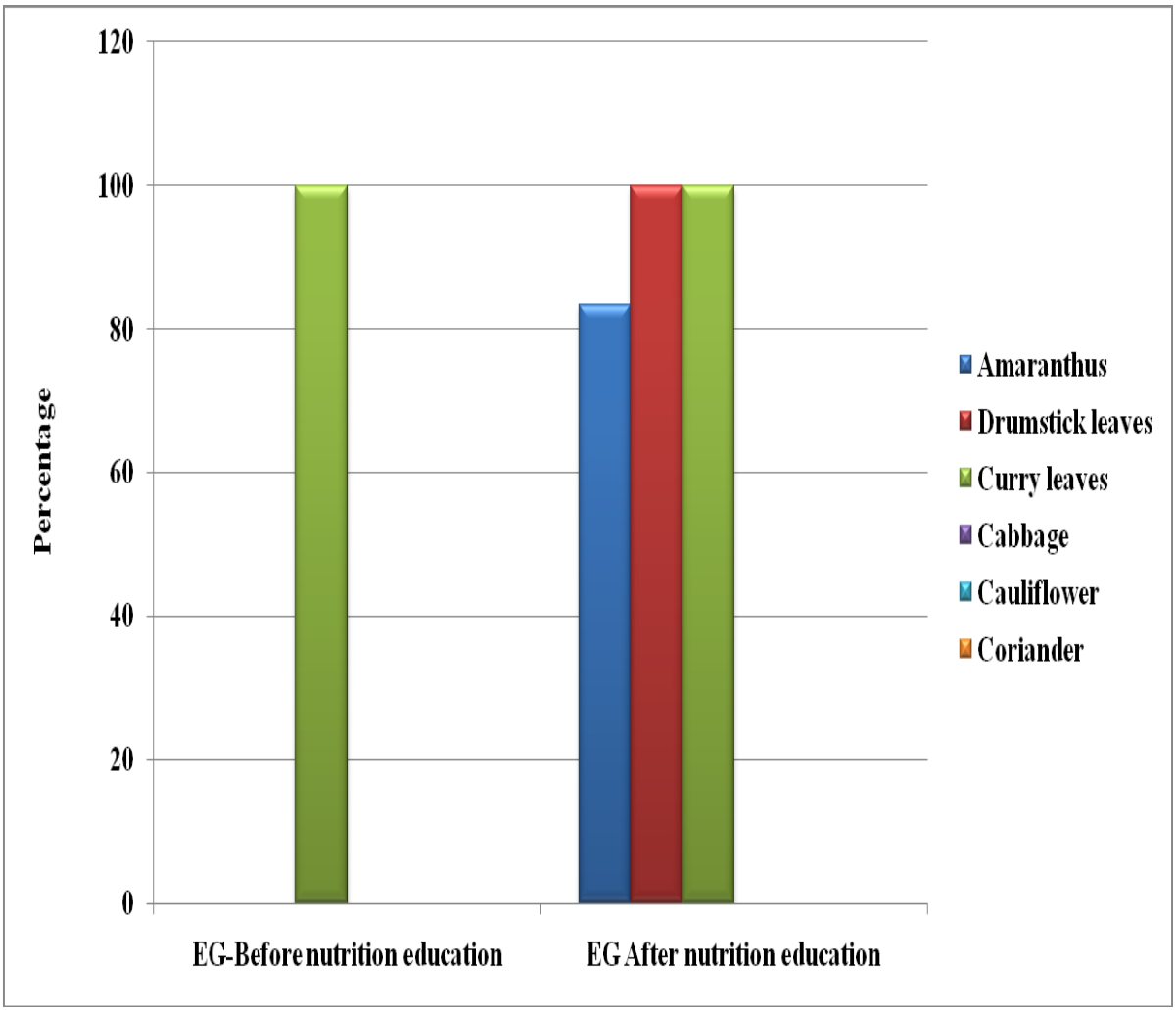

Fig 1. Daily consumption of leafy vegetables before and after nutrition education (EG)

