Compendium of Research Highlights in Home Science

Compiled & Edited by
Dr. Suman K.T., Dr. V. Indira & Dr. Lakshmy P.S.

Department of Home Science
College of Horticulture
Vellanikkara, KAU P.O. 680 656

2014

Compendium of Research Highlights in Home Science

2014

Compiled & Edited by
Dr. Suman K.T., Dr. V. Indira & Dr. Lakshmy P.S.

Published by
Department of Home Science
College of Horticulture
Vellanikkara, KAU P.O. 680 656

Printed at:
Lumiere Printing Works
Thrisur 680 020

Foreword

Teaching, research and extension are the three main functions assigned to our University. Teaching is a prime function and needs to be performed at the highest level of competence, that is possible only when the faculty is engaged in research activities. Such engagements help teachers to remain at the cutting edge with the advances in their own subjects. It also sustains the interest in the academic activities and provides opportunities to the students to get acquainted with frontline areas. It widens the scope of learning and exposes students to the latest developments in research methodology and encourages them to take up careers in the research field.

Food Science and Nutrition, an ever expanding subject with multi disciplinary roots, is vitally important for the physical, mental and social well being of all people. The Department of Home Science of College of Horticulture has contributed significantly in the areas of value addition and product diversification, quality evaluation of foods and food products, documentation of traditional foods and assessment of food and ntritional security of the community.

I am extremely happy to present the compendium of research activities in Home Science (Food Science and Nutrition) highlighting the research so far undertaken in the department. This publication will serve as an indicator to evaluate the progress and trends in research activities. It would also help to suggest necessary measures to be taken to sustain and enhance the research contributions in this field.

I would like to place on record my sincere appreciation of the efforts made by Dr. V. Indira, Dr. Suman K.T. and Dr. Lakshmy P.S. for preparing this compendium in short span of time. I am sure that it will serve as a valuable reference material for anyone interested in the area of food science and nutrition.

Dr. P.K. Valsalakumari
Associate Dean
College of Horticulture

CONTENTS

28. Value addition and quality evaluation of West indian cherry *(Malpighia punicifolia* L.)
29. Standardisation of blended cashew apple RTS beverages
30. Standardisation and quality evaluation of banana based probiotic fermented food mixtures
31. Comparative evaluation of fresh fruit juices sold by street vendors versus restaurants.
32. Process standardisation for banana wine

E. NUTS AND OIL SEEDS

33. Quality evaluation of kernels of different cashew varieties

F. ANIMAL FOODS

34. Standardisation and acceptability of dairy products with cocoa mass
35. Nutrient analysis and value addition of underutilized fish
36. Quality evaluation of value added products with marine and fresh water fish

G. TRADITIONAL FOODS

37. Documentation and quality evaluation of traditional foods of central zone of Kerala

H. LESS FAMILIAR FOODS

38. Standardisation and quality evaluation of grain amaranth (*Amaranthus* spp.) flour supplemented food products
39. Development and quality evaluation of weaning foods incorporating grain amaranth
40. Quality evaluation and value addition of edible bamboo shoots
41. Evaluation of cycas seed flour for product development
42. Nutritional evaluation of cycas seed flour (*Cycas circinalis* L.)

II. COMMUNITY NUTRITION

A. PRESCHOOL CHILDREN

43. Nutritional profile and mental functions of preschool children belonging to agricultural labourer families in Thrissur District
44. Nutritional status and intelligence of preschool beneficiaries of ICDS and non- beneficiaries of Thrissur District.
45. Maternal employment and nutritional status of preschool children
46. Nutritional profile of preschool children of fishermen

B. SCHOOL CHILDREN

47. Nutritional and health impact of substituting green gram by soya products in school lunch programme in Thrissur district
48. Influence of amla (*Emblica officinalis* Gaertn.) products on the nutritional and health status of SOS children in Thrissur district
49. Dietary habits and nutritional profile of school children participating in the school lunch programme

C. ADOLESCENTS

50. Effect of amaranth on the health and nutritional profile of adolescents
51. Food habits and nutritional profile of adolescents
52. Nutritional profile and endurance capacity of adolescent girls

D. WOMEN

53. Food consumption pattern and nutritional status of farm women in Thrissur District
54. Food consumption pattern and nutritional status of women agricultural labourers of Ollukkara Block, Thrissur District
55. Nutritional profile of women labour in rice cultivation
56. Nutritional profile of fisher women
57. Nutritional profile and physical fitness of sports women
58. Nutritional profile of women labour in coir sector
59. Nutritional profile of women participating in kudumbasree programmes

E. ELDERLY

60. Nutritional profile of the elderly

F. FAMILIES

61. Traditional food habits of different communities in Thrissur District
62. Household food security and nutritional status of women agricultural labourers
63. Prevalence of hypertension and assessment of risk factors among agricultural labourers
64. Food security in farm labour households of Kuttanad
65. Food and nutritional security scenario of BPL families of central zone of Kerala

I. QUALITY EVALUATION OF FOODS AND PRODUCT DEVELOPMENT

A. CEREALS AND PULSES

1. Nutritional Studies on the Bioavailability of Iron from Cereals and Pulses

Name of the Student : Jainita M. Mehta (1994-16-06)
Major Advisor: Dr. V. Usha

Evaluation of the *in vitro* availability of iron from commonly consumed cereals and pulses and the effect of cooking utensils, processing and cooking methods on the bioavailablity of iron in cereals and pulses commonly consumed by Keralites were conducted. The possibility of improving the availability of iron from cereal and pulse based Kerala diet by supplementation or substitution was also explored. Three cereals namely rice, wheat and ragi and six pulses namely bengal gram, green gram, black gram, horse gram, cow pea and soybean were selected for the study.

Among cereals, though the total iron was maximum for ragi (6.79mg/100g), the absolute available iron was less (0.49mg/100g) mainly due to its high fibre and tannin contents. However, germination of ragi for 48 hours improved the bioavailability of iron (3.03mg/ 100g). Refined wheat flour had the maximum bioavailabity (0.68mg/100g) owing to the reduction of fibre and phytic acid during refining when compared to whole wheat flour (0.63mg/100g).

Among pulses, maximum absolute available iron was in bengal gram (3.80mg/100g) followed by soybean (3.0mg/100g) and least for black gram (0.50mg/100g) due to high phytin phosphorus and tannin. The total and absolute available iron increased on dehulling the pulses except in the case of soybean. In bengal gram, after dehulling, the absolute available iron increased to 9.7mg/100g. Further increase in iron availability was observed on germination of pulses due to the breakdown of anti nutritional factors. In germinated bengal gram this was found to be 4.80mg/100g.

A slight increase in the absolute available iron of fermented and unfermented idli batter was observed which became more available on cooking by steaming. In pulses, four to six fold increase in the absolute available iron occurred by germination and roasting. In bengal gram, the available iron doubled on roasting, while in black gram 10 to 15 fold increase occurred on roasting. Roasting the pulses after dehulling further increased the iron availability.

Pressure cooking rice was found to be better with respect to total iron and absolute available iron when compared to boiling. In pulses, soaking and boiling/pressure cooking were found

to be better to improve the iron availability. The total iron was found to be maximum when cereals and pulses were cooked in iron vessels. The absolute available iron was maximum when cereals and pulses were cooked in glass, mud or tufflon coated vessels and was least when they were cooked in aluminium vessels.

Iron absorption studies of typical Kerala diet revealed that diet containing heme iron had the highest ionisable iron and all other diets had iron absorption inhibitors like phytin phosphorus, tannin and crude fibre. Thus, absolute available iron of the diet can be improved by modifying the local diet by supplementing or substituting foods containing iron absorption enhancers or by using proper processing methods.

2. Standardisation and Quality Evaluation of Protein Enriched Mango Bars

Name of the Student: Sherine N.A. (2003-16-03)
Name of the Major Advisor: Dr. V. Usha

An attempt was made to standardise protein enriched mango bars and to evaluate the nutritional, organoleptic and shelf life qualities of the developed products. Mango variety Totapuri was used for preparing mango bar. To enrich mango bar, green gram dhal was used as a source of protein. Dhal was roasted for five minutes, powdered and steamed for 10 minutes, dried and used for enrichment of mango pulp. The bar prepared with 100 per cent mango pulp was taken as the control (CMB) and for protein enriched bar (PEMB), 800g mango pulp and 200g pulse flour were taken. Corn flour (20g), citric acid (2.5g), potassium meta bi sulphite (400ppm) and sugar (200g) were also added to prepare both CMB and PEMB. The prepared bars (200g/pack) were packed in metallised polyester polyethylene laminated pouches (MPP) and polypropylene (PP) pouches and stored in ambient storage conditions for three months. The chemical constituents, acceptability and shelf life of the mango bar were evaluated initially and at the end of storage. The chemical constituents in CMB and PEMB are given in Table 1.

Table 1. Chemical constituents present in CMB and PEMB (per 100g)

Constituents	CMB	PEMB
Moisture (g)	13.51	16,09
Acidity (g)	0.65	0.46
TSS (^{0} brix)	54.5	51.5
Reducing sugar (g)	13.62	7.54
Total Sugar (g)	60.31	51.92
Crude fiber (g)	2.48	3.38
Protein (g)	2.04	6.77
Beta-carotene (µg)	377	283
Vitamin C (mg)	24.40	12.53
Calcium (mg)	67	85
Iron (mg)	3.84	4.68
Potassium (mg)	100	212.5

Crude fibre, protein, calcium, iron and potassium were high in protein enriched mango bar when compared to control. During storage, the acidity, TSS and reducing sugar showed an increasing trend while total sugar, protein, beta-carotene, vitamin C, calcium, potassium and iron decreased. Better retention of chemical constituents was noticed in both CMB and PEMB packed in MPP than PP packed sample. Significant reduction in the sensory qualities like appearance, colour, texture and taste occurred during storage. The overall acceptability of CMB was high in both the packaging materials when compared to PEMB. However, the bars had better acceptability when packed in MPP. Gradual increase in the bacterial, fungal and yeast count occurred during storage, but the count was less in MPP packed samples.

The yield and benefit cost ratio was found to be high for PEMB than CMB. When compared to MPP packed sample, the PEMB packed in PP had highest BC ratio. However, nutrient retention and acceptability were more in PEMB packed in MPP and had a BC ratio above one and can be considered as economically beneficial.

3. Bio availability of Minerals from Pulses

Name of the Student: Ambili Appukuttan A. (2005 -16-106)
Name of the Major Advisor: Dr. V. Usha

An investigation to find out the bio-availability of minerals from pulses was under taken to evaluate the effect of different processing and cooking methods on the *in vitro* availability of calcium, iron, phosphorus, potassium and zinc from commonly consumed pulses like bengal gram, green gram and horse gram. The selected pulses were subjected to various processing methods such as soaking, soaking and dehulling, milling and germination and two cooking methods such as ordinary cooking and pressure cooking. The HCl extractability

of minerals from these three pulses was estimated since it indicates an index of their bioavailability from foods.

Among the processing and cooking methods studied, germination for 36 hours and pressure cooking for five minutes was found to be the best method for improving the extractability of minerals like calcium (67.63%), iron (39.75%), phosphorus (55.08%) and zinc (70.41%) in bengal gram. In green gram and horse gram also maximum calcium (29.78% and 52.35% respectively) and phosphorus (56.66% and 52.13% respectively) extractability occurred during germination. This method is also suitable for reducing the tannin content in bengal gram (73%), green gram (35%) and horse gram (90%). Germination for 36 hours and ordinary cooking for 30 minutes caused a further increase in iron extractability. In green gram, iron extractability increased to 70.19 per cent, while in horse gram, extractability of iron, potassium, and zinc increased to 50 to 70 per cent by this method. Germination for 24 hours and 30 mts ordinary cooking showed maximum zinc (76.01%) extractability in green gram. In bengal gram (48.23%) and green gram (50.69%) maximum potassium extractability was noticed when the milled pulses were pressure cooked.

Over all, the processing and cooking methods improved the HCl extractability of minerals from pulses. Maximum improvement was brought about by germination for 24 and 36hours followed by pressure cooking and ordinary cooking and milling. Hence, these processing methods can be used in household processing of legumes to improve the availability of minerals especially in developing countries like India where legumes are an integral part of the daily diet.

4. Standardisation of Green Gram Based Meat Analogues

Name of the Student: Nisha (2006 -16-106)
Name of the Major Advisor: Dr. V. Usha

Meat analogues, which could simulate nutritional and sensory qualities of meat were prepared using green gram as the base and blending with soybean and wheat in different proportions. Gluten was used as a texturizing agent and spices like ginger, garlic, pepper and cinnamon were used for flavouring. Totally, ten treatments were tried with different proportions including one control with 100 per cent green gram.

A standard meat recipe was prepared by replacing meat with the developed products and evaluated organoleptically using a nine point hedonic scale. Three treatments namely 60 per cent green gram, 10 per cent soya and 30 per cent wheat (T_4), control prepared with 100 per cent green gram (T_0), and 80 per cent green gram, 10 per cent soya and 10 per cent wheat (T_6) were selected based on maximum organoleptic scores. The selected three treatments were packed in metallised polyester polyethylene laminate pouches and kept for shelf life studies for a period of six months. Chemical constituents, sensory qualities and microbial

load were analysed initially, third and sixth months of storage. The products were also subjected to benefit cost analysis by comparing with a similar product available in the market and also with fresh meat and mutton. Meat analogue was observed to be a good source of protein; with maximum protein content in T_6 (26g per 100g). Fat content varied from 1.23g to 2.67g $100g^{-1}$ with a maximum fat content in T_4. The fibre content was found to be high in T_6 (1.82%). These three constituents were found to be low in the analogue prepared with green gram (control). Minerals like calcium (276mg $100g^{-1}$), potassium (72.00mg to 73.00mg $100g^{-1}$), phosphorus (177.94mg to 190.85mg 100 g^{-1})and iron (1.77mg to 1.89mg 100 g^{-1}) were also found in the meat analogue. However, on storage, significant decrease in the constituents occurred. A gradual increase in the microbial load was also noticed with the advancement of storage. Insect infestation was not noticed till the end of storage.

Organoleptic evaluation was done by preparing a recipe as in the case of treatment selection. The evaluation revealed that there was decrease in the organoleptic attributes during storage which affected the overall acceptability of the products. High over all acceptability was observed for the meat analogue prepared with 60 per cent green gram, 10 per cent soya and 30 per cent wheat (T_4) followed by T_6

The cost of the developed products was comparatively higher than its available substitute in the market. The cost can be reduced considerably through large scale production. Hence, considering the health benefits compared to red meat, cost factor alone cannot be considered as a constraint in the development of the meat analogues. Therefore, meat analogue prepared with 60 per cent green gram, 10 per cent soya and 30 per cent wheat and the one prepared with 80 per cent green gram, 10 per cent soya and 10 per cent wheat with comparable nutritional qualities and acceptability can be recommended for popularization and large scale production.

5. Standardisation and Quality Evaluation of 'Tempeh' and Tempeh Based Instant Soup Mixes

Name of the Student: Lakshmy P.S. (2006-24-10)
Name of the Major Advisor: Dr. V. Usha

Tempeh and tempeh based instant soup mixes were standardized using green gram, cowpea, soybean, rice and wheat, and nutritional and shelf life qualities of these products were evaluated. Fermentation of tempeh was carried out with pure cultures of *Rhizopus oligosporus* – MTCC 556 and twenty different combinations of selected legumes and cereals as substrates. Among the different fresh tempeh types prepared, one which was prepared using 100 per cent soybean had good appearance and texture. The treatments with green gram had a comparable texture and appearance with the control prepared using soybean. Tempeh types with rice had better appearance and texture than that of wheat.

Tempeh chips and roasts were prepared using the fresh tempeh types and the overall acceptability of tempeh chips prepared with different combinations varied from 6.9 to 8.9 with the highest overall acceptability score in 100 per cent green gram. Highest overall acceptability of roast ranged from 7.5 to 8.9 with the highest score in cowpea (50%) + rice (50%) combination. The highest IVSD of 82.83 per cent was for equal proportion of green gram and rice combination and the highest IVPD of 88.98 per cent was for green gram (75%) + rice (25%) combination.

