INFLUENCE OF AMLA (*Emblica officinalis* Gaertn.) PRODUCTS ON THE NUTRITIONAL AND HEALTH STATUS OF SOS CHILDREN IN THRISSUR DISTRICT

By

JISSY GEORGE

THESIS

Submitted in partial fulfilment of the requirement for the degree of

Master of Science in Home Science

Faculty of Agriculture

Kerala Agricultural University

DEPARTMENT OF HOME SCIENCE

COLLEGE OF HORTICULTURE

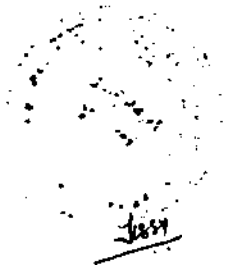
VELLANIKKARA, THRISSUR - 680 656

KERALA, INDIA

2000

DECLARATION

I hereby declare that this thesis entitled **"Influence of amla (*Emblica officinalis* Gaertn.) products on the nutritional and health status of SOS children in Thrissur District"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.



Vellanikkara
21-7-2000

JISSY GEORGE

CERTIFICATE

Certified that this thesis, entitled "**Influence of amla (*Emblica officinalis* Gaertn.) products on the nutritional and health status of SOS children in Thrissur District**" is a record of research work done independently by **Ms.Jissy George,** 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.

V. Indira

Dr.V.Indira
Chairperson
Associate Professor & Head
Department of Home Science
College of Horticulture
Vellanikkara

Vellanikkara
21-7-2000

CERTIFICATE

We, the undersigned members of the Advisory Committee of **Ms.Jissy George,** a candidate for the degree of **Master of Science in Home Science,** with major in **Food Science and Nutrition,** agree that the thesis entitled "**Influence of amla (*Emblica officinalis* Gaertn.) products on the nutritional and health status of SOS children in Thrissur District"** may be submitted by Ms.Jissy George, in partial fulfilment of the requirement for the degree.

Dr.V.INDIRA
(Chairperson , Advisory Committee)
Associate Professor & Head
Department of Home Science
College of Horticulture
Vellanikkara

Dr.V.USHA
Associate Professor
Department of Home Science
College of Horticulture
Vellanikkara
(Member)

Dr.A.AUGUSTIN
Associate Professor (Biochemistry)
AICRP on M&AP
College of Horticulture
Vellanikkara
(Member)

Smt. OMANA PAVUNNY
Assistant Professor
Department of Home Science
College of Horticulture
Vellanikkara
(Member)

24/10/2000
EXTERNAL EXAMINER
Dr. D. MALATHI

ACKNOWLEDGEMENT

I bow my head and bend my knees before my LORD my GOD, who is my refuge and strength, a very present help in trouble. HIS incessant blessings, everlasting guidance, loving kindness and tender mercies has enabled me to complete this work.

With deep sense of gratitude and indebtedness, I express my sincere thanks to ***Dr.V.Indira****, Associate Professor and Head, Department of Home Science and Chairperson of my advisory committee for her everwilling help, painstaking corrections and keen criticism during the course of the present work, without which it would have been very difficult on my part to prepare this thesis.*

I express my sincere gratitude to ***Smt.Norma Xavier.C.****, Assistant Professor, Department of Home Science and former Chairperson of my advisory committee for suggesting me the problem and her valuable guidance, unfailing support and being a constant source of encouragement.*

I am extremely grateful to ***Dr.V.Usha****, Associate Professor, Department of Home Science and member of my advisory committee for her memorable help and timely suggestions in the completion of the thesis.*

I extend my gratitude to ***Dr.A.Augustin****, Associate Professor, AICRP on Medicinal and Aromatic Plants for his keen interest, valuable suggestions and critical evaluation helped me in the completion of this work.*

I express my gratitude to Smt.Omana Pavunny, Assistant Professor, Department of Home Science and member of my advisory committee for her critical evaluation of the thesis work.

I am extremely grateful to Smt.Graciamma Kurian, Assistant Professor, Department of Agricultural Statistics for her valuable suggestions in the analysis and interpretation of the data.

I extend my sincere thanks to Dr.V.George Mathew, Professor, Department of Psychology, Kerala University for providing me with materials for conducting behaviour test and helping me in the interpretation of the data.

My special thanks are due to the little children, mothers and officials of SOS village who spared their valuable time without any hesitation for my study. The help rendered by the SOS officials to carryout the behavioural test and in the collection of the data are gratefully acknowledged.

My sincere thanks are due to Sri.Joy and J.M.J. Computer Centre, Thottappady for their timely help in the neat typing of my manuscript.

The help rendered by Smt.Joice T. John to carryout the statistical analysis is thankfully acknowledged.

It is with immense pleasure that I thank all my school teachers, friends, classmates, seniors and juniors for their blessings, prayers, encouragement and timely help in different stages of my research work.

With immense happiness that I thank my neighbours, relatives, especially Molly aunty, Dr.Gilbert P. Paul and my late grandmas for their blessings, prayers, advices and helps during critical stages of my study.

My heartfelt gratitude to my Mummy, Pappa, my loving sister and her family, my loving brothers Sajan and Basil for their prayers, encouragement, blessings, patience and understanding throughout the period of my study without which this thesis work would have been a dream.

Once again I thank all my teachers who taught me and blessed me.

JISSY GEORGE

Dedicated to

undernourished and orphan children of the World

CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

INTRODUCTION

Malnutrition among children is a serious problem in developing countries. A child who has failed to grow during this crucial and dynamic period of growth may not make up the loss in growth even with an excellent diet in later periods of life. Hence, adequate nutrition during this most vulnerable and growing period is very important (UNICEF, 1990 and Verma *et al.*, 1996).

Generally, malnutrition is more pronounced during the preschool (Dube, 1998) and school age children (Owolabi *et al.*, 1996). Among the various nutritional problems prevalent among children, protein energy malnutrition is more pronounced. Various studies conducted in India indicated prevalence of micro nutrient deficiencies also among children.

To tackle the problem of malnutrition among children, various nutrition intervention strategies have been formulated and implemented in India and supplementary feeding programme being an important one among them.

Ascorbic acid, one of the important water soluble vitamins, beyond its role in collagen formation, is known to increase the absorption of inorganic iron, influences the metabolism of folic acid, some amino acids and hormones and also acts as an antioxidant (Gershoff, 1993).

Among the different fruits cultivated in India, amla is a rich natural source of ascorbic acid which is well preserved during processing (Srivastava, 1984). Apart from ascorbic acid it also contains pectin, alkaloids and flavanoids and has got various medicinal properties (Kurup and Ramadas, 1980).

SOS (Save Our Souls) village programme serves as a milestone in serving orphan children with the basic principle of setting up of family norms. It shares the joy and sorrow of living together and provides a stable nurturing family life for children.

Hence the present study was undertaken with the main objective of assessing the influence of amla products on the nutritional and health status of SOS children in Thrissur District.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

The literature pertaining to the study on the influence of amla (*Emblica officinalis* Gaertn) products on the nutritional and the health status of SOS children in Thrissur District has been reviewed under the following subheadings.

2.1 Importance of amla

2.2 Culinary uses and storage properties of amla

2.3 Role of Vitamin C in the health, nutritional status and behaviour of the individuals

2.4 Significance of childhood nutrition

2.1 Importance of amla

Amla (*Emblica officinalis* Guertn.) belongs to the family Euphorbiaceae. The amla tree is a native of tropical South Eastern Asia particularly Central and Southern India (Morton, 1990).

Amla is astringent, bitter, digestive, aphrodisiac, laxative, diuretic and a tonic fruit. It cures diseases due to morbid, 'vata', 'pitta' and 'kapha' and is especially good for the abundant growth of hair. It also cures thirst, burning sensation, vomiting, diabetes, emaciation, anorexia, toxicosis, fever, impurity of blood and haemorrhage. It is effective in cough, inflammation of eyes, jaundice and leucorrhoea (Kurup and Ramadas, 1980).

Amla fruit is valued high among indigenous medicines in India. Fruit is acrid, refrigerant, diuretic and laxative. Dried fruits have been reported to be useful in haemorrhages, diarrhoea, dysentry, anaemia, jaundice, dyspepsia and cough. Dried Amla is primarily used to prepare a well known indigenous medicine namely Triphala. Chyavanaprash is another commonly used amla fruit preparation for growth, vigour and general upkeep of human health. Some organic acids and

phenolic substances of amla fruit were also found to be useful as drugs (Pillai and Rao, 1987).

Swayamprakash (1991) reported that two main texts of Ayurveda viz., 'Charaka Samhita' and 'Sushruta Samhita', written around 1500 BC mentioned the use of amla. According to the author iron powder processed along with amla has been found to be useful to cure pandu (anaemia). 'Vegbhata', a 4th century AD author of 'Ashtangahridaya' considered iron and 'amla' as the best among drugs for anaemia.

A comparative evaluation of Dhatriygadiyoga and tablets like Rdeplex, Osteocalcium and Promlon was carried out by Dwivedi and Tewari (1991) among pregnant women. The results indicated that Dhatriyadiyoga maintained optimum level of haemoglobin and serum protein. The drug is as effective as modern medicine and is much cheaper.

Suresh (1994) suggested that Navagara Louha an iron containing amla drug is effective to reduce the signs and symptoms of anaemia.

Chawla *et al.* (1987) and Singh and Singh (1987) suggested that herbal preparation of amla is useful for the treatment of non-ulcer dyspepsia and peptic ulcer. These preparations are not only safe but also possess additional beneficial effect on body system. According to Chawla *et al.* (1987) the medicine is also useful against the conventional antacids.

Thripathi and Shaw (1992) suggested that decoction of dried 'amla' is very effective in the treatment of acidity.

Sharma *et al.* (1993) recommended the seed powder of amla as useful medicine in the treatment of 'amlapitta' or acidity of the gastrointestinal tract.

Thakur and Mandal (1984) studied the cholesterol induced hyper cholesterolaemia and atherosclerosis with *Emblica officinalis* fruit. The results indicated that the extracts of amla reduced the serum cholesterol level significantly and had a significant antiatherogenic effect.

Zacharia (1984) conducted experiments with water extracts of amla in the treatment of hyperlipidimia and observed positive results in majority of the subjects.

Mund and Soni (1992) studied the effect of feeding amla to the hypercholesterolemic rabbits for 12 weeks and showed an increase in the lipid mobilization and catabolism and a decrease in the deposition of lipids in the extra hepatic tissues. There was a significant reduction in the lipid levels of liver.

Mathur *et al.* (1996) conducted animal studies by administering *Emblica officinalis* juice for 60 days and revealed a reduction of serum cholesterol, triglycerides, phospholipid and low density lipoprotien (LDL)levels. There was an increase in the excretion of cholesterol and phospholipids, in the animals fed with *Emblica officinalis* juice.

Dwivedi *et al.* (1994) reported that *Emblica officinalis* has got hypotensive activity and is very important in lowering the blood pressure.

A comparative evaluation of aqueous extract of amla fruit and synthetic ascorbic acid equivalent in amla fruit was conducted by Roy *et al.* (1992) to study their hepatotoxic and renotoxic effect on toxic metals like lead and aluminium in albino rats. Histopathological observations indicated that amla fruit extract is more effective than synthetic ascorbic acid to counteract the toxic effect of metals like aluminium and lead.

Ghosh and Sharma (1993) had studied the protective effect afforded by a crude extract of *Emblica officinalis* fruit and an equivalent amount of synthetic

ascorbic acid against the cytotoxic effects of cesium chloride in mice. The results indicated that the crude aqueous extract of *Emblica officinalis* is more effective than vitamin C alone.

Jose and Kuttan (1995) reported that aqueous extract of *Emblica officinalis* is a potent inhibitor in the formation of lipid peroxides and scavenger of hydroxyl and super oxide radicals *in vitro*. An indegenous drug preparation 'chyavanaprasa' containing 63 per cent *Embilica officinalis*, used as a health tonic also had potent antioxidant activity.

Kuttan *et al.* (1996) reported that both the extracts of *Emblica officinalis* and 'chyavanaprasa' are effective inhibiting oxygen free radicals.

Sankaranarayanan and Jolly (1993) reported hypoglycaemic activity of the extract of Emblica officinalis. Bombarde (1995) also reported the beneficial effect of the *Emblica officinalis* in the treatment of diabetes in pregnant women and nursing mothers.

Kulkarni (1992) studied the effect of administering the drug prepared from a mixture of *Emblica officinalis, P. longum, T. chebula* and *T. beleria* and reported a significant reduction in the body weight of obese subjects.

Sharma *et al.* (1991) reported the efficacy of the Ayurvedic recipe 'Madhugashtyadi' syrup prepared with *Emblica officinalis, Abutilon indicus* and *Acorus calamus* in the prevention of upper respiratory tract infection in children. The results indicated significant reduction in the symptoms as well as frequency and duration of upper respiratory tract infection.

Paul and Madan (1992) conducted a controlled study with a herbal eye drop preparation consisting of *Vitex negundo, Emblica officinalis, Rosa damascena, T. chebula* and *T. belerica* in different types of corneal ulcer cases. The patients

who received the conventional mydriatics antibiotics along with herbal preparations recovered fast than those who received only the conventional therapy. The herbal preparation was free of any side effect.

Nagero (1993) conducted a study using both septilin and styplon containing plants like *Emblica officinalis*, *Raphanus sativus*, *Ruta graveolens*, *Mesua ferrea* etc. in subjects suffering from chronic gingivitis. The results indicated a reduction in the inflammation and bleeding of gum.

Date and Kulkarni (1995) reported the beneficial effect of 'Rasadanti' a medicated tooth powder consisting of *Emblica officinalis*, *Acacia arabica*, *Acacia catch*, clove oil and pudina arku used to control and prevent dental caries, spongy and bleeding gums, gingivitis etc.

Malogi and Kamatu (1995) reported the usefulness of *Thakradhara* therapy i.e., pouring specially prepared buttermilk containing *Emblica officinalis* fruit decoction in anxiety, neurosis, depressive psychosis, insomnia and hypertension.

Jayaram *et al.* (1993) reported a significant decrease in lethargy and fatigue after feeding a preparation containing extracts of *Emblica officinalis*, *Asparagus racemosus*, *Tinospora cordifolia*, *Tribulus terestris*, *Picrorrhiza kurchebula* and *Piper longum*. The author also reported a significant increase in the protein and haemoglobin level after feeding the extract.

Shaw and Ber (1993) observed clinical improvement in semen analysis in sexual debility patients after administering 'Vigorex' a herbomineral formulation comprising of mica, *Emblica officinalis*, *Withania somnifera*, *Tribulus terrestris*, *Myristica fragrans;* Asparagus and iron to adult married males aged between 25-45 years.

Indian Council of Medical Research (1997) reported that the drug prepared using herbal plants including amla was effective in the treatment of anal fistulae, filariasis, viral hepatitis, urolithiasis, diabetes mellitus and bronchial asthma.

Malhotra (1984) studied the effect of a herbal drug prepared with amla and reported that the drug is useful in patients of hepatomegaly, splenomegaly, opium poisoning, skin diseases, helminthetic infections, constipation, hyperacidity, ameobiasis, diabetes and malarial fever.

Kuttan *et al.* (1996) suggested that *Emblica officinalis* in 'chyavanaprash' inhibited the sarcoma development by 75 per cent with a subsequent increase in lifespan. The author also reported that amla products if incorporated in the daily menu of the children could reduce the incidence of malignancy and will be relevant especially in population and families with higher incidence of cancer.

2.2 Culinary uses and storage properties of amla

Srivastava (1984) and Jain and Lal (1994) pointed out that amla fruits are made into preserve (murabha), sauce, candy, dried chips, tablets, jellies, pickles, toffies, powder etc.

An easy way to prepare amla murabha with high vitamin C has been reported by Gupta and Bopaiah (1986).

Deb and Chandrasekhar (1990) reported that tannic freed extract of amla contained 1323 mg of vitamin C per 100 g of pericarp. Anon (1992) prepared amla syrup containing 119 mg vitamin C and amla concentrate containing 1000 mg vitamin C per 100 g.

Srivastava (1984) reported that the ascorbic acid and other constituents in amla are well retained after processing. According to Srivastava (1994) almost

entire vitamin C was retained in vacuum drying of amla and at least 85 per cent was retained after normal room temperature storage for 14 months. Storage losses of ascorbic acid in amla fruit can be further minimised with sulphur dioxide gas storage. Not only vitamin C but sugars, acids, starch and proteins were also preserved in dried amla fruits.

Verma and Gupta (1996) reported that *Emblica officinalis* fruits when dried in the open sun following various pre treatments like pricking, blanching, sulfication and flaking singly or in combination retained ascorbic acid to varying extent. Ascorbic acid retention after drying was highest (64%) in sliced samples and lowest (18%) in untreated controls.

Singh and Saxena (1996) reported that dried samples of amla when stored in various packing materials like (cloth, paper, polyethylene and gunny bags) for 24 months also preserved many of the constituents. The effect of gamma radiation of the samples by the authors indicated that, irradiated samples were free from mycoflora through out the study period.

Hanif (1986) reported that since amla contains gallic and ellagic acids and glucose, it prevents or retards the oxidation of vitamin C and render available antiscorbutic condition in amla products.

Jain and Lal (1994) reported that the acridity of amla can be removed completely by keeping the fruit in salt solution or tamarind or lime juice.

Since amla fruit is a richest natural source of vitamin C known to mankind (Shanker, 1989), it can be used to prepare some indigenous medicines. Jeena and Kuttan (1996) reported that *Emblica officinalis* Gaertn. is a major ingredient in 'Chyavanaprash' - an indigenous medicinal preparation in India.

2.3 The role of vitamin C in the health and nutritional status and behaviour of the individuals

Gershoff (1993) pointed out that beyond vitamin 'C's function in collagen formation, it is known to increase the absorption of inorganic iron and in the metabolism of folic acid, amino acids and hormones and act as an antioxidant.

Prasad (1975) reported that vitamin C increased the intestinal uptake and peripheral metabolism of iron.

Ascorbic acid is the best enhancer of non haem iron absorption. The mechanism by which vitamin C promotes iron availability is by reducing ferric iron to its ferric oxidation state and secondly ferric iron may form a ferrous ascorbate complex at the low pH prevailing in the stomach. This iron chelate remain stable during absorption. About 25 mg of ascorbic acid increases non-haem iron absorption three to four fold (Cook and Monsen, 1977; Lynch and cook, 1980, Clydesdale, 1981, Monson, 1988).

Ascorbic acid also improved haemoglobin erythrocyte protoporphyrism and serum iron but not haematocrit, serum ferritin iron binding capacity or transferrin saturation. In iron depleted women consuming a diet with predicted poor iron availability, ascorbic acid supplementation enhanced body iron retention for about five weeks (Hunt *et al.*, 1990).

Hallberg *et al.* (1987), Monson (1988) and Saroj *et al.* (1990) reported that if the meals contain a higher content of factors inhibiting iron absorption, a high percentage of ascorbic acid should be consumed.

According to Deehr *et al.* (1990) ascorbic acid present in orange juice consistently increased non-haeme iron absorption.

Nasolodin and Ferulev (1994) reported that metabolism of iron and copper was closely correlated to the concentration of total protein in serum and to vitamin C availability.

Vitamin C has been found to have protective power against a number of vitamins including thiamine, riboflavin, pantothenic acid, biotin, folic acid, cyanocobalamine, retinol and α tocopherol (Terroine, 1980).

In human beings it has been noted that there is an association between plasma and leucocyte vitamin C levels and folic acid concentration (Exton and Smith, 1980). It has been noted that decreased vitamin C leads to an increase in urinary folic acid excretion which can be corrected by vitamin C therapy (Booth and Todd, 1982).

Vilter (1983) suggested that vitamin C can reduce the folic acid into its biologically active form - tetrahydrofolate. During the deficiency of vitamin C the folic acid becomes unavailable to the body. This leads to an inability to synthesis sufficient nucleic acids which decreases the red cell production accompanied by the release of abnormal red cells namely magaloblasts into the circulation.

Murdock and Donaldon (1984) showed that thiamine deficient rats with an oral supplement of vitamin C had nearly normal growth rate than the thiamine deficient rats with no supplement.

Basu *et al.* (1986) demonstrated the thiamine sparing effect of vitamin C in humans and found that the ordinary excretory levels of thiamine was increased by oral supplementation with vitamin C in the individuals.

Being a strong reducing agent with a reduction potential of +0.080, vitamin C can act as a coenzyme for a number of enzymes including oxygenase, dioxygenase and hydroxylase. These enzymes carry out very important biological activities (Hayashi *et al.*, 1978).

Kuttan *et al.* (1996) pointed out the importance of vitamin C in the reaction involved in the metabolism of amino acids, hormones and folic acid.

In the conversion of proline into collagen, the hydroxylation of amino acids (proline and lysine) which requires prolyl and lysyl hydroxylase enzyme need vitamin C as a cofactor (Herness and Kodick, 1977; Gershoff, 1993).

Nambisan and Kurup (1976) and Ginter (1979) reported that vitamin C is very important in the synthesis of the components of the ground substance of connective tissue, the mucopolysaccharide and maturation of fibroblast, the cell responsible for collagen and mucopolysaccharide production.

Hughes (1980) reported that carnitine which is required for the transfer of fatty acids into cell mitochondria where they can be used for energy production also requires vitamin C.

Hurley and Jones (1980) noted that low carnitine level lead to poor energy production and muscle weakness, which are accountable for the symptoms of fatigue and lassitude during scurvy. Hulse *et al.* (1978) evidenced that vitamin C is essential for two steps in the synthesis of muscle carnitine.

Milnor (1983) showed that supplementation with vitamin C brought about an improvement in patients with depression and schizophrenia. He further suggested that these patients had an increased demand for vitamin C. Dena *et al.* (1975) evidenced that vitamin C status affects brain amine synthesis - *in vivo* and reported that neurological disorders may develop when there were inappropriate amounts of vitamin C in the nerve tissue.

Animal studies have indicated that vitamin C injected into the brain is able to affect dopamine function possibly by increasing its metabolism to noradrenalin (Tolber *et al.*, 1979).

In a number of papers (Goetzal *et al.*, 1974; Gallin and Vaughan, 1975; Anderson, 1979; Anderson and Theron, 1979), it has been shown that vitamin C in high concentration is able to stimulate neutrophil motility to attack bacteria.

Prinz *et al.* (1978) and Vallance *et al.* (1978) reported that there is some association between leucocyte and plasma ascorbic acid levels and immunoglobin components.

Research conducted by Narisawa *et al.* (1976) and Rustia (1977) suggested that the vitamin C may reduce the carcinogenic potential of some chemicals like N-nitrosocompounds. In recent years there appears to be substantial evidence suggesting that a variety of experimental tumours of the alimentary tract, liver, lung and bladder can be produced by nitrosocompounds.

Pauling and Leibovitz (1980) from their studies evidenced that vitamin C in large doses may have a role in suppressing tumourgenesis.

Bram *et al.* (1980) reported that vitamin C inhibit the growth of the melanoma cells 20-500 times more than normal cells.

It has also been suggested that dehydro ascorbic acid function as an electron acceptor in the regulation of mitosis (Edgar, 1980).

Logue and Frommer (1980) reported that high doses of vitamin C reduce colorectal tumour development from rectal polyps in susceptible inbred strains.

Mirvish *et al.* (1982) reported that the potential hazard of ingesting drugs or food containing nitrites and secondary amines which can be nitrosated may be prevented by the addition of vitamin C.

Fiddler *et al.* (1983) have demonstrated that addition of vitamin C to the ingredients used to cure frankfurters greatly reduces the formation of dimethyl nitrosamine which is a potent carcinogen.

Cameron and Pauling (1986) indicated that supplemental vitamin C in large doses, have significant beneficial effects on patients with advanced cancer.

Using the Ames test Gittemplan (1987) demonstrated that vitamin C inhibits bacterial mutagenesis by N-methyl-N-nitroguanidine, mutagenesis being a change which could potentially lead to carcinogenesis in the animal cell.

Ternas *et al.* (1988) reported that ascorbic acid may suppress the formation of carcinogens.

A large number of studies suggested that vitamin C plays a vital role in the protection from cancer (Sauberlich, 1991; Block, 1992).

Liehr (1991) studied the effect of ascorbic acid treatment on oestrogen induced carcinogens to elucidate the mechanism of neoplasm induction by oestrogen. The results showed that ascorbic acid decreased the neoplasm incidence by about 50 per cent. More over ascorbic acid lowered the concentration of diethyl stilbestrol-4',4" quinone the genotoxic metabolite of diethyl stilbestrol *in vitro*.

Hoda and Sinha (1992) reported that ascorbic acid reduced the effects of malathion to a minimum.

Sinha and Bose (1992) reported that vitamin C is more effective in minimising aflatoxin toxicity when given during or after toxin administration than before toxin administration.

Massod and Rajan (1994) studied the effect of a therapeutic dose of vitamin C on T-2 toxin induced clinical abnormalities, including changes in body weight, in young weanling guinea pigs under various treatments. The results indicated that the concurrent administration of vitamin C with T-2 toxin markedly suppressed the toxic effect.

Atroshi *et al.* (1995) suggested that in the brain and spleen of rats, vitamin C and selenium seem to act as an antixoidant system that protects against mycotoxin induced damage.

Helen and Vijayammal (1997) reported that an intake of mega dose of vitamin C can protect the liver from oxidant damage caused by cigarette smoking.

Klenner (1981) reported that much higher doses of vitamin C is beneficial in patients with burns to accelerate healing and alleviate pain.

Vitamin C has also been reported to promote healing of pressure sores (Hunter and Rajan, 1981).

Crandon *et al.* (1976) and Shukla (1980) reported that vitamin C deficiency may be an important factor in the pathogenesis of post operative wound complication in surgical patients. It has been suggested that there is rapid utilisation of vitamin C for the synthesis of collagen at the site of the wound in the post operative period and hence the administration of the vitamin post operatively might be beneficial.

Sokoloff *et al.* (1976) reported that vitamin C is not only implicated as a hypocholesterolaemic agent but also has an effect on the metabolism of triglycerides. Thus is hyperlipidaemic patients, vitamin C supplement of 2-3 g daily for at least a year appear to be effective in reducing serum triglyceride.

Chronic vitamin C depletion in animals without supplementary cholesterol intakes leads to changes in the vessel wall that resemble atherosclerosis (Sulkin, 1976).

The work of Ginter (1978a, 1979) emphasized that moderate vitamin C deficiency in guinea pigs is capable of bringing many changes which may lead to a gradual deterioration of the animal.

Geriatrics Editorial (1978) suggested that vitamin C supplementation is capable of having some effects in the hyper cholesterolaemic subjects.

Experimental studies have shown that vitamin C deficiency results in hypertriglyceridium (Ginter, 1978b and Kotze and Spies, 1980).

Clemetson (1980) has noted that many factors like smoking, infection, soft water including a decrease in the vitamin C levels of blood are associated with ischaemic heart disease and thrombosis.

Massive decrease in circulating triglyceride following vitamin C therapy have also been reported in two patients who had gross hypertriglyceridemias (Geoly and Diamond, 1980).

Spittle (1986) suggested that vitamin C may be able to mobilise cholesterol from the arterial wall.

Bates *et al.* (1980) conducted studies in human beings and noted steady weight loss in all elderly subjects where vitamin C intake was low. Vitamin C supplementation has brought about an increased growth compared with a placebo group.

Angeles and Schultink (1993) studied the effect of vitamin C and iron supplementation on growth and haematological studies of Indonesian anaemic preschool children with low weight for age. Thirty nine pre school children received supplements of vitamin C 30 mg and iron 20 mg for two months. At the start and finish of the study, body weight, height, food intake and haemoglobin and serum ferritin concentrations were estimated. The treatment group showed a significant increase in all haematological values. Height and weight of all children increased significantly as compared with the control group with placebo.

Vanderkamp (1976) reported that low vitamin C reserves have also been associated with psychiatric disease such as schizophrenia and depression.

The work of Kinsman and Hood (1981) also observed behavioural changes during artificial vitamin C depletion.

A study conducted by Milnor (1983) reported a clear improvement in mental condition by supplementing with vitamin C. Thus indicating that vitamin C is required for adequate mental function and plasma concentrations required to maintain this function is rather higher than those required to prevent scurvy.

2.4 Significance of child hood nutrition

Childhood is the base of man's life, it is during this period that man's early training starts with the acquisition of certain values, beliefs and social skills which become more or less a permanent part of his personality and influence his behaviour throughout his life. Malnutrition during this period results in stunted growth among children which adversely affect their development (Easwaran and Devadas, 1984, Kalra, 1989 and Gupta, 1990, UNICEF, 1990 and Anand, 1994).