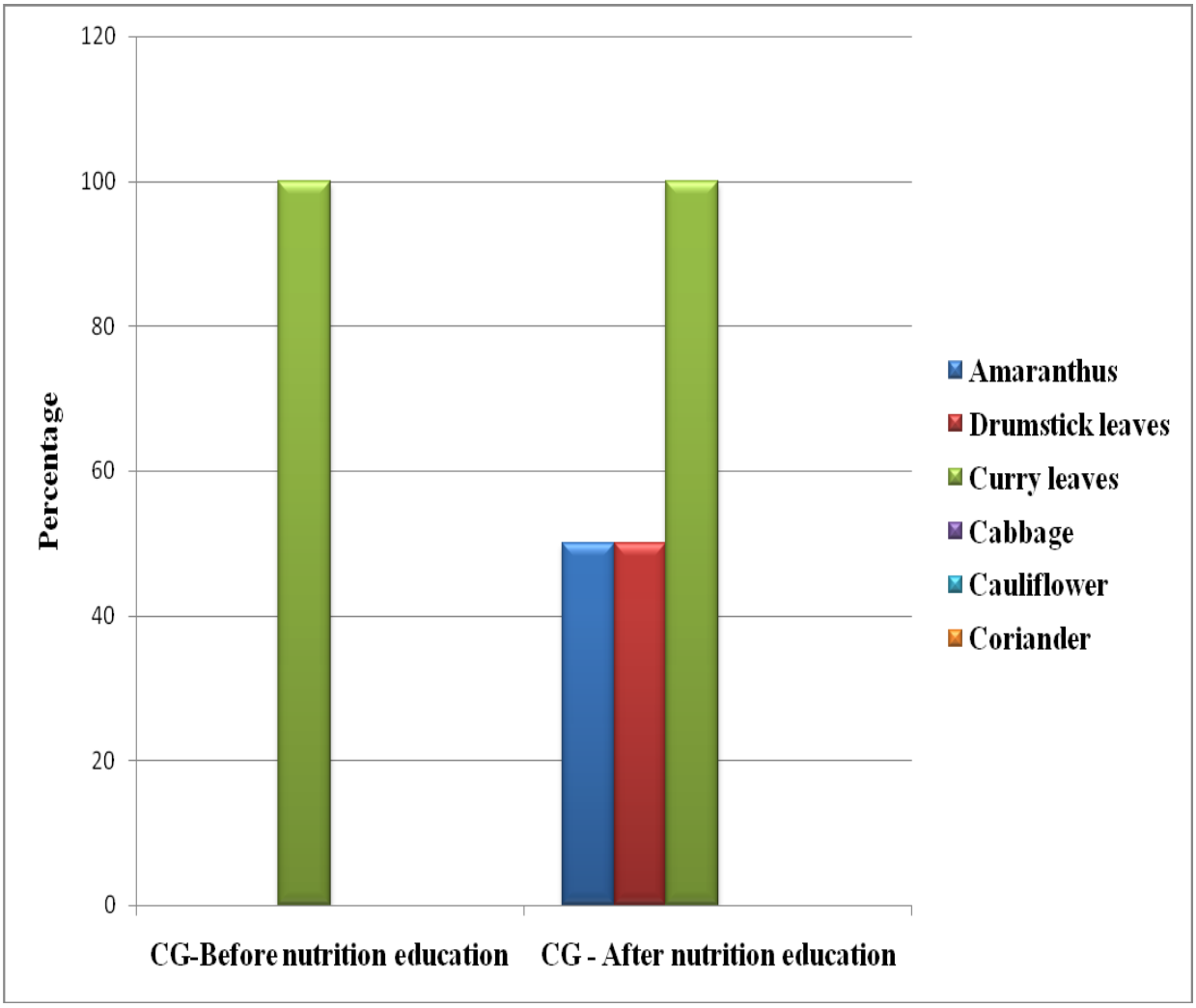

Fig. 2. Daily consumption of leafy vegetables before and after nutrition education (CG)

by the respondents who participated in the nutrition intervention programme increased in the present study. After the intervention programme the most frequently used leafy vegetables were found to be curry leaves, amaranthus, drumstick, cauliflower, cabbage and coriander leaves. Consumption of cauliflower and cabbage were found to be less. This may be due to the fact that the respondents became aware of the nutritive value of locally available green leafy vegetables. Similar studies by Parlato *et al*. (1992) and Hemalatha and Prakash (2002) also provide that respondents who participated in nutrition intervention improved their frequency of consumption of green leafy vegetables. The increase in the actual leafy vegetable consumption may be due to the increase in the nutrition knowledge after the nutrition intervention programme (Figure 1 and 2).

5.5. NUTRITIONAL COMPOSITION OF STANDARDIZED MORINGA SUPPLEMENT AND ITS COST EFFECTIVENESS

According to Kalia and Sood (1996), nutritional quality is the combination of nutrients of a product that have significance in determining the degree of acceptability of the product to a user. Rekha *et al*. (2010) opined that soups with lots of vegetables provides vitamin A and C, pottasium, folate, fibre and the tomatoes and carrots commonly found in vegetable soup boost levels of lycopene and betacarotene, important compound for health. Thilakaratne (2012) suggested that the actual nutrient composition of soup mixes differs depending the ingredients. Soups increase fluid intake over the colder winter months when it is less appealing to drink cold water. In the present study moringa based enriched soup mixes were formulated and the nutrients such as energy, proteins, carbohydrates, beta carotene, vitamin C,iron, calcium, pottasium and sodium were present.

The formulated soup was found to have energy content 429 kcal per 100 g. Irrespective of the base materials, the other ingredients viz corn flour and milk solids influence the energy value. The corn based, rice based, wheat based and commercial mixes were reported to have energy value 353, 347, 350, and 297 kcal per 100 g respectively (Fahima *et al.*, 2007). Abeysinghe and Illeperuma (2006)

reported that dried vegetable soup mixes contained 353 kcal per 100 g of energy. Abeysinghe and Illeperuma (2006) developed instant dehydrated vegetable soup mix which contains 321 kcal per 100 g of energy.

Protein is one of the most important nutrient required by the body to carry out a wide range of functions essential for the maintenance of life (Ensminger *et al*. 1994). The developed soup was found to be a protein rich product. The protein value was 18 g per 100 g. Thilakaratne (2012) found that nutritionally superior and low cost cereal based soup mix contained 19.44 g per 100 g of crude protein. Rekha *et al*. (2010) developed dry soup mix with Anethwn sowa leaves contained 9.2 g per 100 g of protein. Saha and Dunkwal (2009) developed spread instant mix which contains 22.64 g per 100 g of protein. Abeysinghe and Illeperuma (2006) developed instant dehydrated vegetable soup mix which contains 16.1 per cent of protein.

As per the findings the carbohydrate content of the formulated soup was 56 g per 100 g. Irrespective of the base materials, the other ingredients viz corn flour and milk solids, soya ect were also found to influence the carbohydrate content of the mixes. Fahima *et al.* (2007) showed that the corn based, rice based, and wheat based soup mixes were reported to have 66.37, 65.088, and 66.87 per cent of carbohydrate respectively.

Beta carotene is a fat- soluble pigment of plant origin, which is essential in human nutrition. It is antioxidant precursor to vitamin A in the human body and is important in human eye (Lee *et al.,* 2002). As per the findings the beta-carotene content of the formulated soup was 3617 πg per 100 g. Nambiar and Parnami (2008) reported that fresh moringa leaves contains 19, 210 πg per 100g of beta carotene. According to Joshi and Mehta (2010), moringa leaves contained 6780 πg of beta-carotene per 100 g of fresh and dry weight basis respectively.

Vitamin C is essential for connective tissue formation and maintenance, immune system stimulation, works as anti-oxidant, and enhances iron utilization (Shrimpton, 1993). Yameogo (2011) found that ascorbic acid content is usually

adopted as the quality index of nutrients in food processing and storage. Ascorbic acid content of the soup is 34.4 mg per 100 gm. Gatade *et al*. (2012) found that moringa leaves contained 59 mg per 100 gm vitamin C on dry weight basis. Joshi and Mehta (2010) reported that moringa leaves contained 220 mg and 56 mg of vitamin C per 100 g of fresh and dry weight basis respectively. Moreno *et al*. (2004) suggested that eating dried products in relatively higher quantities may compensate for the loss of the vitamin C incurred during processing and preservation and found that all drying methods showed significant losses of the micronutrients. Joshi and Jain (2011) developed moringa fruit pulp powder incorporated biscuits and mathri which contained 12.67 mg and 8.76 mg of vitamin C respectively. Wijayawardana *et al*. (2002) observed that vitamin C content in the fresh sample of the drumstick fruit was118 mg per 100 g edible portion.