Fresh tempeh types prepared with 100 per cent green gram, 75 per cent green gram + 25 per cent rice, and 50 per cent green gram + 50 per cent rice were selected based on their acceptability, IVSD and IVPD for further studies. Fresh tempeh type prepared with 100 per cent soybean was selected as control.

The analysis of chemical constituents of the selected fresh tempeh types were conducted and the treatment prepared with 100 per cent soybean had the maximum moisture (55.85 %), protein (21.09%), total fat (10.12%), beta-carotene (331.85 µg), thiamine (0.31 mg), calcium (149.10 mg), iron (3.6 mg), phosphorus (270.61 mg) and zinc (2.17 mg), whereas the treatment with 100% green gram had the highest fiber (2.52%), reducing sugar (2.01%), total sugar (4.21%) riboflavin (0.30 mg) and potassium (525.11 mg) per 100 gram. Starch content was highest (29.13%) in green gram 50 per cent + rice 50 per cent combination. None of the selected fresh tempeh types had vitamin C. The availability of calcium (61.77 %), iron (66.82 %), phosphorus (65.72%), potassium (63.60per cent) and zinc (88.99%) was highest in green gram and rice (50:50) combination.

None of the tempeh types showed viability at low pH (1.5 to 2.5), bile acid tolerance (1-4 % level) or antibacterial activity against enteropathogens and hence no probiotic activity can be attributed to any of the selected fresh tempeh types.

The shelf life studies of the fresh tempeh types were conducted and the appearance, colour, flavour and texture of the fresh tempeh types stored under refrigerated condition were satisfactory up to 12 days for 100 per cent soybean and 100 per cent green gram tempeh. In green gram and rice combination (75:25 and 50:50), the shelf life was only up to six days under refrigerated storage. Frozen tempeh types were comparable to the fresh tempeh even after the 30th day of storage.

A gradual reduction in the overall acceptability score of the chips and roasts were observed with the stored tempeh types. The bacterial load in the fresh tempeh was found to be high, in the range of 49.3 to 69.3 x 10^8 cfu/g. A gradual decrease in the bacterial count was observed in all the treatments up to the 6th day of refrigerated storage and thereafter there was a slight increase in the bacterial count. No pathogenic bacteria were identified in fresh tempeh types. The total yeast count in the fresh tempeh types was in the range of 42.6 to 66.3 x10^5 cfu/g. The only identified fungus in fresh tempeh types was *Rhizopus oligosporus*. The total fungal count was in the range of 2.6 to 5.3 x 10^6 cfu/g in fresh tempeh types which was reduced to 1.0 to 2.3 x 10^6 cfu/g on the 12th day of refrigerated storage. In frozen tempeh types, the

bacterial count was reduced to 0.17 to 0.49 x 10^8 cfu/g, yeast count to 0.46 to 0.86 x 10^5 cfu/g and fungal count to 0.06 to 0.1 x 10^6 cfu/g after 30 days of storage.

The flour prepared from the tempeh types were packed in metalised polyester laminate pouches and stored for a period of six months under ambient conditions and evaluated for quality and shelf life attributes. The tempeh flour prepared with 100 per cent soybean had the highest protein (43.15%), total fat (20.87%), calcium (331.25mg), iron (8.03 mg), phosphorus (601.36 mg) and zinc (4.82 mg) per 100 gm. Maximum fibre (3.30%), riboflavin (0.03 mg) and potassium (979.68 mg/100g) was observed in tempeh flour prepared with 100 per cent green gram. Starch content was found to be highest (49.38%) in green gram and rice (50:50) combination. Thiamine was not detected in any of the tempeh flour. A decrease in the protein, total fat, riboflavin, and minerals was observed during storage.

The highest IVPD of 90.86 per cent after storage was for green gram (75 %) + rice (25%) and highest IVSD of 83.86 per cent was for green gram (50%) + rice (50%) combinations.

All the tempeh flours remained within the prescribed limit of microbial load making them microbiologically safe even after six months of storage. Insect infestation was not observed in tempeh flours after storage.

Tempeh flours were used for standardising instant soup mixes with suitable blending materials. For each of the selected tempeh flour four different compositions of soup mixes varying the quantity of tempeh flour from 50 to 65g/100g were developed. The soup mixes were packed in metalised polyester laminate pouches and stored for a period of six months under ambient conditions. The soup mixes were evaluated for quality and shelf life attributes.

After storage, the moisture content of soup mixes varied from 6.53 to 7.53 per cent. The nutrients ranged from 5.53 to 34.65 % (protein), 16.67 to 51.45 % (starch), 0.40 to 2.83 % (fiber), 0.67 to 17.93 % (total fat), 0.00 to 0.028 mg/100g (riboflavin), 39.96 to 298.60 mg/100g (calcium), 1.12 to 5.17 mg/100g (iron), 227.61 to 551.66 mg/100g (phosphorus), 432.31 to 961.51 mg/100g (potassium), and 2.11 to 4.42 mg/100g (zinc) in different compositions of soup mixes.

The mean score for overall acceptability of the soups prepared with the stored soup mixes ranged from 7.5 to 8.2. The microbial load in all the soup mixes after storage were within the prescribed limit and all the soup mixes can be considered as microbiologically safe even after storage for six months. Insect infestation was not observed in any soup mixes.

The cost of production of one kilogram of fresh tempeh types varied from Rs. 57.00 to Rs. 68.00. One kilogram tempeh flour varied from Rs. 111.00 to 142.00 and that of soup mixes (50g) varied from Rs. 12.00 to 13.00.

6. Quality Evaluation of Bamboo Seed and its Products

Name of the Student: Shabna Kunhimonn (2008-16-101)
Name of the Major Advisor: Dr. Suman K.T.

The cooking, biochemical, nutritional and organoleptic qualities of bamboo seed were evaluated. The bamboo seed flour was also evaluated for physical, organoleptic, and keeping qualities.

Optimum cooking time of bamboo seed was found to be 70 minutes. The water uptake by bamboo seed while cooking was found to be 6.90 ml/g with a volume expansion ratio of 2.16. Grain elongation ratio in bamboo seed was recorded as 0.89. The amylose content in bamboo seed was found to be 34.4 per cent. The gelatinisation temperature index was high with a medium gel consistency of 48.20 mm. The moisture content in dried and milled bamboo seed was found to be 6.70 per cent. Bamboo seed contains 13.78 per cent protein, one per cent fat, 62.56 per cent starch and 0.92 percent fibre. The calcium, iron and phosphorus contents of bamboo seed were 30.60 mg, 5.94 mg and 158.60 mg respectively per 100g. *In vitro* starch digestibility of bamboo seed was found to be 50.16 per cent. *In vitro* availability of calcium, iron and phosphorus was found to be 20.20, 10.72 and 20.72 per cent respectively.

The organoleptic qualities of bamboo seed were evaluated by preparing cooked rice, *kanji* and *payasam*. Cooked rice, *kanji* and *payasam* obtained a mean score above 7.00 for all organoleptic parameters. Among the three products, bamboo seed *payasam* was found to be the most acceptable product with higher mean score for all the quality parameters except for texture. For texture bamboo seed *kanji* had the maximum score. The physical qualities of roasted and unroasted flours prepared from bamboo seed indicated a decrease in the bulk density of roasted flour during storage whereas in unroasted flour it remained same (0.80 g/ ml). Water absorption index, water solubility index and starch content decreased during three months of storage in both roasted and unroasted bamboo seed flour. The retrogradation property revealed increase in the syneresis percentage with advancement in days of observation and maximum synerisis was observed on 12th day. However, a decrease in percentage of syneresis was noted at the end of three months of storage in both roasted and unroasted bamboo seed flour.

Among the products prepared with the roasted flour namely *puttu*, *idiyappam* and *ada*, *puttu* was identified as the most acceptable product. Among the products prepared using unroasted bamboo seed flour, bamboo seed *unniyappam* was the most acceptable one followed by bamboo seed *murukku* and bamboo seed *appam*. The roasted and unroasted bamboo seed flour was evaluated for bacteria, fungi and yeasts initially and at the end of third month of storage. Presence of bacteria was detected in both roasted and unroasted flour and the count increased in unroasted flour during storage. Fungal count was not detected in roasted bamboo seed flour in both evaluations. But, in unroasted flour, fungal count was noticed at the end of three months of storage. Presence of yeast was not detected in both roasted and unroasted flour. Insect infestation was also not noticed in both roasted and unroasted bamboo seed flour.

7. Quality Evaluation of Germinated Rice and Rice Products

Name of the Student: Neethu Sathyan T. (2008-16-102)
Name of the Major Advisor: Dr. Suman K.T.

Physical, cooking, biochemical, nutritional, organoleptic and keeping qualities of germinated raw rice were evaluated. Physical and keeping qualities of roasted rice flour and the acceptability of the products prepared with rice flour were also conducted.The rice variety Jyothi was selected for the study. After soaking for 12 hours, rice was germinated under laboratory conditions for 12 hours, 3 days and 6 days. Ungerminated rice was kept as the control.

Physical properties of rice like milling loss, total milled rice per cent and head rice yield indicated that compared to control, total milled rice per cent was very low in germinated rice samples which in turn resulted in higher milling loss. The head rice per cent among different treatments varied from 5.30 to 33.66 per cent initially which decreased in all treatments during storage except in the control.

Thousand grain weight of germinated rice varied significantly. At the end of three months of storage, thousand grain weight increased in all treatments. Thousand grain volume was found to be low in germinated samples and it varied from 16.7 to 25.8 mm^3 before and after storage.

To obtain optimum cooked rice, a cooking time of 22.33 to 29.33 minutes was noticed among different treatments. A positive correlation between water uptake, volume expansion and grain elongation was noticed in all the treatments. Germination decreased the amylose content thereby affecting the gel consistency. Intermediate gelatinisation temperature index was noticed in all the treatments.

Moisture content of rice from four treatments varied from 10.51 to 12.67 per cent which increased significantly during storage. A significant increase in total and reducing sugar was observed as a result of starch degradation during germination. Variations were noticed in the protein, fat and fibre content among treatments. Progressive increase in the thiamine content was observed with advancement in days of germination. Compared to control, calcium, iron and phosphorus content were significantly low in germinated rice. During germination, *in vitro* starch digestibility of rice increased by 5 to 17 per cent. Significant increase in *in vitro* mineral availability was also noticed.

Bulk density of roasted rice flour from different treatments varied from 0.78 to 0.84 g per ml. Compared to control, the roasted rice flour from germinated rice had a low water absorption index and high water solubility index.

Three products namely cooked rice, *unniappam* and *kozhukatta* were prepared using rice and *iddiappam* and *puttu* were prepared from rice flour from germinated rice. All products obtained a mean score above 6.0 for different quality attributes. Germinated rice was found to be more suitable for the preparation of *unniappam* and *puttu*. Mean scores for various quality attributes increased when the products were prepared from stored rice and rice flour. The rice and roasted rice flour were evaluated for the presence of bacteria, fungi and yeast initially and after three months of storage. Presence of bacteria was detected in both periods under study. Insect infestation was not noticed in rice and rice flour from different treatments throughout the storage period.

Germination of paddy was found to be beneficial for improving the biochemical and nutritional constituents in rice. Moreover, germination increased the bioavailability of the nutrients. Selective product diversification is also possible from germinated rice.

8. Quality Evaluation of Parboiled Rice and Rice Products from Germinated Rice

Name of the Student: Lakshmi A.S. (2008-16-105)
Name of the Major Advisor: Dr. Suman K.T.

Physical, cooking, biochemical, nutritional, organoleptic and keeping qualities of parboiled rice prepared from germinated paddy were evaluated. The physical and keeping qualities of rice flour prepared from the parboiled rice and the acceptability of the products prepared using the rice flour were also evaluated.

Paddy variety Jyothi was selected for the study. After soaking for 12 hours, the paddy was germinated at laboratory level. Paddy soaked for 12 hours (T_1), germinated for 3 days (T_2) and 6 days (T_3) were selected as treatments. Ungerminated paddy (T_0) was taken as the control. All these were parboiled by hot soaking process.

Milling recovery was found to be very low in germinated samples, compared to control, which in turn resulted in higher milling loss. Milling recovery of germinated samples decreased significantly during storage whereas, in control, an increase in the milling recovery was observed. Significant variation among treatments was observed with respect to thousand grain weight and thousand grain volume.

To obtain optimum cooked rice, cooking time varied from 37.66 to 44.67 minutes among treatments and it increased significantly during storage. A positive correlation between water uptake, volume expansion and grain elongation was noticed in all the treatments. Germination decreased the amylose content by 4 to 14 per cent in different treatments there by affecting

the gel consistency. Intermediate gelatinisation temperature was noticed in all the treatments. Moisture content of parboiled rice from four treatments varied from 11.02 to 12.10 per cent which increased significantly during storage. A significant increase in total and reducing sugar was observed as a result of starch degradation during germination. Variation was noticed in the protein, fat and fibre content among treatments. Progressive increase in the thiamine content was noticed with advancement in the days of germination. Compared to control, significant decrease occured in the calcium, iron and phosphorus content of germinated samples. During germination, *in vitro* starch digestibility of parboiled rice increased by 3 to 14 per cent. Significant increase in *in vitro* mineral availability was also noticed.

Bulk density of roasted rice flour from different treatments varied from 0.78 to 0.84 g/ml. Lower water absorption and water solubility indices were noticed in rice flour from germinated samples compared to control. The evaluation of retrogradation property in roasted rice flour from treatments revealed that syneresis per cent increased with advancement in days of observation. Maximum syneresis was noticed in germinated samples.

Cooked rice, *iddli* and *kozhukatta* prepared using rice and *idiyappam* and *puttu* prepared from rice flour from germinated paddy had better taste. Mean scores for various quality attributes increased when the products were prepared from stored rice and rice flour.

The rice and roasted rice flour were evaluated for bacteria, fungi and yeast initially and after three months of storage. Presence of bacteria was detected in both and the count increased during storage. Fungal and yeast growth were not detected in rice and rice flour initially and after three months of storage. Insect infestation was also not noticed in rice and rice flour during storage.

9. Standardisation and Quality Evaluation of Rice Based Fermented Dairy Products

Name of the Student: Swati Sarabhai (2010-16-104)
Name of the Major Advisor: Dr. Suman K.T.

Fermented dairy products were standardised and enriched with bits and pulp of fruits. The physical, chemical, nutritional, organoleptic and keeping qualities of the standardised products were evaluated.

Rice based fermented dairy products (RBFDP) were prepared using rice slurry made out of roasted and unroasted rice flour of raw rice, parboiled rice and germinated rice in different proportions with or without milk. They were prepared with 100 per cent rice slurry and rice slurry and milk in the ratio of 75: 25 and 50: 50. Rice variety *Jyothi* was selected for the

preparation of RBFDP. Rice slurry having total solids of 12 to 13 per cent was prepared and the fat content of slurry was made to that of milk (3.5%) by adding soybean blended sunflower oil. Pure freeze dried cultures containing *Streptococcus salivarius* ssp *thermophilus* (NCDC NO.074) and *Lactobacillus delbrueckii* ssp *bulgaricus* (NCDC No. 009) purchased from NDRI, Karnal were inoculated to the mixture at the rate of two per cent level. Then, the product was incubated at 42^0 C for four to five hours, cooled and stored at 4^0 C.

With a view to find out the most appropriate combination for the preparation of RBFDP, 18 treatments were evaluated for various organoleptic qualities like appearance, colour, flavour, odour, texture, taste, after taste and overall acceptability and compared with the characteristics of plain yoghurt taken as the control. In different treatments tried for the preparation of RBFDP, the mean scores for different quality attributes showed a decreasing trend with increase in the quantity of rice slurry. The products prepared with milk and rice slurry made out of unroasted flour of raw, parboiled and germinated rice in 50:50 proportions were selected as the most acceptable treatments for the preparation of RBFDP.

The selected RBFDP was enriched with bits and pulp of pineapple and mango separately @ five per cent. Based on the organoleptic scores, RBFDP prepared out of unroasted flour of germinated rice enriched with bits of pineapple and RBFDP prepared from unroasted flour of raw rice enriched with pulp of mango were selected as the most acceptable ones.

The selected RBFDP and fruit enriched RBFDP along with control were stored for 14 days under refrigerated condition (4^0 C) and evaluated for nutritional qualities initially and at the end of storage. The physical, chemical and microbial qualities of the selected products were evaluated initially and at weekly intervals.