Adequate nutritional foundation for the child during the early years are essential for his overall development (Neal, 1988, Baveja *et al.*, 1993).

Normal health and development during childhood years is mainly based on a sound nutritional intake. The interaction between the growth of the mind and the body has been observed and experimented by various investigators (Muller, 1981, Devadas, 1991).

According to Weber *et al.* (1981) energy, protein, vitamin and mineral supplementation to infants had positive effect on the cognitive competence.

Severe protein energy malnutrition was found to have adverse effect on brain growth, cell number and cell morphology which retarded physical and behavioural and mental development of children (Udani and Emery, 1982).

Malnourished children experience high rates of infections and have more frequent complications than do those who are well nourished. The younger the child, the more apt he is to sustain permanent retardation in growth and in brain function. The earlier in life the malnutrition begins, the more lasting the effect on brain development and behaviour. Malnutrition may act on mental development through loss of learning time, interference during critical periods for learning and changes in motivation and personality (Kadam *et al.*, 1984).

Passmore and Eastwood (1986) had shown a beneficial effect of dietary supplements on mental functions and behavioural changes among under fed children.

Proper nourishment during preschool years is essential for proper growth. Faulty nutrition during early life has been identified as a cause for diseases during adulthood (Ali, 1987, Taitz and Wardly, 1989, Shiva, 1993 and Chandran, 1994).

According to Ashwell (1990), Pollitt (1990) and Choksi (1995) nutritional factors played a significant role in resistance to infection among preschool and school going children. Adequate nutrition in terms of quality and quantity is needed for proper functioning of the immune system for the defensive mechanism of the body during preschool and school going years.

The crucial years for a proper foundation of child's personality should be protected and well looked after, if a country has to thrive proper in all spheres of human activity (Warang, 1990).

The nutritional status during the most vulnerable and growing period of childhood lays foundation for good health in later years (UNICEF, 1990 and Verma *et al.*, 1996).

Results of the study conducted by Schoenthaler *et al.* (1991) showed that inadequate vitamin-mineral intake can adversely affect behaviour in children.

Morgane *et al.* (1992) revealed that presence of malnutrition during neurogenesis and cell migration and differentiation will also cause permanent brain damage. They further suggested that the damage could result in relatively minor brain dysfunctions which would eventually lead to attention disorders and learning disabilities. Marginal malnutrition not only affects children's brain growth and mental function but adversely affects their emotional and behavioural quality of life and ability to function in society. Such behavioural changes would affect children's interactions with their environment leading to further delay in development.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

This chapter deals with the methods and procedures followed in the various phases of research. The details are presented under the following headings.

3.1 Locality of the study

3.2 Selection of samples

3.3 Plan of study

3.4 Methods selected for the study

3.5 Development of tools and conduct of the study

3.6 Statistical analysis

3.1 Locality of the study

SOS Village at Mulayam in Thrissur district was selected to conduct the study.

3.2 Selection of samples

All the seventeen families in the SOS Village were selected for the study. Out of 350 children in the seventeen families of SOS village, 50 preschool children between the age group of 4-6 years and 50 school going children between the age group of 7-9 years were selected randomly for the study. From these two groups the children were again categorized into two groups namely control group (CG) and experimental group (EG), consisting of 25 children in each group. Thus 25 preschool (4-6 years) and 25 school going children (7-9 years) formed the control group and 25 preschool children and 25 school going children formed the experimental group.

3.3 Plan of study

Based on the objectives, the plan of study was designed. The study comprised of

1. A baseline survey to study the SOS functioning pattern
2. A dietary survey to assess the food consumption pattern and dietary habits
3. Preparation of amla products using the Chambakad local variety of amla of 7-8 months maturity.
4. Organoleptic evaluation of the amla products to identify the most acceptable product.
5. Analysing the chemical constituents such as Vitamin C, fibre, iron, Total Soluble Solids (T.S.S.) and tannin content of fresh amla, amla products and stored amla products.
6. Supplementary studies among children with the selected amla product.
7. Assessing the nutritional and health status of selected children through
   a) Anthropometric measurements namely weight, height, mid upper arm circumference, chest circumference and head circumference of pre school children and weight and height of school going children before and after the feeding trial
   b) Food weighment survey to assess the actual food and nutrient intake of the children
   c) Biochemical estimation of blood for haemoglobin before and after the feeding trial
   d) Clinical examination before and after the feeding trial
8. Determining the behaviour pattern of children before and after the feeding trial
9. Analysis of data using suitable statistical techniques.

3.4 Methods selected for the study

The data regarding functional pattern of SOS village and dietary habits of the families were collected by direct interview method. According to Lindzey (1954) interview is a face to face verbal exchange by which the interviewer attempts to elicit information or expression of opinion or belief from the other person.

Seven amla products namely preserve, candy, jam, jelly, squash, shred and soft drink were prepared using standard procedures (Santram, 1983 and Bachman, 1985).

According to Araullo (1975) organoleptic qualities play an important role in evaluating the quality of the food product. Hence in this study the organoleptic evaluation of the prepared amla products was carried out using a score card based on a five point hedonic scale for quality parameters like colour, flavour, texture, taste and doneness.

Chemical constituents like vitamin C, iron, fibre, Total soluble solids (TSS) and tannin of fresh amla, amla products and stored amla products were estimated using standard procedures.

Based on the organoleptic evaluation, one amla product was selected to feed the experimental group children. The feeding trial was conducted for a period of six months and the health and nutritional status of children were assessed before and after feeding the amla product.

Aebi (1983) suggested that anthropometric indices, presence of clinical deficiency signs, dietary assessment, actual food intake and biochemical estimation were widely used as direct parameters of nutritional status of children. To assess the nutritional status of selected children the following methods were used.

a) Recording anthropometric measurements
b) Assessing actual food and nutrient intake
c) Biochemical estimation of blood for haemoglobin
d) Conducting clinical examination

Anthropometry has been accepted as an important tool for assessment of nutritional status of children in developing countries (McLaren *et al.*, 1984; Vijayaraghavan, 1987; Sharma and Kalia, 1990; Rao and vijayaraghavan, 1996).

According to Swaminathan (1987) and Rao and Vijayaraghavan (1996) body weight is the most widely used and the simplest reproducible anthropometric measurement for the evaluation of nutritional status of young children. Body weight is sensitive even to small changes in nutritional status due to childhood morbidities. The loss of body weight in children could be considered as an indicator of potential malnutrition (Rao and Vijayaraghavan, 1996).

According to Gopaldas and Seshadri (1987) height is an indicator of long term malnutrition. The extent of height deficit in relation to age could be regarded as a measure of malnutrition.

As suggested by Rao and Vijayaraghavan (1996) among the environmental factors which influence the height of an individual, nutrition and morbidity are very important because inadequate dietary intake and infections reduce nutrient availability at cellular levels leading to growth retardation and stunting.

According to Rao and Singh (1970) weight/height^2 is a reliable age independent index of nutritional status since it takes into consideration weight in relation to height. The index has advantages over using either height or weight singly as an index of growth.

Mid upper arm circumference (MUAC) is an indicator of muscle development and reflects protein calorie malnutrition of early childhood (Jelliffe, 1966 and Kamath, 1986). MUAC is considered as a simple, useful and more feasible method to assess the nutritional status of children (NFI, 1991 and Rao and Vijayaraghavan, 1996).

According to Rao and Vijayaraghavan (1996) head size relates mainly to size of the brain which increases quite rapidly during infancy. The chest in a normally nourished child grows faster than the head during the second and third

year of life. In a malnourished child due to poor growth of the chest, the head circumference may remain greater than the chest.

In the present study anthropometric indices like weight, height, mid upper arm circumference, chest circumference and head circumference of pre school children and weight and height of school going children were recorded before and after the study to assess their nutritional status.

Diet surveys constitute an essential part of any complete study of nutritional status of individuals or groups and provides essential information on nutrient intake levels, source of nutrition and food habits (Gopaldas and Seshadri, 1987). According to Gore *et al.* (1977) weighment method of diet survey could give accurate values of dietary intake.

Mari (1985) suggested that actual food intake within the family through one day weighment could be better mentioned in micro samples. Hence, in the present study one day food weighment survey was conducted among both the experimental and control group children to assess their actual food and nutrient intake.

Biochemical investigation represented the most objective assessment of the nutritional status of an individual and provides subclinical information (Sauberlich *et al.*, 1977). Of the several biochemical parameters, World Health Organisation, in its technical reports on nutritional surveillance, recommended only haemoglobin for the assessment of nutritional status. In the present study, the haemoglobin level of blood of the children was estimated before and after the supplementary study.

According Swaminathan (1986) clinical examination is the most important part of the nutritional assessment, since it provides direct information of signs and symptoms of dietary deficiencies. In the present study the samples were clinically examined for manifestations of deficiency symptoms.

Mathews IAS rating scale can be used as an instrument for measuring personality and to assess the behavioural pattern of children. In the present study behaviour of the children before and after feeding amla product was assessed using Mathews IAS rating scale.

3.5 Development of tools and conduct of the study

To collect functional pattern of the SOS village a questionnaire was developed. The schedule comprised of information on personnels of the SOS village, objectives of the SOS village, training imparted to mothers, facilities of SOS village and inter and intrafamily relations of SOS village. This also included details regarding the details of family size, religion, monthly income, distribution of SOS population on the basis of age and sex, criteria stipulated for the enrolment of children into the village, educational level of inmates and details of index child.

The details of the questionnaire are given in Appendix-I.

Another schedule was prepared to elicit information on dietary habits and food consumption pattern of the families. It included details regarding dietary pattern, food expenditure pattern, frequency of purchase and use of various foods, details regarding meal pattern, snacking habits, food distribution among family members, foods included and avoided during special occasions, cooking practices and methods, storage and preservation of foods, use of left over foods and details of weaning foods.

The questionnaire is given in Appendix-II.

The above two questionnaires were pretested before conducting the actual study.

Seven amla products namely preserve, candy, jam, jelly, squash, shred and softdrink were prepared so as the select the most acceptable product to feed the children. The details of the recipes are given in Appendix-III.

Organoleptic evaluation of seven amla products namely preserve, candy, jam, jelly, squash, shred and softdrink was conducted for five quality attributes like colour, flavour, texture, doneness and taste. The acceptability test was conducted among 10 technical experts from SOS village, 17 SOS mothers and 50 children selected as the experimental group as suggested by Swaminathan (1974). The sensory evaluation was carried out using a score card based on a five point hedonic scale for parameters like colour, flavour, texture, doneness and taste. The score card developed for the study is presented in Appendix–IV.

Chemical composition of fresh amla, various amla products and stored amla products were estimated. The stored amla products were analysed for different constituents at monthly intervals for a period of six months. The details of the procedures adopted are given below.

The vitamin C content of the fresh amla, amla products and stored amla products were estimated by the method of AOAC (1955) using 2,6,dichlorophenol indophenol dye.

For the estimation of vitamin C, 1 g of fresh amla was taken and it was ground and made up to 50 ml using 4 per cent oxalic acid.

In the case of amla products 5 g of preserve, candy, jam, jelly and shred was taken for the estimation of vitamin C whereas 10 ml of squash and soft drink were taken for the estimation. All the solid preparations were ground and made up to 50 ml using 4 per cent oxalic acid. Amla squash and soft drink were made upto 50 ml using 4 per cent oxalic acid.

The crude fibre content of the samples were estimated by acid alkali digestion method as suggested by Chopra and Kanwar (1978).

Two gram of dried samples of fresh amla and amla products were taken for the estimation of total fibre content. Amla products like jelly, squash and soft

drink did not have any fibre since it was prepared using the extracts of amla. The results were expressed in fresh weight basis.

For estimating the iron content of the samples, diacid extract of samples was prepared and estimated in an Atomic absorption spectrophotometer (Ranganna, 1977) and the iron content was expressed in fresh weight basis.

Five gram of dried samples of fresh amla, amla preserve, candy, jam, jelly and preserve was taken for the estimation of Iron. The samples were ignited in a muffle furnace. The ash obtained by the ignition of the samples were used for the estimation of iron.

Total soluble solids (TSS) was found out by Erma hand refractometer (0-32°Brix and 33-78°Brix) and expressed in degree Brix (AOAC, 1980).

The tannin content was estimated using AOAC method (1970).

For the estimation of tannin 5 g of fresh amla, candy, preserve, jam, jelly and shred was taken whereas 5 ml of squash and soft drink were taken. The samples were boiled in 100 ml of water and filtered.

For supplementary studies the children were categorised into two groups i.e., experimental group (EG) and the control group (CG). The most acceptable product namely amla preserve (5g) was fed to the EG children so as to meet one third of the Recommended Dietary Allowances (RDA) of Vitamin C per day for a period of six months.

Anthropometric indices like weight, height, mid upper arm circumference, chest circumference and head circumference of preschool children and weight and height of school going children were recorded as suggested by Jelliffe (1966).

One day food weighment survey was conducted among children to assess their actual food and nutritient intake before the study. To conduct the food weighment survey standardized food weighing balance and standard measuring cups and spoons were used. The schedule used for the weighment survey is given in Appendix-V. The nutrients available from the food consumed were computed using food composition tables (Gopalan *et al.*, 1989).

The haemoglobin level of the blood was estimated by cyanmethaemoglobin method suggested by NIN (1983).

Clinical examination of the children was conducted with the help of a qualified physician. Schedule used for this purpose is given in Appendix-VI.

The Mathews IAS rating scale measures the degree of inertia, activation and stability in an individual. The scale can be used for rating self personality or the personality of another person. In this study the children were rated by the Assistant director of the SOS village (Superior rating). The IAS rating scale consisted of 35 sub scales. Each scale has three sets of descriptions or qualities designated by the letters I, A and S and has a total of 3 points to divide among the three alternatives. If the ratee possesses the three qualities equally as seen in his general behaviour, the rator can divide the three points equally (as 1,1,1). If the ratee possess only one quality and not the other two, the rator can give all the three points to that and zero to each of the other two. On the other hand if the rator feel that the ratee possesses one among the three to a large degree, another to a smaller degree and he does not possesses the third the rator can distribute the points as 2,1,0. Writing the three numbers under the appropriate letters (I, A, S) in the separate answer sheet is necessary, against the scale number. The total of points given to one scale should be 3. Fractions should be avoided. Add the points in each column so as to get three scores (for I, A and S) for each type of rating. The total of three scores should be 105. The Mathews IAS rating scale and score card used for the behaviour assessment is given in Appendix-VII.

3.8 Analysis of data

Various statistical techniques used in the present study to analyse the results were percentage analysis, 't' test, paired 't' test, analysis of variance and simple regression analysis.

RESULTS

4. RESULTS

The results of the study on the influence of amla (*Emblica officinalis* Gaertn.) products on the nutritional and health status of SOS children in Thrissur District are presented in this chapter under the following subheadings.

4.1 Functioning pattern of SOS village

4.2 Food consumption and dietary pattern of the families

4.3 Organoleptic evaluation of amla products

4.4 Chemical composition of fresh amla, amla products and stored amla products

4.5 Nutritional status of the children

4.6 Behaviour pattern of the children

4.7 Association between nutritional status and behaviour of the children

4.1 Functioning pattern of SOS village

Functioning pattern of SOS village was assessed in terms of personnels of the SOS village, objectives of SOS village, training of the mothers in family management, facilities of SOS village, inter and intrafamily relations of SOS village.

The details regarding the family size and religion, monthly income, distribution of SOS population, criteria stipulated for the enrolment of children into the village, educational level of inmates and details of index child were also enquired. The results are given below.

4.1.1 Personnels of the SOS village

The personnels involved in the functioning pattern of SOS village are presented in Table 1.

Table 1. Personnels of SOS village

Personnels	Job
Director	Co-ordinator
Asst. Director	Co-ordinator
Lady Counsellor	Counselling the problems of children
Accountant	Keeping the account
Clerk	Keeping records
Village master	Supervision
Village doctor	Health care system
Health nurse	Health care facilities
Store keeper	Purchase and supply things
Foster mothers	Managing the house
Aunties	Helping the mothers

Directors, Village master and lady counsellor were the key personnels involved in the SOS programme. Their main job responsibility was to contribute the smooth maintenance of the families. Problems of the mothers and the children were solved by a lady counsellor. Official work and financial matters were carried out by one clerk and accountant. Maintenance work of houses, supervision of power supply, water supply, maintenance of SOS garden were under the control of village master. A doctor and a nurse in-charge residing in the same locality provided the health care facilities to the children. Purchasing and supply of food items were under the control of village store keeper. The overall duties of the families were carried out by SOS mothers. Mothers were assisted by aunties whenever necessary.

Majority of the SOS mothers (82.35%) had obtained high school education while the rest (17.65%) had college level education. Nearly 53 per cent of the mothers were between the age group of 35 to 40 years and 47 per cent were above the age of 40 years.

4.1.2 Objectives of SOS village

The main objective of the SOS village was to provide care and rehabilitation for children by providing a family atmosphere, to develop wholesome personality among children and to help the disadvantaged women.

4.1.3 Training of the SOS mothers in family management

All the SOS mothers had undergone an orientation training for six months on family management and a refresher training for two weeks. All the SOS mothers were well oriented with nutrition, human psychology, health and hygiene and family resource management.

4.1.4 Facilities of SOS village

Regarding the facilities of the SOS village it was found that all the families had well maintained drainage, safe drinking water, toilet and laundry facilities. The medical and educational facilities in the SOS village were also found to be highly appreciable. Most of the children were found to be engaged in different recreational activities like sports, dance, drawing, stitching, clay modeling, book binding etc.

4.1.5 Inter and intrafamily relations in SOS village

The interfamily and intrafamily relationship of the members of the SOS village were found to be very good. The mothers in each house considered the children as their own children. The children in the SOS village considered the other children in their house as their own brothers and sisters. There was no difference between SOS family and a natural family.

4.1.6 Family size and religion

Table 2. Details of family size and religion

Details	Families	
	Number	Percentage
a) Family size (No.)		
19	1	5.88
20	5	29.41
21	11	64.71
Total	17	100.00
b) Religion		
Hindu	2	11.76
Christian	15	88.24
Total	17	100.00

Majority of the families (64.71%) had 21 members in the family while 29.41 per cent and 5.88 per cent had 20 and 19 members respectively excluding the mother of the family (Table 2).

In SOS village 88.24 per cent of the families belonged to Christian community and the rest belonged to the Hindu community.

4.1.7 Income of SOS families

The monthly income of most of the families ranged from Rs.7500-8000. The monthly income of the SOS families was based on cost estimate per child and salary of the mother. Cost estimate per child was found to be Rs.400 for children above 12 years and Rs.300 for children below 12 years per month. Each SOS mother had a salary of Rs.4500 per month.

4.1.8 Distribution of SOS population on the basis of age and sex

Table 3. Distribution of SOS population on the basis of age and sex

Age group (Years)	Boys (No.)	Percent-age	Girls (No.)	Percent-age	Total (No.)	Percent-age
Upto 4	21	6.00	17	4.86	38	10.86
4-6	30	8.57	34	9.71	64	18.28
7-9	40	11.43	36	10.28	76	21.71
10-12	42	12.00	31	8.86	73	20.86
12-18	34	9.71	28	8.00	62	17.71
> 18	16	4.57	21	6.00	37	10.57
Total	183	52.29	167	47.71	350	100.00

As revealed in Table 3 out of the 350 inmates in the SOS village nearly 40 per cent was in the age group of 4-9 years and comprised of 20 per cent boys and 20 per cent girls. The percentage of inmates above nine years constituted 49.14 per cent and children below four years constituted 10.86 per cent of the total inmates.

4.1.9 Criteria stipulated for the enrolment of children

Majority of children (65.71%) in the SOS village were orphans, 26.29 per cent had lost any of the parents and 8 per cent were destitutes.

4.1.10 Educational level of inmates

Table 4. Distribution of inmates on the basis of educational status

Educational level	Boys (No.)	Percent-age	Girls (No.)	Percent-age	Total (No.)	Percent-age
Pre-school	28	15.30	20	11.98	48	13.72
Lower Primary	40	21.86	34	20.36	74	21.14
Upper primary	30	16.39	40	23.95	70	20.00
High school	41	22.40	45	26.95	86	24.57
P.D.C. and others	34	15.58	21	12.57	55	15.71
Graduation and other course	10	5.47	7	4.19	17	4.86
Total	183	100.00	167	100.00	350	100.00

The educational status of the inmates of the SOS village is presented in Table 4. About 24.57 per cent of the inmates were studying in the high school classes which is comprised of 22.40 per cent boys and 26.95 per cent girls. Nearly 20.57 per cent of the inmates had attained college level education while 21.14 per cent and 20 per cent were studying in the lower primary and upper primary classes respectively.

4.1.11 Details of index child

The preschool children between 4-6 years and school children between 7-9 years were considered as the index child and details like gender, birth weight, birth order, morbidity, immunization status and deworming pattern were assessed and the results are given in Tables 5 and 6.

With regard to birth order 44 per cent of preschool children in the control group and 60 per cent in the experimental group belonged to the first birth order. Forty four per cent of the children (CG) and 32 per cent (EG) belonged to the second birth order. Rest of the children which comprised of 12 per cent in CG and 8 per cent in EG belonged to the third birth order.

Among school children also (Table 6) majority in the control group (66%) and experimental group (56%) belonged to the first birth order. While 32 per cent in control group and 24 per cent in the experimental group belonged to the second birth order.

With regard to birth weight 80 per cent of the children in control group and 68 per cent in the experimental group in the preschool had a weight of above 2.5 kg. Rest of the children had a birth weight of either 2.5 kg or less than 2.5 kg (Table 5). In the case of school children also majority in the control group (88%) and experimental group (76%) had a birth weight of above 2.5 kg (Table 6).

Table 5. Details of index child (Preschool children)

Details	CG (No.)			EG (No.)		
	B	G	T	B	G	T
a) Gender	12	13	25	12	13	25
b) Birth order						
First	6 (50)	5 (38.46)	11 (44)	8 (66.7)	7 (53.85)	15 (60)
Second	5 (41.7)	6 (46.15)	11 (44)	3 (25)	5 (38.46)	8 (32)
Third	1 (8.31)	2 (15.38)	3 (12)	1 (8.31)	1 (7.69)	2 (8)
Total	12	13	25	12	13	25
c) Birth weight (kg)						
> 2.5	11 (91.7)	9 (69.2)	20 (80)	10 (83.3)	7 (53.85)	17 (68)
2.5	1 (8.3)	2 (15.4)	3 (12)	1 (8.3)	6 (46.15)	7 (28)
< 2.5	0	2 (15.4)	2 (8)	1 (8.3)	0	1 (4)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)
d) Morbidity						
Yes	2 (16.7)	1 (7.7)	3 (12)	1 (8.3)	1 (7.7)	2 (8)
No	10 (83.3)	12 (92.3)	22 (88)	11 (91.7)	12 (92.3)	23 (92)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)
d) Immunisation status						
Complete	12 (100)	11 (84.6)	23 (92)	11 (91.7)	13 (100)	24 (96)
Partially complete	0	2 (15.4)	2 (8)	1 (8.3)	0	1 (4)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)
e) Deworming pattern						
Regular	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)
Irregular	-	-	-	-	-	-
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

CG – Control group EG – Experimental group B – Boys G – Girls T- Total
Numbers in parentheses are percentages

Table 6. Details of index child (School children)

Details	CG (No.)			EG (No.)		
	B	G	T	B	G	T
a) Gender	12	13	25	12	13	25
b) Birth order						
First	8 (66.7)	6 (46.15)	14 (66)	7 (58.3)	7 (53.85)	14 (56)
Second	2 (16.7)	6 (46.15)	8 (32)	3 (25)	3 (23.08)	6 (24)
Third	2 (16.6)	1 (7.69)	3 (12)	2 (16.7)	3 (23.08)	5 (20)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)
c) Birth weight (kg)						
> 2.5	12 (100)	10 (76.92)	22 (88)	11 (91.76)	8 (61.54)	19 (76)
2.5	0 (0)	2 (15.38)	2 (8)	1 (8.3)	4 (30.77)	5 (20)
< 2.5	0 (0)	1 (7.69)	1 (4)	0 (0)	1 (7.69)	1 (4)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)
d) Morbidity						
Yes	2 (16.7)	0 (0)	2 (8)	0 (0)	2 (15.38)	2 (8)
No	10 (83.3)	13 (100)	23 (92)	12 (100)	11 (84.62)	23 (92)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)
d) Immunisation status						
Complete	11 (91.7)	12 (92.3)	23 (92)	11 (91.7)	11 (84.6)	22 (88)
Partially complete	1 (8.3)	1 (7.7)	2 (8)	1 (8.3)	2 (15.4)	3 (12)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)
e) Deworming pattern						
Regular	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)
Irregular	-	-	-	-	-	-
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

CG – Control group EG – Experimental group B – Boys G – Girls T- Total
Numbers in parentheses are percentages

Regarding the morbidity of the index children majority in the preschool group both in the control (88%) and experimental group (92%) were not affected by any major illnesses during the past one year. Among the school going children also 92 per cent each in the control and experimental groups were not affected by any major illness during the past one year. Rest of the children suffered from different illnesses like chicken pox and measles.

Majority of the children in the 4-6 age group i.e. 92 per cent in the control group and 96 per cent in the experimental group had completed the immunization schedule. Among 7-9 age group also 92 per cent and 88 per cent of children in the control and experimental group had completed the immunization schedule.

Regarding the deworming pattern of the index children, it was found that all the children had the habit of deworming at regular intervals.

4.2 Food consumption and dietary pattern of families

Food consumption and dietary pattern of the families with respect to food expenditure, frequency of purchase and use of various foods, details regarding meal pattern, snacking habit, food distribution among family members, food included and avoided during special occasions, cooking practices and methods, storage and preservation of foods, use of left over foods, equipments of SOS families and details of supplementary foods given were assessed and the results are furnished below.

4.2.1 Dietary pattern of the families

All the families surveyed were found to be non-vegetarians. Rice was the staple food of all the families. All the families used boiled water for drinking and had the habit of eating raw vegetables as salads.

4.2.2 Food expenditure pattern

Table 7 reveals the details regarding monthly expenditure pattern of the families on different food items.

Table 7. Monthly expenditure pattern of the families on different food items

Food item	Monthly expenditure (per cent)			
	<1	1-10	11-20	21-30
Cereals	-	-	-	17 (100)
Pulses	-	13 (76.48)	4 (23.52)	-
Green leafy vegetables	17 (100)	-	-	-
Other vegetables	-	17 (100)	-	-
Roots and tubers	-	17 (100)	-	-
Fruit	-	17 (100)	-	-
Milk and milk products	-	3 (17.65)	14 (82.35)	-
Egg	-	17 (100)	-	-
Meat	-	17 (100)	-	-
Fish	-	17 (100)	-	-
Nuts and oil seeds	-	17 (100)	-	-
Spices and condiments	-	17 (100)	-	-
Fats and oils	-	17 (100)	-	-
Sugar and jaggery	-	17 (100)	-	-
Others (bakery items)	-	17 (100)	-	-

Numbers in parentheses are percentage

It was found that all the families spent 21-30 per cent of their food expenditure on cereals. For the purchase of pulses majority (76.48%) of the families spent up to 10 per cent of their food expenditure.

All the families surveyed spent less than one per cent of their food expenditure for the purchase of green leafy vegetables. Up to 10 per cent of total food expenditure was spent for the purchase of other vegetables, roots and tubers, fruit, egg, meat, fish, nuts and oil seeds, spices and condiments, fats and oils, sugar and jaggery by all the families. It was found that 82.35 per cent of the families spent 11-20 per cent of food expenditure for the purchase of milk. For the purchase of other food items especially the bakery items all the families spent upto 10 percentage of their food expenditure.

4.2.3 Frequency of purchase of food items

The details of frequency of purchase of various food items by the SOS families are presented in Table 8.

The table showed that all the families purchased cereals, pulses, green leafy vegetables, other vegetables, roots and tubers and other items like bakery items once in a week. All the families purchased meat and fish twice in a week. Egg and spices and condiments were purchased monthly once by all the families. All the families purchased nuts and oilseeds, fats and oil and sugar and jaggery, twice in a month. Milk was the only food item purchased on a daily basis by all the families.