On computation of iron values of moringa based soup mixes, iron was found to be within a range of 0.024 mg per 100 g of mixes. Abeysinghe and Illeperuma (2006) developed instant dehydrated vegetable soup mixes which contains 0.17 mg of iron per 100 g of mix. The highest value was observed in moringa pulp alone incorporated mixes formulated using drying- blending process. Nambiar and Parnami (2008) reported that moringa leaves contains 0.26 mg per 100 g of iron on dry weight basis. As per the findings in the present experiment the processing techniques and base materials do not influence the iron content of the soup mixes because the four standardized mixes contain same range of iron.

In the present investigation the calcium content in the formulated soup mix was 190 mg per 100 g. Joshi and Jain (2011) found that moringa fruit (pods) contained 6.66 mg of calcium per 100 g on dry weight basis and they developed moringa fruit pulp powder incorporated biscuits and mathri which have the calcium content of 16.08 mg and 5.26 mg respectively. As per this finding, along with the base materials other ingredients such as soya flour (5-7%) and milk solid (23-25%) enhances the calcium content of the mixes. The drying blending process retained more calcium content in the soup mixes.

In the present experiment, moringa soup mix showed higher sodium content of 328 mg per 100g. Ogbe and Affiku (2011) reported that moringa leaves contains 192.9 mg of sodium per 100 g of fresh sample. Joshi and Jain (2011) found that moringa fruit (pods) contained 202.98 mg of of sodium per 100 g on dry weight basis. As per the references moringa leaves in the soup mix increases the sodium content.

In the present feeding trial potassium content of the soup mix used was 28.6 mg per 100 g. Joshi and Jain (2011) found that moringa fruit (pods) contained 1772 mg of potassium per 100 g on dry weight basis. According to Yameogo (2011), moringa leaves contain about 260 mg of potassium per 100 g, while the leaf powder has 1,300 mg per same weight. Ogbe and Affiku (2011) reported that moringa leaves contains 970 mg of potassium per 100 g of fresh sample. Moringa fruit and leaves are the richest sources of potassium. Taking in to account the average values of potassium content of soup mixes made with two combinations showed that moringa pulp with leaf incorporated combinations found to be higher potassium retention than moringa pulp alone combination. The soup mixes formulated by drying the ingredients seperately and blended together, retained more potassium.

The fibre, vitamin C, beta carotene, sodium and potassium content were found to be higher in moringa pulp with leaf incorporated combinations. Amla (2003) found that while developing new products, the nutritive value may get lost because of the inappropriate processing methods but in this study nutrients in the soup mixes were retained due to appropriate processing techniques. The nutrient retention was found to be higher in soup mixes formulated using drying-blending.

5.5.1 Cost of Production of Moringa Soup Mix

The cost of soup mixes were calculated by adding the costs of ingredients used for the preparation of soup mix with 10 per cent over head charges needed for processing each item. The cost of the mixes ranged between Rs 52/- per 100 g.

The cost of the soup mix was Rs 234/- per 15 g for 30 days for one month of feeding trial. Hence the cost of the soup mix should be affordable.

The moringa enriched soup mixes can be marketed and the formulation is applicable for the development of other instant soup mixes. Instead of soup mixes moringa based other nutritious instant mixes also can develop as a future line of work.

Fig. 7. Change in clinical symptoms of experimental group before and after supplementation

5.6. IMPACT EVALUATION OF FEEDING TRIAL

Children form significant part of our population and the assessment of their nutritional status is relevant as healthy children are a pre-requisite to healthy adult life and healthy future generation. The solution for the problem of children malnutrition therefore lies in supplementation; the process of getting the children gradually accustomed to the full adult diet Dube *et al*. (2006).

In a supplementary feeding, protective foods of animal origin such as milk, meat, fish and egg are expensive and beyond the reach of common man. Hence the child malnutrition can be solved by the judicious use of inexpensive local foods.

The present study is also an endeavour to introduce a moringa based supplementary food, which satisfies the requirements of soup mix, in the child's diet. The supplementary feed is found to be with the derived characteristics of high nutrient density, low bulk property low cost and locally available.

The feeding trial was conducted for 60 days on thirty children, fifteen males and fifteen females. The moringa based supplementary food (15 grams) was fed to the thirty children who formed experimental group for six days in a week. Majority of the children were found to be very regular in attending the feeding programme. Dahiya *et al*. (2008) have revealed that adequate supplementary feeding started at the appropriate month providing required calories, vitamins and minerals promoted growth in normal children.

So in the present study, regular measurement of growth was ensured by ascertaining the variation in anthropometric measurements such as weight, height,