A significant decrease was noticed in protein, fat and starch content of RBFDP and fruit enriched RBFDP during storage. Enrichment with fruits improved the fibre, beta-carotene and vitamin C content of RBFDP. The products were found to be a fair source of thiamine and riboflavin. The products had appreciable amounts of calcium and phosphorus which decreased significantly during storage.

A decrease in the curd tension and a subsequent increase in viscosity of the RBFDP and fruit enriched RBFDP was recorded in seven days of storage. By 14th day of storage the curd tension increased. Syneresis was noticed only during the initial evaluation.

The moisture content and pH of RBFDP and fruit enriched RBFDP decreased during storage with an increase in the titrable acidity thereby influencing the organoleptic qualities of the products. An increase in the total soluble solids (TSS) of RBFDP and fruit enriched RBFDP was noticed during storage whereas a decrease was observed in plain yoghurt (control).

Presence of contaminating bacteria was not detected in any of the samples during storage. Mold and yeast were not detected in the products till 7th day of storage. But in fruit enriched RBFDP presence of mold and yeast were detected during final evaluation. Viable count of

Lactobacillus delbrueckii ssp *bulgaricus* and *Streptococcus salivarius* ssp *thermophilus* decreased in 14 days of storage. The viable count of cultures noticed in RBFDP made out of germinated rice was comparable with control.

The cost of production for RBFDP prepared from raw, parboiled and germinated rice and RBFDP enriched with pineapple and mango was found to be Rs. 13 and Rs. 15 respectively per 100 ml. The cost computed for production of RBFDP and fruit enriched RBFDP was found to be lower than the price of similar products available in the market.

Thus, acceptable products are possible with cereal milk combinations. They can provide considerable scope for dairy industry to diversify its processing operation and can satisfy the need for value addition in the rapidly changing socioeconomic scenario. These types of products can fetch good market if commercially exploited.

B. VEGETABLES

10. Nutritive Value and Acceptability of Winged Bean Genotypes (*Psophocarpus tetragonolobus* L.)

Name of the Student: Anju M. Neeliyara (1994-16-02)
Major Advisor: Dr. V. Indira

The chemical composition and acceptability of flowers, leaves, seeds and pods of five winged bean genotypes maintained in the Department of Olericulture, College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur were evaluated. The five genotypes selected for the study were PT-98, PT-82, PT-52, PT-92 and PT-50-1. Tender leaves, fresh pods of 12 to 14 days maturity and the seeds of fully mature pods were taken for the study. Flowers were collected from the plants after 50 to 60 days of sowing. The constituents namely moisture, protein, starch, fat, fibre, energy, calcium, iron and vitamin C were estimated in all the four edible parts. The antinutritional factor namely tannin was estimated in the mature seeds before and after cooking. The acceptability of the edible parts of the selected genotypes was carried out after cooking using score cards.

The results of the study indicated that among the four edible parts, the dry seeds had high percentage of protein than other parts with a maximum of 31.8 per cent in PT-82. In leaves, flowers and fresh pods, the protein content varied from 2.9 per cent to 3.24 per cent on dry weight basis. The dry seed also contained higher percentage of starch and fat than other edible parts. The fibre content varied from 7.04 per cent in the flowers to 17.72 per cent in leaves on dry weight basis with significant variation between genotypes in all parts except seeds. Corresponding to the high protein, starch and fat in the dry seeds, the calorific value of the seeds was also found to be very high than other parts. Calcium was abundantly present

in the leaves (245mg/100g) as well as immature pods (201mg/100g). Iron was also present in higher amounts in leaves (2.20mg/100g) and flowers (1.48mg/100g) with significant variation between the genotypes. The vitamin C content varied from 4.86mg in the dry seeds to 15.26mg/100g in the immature pods. The winged bean seeds contained the antinutritional factor tannin in the range of 0.65 to 0.92g/100g and the content decreased to the extent of 15 to 29 per cent after cooking. All the edible parts of winged bean genotypes were highly acceptable. Based on overall acceptability, PT-92 was found to be comparatively better than the other five genotypes.

11. Nutritive Value and Organoleptic Evaluation of Thamara Venda Genotypes (*Abelmoschus caillei*)

Name of the Student: Sona Thampi K. (1995-16-01)
Major Advisor: Dr. V. Indira

Twenty genotypes of thamara venda (*Abelmoschus caillei*) were evaluated for their chemical constituents and acceptability and compared with okra variety Pusa Sawani. The samples were collected from the Department of Olericulture, College of Horticulture at three maturity levels ie 5th, 8th and 11th days after flowering. The major chemical constituents evaluated were moisture, protein, fat, total carbohydrate, starch, crude fibre, calcium, phosphorus, iron, vitamin C and mucilage. The organoleptic evaluation of the selected genotypes was assessed for five quality attributes on a five point hedonic scale by ten judges after cooking.

Twenty genotypes of thamara venda differed very much in their chemical constituents. The mean fat, iron, vitamin C and mucilage contents of the control variety were lower than the lowest obtained for thamara venda genotypes. On dry weight basis, the fat and iron content varied from 12.52 to 14.83g and 1 to 1.58 mg per 100g respectively. Pusa Sawani had a fat content of 10.45g and iron content of 0.89mg per 100g. Vitamin C and mucilage contents of thamara venda genotypes varied from 78.67 to 92.29mg and 0.27 to 0.49g per 100g on fresh weight basis in comparison with 63.13mg vitamin C and 0.24g of mucilage in 100g Pusa Sawani. Pusa Sawani was found to have a lower disposition in the case of total carbohydrates (12.61%), starch (4.34%) and calcium (110.7mg) per 100g on dry weight basis in comparison with the thamara venda genotypes. The mean protein (16.21%) and phosphorus (102.8mg) contents of Pusa Sawani were found to be in comparison with those of thamara venda genotypes. The protein content of these genotypes varied from 14.19 to 17.65 per cent and phosphorus varied from 91.61 to 11mg per 100g on dry weight basis. It was also seen that there was no concordance between the different genotypes of *A.caillei* in the case of different chemical constituents. As the maturity of the pods increased, moisture, protein, fat, calcium, phosphorus, iron and ascorbic acid contents of both thamara venda genotypes and Pusa Sawani decreased significantly. However, the carbohydrate, starch, crude fibre and mucilage increased with increase in maturity.

The organoleptic evaluation of the selected genotypes indicated that the thamara venda genotypes had better acceptability than Pusa Sawani. However, the acceptability decreased with an increase in the maturity of the pods. The mean total scores for colour, texture, doneness, flavour and taste after cooking varied from 15.60 to 21.07 while that of Pusa Sawani was found to be 17.30.

12. Quality Evaluation of Banana by-Products

Name of the Student: Raji M. John. (1997-16-15)
Name of the Major Advisor: Smt. Omana Pavunny

Nutrient composition of banana peel, pseudostem, flower bud and rhizome of nendran (*Musa* AAB 'Nendran'), poovan (*Musa* AAB Rasthali'), palyankodan (*Musa* AAB 'Mysore' robusta (*Musa* AAA 'Robusta') and Kunnan (*Musa* AB 'Kunnan') was evaluated. Pickle and vattal were prepared using all the four by-products of selected five banana varieties. Both the products were evaluated for organoleptic and keeping qualities at monthly intervals for a period of six months.

Among the different varieties, flower bud of kunnan had the highest protein (2.24%) content and the highest fat content was in the peel of robusta (1.01%). Rhizome of robusta and its peel were high in starch (10.81%) and fibre (2.60%) respectively. Calcium (32mg/100g) and iron (1.55mg/100g) were high in flower bud of poovan and palyankodan respectively. Flower bud of robusta was rich in phosphorus (46mg/100g). Kunnan rhizome had the highest potassium (198mg/100g) and sodium (29mg/100g) content while vitamin C (13.59mg/100g) was high in robusta flower bud.

Among the two products prepared with the four by products of five nendran varieties, pickle made from banana peel and vattals made from banana pseudostem were found to be more acceptable compared to pickle and vattal prepared with banana rhizome and flower bud. Among the different banana varieties, pickle prepared with nendran peel and vattal prepared with palayankodan pseudostem was found to be more acceptable. Regarding the keeping quality of the products, it was seen that both the products were free from microbial contamination upto fifth month of storage. Though, pickle made from kunnan flower bud and nendran pseudostem showed contamination at the end of sixth month of storage, most of the products prepared from banana by-products had good keeping quality.

13. Acceptability and Nutritional Evaluation of Hyacinth Bean Genotypes (*Lablab purpureus* (L.) sweet)

Name of the Student: Vanisree Kathi (2000-16-06)
Major Advisor: Dr. V. Usha

The nutritional evaluation and acceptability of five hyacinth bean genotypes maintained in the Department of Olericulture, College of Horticulture in their vegetable maturity was undertaken to identify the genotypes with high nutritional qualities and with better acceptability. The five genotypes selected were DL-40, DL-44, DL-48, DL-50 and DL-6-1. The vegetative characters, performance of duration, yield, pod characters, nutritional composition and organoleptic qualities of the selected genotypes were evaluated.

The vegetative characters of the five selected genotypes indicated normal leaf shape with small leaf size in DL-40 and DL-48. The rest of the genotypes had a medium leaf size. All the genotypes except DL-40 had white coloured flowers while the flowers of DL-40 were purple in colour. The days to first flowering varied from 82 (DL-40 & DL-6-1) to 92 days (DL-48) and days to 50 per cent flowering varied from 110 (DL-6-1) to 117 days (DL-48). Days to first harvest were in between 166 to 175 days with a mean duration of 248 days from the date of sowing to the date of final harvest. Days to vegetable maturity was found to be 11 days for DL-40, DL-44 and DL-6-1 and 17 days for DL-48 and DL-50.

Among the five genotypes, DL-48 had the maximum pod length (14.5cm) with light green coloured pods. The minimum pod length was noticed in DL-44 also with green coloured pods. The girth of the pod varied from 3.7 cm (DL-48) to 5.5cm (DL-6-1). The maximum weight was noticed in DL-6-1 followed by DL-40 and DL-48 and the minimum weight was in DL-44 (2.1g). DL-40 had the maximum number of pods (4215 pods) with a maximum yield of 8.43 kg while DL-48 had the minimum number of pods (1467 pods) with the lowest yield of 3.19kg per plant.

With respect to nutrients, DL-6-1 had the highest protein (4.2%) content. Fibre (1.5%) and beta-carotene were found to be high in DL-50 and starch, vitamin C, iron, calcium, potassium and phosphorus were high in DL-48. The nutrient composition of hyacinth bean genotypes is given in Table 2.

Organoleptic evaluation of the genotypes after cooking indicated that the maximum score for color, doneness, texture and flavour was obtained for the genotype DL-50. With respect to taste, DL-40 and DL-50 were found to be the best. On the basis of the total mean scores for colour, doneness, texture, flavor and taste, the genotype DL-50 obtained the highest total mean score of 20.7 followed by DL-40 (18.9), DL-44 (18.5), DL-48 (18.4) and DL-6-1 (18.3). On the basis of nutritional quality, acceptability and yield, DL-50 and DL-40 were found to be the best followed by DL-6-1, DL-48 and DL-44.

Table 2. Nutritive value of hyacinth bean genotypes (Per 100g on FWB)

Genotype	Moisture (g)	Fibre (g)	Protein (g)	Vitamin C(mg)	beta carotene (µg)	Iron (mg)	Calcium (mg)	Phosphorus (mg)	Potassium (mg)
DL-40	84.3	0.5	2.5	8	177.6	1.6	216	63	65
DL-44	86.3	0.6	3.2	9.10	180.2	1.6	200	82	82
DL-48	88.7	0.5	3.3	13.17	178.4	1.9	224	83	92
Dl-50	86.3	1.5	3.8	9	186.2	1.7	208	67	74
Dl-6-1	89	0.5	4.2	9.10	185.7	1.5	200	78	80

FWB - Fresh weight basis

14. Nutritional and Organoleptic Qualities of Value Added Products from Breadfruit (*Artocarpus altilis* (Park) Fosberg)

Name of the Student: Sharon C.L. (2001-16-02)
Name of the Major Advisor: Dr. Usha V.

Value added bread fruit products were standardized and their nutritional, organoleptic and shelf life qualities were determined. Two primary products namely chips and flour and one secondary product namely wafer were prepared.

Chips were prepared using fresh bread fruit and after blanching. Organoleptic evaluation of chips was conducted after frying in oil. Shelf life of chips was determined by packing the chips in pet jars and in 200 gauge polyethylene bags. Organoleptic evaluation of the stored chips was conducted at an interval of 15 days for a period of two months. Chemical constituents, organoleptic qualities and microbial count of the bread fruit flour were estimated. To determine the shelf life, the flour was packed in pet jars and stored for three months and chemical, organoletic and microbial count of the flour were evaluated at monthly intervals for a period of three months. Secondary product namely wafer was prepared using the flour in eight different combinations using rice flour, tomato paste and ginger garlic paste. Wafer was also prepared with 100 per cent breadfruit flour. Organoleptic qualities of the wafer were conducted initially and at monthly intervals for a period of three months.

The fresh chips were found to be more acceptable than the blanched chips after frying in oil. Organoleptic qualities such as appearance and taste of fresh chips stored in polyethylene bags and pet jars were comparable during the storage period. However, significant changes in the overall quality criteria in fresh chips was observed after 45 days of storage in polyethylene bags where as in pet jars significant changes were noticed after 30 days of storage indicating the suitability of 250 gauge polyethylene bags for packing breadfruit chips.

The breadfruit flour contained 66g starch, 4.53g protein, 4.28g fibre 82.20mg calcium 67.25mg phosphorus and 5.30mg iron per 100g and all these constituents reduced gradually with the advancement of storage period. All the sensory qualities except colour were retained in the flour during storage. The bacterial and fungal count increased during storage but yeast was not detected in the flour during storage.

Among the eight different treatments tried, wafer made with 40 per cent breadfruit flour, 40 per cent rice flour and 20 per cent ginger garlic paste was found to be the best followed by 50 per cent breadfruit flour and 50 per cent rice flour and 40 per cent breadfruit flour, 40 per cent rice flour and 10 per cent ginger garlic paste and 10 per cent tomato paste . During storage, the acceptability of wafers decreased and the overall acceptability was maximum for wafers stored upto one month.

15. Quality Evaluation of Selected Vegetables under Rain Shelter and Open Field Cultivation

Name of the Student: Nashath K. H. (2003-16-02)
Name of the Major Advisor: Dr. V. Usha

Nutritional composition, anti nutritional factors, duration of maturity and acceptability of amaranth, capsicum and tomato cultivated under rain shelter and open field during rainy season were evaluated. Two varieties of each vegetable were selected from the Department of Olericulture, College of Horticulture, Kerala Agricultural University. Amaranth varieties namely Arun and Mohini, Capsicum varieties namely California Wonder and Pusa Deepthi and tomato varieties namely Shakthi and Anagha were selected for the study. Amaranth was collected in the edible stage, tomato in the red ripe stage and capsicum before ripening. Chemical constituents namely moisture, fibre, protein, starch, calcium, iron, phosphorus, potassium, sodium, vitamin C and beta carotene content of the vegetables cultivated under rain shelter and open field were estimated. In tomato, apart from these, lycopene was also estimated. The antinutritional factors namely oxalate and nitrate in amaranth were determined. Sensory evaluation of the vegetables was conducted using score card for five qualities namely appearance, colour, flavor, texture and taste. Sensory evaluation of amaranth was conducted after cooking and capsicum and tomato were evaluated in the fresh stage.

The duration of maturity of amaranth, calculated from the day of sowing to harvest at tender stage varied from 55 to 59 days with maximum in Amaranth cultivated under open field condition. For capsicum, the duration varied from 103 to 110 days with the highest for the crop cultivated under open field condition. The duration of maturity of tomato was more for rain shelter crop (98 to 100 days) when compared to open field crop (94 to 96 days).