Table 8. Frequency of purchase of various food items by the families

Food items	Daily	Weekly				Monthly				Never
		1	2	3	4	1	2	3	4	
Cereals	-	17 (100)	-	-	-	-	-	-	-	-
Pulses	-	17 (100)	-	-	-	-	-	-	-	-
Green leafy vegetables	-	17 (100)	-	-	-	-	-	-	-	-
Other vegetables	-	17 (100)	-	-	-	-	-	-	-	-
Roots and tubers	-	17 (100)	-	-	-	-	-	-	-	-
Fruit	-	17 (100)	-	-	-	-	-	-	-	-
Milk	17 (100)	-	-	-	-	-	-	-	-	-
Egg	-	-	-	-	-	17 (100)	-	-	-	-
Fish	-	-	17 (100)	-	-	-	-	-	-	-
Meat	-	-	17 (100)	-	-	-	-	-	-	-
Nuts and oil seeds	-	-	-	-	-	-	17 (100)	-	-	-
Spices & condiments	-	-	-	-	-	17 (100)	-	-	-	-
Fats and oils		-	-	-	-	-	- (100)	17	-	-
Sugar and Jaggery	-	-	-	-	-	-	17 (100)	-	-	-
Others (Bakery items)	-	17 (100)	-	-	-	-	-	-	-	

Numbers in parentheses are percentage

4.2.4 Frequency of use of various food items

Table 9 revealed the details regarding the frequency of use of various food items by the SOS families.

Table 9. Frequency of use of various food items by the families

Food items	Daily	Weekly					Total
		1	2	3	4	>4	
Cereals	17 (100)	-	-	-	-	-	17 (100)
Pulses	17 (100)	-	-	-	-	-	17 (100)
Green leafy vegetables		17 (100)	-	-	-	-	17 (100)
Other vegetables	17 (100)	-	-	-	-	-	17 (100)
Roots and tubers	12 (70.59)	-	-	-	-	5 (29.41)	17 (100)
Fruits	-	-	9 (52.94)	8 (47.06)	-	-	17 (100)
Milk & milk products	17 (100)	-	-	-	-	-	17 (100)
Egg	17 (100)	-	-	-	-	-	17 (100)
Meat	-	-	17 (100)	-	-	-	17 (100)
Fish	-	-	17 (100)	-	-	-	17 (100)
Fats and oils	17 (100)	-	-	-	-	-	17 (100)
Nuts and oil seeds	17 (100)	-	-	-	-	-	17 (100)
Spices & condiments	17 (100)	-	-	-	-	-	17 (100)
Sugar & jaggery	17 (100)	-	-	-	-	-	17 (100)
Others (Bakery items)	-	-	-	-	-	17 (100)	17 (100)

Number in parentheses are percentages

It was found that all the families used cereals, pulses, other vegetables, milk and milk products, egg, fats and oils, nuts and oil seeds, spices and condiments and sugar and jaggery daily in their diet. Majority of the families (70.59%) included roots and tubers also in their daily diet. All the families included meat and fish twice in a week while fruit was consumed by 52.94 per cent of the families twice in a

week. All the families included green leafy vegetables once in a week. All the families used bakery items more than four times in a week.

4.2.5 Meal pattern

The details regarding the meal pattern adopted by the families are presented in Table 10.

Table 10. Meal pattern of the families

Details	Number	Percentage
a) Advanced meal planning		
Yes	17	100.00
No	-	-
b) Basis for planning		
Family requirement	17	100.00
Money available	4	23.54
Likes and dislikes of family members	17	100.00
Food availability	10	58.82
c) Meal pattern		
Two major meal	4	23.53
Three major meal	13	76.47
Total	17	100.00
d) Specific time schedule		
Yes	11	64.71
No	6	35.29
Total	17	100.00
e) Type of snack		
Home prepared	11	64.71
Bakery items	6	35.29
Total	17	100.00

As depicted in the table all the families planned their meal in advance. About 24 per cent of the families planned their meals on the basis of money available to the families and all the families considered the likes and dislikes of the members also while planning the meals.

Most of the families (76.47%) observed three meal a day pattern. It was observed that majority (64.71%) maintained specific time schedule for taking meals.

It was observed that majority (64.71%) of the families preferred home made snack items while 35.29 per cent preferred bakery items purchased from outside.

4.3.6 Foods given during special conditions

Table 11 depicts that most of the families prepared special foods during birthdays, festivals and feast. Special foods like cake, payasam and non-vegetarian special foods were prepared during birthdays. Porridges, juices, mashed foods, fluid foods were given during infancy. During preschool period majority (70.59%) of the families preferred soft or bland diet. School going and adolescent children were given adult's diet.

During fever all the families preferred 'kanji', pappad, pickle etc. During diarrhoea, children were given light tea, coconut water, salted kanji water and buttermilk in order to reduce dehydration. Fried and fatty items were restricted during diarrhoea, jaundice etc.

Table 11. Details of foods during special conditions

Conditions	Number	Percentage
Special Occasion		
a) Birthdays		
Special foods	17	100.00
Usual foods	-	-
Total	17	100.00
b) Festivals/Feast		
Special foods	17	100.00
Usual foods	-	-
Total	17	100.00
Special condition		
a) Infancy		
Adult food	-	-
Porridge/fluid	17	100.00
Total	17	100.00
b) Preschool age		
Adult food	5	24.41
Soft/bland diet	12	70.59
Total	17	100.00
c) School going		
Adult food	17	100.00
Special diet	-	-
Total	17	100.00
d) Adolescents		
Adult food	17	100.00
Special diet	-	-
Total	17	100.00
Diseased condition		
Modified diet	17	100.00
Usual diet	-	-
Total	17	100.00

4.3.7 Cooking practices

Various cooking practices followed by the families are given in Table 12.

Table 12. Details of cooking practices adopted by the families

Food items	Washing & drying soon after purchase	Washing just before cooking	Cleaning, winnowing & washing	Washing before cutting	Washing after cutting	Washing before and after cutting
Cereals	12 (70.59)	5 (29.41)	17 (100)	-	-	-
Pulses	-	17 (100)	-	-	-	-
Green leaf vegetables	-	-	-	17 (100)	-	-
Other vegetables	-	-	-	10 (58.82)	7 (41.18)	-
Roots & tubers	-	-	-	-	17 (100)	-
Fish	-	-	-	-	-	17 (100)
Meat	-	-	-	-	-	17 (100)

Numbers in parentheses are percentages

All the families washed the dry food articles like cereals and pulses 2-3 times before cooking. Cereals like wheat and ragi were cleaned, washed and dried before pounding by 70.59 per cent of families. All the families adopted the practice of cleaning, winnowing and washing the rice before cooking.

In the case of pulses all the families washed it just before cooking. All the families washed green leafy vegetables before cutting. In the case of other vegetables, 58.82 per cent washed it before cutting and 41.18 per cent washed it after cutting. All the families washed roots and tubers after cutting while non-vegetarian items like meat and fish were washed before as well as after cutting.

4.2.8 Cooking methods

Table 13. Details of the cooking methods adopted by the families

Food items	Methods					
	Boiling & straining	Boiling	Absorption	Steaming	Frying Shallow	Deep
Cereal	17 (100)	-	-	17 (100)	-	-
Pulses	-	17 (100)	-	-	-	-
Green leafy vegetables	-	-	17 (100)	-	-	-
Other vegetables	-	17 (100)	-	-	-	-
Roots and tubers	-	17 (100)	-	-	-	-
Fruits	-	-	-	17 (100)	-	-
Milk	-	17 (100)	-	-	-	-
Egg	-	17 (100)	-	-	17 (100)	-
Meat	-	17 (100)	-	-	-	17 (100)
Fish	-	17 (100)	-	-	-	17 (100)

Numbers in parentheses are percentages

Among the various cooking methods adopted by the SOS families, boiling was found to be the predominant method adopted for cooking pulses, other vegetables, roots and tubers, milk, egg, meat and fish (Table 13). Cereals were mainly boiled in excess water and strained by all the families. Green leafy vegetables were cooked by absorption method by all the families.

4.2.9 Storage and preservation of foods

Storage and preservation methods adopted by the families for various food items are presented in Table 14.

Table 14. Storage and preservation methods adopted by the families

Food items	Methods						
	Closed containers	Drying	Refrigeration	Pickling	Salting & drying	Smoking	Fermenting
Cereals	17 (100)	17 (100)	-	-	-	-	-
Pulses	17 (100)	-	-	-	-	-	-
Vegetables	-	-	17 (100)	17 (100)	-	-	-
Fruits	-	-	17 (100)	17 (100)	-	-	-
Fish	-	-	17 (100)	17 (100)	17 (100)	17 (100)	-
Meat	-	-	17 (100)	-	17 (100)	17 (100)	-
Milk	-	-	17 (100)	-	-	-	17 (100)

Numbers in parantheses are percentages

All the families stored cereals and pulses in containers, while vegetables, fruits, fish, meat and milk were stored under refrigerated conditions by all families (Table 14). All the families preserved vegetables, fruits and fish by pickling,. Meat and fish were preserved by salting and drying as well as by smoking.

4.2.10 Use of left over foods

All the families used left over foods either by reheating or by preparing other dishes like uppuma, vattals etc.

4.2.11 Equipments of SOS families

All the SOS families had labour saving devices like mixy, pressure cooker and gas stove. Recreational facilities like television and radio were also present in all the SOS families. Other electrical gadgets like fan, iron box and refrigerator were also present in all the SOS families. All these devices were provided by the SOS authorities.

4.2.12 Supplementary foods

Table 15. Details of supplementary foods given to the infants

Food included	Number of feeding		
	1-2	3	>3
Cereal	-	17 (100)	-
Pulses	17 (100)	-	-
Fruits	12 (70.59)	5 (20.41)	-
Egg, meat, fish	17	-	-
Roots and tubers	13 (76.47)	4 (23.53)	-
Vegetables	17 (100)	-	-
Milk	-	-	17 (100)
Cerelac/Farex/Lactogen	17 (100)	-	-

Numbers in parentheses are percentages

All the families included cereals, pulses, fruits, egg, meat, fish, roots and tubers, vegetables and milk as the supplementary food for children (Table 15). Synthetic infant foods like cerelac, farex and lactogen were also purchased by all the families to feed babies. Milk was the only food item given more than three times daily while other food items were given less than three times per day.

4.3 Organoleptic evaluation of amla products

The sensory evaluation of seven amla products viz, are preserve, candy, jam, jelly, squash, shred and soft drink was carried out among SOS mothers, technical experts and SOS children. The mean scores obtained for five quality attributes like colour, flavour, texture, doneness and taste on a five point hedonic scale are furnished in Table 16.

Table 16. Mean scores of the organoleptic evaluation of amla products

	Score					
Products	Colour	Flavour	Texture	Doneness	Taste	Total
Preserve	4.88	4.41	4.41	4.02	4.62	22.34
Candy	4.43	4.04	4.88	4.40	4.32	22.07
Jam	3.92	4.28	4.65	4.14	4.73	21.72
Jelly	4.30	4.40	4.41	4.06	4.88	22.05
Squash	4.11	3.52	4.04	3.72	4.14	19.53
Shred	4.16	4.10	3.78	3.92	4.28	20.24
Soft drink	3.43	3.50	4.01	3.72	4.21	18.91

Maximum score of each quality = 5
Maximum total score = 25

When the characters namely colour and flavour were analysed the maximum score of 4.88 and 4.41 respectively were obtained for amla preserve and the lowest score of 3.43 and 3.50 respectively were obtained for amla soft drink. Amla candy had the maximum score of 4.88, when the character texture was analysed while amla shred had the minimum score of 3.78.

The maximum score of 4.40 and the minimum score of 3.72 were obtained for amla candy and amla squash as well as soft drink for the character doneness.

Amla jelly was ranked as the best for the character taste with an highest score of 4.88 and squash obtained the least score of 4.14.

When all the characters were analysed together to find out the overall acceptability it was found that the total score for seven amla products varied from 18.91 to 22.34. Amla preserve and soft drink obtained the highest and the lowest scores respectively. Hence amla preserve was selected to conduct the feeding trial among SOS children.

4.4 Chemical composition of fresh amla and amla products

The chemical composition of fresh amla and amla products like vitamin C, fibre, iron and total soluble solids (TSS) and tannin were analysed and the results are presented in Table 17.

Table 17. Chemical composition of fresh amla and amla products (100 g^{-1})

Items	Vitamin C (mg)	Fibre (g)	Iron (mg)	TSS °Brix	Tannin (mg)
Fresh amla	598.9	3.2	1.20	12	2.27
Preserve	587.5	3.2	1.20	72	2.56
Candy	589.6	3.2	1.20	68	2.24
Jam	376.8	1.4	1.20	68	2.14
Jelly	429.8	-	0.63	68	1.95
Squash	534.8	-	0.32	40	1.85
Shred	587.6	3.2	1.20	72	2.25
Soft drink	378.2	-	0.20	10	2.34

It was found that the mean vitamin C content of various amla products varied from 376.8 mg to 589.6 mg 100 g^{-1}. The highest vitamin C content was observed in amla candy and the lowest in amla jam. Fresh amla had a mean vitamin C content of 598.9 mg 100 g^{-1}.

The mean fibre content of fresh amla was found to be 3.2 g 100 g^{-1}. The fibre content of amla products ranged between 1.4 to 3.2 per cent. Amla preserve, candy and shred had the highest fibre content and amla jam had the lowest amount of fibre. Amla jelly, squash and soft drink had no fibre.

The mean iron content of the amla products varied from 0.20 mg in amla soft drink to 1.2 mg 100 g^{-1} in amla preserve, candy, jam and shred. Fresh amla also had 1.2 mg of iron 100 g^{-1}.

The TSS of various amla products varied from 10 to 72° brix. The highest TSS was found in amla preserve and shred and the lowest in soft drink. Fresh amla had a TSS content of 12°brix.

The tannin content of amla products varied from 1.85 mg in amla squash to 2.56 mg in amla preserve 100 g^{-1} of the product. The tannin content of fresh amla was found to be 2.27 mg 100 g^{-1}.

Table 18. Vitamin C content (mg 100 g^{-1}) of stored amla products

Product	Initial	Month					
		1	2	3	4	5	6
Preserve	587.5	583.4	581.6	580.2	579.1	578.2	577.2
Candy	589.6	586.5	582.5	581.3	580.1	579.1	578.3
Jam	376.8	372.4	370.8	369.8	368.2	366.1	365.3
Jelly	429.8	425.4	423.2	422.6	420.1	419.2	418.1
Squash	534.8	532.2	530.2	529.8	527.6	526.3	525.2
Shred	587.6	586.3	583.2	581.2	580.1	579.0	578.2
Soft drink	378.2	376.2	374.3	372.3	370.2	369.2	367.2

Table 19. Fibre content (g 100 g^{-1}) of stored amla products

Product	Initial	Month					
		1	2	3	4	5	6
Preserve	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Candy	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Jam	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Jelly	-	-	-	-	-	-	-
Squash	-	-	-	-	-	-	-
Shred	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Soft drink	-	-	-	-	-	-	-

Table 20. Iron content (mg 100 g^{-1}) stored amla product

Product	Initial	Month					
		1	2	3	4	5	6
Preserve	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Candy	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Jam	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Jelly	0.63	0.63	0.63	0.63	0.60	0.60	0.60
Squash	0.32	0.32	0.32	0.32	0.30	0.30	0.30
Shred	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Soft drink	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Table 21. T.S.S. of stored amla product (°Brix)

Product	Initial	Month					
		1	2	3	4	5	6
Preserve	72	72	72	72	72	72	72
Candy	68	68	68	68	68	68	68
Jam	68	68	68	68	68	68	68
Jelly	68	68	68	68	68	68	68
Squash	40	40	40	40	40	40	40
Shred	72	72	72	72	72	72	72
Soft drink	10	10	10	10	10	10	10

Table 22. Tannin content (mg 100 g^{-1}) of stored amla product

Product	Initial	Month					
		1	2	3	4	5	6
Preserve	2.56	2.25	2.25	2.25	2.25	2.25	2.25
Candy	2.24	2.24	2.24	2.24	2.24	2.24	2.24
Jam	2.14	2.14	2.14	2.14	2.14	2.14	2.14
Jelly	1.95	1.95	1.95	1.95	1.95	1.95	1.95
Squash	1.85	1.85	1.85	1.85	1.85	1.85	1.85
Shred	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Soft drink	2.34	2.14	2.14	2.14	2.14	2.14	2.14

The various amla products were stored for a period of six months at normal room temperature and the results of the chemical constituents of the amla products were analysed at monthly intervals for a period of six months. The results are furnished in Tables 18 to 22.

From Table 18 it is clear that there is decrease in the vitamin C content of various amla products from the initial value. The decrease varied from 9.4 mg (amla shred) to 11.5 mg 100 g^{-1} amla jam.

Table 19 indicates that there is no change in the fibre content of preserve, candy, jam and shred even after six months of storage.

There was no change in the iron content of preserve, candy, jam, shred and soft drink during storage (Table 20). The iron content of jelly and squash was retained upto three months of storage and after that there was a slight decrease in its iron content.

The total soluble solid was retained during six months of storage in all amla products (Table 21).

Except the tannin content of amla preserve and soft drink there was no change in the tannin content of other five products during six months of storage (Table 22).

4.5 Nutritional status of the children

The selected amla preserve (5 g) was fed daily to the selected preschool and school children of 4-6 years and 7-9 years of age respectively so as to meet one third of the Recommended Dietary allowances of nutrients. The feeding was continued for a period of six month.

The nutritional status of preschool and the school going children was ascertained through anthropometric studies, actual food and nutrient intake,

biochemical estimation and clinical examination. The results are presented as follows.

4.5.1 Anthropometric measurements of children

Anthropometric measurements namely body weight, height of control group (CG) and experimental group (EG) of preschool and school going children were recorded before and after the supplementation study. In the case of preschool children mid upper arm circumference, chest and head circumferences were also measured before and after study. The results were compared with the standard measurements suggested by ICMR.

4.5.1.1 Weight for age

The mean weight of preschool and school going children before and after the supplementation study in comparison with the Indian standards and its statistical interpretations are given in Table 23.

As furnished in table 23 an increase of 1.6 kg for boys and 1.36 kg for girls was observed in the EG preschool children after the study which was found to be statistically significant. In the control group preschool children, an increase of 0.35 kg and 0.14 kg was observed for boys and girls respectively. Which was found to be statistically significant.

The mean weight of EG and CG pre school boys and girls before the feeding and among CG boys and girls after the study period was found to be significantly lower than the Indian standards suggested by ICMR. Though an increase of 0.18 kg than the standard was observed among the CG girls after the study period the increase was found to be statistically not significant.

Among EG school going children the mean body weight increased to 1.47 kg for boys and 1.39 kg for girls after the study period. In the control group

Table 23. Comparison of the mean weight of children with the Indian standards before and after the study

Group	Sample size	Indian standard ICMR (kg)	Mean weight (kg)		Deviation from standard (kg)				Average increment in weight (kg)	't' value
			BS	AS	BS	't' value	AS	't' value		
Pre-school										
EG (B)	12	19.20	17.58	19.18	-1.62	15.78**	-0.02	0.29^{NS}	1.60	-10.15**
EG (G)	13	18.69	17.51	18.87	-1.18	11.28**	+0.18	1.60^{NS}	1.36	-5.66**
CG (B)	12	19.20	17.62	17.97	-1.58	14.46**	-1.23	14.61**	0.35	-2.64*
CG (G)	13	18.69	17.48	17.62	-1.21	11.73**	-1.07	10.54**	0.14	7.22*
School children										
EG (B)	12	27.00	25.71	27.18	-1.29	13.58**	+0.18	1.75^{NS}	1.47	-11.455**
EG (G)	13	26.75	25.48	26.87	-1.27	14.48**	+0.12	1.32^{NS}	1.39	-23.17**
CG (B)	12	27.00	25.95	26.41	-1.05	10.08**	-0.59	5.62*	0.46	9.29*
CG (G)	13	26.75	25.50	25.85	-1.25	14.01**	-0.90	8.01*	0.35	24.05**

* Significant at 5% level
** Significant at 1% level
NS - Not significant
EG – Experimental group
CG – Control group

B – Boys
G – Girls
BS – Before study
AS – After study

also there was an increase of 0.46 kg (boys) and 0.35 kg (girls) in the body weight after the study period. The increments in body weight were found to be statistically significant.

The body weight of school going children before and after the study period was compared with the Indian standards. It was observed that the mean weight of boys and girls were significantly lower than the standards suggested by ICMR in both groups except in EG boys and girls after supplementation which was found to be insignificant statistically.

Based on the weight for age, the children in the two groups before and after the study period was categorized into different grades of nutritional status and the results are furnished in Table 24 and 25.

The results indicated that, as per the classification suggested by Gomez *et al.* (1956) 68 per cent and 64 per cent of CG and EG preschool children were having normal nutritional status before the study which increased to 76 per cent and 96 per cent respectively after the study period (Table 24).

The percentage of preschool children with grade I malnutrition decreased to 4 per cent after the study period initial value of 36 per cent in the experimental group. In the control group the percentage of children with grade I malnutrition decreased to 24 per cent from 32 per cent after the study (Fig.1).

In the school going group, all the children in the EG group attained normal nutritional status after the study period while in the control group the children with normal nutritional status increased by 4 per cent after the study (Table 25). None of the children in the experimental group had Grade I malnutrition after the study. In the control group there was a decrease of 4 per cent in children with grade I malnutrition (Fig.2).

Table 24. Distribution of preschool children on the basis of weight for age (Gomez *et al.*, 1956)

Nutritional status	Weight for age % of the std.	CG						EG					
		BS			AS			BS			AS		
		B	G	T	B	G	T	B	G	T	B	G	T
Normal	>90	8 (66.7)	9 (69.23)	17 (68)	9 (75)	10 (76.9)	19 (76)	7 (53.38)	9 (69.23)	16 (64)	11 (91.7)	13 (100)	24 (96)
Grade I Malnutrition	76-90	4 (33.3)	4 (30.77)	8 (32)	3 (33.3)	3 (23.1)	6 (24)	5 (41.7)	4 (30.77)	9 (36)	1 (8.3)	-	1 (4)
Total		12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value (B) = 14.310 * * significant at 1% level
F value (G) = 4.276 * significant at 5% level
B – Boys
G – Girls
BS – Before study
AS – After study
EG – Experimental group
CG – Control group
Numbers in parentheses are percentages

Table 25. Distribution of school children on the basis of weight for age (Gomez *et al.*, 1956)

Nutritional status	Weight for age % of the std.	CG						EG					
		BS			AS			BS			AS		
		B	G	T	B	G	T	B	G	T	B	G	T
Normal	>90	10 (83.3)	11 (84.62)	21 (84)	11 (91.7)	11 (84.62)	22 (88)	9 (75)	10 (76.92)	19 (76)	12 (100)	13 (100)	25 (100)
Grade I Malnutrition	76-90	2 (16.7)	2 (15.38)	4 (16)	1 (8.3)	2 (15.38)	3 (12)	3 (25)	3 (23.08)	6 (24)	-	-	-
Total		12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value (B) = 2.05^{NS}
F value (G) = 3.568*
NS – Not significant
* Significant at 5% level
B – Boys
G – Girls
BS – Before study
AS – After study
EG – Experimental group
CG – Control group
Numbers in parentheses are percentages

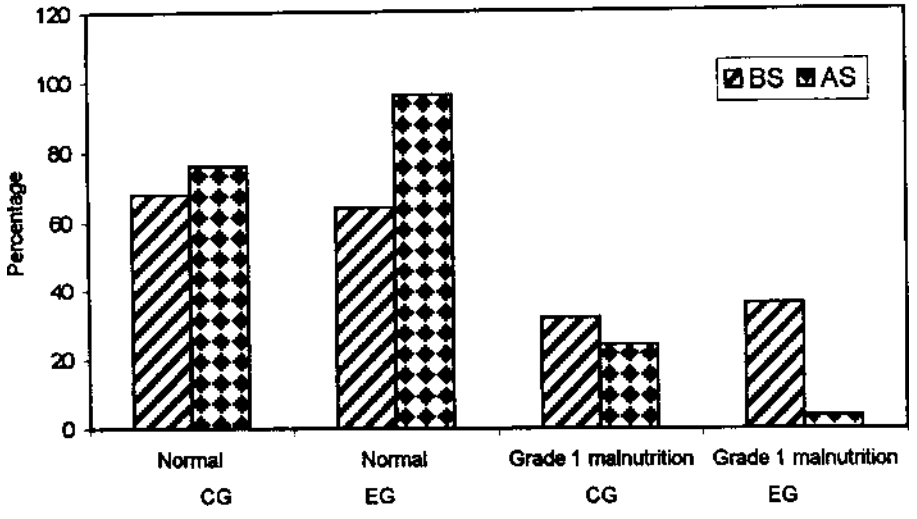


Fig.1. Nutritional status of preschool children on the basis of weight for age before and after study

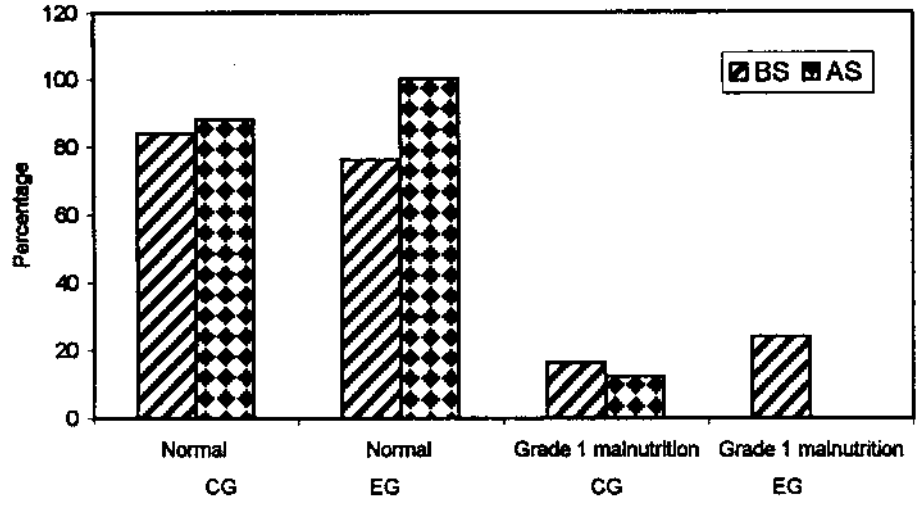


Fig.2. Nutritional status of school children on the basis of weight for age before and after study

CG - Control group
EG - Experimental group

Analysis of variance was done to compare the weight for age of preschool and school going boys and girls after the study indicated that significant variation existed in nutritional status on the basis of weight for age among the boys and girls between control and experimental group preschool children after the study. In the case of school children the variation was found to be insignificant.

4.5.1.2 Height for age

The mean height of children before and after the supplementary feeding in comparison with the Indian standards (ICMR, 1990) and its statistical interpretations are given in Table 26.

From the table it is seen that the mean height of preschool and school going boys and girls increased in both EG and CG categories after the study. The increments in height were found to be statistically significant in most of the groups.

An increase of 0.8 cm and 1.11 cm was observed in EG boys and girls respectively, while an increase of 0.22 cm and 0.51 cm was observed in CG boys and girls respectively after the study.

In the case of school going children an increase of 1.71 cm and 0.66 cm was observed among boys and an increase of 1.17 cm and 0.34 cm was observed among girls of experimental and control groups respectively.

When the height of children was compared with the Indian standards, it was seen that except in the experimental group and control group preschool boys, the mean height of children in all the other groups were significantly lower than the standard height before study period. In the experimental group children the mean height was found to be higher than the standard after the study period but in the increase was found to be statistically insignificant.