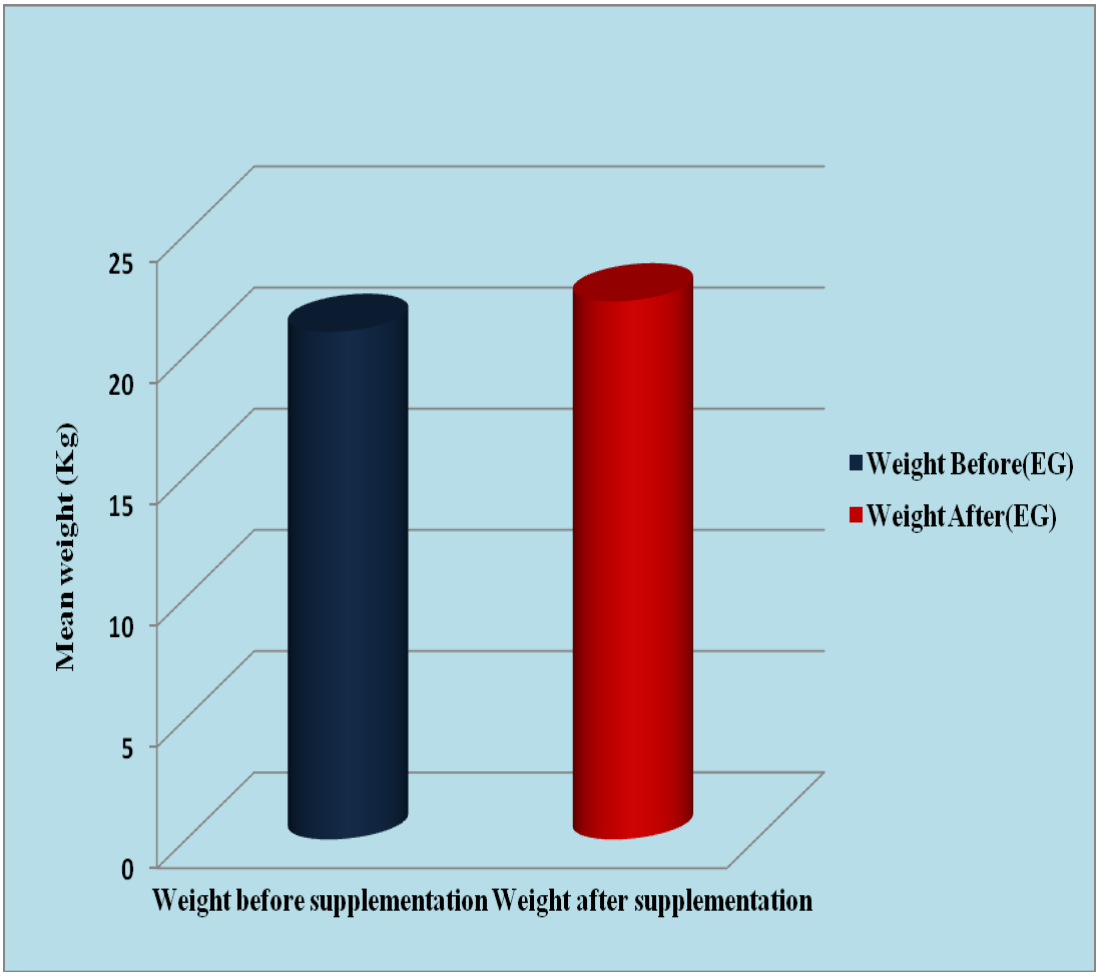

Fig. 3. Weight of experimental group before and after supplementation

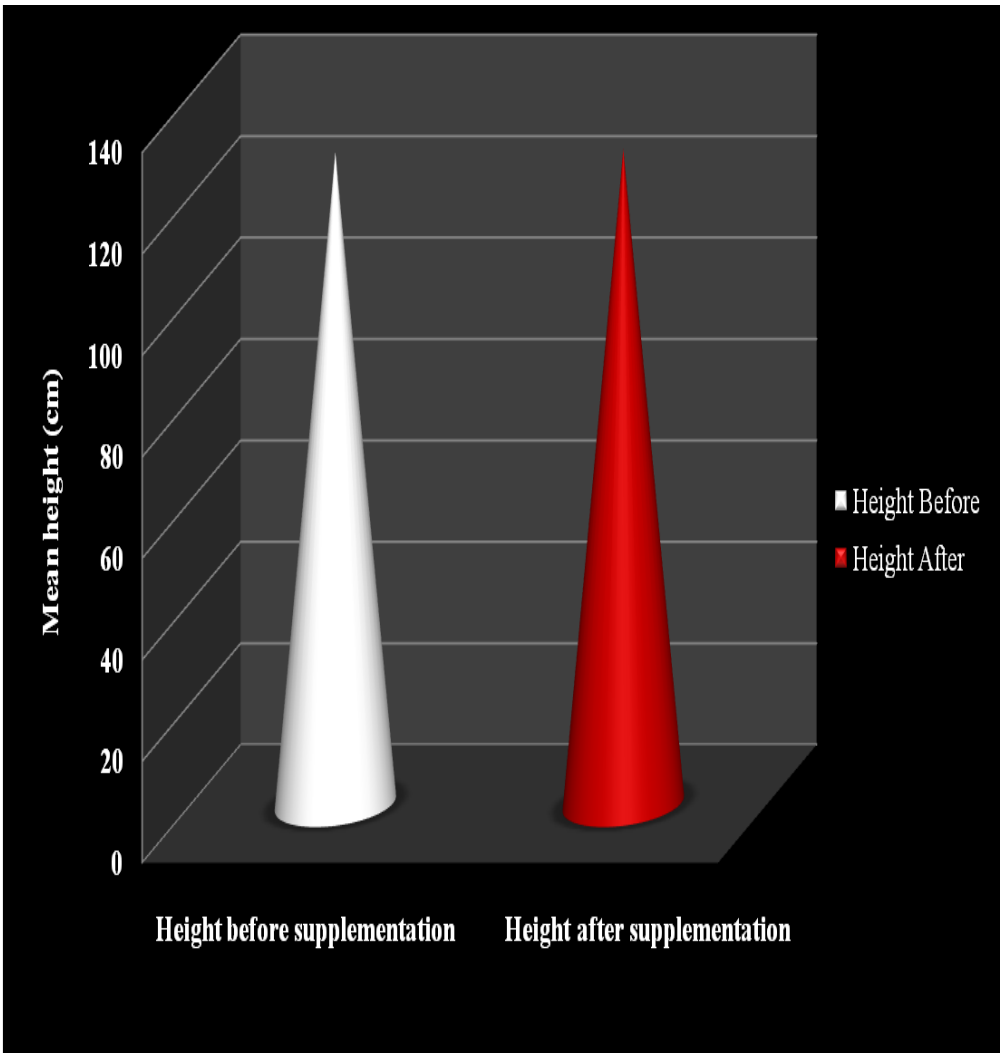

Fig. 4. Height of experimental group before and after supplementation

and mid arm circumference. Nutritional anthropometry is the measurement of the human body at various ages and it is based on the concept that on appropriate amount should reflect any morphological variation due to significant functional and physiological change Rao (1996). Anthropometric measurements viz, height, weight, mid upper arm circumference (MUAC) were taken in to account for assessing the nutritional status of the respondents.

When the weights of the respondents were assessed , it was seen that 10 per cent of boys and 13.3 per cent of girls in EG and 23.3 per cent of boys and 20 per cent of girls in CG in the age group 7-9 years were normal. Weight for age is generally considered as an indicator of nutritional status Khader (2004). Here, the weights were some what low for boys in the EG. Weight for age was found to be better for the girls compared to boys. According to Christakis (2002) deviations in weight for age are considered to be the most sensitive indicators of a child's growth performance and nutritional status. By the end of 60 days there was a significant increase in the weight before and after supplementation in EG and no significant difference was found in control group (Figure 3).

The height of an individual is said to be a reflection of past nutritional status or a long term consequence of nutrition. Nandha (2000) stated that height or total body length is influenced by heredity apart from nutritional and other environmental factors. Here the heights when studied before supplementation showed that 12 per cent boys and 10 per cent girls in EG and 15 per cent boys and 13 per cent girls in CG were having normal height. So majority of the respondents can be considered as having height above normal which may be a reflection of their past nutritional status. Similarly an assessment of height for age after supplementation also revealed similar trends with slight variation. In the case of control group, no significant increase was found after three months (Figure 4).