Among the different constituents analysed, all constituents except, beta-carotene in amaranth (Mohini) and capsicum (California Wonder) were found to be high in the crops cultivated under rain shelter. In amaranth, moisture, protein, phosphorus and sodium were high in the variety Arun, and the fibre, starch, calcium, iron, potassium and vitamin C were high in Mohini. In the case of capsicum, moisture, starch, calcium, phosphorus and vitamin C were high in the variety Pusa Deepthi where as fibre, protein, iron, potassium and sodium were high in the variety California Wonder. In tomato, protein, starch, calcium, iron, phosphorus, vitamin C, beta carotene and lycopene were high in Anagha where as moisture, fibre, potassium and sodium were high in variety Shakthi. The antinutritional factors namely oxalates and nitrates in amaranth did not show any significant variation between rain shelter and open field crops in both varieties. With respect to acceptability, vegetables cultivated under rain shelter were found to be more acceptable. Thus, amaranth, capsicum and tomato grown under protected cultivation in rainy season will ensure a constant production of vegetables throughout the year in a particular place.

16. Nutritional Evaluation and Acceptability of Ivy Gourd Genotypes (*Coccinia indica* (L.) Voigt

Name of the Student: Renjumol P.N. (2004-16-04)
Name of the Major Advisor: Dr. V. Usha

The chemical composition and acceptability of three morphologically distinct genotypes with maximum yield, i.e., CG-27, CG-81 and CG-82 maintained in the Department of Olericulture, College of Horticulture, Vellanikkara, Thrissur was evaluated. The released variety Sulabha was taken as the control.

The physical characteristics of the fruits of all genotypes showed variations. Maximum fruit length and fruit weight were observed in the released variety Sulabha. The day for attaining vegetable maturity was seven days for CG-82 and nine days for Sulabha and CG-81. Sulabha took six days from vegetable maturity to show visible changes of over maturity, where as the other three genotypes over matured within five days.

The fruits in vegetable maturity and over maturity were analysed for moisture, fibre, protein, vitamin C, beta-carotene, total phenol, total pectins, mucilage, calcium, phosphorus, iron and potassium. There was no significant difference between genotypes in the case of constituents like protein and total pectins. But other constituents like moisture, fibre, vitamin C, beta-carotene, total phenol, mucilage, calcium, phosphorus, iron and potassium, differed significantly between the genotypes. When compared to vegetable maturity and over maturity, there was significant difference in constituents between these two maturity stages.

The changes in constituents like vitamin C, beta-carotene and total phenol were analysed in three different stages of vegetable maturity i.e., the day just before the average vegetable maturity (7^{th} day after flowering), the day of average vegetable maturity (8^{th} day after flowering) and the day just after the day of average vegetable maturity (9^{th} day after flowering). Vitamin C and total phenol showed a decreasing trend with increase in the maturity. But beta-carotene content increased as maturity increased. Changes in vitamin C, beta-carotene and total phenol in average vegetable maturity and observed vegetable maturity revealed that there was no significant difference in vitamin C content of all genotypes in these two maturity stages. But in the case of beta-carotene and total phenol there observed a significant difference between these two maturity stages.

Ivy gourd genotypes in their vegetable maturity was found to be more acceptable when compared to over maturity stage. A significant decrease was also noticed in the nutrients like calcium, phosphorus, iron, potassium and vitamin C in over mature fruits. But in all genotypes, beta-carotene content was significantly high in over mature stage.

In Sulabha, even though there was no significant difference in the overall acceptability during the 7^{th}, 8^{th} and 9^{th} day, taste was highly acceptable during the 9^{th} day, which was its observed vegetable maturity. There was no difference in vitamin C and total phenols but beta-carotene was significantly high in the 9^{th} day. So, for Sulabha, vegetable maturity can be considered as nine days after flowering and also the fruits attained their maximum fruit length and weight by the 9^{th} day.

17. Optimisation of Process Variables for Value Added Pumpkin (*Cucurbita moschata* Poir.) Products

Name of the Student: Shabina (2009-16-103)
Name of the Major Advisor: Dr. Suman K.T.

The process variables for value added dehydrated products of pumpkin (*Cucurbita moschata* Poir.) were standardised. For this, sweet and salted flakes and ready to use custard powder were prepared and nutritional, organoleptic qualities and shelf life of the products were evaluated. Eight different treatments were tried for sweet flakes varying the concentration of sugar from 30 to 60 per cent and citric acid @ 0.3 and 0.4 per cent. For salted flakes also eight treatments were carried out varying the concentaration of salt from 3 to 15 per cent and citric acid @ 0.3 and 0.4 per cent. In all treatments, 0.1 per cent KMS was also added. Ready to use custard powder was prepared using 5 to 35 per cent pumpkin powder along with corn flour (5 to 35 %) and milk powder, sugar, cashew nuts and desiccated coconut powder

Among the different treatments tried, sweet flakes prepared from pumpkin slices soaked in

60 per cent sugar and 0.3 per cent citric acid solution for two hours and salted flakes prepared from pumpkin slices soaked in three per cent salt solution containing 0.3 per cent citric acid for one hour were selected as the most acceptable treatments. Among the seven treatments tried, for custard, the treatment having 10 per cent pumpkin powder and 25 per cent corn flour were selected as the most acceptable one. The selected products were stored in metalized polyester laminate pouches and stored at ambient temperature for three months. The selected custard powder was found to be free flowing without any lumps even after three months of storage. Bulk density of the product was found to be constant (0.72g per ml) throughout the storage period.

The percentage of weight loss, solid gain and water loss increased gradually in dehydrated sweet and salted flakes with increase in concentration of the solute up to four hours of soaking. Fluctuations in the above mentioned parameters were noticed in the fifth and sixth hours of soaking. In sweet flakes, maximum sucrose gain was noticed in flakes prepared from pumpkin slices soaked in 60 per cent sugar solution. The salted flakes prepared using 15 per cent salt solution had the highest percentage of salt gain.

The moisture content and titrable acidity of sweet and salted flakes and custard powder increased during storage, whereas a reduction in pH was noticed during storage. Due to inter conversion of biological components, the reducing sugar, total sugar and TSS showed a decreasing trend in all the three products. A decrease in beta carotene content was also noticed during three months of storage.

The enhanced moisture absorption during storage slightly decreased the crispness of flakes thereby affecting their acceptability. The mean scores for different organoleptic qualities of sweet and salted flakes decreased during three months of storage. The custard prepared from custard powder was acceptable till the end of storage.

Microbial count was not observed in sweet and salted flakes initially. But, on storage, microbial contamination was noticed from first month onwards. In custard powder, bacterial and fungal growth was not observed throughout the storage period but yeast count of 0.33×10^3 cfu g^{-1} was observed at the end of three months of storage. Insect infestation was not observed in custard powder throughout the storage period.

The cost of production of 500 g of dehydrated sweet flakes and salted flakes was Rs. 67.30 and Rs. 69.00 respectively. The cost of production of 100 g of ready to use custard powder was Rs. 35.00. The cost computed for the production of dehydrated pumpkin products was found to be slightly higher than the similar products available in the market. Thus, pumpkin has high potential for product diversification and has a good scope for commercial exploitation.

C. LEAFY VEGETABLES

18. Quality Attributes of Selected Leafy Vegetables

Name of the Student: Maya Mathew (1997-16-01)
Major Advisor: Dr. V. Indira

The nutrient composition, anti nutritional factors and organoleptic qualities of eight leafy vegetables maintained in the Department of Olericulture, College of Horticulture were evaluated. The leafy vegetables selected for the study were Kangkong (*Ipomoea acquatica* Forsk.), Basella (*Basella rubra* L.), Waterleaf (*Talinum triangulare* Willd), Arakeera (*Amaranthus tristis* Roxb.), Centella (*Centella asiatica*), Horse purslane (*Boerhaavia diffusa* L) (red), Akshara keera (*Alternanthera ficoidea* L.) (red) and Bengal keera (*Alternanthera ficoidea* L.) (green). The quality attributes of these leafy vegetables were compared with the control variety *Amaranthus tricolor* L. All the quality attributes were evaluated during summer and rainy seasons.

The leaves were evaluated for moisture, protein, fat, fibre, starch, soluble carbohydrates, calcium, phosphorus, iron, beta carotene and vitamin C. The antinutritional factors namely oxalates and nitrates were also estimated. Acceptability of the leaves was evaluated after cooking for five quality attributes namely appearance, colour, flavor, texture and taste.

The mean moisture content of the leaves varied from 78.98 per cent to 92.78 per cent. The control variety had a moisture content of 86.66 per cent. The mean protein content was in the range of 1.2 to 3.13 per cent on fresh weight basis and that of amaranth was 3.19 per cent. The mean protein content of the control was found to be significantly higher than the other leafy vegetables. The fat content varied from 0.18 to 0.65 per cent with 0.30 per cent fat in amaranth. The control variety had low fibre content (1.5%) and the fibre content of other leafy vegetables varied from 0.92 to 4.08 per cent. Starch and soluble carbohydrate contents varied from 0.07 per cent to 1.70 per cent and 0.63 to 2.12 per cent respectively. The control variety had a starch content of 0.17 per cent and soluble carbohydrate content of 1.32 per cent. The calcium and iron contents in the selected leaves were in the range of 134.2 to 135.2mg and 5.16 to 34.76mg per 100g respectively with amaranth having a calcium content of 109.33mg and iron content of 26.74 mg. The mean beta-carotene content of the leaves was in between 4007 to 22147µg per 100g. The control variety had a beta-carotene content of 12000 µg per 100g. The vitamin C of the leaves varied from 52 mg to 127 mg per 100g with the control variety having a mean vitamin C content of 124mg per 100g.

Highest fibre, soluble carbohydrate and vitamin C were found in centella where as bengalkeera had the highest starch and calcium contents. The highest phosphorus, iron and beta-carotene were found in kangkong leaves. Average nutritive value computed by the formula suggested by Grubben (1997) using the protein, fibre, calcium, iron, beta-carotene and vitamin C contents of the leaves varied from 16.32 to 30.56 with the highest value for kangkong and

lowest for horse pursalane. *Amaranthus tricolor* obtained an average nutritive value of 37.65. All the constituents varied significantly during summer and rainy seasons except the beta-carotene content of the leaves during summer. Calcium, phosphorus, iron and vitamin C content of the leaves were found to be significantly high during rainy season. The variation noticed in the nutritive value of the selected leaves during summer and rainy seasons were found to be statistically significant. However, the average nutritive value of the leaves was found to be high during rainy season.

The anti nutritional factors namely oxalates and nitrates varied from 0.23 to 1.08 per cent and 0.11 per cent to 0.35 per cent. Amaranth had an oxalate content of 0.56 per cent and nitrate content of 0.68 per cent. It was also seen that bengalkeera and *Amaranthus tricolour* had the highest oxalate and nitrate contents respectively. Significant variation in the anti nutritional factors was observed between the leaves during both seasons. However, the variation in these contents was found to be insignificant between summer and rainy seasons. On the basis of nutrient composition and anti nutritional factors, the leafy vegetables were grouped into three clusters, each cluster containing similar leafy vegetables. Arakeera, centella, horse purslane and kangkong along with control variety amaranth were grouped in cluster I. Basella and water leaf constituted cluster II and aksharakeera and bengalkeera constituted cluster III. The leaves included in cluster I were high in protein, soluble carbohydrate, phosphorus and beta carotene with low oxalate content. Vitamin C was found to be high in the leaves included in cluster II. Aksharakeera and bengal keera which were included in cluster III were high in fat, starch, calcium and iron. The leafy vegetables namely arakeera, centella, horse purslane and kangkong along with *Amaranthus tricolor* was adjudged as the best group on the basis of nutrients and low oxalate content.

The total score obtained in the organoleptic evaluation of the leaves varied from 16.3 to 18.9 during summer and 14.25 to 17.85 during rainy seasons. The control variety had a total score of 21.15 and 20.90 during summer and rainy seasons respectively. Significant variation was noticed in the acceptability between the leaves during summer and rainy seasons and the leafy vegetables grown during summer were found to be more acceptable. Among the leafy vegetables evaluated, arakeera and bengal keera obtained the highest score during summer and rainy seasons respectively while water leaf and horse purslane were the least acceptable.

19. Nutritional Profile of Selected Greens

Name of the Student: Vineetha Kumaran (2000-16-01)
Name of the Major Advisor: Smt. Omana Pavunny

The nutritional composition, antinutritional factors and the acceptability of nine leafy vegetables maintained in the kitchen garden of the Department of Olericulture, College of Horticulture were evaluated. The tender leaves of greens belonging to different categories namely tree, conventional and spicy were selected for the study. Under each category, the leaves selected were lettuce tree leaves (*Pisonia grandis*), tamarind (*Tamarindus indica*) and ponnaviram (*Cassia occidentalis*) under tree leaves and cowpea (*Vigna unguiculata*), pumpkin (*Cucurbita moschata*) and colocasia (*Colocasia esculenta*) under conventional leaves. The three spicy leaves selected were mint (*Mentha arvensis*), coriander (*Coriandrum sativum*) and burmese coriander (*Eryngium foetidum*).

The colocasia leaves was found to be high in moisture, fibre and potassium. Phosphorus and vitamin C were high in the leaves of lettuce and ponnaviram respectively. The calcium, iron and beta-carotene were high in the leaves of burmese coriander while cow pea leaves was found to be high in protein. Among the nine leaves, burmese coriander had the highest average nutritive value of 63.06 per cent. The oxalate content of the leaves varied from 0.004g to 2.97g per 100g and lettuce leaves exhibited the highest oxalate content. Nitrate content varied from 1.23 to 3.22g per 100g with the highest in mint leaves and lowest in burmese coriander. The nutritive value of the leaves is given in Table 3.

Table 3. Nutritional composition of leaves (per 100g FWB)

Leaves	Moisture (g)	Fibre (g)	Protein (g)	βcarotene (µg)	Vit.C (mg)	Calcium (mg)	Iron (mg)	Phosphorus (mg)	Potassium (mg)
Lettuce	81.08	0.03	3.36	3482	66	200	2.33	234	356
Tamarind	75.22	0.39	1.97	566	69	240	0.24	114	236
Ponnaviram	72.33	0.47	2.55	4914	523	280	2.85	150	200
Cowpea	84.37	0.78	6.18	4438	88	280	1.48	180	248
Pumpkin	81.40	0.38	3.63	3304	83	120	4.51	209	183
Colocasia	85.78	1.44	5.87	3133	32	160	1.13	131	428
Mint	73.46	0.24	1.12	2147	37	80	0.26	136	127
Coriander	81.57	0.27	1.26	5977	131	400	0.47	134	117
Burmese Coriander	75.19	0.55	1.28	18942	48	2000	14.63	175	205

FWB - Fresh weight basis

Organoleptic evaluation of the fresh tender leaves was carried out by preparing chutney, salad and thoran. Salads were prepared from the leaves of mint, coriander and burmese coriander, chutney was prepared using tamarind leaves, mint, coriander and burmese coriander. Leaves of cowpea, colocasia, pumpkin, ponnaviram and lettuce were cooked in the form of thoran. Chutney and thoran prepared using the leaves were found to be highly acceptable while salads were not acceptable.

On the basis of nutritional and antinutritional constituents, the leaves were grouped into three clusters and burmese coriander with high calcium, iron and beta-carotene and lower amounts of oxalate and nitrate was found to be the best among the nine leaves.

20. Quality Evaluation of Selected Leafy Vegetables Consumed by the Tribes of Wayanad District

Name of the Student: Neetha Hyder (2002-16-01)
Name of the Major Advisor: Dr. V.Indira

Nutrient composition, antinutritional factors and organoleptic qualities of ten most commonly consumed leafy vegetables by the tribal communities of Wayanad district was evaluated. The leafy vegetables selected were Ambasheppu (*Bidens pilora* Linn.), Chumalacheera (*Alternanthera amabilis*), Churuli (*Diplazium esculentum*), Kandariyila (*Capsicum frutescens* Linn.), Kannisoup (*Commelina benghalensis* Linn.), Kozhuppa (*Portulaca oleracea*), Murikkila (*Erythrina stricta* Roxb.), Ponnankanni (*Alteranthera triandra*), Thakara (*Cassia alata* Linn.) and Valiya kadaladi (*Aerva wightii* Hook). The leaves were analysed for moisture, protein, fat, crude fibre, total carbohydrates, calcium, phosphorus, iron, sodium, potassium, beta-carotene and vitamin C. Other constituents like phenols, flavanoids and methanol extractable crude alkaloids as well as the antinutritional factors namely oxalates and nitrates were also estimated. The organoleptic evaluation of the leafy vegetables was conducted after cooking by a panel of ten judges using score card.