Table 26. Comparison of the mean height of children with the Indian standards before and after study

Group	Sample size (No.)	Indian standard (cm)	Mean height (cm)		Deviation from standard (cm)				Average increment in height (cm)	't' value
			BS	AS	BS	't' value	AS	't' value		
Pre-school										
EG (B)	12	112.37	111.83	112.63	-0.54	2.08^{NS}	+0.26	1.37^{NS}	0.80	-8.05*
EG (G)	13	111.39	110.41	111.52	-0.98	4.85*	+0.13	0.72^{NS}	1.11	-24.09**
CG (B)	12	112.37	111.87	112.09	-0.50	1.91^{NS}	-0.28	1.91^{NS}	0.22	4.78*
CG (G)	13	111.39	110.46	110.97	-0.93	4.58*	-0.42	1.91^{NS}	0.51	3.24*
School children										
EG (B)	12	128.27	127.27	128.98	-1.00	4.93*	+0.71	2.63^{NS}	1.71	-11.59**
EG (G)	13	127.65	126.67	127.84	-0.98	6.96*	+0.19	1.83^{NS}	1.17	-20.68**
CG (B)	12	128.27	127.37	128.03	-0.90	5.00*	-0.24	1.27^{NS}	0.66	1.21^{NS}
CG (G)	13	127.65	126.73	127.07	-0.92	3.76*	-0.58	4.18*	0.34	2.60

* Significant at 5% level
** Significant at 1% level
NS - Not significant
EG – Experimental group
CG – Control group

B – Boys
G – Girls
BS – Before study
AS – After study

Table 27. Distribution of preschool children on the basis of height for age (Waterlow, 1972)

Nutritional status	Height for age % of std.	CG						EG					
		BS			AS			BS			AS		
		B	G	T	B	G	T	B	G	T	B	G	T
Normal	>90	11 (91.7)	11 (84.62)	22 (88)	11 (91.7)	11 (84.62)	22 (88)	10 (83.3)	12 (92.31)	22 (88)	12 (100)	13 (100)	25 (100)
Marginal Malnutrition	90-95	1 (8.3)	2 (15.38)	3 (12)	1 (8.3)	2 (15.38)	3 (12)	2 (16.7)	1 (7.69)	3 (12)	0	0	0
Total		12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value (B) = 0.172^{NS}
F value (G) = 0.429^{NS}
NS – Not significant
B – Boys
G – Girls
BS – Before study
AS – After study
EG – Experimental group
CG – Control group
Numbers in parentheses are percentages

Table 28. Distribution of school children on the basis of height for age (Waterlow, 1972)

Nutritional status	Height for age % of std.	CG						EG					
		BS			AS			BS			AS		
		B	G	T	B	G	T	B	G	T	B	G	T
Normal	>90	10 (83.3)	11 (84.62)	21 (84)	11 (91.7)	11 (84.62)	22 (88)	11 (91.7)	11 (84.6)	22 (88)	12 (100)	13 (100)	25 (100)
Marginal Malnutrition	90-95%	2 (16.7)	2 (15.38)	4 (16)	1 (8.3)	2 (15.38)	3 (12)	1 (8.3)	2 (15.4)	3 (12)	-	-	-
Total		12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value (B) = 0.524^{NS}
F value (G) = 1.511^{NS}
NS – Not significant
B – Boys
G – Girls
BS – Before study
AS – After study
EG – Experimental group
CG – Control group
Numbers in parentheses are percentages

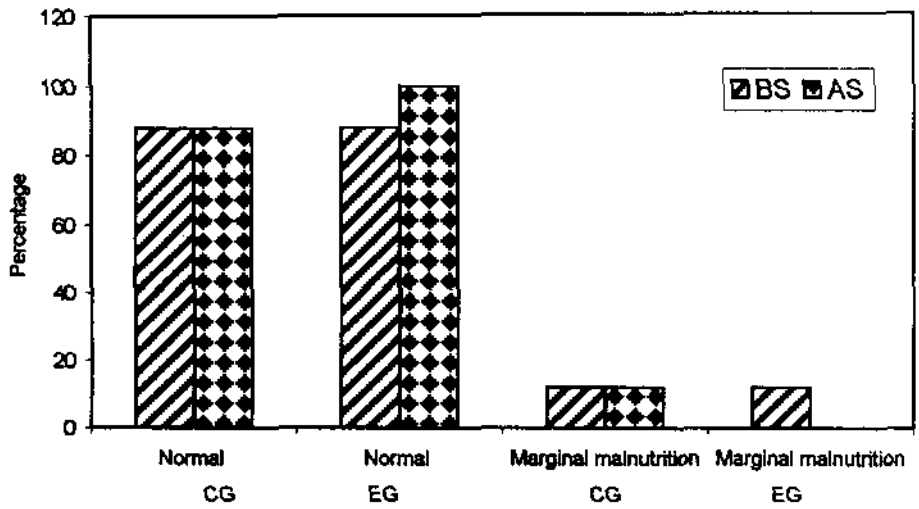


Fig.3. Nutritional status of preschool children on the basis of height for age before and after study

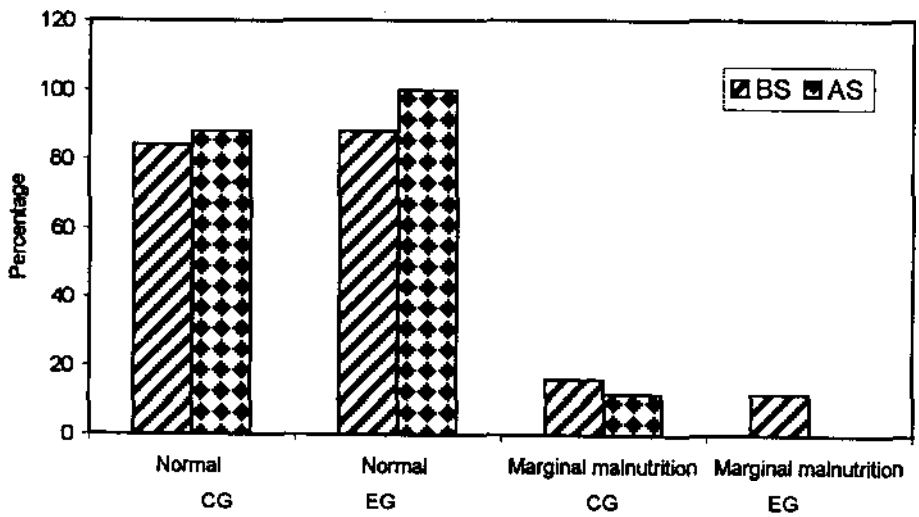


Fig.4. Nutritional status of school children on the basis of height for age before and after study

CG - Control group
EG - Experimental group

The height for age distribution of preschool children in the CG and EG categories, based on Waterlow's (1972) classification is given in Table 27.

The above table revealed a 12 per cent increase in preschool children with normal nutritional status after the supplementary study in the experimental group and with no change in the control group.

Children with marginal malnutrition reduced from 12 per cent to zero per cent in experimental group whereas in the control group the percentage remained the same before and after the study period (Fig.3).

In the case of school going children (Table 28), all the children attained normal nutritional status after the feeding trial in the experimental group while in the control group, an increase of four percentage was observed in children with normal nutritional status (Fig.4).

Variation observed in nutritional status based on height for age among the experimental and control group preschool and school boys and girls after the study period was found to be statistically insignificant.

Weight/height^2 ratio

Anthropometric ratios were worked out using the weight and height measurements of children by the formula suggested by Rao and Singh (1970) and is presented in Table 29 and 30.

As indicated in table 29 the percentage of preschool children having normal nutritional status increased by 20 per cent and 4 per cent respectively in the EG and CG after the feeding trial (Fig.5). A decrease of 20 per cent and 4 per cent was also noticed in experimental and control group children respectively with respect to moderate malnutrition.

Table 29. Distribution of preschool children by weight/height^2 ratio (Rao & Singh, 1970)

Nutritional status	Weight /height^2	CG						EG					
		BS			AS			BS			AS		
		B	G	T	B	G	T	B	G	T	B	G	T
Normal	>0.0015	7 (53.3)	8 (61.54)	15 (60)	7 (53.3)	9 (69.2)	16 (64)	8 (66.4)	7 (53.8)	15 (60)	10 (83.3)	10 (66.9)	20 (80)
Moderate Malnutrition	0.0013-0.0015	5 (41.7)	5 (38.4)	10 (40)	5 (41.7)	4 (30.8)	9 (36)	4 (33.3)	4 (46.2)	10 (40)	2 (16.7)	3 (23.08)	5 (20)
Total		12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value (B) = 3.135^{NS} NS – Not significant
F value (G) = 5.88* Significant at 5% level
B – Boys
G – Girls
BS – Before study
AS – After study
EG – Experimental group
CG – Control group
Numbers in parentheses are percentages

Table 30. Distribution of school [illegible] children by weight/height^2 ratio (Rao & Singh, 1970)

Nutritional status	Weight /height^2	CG						EG					
		BS			AS			BS			AS		
		B	G	T	B	G	T	B	G	T	B	G	T
Normal	>90	9 (75)	8 (61.5)	17 (68)	9 (75)	9 (69.2)	18 (72)	10 (83.3)	10 (76.9)	20 (80)	11 (91.7)	12 (92.4)	23 (92)
Moderate Malnutrition	90-95%	3 (25)	5 (38.5)	8 (32)	3 (25)	4 (30.8)	7 (28)	2 (16.7)	3 (23.1)	5 (20)	1 (8.3)	1 (7.6)	2 (8)
Total		12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value (B) = 0.053^{NS}
F value (G) = 0.623^{NS}
NS – Not significant
B – Boys
G – Girls
BS – Before study
AS – After study
EG – Experimental group
CG – Control group
Numbers in parentheses are percentages

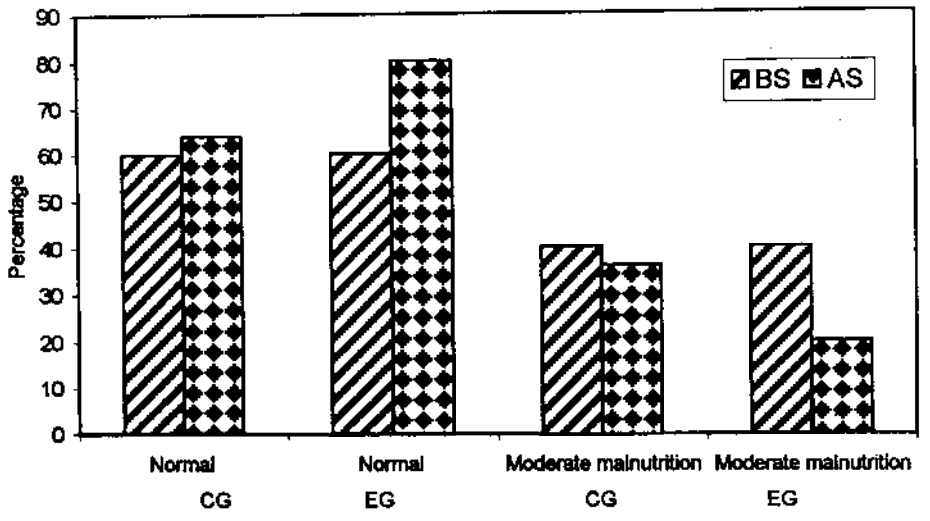


Fig.5. Nutritional status of preschool children on the basis of weight / height^2 before and after study

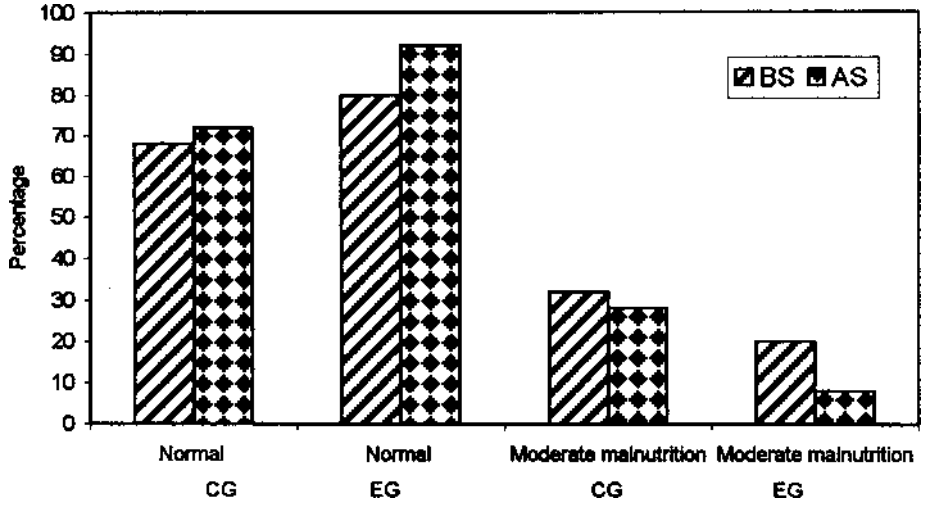


Fig.6. Nutritional status of school children on the basis of weight / height^2 before and after study

CG - Control group
EG - Experimental group

In the case of EG and CG school children (Table 30) an increase of 12 per cent and 4 per cent respectively was observed in the percentage of children with normal nutritional status while the percentage of children with moderate malnutrition decreased from 20 per cent to 8 per cent in the experimental group and from 32 per cent to 28 per cent in control group (Fig.6).

Variation in the weight/height^2 ratio observed between control and experimental group preschool girls only was found to be statistically significant after the study.

4.5.1.3 Mid Upper Arm Circumference (MUAC)

Mid upper arm circumference of preschool children before and after the study was compared with Indian standards (NFI, 1991) and the results are given in Table 31.

As shown in Table 31 with regard to MUAC, both before and after the study period, the values were found to be significantly lower than the standards except in the experimental group boys and girls after the study period in which the deviation was statistically insignificant. The increment of 0.41 cm (boys) and 0.67 cm (girls) noticed in the experimental group children after the study was found to be statistically significant while the increment observed among in the control group for boys (0.06 cm) was statistically insignificant.

Observations of the mid upper arm circumference of preschool children were interpreted according to the classification suggested by Gopaldas and Seshadri (1987) and is presented in Table 32 and Fig.7.

As revealed in the table an increase was observed in the percentage of children with normal nutritional status in the EG children by 20 per cent, after the study period while there was no change in the control group. None of the

Table 31. Comparison of the mean mid upper arm circumference of preschool children with the Indian standard before and after study

Group	Sample size (No.)	Indian standard (cm)	Mean MUAC (cm)		Deviation from standard (cm)				Average increment in MUAC (cm)	't' value
			BS	AS	BS	't' value	AS	't' value		
Pre-school										
EG (B)	12	16	15.54	15.95	-0.46	5.16*	-0.05	0.55^{NS}	0.41	-18.42**
EG (G)	13	16	15.18	15.85	-0.82	9.12**	-0.15	1.82^{NS}	0.67	-11.29**
CG (B)	12	16	15.63	15.69	-0.37	4.00*	-0.31	3.21*	0.06	0.021^{NS}
CG (G)	13	16	15.21	15.28	-0.79	8.70*	-0.72	7.80*	0.07	10.64*

* Significant at 5% level
** Significant at 1% level
NS - Not significant
EG – Experimental group
CG – Control group

B – Boys
G – Girls
BS – Before study
AS – After study

Table 32. Distribution of pre-school children based on mid upper arm circumference (Gopaldas and Seshadri, 1987)

Nutritional status	MUAC (cm)	CG						EG					
		BS			AS			BS			AS		
		B	G	T	B	G	T	B	G	T	B	G	T
Normal	>13.5	11 (91.7)	10 (76.9)	21 (84)	11 (91.7))	10 (76.9)	21 (84)	10 (83.3)	10 (76.9)	20 (80)	12 (100)	13 (100)	25 (100)
Moderate malnutrition	12.5-13.5	1 (8.3)	3 (23.1)	4 (16)	1 (8.3)	3 (23.1)	4 (16)	2 (16.7)	3 (23.1)	5 (20)	-	-	-
Total		12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value (B) = 13.08** significant at 1 % level
F value (G) = 7.79* significant at 1 % level
B – Boys
G – Girls
BS – Before study
AS – After study
EG – Experimental group
CG – Control group
Numbers in parentheses are percentages

experimental group had moderate malnutrition after the study period which was observed to be 20 per cent before the study. In the control group children there was no change in the nutritional status before and after the study. Analysis of variance data indicated significant variation in nutritional status between control and experimental group boys as well as girls on the basis of MUAC.

4.5.1.4 Chest circumference

The mean chest circumference of preschool children was compared with the Indian standards suggested by NFI (1991) and the results are presented in Table 33.

As furnished in the table, an increase of 1.38 cm and 0.28 cm in the chest circumference was observed among boys and girls respectively of the experimental group. These increments were found to be statistically significant. In the control group children though an increase in chest circumference was observed in boys (0.62 cm) and girls (0.10 cm), the increase was found to be statistically significant only in the case of boys.

As shown in Table 33 with regard to chest circumference, both before and after the study in EG and CG boys, the chest circumference was found to be higher than the standards. In the case of girls of EG category though, the chest circumference was found to be significantly lower than the standards before the study, the CC was found to be significantly higher than the standards after study. In the case of control group girls both before and after the study period, the mean chest circumference was found to be significantly lower than the standards.

4.5.1.5 Head circumference (HC)

Comparison of the mean HC of preschool children with the Indian standards (NFI, 1991) are given in Table 34.

Table 33. Comparison of mean chest circumference of preschool children with the Indian standard before and after study

Group	Sample size (No.)	Indian standard (cm)	Mean CC (cm)		Deviation from standard (cm)				Average increment in CC (cm)	't' value
			BS	AS	BS	't' value	AS	't' value		
Pre-school										
EG (B)	12	51.10	51.31	52.69	+0.21	3.27*	+1.59	2.45^{NS}	1.38	-8.26*
EG (G)	13	52.10	51.91	52.19	-0.19	5.04*	+0.09	3.44*	0.28	-9.36*
CG (B)	12	51.10	51.29	51.91	+0.19	3.88*	+0.78	15.12**	0.62	5.42*
CG (G)	13	52.10	51.88	51.98	-0.22	6.21*	-0.12	2.73*	0.10	1.164^{NS}

* Significant at 5% level
** Significant at 1% level
NS - Not significant
EG – Experimental group
CG – Control group

B – Boys
G – Girls
BS – Before study
AS – After study

Table 34. Comparison of the mean head circumference of pre school children with the Indian standard before and after study

Group	Sample size (No.)	Indian standard (cm)	Mean HC (cm)		Deviation from standard (cm)				Average increment in HC (cm)	't' value
			BS	AS	BS	't' value	AS	't' value		
EG (B)	12	50.43	50.23	50.56	-0.20	15.04*	+0.13	10.40*	0.33	-5.86*
EG (G)	13	49.42	49.83	50.16	+0.41	17.23*	+0.74	18.50*	0.33	5.31*
CG (B)	12	50.43	50.28	50.31	-0.15	12.24*	-0.12	11.12*	0.03	3.00*
CG (G)	13	49.42	49.95	50.03	+0.53	15.27*	+0.63	16.21*	0.08	6.74*

* Significant at 5% level
** Significant at 1% level
NS - Not significant
EG – Experimental group
CG – Control group

B – Boys
G – Girls
BS – Before study
AS – After study

Table 35. Distribution of pre-school children on the basis of head/chest circumference ratio

Nutritional status	HC/CC ratio	CG						EG					
		BS			AS			BS			AS		
		B	G	T	B	G	T	B	G	T	B	G	T
Normal	<1	12 (100)	12 (92.31)	24 (96)	12 (100)	12 (92.31)	24 (96)	11 (91.7)	12 (92.31)	23 (92)	12 (100)	13 (100)	25 (100)
Malnutrition	>1	-	1 (7.69)	1 (4)	0	1 (7.69)	1 (4)	1 (83.)	1 97.69)	2 (8)	-	-	-
Total		12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value (EG) = 10.96* significant at 5% level
F value (CG) = 0.288^{NS}
NS – Not significant
B – Boys
G – Girls
BS – Before study
AS – After study
EG – Experimental group
CG – Control group
Numbers in parentheses are percentages

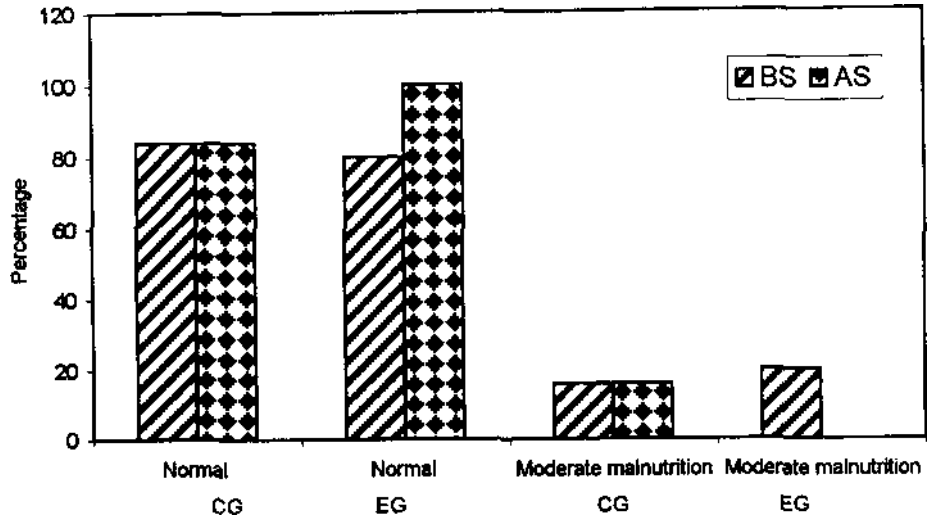


Fig.7. Nutritional status of preschool children on the basis of MUAC before and after study

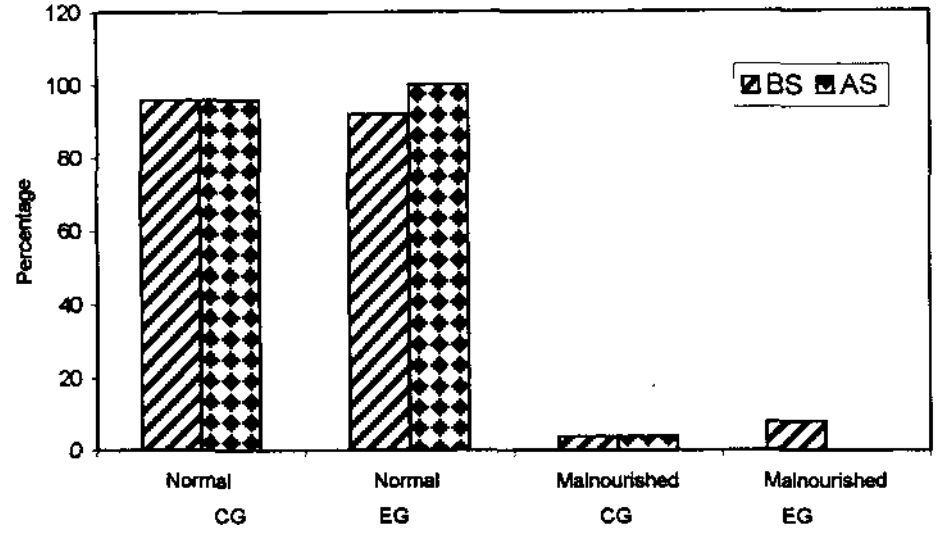


Fig.8. Nutritional status of preschool children on the basis of HC/CC before and after study

CG - Control group
EG - Experimental group

The results revealed that the mean HC of EG boys was significantly lower than the standards before the study period, which became significantly higher than the standards after the study period. In the EG and CG girls the HC was found to be significantly higher than the standards before and after the study, the CG boys had significantly lower mean HC before and after the study.

An increase of 0.33 cm in HC was observed in EG boys and girls after the study, both of which were found to be statistically significant. The increase in HC observed among boys (0.03 cm) and girls (0.08 cm) of the control group, was found to be statistically significant.

Head/chest circumference ratio

The head to chest circumference ratio as suggested by Gopaldas and Seshadri (1987) was used to interpret the grades of malnutrition among children. The results are furnished in Table 35.

From the table it is seen that all the EG children attained normal nutritional status after the study period which was found to be 92 per cent before the study. In the case of control group children there was no change in the percentage of children with normal nutritional status before and after the study (Fig.8). Variation in nutritional status on the basis of HC/CC ratio between experimental and control group boys was found to be statistically significant.

4.5.2 Food and nutrient intake

The data on the actual food intake of children as assessed by weighment method of diet survey is given in Tables 36 and 37.

From the table it is evident that the intake of all food groups except pulses, other vegetables and roots and tubers by the CG and EG preschool (Table 36) and school going children (Table 37) was significantly lower than the RDA

Table 36. Mean food intake of preschool children in comparison with RDA

	CG				EG		
Food item	RDA (g)	Mean food intake	% RDA	't' value	Mean food intake	% RDA	't' value
Cereals	270	240.6	89.1	12.64*	239.5	88.70	8.54*
Pulses	20	30.8	154.0	0.42^{NS}	29.4	147.0	0.38^{NS}
Green leafy vegetables	50	14.6	29.2	13.21*	10.4	20.8	14.62*
Other Vegetables	30	58.2	194.0	0.02^{NS}	56.4	188.0	0.28^{NS}
Roots & tubers	20	38.3	191.5	0.01^{NS}	35.6	178.0	0.31^{NS}
Fruits	50	27.3	54.6	7.31*	26.0	52.0	7.73*
Milk	250	152.3	60.92	10.14*	144.6	57.8	8.92*
Meat/Fish/ Egg	30	28.5	95.0	3.21*	28.0	93.3	3.24*
Fats & Oils	30	12.3	41.0	12.35*	13.0	43.33	12.61*
Sugar & Jaggary	40	17.2	43.0	13.41*	16.8	42.0	6.42*

EG – Experimental group
CG – Control group
** Significant at 1% level
* Significant at 5% level
NS - not significant

Table 37. Mean food intake of School children in comparison with RDA

	CG				EG		
Food item	RDA (g)	Mean food intake	% RDA	't' value	Mean food intake	% RDA	't' value
Cereals	325	295.6	90.95	2.78*	292.6	90.03	3.06*
Pulses	20	32.3	161.50	0.49^{NS}	31.4	157.00	0.46^{NS}
Green leafy vegetables	50	21.3	42.6	4.44*	19.6	39.2	4.71*
Other Vegetables	30	95.3	317.66	0.02^{NS}	98.2	327.30	0.02^{NS}
Roots & Tubers	20	69.2	346	0.08^{NS}	71.4	357.00	0.07^{NS}
Fruits	50	40.8	81.6	2.96*	38.2	76.40	3.79*
Milk	250	118.4	47.4	13.25*	121.2	48.5	10.46*
Meat/Fish/ Egg	60	29.6	49.3	20.83*	25.8	43.00	22.39**
Fats & Oils	35	14.2	40.57	13.28*	13.8	39.43	14.12**
Sugar & Jaggary	45	15.8	35.11	10.24*	14.3	31.77	11.12*

NS – Not significant
** - Significant at 1% level
* - Significant at 5% level
EG – Experimental group
CG – Control group

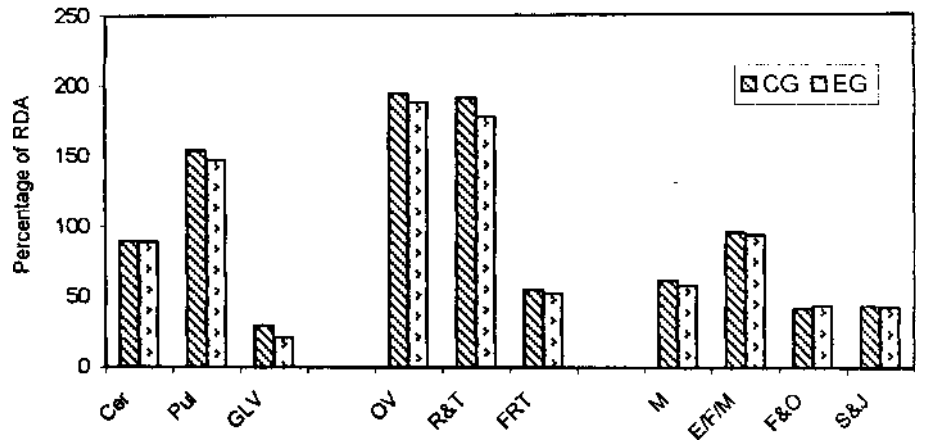


Fig.9. Food intake of pre school children as percentage of RDA

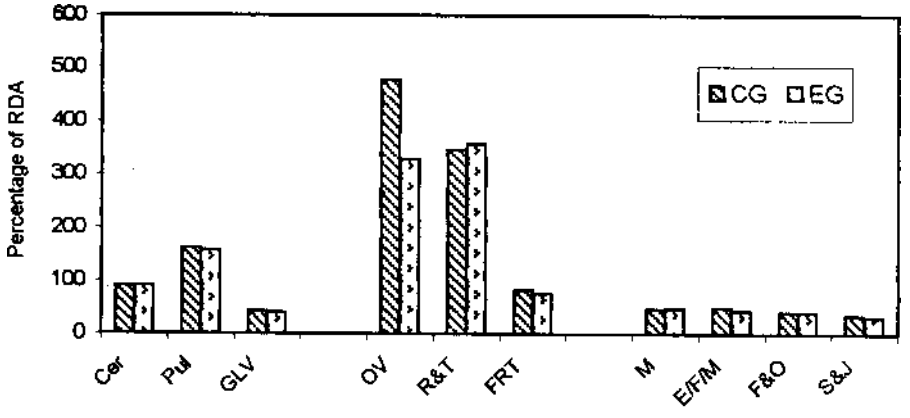


Fig. 10. Food intake of school children as percentage of RDA

Cer - Cereals	GLV - Green leafy vegetables
Pul - Pulses	OV - Other vegetables
R&T - Roots & tubers	FRT - Fruits
M - Milk	E/F/M - Egg/Fish/Meat
F&O - Fats & Oils	S&J - Sugar & Jaggery