Measurements of mid upper arm circumference of the respondents of 7-9 years when assessed showed that with regard to EG, 93per cent of the boys had normal MUAC while cent per cent of boys had normal MUAC in CG before the feeding trial. Data on initial and final assessment further strengthens the point that

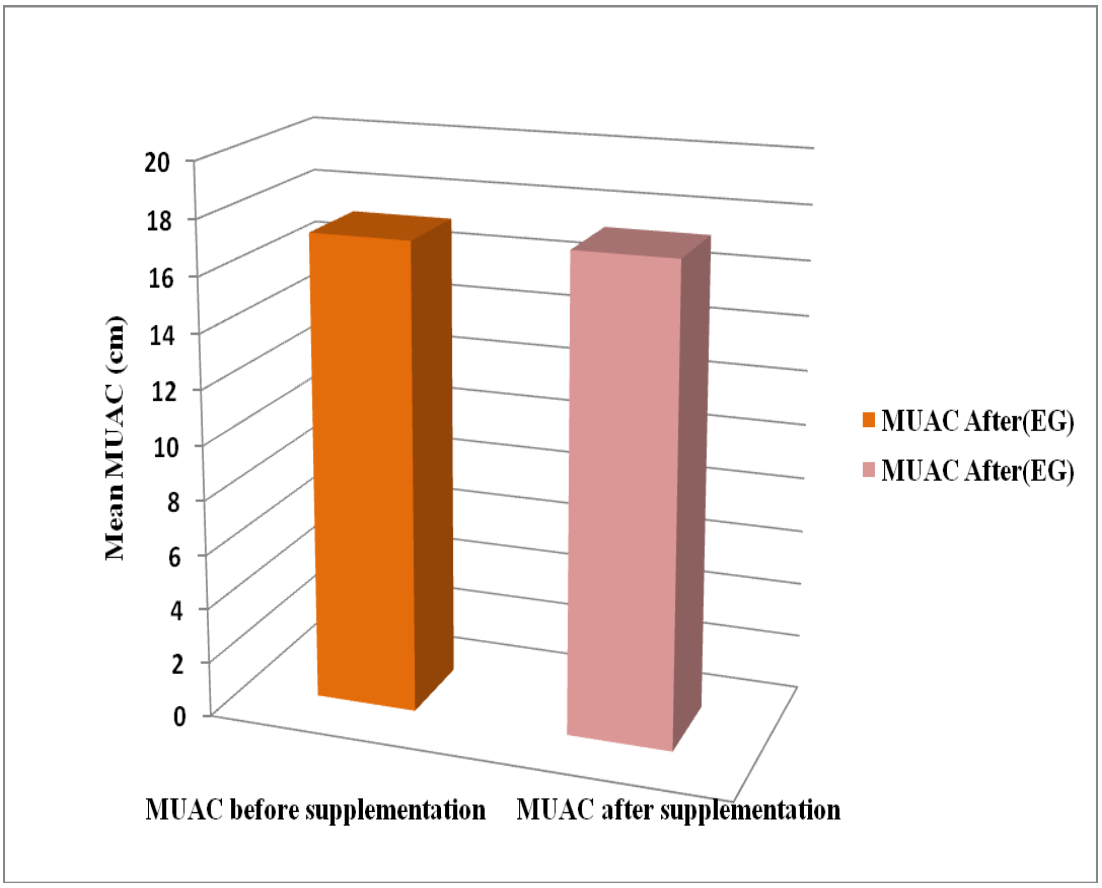

Fig. 5. MUAC of experimental group before and after supplementation

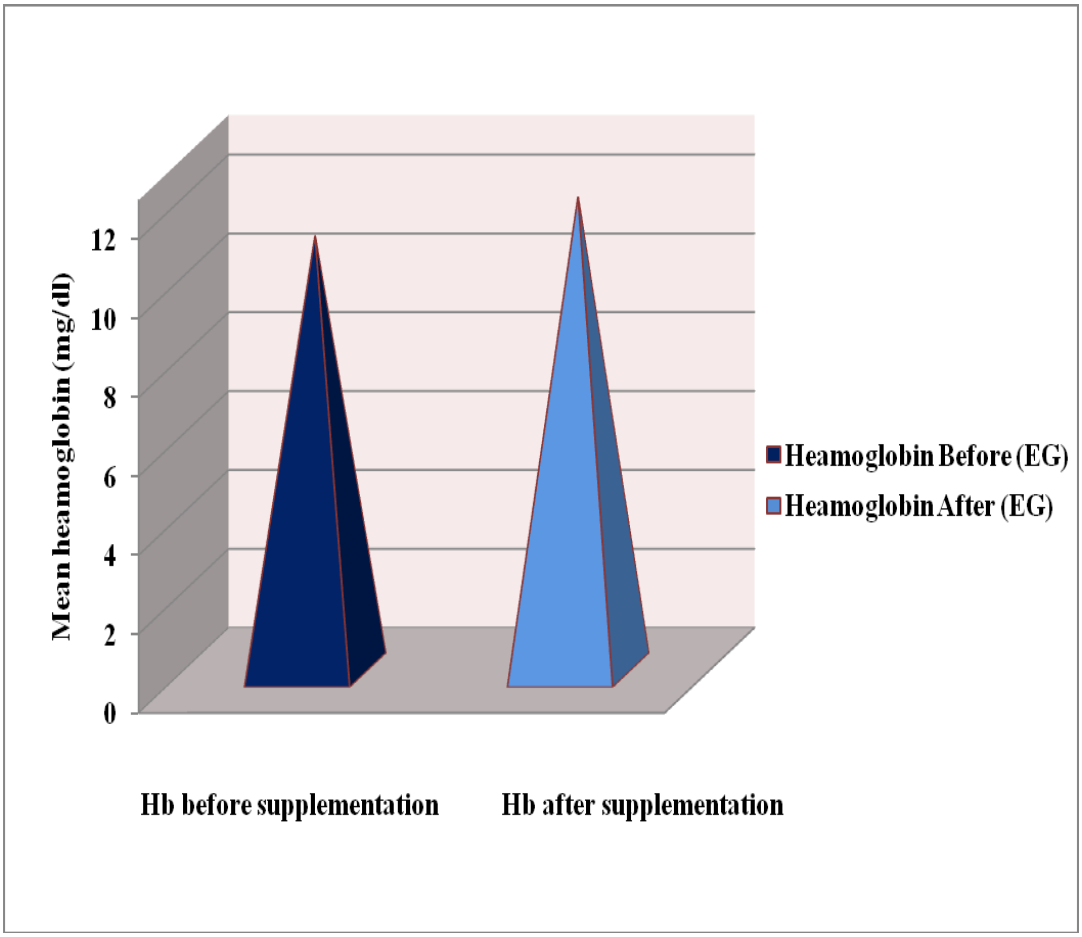

Fig. 6. Heamoglobin of experimental group before and after supplementation

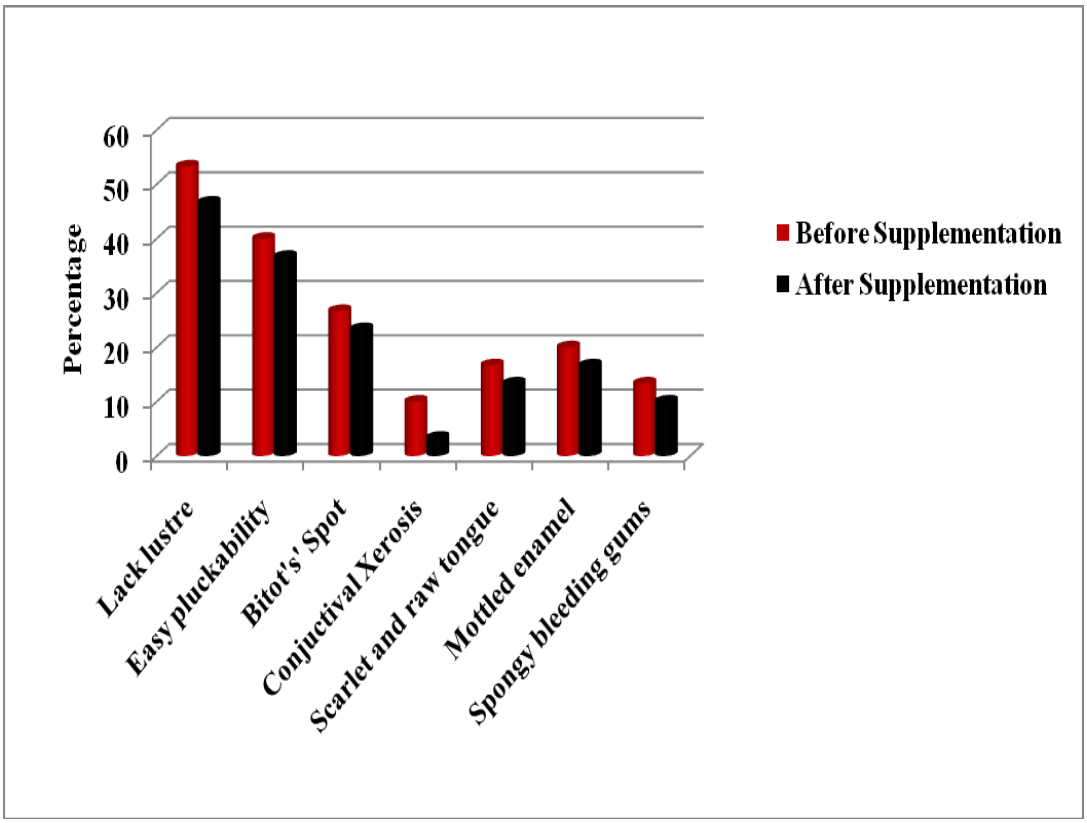

Fig7. Change in clinical symptoms of experimental group before and after supplementation

infant who are mildly malnourished in the beginning of experiment became normal on completion of the experiment (Figure 5).

When haemoglobin of the respondents were assessed , it was seen that 50 per cent were mildly anaemic, 50 per cent were in the non-marginal category in the EG and in the case of CG cent per cent of the respondents were mildly anaemic. By the end of two months there was a significant difference in the haemoglobin before and after supplementation in EG and no significant difference was found in control group (Figure 6).

According to Gopaldas (2005), a well accepted procedure for evaluating the impact of supplementary feeding is to measure absolute weight gains and significant growth differences in the intervened controls. In the present study there was significant increase in all anthropometric measurements except mid upper arm circumference.

A comparison of the morbidity status of the children of the two groups had also depicted lowest number of episodes among the children belonging to the experimental group. The clinical symptoms related to vitamin A deficiency were detected among the two groups in the beginning of the experiment. Clinical assessment conducted throughout the experiment period revealed a remarkable reduction in the morbidity state of the children. The present study revealed that after two months of supplementation there was decrease in the clinical symptoms of the respondents in experimental group and no progress was found in control group (Figure 7).

Summary

6. SUMMARY