Among the ten leaves, the protein content was high in thakara (5.65%). Fat (0.79%), phosphorus (125mg/100g) and sodium (9mg/100g) were highest in kandariyila where as kannisoup had the highest value for total carbohydrates, iron and potassium. The highest crude fibre (2.56%), calcium (670mg/100g) and beta-carotene (1879µg/100g) were in valiya kadaladi. Chumalacheera was found to be high in vitamin C (222mg/100g). The anti nutritional factors namely oxalates (0.3%) and nitrates (0.031%) were found to be high in kandariyila while kozhuppa had the lowest oxalate (0.015%) content and kannisoup had the lowest nitrate (0.013%) content. The total phenol was high in chumalacheera (50mg/100g) whereas the flavanoid (963mg/100g)and methanol extractable crude alkaloid (1.99%) content were found to be high in kandariyila. The average nutritive value computed on the basis of nutrient content indicated that valiya kadaldi had the highest nutritive value. The total mean

score for organoleptic evaluation of the leaves conducted after cooking varied from 13.2 to 20 with the highest score for churuli and least for kozhuppa. Thus, on the basis of organoleptic evaluation, churuli was found to be more acceptable.

On the basis of nutrient and antinutrient constituents, the leafy vegetables were grouped into four clusters each containing similar leafy vegetables. Cluster I contained churuli, kandariyila and murikkila. Kozhuppa and valiya kadaladi were included in cluster II and III respectively. Ambasheppu, chumalacheera, kannisoup, ponnankanni and thakara were included in Cluster IV. Valiya kadaladi which was included as the sole member of Cluster III was found to be the best with respect to higher nutrients and lower antinutritional factors.

21. Quality Evaluation in Organic Amaranthus (*Amaranthus tricolor* L.)

Name of the Student: Aparna T. (2009-16-101)
Name of the Major Advisor: Dr. Seeja Thomachan Panjikkaran

The effect of different organic manures on the physical characters, biochemical and nutritional constituents, antinutritional factors and organoleptic qualities of amaranthus (*Amaranthus tricolor* L.) was undertaken. Amaranthus were grown with four different organic manures namely vermi compost, farm yard manure, neem cake and poultry manure. They were compared with amaranthus cultivated by applying recommended NPK which was taken as the control. The quantity of organic manures used in each treatment was equivalent to 100 per cent recommended nitrogen.

Amaranthus cultivated using poultry manure was found to be having increased plant height (130.30 cm), maximum yield (20.17 t/ha) and was late flowering (125.75 days) when compared to all other treatments. The appearance of amaranthus cultivated with recommended NPK, farm yard manure and poultry manure was good. The colour of amaranthus grown with different organic manures as well as recommended NPK was found to be maroon red. The leaves of amaranthus were analysed for various biochemical and nutritional components. Amaranthus cultivated using vermicompost had the highest moisture, beta-carotene, carotenoids and chlorophyll. The protein and starch were found to be maximum in amaranthus grown with poultry manure. Amaranthus cultivated with recommended NPK had the lowest fibre and protein content. Application of farm yard manure improved the mineral content in amaranthus. Maximum iron content was noticed in amaranthus cultivated using poultry manure where as phosphorus was maximum in amaranthus grown with recommended NPK. Lowest mineral content was noticed in amaranthus cultivated using vermicompost. Anthocyanin and vitamin C were also found to be high in amaranthus cultivated using farm yard manure. Lowest vitamin C was noticed in amaranthus grown with recommended NPK. The lowest percentage of oxalate was noticed in amaranthus cultivated using neem cake

where as the nitrate was found to be low in amaranthus grown with recommended NPK and vermi compost.

Amaranthus cultivated using organic manures and recommended NPK was found to be organoleptically acceptable. Comparatively, highest mean scores for different organoleptic qualities were noticed in amaranthus grown with poultry manure.

Among the different treatments, Amaranthus cultivated using farm yard manure was found to be the most ideal treatment for improved biochemical and nutritional constituents with better acceptability and low antinutritional factors.

D. FRUITS

22. Quality Evaluation of Indian Gooseberry (*Emblica officinalis* Gaertn.) Products

Name of the Student: Saima N.S. (1998-16-02)
Name of the Major Advisor: Dr. V. Usha

Nutritional quality, acceptability and storage stability of Indian gooseberry products was evaluated. The locally available Chambakkad variety was selected for the study. Eighteen products were prepared after pretreating the fruit with salt and alum followed by sugar so as to remove the astringency of the fruit. The chemical constituents of salt and sugar treated and fresh gooseberry were evaluated. Acceptability of the products was carried out using score card among 120 individuals. The most acceptable six products namely tuti- fruity, candy, preserve, jelly, samosa and salad were selected for further study. From these six products, four products namely tuti-fruity, candy, preserve and jelly were stored in glass containers, polypropylene bottles as well as polypropylene bags at ambient and refrigerated conditions. Chemical constituents and microbial qualities of these products were evaluated at monthly intervals for a period of six months.

The sugar treated gooseberry retained all the chemical constituents better than the salt treated samples. Among the initial six products selected, candy was found to be the most economical product for commercialization followed by salad, preserve, samosa and jelly on the basis of yield and cost ratio. During storage, the moisture, vitamin C, tannin, fibre and iron content of all products reduced and sugar content increased with the advancement of storage under both ambient and refrigerated conditions. In all products, the retention of vitamin C was more when stored under refrigerated condition. The maximum retention of vitamin C was found in candy (38%) stored in glass bottles under refrigerated condition. The packaging systems had significant effect on the vitamin C content of all products under both storage conditions. The products stored in glass bottles retained maximum vitamin C while least retention was in products packed in polypropylene bags.

The organoleptic evaluation of the stored product revealed that the products packed in glass bottles were more acceptable. Thus, the study highlighted the significance of processed

amla products as a solution for the increased consumer demand for nutritious, delicately flavoured and economical fruit products throughout the year.

23. Evaluation of Banana Varieties for Quality Attributes

Name of the Student: Sabeena Thajuddeen (1998-16-01)
Name of the Major Advisor: Smt. Omana Pavunny

Physical characters, nutritional constituents and acceptability of nine local banana varieties of different genomes in the raw and ripe stages were evaluated. The banana varieties selected were Nendran (*Musa* AAB 'Nendran') Palayankodan (*Musa* AAB 'Mysore;), Karpooravally (*Musa* ABB 'Karpooravally') Monthan (*Musa* ABB 'Monthan') Robusta (*Musa* AAA 'Robusta') Red banana (*Musa* AAA 'Red banana') Kunnan (*Musa* AB 'Kunnan') Njalipoovan, (*Musa* AB 'Njalipoovan') Kadali (*Musa* AA 'Kadali') Matti (*Musa* AA 'Matti') and Kanchikela (*Musa* ABB 'Kanchikela').

The physical characters of the fruits like weight of bunch and hands, number of hands, number of fingers in each hand and pulp /peel ratio varied significantly between the varieties. The weight, volume and firmness of the fruit and pulp decreased significantly on ripening. The bunch weight varied from 5.66 to 12.83kg with the highest bunch weight in Robusta. The number of hands per bunch varied from 4.33 in Red banana to 11.67 in Njalipoovan. The pulp/peel ratio of banana in the raw stage varied from 0.60 to 2.40 in Palyankodan and Kadali respectively and for the ripe banana from 1.86 in Robusta to 8.33 in Kadali.

The weight of the raw fruit varied between 35g for Njalipoovan and 153.3g for Monthan and in ripe fruit the maximum weight was in Nendran (136.7g) and the lowest in Matti (28.33g). The volume of the fruit varied from 33.33ml (Matti) to 163.3 ml (Robusta). The firmness of the fruit ranged from 1.43kg cm^{-2} in Palayankodan to 4.06kg cm^{-2} in Nendran.

All the varieties in the raw stage were found to be high in starch and potassium. The calcium, phosphorus and iron were highest in Karpooravalli while Red banana had the highest fibre and potassium and Njalipoovan was high in starch and vitamin C. In the ripe stage, Nendran was found to have highest calcium, phosphorus and beta-carotene. Except total fibre, all other constituents of different varieties varied significantly in the raw and ripe stages. In ripe banana, total soluble solids, reducing and total sugar were found to be high in Karpooravalli where as Kunnan had the highest titrable acidity.

Organoleptic evaluation of raw banana conducted by preparing thoran and porridge indicated that thoran prepared from the fruit of Kanjikela was more acceptable and Nendran scored highest for porridge. Among ripe fruit, Karpooravalli was the most acceptable.

24. Physico-chemical and nutritional attributes of cashew apple and its products

Name of the Student: Suman K.T.(2000-24-01)
Name of the Major Advisor: Dr. V.Indira

Twenty six varieties of cashew apple maintained at Cashew Research Station, Madakkathara were evaluated for their pysico-chemical and nutritional attributes. Two products namely candy and tutty fruity were prepared from selected varieties and storage studies were carried out to find out changes in physico-chemical and nutritional attributes, organoleptic qualities and shelf life of products stored for a period of six months and the most suitable varieties for preparation of candy and tutty fruity were identified. The details of cashew varieties selected for the study are given in Table 4.

Table 4. List of selected cashew apple varieties

Sl. No.	Varieties	Source
1	Akshaya	Anakkayam
2	Amrutha	Madakkathara
3	Anagha	Anakkayam
4	Anakkayam-1 (AKM-1)	Madakkathara
5	Dhana	Madakkathara
6	Dharasree	Anakkayam
7	H-1593	Madakkathara
8	H-1596	Madakkathara
9	H-1600 (Damodar)	Madakkathara
10	H-1602	Madakkathara
11	H-1610 (Raghav)	Madakkathara
12	H-3/13	Anakkayam
13	Kanaka	Madakkathara
14	K 22-1	Madakkathara
15	Madakkathara-1 (MDK-1)	Madakkathara
16	Madakkathara-2 (MDK-2)	Madakkathara
17	M -26/2	Vridhachalam
18	M -33/3	Vridhachalam
19	M -44/3	Vridhachalam
20	Priyanka	Madakkathara
21	Sulabha	Anakkayam
22	Vengurla-1 (V-1)	Vengurla
23	Vengurla-3 (V-3)	Vengurla
24	Vengurla-4 (V-4)	Vengurla
25	Vengurla-5 (V-5)	Vengurla
26	VTH 30/4	Vittal

The physical characters of different varieties of cashew apple like fruit weight, fruit colour, juice yield, pulp weight and juice residue ratio varied significantly except pulp weight. The fruit weight varied from 44.15 g in V-5 to 99.16 g in Priyanka with a mean fruit weight of 70.45 g. A mean fruit weight above 70 g was noted in 13 varieties. The variety Amrutha had the highest juice yield and juice residue ratio. Juice yield above 70 per cent was noted in nine varieties. The pulp weight in different varieties of cashew apples varied from 96.15 to 98.67 per cent in Dharasree and H-3/13 respectively. The highest juice residue ratio was found in Amrutha (3.06) and lowest in Anagha (1.80). The fruit colour in 26 varieties was categorized into yellow, golden yellow, red, orange red and light orange.

The variety Kanaka had the highest tannin content and lowest was in Amrutha and Anakkayam-1. Cashew apple was found to be low in acidity, pectin and reducing sugar. Significant variation between the cashew apple varieties was observed for various nutritional constituents. Eventhough the cashew apple is having a low content of protein and fat, it was found to be a rich source of carbohydrate, fibre, beta-carotene, vitamin C and minerals especially potassium. The highest vitamin C content of 367.26 mg 100 g^{-1} was noted in variety H-1610. The variety Madakkathara-2 had the highest phosphorus, manganese, sodium and potassium contents. The highest and lowest polyphenol oxidase activity was observed in V-1 and H-1593 respectively.

Based on various physico-chemical and nutritional attributes, the 26 varieties of cashew apple were grouped into four clusters. From the four clusters formed, varieties for the preparation of products were selected based on fruit weight, tannin, fibre, total sugar and vitamin C contents. From each cluster, varieties with high, medium and low contents of the above mentioned attributes were selected to prepare candy and tutty fruity. Thus, varieties namely Anakayam-1, H-1596 and H-3/13, from cluster I, Kanaka, M-26/2, H-1593 and H-1602 from cluster II, Madakkathara-2, Sulabha, V-5 and VTH-30/4 from cluster III, Priyanka, Amrutha and Dharasree from cluster IV were selected for preparation of products. Thus, 14 varieties were selected for the preparation of candy and tutty fruity and the quality attributes of the products were studied during storage for a period of six months.

Among the various chemical constituents, the mean acidity, tannin and pectin contents decreased significantly in both the products during storage. The mean reducing sugar, total sugar, TSS and sugar acid ratio increased significantly during storage in candy and tutty fruity. The percentage of mineral content of cashew apple candy and tutty fruity slightly increased on six months of storage due to the loss in moisture.

For overall acceptability in candy, the highest and lowest mean scores were noted in variety Dharasree (4.01) and Madakkathara-2 (2.77) respectively. In tutty fruity, the highest mean score was also found in variety Dharasree (3.23) and lowest in Madakkathara-2 (2.54). Although the acceptability scores decreased in all varieties of candy and tutty fruity, the product remained acceptable even after six months of storage.

Browning and increase of sweetness showed a negative impact on acceptability which expressed a different flavour and taste in candy and tutty fruity stored for six months.

Dharasree which had a low fibre and tannin content produced high quality candy and tutty fruity with an appealing golden yellow colour.

Bacteria and yeast were not detected in candy and tutty fruity during six months of storage. Fungal count was observed in candy and tutty fruity throughout the storage which increased with advancement of storage period. The increase in count was found to be minimum in both the products and the products had good shelf life.

The most suitable varieties for the preparation of candy and tutty fruity were selected mainly based on crude fibre, tannin, sugar content and oragnoleptic scores. For the preparation of candy, Amrutha, Anakkayam-1, Dharasree, V-5 and VTH 30/4 and for tutty fruity Amrutha, Anakkayam-1, Dharasree, H-1593 and V-5 were found to be most suitable.

The cost of production for candy was found to be Rs.36.54/kg and for tutty fruity Rs.39.40/ kg. The mean yield of candy and tutty fruity from 1 kg cashew apple was found to be 745 g and 715 g respectively.

25. Utilization of Selected Underexploited Fruits for Product Development

Name of the Student: Teena Joy (2000-16-05)
Major Advisor: Smt. Omana Pavunny

The physico-chemical and sensory characters of three underutilized fruits namely bilimbi, (*Averrhoea bilimbi*), rose apple - rose and white coloured (*Syzygium jambos* L.) and lovi-lovi - sweet and sour types (*Flacourtia cataphracta, Flacourtia inermis*) were evaluated. Value added products namely bilimbi jam, rose apple squash, lovi-lovi preserve in sugar with sweet type and lovi-lovi in brine with sour type were developed. The organoleptic, chemical and shelf life qualities of the developed products were evaluated at monthly intervals for a period of six months.

The bilimbi fruit was cucumber shaped with green colour, while rose apple was spongy and aromatic. Sweet lovi-lovi was red coloured where as sour type was purplish red in colour. The chemical composition of the fruits indicated that bilimbi had high moisture, iron and acidity when compared to rose apple and lovi-lovi. Potassium and beta-carotene were found to be more in white coloured rose apple, while starch, vitamin C, TSS, reducing and non reducing sugars and total sugars were observed to be high in sweet lovi-lovi. Among the selected fruits, rose coloured rose apple obtained the highest overall acceptability with a mean score of 4.78/5 followed by white rose apple (4.62), sweet lovi-lovi (4.62), sour lovi-lovi (4.28) and bilimbi (3.52).

Table 5. Chemical composition of the products developed from underexploited fruits (per 100 g)

Parameters	Bilimbi	Bilimbi	Rose apple Squash		Lovi-lovi preserve	
	Jam	Pick le	Rose	White	In sugar	In salt
TSS (°brix)	76.10	25.10	45.03	48.03	70.06	15.10
Acidity (%)	1.54	1.22	3.06	2.06	0.98	1.26
Vitamin C (mg)	9.65	10.13	10.13	10.46	18.56	8.26
Reducing sugar (%)	36.63	1.46	26.77	30.02	30.01	1.42
Non reducing sugar (%)	28.02	1.12	14.43	13.32	30.41	1.23
Total sugar (%)	64.66	2.58	41.20	43.35	60.43	2.65

The chemical constituents of the products developed from the fruits were estimated and the details are given in Table 5. All the developed products confirmed the FPO specifications

Bilimbi jam had 76 per cent TSS while the TSS of white and rose coloured rose apple squash were 48 and 45 per cent respectively. The squash had 38 per cent fruit juice. The TSS of lovi-lovi preserve was 70 per cent with a fresh fruit content of 58 per cent. The lovi-lovi in brine had a salt content of 12 per cent. Rose apple squash exhibited high fruit product yield ratio followed by bilimbi jam, lovi-lovi preserve in sugar, lovi-lovi in brine and bilimbi pickle.