Table 38. Mean nutrient intake of preschool children in comparison with RDA

	CG				EG		
Nutrient	RDA	Mean nutrient intake	% RDA	't' value	Mean nutrient intake	% RDA	't' value
Energy (K cal)	1690	1498	88.63	6.43*	1475	87.28	4.52*
Protein (g)	30	32.8	109.3	0.13^{NS}	32.4	108.2	0.35^{NS}
Calcium (mg)	400	311.3	77.83	8.32*	308.6	77.5	6.73*
Iron (mg)	18	15.4	85.5	6.42*	14.6	81.1	8.42*
Vitamin A (mcg)	400	284.0	71.1	9.53*	292.8	73.2	10.52**
Thiamine (mg)	0.9	0.71	78.8	10.46*	0.58	75.5	8.42*
Riboflavin (mg)	1.0	0.69	69.0	5.92*	0.69	69.0	9.54**
Niacin (mg)	11.0	8.3	75.5	8.93*	8.1	73.2	11.34**
Vitamin C (mg)	40	16.3	40.7	10.42**	14.7	36.8	15.46**

NS – Not significant
** - Significant at 1% level
* - Significant at 5% level
EG – Experimental group
CG – Control group

Table 39. Mean nutrient intake of school children in comparison with RDA

		CG			EG		
Nutrient	RDA	Mean nutrient intake	% RDA	't' value	Mean nutrient intake	% RDA	't' value
Energy (K cal)	1950	1810	92.82	5.60*	1824	93.54	4.04*
Protein (g)	41	43.2	106.1	0.28 NS	43.08	105.1	0.23 NS
Calcium (mg)	400	348.6	87.6	4.54*	358.4	89.6	5.43*
Iron (mg)	26	21.2	84.8	12.30*	20.7	82.8	14.73*
Vitamin A (mcg)	600	474.0	74.5	8.42*	438.7	73.1	8.32*
Thiamine (mg)	1.0	0.73	73.0	7.32*	0.78	78.0	5.42*
Riboflavin (mg)	1.2	0.79	65.8	8.46*	0.75	62.5	6.73*
Niacin (mg)	13.0	8.4	64.6	6.73*	8.9	68.5	6.8*
Vitamin C (mg)	40	18.2	45.5	8.92*	19.1	47.7	17.42**

NS – Not significant
** - Significant at 1% level
* - Significant at 5% level
EG – Experimental group
CG – Control group

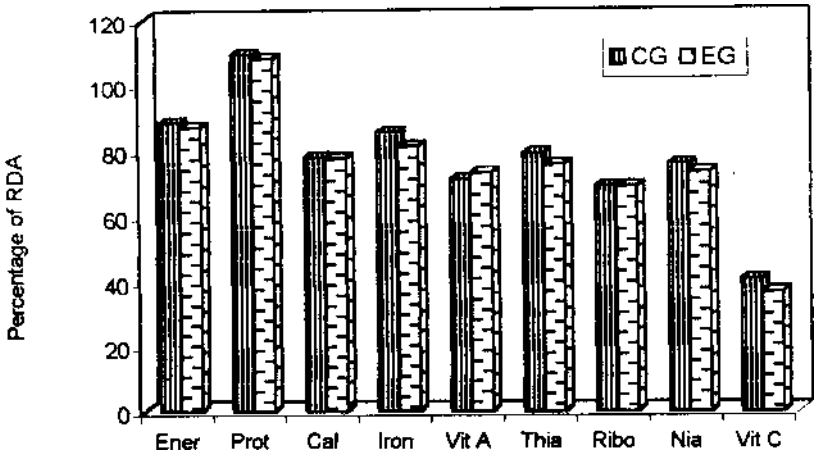


Fig. 11. Nutrient intake of preschool children as percentage of RDA

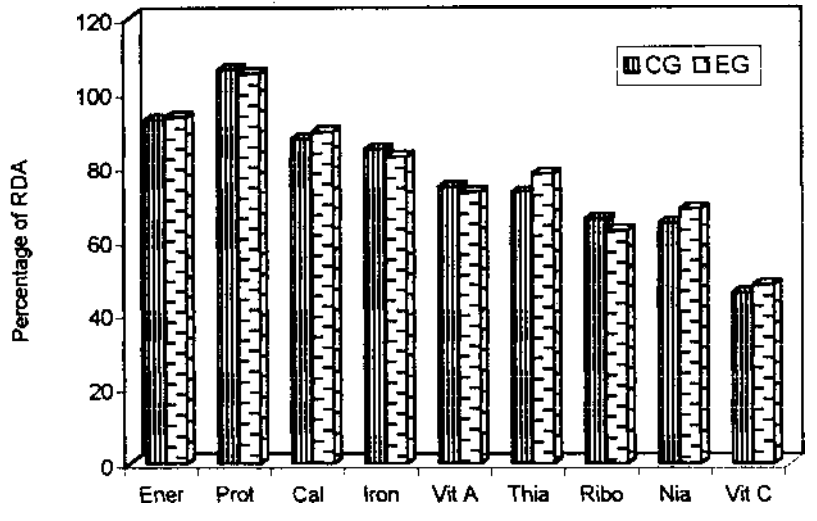


Fig. 12. Nutrient intake of school children as percentage of RDA

Ener - Energy
Prot - Protein
Cal - Calcium
Iron - Iron
Vit A - Vitamin A
Thia - Thiamine
Ribo - Riboflavin
Nia - Niacin
Vit C - Vitamin C

suggested by ICMR (1984). Though the consumption of pulses ,other vegetables and roots and tubers was higher than the RDA, they were not statistically significant in all the four groups (Fig.9 and 10) .

Table 38 presents the details regarding the intake of nutrients by the preschool children.

The results indicated that the intake of all nutrients except protein was significantly lower than the RDA suggested by ICMR (1990) among preschool children in the control and experimental groups. Though the intake of protein was found to be higher than the RDA in both categories, it was statistically insignificant.

In the case of school children also (Table 39) the intake of all nutrients except protein was found to be significantly lower than the RDA. The intake of protein was found to be higher than the RDA in both control and experimental group children and it was statistically insignificant.

4.5.3 Biochemical estimation of blood

Table 40 furnishes the results of the mean haemoglobin estimation of blood of the preschool and school children before and after the supplementary feeding trial with amla.

From the table it is seen that the haemoglobin level of blood had increased in both control and experimental groups. The control group preschool boys and girls showed an increase of 0.5 and 0.3 g 100 ml^{-1} respectively. Experimental group boys and girls showed an increment of 1.3 and 1.1 g 100 ml^{-1} respectively. Statistical analysis also revealed that the increment in the mean haemoglobin levels after the study was significant in both the groups.

Among the school children also there was an increase in the haemoglobin level of blood after the study in both boys and girls. An increase of

Table 40. Mean haemoglobin values of children before and after the study.

Group	Mean haemoglobin g/100ml													
	Control group							Experimental group						
	BS		AS		Average increment (g/100ml)		't' value for increment	BS		AS		Average increment (g/100ml)		't' value for increment
	B	G	B	G	B	G		B	G	B	G	B	G	
Preschool	10.1	10.4	10.6	10.7	0.5	0.3	3.64*	9.8	10.1	11.1	11.2	1.3	1.1	29.33**
School children	10.3	10.2	10.7	10.6	0.4	0.4	6.12*	10.2	10.3	11.2	11.0	1.0	0.7	47.57**

* Significant at 5 % level
** Significant at 1% level
CG – Control group
BS – Before study
B - Boys
G - Girls
EG – Experimental group
AS – After study

Table 41. Distribution of preschool children on the basis of haemoglobin level before and after study

Haemoglobin level g/dl	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
>11 (acceptable)	2 (16.67)	4 (30.71)	6 (24)	2 (16.67)	5 (38.46)	7 (28)	3 (25)	2 (15.36)	5 (20)	9 (75)	7 (38.9)	16 (64)
10-10.9 (low)	8 (66.67)	6 (46.15)	14 (66)	8 (66.67)	7 (53.85)	15 (60)	7 (58.3)	5 (58.46)	12 (48)	3 (25)	4 (30.7)	7 (28)
<10 (deficient)	2 (16.67)	3 (23.08)	5 (20)	2 (10.67)	1 (9.69)	3. (12)	2 (16.7)	6 (46.16)	8 (32)	0	2 (15.4)	2 (8)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value = 0.738^{NS} (CG)
F value = 118.53** (EG)
B – Boys
G - Girls
CG – Control group
EG – Experimental group

**Significant at 1% level
NS – not significant
AS – After study
T - Total
BS – Before study
Numbers in parentheses are percentage

Table 42. Distribution of school children on the basis of haemoglobin level before and after study

Haemoglobin level g/dl	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
>11 (acceptable)	2 (16.67)	3 (23.08)	5 (20)	3 (25)	3 (23)	6 (24)	1 (8.33)	2 (15.38)	3 (12)	7 (58.3)	10 (76.92)	17 (68)
10-10.9 (low)	5 (41.7)	7 (53.85)	12 (48)	5 (41.7)	8 (61.5)	13 (52)	7 (58.33)	8 (61.53)	15 (60)	4 (33.3)	2 (15.38)	6 (24)
<10 (deficient)	5 (41.7)	3 (23.08)	8 (32)	4 (33.3)	2 (15.4)	6 (24)	4 (33.3)	3 (23.08)	7 (28)	1 (8.33)	1 (7.69)	2 (8)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value = 0.286^{NS} (CG)
F value = 117.03** (EG)
B – Boys
G - Girls
CG – *Control group*
EG – Experimental group

**Significant at 1% level
NS – not significant
AS – After study
T - Total
BS – Before study
Numbers in parentheses are percentage

0.4 g 100 ml^{-1} was observed among boys and girls while an increase of 1.0 and 0.7 g 100 ml^{-1} respectively was observed among the boys and girls of experimental group. The increments were found to be statistically significant.

The haemoglobin values of the preschool and school going children before and after the study was compared with the standard values suggested by WHO as given by Gopaldas and Seshadri (1987) and the results are given in Tables 41 and 42.

From the table it is revealed that 24 per cent and 20 per cent of preschool and school children in the control group had an acceptable level (above 11 g 100 g^{-1}) of haemoglobin before the study which increased to only 28 per cent and 24 per cent respectively after the study. In the experimental group 20 per cent (preschool) and 12 per cent (school going) children had acceptable haemoglobin values before the study which increased to 64 per cent and 68 per cent respectively after the study. Analysis of variance data also indicated significant variation in the haemoglobin level between the control and experimental groups after the study.

4.5.4 Clinical examination of children

The control and experimental group preschool and school going children were examined for manifestation of any clinical symptoms before and after the study. The results are tabulated in Tables 43 and 44.

From the table it is clear that before the feeding trial 40 per cent and 48 per cent preschool children in the control and experimental group respectively manifested clinical symptoms. After the study period the percentage of preschool children with clinical symptoms reduced to 36 per cent in the control group and 24 per cent in the experimental group. In the case of school children 36 per cent and 24 per cent of children in the control group had clinical symptoms before the study which decreased to 32 per cent in control group and 8 per cent in experimental

Table 43. Manifestation of clinical symptoms among pre school children before and after study

Clinical symptoms	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
Present	6 (50)	4 (30.77)	10 (40)	5 (66.7)	4 (30.77)	9 (36)	6 (50)	6 (46.2)	12 (48)	4 (33.3)	2 (15.38)	5 (24)
Absent	6 (50)	9 (69.23)	15 (60)	7 (33.3)	9 (69.23)	16 (64)	6 (50)	7 (53.8)	13 (52)	8 (66.7)	11 (84.62)	19 (76)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

B – Boys
G - Girls
CG – Control group
EG – Experimental group
Numbers in parentheses are percentages

AS – After study
T - Total
BS – Before study

Table 44. Manifestation of clinical symptoms among school children before and after study

Clinical symptoms	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
Present	5 (66.7)	4 (30.77)	9 (36)	5 (66.7)	3 (23.1)	8 (32)	4 (33.3)	2 (15.4)	6 (24)	1 (8.3)	1 (92.31)	2 (8)
Absent	7 (33.3)	9 (69.23)	16 (64)	7 (33.3)	10 76.92)	17 (78)	8 (66.7)	11 (84.6)	19 (76)	11 (91.77)	12 (7.69)	23 (92)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

B – Boys
G - Girls
CG – Control group
EG – Experimental group
Numbers in parentheses are percentages

AS – After study
T - Total
BS – Before study

Table 45. Clinical signs present among pre school children before and after study

Clinical signs	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
Anaemia	2 (16.67)	3 (23.03)	5 (20)	2 (16.67)	3 (23.08)	5 (20)	2 (16.67)	2 (15.38)	4 (16)	0	0	0
Dental carries	3 (25)	1 (7.69)	4 (16)	3 (25)	1 (7.69)	4 (16)	4 (33.3)	2 (15.35)	6 (24)	4 (33.3)	2 (15.4)	6 (24)
Anore-xia	1 (8.35)	0	1 (4)	0	0	0	0	2 (15.38)	2 (8)	0	0	0
None	6 (50)	9 (69.23)	15 (60)	7 (58.3)	9 (69.23)	16 (64)	6 (50)	7 (58.5)	13 (52)	8 (66.7)	11 (84.6)	19 (76)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

B – Boys
G - Girls
CG – Control group
EG – Experimental group
Numbers in parentheses are percentages

AS – After study
T - Total
BS – Before study

Table 46. Clinical signs present among school children before and after study

Clinical signs	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
Anaemia	2 (16.7)	2 (15.38)	4 (16)	2 (16.7)	2 (15.38)	4 (16)	2 (16.7)	1 (7.7)	3 (12)	0	0	0
Dental carries	2 (16.7)	1 (7.69)	3 (12)	2 (16.7)	1 (7.69)	3 (12)	1 (8.3)	1 (7.7)	2 (8)	1 (8.3)	1 (7.69)	2 (8)
Anore-xia	1 (8.33)	1 (7.69)	2 (8)	1 (8.3)	0	1 (4)	1 (8.3)	0	1 (4)	0	0	0
None	7 (58.3)	9 (69.23)	16 (64)	7 (38.3)	10 (76.92)	17 (68)	8 (66.7)	11 (84.6)	19 (76)	11 (91.7)	12 (92.31)	23 (92)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

B – Boys
G - Girls
CG – Control group
EG – Experimental group
AS – After study
T - Total
BS – Before study
Numbers in parentheses are percentages

group (Table 44). Majority of preschool and school going children did not have any clinical symptoms.

As evident from Table 45 and 46 only dental carries, anaemia and anorexia were prevalent among both preschool and school going children in the control and experimental groups.

Among control group, 20 percent preschool children manifested symptoms of anaemia before the study and there was no change in the percentage after the study (Table 45). In the case of experimental group preschool children 16 per cent had anaemic symptoms before the study which decreased to zero percentage after the study.

In the case of school children also 16 per cent (CG) and 12 per cent (EG) had manifested symptoms of anaemia before the study period which decreased to zero percentage in the experimental group after the study, While there was no change in the control group (Table 46).

Dental caries was observed among 16 per cent and 24 per cent of preschool children and 12 per cent and 8 per cent of school children in the control and experimental group respectively before the study. There was no change in the symptoms after the study period in both groups.

From the table it is clear that only few children had anorexia in different groups which reduced to zero percentage in experimental group preschool and school going children.

4.6 Behaviour of the children

The behaviour trait with particular reference to inertia, activation and stability was conducted among children before and after the study period and the results are furnished in Tables 47 to 52.

Table 47. Distribution of preschool children on the basis of behaviour trait (Inertia) before and after study

Inertia (points)	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
35	0	2 (16.67)	2 (8)	0	2 (16.67)	2 (8)	1 (8.3)	0	1 (4)	2 (16.7)	4 (30.6)	6 (24)
<35	2 (16.7)	3 (23.07)	5 (20)	2 (16.7)	3 (23.07)	5 (20)	3 (25)	1 (7.7)	4 (16)	4 (33.3)	2 (16.6)	6 (24)
>35	10 (83.3)	8 (61.54)	18 (72)	10 (83.3)	8 (61.54)	18 (72)	8 (66.7)	12 (92.3)	20 (80)	6 (50)	7 (53.8)	13 (52)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value = 0.00^{NS} (CG)
F value = 0.738^{NS} (EG)
NS – Not significant
B – Boys
G - Girls
T - Total
BS – Before study
AS – After study
CG – Control group
EG – Experimental group
Numbers in parentheses are percentages

Table 48. Distribution of school children on the basis of behaviour trait (Inertia) before and after study

Inertia (points)	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
35	0	3 (26.07)	3 (12)	1 (8.3)	3 (26.07)	4 (16)	0	2 (15.4)	2 (8)	2 (16.7)	4 (30.77)	6 (24)
<35	2 (16.7)	2 (15.38)	4 (16)	3 (25)	2 (15.38)	5 (20)	2 (16.7)	3 (26.1)	5 (20)	4 (33.3)	5 (38.46)	9 (36)
>35	10 (83.3)	8 (61.54)	18 (72)	8 (66.7)	8 (61.54)	16 (64)	10 (83.3)	8 (61.5)	18 (72)	6 (50)	4 (30.77)	10 (40)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value = 0.16^{NS}

F value = 0.172^{NS}

NS – Not significant

B – Boys

G – Girls

T - Total

BS – Before study

AS – After study

CG – Control group

EG – Experimental group

Numbers in parentheses are percentages

From table 47 it is clear that the mean total points obtained for normal inertia (35 points) showed an increase from 4 per cent to 24 per cent in the experimental group preschool children, while there was no change in the control group. There was no change in the percentage of children with less and high inertia in the control group preschool children. But in the experimental group children the percentage of children with high inertia reduced to 52 per cent from the initial value of 80 per cent before the study. The percentage of children with less inertia increased by 8 per cent in the experimental group children.

Analysis of variance data indicated that the variation observed among control and experimental group preschool children before and after study was statistically not significant.

In the case of school going children (Table 48) there was an increase in the percentage of children with normal inertia in both control and experimental group. The increase being 4 per cent in the control group and 16 per cent in the experimental groups. There was a decrease in the percentage of children with high inertia in the control (from 72% to 64%) and experimental groups (72% to 40%) and an increase in the percentage of children with less inertia in control group (16 to 20%) and in experimental group (20% to 36%).

The variation observed was found to be statistically not significant.

The mean scores obtained for the second attribute of behaviour trait namely activation is furnished in Tables 49 and 50.

From table 49 it is evident that the normal score of 35 was obtained for 16 per cent and 4 per cent of preschool children in the control and experimental groups respectively before the study period, while after the study period the percentage increased to 24 per cent and 16 per cent respectively. There was no change in the percentage of children with a score of above 35, before and after the

Table 49. Distribution of preschool children on the basis of behaviour traits (Activation) before and after study

Activation (Points)	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
35	2 (16.7)	2 (15.38)	4 (16)	3 (25)	3 (23.08)	6 (24)	0	1 (7.67)	1 (4)	2 (16.7)	2 (15.38)	4 (16)
<35	7 (53.3)	8 (61.54)	15 (60)	6 (50)	7 (53.85)	13 (52)	10 (83.3)	10 (76.9)	20 (80)	9 (75)	10 (76.9)	19 (86)
>35	3 (25)	3 (23.08)	6 (24)	3 (25)	3 (23.08)	6 (24)	2 (16.7)	2 (15.38)	4 (10)	1 (8.3)	1 (7.69)	2 (8)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value = 0.112^{NS} (CG)
F value = 2.08^{NS} (EG)
NS – Not significant
T - Total
BS – Before study
AS – After study
CG – Control group
EG – Experimental group
Numbers in parentheses are percentages

Table 50. Distribution of school children on the basis of behaviour trait (Activation) before and after study

Activation (Points)	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
35	1 (8.3)	2 (15.38)	3 (12)	1 (8.3)	2 (15.38)	3 (12)	2 (16.6)	3 (23.1)	5 (20)	6 (50)	4 (30.7)	10 (40)
<35	5 (41.7)	7 (53.85)	12 (48)	5 (41.7)	7 (53.85)	12 (48)	5 (41.7)	7 (53.85)	12 (48)	4 (33.3)	6 (46.2)	10 (40)
>35	6 (50)	4 (30.77)	10 (40)	6 (50)	4 (30.77)	10 (40)	5 (41.7)	3 (23.1)	8 (32)	2 (16.7)	3 (23.1)	5 (20)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value = 1.327^{NS} (CG)
F value = 3.27^{NS} (EG)
NS – Not significant
T - Total
BS – Before study
AS – After study
CG – Control group
EG – Experimental group
Numbers in parentheses are percentages

study period the percentage increased to 24 per cent and 16 per cent respectively. There was no change in the percentage of children with a score of above 35, before and after the study period in the control group, while the percentage decreased by 8 per cent in the experimental group after supplementation.

Analysis of variance indicated that the variation observed in the two group before and after the study was statistically insignificant.

In the school going group also there was no change in the percentage of children in the three categories of activation (Table 50) before and after study in the control group, while the percentage of children with normal activation increased by 20 per cent in the experimental group after supplementation and the percentage of children with more than 35 and less than 35 decreased by 12 per cent and 8 per cent respectively in the experimental group.

The mean total points observed for third component of behaviour trait namely stability is furnished in Table 51 and 52.

From table 51 it is clear that there is no change in the scores obtained for control group preschool and school going children before and after study with respect to various scores for stability. In the case of experimental group preschool children the percentage of children with normal stability increased from 12 per cent to 24 per cent. In the other two categories a decrease was observed. The variation was found to be statistically not significant.

Among the school children (Table 52) in the experimental group there was an increase of 44 per cent after supplementation from the initial percentage of 28 per cent with respect to normal stability, while a decrease was observed in the other two groups. The variation was statistically not significant.

Table 51. Distribution of preschool children on the basis of behaviour trait (Stability) before and after study

Stability (Points)	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
35	2 (16.7)	3 (23.08)	5 (20)	2 (16.7)	3 (23.08)	5 (20)	2 (16.7)	1 (8.3)	3 (12)	3 (25)	3 (23.08)	6 (24)
<35	9 (7.5)	8 (61.54)	17 (68)	9 (75)	8 (61.54)	17 (68)	8 (66.4)	10 (76.9)	18 (72)	7 (53.3)	9 (69.2)	16 (64)
>35	1 (8.3)	2 (15.38)	3 (12)	1 (8.3)	2 (15.38)	3 (12)	2 (16.7)	2 (15.38)	4 (16)	2 (16.7)	1 (7.69)	3 (12)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value = 0.280^{NS} (CG)
F value = 0.727^{NS} (EG)
NS – Not significant
T - Total
BS – Before study
AS – After study
CG – Control group
EG – Experimental group
Numbers in parentheses are percentages

Table 52. Distribution of school children on the basis of behaviour trait (Stability) before and after study

Stability (Points)	CG						EG					
	BS			AS			BS			AS		
	B	G	T	B	G	T	B	G	T	B	G	T
35	1 (8.3)	2 (15.38)	3 (12)	1 (8.3)	2 (15.38)	3 (12)	3 (25)	3 (23.08)	6 (24)	2 (16.7)	2 (15.38)	4 (10)
<35	7 (53.3)	8 (61.54)	15 (60)	7 (53.3)	8 (61.54)	15 (60)	6 (50)	6 (46.2)	12 (48)	4 (33.3)	6 (46.2)	10 (40)
>35	4 (33.3)	3 (23.08)	7 (28)	4 (33.3)	3 (23.08)	7 (28)	3 (25)	4 (30.77)	7 (28)	6 (25)	5 (38.5)	11 (44)
Total	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)	12 (100)	13 (100)	25 (100)

F value = 2.824^{NS} (CG)
F value = 10.808* (EG)
Significant at 5 % level
NS – Not significant
T - Total
BS – Before study
AS – After study
CG – Control group
EG – Experimental group
Numbers in parentheses are percentages

4.7 Association between nutritional status and behaviour

Behaviour pattern of children with their body weight was analysed through simple regression to find out the association between nutritional status and behaviour. The result indicated that there was no significant correlation between nutritional status and behaviour for both control and experimental groups.

DISCUSSION

5. DISCUSSION

The present study was carried out to assess the influence of amla (*Emblica officinalis* Gaertn.) products on the nutritional and health status of SOS children in Thrissur District. This chapter presents a discussion on the major findings of the study under the following sections.

5.1 Functioning pattern of SOS village

5.2 Food consumption and dietary pattern of the families

5.3 Organoleptic evaluation of amla products

5.4 Chemical composition of fresh amla, amla products and stored amla products

5.5 Nutritional status of the children

5.6 Behaviour pattern of the children

5.7 Association between nutritional status and behaviour of the children

5.1 Functioning pattern of SOS village

SOS village at Mulayam in Thrissur district was started with the main objective of providing care and rehabilitation to children by giving a family atmosphere for the development of wholesome personality among children and to help the disadvantaged women.

The SOS village had seventeen families and the activities of each family was carried out by the mother in charge of the family who is well trained in different subjects like family management, nutrition, human psychology, health and hygiene and family resource management.

The day to day activities of the SOS village were carried out by an efficient panel of personnels under the control of Director of the SOS village who actively co-ordinated the different activities.

The facilities with respect to sanitation, health, education and recreation in the SOS village were found to be highly appreciable. Environmental sanitation is one of the major factors influencing the health and nutritional status of the family members. The environmental sanitation of all the SOS families was found to be excellent with safe drinking water facilities, compost pits, lavatory facilities, toilets, washing and laundry areas.

The health and nutritional status of the children is closely related to the health care facilities available in the locality. SOS village had a clinic inside the village and had adequate facilities to ensure the health care services for the inmates.

Inter family relationship of the village was found to be satisfactory. All the mothers were found to be very keen to keep a warm intra family relationship also which included sharing of house, helping the mothers when they are sick, inviting the other family members on special occasions and looking after the children in the other family when there is a need.

SOS village had quality educational provisions to impart good education to the children.

The extracurricular activities had a positive influence on the personality and behaviour of the children. The SOS village had good facilities for various extracurricular activities also.

Majority of the SOS families (88.24%) belonged to the Christian community and the rest were Hindus.

Large family size is considered as an important risk factor of malnutrition among young children (Tuncbilek *et al.*, 1995). In SOS village all the seventeen families had a family size ranging from 19-21 members.

SOS village had a population of 350, which constituted 52 per cent boys and 48 per cent girls. Among the inmates 65.71 per cent were orphans, 26.29 per cent lost one of the parents and the rest were destitutes.

Education is considered to be a catalyst of change and its role in the national development cannot be over emphasized (Manorama Year book, 1996). The present study revealed that since the educational facilities of SOS village is excellent all the inmates of the village are undergoing various levels of education either in schools or in colleges.

Engle (1991) and Sichieri *et al.* (1993) stated that the birth weight of children is significantly correlated to their nutritional status. Majority of the children in both control and experimental group had a normal birth weight of 2.5 kg. Mathen (1998) and Jose (1998) also reported that most of the preschool children in Thrissur District had the desirable birth weight of 2.5 kg.

Increasing birth order is associated with poor nutritional status. In the present study majority of the children in both groups were of the first and second birth order. Jose (1998) also observed similar findings in Thrissur district.

As reported by the mothers, in more than 88 per cent of children there was no occurrence of serious childhood diseases during the past one year. Above 90 per cent of children in the present study had completed the immunization schedule to date. It is in accordance to the findings of Mubarak *et al.* (1990) and Jose (1998). Lower percentage of childhood morbidities and successful immunization coverage could be due to the greater awareness with respect to health among mothers attained through the training they attended and also due to the better health care facilities available in the SOS village.

5.2 Food consumption and dietary pattern of the families

Diet is a vital determinant of health and nutritional status of an individual (Thimmayamma and Rau, 1996). What a man eats will affect in a high degree his ability to keep well, to work, to be happy and to live long (Robinson, 1990). Precise information on the food consumption pattern of people is essential not only for assessing the nutritional status of the community, but also for elucidating the food needs of population groups at national or regional levels (Thimmayamma and Rau, 1996).

The present study revealed that all the SOS families were habitually non-vegetarians. Rice was found to be their staple food item. Similar findings were reported by Sujatha (1990), Karuma (1993), Ranganathan (1996) in Thiruvananthapuram District and Udaya (1996), Jose (1998) and Mathan (1998) in Trichur District of Kerala.

Food expenditure is an important factor influencing the dietary habits. Food expenditure pattern of the SOS families indicated that maximum amount was spent on cereals by all the families. This is in accordance with the findings of Jose (1998) and Devi (2000).

For other vegetables, roots and tubers, fruits, non vegetarian items like egg, meat and fish, nuts and oilseeds, spices and condiments, fats and oils, and sugar and jaggery all the families spent less than 11 per cent of their food expenditure. For the purchase of green leafy vegetables all the families spent less than one per cent of their food expenditure.