The present study entitled **"**Impact of drumstick (*Moringa oleifera* Lam.) supplement on the nutritional status of school children" was conducted with the objective to study the impact of drumstick (*Moringa oleifera* Lam.) on the nutritional status of the primary school children in the coastal areas of Alappuzha district. A government school in Chennavely in Mararikulam sea coast of Alappuzha district was chosen for the study. Thirty primary school children in the age group of 7 to 9 years belonging to BPL families were selected purposively as the experimental group. Twenty children with the same socio-economic profile were identified as control group for the study. The conduct of the supplementary feeding in the school was studied with the help of head master and teachers so as to gain insight into the general quality of the programme's implementation and also for the inclusion of green leafy vegetables in the supplementary feeding programme. Data regarding socio-economic and personal characteristics of the respondents, frequency use of green leafy vegetables in their daily diet and dietary habits were collected. Assessment of nutritional profile and general health status of the respondents were also done.

Results of the socio-economic and personal survey showed that majority of the respondents (43 %) belonged to the age group nine years, 40 per cent of the respondents belonged to the age group 7 years and 17 per cent constituted those in the age group 7 years in the EG group. Whereas, in the CG, majority of the respondents (60 %) belonged to the age group eight years, 20 per cent of the respondents belonged to the age group seven and nine years. The religion wise distribution of the respondents revealed that majority (77 %) of the respondents in the EG belonged to the Christian community and 23 per cent belonged to Hindu community and in the case of CG 60 per cent were from Christian community and in EG 40 per cent were from Hindu community. While analyzing the family type majority of the respondents in the EG belonged to joint family (57 per cent) and in CG, 45 per cent belonged to joint family. 43 per cent of the respondents in the EG and 55 per cent of the respondents in the CG belonged to nuclear family.

Regarding the sibling size, in the EG 60 per cent of the respondents belonged to category with one sibling in the case of CG it was 40 per cent. 30 per cent of the respondents in the EG and 45 per cent of the respondents in the CG belonged to category with two siblings. In the EG 10 per cent of the respondents belonged to category with four siblings, where as in CG it is 15 per cent.