During storage, an increase in the chemical constituents like TSS, acidity and reducing sugar contents of most of the products occurred, while vitamin C content decreased during six months storage. The organoleptic qualities like flavour, texture, taste and overall acceptability of bilimbi jam and lovi-lovi preserve gradually increased during storage, while in all other products, the scores decreased. Microbial contamination was not detected in any of the products during the entire storage period.

Cost analysis of the products indicated that lovi-lovi in brine is the cheapest product with Rs.25.60 per kg followed by bilimbi pickle (Rs.35.44/kg) and bilimbi jam (Rs 37.47/kg). The cost of squash developed from rose and white coloured rose apples were Rs.39.21/Kg. The highest expenditure was encountered for lovi-lovi preserve in sugar.

26. Evaluation of fruit quality in banana 'Nendran' (*MUSA* AAB)

Name of the Student: Lakshmy P.S. (2001-16-08)
Name of the Major Advisor: Dr. V. Indira

The study entitled "Evaluation of fruit quality in banana 'Nendran' (*MUSA* AAB)" was undertaken with the objectives of evaluating the chemical constituents of seven nendran types and their products and also to assess the quality characters of banana products during

storage. Seven nendran types namely Attunendran, Changanassery nendran, Chengalikodan, Kaliethan, Manjeri nendran 1, Myndoli and Nedunendran were evaluated for different physical characteristics and nutrient composition. Two products namely banana flour and chips were prepared from the selected nendran types to find out the suitability of the nendran types for product development and to evaluate the quality attributes.

The nendran types were evaluated for physical characteristics like finger weight, finger length, pulp/peel ratio, curvature and angularity. Significant variation in all the physical characters was noted between the nendran types.

The chemical composition of raw nendran types also showed significant variation and were found to be rich in starch, potassium and phosphorus, but lower in protein and crude fibre. The nendran type Chenglikodan had the highest mineral, protein and starch content. The highest value for moisture and vitamin C was observed in Attunendran and the highest crude fibre content was observed in Nedunendran.

The banana flour prepared from the selected nendran types was also analysed for different chemical constituents at monthly intervals for a period of three months. A gradual decrease in the mean protein, crude fibre, starch, calcium, phosphorus, iron and potassium contents was noticed in the banana flour during storage. The banana flour of all nendran types was poor in crude fibre. The banana flour prepared from the nendran types Chengalikodan and Nedunendran showed good starch and mineral contents.

The acceptability studies of cooked banana revealed that Attunendran is the best nendran type for table purpose while Chengalikodan was organoleptically the best to prepare chips and porridge. Storage studies revealed a gradual decrease in the quality attributes and overall acceptability of chips and porridge.

The enumeration of total micro flora of the banana flour revealed a gradual increase in the bacterial and fungal count on storage. The presence of yeast was found to be negligible. The banana flour prepared from the nendran types Attunendran, Manjeri nendran I and Myndoli showed minimum total micro flora when compared with the banana flour prepared from other nendran types.

27. Quality Evaluation of Fruit Beverages

Name of the Student: Sujatha Sethy. (2003-16-07)
Name of the Major Advisor: Dr. V. Indira

Commercially available fruit beverages were evaluated for chemical constituents, acceptability and microbial qualities. After conducting a market survey in the different supermarkets and bakeries of Thrissur Corporation area, three most popular and three least popular fruit based beverages were selected for the study. The selected beverages were analysed for chemical

constituents, like acidity, TSS, total, reducing and non reducing sugars, sodium, potassium, vitamin C, beta-carotene, pectin, sulphur di oxide, colouring agents and heavy metals at bimonthly intervals up to the expiry date. Acceptability and microbial enumeration of the beverages were also conducted at bimonthly intervals till the expiry date.

An increase in the acidity of the beverages was noticed during storage and none of the beverages satisfied the FPO specification for acidity. However, the TSS of the beverages was in accordance with the FPO specifications. In two squashes, the TSS remained constant while in other beverages TSS increased with the period of storage. An increase in the total and non reducing sugar contents of the beverages was noticed while the reducing sugar of three beverages decreased with advancement of storage. A decrease in the vitamin C and beta-carotene occurred during storage, while minerals like sodium and potassium remained constant. The sulphur dioxide content of the beverages was found to be within the permissible limit. However, a decrease in sulphur di oxide and pectin occurred during storage. Tartrazine and sunset yellow were found to be the predominant colours added to the beverages. The quantity of colour added to three beverages was within the permissible level. However, in three beverages the quantity exceeded the permitted level. The beverages were contaminated with heavy metals like lead and cadmium. However, the quantity of cadmium was found to be very low. The beverages were acceptable initially and a decrease in the organoleptic qualities was observed during storage. Bacteria and fungi were detected in beverages, which increased during storage. However, yeast and *E. coli* were not detected in any of the beverages during the entire storage period.

28. Value Addition and Quality Evaluation of West Indian Cherry (*Malpighia punicifolia* L.)

Name of the Student: Pokkandath Jyothi (2004-16-02)
Name of the Major Advisor: Dr. V. Usha

A study was undertaken to evaluate the nutritional composition of West Indian cherry fruits and to develop value added products from the fruits. The chemical, organoleptic and shelf life qualities of the developed products were also evaluated.

West Indian cherry fruits in their fully mature stage and red ripe stage were collected from the Orchard of College of Horticulture, Vellanikkara. Physical characters of the fruits like colour, firmness, weight, number of fruits per 100g and fruit pulp ratio were evaluated in both stages. Chemical constituents like moisture, fibre, calcium, phosphorus, iron, potassium, beta-carotene, vitamin C, TSS, acidity, reducing and total sugar were estimated in fully mature and ripe stages. Squash and sauce with fruits in red ripe stage and pickle and preserve with fully mature fruits were prepared. All products were stored in glass bottles for six

months and evaluated initially, after three months and six months for organoleptic qualities, chemical constituents namely vitamin C, beta-carotene, TSS and total sugar and keeping qualities.

On the basis of physical qualities, red ripe fruits were superior in fruit weight (6.25g), pulp recovery (60%) and colour (red). Based on chemical constituents, fully mature fruits were superior with respect to fibre (1.13%), vitamin C (890mg/100g), acidity (1.8%), calcium (12.04mg/100g), phosphorus (21.56mg/100g), and iron (1.03mg/100g). Beta-carotene (210 µg/100g), total sugar (5.71%), TSS (7.40 brix) and reducing sugar (5.04%) were found to be high in red ripe fruits.

The sensory qualities like appearance, colour, consistency and taste of the squash decreased from the maximum score of five to 3.5 at the end of storage. A decrease in the overall acceptability of squash and sauce was also noticed at the end of storage indicating that these products are highly acceptable during the initial period. The overall acceptability of West Indian cherry preserve improved significantly from the initial score of 3.2 to 4.5 by 6^{th} month of storage. The overall acceptability of pickle decreased significantly at the end of storage period. During storage, the TSS and acidity of the products increased, while vitamin C and beta-carotene decreased. However, the retention of vitamin C was better in West Indian cherry products when compared to other processed products. Microbial count was not detected in pickle and squash during storage, but in sauce and preserve microbial contamination was noticed from third month onwards. All products had a BC ratio above one with sauce having the highest followed by pickle, squash and preserve.

29. Standardisation of Blended Cashew Apple RTS Beverages

Name of the Student : Remyamol K.K. (2004-16-03)
Name of the Major Advisor: Dr. V.Indira

This study was attempted to standardize cashew apple RTS beverages by blending cashew apple juice with other fruit juices like orange, pineapple and lime and spice extracts namely ginger and cardamom and to find out the acceptable beverages with high sensory and nutritional qualities and with good shelf life.

Thirty four different combinations of RTS beverages as per FPO specifications were prepared using cahew apple juice (100%, 85%, 75% and 50%) as the base and mixing with orange, pineapple and lime juices at different combinations (0%, 15%, 25% and 50%) with and without spice extracts. On the basis of the acceptability of these beverages, twelve most acceptable beverages were selected and stored under ambient and refrigerated conditions for three months. These were analysed for chemical constituents, sensory and microbial qualities at monthly intervals.

An increase in the acidity and total sugar of the beverages was noticed during storage under ambient conditions, while a decrease was noticed under refrigerated condition. The TSS and reducing sugar increased in almost all beverages stored both under ambient and refrigerated conditions. A decrease in the vitamin C and beta-carotene was also noticed during storage. Higher percentage of these two constituents were retained in beverages stored under refrigerated condition. The tannin content decreased significantly during storage and the decrease was more in beverages stored under ambient condition. All the beverages were found to be acceptable even after third month of storage under refrigerated condition. In ambient storage, the beverages were unacceptable after the first month. Though, no bacterial growth was noticed initially, after third month of storage the bacterial growth occurred in all beverages. However, the rate of increase was comparatively low under refrigerated storage conditions.

Among the different combinations, the RTS beverage prepared with 75 per cent cashew apple juice and 25 per cent lime juice without any spice extract was the most acceptable up to one month under ambient condition and up to three months under refrigerated condition with respect to nutritional quality, acceptability and lower tannin content. The beverage prepared by blending equal proportion of cashew apple and pineapple juice with one drop of cardamom extract also was found to be acceptable after one month of ambient storage and up to two months under refrigerated storage. Blending of cashew apple juice with other fruit juices and spice extracts is good to improve the nutritional quality and acceptability of cashew apple juice in terms of taste, flavour and mouth feel.

30. Standardisation and Quality Evaluation of Banana based Probiotic Fermented Food Mixtures

Name of the Student: Sharon C.L. (2004-24-102)
Name of the Major Advisor: Dr. V. Usha

The study was undertaken to standardise indigenous food mixtures based on banana flour with probiotic fermentation involving *Lactobacillus acidophilus* and to evaluate the nutritional factors, organoleptic qualities and storage stability of food mixtures. Probiotic characteristics like acid and bile tolerance and antimicrobial activity of *L.acidophilus* MTCC 447 was studied and found that the selected strain could survive in a pH range of 2.0 to 9.0 and at 3 per cent bile salt concentration . *In vitro* studies with the strain also revealed an antagonistic activity against enteropathogens viz *Salmonella enteritidis, E.coli, Bacillus cereus* and *Staphylococcus aureus. Salmonella enteritidis* was the maximum inhibited pathogen by *L. acidophilus* at pH 3.0.

The foods selected for developing the probiotically fermented food mixtures were banana (Nendran) flour, defatted soya flour, green gram flour, ripe mango, papaya and tomato.

From the 56 combinations tried, 14 fermented food mixtures with *L.acidophilus* MTCC 447 were selected based on their organoleptic qualities.

All the selected 14 food mixtures contained 60-70 per cent banana flour, 20 per cent defatted soy flour/ green gram flour and 10-20 per cent fruit pulp. The variables for *L.acidophilus* fermentation were optimised. For all the treatments, fermentation with 25g of the food mixture at pH 4.5, inoculated with 300µl and incubated at 37°C for 24 h gave the maximum total viable counts of *L.acidophilus* ranging from 9.13 to 9.45 log cfu/g. All the fermented foods along with unfermented controls were freeze dried. Constituents like titrable acidity (2.59 g lactic acid/100g), protein (7.82g/100g), iron (6.48mg/100g), thiamine (0.073 mg/100g) and riboflavin (0.535 mg/100g) were significantly high in fermented food mixtures. *In vitro* digestibility of starch and protein were also significantly high in fermented food mixtures. Total viable count of *L. acidophilus* ranged from 9.13 to 9.45 log cfu/g. Mean score of overall acceptability of fermented products varied between 7.9-8.0 in a 9 point hedonic scale, where as that of controls were in between 7.2 -7.3. The high acceptability for the fermented food mixtures were mainly contributed by the high scores for flavour and taste.

From the 14 fermented food mixtures, six fermented food mixtures were selected considering all the quality criteria by computing geometric mean scores and along with their respective controls were packed in metallised poly ester/poly ethylene laminate pouches and kept for storage studies under ambient conditions for a period of six months and evaluated at monthly intervels.

From the six fermented food mixtures with maximum shelf life qualities, three fermented food mixtures were selected by applying geometric mean scores. The treatments with maximum geometric mean score were T_1 (70 per cent banana flour, 20 per cent defatted soy flour, 10 per cent mango), T_3 (60 per cent banana flour, 20 per cent defatted soy flour, and 10 per cent tomato pulp) and T_8 (60 per cent banana flour, 20 per cent defatted soy flour, 10 per cent mango and 10 per cent tomato pulp)

Substrate composition was modified by adding sucrose, sorbitol, wheat bran and skimmed milk powder to the three selected combinations. The level of these ingredients were standardized as 5 per cent with maximum viable counts of *L.acidophilus* in food mixture T_3.Viable counts in T_3 with 5 per cent sucrose (T_3S) was 351 cfu/g x 10^7, with 5 per cent sorbitol (T_3SB) was 284 x 10^7cfu/g, with 5 per cent wheat bran (T_3W) was 333 x 10^7cfu /g and with 5 per cent skimmed milk powder (T_3SK) was 347 x 10^7cfu /g. Thus, four treatments (T_3 + sucrose 5 per cent, T_3 + 5per cent sorbitol, T_3 + 5per cent wheat bran and T_3 + 5 per cent skimmed milk powder were subjected to shelf life studies and quality evaluation.

Constituents like TSS, reducing sugars, total sugars were significantly high in T_3S (sucrose added T_3) where as constituents like moisture, starch, protein, beta-carotene, calcium, potassium, iron, IVSD and IVPD showed no significant difference from that of T_3 after six months of storage. Viable count and overall acceptability showed an increase when compared with their fermented control (T_3).

The present study revealed that dry food mixtures T_1 (70 per cent banana flour, 20 per cent defatted soy flour and 10 per cent mango), T_3 (60 per cent banana flour, 20 per cent defatted soy flour and 10 per cent tomato pulp) and T_8 (60 per cent banana flour, 20 per cent defatted soy flour,10 per cent mango and 10 per cent tomato pulp), T_3S (with 5 per cent sucrose), T_3SB (with 5 per cent sorbitol), T_3W (with 5 per cent wheat bran) and T_3SK (with 5 per cent skimmed milk powder) are fermented food mixtures with good acceptability and desirable viable counts after six months of storage under room temperature. T_3SB (with 5 per cent sorbitol) is also an equally good low calorie probiotic food. All these food mixtures contained a viable count ranging from 9.13 to 9.32 log cfu/g.

The viable count of *L. acidophilus* in the developed probiotic food mixtures at the expiry period (after six months of storage) ranged between 95 to 210 x 10^7 cfu/g and in five grams the viability ranged between 475 to 1040 x 10^7 cfu. This was within the recommended level of the probiotic organism to assure health benefits. The cost of the developed food mixtures ranged between Rs 530 to Rs 550 for 400 grams.

31. Comparative Evaluation of Fresh Fruit Juices Sold by Street Vendors Versus Restaurants

Name of the Student: Bindhya Dhanesh T. (2007-16-101)
Name of the Major Advisor: Dr. V. Indira

Quality attributes of fresh fruit juices sold in the street vending sites and restaurants with respect to chemical constituents and microbial contamination were evaluated.

A survey was conducted among the street vendors and restaurant workers from selected street vending sites and restaurants belonging to five wards of Thrissur Corporation to elicit general information of vendors and restaurant workers and information on their knowledge and practices. Most of the vendors and restaurant workers were below 20 years of age and earned an income to fulfill their basic needs. Most of the vendors were educated up to primary school level while the restaurant workers were found to be high school educated.