Frequency of purchase of various food items by the SOS families revealed that most of the food items like cereals, pulses, vegetables and fruits were purchased on a weekly basis. Meat and fish were purchased weekly twice while egg was purchased on a monthly basis, which indicates the inclusion of non-vegetarian item

also in their daily diet. Milk was bought daily in all the houses. These results are in accordance with the findings indicated by Augustine (1993) and Udaya (1996) among the households of Kerala. Purchasing pattern of the SOS families indicated that the mothers preferred bulk purchasing so as to reduce the trips to the shops and there by saving their time and energy which can be utilized for the better care of the children.

The economic status and the availability of the foods are the two important factors which influence the frequency of use of various foods. The frequency of use of various foods by the SOS families indicated that except green leafy vegetables and fruits all the others food groups including flesh foods were including in their daily diet by all the families. This may be due to the better awareness of the mothers on health and nutrition acquired through the various training programmes they attended.

Meal planning was done by all the families and the advance meal planning might have helped in better organisation and faster completion of household chores by the mothers. Meal planning of the families was based on the availability of money and likes and dislikes of the family members in all the houses.

Meal pattern of the families indirectly indicate their dietary habits. Analysis of the meal pattern of the SOS families indicated that three meals a day was common in majority of the families. This is in accordance with the studies conducted in Kerala by Karuna (1993), Udaya (1996), Shyna (1996) and Jose (1998).

Majority of the SOS families maintained a routine time schedule for consuming meals. However, 35 per cent of the families consumed meals as and when they liked. Similar findings were reported by Karuna (1993), Ranganathan (1996) and Jose (1998) in the households of Kerala.

Majority of the families preferred snacks prepared at home rather than the different bakery items and other snacks purchased from the market.

An indepth study of the foods given during special occasions like birthdays, festivals and feasts indicated that all the families prepared special foods like payasam, cake, vegetarian and nonvegetarian items during these occasions. This is in accordance with the findings reported by Sujatha (1990), Karuna (1993), Mathen (1998) and Jose (1998) in the households of Kerala.

Foods given for children at specific ages indicated that all families gave special foods like porridges, juices, mashed foods and fluid foods during infancy. All the families included synthetic foods purchased from the market also in the infant's diet. This has become necessary because, most of the children in the SOS families being orphans, even at infancy they are deprived of the mothers milk.

Bhat and Dahiya (1985) reported that majority of the preschool children in India received only ordinary home diets which are deficient in many of the micronutrients. In contrast to this, in the present study it was found that majority of the preschool children in the SOS households were fed with special dishes of egg, boneless fish, boiled vegetables, mashed pulses and biscuits which are bland and soft. In contrast to this finding Usha *et al.* (1990), Cherian (1992) and Jayanthakumari (1993) reported that preschool children received only family diet without any special foods. However, Jose (1998) observed that though the diet of preschool children consumed the same adult diet in the family, they were made bland and soft.

All the families included only adult food for older children and adolescents. Similar findings were reported by Udaya (1996) and Jose (1998).

Modifications of the normal diet is necessary during disease conditions. In the present study it was found that all the families made modifications in the daily

diet during diseased conditions. Inclusion of special foods during the most needed periods like infancy and preschool age and modifications in the diet during diseased conditions could be due to the better awareness of the SOS mothers on health and may also be due to the better health care facilities available in the SOS village.

Regarding the cooking methods followed, all families used boiling and straining for cooking cereals. Boiling was the predominant cooking method followed by all families for pulses, vegetables, roots and tubers, milk and flesh foods. Absorption method was used to cook green leafy vegetables. Fruits especially bananas were eaten after steaming. Similar findings were reported by Karuna (1993), Shyna (1996), Udaya (1996) and Jose (1998) in the rural households of Kerala.

All the families stored the perishable food items like vegetables, fruits and flesh foods under refrigerated conditions while cereals and pulses were stored in closed containers. Vegetables were also preserved by pickling. Smoking, salting and drying were used as the preservation methods for fish and meat. Thus it was found that majority of the SOS families adopted ideal cooking, storage and preservation practices. This could be also due to the better awareness of the mothers which they acquired through the training programmes.

All the SOS families had some labour saving devices in their home. This might have helped the mothers to utilize their time and energy for giving better care and attention to their children.

5.3 Organoleptic evaluation of amla products

Quality is the ultimate criteria of the desirability of any food product to the consumer. Overall quality depends on quantity, nutritional and other hidden attributes and sensory quality. Seven amla products were evaluated by technical

experts, SOS mothers and SOS children so as to select the most acceptable product for feeding trial.

Since the sensory evaluation of a product encompasses all the senses, the various quality attributes like colour, flavour, texture, taste and doneness were evaluated on a five point hedonic scale by means of a score card.

The mean total score for the amla products varied from 18.91 to 22.34. Amla preserve had the highest score followed by candy, jelly, jam, shred, squash and soft drink. All the products got a total score higher than 18. Thus all the amla products were found to be acceptable and the most accepted product namely amla preserve was selected to feed the children.

5.4 Chemical composition of fresh amla and amla products

Amla is an acrid fruit which has the highest vitamin C content and has many medicinal and culinary uses. Fresh amla and the seven amla products were analysed for vitamin C, fibre, iron, TSS and tannin.

The mean vitamin C content of fresh amla was found to be 598.9 mg 100 g^{-1}. This is found to be almost similar to the vitamin C content of amla as reported by Gopalan *et al.* (1989) in which the authors reported 600 mg of vitamin in 100 g of amla.

Among the different products prepared with amla, candy had the highest vitamin C content (589.6 mg 100 g^{-1}). The lowest was found to be in amla jam. Srivastava (1984) reported that amla fruit can be made into different products like preserve, sauce, candy, dried chips, jelly, pickle, toffy etc. with retention of much of the vitamin C found in fresh amla. It was found from the present study that amla jam which requires heating for a prolonged period also retained more than 60 per cent of the vitamin C of fresh amla. According to Srivastava (1984) the retention of vitamin

C in amla product is due to the presence of polyphenolic substances present in the fruit.

Amla fruit had high fibre content (3.2 g 100 g^{-1}) which was retained in different products like preserve, candy and shred while in the jam more than 55 per cent of the fibre was lost. In the case of squash, jelly and soft drink there was no fibre in the finished product became all these products were prepared after straining the fruit pulp. The fibre content of fresh amla was also found to be almost similar (3.4 g 100 g^{-1}) to the values reported by Gopalan *et al.* (1989).

The iron content of fresh amla (1.2 mg 100 g^{-1}) was found to be the same as reported by Gopalan *et al.*, 1989). The iron content of fresh amla was well retained in most of the products except in jelly, squash and soft drink. This loss might have occurred while discarding the fruit residue after straining the juice.

TSS of fresh amla was found to be 12 per cent which increased upto 72 per cent in preserve and shred. The increase in TSS is due to the addition of required quantity of sugar while preparing the product. The lower TSS content of soft drink is mainly due to the addition of more amount of water in the product.

Tannin content of fresh amla was found to 2.27 mg 100 g^{-1}. Tannin is reported to be an antinutritional factor which if present in the food will adversely affect the bioavailability of nutrients especially the minerals. Though, there is not of much variation in amla products like preserve, candy, jam, shred and soft drinks, about 15 per cent and 19 per cent of the tannin was lost while preparing jelly and squash respectively.

The chemical constituents of various amla products were analysed at monthly intervals after storing the seven amla products for a period of six months at normal room temperature.

The analysis of vitamin C in the products indicated that about 97-98 per cent of vitamin C was retained even upto six months of storage. Srivastava (1984) also reported that ascorbic acid content of various amla products is well retained during storage. According to the author almost entire vitamin C is retained during vacuum drying and 85 per cent was retained even after fourteen months of storage in ambient conditions.

All the other constituents like fibre, iron, TSS and tannin of the amla products were also well retained during six months of storage. Verma and Gupta (1996) also observed that sundried amla slices retained 64 per cent of ascorbic acid and the higher retention of vitamin C was found to be due to the presence of antioxidants and ellagic acid present in amla.

5.5 Nutritional status of children

In the present study, anthropometric indices, actual food and nutrient intake, haemoglobin estimation of blood and clinical examination were used to assess the impact of feeding amla product among SOS children with particular reference to their nutritional status.

Anthropometric measurements like weight, height, mid upper arm circumference (MUAC), head cicumference (HC) and chest circumference (CC) were considered as the best tools to detect various degrees of growth retardation among the population. Even before clinical manifestations, the growth pattern provides information regarding changes in nutritional status.

Comparison of the weight for age values with reference standards at corresponding ages will help to determine the degree of underweight in a community (Gopaldas and Seshadri, 1987). This index is used to determine the impact of feeding amla product among SOS children.

In the present study, though a significant increase in body weight was observed among control and experimental group children of both age groups, the increase was comparatively lower among the control group. The maximum increase was found in preschool boys (1.60 kg) of the experimental group. The body weight of children was found to be significantly lower than the standards suggested by ICMR (1990) in the control group children after the study period while in the experimental group the mean body weight was found to be higher than the standards except in preschool boys.

The weight for age has been used as an index of current nutritional status (Sathy *et al.*, 1991; Lucas, 1992 and Narins, 1992). Distribution of children on the basis of weight for age classification suggested by Gomez *et al.* (1956) to differentiate the grades of malnutrition indicated that though, most of the preschool children in the control and experimental groups before study period had normal nutritional status, there observed a much better increase in the experimental group after study period. An increase of 32 per cent was observed in children with normal nutritional status as against 8 per cent in the control group. The variation observed between control and experimental group children was found to be statistically significant. Among school children also there was an increase of 24 percentage in children with normal nutritional status among experimental group against the 4 percentage increase in control group.

The rapid increase in body weight and better nutritional status among the experimental group children may be due to the protective effect of vitamin C present in amla which might have reduced the infectious diseases among children and thus helped in a faster rate of growth among experimental group children.

Height is an indicator of long term nutritional status. As observed in the case of weight for age, there was a better increment in the height of children in the experimental group than in the control group.

The height of children in most of the groups were found to be lower than the Indian standards both before and after study except in the experimental group children. Similar observations were reported by Shyna (1996), Jose (1998) and Mathen (1998) among preschool children.

Height for age profile shows the state of chronic malnutrition or stunting in children (Gopaldas and Seshadri, 1987). The results of the present study indicated that, as in the case of weight for age profile, in the case of height for age also, an increase in the percentage of preschool and school children with normal nutritional status was observed among amla fed group. This may also be due to the protective effect of vitamin C present in amla which helped to reduce the child hood morbidities and thus an increase in their growth.

A composite age independent index namely weight/height^2 ratio also known as Quetlet's index suggested by Rao and Singh (1970) is another means used to detect the state of malnutrition among children since it indicates weight in relation to height.

Application of this index in the present study showed that as in the case of other two age dependent indices, the percentage of children with normal nutritional status in the experimental group was found to be higher than in the control group after the study. Children with moderate malnutrition also decreased to a higher degree in the experimental group than in the control group.

Taking the three indices namely weight for age, height for age and weight/height^2 ratio it was found that there was no incidence of severe grades of malnutrition among the SOS children. The percentage of moderately malnourished children was also found to be low. This is mainly due to the better care imparted by the SOS mothers in looking after the children. NNMB (1991) also observed lower percentage of severely malnourished children in Kerala. In contrast to this, various

studies conducted among preschool children in Kerala by Shyna (1996), Mathan (1998) and Jose (1998) revealed that most of the preschool children had moderate malnutrition.

Mid upper arm circumference is a useful indicator to assess the nutritional status of children. Poor musculature and wasting are cardinal features of protein energy malnutrition in early childhood and indicate the status of muscle development. The mean MUAC of children was found to be significantly lower than the Indian standards in both groups except the experimental group preschool children in which the decrease was found to be insignificant.

Classification of children on the basis of MUAC suggested by Gopaldas and Seshadri (1987) showed an increase of 20 per cent with normal nutritional status among experimental group children after the study with no change in the control group. Sixteen per cent of children in the control group was also found to have moderate malnutrition while none of the experimental group had moderate malnutrition after the study. Here also it can be concluded that protective effect of amla might be the reason for better nutritional status among the experimental group children who received one third of the recommended dietary allowances of vitamin C daily from amla preserve.

The chest circumference of experimental group girls though found to be significantly lower, before study, it became significantly higher than the standards after study. In the case of control group girls the mean values were lower than the Indian standards both before and after study. Jose (1998) also observed lower chest circumference among preschool children in Thrissur District.

Significant increase in chest circumference was observed in both groups after study, except in control group girls.

In the case of head circumference also, better and statistically significant increase was noticed among experimental group boys and girls after the study.

The head circumference of boys though found to be lower than the standards before the study among experimental and control groups, it became significantly higher only in the experimental group after the study period. Among girls, both before and after the study this measurement was found to be better than the standards.

The head by chest circumference ratio as suggested by Gopaldas and Seshadri (1987) indicated that all the experimental group children achieved normal nutritional status after study while there was no change in the control group.

All these positive effects among experimental group children might be due to the protective effect of vitamin C present in amla. Balachandran (1991) also reported the beneficial effect of amla which is capable of imparting youthful vigour, strength and vitality. These findings are also in line with a number of studies reported by Pillai and Kurup (1987), Swayamprakash (1991) and Jayaram *et al.* (1993). Moreover, the excellent health care facilities of the SOS village and better care and attention given by the SOS mothers to their children and the co-ordination of SOS officials might have contributed to the better nutritional status of the SOS children.

The nutritional problems of developing countries are mainly due to the inadequate diet in terms of both quantity and quality among majority of the population (Gopalan, 1991). Hence, estimation of actual food and nutrient intake of the people is very important.

One day food weighment survey conducted among children indicated that the intake of most of the food groups were lower than the Recommended Dietary Allowances suggested by ICMR (1984). Pulikkottil (1993), Shyna (1996) and Jose

(1998) also observed an inadequate intake of most of the food groups among preschool children.

The intake of nutrients revealed that only protein intake met the Recommended Dietary Allowances of nutrients suggested by ICMR. Mathen (1998) and Jose (1998) also observed adequate intake of proteins among preschool children. There was a deficit of macro and micro nutrients among preschool and school going children. This is in accordance with the findings of Pulikkotil (1993) and Jose (1998). A calorie gap in the dietaries of preschool children in different states was observed by Brahmam *et al.* (1987), Gopalan (1989), Shyna (1996) and Mathen (1998). In contrast to this Mathen (1998) also reported that the intake of micronutrients was either very close to or above the RDA among ICDS preschool beneficiaries. Devi (2000) also observed higher intake of almost all nutrients among school children. However, Shyna (1996) observed deficient intake of micronutrients among the dietaries of preschoolers.

The mean haemoglobin level of blood among SOS children was found to be lower than the normal values of 11 g/100 ml suggested by WHO (1979) indicating anaemia among children. The lower haemoglobin values may be due to the decreased intake of green leafy vegetables which in turn resulted in a low intake of iron and vitamin C essential for the absorption of iron. The frequency of purchase of green leafy vegetables by the SOS families also was found to be once in a week.

Though, significant increase in haemoglobin values was noted among control and experimental group children after study better increase was observed among the later group. This increase observed among the experimental group may be due to the impact of amla which had 1.2 mg of iron and 587.5 mg of vitamin C 100 g^{-1} in the product used for study.

Clinical examination is considered to be an important part of nutritional assessment and gives direct information on signs and symptoms of dietary

deficiencies prevalent among people (Swaminathan, 1986). Hence, in this study also clinical examination of all children before and after the study was conducted. The most important clinical symptoms observed among children was anaemia, dental caries and anorexia, while majority of SOS children did not show any nutritional deficiency symptoms clinically. Anaemia and dental caries were also observed by Jose (1998) and Mathen (1998) among preschoolers and by Devi (2000) among school children. Though, 16 per cent and 12 per cent of experimental group preschool and school children respectively had anaemic symptoms before the study, no child showed the anaemic symptoms after the study while there was no change among control group. This finding supports the observations of haemoglobin estimation of children in which better increase in haemoglobin was noticed in experimental group who were fed with amla for a period of six months. Vitamin C and iron present in amla might have brought a better results among children who are fed with amla.

Though, dental caries was observed among few children before the study there was no change in the presence of this symptom even after the study.

The anorexia present among few children before study was also reduced to zero percentage after the study.

Behaviour of the children

The behaviour trait with particular reference to inertia activation and stability was carried out using Mathews IAS rating scale among children before and after the study. The results indicated a better increase in inertia, activation and stability among experimental group of preschool and school going children. Statistical analysis revealed that there is no significant variation in the three behavioural traits, namely inertia, activation and stability between the control and experimental groups. From the results it can be concluded that amla supplementation had no significant impact on the behavioural traits of children.

SUMMARY

6. SUMMARY

The present study entitled Influence of amla (*Emblica officinalis* Gaertn.) products in the nutritional and health status of SOS children in Thrissur district was conducted among children in the age group of 4 to 6 years and 7-9 years selected from the SOS village at Mulayam in Thrissur District. Fifty children selected in each group were classified into two categories namely control and experimental groups consisting of 25 children in each group.

The study carried out threw light on the functioning pattern of SOS village including the details of index child, food consumption pattern of the SOS village, organoleptic evaluation of amla products, chemical composition of fresh amla, amla products and stored amla products and impact of feeding amla preserve on the nutritional and health status as well as behaviour pattern of children.

Information regarding the functional pattern of SOS village indicated that the activities were carried out by an efficient panel of personnels and activities of each family was looked after by the mother in charge of the family who is well trained in various subjects.

SOS village had excellent facilities for education, recreation health care and extracurricular activities. The environmental sanitation as well as inter and intra family relationship of the village were found to be excellent.

Out of the seventeen SOS families 88.24 per cent belonged to the Christian community and the rest were Hindus. Out of the 350 children in the village, majority were orphans.

Majority of the children had a normal birth weight of 2.5 kg with low morbidity and had completed the immunization.

Food consumption pattern of the families indicated that rice was the staple food and all the families were non-vegetarians. Majority of their income was spent for the purchase of cereals. All the families spent 1 to 10 per cent of their income for the purchase of other vegetables, roots and tubers, fruits, flesh foods, nuts and oil seeds, spices, fats and oils, sugar and jaggery as well as bakery items. Most of the food items were purchased on a weekly basis and except green leafy vegetables and fruits all the food groups were included in their daily diet.

Advance meal planning was practiced by all the families and majority of the families maintained specific time schedule also for taking meals. Most of the families are in the habit of preparing special food items during special occassions, festivals and feast.

Boiling was the most common method adopted for cooking.

Organoleptic evaluation of seven amla products indicated that all the products were acceptable and are rich in vitamin C and other constituents. Among the seven products amla preserve was found to be the most acceptable. Most of the chemical constituents including vitamin C were well retained in the products even upto six months of storage.

The most acceptable product namely amla preserve was given to children in the experimental group for a period of six months so as to meet one third of the daily requirement of vitamin C per child. The impact of feeding amla preserve on the nutritional and health status was assessed.

Most of the anthropometric parameters were found to be significantly better in the amla fed group when compared to the control group children after the study period.

The results on actual food and nutrient intake indicated that the intake of most of the food groups were lower than the RDA. Among the nutrients, only the protein intake was found to be adequate.

The biochemical estimation of blood for haemoglobin indicated a significant increase in haemoglobin in both control and experimental groups after study.

Majority of the children did not manifest any clinical deficiency symptoms. Among children who had clinical symptoms the most important were anemia, dental caries and anorexia. Though, anaemia was observed among control and experimental groups before study, no child showed any symptoms of anemia after the study period in the amla fed group.

The behaviour trait with particular reference to inertia, activity and stability conducted using Mathews IAS rating scale did not show any significant variation in the behavioural trait between control and experimental groups. Association between nutritional status and behaviour also did not reveal any significant relationship both in control and experimental groups.

REFERENCES

REFERENCES

Aebi, H.I. 1983. Biochemical parameters as indicators for the nutritional status. *Fourth Asian Congress of Nutritional Programme and Abstracts*. p.7

Ali, A. 1987. Food habits, Nutrition and health status of Lanjia Soras - a primitive tribe of Orissa. *Proc. Nutr. Soc. India.* National Institute of Nutrition, Hyderabad **33**:56-59

Anand, R.K. 1994. Problems in feeding infants and children. *J. Indian Acad. Paediatrics.* **31**(1):12-29

Anderson, R. 1979. Vitamin C. *S. Afr. Med. J.* **56**:401

Anderson, R. and Therone, A. 1979 ab. Vitamin C and atherosclerosis. *S. Afr. Med. J.* **56**:429

Angeles, I.T., Schultink, W.J. 1993. Decreased rate of stunting among anaemic Indonesian preschool children through iron supplementation. *Am. J. Clin. Nutr.* **58**(3):339-342

Anon. 1992. Chemical properties of aonla syrup. *J. Fd. Sci. Tech.* **29**(3):67-75

A.O.A.C. 1970. *Official and Tentative Methods of Analysis*. 11th ed. Association of Official Analytical Chemists, Washington, D.C.

A.O.A.C. 1980. *Official and Tentative Methods of Analysis*. 13th ed. Association of Official Analytical Chemists, Washington, D.C.

Araullo,F.V. 1975. Influence of colour on sensory perception and food choices. Walford Applied Sciences NewYork p 76

Ashwell, M. 1990. Why we eat and what we eat. *Proc. Twelfth British Nutr. Foundation*, p.18

Atroshi, F., Rizzo, A., Biese, I. and Salonen, M. 1995. Effects of feeding T-2 toxin and deoxy nivalenol on DNA and GSH contents of brain and spleen of rats supplemented with vitamin C and E. *J. Animal. Physiol. Animal. Nutr.* **74**(3):157-164

Augustine, J. 1993. Factors influencing the working efficiency of women engaged in stone breaking with special reference to nutritional status. M.Sc. Home Science (FS&N) thesis, Kerala Agricultural University, Vellanikkara, Thrissur

Bachman. 1985. Continental confectionary, MaClaren and Sons Ltd., London p.178-179

Balachandran, V. 1991. Amalaki and its Pharmaceutical preparations. *Sachitra Ayurveda* **44**(2):120-134

Barnes, M.J. and Kodick, E. 1975. Vitamin C and Hormones. *Am. J. Clin. Nutr.* **33**:21

Basu, T.K., Jenner, M. and William, D.C. 1986. Vitamin C in metabolism. *Nutr. Metabol.* **30**:425

Bates, R.N., Broussard, H.L., Ames, T.S., Olich, M.S. 1980. Geriatric Problems. New Frontiers of Research. *Geriatrics* **35**:84

Baveja, R., Agarwal, R. and Pal.A. 1993. Maternal nutritional assessment. *J. Obstet and Gynecol.* **43**(4):469

Bhat, C.M. and Dahiya, S. 1985. Nutritional status of Preschool children in Gangua village of Hissar District. *Indian J. Nutr. Dietet.* **22**:206-214

Block, G. 1992. Epidemiological evidence regarding vitamin C and cancer. *Am. J. Clin. Nutr.* **54**(10):1310-1314

Bombarde, A. 1995. Diabetes in Pregnant and nursing mothers. *Sachitra Ayurveda* **47**(12):108-111

Booth, J.B. and Todd, G.B. 1982. Atherosclerosis. *Int. J. Vit. Nutr. Res.* **49**:434

*Brahmam, G.N.V., Sastry, J.G. and Prahlad Rao, N. 1988. Intra family distribution of dietary energy – An Indian experience. *Ecol. Fd. Nutr.* **22**(1):125-130

Bram, S., Froussard, P., Guichard, M., Jasmin, C., Angery,Y., Sinoussi-Barre, Fand Wray, W. 1980. Vitamin C in inhibiting tumour growth. *Nature* **284**:629

Cameron, E. and Pauling, L. 1986. Vitamin C - role in suppressing tumour agencies. *Proc. National Acad. Sci.* **75**:4538

Chandran, R.P. 1994. Low Birth weight infants, invention intelligence. National Research Development Cooperation Report. **29**(5):287

Chawla, Y.K., Dobey, P., Singh, R., 1987. Treatment of dyspepsia with Amalaki (*Emblica officinalis* Linn.) on Ayurvedic drug. *Vagabhatta* **5**(3):24-26

Cherian, L. 1992. Food consumption and energy expenditure pattern of agricultural labourers of Thiruvananthapuram district. M.Sc. Home science (FS&N) thesis, Kerala Agricultural University, Vellanikkara, Thrissur

Choksi, M.A. 1995. Advancing social development. World Bank Contribution to the Social Summet. World Bank, Washington, DC

Chopra, S.L. and Kanwar, J.S. 1978. *Analytical Agricultural Chemistry.* Kalyani Publishers, Ludhiana.

Clemetson, C.A. 1980. Ischaemic Heart Diseases. *Med. Hypotheses.* **5**:825

Clydesdale, F.M. 1981. The effect of physico chemical properties of food on the chemical status of iron. Presented at the 81st National Meeting ofAmerican Chemical Society. *Atlanta. J. Fd Sci.* 47(2):228

Cook, J.D. and Monsen, E.R. 1977. Vitamin C and common cold and iron absorption in man. *Am. J. Clin. Nutr.* **30**:235-41

Crandon, J., Landau, B., Mikal, S. and Reif, A.E. 1976. Wound Healing. *New. Eng. J. Med.* **258**:105

Cravioto, J. and Gaona, C. 1963. the influence of protein calorie malnutrition on psychological test behaviour, mild-moderate forms of protein calorie malnutrition. Symposia Swedish Foundation, Uppsula

Date, R.P and Kulkarni, S.K. 1995. Efficacy of 'Rasadanti'- tooth powder in dental disorders. *Probe* **35**:43-45

Dena, R., Bhuraj, B.S., Verjee, Z.H. and Galzigna, L. 1975. Vitamin C. and Brain Development. *Int. J. Vit. Nutr. Res.* **45**:175

Deb, R. and Chandrasekhar, S. 1990. Ascorbic acid concentrate from Phyllanthus embilica Linn. *J. Fd Sci. Tech.* **26**(7):77-81

Deehr, M.S., Dallal, G.E., Smith, K.T., Taulbee, J.D. and Dewson Hugher, B. 1990. Effect of different calcium sources on iron absorption in post menopausal women. *Am. J. Clin. Nutr.* **51**:95-97

Devadas, R.P. 1991. Assessing status of a given group. Sri Avinashalingam Home Science Autonomous College for Women, Coimbatore. p.1-14

Devi, L. 2000. Nutritional and health impact of substituting greengram by soya products in school lunch programme in Thrissur district. M.Sc. (Home science) thesis, Kerala Agricultural University, Vellanikkara, Thrissur, Kerala

Dube, A.K. 1998. How to affect behaviour changes. *Nutr* **32**(1):15

Dwivedi, S., Pachorl, S.B. and Amrita, S.C. 1994. Medicinal plants with hypotensive activity. *Ind. Practioner* **11**(2):117-134

Dwivedi, S. and Tewari, L. 1991. Effect of 'Dhatriygadiyoga' in the haemoglobin and serum protein level in pregnant woman. *Indian Pharmacol* **12**(3):88-92

Easwaran, P.O. and Devadas, R.P. 1984. Growth performance and secular trends among children of Coimbatore. *Indian J. Nutr. Dietet.* **18**(2):355

Edgar, J.A. 1980. Carcinostatic effect of vitamin C. *Nature*. **227**:24-28

Engle, P.L. 1991. Maternal work and child care strategies in Peri-urban Guatemala. Nutritional effects. *Child Dev.* **62**(5):959-965

Exton, B.M. and Smith, G.S. 1980. Influence of high Vitamin C level and folic acid concentration. Symposia. American chemical society. Atlanta.