Analyzing the socio-economic characteristics a considerable percentage ie, 90 per cent of the respondents in the EG had a monthly income within the range of Rs < 1000 ; and in the case of CG it was 10 per cent. Ninety five per cent of the respondents in the EG and 5 per cent of the respondents in the CG had a monthly income within the range of Rs 1001- 5,000. While analyzing mass media exposure, television was watched by 83 per cent in EG and 90 per cent of respondents in CG. Radio was listened by 70 per cent in EG and 20 per cent of respondents in CG. On daily basis, newspapers were read daily by 93 per cent of respondents in EG and 95 per cent respondents in CG and computer was used by all of the respondents in both EG and CG. With respect to social participation majority of the participant's parents (72 per cent) functioned as members, while only 3 per cent functioned as office bearers of social organizations, and 25 per cent did not have membership in any of the social organizations.

Regarding educational status of respondents mother's, it was found that 27 per cent in EG and 30 per cent in CG had studied up to upper primary. Forty seven per cent in EG and 50 per cent in CG had studied up to High school. Thirteen per cent in EG and 15 per cent in CG had studied up to pre-degree. Ten per cent in EG and five per cent in CG had studied up to degree and three per cent of respondents in EG had studied up to PG level.

Dietary habits of the respondents indicated that all of the respondents were non- vegetarians. It was revealed that 43 per cent and 40 per cent of the respondents took home food in EG and CG respectively. Thirty per cent respondents in EG and 20 per cent respondents in CG were found to dine outside, and 27 per cent of therespondents from EG and eight per cent respondents from CG were found to prefer eating outside and home food. It was observed that majority of the respondents in EG (36.6 per cent) were choosy in food, (46.7 per cent) of the

respondents skip their meals and 17 per cent of the respondent were having the habit of nibbling. In the case of CG majority of the respondents (40 per cent) were having the habit of skipping their meals, 30 per cent were choosy in foods and 15 per cent were having the habit of nibbling. Dietary habits (skipping meals) of the respondents indicated that majority of respondents in EG (43 per cent) skip their breakfast and three per cent skip their lunch and in CG (40 per cent) respondents skip their breakfast and five per cent skip their supper.

Distribution of respondents based on dislike towards food revealed that in EG (36.6 per cent) disliked milk, 16.6 per cent disliked green leafy vegetables, 23.3 per cent disliked vegetables, 20 per cent disliked egg and 6.6 per cent each disliked bakery foods and meat. In CG majority of the respondents (70 per cent) disliked vegetables, 20 per cent disliked green leafy vegetables, 15 per cent disliked milk and 10 per cent of the respondents disliked pulses. The study on frequency of green leafy vegetables revealed that all of the respondents used curry leaves daily 40 per cent in EG and 30 per cent of respondents from CG consumed coriander leaves weekly. Amaranth and drumstick leaves was found to be consumed only by 43 per cent, and 23 per cent of respondents in EG and 85 per cent and 40 per cent respondents in CG respectively on weekly basis.

A nutrition education programme was planned and conducted both for EG and CG. The impact of nutrition education was assessed after three months. The results showed that after the intervention consumption of all the leafy vegetables increased. The frequency score revealed that there was progress in the consumption of leafy vegetables both in experimental and control group.

Assessment of nutritional profile and general health status revealed that after three months of supplementation there was a significant difference in the weight before supplementation and weight after supplementation in the experimental group. In the case of height even though there was a slight increase in the mean height before and after the study, it was not that satisfactory. In case of the MUAC of the respondents, there was difference in the MUAC before supplementation and after supplementation. Results of haemoglobin

level showed that after three months of supplementation there was significant difference in the haemoglobin level of the respondents before and after supplementation. There was no significant difference found in weight, height, MUAC and haemoglobin in control group during this period.

Regarding the clinical symptoms it was seen that there was a decrease in the clinical symptoms of the respondents in the EG after three months of supplementation and no change was seen in CG.

There was a significant improvement among the EG after three months of supplementation. Hence a long term implementation of this supplementary feed will help to improve nutritional status of children.

Based on the study, following recommendations are put forward,

- The supplementary feed can be considered as a provision of extra food to children beyond the normal ration of their home diets, and can take place in the home, feeding centre's, health care centre's and schools.
- Incorporation of moringa soup powder as one of the food supplement in the mid day meal programme with the active support of kudumbasree units.
- ICDS scheme of India aims at the improvement in the nutritional status of the school children and is an ideal platform to introduce Dehydrated Drumstick Leaves into the diets of this target group as a nutritional intervention.

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Appendices

APPENDIX I

INTERVIEW SCHEDULE USED TO ASSSESS PERSONAL INFORMATION OF THE RESPONDENT

1. Name of the respondent:
2. Address:
3. Age:
4. Class:
5. Religion:
6. Caste:
7. Type of family:
8. Family size:
9. Family composition:

Sl no:	Name of family members	Age	Sex	Relationship with the respondent	Education	Occupation	Monthly income

10. Do you receive any food supplements through the organization?

    Yes/ No

11. If yes, which organization do you give and how much?

12. Do you receive any medical supplements through the organization?

Yes/No

If yes, give details.

13. Do you receive IFA tablets?

14. How often you receive the tablets?

Daily/ Weekly/ Once in a fortnight/ Monthly/ Occasionally/ Never

15. Do you consume the tablets regularly?

Yes/ No

16. Do you participate in any of the educational programme through these organization?

17. Does your family have social participation?

18. How often?

Always/ Sometimes/ Never

19. Do you make use of mass media? If yes specify.

APPENDIX II

INTERVIEW TO ELICIT INFORMATION IN DIETARY HABITS AND FOOD CONSUMPTION PATTERN

A. FOOD HABITS

1. Vegetarian/ Non vegetarian?

2. Are you a good eater?

   Yes/ No

3. Are you very fussy in eating?

   Yes/ No

4. Do you have the habit of nibbling?

   Yes/ No

5. Are you choosy in your food?

   Yes/ No

6. What is your opinion on dieting?

   Yes/ No

7. Do you skip any meal?

   Yes/ No

   a) if yes, which meal?

   Breakfast/Lunch/ Evening tea/ Supper

   b) why?