Better cleaning practices were observed among the restaurant workers. Good quality cleaning materials were used by the restaurant workers compared to street vendors in cleaning the preparation area. Both the vendors and workers used disinfectants to keep away insects and rodents. Better water facilities and storage of collected water were noticed among the restaurant workers. Both the street vendors and restaurant workers used glass tumblers to serve fruit juices but unhygienic washing practices among the street vendors were observed with regard to washing of used glasses.

Hygienic conditions with good toilet facilities were noticed in the restaurants when compared to the conditions in and around the street vending sites. Flies, dust and foul smell were noticed in the street vending sites while it was not noticed in the restaurants. Garbage disposal facilities were available for both the sites but better facilities were noticed in the restaurants. The restaurant workers were found to be neat and clean in appearance when compared to street vendors. The restaurant workers used head gears and aprons and majority used gloves during the preparation of fruit juices while the same was not noticed among the street vendors. Positive responses with respect to their knowledge and washing practices before and after preparation were obtained from the street vendors and restaurant workers.

For quality evaluation, three most frequently consumed fresh fruit juices namely pineapple, grape and lime juices were selected. The juices were collected from the six street vending sites and four restaurants and analysed for chemical constituents like acidity, pH, TSS, reducing sugar, total sugar, non-reducing sugar, vitamin C, beta-carotene, sodium, potassium and artificial food colours. Enumeration of microorganisms and the presence of any pathogenic microorganisms in the selected juices were also evaluated.

The acidity of pineapple juice collected from the street vending sites and restaurants was found to be same. Variation in the acidity was observed in the grape and lime juices collected from both the sites but statistically significant variation was observed only in the case of lime juice. An increase in the TSS content of pineapple and grape juices collected from the restaurants compared to juices collected from the street vending sites was noticed. In lime juice, the TSS content was found to be high in the samples collected from street vending sites.

Significant variation in the total sugar content was observed only in pineapple juice collected from street vending sites and restaurants. Significant variation in the reducing sugar content was observed in pineapple and grape juices collected from the two sites. However, the non-reducing sugar content of all the three fruit juices collected from the restaurants was high. Higher vitamin C content was obtained in grape and lime juices collected from the restaurants while the vitamin C content of pineapple juice collected from both sites was same. Significant variation in the beta-carotene content was not noticed in the three fruit juices collected from the street vending sites and restaurants.

Artificial colouring agents were not present in the fruit juices collected from the street vending sites and restaurants.

The fresh fruit juices collected from the street vending sites and restaurants were contaminated with bacteria, yeast and mould. The juices collected from the street vending sites were grossly contaminated with micro organisms. The bacterial count in all the fruit juices collected from the street vending sites was significantly high. Yeast count of grape and lime juices collected from the street vending sites was also found to be significantly high while the mould count was high in lime juice collected from the street vending sites.

Pathogenic microorganisms like *E.coli* and *Salmonella spp.* were detected in the juices collected from the street vending sites. *E.coli* was noticed in juices collected from only one restaurant. *E.coli* was also detected in the water samples collected from almost all the street vending sites and one restaurant. However, *Salmonella* was not observed in the juices collected from the restaurants.

Thus, it is evident that fruit juices sold in the street vending sites are unsafe in terms of microbial quality though they possess almost similar nutritional qualities to the juices sold in the restaurants.

32. Process Standardisation for Banana Wine

Name of the Student: Saritha E.V. (2007-16-106)
Name of the Major Advisor: Dr. V. Usha

A process was standardized to prepare banana wine with pure strains of wine yeast *Saccharomyces cerevisiae* and commercial baker's yeast. The effect of pectinase, potassium metabisulphite and pressure cooking of banana pulp on the physico chemical and sensory qualities of the fresh and stored wines were also evaluated. Fully ripe *Palayankodan* variety of banana was selected for the study.

Three pure strains of *Saccharomyces cerevisiae viz* MTCC 172, MTCC 174 and MTCC180 obtained from IMTECH and the commercial baker's yeast were used in two different dilutions (10^{-6} and 10^{-7}) for fermentation of banana pulp. Inoculum concentration was standardised by standard procedures before fermentation.

Wine yield was significantly high with baker's yeast in both 10^{6} dilution (68.36%) and 10^{-} dilution (67.76%). Among pure strains, wine yield was high with MTCC 172 in both dilutions (59.53 and 57.57% respectively). MTCC 172 (10^{6}) also produced wines with significantly high TSS (13.93° brix) and high pH (4.25). Among wines with baker's yeast, 10^{6} dilution showed highest alcohol content (8.23%) and TSS (12.46° brix) with a corresponding high titrable acidity and low pH. Clarity of wine was maximum with baker's yeast (78.75% light transmittance) in 10^{7} dilutions. Sensory qualities of the wines indicated that among pure strain, MTCC 172 (10^{6}) dilution had the maximum score for colour and appearance, flavour, taste and overall acceptability. Among wines with baker's yeast, the wine prepared with banana pulp, water and sugar in 10^{6} dilutions had the best score for colour and appearance, flavour and overall acceptability. Based on the overall acceptability score of the wines, pure strain MTCC 172 (10^{6} dilution) and baker's yeast in 10^{6} dilutions were selected for wine development.

Eight treatments of banana pulp were tried for studying the quality of banana wines with the selected pure strain MTCC 172 (10^6 dilution) and also with the baker's yeast (10^6 dilution). Banana pulp was treated with commercial food grade pectinase and potassium metabisulphite (KMS). Pressure cooked bananas was also included as a treatment for wine making. The quality attributes of wines developed by the selected yeast strains indicated that the wine prepared with banana pulp + sugar + pure strain + enzyme and the one prepared with pressure cooked pulp + sugar + pure strain + enzyme + KMS obtained the maximum overall acceptability score. Among treatments with baker's yeast, the selected treatments with highest acceptable quality parameters were the wine prepared with banana pulp + sugar + baker's yeast + enzyme and banana pulp + sugar + baker's yeast + enzyme + KMS.

The selected wines were pasteurised and bottled in amber coloured bottles with cork caps and were stored in ambient temperature for three months for storage studies. The physico chemical characteristics of the wines showed a significant increase in clarity, titrable acidity, tannin and a significant reduction in reducing sugar. Maximum wine clarity, titrable acidity and maximum reduction in reducing sugar were found in wine prepared with banana pulp, sugar, pure strain and enzyme (T_2PS).

With respect to organoleptic qualities, there was no significant change with regard to colour and appearance, taste and overall acceptability of the wines during storage. A significant increase in flavour, desirable level of astringency and acceptable level of alcohol were observed in T_2PS after storage. Yeast, bacteria and fungi were not detected in the wines after storage.

The cost of production of the selected wine treatment T_2PS (pulp + sugar + PS + enzyme) was worked out and compared with the cost of 750 ml of grape wine locally available made by wine makers. Grape wine (750 ml) costs Rs.150/- whereas the banana wine costs Rs. 96/- which can be reduced further in large scale production of banana wine. If wine making from bananas can be explored commercially, it might ultimately reduce the annual wastage of bananas and also increase the income of banana farmers.

D. NUTS AND OIL SEEDS

33. Quality Evaluation of Kernels of Different Cashew Varieties

Name of the Student: Vandana V. (1998-16-04)
Name of the Major Advisor: Dr. V. Indira

The physical characters, nutritional composition and processing characters of twenty three cashew varieties collected from the Cashew Research Station, Madakkathara, Kerala Agricultural University were evaluated. The physical characters like weight, length, breadth and thickness and nutrients like moisture, protein, fat, carbohydrate, sugar, amino acid, calcium, iron and phosphorus were evaluated. The nutrients were evaluated before and after

processing. Kernel weight, shelling percentage, percentage yield of whole kernels and kernel count of cashew nuts were also analysed after processing. The varieties evaluated were Amrutha, Anakkayam, Dhana, Dharasree, Kanaka, Madakkathara-1, Madakkathara-2, Priyanka, Sulabha, H-1600, H-1610, H-2/15, H-2/16, Hybrid- 4/5, M-26/2, M-33/3, M-44/3, Tree No.40, Tree No.129, Vengurla-2, Vengurla-4, VTH-30/4 and VTH-59/2.

Among the twenty three varieties, the highest weight, length, breadth and thickness were observed in H-1600 (11.4g), M-33/3 (4.5cm), Priyanka (3.04cm) and H-2/15 (22.01mm) respectively. The sugar (10.15%) content before processing, fatty acid before (3.08% oleic acid) and after processing (2.98% oleic acid) and iron content (4.97mg/100g) after processing were highest in Sulabha, where as H-1600 had the highest sugar (9.96%) and fat (47.17%) content after processing. The highest protein (22.31% & 22.11%) and amino acid (3.20mg & 3.17mg/100g) before and after processing was observed in H-2/16. Dharasree had the highest fat (46.77%) before processing. Highest calcium before and after processing was found in Madakkathara - 2 (57.88mg/100g) and Dharasree (58.46mg/100g) respectively. Anakkayam had the highest carbohydrate before (24.02%) and after (23.26%) processing and the lowest was in Madakkathara-1(17.69% & 17.18%). Significant variation was noticed in all the nutrients except phosphorus between varieties. However, the difference in nutrients before and after processing was not significant except in the case of calcium.

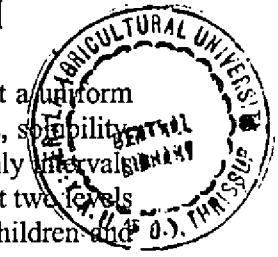
Shelling percentage (32.37%) and percentage yield of whole kernels (96.33) were found to be high in Madakkathra-1 and 2 respectively. Highest kernel weight (2.46g) was noticed in Priyanka followed by Madakkathra -1(2.27g). On the basis of physical characters, Priyanka was found to be the best variety. Based on nutritional characters Sulabha was found to be the best, while Madakkathra-1 was adjudged as the best with respect to processing characters. On the basis of all the three criteria, Priyanka with best physical characters and with nutritional composition almost similar to Sulabha and processing characters similar to Madakkathara-1 was found to be the best variety.

E. ANIMAL FOODS

34. Standardisation and Acceptability of Dairy Products with Cocoa Mass

Name of the Student: Sunitha Nair (1999-16-02)
Name of the Major Advisor: Dr. V. Usha

Dairy products namely milk chocolate, burfi, fudge, biscuit and ice cream were standardized by incorporating cocoa mass at five and 10 per cent level and acceptability of the products was evaluated. Fermented and dried cocoa beans for the study were procured from Cadbury Cocoa Research Project of College of Horticulture, Kerala Agricultural University. The



beans were roasted for five and ten minutes, powdered and sieved so as to get a uniform powder. This was stored for three months at ambient condition. Free flowness, solubility, microbial count and peroxide value of this cocoa mass were evaluated at monthly intervals for a period of three months. Products developed by incorporating cocoa mass at two levels were subjected for organoleptic evaluation among technical experts, school children and college students using score card initially and at the end of three months storage.

The cocoa powder got clumped by the third month and became pale brown in colour. The microbial population and peroxide value increased in both five and 10 minutes roasted samples during storage. All the products developed by incorporating cocoa mass at five per cent level were highly acceptable. The time of roasting cocoa beans to prepare cocoa mass influenced the organoleptic qualities of the products. For milk chocolates five minutes roasting of cocoa beans had better acceptability for appearance, flavour, texture and taste. However, colour was better when cocoa was roasted for 10 minutes. For burfi and biscuit, five minutes roasting of cocoa beans was highly acceptable for all quality criteria. For fudge, 10 minutes roasting of beans produced better flavour, texture and taste. In the case of icecream, the appearance, colour, flavour and texture were found to be better when cocoa beans were roasted for five minutes. For taste, 10 minutes roasting was found to be good. Thus, five minutes roasting was found to be good for most of the oragnoleptic qualities of the products. The organoleptic qualities of fudge, biscuit and ice cream improved when they were prepared using stored cocoa mass.

35. Nutrient Analysis and Value Addition of Underutilised Fish

Name of the Student: Jishy K.K.. (2002-16-07)
Name of the Major Advisor: Smt. Omana Pavunny

Nutritive value of fresh and dried underutilised fish varieties namely netholi (*Stoliphorus heterolobus*) flat fish (*Cynoglossus macrostorus*) and veluri (*Kovala koval*) and value addition of these fishes by drying and pickling was undertaken. The quality of dehydrated fish and pickles prepared from fresh and dehydrated fish during storage were also evaluated.

Dehydrated fish was stored for three months in polythene bags and peroxide value, acceptability and microbuial population were analysed at monthly intervals. Peroxide value of dried fish increased during storage and organoleptic qualities gradually decreased. Veluri had the highest acceptability throughout the storage period. Lowest was found in flat fish. The bacterial population in dried fish gradually increased during storage. Highest bacterial and fungal population was found in veluri and lowest in flat fish.

The pickle prepared from fresh and dried fishes were stored in glass bottles and polyester laminated HDPE film for a period of six months. The peroxide value and acidity of the

pickle in both packaging materials increased during storage. The pickle stored in polyester laminated HDPE film had higher peroxide value and acidity than pickle stored in glass bottle. Within a package, dried fish pickle had higher peroxide value and acidity than fresh pickle. It was also seen that the pickle stored in glass bottle had better acceptability than the pickle stored in polyester laminated HDPE film. Within a variety fresh fish pickle had better acceptability than dried pickle in both packages. Among them veluri pickle was found to be the best.

The bacterial population of the pickle increased slightly during storage. The pickle stored in glass bottle had the higher microbial population. The fungal population was found only from third month onwards and it remained almost the same throughout the storage period in both packaging materials. In both packaging conditions dried fish pickle had higher microbial population than fresh pickle.

The fresh fish pickle had higher yield than dried fish pickle. Dried netholi pickle was found to have the lowest cost. However, all the products had BC ratio greater than one and thus economically beneficial. Veluri was found to be the most suitable fish for preparing products.

36. Quality Evaluation of Value Added Products with Marine and Fresh Water Fish

Name of the Student: Soumya P.S (2005-16-104)
Name of the Major Advisor: Smt. Omana Pavunny

Value added products were developed from four fish varieties namely Pink Perch (*Nemipterus raponicus*) and Silver belly (*Gerres filamentoses*) belonging to marine species and Tilapia (*Tilapia mossambica*) and Katla (*Catla catla*) of fresh water species. The nutritive value of these four fish varieties was evaluated. Cutlet and stick from selected marine and fresh water fish varieties were developed and the acceptability and shelf life of the developed products were also evaluated.

Marine fishes were found to be rich in calcium, phosphorus iron and fat, whereas fresh water fishes were rich in protein and vitamin A. Fat content was comparatively low. Yield of fish muscle was found to be high in fresh water species like katla (78 per cent) and tilapia (75.5 per cent). Higher peroxide value was observed in marine varieties.

The fish products namely cutlet and stick were packed in polythene covers and stored under frozen condition for a period of two months. The peroxide value of the products increased with the storage period. Products made out of pink perch had the highest peroxide value throughout the storage period and the lowest was in silver belly. Organoleptic evaluation of the products was carried out using a 9-point hedonic scale for quality attributes namely

appearance, colour, flavour and texture at fortnightly intervals for a period of two months. The sensory qualities of the products decreased during storage. Fish cutlets and sticks made of katla fish had the highest acceptability throughout the storage period.

Microbial enumeration of the products revealed that there was a gradual increase in the microbial population with the storage period. Maximum bacterial count was in cutlets made of pink perch initially and at the end of storage. Fungal population was detected in cutlets after 15th day of storage. Maximum yeast population was also noticed in pink perch cutlet. In fish stick also, after 60 days of storage, bacterial count was maximum in pink perch. The shelf life of the products with acceptable maximum total plate count was for 30 days.

Computation of nutritive value of cutlets per packet (4 cutlets, 20g each) revealed a high protein content in cutlets prepared with tilapia (11.92g), calcium in pink perch (498.24mg), phosphorus (382mg) and iron (2.96mg) in silver belly and vitamin A (93.12µg) in katla. Nutritive value of fish stick per packet (4 sticks, 25g each) revealed a high protein (16.36g) in tilapia, calcium (698.12mg) in pink perch, phosphorus (519.68mg) and iron (2.84mg) in silver belly and vitamin A (72.96µg) in katla. Thus, value addition of underutilised fishes is essential to improve the acceptability and for income generation.