Fiddler, W., Pensabene, J.W., Piotroswski, E.G., Doerr, R.C. and Wassherman, J. 1983. Vitamin C. *J. Fd. Sci.* **38**:1084-1086

Gallin,J.I. and Vaughan, Z. 1975. Role of vitamin C in Immune mechanism. *Sci.* **179**:702-708

Geoly, K.L. and Diamond, L.H. 1980. Vitamin C. Therapy in Hypertriglyceridemias. *Ann. International. Med.* **93**:511-518

Geriatric Editorial. 1978. New Frontiers of Research. *Geriatrics*. **33**:91

Gershoff, S.N. 1993. Vitamin C (ascorbic acid). New roles, New requirements. *Nutr. Rev.* **51**(8):313-326

Ghosh, A. and Sharma, A. 1993. The relative effect of crude aqueous extract of *Emblica officinalis* against cesium chloride in mice. *Int. J. Pharmacol* **31**(2):116-120

Ginter, E. 1978b. Role of vitamin C in Hypertriglyceridemia. *Lancet.* **6**:1233

Ginter, E. 1978a. Vitamin C deficiency. *New. Eng. J. Med.* **294**:559

Ginter, E. 1979. Role of vitamin C in Human Nutrition. *World. Rev. Nutr. Dietet.* **33**:104

Goetzal, E.J., Wasserman, S.I., Gigli, I. and Austin, F.K. 1974. Vitamin C and Immunity of the body. *J. Clin. Invest.* **53**(7):813

Gomez, F., Ramos, G.R., Frenk, S., Cravioto, J., Charez, R. andVazquez, J. 1956.Mortality in second and third degree malnutrition. *J. Trop. Paediatrics* **2**:77-83

Gopalan, C., Sastri, B.V.R. and Balasubramanian, S.C. 1989. *Nutritive value of Indian Foods*. National Institute of Nutrition, Indian council of Medical Research, Hyderabad, India.

Gopalan, C. 1991. The National Nutrition Scene: The changing profile. *Proc. Nutr. Soc. India.* National Institute of Nutrition, Hyderabad, India, **37**:10-11

Gopaldas, T. and Seshadri, S. 1987. *Nutritional Monitoring and Assessment.* Oxford University Press, Delhi

Gore, A.P., Tilve, S. and Kulkarni. M. 1977. Nutritional status of tribes in the Indravati river basin. *Indian J. Nutr. Dietet.* **14**:167-172

Gosiewska, A., Mahmoodian, F. 1996. Gene expression of iron-related proteins during iron deficiency caused by scurvy in guinea pigs. *Archives. Biochem. Biophys.* **325**(2):295-303

Gupta, R.L. and Bopaiah, C.D. 1986. Vitamin C content of amla preparations. *Bull. CFTRI.* Mysore **47**(10):112-114

Gupta, S. 1990. The influence of early protein energy malnutrition on subsequent behaviour and intellectual performance. *Canadian Home Economics J.* **40**(1):16-20, 32

Guttemplan, J.B. 1987. Cancer. *Nature* **268**:368

Hallberg, L., Brune, M., Rossander, L. 1987. Is there a physiological role of vitamin C in iron absorption. *Ann. NewYork. Acad. Sci.* **498:**324-332

Hanif, S. 1986. The antioxidant factor of aonla fruit. *Am. J. Clin. Nutr.* **46**(9):1071-1075

Hayashi, O., Nazaki, M. and Abbott, M.T. 1978. The Enzymes. (Ed. Boyer, P.D.) Vol.XII. Academic Press, London p.119-130

Helen, A. and Vijayammal, P.L. 1997. Vitamin C supplementation on hepatic oxidative stress induced by cigarette smoke. *J. Applied. Toxicol.* **17**(5):289-295

Herness, G.H. and Kodick, T.S. 1977. Vitamin C in the enzyme activity. *Lancet* **5**:1044-1046

Hoda, Q. and Sinha, S.P. 1992. Minimization of cytogenetic toxicity of malathion by vitamin C. *J. Nutritional. Sci. Vitaminol.* **37**(4):329-339

Hughes, R.E. 1980. Fat metabolism. *Analyst* **89**(10):618

Hulse, J.D., Ellis, S.R. and Hendorson, L.M. 1978. Carnitine in the Fat Metabolism. *J. Biol. Chem.* **253**:1654

Hunt, J.R., Muller, L.M., Lyliken, G.F., Gallagher, S.H. and Nielsen, F.H. 1990. Ascorbic acid effect on ongoing iron absorption and status in iron depleted young women. *Am. J. Clin. Nutr.* **51**:449-455

Hunter, J. and Rajan, K.T. 1981. Pressure sores. *Paraplegia* **8**(3):211

Hurley, S.H. and Jones, J.L. 1980. Vitamin C in lassitude and fatigue. *Am. J. Clin. Nutr.* **23**:1123-1125

ICMR. 1984. *Recommended Dietary Intakes for Indians*. ICMR, New Delhi

ICMR. 1990. *Nutrient requirement and recommended dietary allowances for Indians*. ICMR, New Delhi

ICMR. 1997. Traditional Medicine. Annual Report of Indian Council of Medical Research,New Delhi p.119-124

Jain, R. and Lal, M. 1994. Studies on the preparation of syrup. *Bull. CFTRI. Mysore*. **53**(9):971-979

Jayanthkumari, S. 1993. Food consumption pattern of selected farm families in Thiruvanandapuram District. M.Sc.(Home Science) thesis, Kerala Agricultural University, Vellanikkara, Thrissur

Jayaram, S., Walwakar, P.P. and Rajadhyaksha, S.S. 1993. Evaluation of efficacy of a preparation containing combination of Indian Medicinal plants in patients of generalized weakness. *Indian Drugs* **30**(10):498-500

Jeena, K.J. and Kuttan, R. 1996. Antioxidant activity of *Emblica officinalis*. *J. Am. Clin. Nutr.* **988**:3128-3131

Jelliffe, D.B. 1966. The assessment of the nutritional status of the community. *WHO Monograph Series, 33*. W.H.O., Geneva

Jose, J.K. and Kuttan, R. 1995. Anti oxidant activity of *Emblica officinalis*. *J. Clin. Biochem. Nutr.* **19**(2):63-70

Jose, M.P. 1998. Maternal employment and nutritional status of preschool children. M.Sc.(Home Science) thesis, Kerala Agricultural University, Vellanikkara, Thrissur.

Kadam, S.S., Salunkhe, D.K., Jadhav, S.J. and Bhausle, R.K.I. 1984. Protein Calorie Malnutrition : Brain Development Intelligence and Behaviour. II. Postnatal Nutrition. *Ind. J. Nutr. Dietet.* **21**:69-73

Kalra, T.J. 1989. The impact of malnutrition on intelligence. *Ind. J. Paediat.* **18**(4):23-27

Kamath, S.V. 1986. Influence of nutritional status on intelligence of children. M.Sc. (Home Science) thesis, Kerala Agricultural University, Vellanikkara, Thrissur

Karuna, M.S. 1993. Nutritional status of women engaged in fishvending in Trivandrum district. *Ph.D. thesis*, Kerala Agricultural University, Vellanikkara, Thrissur

Khanna, S.E., Kirshnamurthy, K.G. 1989. Food and Nutritional Security by 2000 AD. National Workshop, p.1-2

Kinsman, R.A. and Hood, J. 1981. Vitamin C and behavioural changes of the individual. *Am. J. Clin Nutr.* **24**(4):455

Klenner, F.R. 1987. Vitamin C in healing burns. *J. Applied. Nutr.* **23**(5):61

Kotze, G.M. and Spies, H.S. 1980. Vitamin C status and lipid levels of experimental group guinea pigs. *Biomedical Letters*. **48**(180):215-218

Kulkarni, S.K. 1992. A Herbal preparation improves learning and memory performance in mice. *Ind. Drugs.* **30**(3):97-107

Kurup, P.N.V. and Ramadas, V.N. 1980. Amla (*Emblica officinalis* Gaertn.) Hand Book of Medicinal Plants. New Delhi. p.178-182

Kuttan, R., George, J., Jeena, K.J., Kuttan, G. 1996. Antimutagenic and anticarcinogenic activity of *Emblica officinalis* Gaertn. *Am. J. Clin. Biochem.* **25**(6):158-161

Kuttan, R., Praveenkumar, V., Latha, G.M., Jeena, K.J., Kuttan, G. 1996. Anticarcinogenic and antimutagenic activity of *Emblica officinalis*, *15th Annual Convention ICAR*-41

Liehr, J.G. 1991. Vitamin C reduces the incidence and severity of renal tumours induced by estradiol or diethylstilbesterol. *Am. J. Clin. Nutr.* **54**(6):1256-1260

Lindzey, J. 1954. *Hand book of Social Psychology* (Vol.I). Anderson and Westey Publication, London, p.449

Logue, T. and Frommer, D. 1980. Colorectal Tumours. *Aust. J. Med.* **90**(3):588

*Lucas. B. 1992. *Nutrition in childhood.* W.B.Saunders, Philadelphia

Lynch, S.R. and Cook, J.D. 1980. Interaction of vitamin C and iron. *Ann. N.Y. Acad. Sci.* **335**:32-44

Manorama Year Book. 1996. *Thirty first year of Publication.* Malayala Manorama, Kottayam, p.142-146

Malhotra, S.K. 1984. A new formulation for gastrointestinal disorders. *J. Nat. Integ. Med. Assoc.* **26**(5):135-136

Malogi, K.J. and Kamatu, M.S. 1995. An Ayurvedic approach to combact stress. *Sachetra Ayurveda* **47**(4):302-303

Mari, J. 1985. Individual dietary survey, purpose and methods. *World. Rev. Nutr. Dietet.* **13**:105-101

Massod, A. and Rajan, K.S. 1994. Cumulative effect of vitamin C and T-2 toxin on clinical abnormalities in guinea pigs. *Biomedical Letters*. **49**(195):213-217

Mathen, M.M. 1998. Nutritional status and intelligence of preschool beneficiaries of ICDS and non-beneficiaries of Thrissur district. M.Sc. (F&N) thesis, Kerala Agricultural University, Vellanikkara, Thrissur.

Mathew, V.G. 1995. Mathew's IAS Rating Scale for behavioural traits. Professor, Department of Psychology, University of Kerala, Kariavattom, Trivandrum

Mathur, R.S., Sharma, H., Tewari, P.V. 1996. Hypocholesteroleamic effect of *Emblica officinalis* Juice. *Indian Med. Practioner* **13**(7):40-47

McLaren, D.S., Johnston, E.E., Lampl, M., Martorell, R., Waterlow, J.C., Hansen, J.D.L. and Mora, J.O. 1984. Forms and assessment of energy protein malnutrition. *Malnutrition and Behaviour – Critical Assessment of Key Issues* (eds. Brozek, J. and Schurch, B.). Nestle Foundation, 41-106

Milnor, C. 1983. Role of vitamin C in mental functions. *Br. J. Psychiatry* **109**:294

Mirvish, S.S., Cardesa, A., Wallcave, L. and Shubik, P. 1982. Vitamin C in prevention of Nitrosation. *J. National Cancer. Inst.* **55**(6):633

Monson, E.R. 1988. Iron nutrition and absorption dietary factors which impact iron bioavailability. *J. Am. Diet. Assoc.* **88**(7):786-790

Morgane, D.J., Austin-La France, J., Branzine, J., Tonkiss, J. and Galler, J. 1992. Malnutrition and the developing Nervous system. *The vulnerable Brain and Environmental Risks. Vol.I. Malnutrition and Hazard Assessment.* (ed. Issacson, R.L. and Jeenson, K.F.). Plenum Press, New York.

Morton, P.N. 1990. The Emblica (*Phyllathus emblica* L.) *Botany.* **14**(6):119-127

Muller, D. 1981. The current status of urban/rural differences in psychological disorder, an emerging trend for depression. *JNMD* **169**:18-27

Mund, J.K., Soni, G.L., 1992. Effect of Amla (*Emblica officinalis*) on the development of atherosclerosis on hyper cholesterolemic rabbit. *J. Res. Edn. Indian Med.* **10**(2):1-7

Murdock, D.S. and Donaldon, M.L. 1984. Sparing Property of vitamin C. *Am. J. Clin. Nutr.* **27**(3):696

Nagero, A. 1993. Efficacy of combined therapy with septilin and styplon in gingival inflammation and bleeding. *Probe.* **33**(1):51-54

Nambisan, B. and Kurup, P.A. 1976. Atherosclerosis. *Indian J. Clin. Nutr.* **22**(3):447

*Narins, C.M.D. 1992. Water electrolytes and acid base balance. *Krauses Fd. Nutr. Diet. Therapy.* P.141

Narisawa, T., Wong, C.Q., Maronpot, R.R. 1976. Action of vitamin on cancer causing substances. *Cancer Res.* **36**(3):505

Nasolodin, V.V., Ferulev, N.I. 1994. Annual changes in trace element metabolism, vitamin C availability and physical work capacity of forge workers. *Voprosy Pitaniya* **4**:6-9

Neal,G. 1988. *Clinical Nutrition.* Heire Mann Medical Books, London

NFI. 1991. Growth performance of affluent Indian Children (under five) *Scientific Rep.* **11**:69

NIN. 1983. *A Manual of Laboratory Techniques*. (eds. Raghuramalu, N., Nair, K.M. and Kalyanasundaram, S.) ICMR, Hyderabad

NNMB. 1989. Children and Women in India. *A situation analysis*. UNICEF. p.37

NNMB. 1991. National Nutrition Monitoring Bureau. Report of repeat surveys. NIN, Hyderabad

Owolabi, A.O., Mac-Inegite, J.D., Olowoniyan, F.D. and Chindo, H.D. 1996. A comparative study of the nutritional status of children in villages in northern Nigeria using and not using soyabeans. *Fd. Nutr. Bull.* **17**(1):42-48

Passmore, M. and Eastwood, M.A. 1986. Human Nutrition and Dietetics, Churchil Livingstone, London.

Pathak. R. 1991. Some facts of child development. NIPCCD Publication. New Delhi. p.275

Paul, A.K. and Madan, S., 1992. Clinical evaluation of an indigenous herbal eye drops preparation. *Indian J. Clin. Practice.* **11**(2):58-60

Pauling, M. and Leibovitz, S. 1980. Vitamin C and the common cold. *Am. J. Clin. Nutr.* **23**:1259-12560

Pillai, R. and Rao, S.J. 1987. Antioxidant role of Phyllanthus emblica Linn. *J. Fd. Sci. Tech.* **24**(6):91-93

Pillai, R. and Kurup, P.A. 1987. Fruits of India. *J. Indian Hort.* **32**(2):45-47

Pollitt, E. 1990. Iron deficiency and behaviour. *Nutrition and Brain* (ed. Wartman, R.J. and Wartman, J.J.) Raven Press, New York 101-146

Prasad, M. 1975. Role of vitamin C in the peripheral metabolism of iron. *Indian J. Nutr. Dietetics.* **12**:67-72

Prinz, W., Bortz, R., Bregin, B. and Hersch, M. 1978. The Humoral antibodies. *Int. J. vit. Nutr. Res.* **47**(5):248

Pullikkottil, M.U. 1993. Nutritional status of ICDS beneficiaries with respect to participation. Ph.D. thesis, Kerala Agricultural University, Vellanikkara, Thrissur, Kerala

Ranganathan, L. 1996. Nutritional status of women engaged in the coir industry. M.Sc. (Home Science) thesis, Kerala Agricultural University, Vellanikkara, Thrissur

Ranganna, S. 1977. *Mannual of Analysis of Fruit and Vegetable Products.* Tata McGraw-Hill Publishing Company Limited, New Delhi.

Rao, K.V. and Singh, D. 1970. An evaluation of the relationship between nutritional status and anthropometric measurements. *Am. J. Clin. Nutr.* **23**:83-93

Rao, V.K. and Singh. 1987. Vital statistics and Nutritional status of Indians. *Indian J. Nutr. Dietet.* **24**(9):303-309

Rao, D.H. and Vijayaraghavan, K. 1996. Anthropometric assessment of nutritional status. *Textbook of Human Nutrition* (eds. Bamji, M.S., Rao, N.P. and Reddy, V.). Oxford and IBH Publishing Co. Pvt. Ltd., p.148-162

Robinson, C.H. 1990. Normal and Therapeatic nutrition Macmillian Publishing House, New York, p.68

Roy, A.K., Haimanti, D., Archana, S., Geeta, T. 1992. *Phyllanthus emblica* fruit extract and ascorbic acid modify Lepatotoxic and renotoxic effects of metals in mice. *Int. J. Pharmaco.* **29**(2):117-126

Rustia, M. 1977. The effect of vitamin C on tumours. *J. National Cancer. Inst.* **55**:1389

Sankaranarayanan, R.L. and Jolly, P.H. 1993. Hypoglycaemic effect of *Emblica officinalis*. *Res. Bull.* **314**:78-84

Santram. 1983. Aonla (*Emblica officinalis* Gaertn.) Uses. Botany and Cultivation, G.B.Pant Krishi Evam Praudyogik, Vishwa Vidyala Pantnagar (11):3-9

Saroj, K., Rathee, K., Pradhan, S. 1990. Amla for daily requirement of vitamin C. *Indian J. Hort.* **13**(4):9-11

Sathy, N., Elizabeth, K.E., Nair, M.K.C. and Bai, S. 1991. Growth faltering and development delay in children with protein energy malnutrition. *J. Indian Acad. Paediatrics*. **28**(3):255-258

Sauberlich, H.E., Dowdy, R.P. and Skala, J.H. 1977. *Laboratory Tests for the Assessment of Nutritional Status*, CRC Press, Inc. Cleveland, Ohio

Sauberlich, K.S. 1991. Vitamin C and cancer. *Life Science. Research Office. Bethesda. Federation of American Society for Experimental Biology* 1117-1121

Schoenthaler, S.J., Moody, J.M. and Pankow, L.D. 1991. Applied Nutrition and behaviour. *Jl. Applied Nutr.* **43**(1):31-39

Shanker, H. 1989. Chemical composition of fresh and dried aonla fruits. *Res. Bull.* **310**:71-91

Sharma, S.D. and Kalia, M. 1990. Anthropometric measurements of preschool children in Ghumarum block of Himachal Pradesh. *Indian J. Nutr. Dietet.* **27**(2):47-52

Sharma, R., Kumar, A., Tewari, P.V. 1991. Ayurvedic approach in prevention of upper respiratory tract infections in children. *J. Res. Edn. Ind. Med.* **12**(1):15-26

Sharma, P.K., Mohra, P.K., Tripathi, P.C. and Shaw, B.P. 1993. Clinical evaluation of Amlaki churna in the treatment of Amalpitta. *Aryavaidyam*. **4**(2):120-122

Shaw, B.P. and Ber, C.H. 1993. A preliminary clinical study to evaluate the effect of Vigorex-ST in sexual debility patients. *Ind. J. Internal. Med.* **3**(6):165-169

Shiva, M. 1993. Empowering women and health care voluntary Health Association of India. **1**(1):2

Shukla, S.P. 1980. Vitamin C in collagen synthesis. *Experientia* **25**(2):704

Shyna, P.K. 1996. Nutritional profile and mental functions of preschool children belonging to agricultural labourer families in Thrissur District. M.Sc. (Home Science) thesis, Kerala Agricultural University, Thrissur

*Sichieri, R., Moura, A.S., Goeloy, J.L., Niero, N. and Matsumoto, F.N. 1993. Nutritional status of children and categories of the family in a rural community of Parama, Brazil. *Cadernos-de-saude-public* 9(1):28-35

Singh, K.P., Singh, R.H., 1987. Recent advances in the management of Amalpitta - Parinama Sula non-ulcer dyspepsia and peptic ulcer disease. *J. Res. Ayurveda. Siddha* **6**(2):132-142

Singh, A.K., Sinha, S.K., Singh, S.N., Jayaswal, M. and Jabbi, M.K. 1987. The myth of the healthy tribal. *Social change* **17**(1):3-22

Singh, M. and Saxena, V.S. 1996. Effect of gamma radiation and different packings used for storage of the drug amla fruit on microflora population and on the phytoconstituents. *Hamdard Medicus* **39**(3):66-72

Sinha, S.P. and Bose, S. 1992. Effect of dietary concentration of aflatoxin B1 and vitamin C on mitotic chromosomes. Sperm head morphology and sperm count in mice. *Cytologia*. **57**(1):75-80

Sokoloff, B., Hori, M., Saclhof, C., Wzolek, T. and Imai, J. 1976. Vitamin C in hypertriglycerdimia. *J. Nutr.* **91**(6):107

Spittle, C. 1986. Mobilisation of cholestrol from the arterial wall. Lancet. **2**(3):1280

Srivastava, R. 1984. Physicochemical studies on Indian Gooseberry constituents. *Proc. Indian Acad. Sci.* **68**(4):59-66

Srivastava, R. 1994. Vitamin C in Indian gooseberry (Phyllanthus emblica Linn.) NDUAT. *Res. Bull.* **12**(4):3-9

Sujatha, A.S. 1990. Food consumption and energy expenditure pattern of self employed women in unorganized sector. M.Sc. (Home Science) thesis, Kerala Agricultural University, Vellanikkara, Thrissur

Sulkin, N.M. 1976. Development of Atherosclerosis. *Ann. New York Acad. Sci.* **258**:317

Suresh, P. 1994. Study of Navagara Louha. *Sachitra Ayurved.* **46**(8):599-608

Swaminathan, M. 1974. *Essentials of Food and Nutrition*. Vol.II. Ganesh and Company, Madras, p.480-481

Swaminathan, M. 1986. *Principles of Nutrition and Dietetics*. Bangalore Printing and Publishing Co. Ltd., Bangalore.

Swaminathan, M.C. 1987. Non-invasive parameters for field monitoring and evaluation their sensitivity, specificity and cost. In Nutrition Monitoring and Assessment (eds. Gopaldas, T. and Seshadri, S.). Oxford University Press, Delhi, p.22

Swayamprakash, M.K. 1991. Treatment of anaemia with special reference to iron in ancient Indian Medicine. Ayurveda. A historical perspective Bulln. *Ind. Inst. History Med.* **21**(2):99-103

Taitz, L.S. and Wardly, S.L. 1989. *Hand book on Child Nutrition.* Oxford University Press, New York. p.108-111

Ternas, T., Todiscot, H., Trizna, L. 1988. Inhibiting effect of ascorbic acid on the growth of human mammary tumor. *Am. J. Clin. Nutr.* **58**(9):381-389

Terroine, T. 1980. Absorption of vitamin. *Wld. Rev. Nutr. Dietetics.* **5**(4):105

Thakur, C.P., Mandal, K. 1984. Effect of *Emblica officinalis* on cholesterol-induced atherosclerosis in rabbits. *Indian J. Med. Res.* **79**(1):142-1146

Thimmayamma, B.V.S. and Rau, P. 1996. Dietary Assessment as part of Nutritional status. Textbook of Human Nutrition (eds. Bamji, M.S., Rao, N.P. and Reddy, V.), Oxford and IBH publishing Co. Pvt. Ltd., New Delhi, p.125-135

Thripathi, P.C., Shaw, B.P. 1992. The role of 'amalaki' in the management of amlapitta. *Indian Med.* **4**(2):11-12

Tolbert, L.C., Thomas, T.N., Middaugh, L.D. and Zemp, I.W. 1979. Noradrenaline in metabolism. *Life. Sci.* **25**(6):2189

*Tuncbilek, E., Coskun, T. and Unalan, T. 1995. Indicators of nutritional status in Turkish Preschool children. *Courk-sagligi-ve-Hastaliklari-Dergiri* **38**(4):485-496

Udani, P.N. and Emery, C. 1982. Neurological and morphological studies on children suffering from protein energy malnutrition. *Baroda J. Nutr.* **9**:257

Udaya, P.K. 1996. Food consumption and nutritional status of farm women in Thrissur District. M.Sc. (FS&N) thesis, Kerala Agricultural University, Thrissur

UNICEF. 1990. Children and Women. A situation Analysis. UNICEF, New Delhi, p.1-5

Usha, V., Thomas, S.P. and Prema, L. 1990. The nutritional status of farm women of instructional farm. Workshop on women in Agriculture. Background papers, National Institute of Rural Development, Rajendra Nagar, Hyderabad

Vallance, B.D., Hume, R. and Weyers, E. 1978. Ascorbic acid levels and immunoglobin components. *Br. Heart. J.* **40**(5):64-65

Vanderkamp, H. 1976. Association of low vitamin C with Depression. *Int. J. Neuropsychiatry.* **8**(3):264

Verma, M., Kapoor, M. and Goyle, A. 1996. *Child Nutrition - Problems and Prospects. Vol. I.* A study sponsored by UNICEF INA Shree Publishers, Jaipur, p.163

Verma, T.S. and Gupta, V. 1996. Effect of postharvest treatment on Ascorbic acid content of amla (*Emblica officinalis* Gaertn.). *Indian Fd. Packer.* **14**(8):41-46

Vijayaraghavan, K. 1987. Anthropometry for assessment of nutritional status. *Indian J. Paediatrics.* **54**(4):511-520

Vilter, R.N. 1983. *The Vitamins*. (ed. Sebrell, S.H. and Harris, R.S.) Academic Press, London. p.457

Warang, H. 1990. The Development of Intelligence in early childhood, children in the Tropic. *Oxford Publications* **12**:41-45

*Waterlow, J.C. 1972. Classification and definition of protein calorie malnutrition. *Br. Med. J.* **3**:566-569

Weber, D., Vouri-Christiansen, L., Ortiz, N., Clement, J.R., Christiansen, N.F., Mora, J.O., Reed, R.B. and Herrera, M.G. 1981. Nutritional supplementation, maternal education and cognitive development of infants at risk of malnutrition. *Am. J. Clin. Nutr.* **34**(4):807-813

*WHO. 1979. Nutritional anaemia: Nutritional anaemia a brief for policy makers, ACC/SCN-NSZ

Zacharia, G. 1984. *Emblica officinalis*. A remedy for hyper hidrosis. *Antiseptic*. **81**(6):312-315

* Original not seen

APPENDICES

APPENDIX-I

KERALA AGRICULTURAL UNIVERSITY

DEPARTMENT OF HOME SCIENCE

Interview schedule to elicit information regarding the functioning pattern of SOS village

Serial No.

1. Name of the respondent :
2. Address :

3. Personnals of the SOS village

Sl. No.	Category	Job responsibility	Qualification

4. Main objectives of the SOS village
   Main objectives - extent of achievement

Sl.No.	Main objectives	Highly satisfied	Partially satisfied	Satisfied	Reasons

5. Training of the mothers

Sl.No.	Criteria	Duration	How do you make use of it
1.	Nutrition		
2.	Human Psychology		
3.	Child care		
4.	House keeping		
5.	First aid		
6.	Account maintenance		
7.	Health and Hygiene		
8.	Practice in running of home		
9.	Internship		
10.	Any others		

6. Facilities of SOS village

(a) Facilities of SOS home

Sl.No.	Aspects	Satisfied	Dissatified
1	Drainage facility		
2	Safe drinking water		
3	Compost pits		
4	Toilets		
5	Washing area		
6	Laundry		
7	Fuel storage		

(b). Educational provisions of SOS village

Sl.No.	Educational provisions	Yes	No
1	Availability of books		
2	Methods of teaching		
3	Status of educational institution		
4	Availability of tution		

5	Availability of other learning materials
6	Availability of time for study
7	Institutional transport facility
8	Others

(c). Medical facilities of SOS village

Sl. No.	Details	Frequency	Personnel incharge
1	Health check up		
2	Immunization a) BCG b) DPT Polio c) DPT Polio d) DPT Polio e) MMR f) DPT Polio (Booster) g) Pulse polio		
3	Distribution of medicines 1. Tablets 2. Dressing of wounds and cuts		
4	Any others Referral services		

(d). Facilities regarding extra curricular activities

Sl. No.	Activities	Area	No. of children participated
1	Dance		
2	Music		
3	Drawing		
4	Painting		
5	Sports		
6	Games		
7	Stitching		
8	Clay modelling		
9	Wood carving		
10	Embroidery		
11	Crafts		
12	Cooking		
13	Tailoring		
14	Book binding		
15	Weaving		
16	Baking		
17	Flower making		
18	Knitting		
19	Plastic wire work		
20	Others		

(e). Recreational facilities

Sl.No.	Item	Age group	Satisfied	Dissatisfied
1	Games			
2	Sports			
3	Arts club			
4	Watching TV programme			
5	Radio			
6	Going to movies			
7	Gatherings			
8	Others			

7 (a). Inter family relations in SOS village

Sl. No.	Type of relationship in each home among children	Type of relationship among mother and other family members

(b) Intra family relations in SOS village

Sl.No.	Type of relationship among children	Yes	No
1	Participatory activity in various programme		
2	Participation occasions like birthday		
3	Participation in sports and games		
4	Visits to other homes		
5	Going to school together		
6	Combined studies		
7	Others		

(c) Intra family relationship between mother

Sl.No.	Type of relationship among mother	Yes	No
1	Sharing of house		
2	Work when sick		
3	Inviting other families or special occasions		
4	Looking after neighbours children if needed (or) in need		
5	Learning hand work, handicrafts etc.		
6	Getting advice		
7	Getting advice on nutrition and health aspects		
8	Getting knowledge on healthy life styles		
9	Getting skills and talents in imparting better behaviour development in children		
10	Getting knowledge in trading children skills in home making		
11	Getting knowledge to impart better education		
12	Other		

8. Family size and religion

Sl. No.

(a) Family size

(b) Religion

---

9. Income of SOS families

Sl. No.