8. Which meal do you believe that must be consumed in greater amount? why?

   Breakfast/Lunch/ Evening tea/ Supper

9. Which food you dislike most? Specify?

10. What do you prefer?

    Home food/ Eating outside/ Both

B. Frequency of using different fixed items

Food items	Daily	Weekly	Monthly	Once in a week	Fortnightly	Occasionally	Rarely	Never
<u>Cereals</u> Parboiled rice Wheat flour Rice flakes Ragi								
<u>Pulses</u> Black gram dhal Bengal gram Green gram Sprouted pulses								
<u>Leafy vegetables</u> Amaranthus Coriander leaves Drumstick leaves Curry leaves								

Food items	Daily	Weekly	Monthly	Once in a week	Fortnightly	Occasionally	Rarely	Never
<u>Other vegetables</u> Cucumber Ladies finger Plantain green Brinjal Tomato								
<u>Roots & Tubers</u> Onion big Carrot Beetroot Potato Tapioca								
<u>Fruits</u> Mango (ripe) Pineapple Orange Jackfruit Amla Guava Pappaya								

Food items	Daily	Weekly	Monthly	Once in a week	Fortnightly	Occasionally	Rarely	Never
Nuts &oil seeds Ground nut Coconut								
Animal foods Egg Meat Fish Milk								
Others								
Jaggery								
Tea/ Coffe								

C. Daily meal pattern of the respondents

Foods	Time
Breakfast	
Lunch	
Tea time	
Dinner	

2. Do you consume leftover food?

Yes/ No

3. Do you consume any special foods during different stages of the life cycle?(if yes?) Infancy/ Preschool/ School going/ Others

APPENDIX III

INTERVIEW SCHEDULE TO ELICIT INFORMATION ON SOCIO-ECONOMIC AND DOMESTIC ENVIRONMENT FROM THE RESPONDENT

A1. Personal and economical details

1.1 Name of the child:
1.2 Sex:
1.3 Class:
1.4 Division:
1.5 Name of school:
1.6 Place of school:
1.7 Date of birth:
1.8 Age: Year Month
1.9 Religion: Hindu/ Muslim/ Christian
1.10 Caste: General/ OBC/ SC/ ST
1.11 Community:
1.12 Place of residence:
Rural/ Urban/ Sub urban
1.13 Native place:
1.14 Mother tongue of the child:

A2. Family details

1.1 Family type
Nuclear/ Joint/ Extended
1.2 Family size: ☐ ☐ ☐ ☐

1.3 No. of siblings:

1	2	3	4	5	6

1.4 Ordinal position: First/ Middle/ Last

1.5 Order of birth

1th	2nd	3rd	4th	5th	6th

B. Health and nutritional assessment

B.1 Birth history

1.1 Birth weight (Kg)-

1.2 Birth length (cm)-

1.3 Type of delivery- Normal/ Caesarian/ Forceps/ Vaccum

1.4 Birth term- Normal/ Pre mature/ Post mature

B.2 Health assessment

2.1 General health: Normal/ Underweight/ Obese/ Handicapped

Specify if any other

2.2 Immunization taken

Vaccine	Yes/ No	Age
HBY		
BCG		
DPT		
Measles vaccine		
MMR		
Hepatitis vaccine		

2.3 Record of illness the child had

Disease	Age	Duration	Complication	treatment	Any other effects
Mealses Mumps Diarrhoea Dysentery Jaundice Worn Infestation Serious illness if any Accidents Operations					

APPENDIX IV

SCHEDULE TO ASSESS ANTHROPOMETRIC BIOCHEMICAL AND CLINICAL ASSESSMENT OF THE RESPONDENTS

1. A. Anthropometric measurements

Weight (Kg)-

Height (cm)-

Body mass index-

MUAC -

B. Biochemical estimation

Heamoglobin

Bp

C. Clinical symptoms

Symptoms	Severe	Moderate	Mild	Nill
1. Hair a) Lacklusture b) Dispigmentation c) Easy plukability				
2. Face a)Moon face b) Odema				
3. lips a) Angular stomatitis b) Chelosis				
4. Eyes a) Bitot's spot b)Conjuctival xerosis c)Keratomalacia				
5. Tongue a) Oedma b)Scarlet and raw				

tongue c)Mangenta tongue d)Atropic papillae				
6. Teeth a)mottled enamel				
7. Glands a)Thyroid enlargement b)parathyroid enlargement				
8. Skin a)Sclerosis b)Pellagrous dermatitis c)Gazy pavement dermatitis d) Scrotal dermatitis				
9. Gums a)Spongy bleeding				
10. General a) Anaemia b) Beading of ribs c)Enlargement of spleen d) Enlargements of liver				

Abstract

IMPACT OF DRUMSTICK (*Moringa oleifera* Lam.) SUPPLEMENT ON NUTRITIONAL STATUS OF SCHOOL CHILDREN

by

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THESIS

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ABSTRACT

The study entitled "Impact of drumstick (*Moringa oleifera* Lam.) supplement on the nutritional status of school children" was conducted at the Department of Home Science, College of Agriculture, Vellayani, during the year 2012-2014. The major objective was to study the impact of drumstick (*Moringa oleifera* Lam.) on the nutritional status of primary school children.

The study was conducted at St. Antony's school of Mararikulam Panchayath in the coastal area of Alappuzha district. The survey was conducted among 300 children of the age group 7- 9 years. Clinical assistance from the physician of Alappuzha medical college was aided in conducting medical camp to screen fifty children with low nutritional status in the age group of 7-9 years. The children were divided into experimental and control group of 30 and 20 respondents respectively. Moringa soup supplement which was formulated by Saranya (2012) in the Department of Home Science and provided at the rate of 15g/child/day to experimental group for sixty days for impact study.

The findings of the socio-economic survey, revealed that majority of respondents belonged to the age group 8 years.

Dietary surveys revealed an absolutely ill balanced diet with an uniform pattern comprising of rice and fish. All the respondents were non- vegetarians and fish was the main non-vegetarian food in the diet. However consumption of vegetables, green leafy vegetables, pulses, egg and milk products were less.

Nutritional status revealed that 66.6 per cent children were below the standard weight and 50 per cent children were below the standard height for their age. Clinical examination after feeding trial indicated that there was decrease in the number of children suffered from lack of hair lustre by 46.62 per cent, dispigmentation by 28 per cent and easy pluckable hair by 33.3 per cent and vitamin A deficiency also decreased to 28.99 per cent. Data on height for age profile, weight for age, mid upper arm circumference ratio, blood haemoglobin and clinical record indicated favourable progress in the case of children belonging to experimental group. Meanwhile in the control group there was no variation. An assessment of anthropometric measurements of the children of

experimental group indicated a significant increase when compared with the control group.

Hence, it can be concluded that the *Moringa oleifera* based supplementary food tried in the above feeding trial is found to be a suitable one for popularizing as a supplementary food for the children and it is recommended to provide in the mid-day meal programme for improving their health status.