(a) Cost estimate per children

> 12

< 12

(b) Salary of mothers

---

10. Age and educational level of inmates of SOS village

Sl.No.	Age	Educational level

---

11. List out the criteria stipulated by the activities for the enrolment of children into the village

Sl.No.	Criteria stipulated	Do you follow the criteria	If no changes made	Reasons

12. Details of index child

Sl. No.	Item
(a)	Gender
(b)	Birth order
	First
	Second
	Third
(c)	Birth weight
	>2.5 kg
	2.5 kg
	< 2.5 kg
(d)	Morbidity
	Yes
	No.
(e)	Immunisation status
	Complete
	Partially complete
(f)	Deworming pattern
	Regular
	Irregular

APPENDIX-II

KERALA AGRICULTURAL UNIVERSITY

DEPARTMENT OF HOME SCIENCE

Interview schedule to elicit information regarding food consumption, expenditure and dietary pattern of SOS families

1. Serial No. :

2. Name of the respondent :

Age : Sex :

3. Address :

4. Place of residence :

a) Block :

b) Panchayat :

c) Ward :

5. House No. :

6. Total income of the family :

7. Food habit : Vegetarian/non-vegetarian

8. Name of the staple food :

9. Details of food expenditure pattern

Sl. No.	Food item	Quantity purchases	Frequency of purchase				Total cost	% of total expend-iture
			Daily	Weekly	Monthly	Occas-ionaly		
1	Cereals							
2	Pulses							
3	Green leafy vegetables							
4	Roots and tubers							
5	Other vegetables							
6	Fruits							
7	Milk & milk products							
8	Meat							
9	Fish							
10	Egg							

11 Fats & oil
12 Spices & condiments
13 Nuts & oil seeds
14 Sugar & jaggery
15 Others

---

10. Frequency of use of various food materials

Sl. No.	Food items	Frequency of use					Occasionally	Never
		Daily	Weekly 4 times	Weekly thrice	Weekly twice	Weekly once		
1	Cereal							
2	Pulses							
3	Green leaf vegetables							
4	Roots and tubers							
5	Other vegetables							
6	Fruits							
7	Milk & milk products							
8	Egg							
9	Meat							
10	Fish							
11	Nuts & oil seeds							
12	Spices & condiments							
13	Fats and oil							
14	Sugar and jaggery							
15	Others (specify)							

---

11. Do you maintain accounts food expenditure : Yes/No
If yes,

i) In what form : a) written
b) memory

ii) period : a) Daily
b) Weekly
c) Monthly

12. Details regarding meal planning

i) Do you plan your meal in advance : Yes/No

ii) If yes, what is the basis for planning

a) Total family requirement
b) Money available
c) Likes and dislikes of family members
d) Food availability
e) Others (specify)

13. How many times do you and your family take food daily?

a) One
b) Twice
c) Thrice
d) More than 3 times
e) and when they like
f) others (specify)

14. How many times the index child take food daily?

a) Once
b) Twice
c) Thrice
d) More than 3 times
e) As and when they like
f) Others (specify)

15. Do you maintain specific time schedule for taking food?

Yes/No

a) Specify reason

16. Do you use boiled water or water without boiling for drinking?

Yes/No

17. Have you changed food pattern because of any religious reason?

Yes/No

18. Snacking habit of the child

a) Type of snack :
b) Snack food : Prepared at home/shop

19. Do you prepare different foods on special occasion

Yes/No
If Yes, specify

Occasion	*Food prepared*	*Reason*
1. Birthday		
2. Festivals		
3. Feasts		
4. Others (specify)		

20. Food given during special conditions

Sl.No.	Condition	Breakfast	Lunch	Dinner
1	Infancy			
2	Preschool age			
3	School going			
4	Adolescence			
5	Others (specify)			

21. Do you change the dietary pattern of child during these following conditions?

Yes/No
If yes, specify the disease

Sl.No.	Disease	Food item included	Reason	Food item included	Reason
1	Cholera				
2	Diahorrea				
3	Fever				
4	Vomiting				
5	Jaundice				

22. Do you give supplementary foods to your child : Yes/No

i) If yes, what type of food? :
ii) From which age onward? :

23. Methods of preparing various food articles prior to cooking

i) Dry food articles (like cereals)

a) Washing and drying soon after purchase
b) Washing just before cooking
c) Cleaning/winnowing and then washing
d) Others (specify)

ii) Washing (specify the number of times)

a) Once
b) Twice
c) Thrice
d) More than 3 times
e) Washing till the water is clear

iii) Perishable foods

Sl.No.	Food item	Washing & drying soon after purchase	Washing just before cooking	Cleaning winnowing & washing	Washing before cutting	Washing after cutting	Washing before & after cutting
1	Vegetables						
2	Roots and tubers						
3	Leaf vegetables						
4	Fruits						
5	Fish						
6	Meat						

24. Do you eat any raw foods : Yes/No

If yes, specify

25. Cooking methods followed for various food items

Foods	Boiling	Straining	Absorption	Steaming	Frying		Baking	Others
					Deep fat	Shallow fat		
1. Cereal								
2. Pulses								
3. Roots & tubers								
4. Other vegetables								
5. Green leafy vegetables								
6. Fruits								
7. Meat								
8. Fish								
9. Egg								
10. Milk & milk products								
11. Others								

26. Storage and preservation methods

Methods	Cereals	Pulses	Vegetables	Fruit	Fish	Meat	Milk
Closed containers							
Drying							
Refrigeration							
Pickling							
Salting and drying							
Smoking							
Fermenting							

27. Do you use any left over foods : Yes/No
If yes, specify method of reuse

28. Equipments of SOS village

Item	Yes	No
Refrigerator		
Television		
Radio		
Gas stove		
Kerosene stove		
Mixy		
Washing machine		

29. Supplementary foods

Foods included	Number of feeding		
	1-2	3	> 3
Cereal			
Pulses			
Fruits			
Egg, meat, fish			
Roots and tubers			
Vegetables			
Milk			
Cerelac/Farex/Lactogen			

APPENDIX-III
RECIPES OF AMLA PRODUCTS

1. Amla Preserve

Large size fruit	: 1 kg
Alam (Food grade)	: 2%
Sodium sulphate	: 0.5%
Sugar	: 1½ kg
Citric acid	: 2 g

Procedure

Large size amla was selected and put in water for 2 days and then pricked thoroughly with stainless steel fork. The fruits were kept in 2% alum and 0.5% sodium sulphate solution for 5 minutes. The fruits and sugar were kept in alternate layers and then left for 24 hours. In the following day the sugar would dessolved The fruits were taken out from syrup and boiled and 2 g citric acid was added per kg of sugar at boiling point. Syrup was strained with muslin cloth and the fruit were kept in hot syrup for 24 hours. On third day again the fruits were taken out from the syrup, boiled till the sugar percentage reaches 70-72°Brix. At this stage preserve was ready for use.

2) Amla Jam

Amla	: 1 kg
Sugar	: 1 kg
Citric acid	: 4-5 g (per kg)

Procedure

Fruits were kept in 8% salt solution for 2 days to remove astringency, then washed thoroughly and boiled for 10 minutes. Removed the seeds and blended. Mixed the blended amla and sugar and kept for 2-3 hours. Cooked the mass. Citric acid was added while cooking. As the product attained desired consistency, or the

sugar percentage reached 68° brix, jam was ready. The hot jam was filled into wide mouth sterilized bottled up to the brin. On cooling jam would set.

3) Amla candy

Amla	: 1 kg
Sugar	: 1½ kg
Alum (Food grade)	: 2%
Sodium sulphate	: 0.5%

Procedure

Large size amla fruits were selected and put in water for 2 days and then pricked thoroughly with stainless steel fork. The fruits were kept in 2% alum and 0.5% sodium sulphate solution for 5 minutes. The fruits and sugar (1½ kg) were kept in layers and then left for 24 hours. In the following day the sugar would dissolved. The fruits were taken out from syrup and boiled the syrup. The syrup was strained through a muslin cloth and the fruits were kept in hot syrup for 24 hours. On the third day again the fruits were taken out from the syrup and boiled till the sugar percentage reached 70-72°brix. At this stage the fruits were kept in hot syrup, kept the candy for 20 days and then heated the candy for 5 minutes. Took out the fruits from the syrup. Ground sugar was then sprinkled on the fruits and the fruits were allowed to dry at room temperature. Candy was ready for use.

4) Amla Jelly

Amla	: 1 kg
Sugar	: ¾ cup for 1 cup of extract
Citric acid	: 4-5 g

Procedure

Removed the seed from the fruits and added equal quantity of water and 2 per cent citric acid and boiled gently for ½ hour with occasional stirring. Strained the mass through a cloth to separate the extract. Reheated the fruits with half

quantity of water and citric acid for 15 minutes and drained again. Mixed the two extract and kept aside for setting. Decanted the clear extract to prepare jelly.

Boiled the extract, when it start boiling added sugar and stirred well. When the sugar was completely dissolved, strain the extract through a cloth to remove the impurities of sugar and boil it again. When it reached the boiling point added citric acid and stirred well. When the sugar percentage reached 68°brix the jelly was cooked. Removed from fire and filled the jelly in a wide mouth sterilized bottle and kept overnight for setting.

5) Amla Squash

Amla	: 1 kg
Water	: 1 cup
Sugar	: 1½ cup (for 1 cup of pulp)
Citric acid	: 1 teaspoon
Yellow colour	: a pinch

Procedure

Kept the fruits in salt solution for 2 days. Washed thoroughly and removed the seeds and pulp the fruits. Boiled the water and sugar and cooled it. Added the cooled sugar syrup to the juice Then added the citric acid and colour and stirred well. Filled the squash in sterilized bottles.

6) Amla soft drink

Amla fruit pulp	: 150 g
Sugar	: 200 g
Yellow colour	: a pinch
Citric acid	: ½ teaspoon
Water	: 700 ml

Procedure

Prepared the fruit pulp as explained in the procedure of squash. Boiled the water and added to the sugar and dissolved it. Kept it aside for cooling. Colour

and citric acid was added to the sugar syrup. Then added the fruit juice to the sugar syrup and mixed well, until the product was mixed. The sugar percentage of the soft drink should be 10°brix. Filled the soft drink in sterilized bottles.

7) Amla shred

Amla fruit pulp	: 1 kg
Sugar	: 250 g
Citric acid	: 2 g
Yellow colour	: 1 pinch

Procedure

Prepared the fruit pulp as explained in the procedure of squash. Added sugar to pulp and stirred well till the sugar dissolved. Dissolved citric acid and colour in boiled water and added to the pulp and mixed well. Greased a steel tray with ghee and poured the prepared pulp to it. Dried it in a cabinet at 50°C. Drying done till it can be separated as sheets. Cut the dried material to pieces of convenient size. Kept 4-5 layers one above and pressed well.

APPENDIX-IV

SCORE CARD FOR THE ORGANOLEPTIC EVALUATION OF AMLA PRESERVE AND CANDY

No.	Character	Description	Score
1	Colour	Brownish	5
		Light brownish	4
		Yellowish	3
		Light yellowish	2
		Pale yellowish	1
2	Doneness	Adequately cooked	5
		Soft	4
		Mushy	3
		Overcooked	2
		Raw	1
3	Texture	Highly tender	5
		Slightly tender	4
		Neither tender nor fibrous	3
		Slightly fibrous	2
		Fibrous	1
4	Taste	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1
5	Flavour	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1

SCORE CARD FOR THE ORGANOLEPTIC EVALUATION OF AMLA JAM

No.	Character	Description	Score
1	Colour	Yellow	5
		Pale yellow	4
		Light brown	3
		Brown	2
		Dark brown	1
2	Doneness	Adequately cooked	5
		Soft	4
		Mushy	3
		Overcooked	2
		Raw & bitter	1
3	Texture	Sheet form	5
		Too loose sheet	4
		Cohesive	3
		Slightly hard	2
		Very hard	1
4	Taste	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1
5	Flavour	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1

SCORE CARD FOR THE ORGANOLEPTIC EVALUATION OF AMLA JELLY

No.	Character	Description	Score
1	Colour	Reddish brown	5
		Pale reddish brown	4
		Dark reddish brown	3
		Brown	2
		Dark brown	1
2	Doneness	Adequately cooked	5
		Soft	4
		Mushy	3
		Overcooked	2
		Raw & bitter	1
3	Texture	Soft	5
		Moderate soft	4
		Cohesive	3
		Hard	2
		Very hard	1
4	Taste	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1
5	Flavour	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1

SCORE CARD FOR THE ORGANOLEPTIC EVALUATION OF AMLA SQUASH

No.	Character	Description	Score
1	Colour	Dark yellow	5
		Light yellow	4
		Pale yellow	3
		Light brown	2
		Dark brown	1
2	Doneness	Adequately cooked	5
		Slightly boiled	4
		Raw	3
		Sluggish	2
		Over sluggish	1
3	Texture	Opt. concentration	5
		Thin concentration	4
		Too thin concentration	3
		High concentration	2
		Too high concentration	1
4	Taste	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1
5	Flavour	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1

SCORE CARD FOR THE ORGANOLEPTIC EVALUATION OF AMLA SHRED

No.	Character	Description	Score
1	Colour	Brownish	5
		Light brownish	4
		Yellowish	3
		Light yellowish	2
		Pale	1
2	Doneness	Adequately cooked	5
		Soft	4
		Mushy	3
		Overcooked	2
		Raw	1
3	Texture	Tender	5
		Slightly tender	4
		Neither tender nor fibrous	3
		Slightly fibrous	2
		Fibrous	1
4	Taste	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1
5	Flavour	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1

SCORE CARD FOR THE ORGANOLEPTIC EVALUATION OF AMLA SOFT DRINK

No.	Character	Description	Score
1	Colour	Yellow	5
		Light yellow	4
		Pale yellow	3
		Dark yellow	2
		Light brown	1
2	Doneness	Adequately cooked	5
		Slightly boiled	4
		Raw	3
		Sluggish	2
		Over sluggish	1
3	Texture	Opt. concentration	5
		Thin concentration	4
		Too thin concentration	3
		High concentration	2
		Too high concentration	1
4	Taste	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1
5	Flavour	Excellent	5
		Good	4
		Fair	3
		Poor	2
		Very poor	1

APPENDIX-V

DIET SURVEY OF THE INDEX CHILD - ONE DAY WEIGHMENT

Family No.: Name of the head of the family: Date:

Village : District : State:

Age and sex composition of those who have part taken the mean

Age	3-6	6-9
M		
F		

Cereals

1. Rice
2. Wheat flour
3. Ragi
4. Maida
5. Rava
6. Others

Pulses

7. Bengal gram
8. Black gram
9. Red gram
10. Soyabean
11. Green gram
12. Others
13. Leafy vegetables
14. Others vegetables

Roots and tubers

15. Carrot
16. Onion big
17. Beet root
18. Tapioca
19. Potato
20. Sweet potato
21. Yam
22. Others

Fruits
23. Amla
24. Apple
25. Banana, ripe
26. Lime and orange
27. Mango, ripe
28. Melon water
29. Papaya, ripe
30. Tomato, ripe
31. Others

Fish
32. Fish fresh
33. Fish dry

Other flesh foods
34. Meat
35. Chicken
36. Liver, goat
37. Egg, hen

Milk and milk products
38. Milk
    Curds
    Butter milk
39. Skimmed milk, liquid
40. Cheese

Fats and oils
41. Butter
42. Ghee
43. Hydrogenated oil
44. Cooking oil

APPENDIX-VI

Schedule for clinical assessment

(N.A.C.I.C.M.R.)

1. Sex : HC:
2. Age : CC:
3. Height : MUAC:
4. Weight :
5. General appearance
   0. Good
   1. *Fair*
   2. Poor
   3. Very poor
6. Eyes
   a) Conjunctiva
      i. Xerosis
         0. Absent, glistening and moist
         1. Slightly dry on exposure for a minute, lack of lustre
         2. Conjuctiva dry and wrinkled
         3. Conjunctiva very dry and Bitot's spot present
      ii. Pigmentation
         0. Normal colour
         1. Slight discolouration
         2. Moderate browning in patches
         3. Severe earthy discolouration
      iii. Discharge
         0. Absent
         1. Watery, excessive, lachrymation
         2. Mucopurulent
         3. Purulent

b) Cornea

i. Xerosis

0. Absent

1. Slight dryness and diminished sensibility

2. Haziness and diminished transparency

3. Ulceration

ii) Vascularization

0. Absent

1. Circumcorneal infection

2. Vascularization of cornea

c) Lids

i) Excoriation

0. Absent

1. Slight excoriation

2. Belpharitis

ii) Folliculosis

0. Absent

1. A few granules

2. Lids covered with extensive granules

3. Hypertrophy

iii) Angular conjunctivitis

0. Absent

1. Present

d) Functional

i) Night blindness

0. Absent

1. Present

NB: Exclude other eye diseases not associated with nutritional defects

7. Mouth

a) Lips

i) Condition

0. Normal

1. Angular somatitis, mild

2. angular somatitis, marked

b) Tongue

i) Colour

0. Normal

1. Pale but coated

2. Red

3. Red and Raw

ii) Surface

0. Normal

1. Fissured

2. Ulcered

3. Glazed and atrophic

c) Buccal mucosa

i) Condition

0. Normal

1. Bleeding and/or gingivitis

2. Pyorrhoea

3. Retracted

d) Gums

i) Condition

0. Normal

e) Teeth

i) Fluorosis

0. Absent

1. Chalky teeth

2. Pitting of teeth

3. Mottled and discoloured teeth

ii) Carries

0. Absent

1. Slight

2. Marked

8. Hair

i) Condition

0. Normal

1. Loss of lustre

2. Discoloured and dry

3. Spares and brittle

9. Skin

a) General

i) Appearance

0. Normal

1. Loss of lustre

2. Dry and rough or crazy pavements

3. Hyperkeratosis, phrynoderma

ii) Elasticity

0. Normal

1. Diminished

2. Wrinkled skin

b) Regional

i) Trunk

0. Normal

1. Collar-like pigmentation and dermatitis around the neck

2. Moon face

ii) Face

0. Normal

1. Nasolabial seborrhoes

2. Symmetrical suborbit pigmentation

3. Moon face

iii) Perineum

0. Normal

1. Scrotal or pudental dermatitis

iv) Extremities

0. Normal

1. Symmetrical dermatitis with pigmentation glove or stocking type

10. Adipose tissue (to be judged by the examination of arm over the biceps)

i) Quantity

0. Normal

1. Difficient

11. Oedema

i) Distribution

0. Absent

1. Oedema on dependent parts

2. Oedema on face and dependent parts

12. Bones

i) Condition

0. Normal

1. Stigmata of past rickets

13. Heart

i) Size

0. Normal

1. Apex outside the nipple line

2. Enlarged

14. Ailmentary system

i) Appetite

0. Normal

1. Anorexia

ii) Stools

0. Normal evacuation

1. Diarrhoea

iii) Liver

0. Not palpable

1. Palpable

iv) Spleen

0. Not palpable

1. Palpable

15. Nervous system

i) Calf tenderness

0. Absent

1. Present

ii) Paresis

0. Absent

1. Present

APPENDIX-VII

MATHEW

IAS RATING SCALE

V.George Mathew, Ph.D.

1995

The scale measures the degree of Inertia, Activation and Stability in an individual. The scale can be used for rating your own personality or the personality of another person.

Do not write in this booklet. Use the separate answer sheet.

35 Sub-scales are given below. Each scale has three sets of descriptions or qualities designated by the letters, I, A and S. You have a total of 3 points to divide among the three alternatives. Be as objective as possible in your judgement. If you feel that the ratee possesses the three equally as seen in his general behaviour, you can divide the three points equally (as 1,1,1). If you think that he possesses only one and not the other two, you can give all the three points to that and zero to each of the other two. On the other hand if you feel that he possesses one among the three to a large degree, another to a smaller degree and he does not possess the third you can distribute the points as 2,1,0 of course writing the three numbers under the appropriate letters (I,A,S) in the answer sheet, against the scale number. Remember that the total of points given to one scale should be 3. Avoid giving fractions. Avoid omitting items.

1. Activity Level

I. Underactive, Unable to become active, Not acting when required
A. Restless, Acting even when not required, Overactive, Blind action
S. Right action at the right time, Appropriate controlled action, Acting without ego-involvement, Restful detached action

2. Energy

I. Lazy, Lethargic, Lacks energy
A. Too much, uncontrolled energy
S. Balanced, controlled energy

3. Speed and accuracy

I. Slow and careless, Overcautious
A. Fast, Overspeed, Unable to act slowly
S. Fast and accurate, Fast or slow as the situation demands

4. Punctuality

I. Usually late
A. Hasty, Hurried, Impatient
S. Punctual

5. Perspective

I. Concerned with immediate present problems only
A. Efficient in planning and anticipating practical things for the future
S. Philosophical, Wise, Concerned with ultimates, has wide perspective

6. Mentality

I. Not particularly thoughtful
A. Analytical and thoughtful in practical matters
S. Integrative, Intuitive, Holistic

7. Risk Taking

I. Not Venturing
A. Taking too many risks, Adventurous
S. Taking calculated risks

8. Temperament

I. Timid, Inhibited
A. Impulsive, Excitable
S. Balanced, Mature

9. Courage

I. Fear
A. Blind, physical, rash courage
S. Mental strength and courage, Courage of conviction, Moral courage

10. Approach to Life

I. Brooding, Withdrawn
A. Pushing, Grabbing, Go-getting
S. Open, Warm, Detached

11. Motivation

I. Unrealistic ambitions, Daydreaming, Having vain desires
A. Intense and realistic ambitions and actions, Greed
S. Self-sufficient, Contented, Meta-motivation

12. Adjustment

I. Shallow temporary emotions like anxiety, Hysteria
A. Maniacal, Excitable, Depressive, Definite moods
S. Even tempered, Stable, Relaxed, Peaceful, High stress tolerance, Capacity for deep prolonged emotions

13. Emotionality

I. Weak emotionality (low libidinal level)
A. Passionate, High drive, Ego-involvement, Strong identifications
S. Dispassionate, Sublimated and controlled emotions

14. Will

I. Weak-will, Highly suggestible
A. Struggling with oneself, Having conflicts
S. Fully controlled, Easy control of self

15. Rights and duties

I. Not conscious of one's rights or duties
A. Fighting for one's rights, but not conscious of one's responsibilities
S. Aware of and discharging one's responsibilities and Duties

16. Leadership

I. Submissive, Inability to be a leader, Inability to command
A. Autocratic leader, Dominant, Egoistic, Inability to be a follower
S. Democratic, Can be a leader or follower with equal ease

17. Assertiveness

I. Inability to demand or protest, Inability to refuse or argue
A. Rude, Arrogant, Inability to suffer silently
S. Ability both to strongly voice one's opinion or suffer in silence as the occasion demands

18. Anger

I. Inability to show anger
A. Short temper, Inability to control anger
S. Can make a show of anger, without really losing control

19. Fairness

I. Allows oneself to be exploited by others
A. Aggressive, Exploits others
S. Just and fair to oneself and others

20. Relation to People

I. Oversensitive, Delicate, Easily hurt
A. Thick-skinned, Clever, Manipulative, Self-centered
S. Tolerant, Kind, Considerate, Loving, Unselfish

21. Relation to Possessions

I. Letting possessions go because of inability to hold them
A. Attached, Proud, Possessive, Greedy
S. Altruistic, Detached

22. Self-Concept

I. Inferiority feelings, Low self-confidence
A. Superiority complex, Boastful, Over-confidence, Likes to show off
S. Self-acceptance, Self-sufficient

23. Values

I. Values only pleasure, No values
A. Values power, fame, position and status
S. Values friendship, wisdom and character

24. Aggression

I. Punishing oneself (intropunitive), Masochistic (inflicting pain on oneself), Unable to defend oneself
A. Sadistic, Extrapunitive, No difficulty to punish others
S. Impunitive, Forgiving and kind to oneself and others

25. Attitude to strangers

I. Feels upset in the company of strangers, Inability to relate to or mix with strangers
A. Mixes with everybody, can easily make friends, Feels upset when alone
S. Can remain alone or mix with people with equal case, but prefers to have a few close friends

26. Sociability

I. Keeping aloof, Shut-in, Does not enjoy company, Lacks Sociability
A. Has social skills, Enjoys large gatherings, Cannot tolerate loneliness
S. Comfortable and happy both in being alone as well as with people

27. Speech Making

I. Nervous, Has stage fright, Talking difficulty, Inability to make a speech
A. Likes to talk, Finds it difficult to remain silent
S. Good listening ability and good speaking talent, Likes Both

28. Opposite sex

I. Shy before the opposite sex, Sexually inhibited
A. Aggressively sexed
S. Transcending sex, Control

29. Conformity

I. Blind conformity to group, Identified with group, Collectivistic
A. Individualistic, Competitive, Deliberately deviates from group, Rebel
S. Autonomous, Thinks and functions independently, Helps group to improve

30. Friendship

I. No strong friendship connections
A. Passionate human relationships, Intense love or hate
S. Detached altruistic love, Compassion

31. Group Identification

I. No strong friendship connections
A. Strong identification with relatively narrow groups, intensely patriotic
S. Identification with larger groups, wider humanity, All creatures

32. Conscience

I. Weak superego, Not concerned with right and wrong
A. Strong conscience and guilt feelings, Rigid moral codes
S. Moral sense based on love, internal control and Integration

33. Beliefs

I. Beliefs based on fear, need for certainty, escape and security
A. Rigid beliefs based on need to control oneself and one's emotions
S. Tolerance of ambiguity, open-mindedness, Intuitiveness

34. Notion of Reality

I. Not philosophically inclined, Non-critical, Ready to accept the world as unreal
A. Pragmatic, Argumentative, Regards the world as absolutely real
S. Open to new ideas and experiences, World seen as both real (phenomenologically) and unreal (in relation to possible higher states)

35. Determinism

I. Believes in fate, luck and ill-luck only
A. Believes in value of self-effort and freedom of the will only
S. Will and effort are seen as links in the causally connected pre-determined chain of events

IAS RATING SCALE

V. GEORGE MATHEW, Ph.D.

1995

ANSWER SHEET

Version of scale (language)

I Your name . . . . . Age . . . . . Sex . . . . . .

II TOM (typical group member) rating:

Description of group . . . . . Age range. . . . . Sex . . . . . .

Your relationship to the ratee . . . . . .

III Peer rating

Name of ratee . . . . . Age . . . . . Sex . . . . . .

Your relationship to the ratee . . . . . .

IV Subordinate rating

Name of ratee . . . . . Age . . . . . Sex . . . . . .

Your relationship to the ratee . . . . . .

Scale No.	I. SELF R.			II. TGM R.			III. PEER R.			IV. SUP. R.			V. SUB R.		
	I	A	S	I	A	S	I	A	S	I	A	S	I	A	S
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															
26															
27															
28															
29															
30															
31															
32															
33															
34															
35															

INFLUENCE OF AMLA (*Emblica officinalis* Gaertn.) PRODUCTS ON THE NUTRITIONAL AND HEALTH STATUS OF SOS CHILDREN IN THRISSUR DISTRICT

By

JISSY GEORGE

ABSTRACT OF THE THESIS

Submitted in partial fulfilment of the requirement for the degree of

Master of Science in Home Science

Faculty of Agriculture
Kerala Agricultural University

DEPARTMENT OF HOME SCIENCE
COLLEGE OF HORTICULTURE
VELLANIKKARA, THRISSUR - 680 656
KERALA, INDIA

2000

ABSTRACT

A study on the influence of amla (*Emblica officinalis* Gaertn.) products on the nutritional and health status of SOS children in Thrissur District was conducted among children in the age group of 4 to 6 years and 7-9 years.

The functioning pattern of SOS village indicated that the activities were carried out by an efficient panel of personnels and the mother in charge of each family looked after the activities of each family.

The facilities with respect to education, recreation, health, sanitation, inter and intra family relations and extracurricular activities of the village were found to be excellent.

Majority of the selected children had a normal birth weight with low morbidity and had completed the immunization schedule.

All the families were non-vegetarians. All the families planned their meals in advance and maintained specific time schedule for taking meals.

Among the seven amla products prepared, amla preserve was found to be the most acceptable. Most of the chemical constituents analysed were retained even upto six months of storage.

The impact of feeding amla preserve on the nutritional status of children indicated that most of the anthropometric parameters were significantly better in the amla fed group. Most of the food groups and nutrients were found to be inadequate in their daily diet. Anaemia, anorexia and dental caries were found to be the most important clinical symptoms observed among SOS children. No child in the experimental group showed anaemic symptoms after the feeding trial.

The behaviour traits of children did not show any significant variation between control and experimental groups.