F. TRADITIONAL FOODS

37. Documentation and Quality Evaluation of Traditional Foods of Central Zone of Kerala

Name of the Student: Aneena E.R. (2004-24-01)
Name of the Major Advisor: Dr. V. Indira

The study was undertaken with the aim of identifying and collecting information on the various traditional foods of central zone of Kerala and to document their mode of processing. The quality characteristics of the selected less used traditional foods were also evaluated..

Four districts of central Kerala namely, Ernakulam, Thrissur, Palakkad and Malappuram were selected for the study. Ten study locations were identified from each district, and elderly persons above the age of sixty years with expertise in traditional food preparations were selected to collect the relevant information. The respondents were categorised into different communities like Kerala Brahmins (KB), Tamil Brahmins (TB), Ezhavas (EZ), Scheduled Castes (SC), Hindus of Palakkad (HIPKD), Muslims (MU) and Christians (CH). From the identified study locations, information regarding the traditional foods and food habits of each community associated with religious customs, festivals, special occasions, rituals, physiological conditions and their method of preparation were collected through Participatory Learning Action (PLA) using tools like focus group interview, trend line/ time line and flow chart analysis. Transition occurred in the traditional food pattern and in the preparation of

traditional foods was also collected. Quality evaluation of selected traditional foods was conducted at laboratory level with respect to chemical constituents, acceptability and microbial growth.

All respondents of KB, TB, HIPKD and CH and majority of respondents in EZ, SC and MU communities gave preference to traditional foods due to their health benefits and palatability. Majority of the respondents in different communities prepared traditional foods for breakfast and lunch. Most of the respondents did not prepare traditional health foods at home due to the laborious procedure involved in the preparation and their commercial availability. The important traditional food items of Kerala Brahmins during special occasions like *annaprasam, ayanionnu, namakaranam* and *upanayanam* included *ada, appam, pazhampuzhungiyathu, varuthupperi* and *sharkkaravaratty* and traditional Kerala *sadya*. Tamil Brahmins prepared *laddu, murukku, muthusaram, mysorepak, athirasam, therattipal, thengaitherttipal,*etc for various occasions like *seemantham, jatha karma, namakarana*, and cradling and *annamprasa* ceremonies. For *Deepavali,* and *navarathri* they prepared items like *ukkarai, therattupal, maaladu, murukku, thenkuzhal, laddu, payasam, kosumalli, kozhukattai, maduraputtu, pollavada, avalputtu* and *maaladu.* Traditionally, feasting habits were less common among Ezhavas and Scheduled caste communities and had less variety of traditional foods. Scheduled caste communities prepared *kanniyappam, and* served meat preparations and toddy for religious festivals.

Traditionally, Muslims included *neichoru, pathiri,* beef curry and *biriyani* for marriage feast. Muslims prepared variety of special dishes namely *jeeraka kanji, thari kanji, kuzhalpathiri, unnakkaya, nirachapathiri, aleesa, kalathappam, unnakkaya, pazhamnirachathu, mutta mala, muttasurukka, muttamarichathu, kozhinirachathu, valayappam, tharippola, pinjanathappam, kalathappam* etc for different occasions like *noyambuthura* and *puthiyaplasalkkaram. Inderiyappam, kozhukkatta, kozhimbidi, achappam, kuzhalappam, muttayappam, vettappam, vattayappam, vellayappam, avilosupodi, avilosunda, churuttu, cheeppappam, payattunda* etc were the major traditional food items of Christians prepared for different occasions. Special health foods included during the month of Karkkidakam by different communities included *pathila curry, marunnu kanji, navadhanya kanji, njavara kanji, kakkum kaya kanji. chamachoru, thavidappam, thaviduada* and *cheeda* as well as mango kernel flour and tamarind seed flour based foods like *unda, ada* and *kumbilappam* and *thengachoru.*

Changes were observed in the traditional food pattern and traditional foods over different years with respect to ingredients, method of preparation and vessels/utensils used for the preparation. One of the major changes noticed in the breakfast pattern of different communities was a shift from taking rice or *kanji* with *puzhukku* to different types of rice and wheat based items in the morning. Presently all the respondents included *dosa, idli, puttu, noolappam, chappathi, appam, poori, uppuma* and *seva* for breakfast. The important transition observed in marriage *sadya* of different communities was an elaborate *sadya* including different traditional and modern dishes. Inclusion of nontraditional items and a shift to a course meal pattern was also observed. The recent trend of food consumerism was assessed and found that 34.01 per cent of respondents had snacks from outside on weekly basis. Most of the

respondents purchased various instant mixes (76.92%), spice powders (67.61%) and few of the respondents purchased mixes for breakfast items (34.41%) also.

Quality evaluation of twelve selected traditional foods and three beverages indicated that most of the traditional foods are rich in certain macro and micro nutrients. The highest total carbohydrate content was observed in *paniyaram* (74.22%). Protein content of the replicated foods varied from 0.56 to 18.97 per cent with the highest protein content in *rankayyan* and the lowest in *karinellikka*. *Nirachapathiri* had the highest fat content of 12.36 per cent. Above 20 mg of calcium per 100 g was found in *kaliyadakka, karinellikka, madhura puttu, muttayappam, paniyaram, poruvelangai* and *rankayyan*. The iron content of 100 g of replicated foods varied from 0.36 mg to 2.86 mg. The sodium content of traditional foods varied from 0.016 to 38.4 mg per 100 g.

Organoleptic evaluation of the replicated foods indicated that most of the traditional foods were acceptable to the younger generation. *Inderiyappam, madhuraputtu, muttayappam, nirachapathiri, paniyaram, rankayyan* and *vishukatta* were highly perishable. The mean scores obtained for perishable foods like *inderiyappam, madhuraputtu, muttayappam, nirachapathiri, rankayyan* and *vishukatta* packed using different packing materials and stored under different storage conditions showed a considerable decrease in the quality attributes of most of the foods. The minimum microbial count was obtained for *kalakala, kaliyadakka, manda and poruvelangai* at the end of storage period which were packed under vacuum.

Even though, there is a rich treasure of diversified traditional foods in Central Kerala, many of them are facing extinction and are undergoing several changes. Transitions and modifications were occurred in the traditional food pattern and food habits. The recent trend of consumerism has affected the food habits and led to the dilution of food preparations. It is evident that the endangered traditional foods can be replicated under prevailing conditions without change in their quality attributes and these can be popularised as an attempt to conserve traditional foods of Kerala.

G. LESS FAMILIAR FOODS

38. Standardisation and Quality Evaluation of Grain Amaranth (*Amaranthus* spp.) Flour Supplemented Food Products

Name of the Student: Nidhi Bhatiwada (2005-16-108)
Name of the Major Advisor: Dr. V. Indira

Grain amaranth belonging to the family Amaranthaceae is considered as an underexploited grain and suggested as a food for future. This crop is having an important role in the human food system due to its easy cultivation and nutritional aspects. In the present study, an attempt was made to estimate the quality of grain amaranth flour and to develop value added products. Flour was prepared from grain amaranth seeds and stored for a period of six months in glass

bottles at ambient storage conditions. Quality evaluation of the flour with respect to chemical constituents and organoleptic qualities was conducted at three monthly intervals up to a period of six months. Microbial enumeration of flour with respect to bacteria, fungi and yeast was also conducted at monthly intervals up to six months. Three products namely chapathi, biscuit and puttu were prepared by substituting the main ingredients with amaranth flour at different proportions. The products prepared were evaluated for organoleptic qualities and nutritive value of the products was computed.

Amaranth flour was found to be rich in protein, starch, fibre and minerals like iron, calcium, magnesium, potassium and phosphorus and low in anti nutritional factors such as tannin and phytic acid. The chemical composition of grain amaranth flour is given in Table 6. The moisture, tannin and phytic acid contents increased whereas the protein, starch, fat, fibre, calcium, magnesium, iron, potassium and phosphorus contents decreased gradually with advancement of the storage period. A gradual increase in the bacteria, fungi and yeast count in amaranth flour was also observed with advancement of storage period.

Table 6. Chemical composition of grain amaranth flour (per 100 g)

Constituents	Quantity
Moisture (g)	16.66
Protein (g)	14.70
Starch (g)	62.2
Fat (g)	6.73
Fibre (g)	2.87
Calcium (mg)	187.16
Magnesium (mg)	226
Iron (mg)	13.58
Potassium (mg)	248.2
Phosphorus (mg)	315.68
Tannin (mg)	1.23
Phytic acid (mg)	0.53

With regard to the organoleptic evaluation of the flour, reduction in various quality attributes including overall acceptability was noticed during storage. Amaranth flour was found to be unacceptable after a storage period of six months due to the slight rancid flavour developed in the flour.

The products like chapathi, biscuit and puttu were prepared by substituting grain amaranth flour for respective main ingredients namely wheat flour, maida and rice flour. Grain amaranth flour was incorporated at 10 to 50 per cent level along with the main ingredient in different recipes. The recipe prepared with 100 per cent main ingredient was taken as the control. The organoleptic evaluation of the products showed significant variation between treatments. Chapathi prepared by substituting wheat flour up to 30 per cent amaranth flour was found to be acceptable. However, biscuit and puttu prepared even up to 50 per cent substitution of

grain amaranth flour obtained high organoleptic scores indicating that these products are also highly acceptable. It was also seen that as the percentage of amaranth flour increased, nutritive value of the recipes also increased except carbohydrates. Therefore, products prepared by substituting main ingredient with amaranth flour at different proportions were found to be more nutritious than the prevailing food products.

One serving of amaranth supplemented recipes if incorporated in our diet will meet 3.04 to 20.1 per cent protein, 28 to 53.3 per cent fat, 0.20 to 5.93 per cent fibre, 4.46 to 13.5 per cent carbohydrates, 1.55 to 22 per cent calcium and 1.72 to 23.1 per cent iron requirement.

The study highlighted the significance of value added products from underutilised grain amaranth as a solution to the problems related to malnutrition.

39. Development and Quality Evaluation of Weaning Foods Incorporating Grain Amaranth

Name of the Student: Kavitha Raj K.N. (2007-16-105)
Name of the Major Advisor: Dr. V. Indira

Weaning foods with grain amaranth flour in combination with ragi flour and skim milk powder were developed and the quality attributes with respect to chemical constituents, acceptability and shelf life were evaluated.

Black and white grain amaranth seeds collected from the Department of Olericulture, College of Horticulture, Vellanikkara was used for the study. Nine combinations of weaning foods were prepared using processed black, white as well as black and white coloured grain amaranth flour along with processed ragi flour in different proportions. Ten per cent skim milk powder was also added to each treatment so as to get minimum 14 per cent protein as specified for cereal based weaning foods. Weaning food prepared with processed ragi flour was taken as the control. Altogether, nine different combinations were tried using black, white and black and white coloured (1:1) grain amaranth flour at 50, 60 and 70 per cent level along with ragi flour.

The processed weaning foods were stored in aluminium laminated pouches for a period of three months at ambient storage conditions. Chemical constituents like moisture, protein, fat, carbohydrate, calcium, iron, phosphorus and total free amino acids as well as *in vitro* digestibility of protein and starch of the weaning foods were estimated initially and at the end of storage. Physical qualities, microbial enumeration and peroxide value of weaning foods were also evaluated. Organoleptic qualities of weaning foods and porridges prepared with the formulated weaning foods were assessed for appearance, taste, flavour, colour, texture and over all acceptability.

Weaning foods developed with grain amaranth flour were found to be rich in protein (16.66 to 19.16%), fat (6.20 to 7.06%) and carbohydrate (75 to 77%) and satisfied the composition specified for cereal based weaning foods by Indian Standards. During storage, a decrease in the protein, fat, carbohydrate, fibre, calcium, iron, phosphorus, total free amino acids and *in vitro* digestibility of protein and starch occured in all weaning foods. Peroxide value of all the weaning foods increased during storage.

The weaning foods and porridges prepared with grain amaranth flour were equally acceptable like the weaning foods and porridges prepared with ragi flour for all the quality attributes including over all acceptability.

A gradual increase in the microbial count and peroxide value was noticed during storage. The cost of developed weaning foods was found to be much cheaper than the commercially available weaning foods.

Among the different combinations of weaning foods prepared with grain amaranth flour, the weaning food prepared with 20 per cent ragi flour, 70 per cent white and black coloured grain amaranth flour (1:1) and 10 per cent skim milk powder was found to be the best combination on the basis of chemical constituents, acceptability and shelf life.

40. Quality Evaluation and Value Addition of Edible Bamboo Shoots

Name of the Student: Mittu Mathew (2007-16-107)
Name of the Major Advisor: Dr. K.T.Suman

Evaluation of chemical constituents of fresh and processed bamboo shoots from four species namely *Bambusa bambos, Bambusa tulda, Dendrocalamus hamiltonii* and *Dendrocalamus strictus* and their value addition was undertaken.

Among the four species evaluated, fresh shoots of *B. tulda* had the highest content of crude fibre (0.62%), soluble fibre (0.03%), reducing sugar (0.82%), iron (0.79mg/100g), sodium (37.67mg/100g) and total free amino acids (0.112%). Highest content of nitrates and oxalates were recorded in fresh shoots of *B. bambos*.

In processed shoots, the highest content of fibre, protein, calcium, potassium, sodium and nitrates were observed in *B. bambos*. Processed shoots of *D. strictus* had the highest oxalate content. In fresh shoots, significant variation among the four species was observed in reducing sugar, potassium, sodium and oxalate content, where as in processed shoots significant variation among species was noted only in total carbohydrates, reducing sugar and oxalate contents. Fresh and processed shoots from four species were found to be a poor source of vitamin C.

A significant decrease in biochemical constituents was observed in the four species of bamboo shoots after processing except for moisture and total carbohydrates, which increased significantly on processing. The anti nutritional factor viz., nitrates and oxalates were also reduced significantly in the four species of bamboo shoots on processing.

Based on the nutritional qualities and availability of bamboo shoots, *B. Bambos* was selected as the ideal species for product development. Two products namely pickle and vattal were prepared from processed shoots of *B. Bambos* and the pickle was stored in glass bottles and vattals in polythene bags and the quality attributes were studied for a period of three months.

Pickle made from bamboo shoot of *B. bamoos* had the highest mean score for taste, flavour, texture, colour and overall acceptability at the end of second month of storage. Although, there was fluctuation in mean score for different quality attributes during storage, mean score above 7.5/10 was recorded for different attributes initially and throughout the storage period. The pickle was found to be highly acceptable at the end of second month of storage. The vattals prepared by incorporating processed bamboo shoots were found to be highly acceptable initially and during storage. Initially, the vattals obtained a mean score of above 7 for different quality attributes with an overall acceptability score of 7.56. During storage, a gradual increase in the mean score for different quality attributes were observed with the highest score at the end of third month of storage. An increase in the peroxide value of pickle occurred during storage.

The bacterial population of the products increased significantly during storage. The fungal population was detected only at the end of third month of storage both in pickle and vattal. Growth of yeast was not detected in both products throughout the storage period.

Fresh bamboo shoots were found to be a good source of nutrients especially minerals. Primary processing considerably reduced the nutritional qualities of bamboo shoots. Processing of shoot is an inevitable step before consumption because it helps to reduce the anti nutrients in shoots. Bamboo shoots are gaining popularity in Indian cuisines as a delicacy mainly due to the acceptable taste and health benefits associated with its consumption. Being a lesser known food product, bamboo shoot processing has potential to be developed as an innovative and promising enterprise.

41. Evaluation of Cycas Seed Flour for Product Development

Name of the Student: Lijitha S. (2009-16-102)
Name of the Major Advisor: Dr. V. Indira

Processed cycas seed flour was evaluated for the chemical constituents and shelf life qualities. Different products were developed using cycas seed flour by supplementing with other

cereal flours and nutritional and organoleptic qualities of the developed products were also evaluated.

Cycas seeds procured from the market were processed by soaking in cold water for six hours and draining the soaked water repeatedly for seven times prior to the preparation of the flour. The cycas flour thus prepared was dried in a cabinet drier at 60 ± 5°C to a moisture content of 10-12 per cent and stored in glass bottles for a period of three months under ambient conditions. The constituents like moisture, protein, starch, total carbohydrates, crude fibre, fat, calcium, phosphorous, sodium, potassium and iron were estimated initially and after three months of storage. The antinutritional and/ toxic factors in the flour such as crude alkaloids, and hydrocyanic acid were also analysed. Shelf life of cycas seed flour was also evaluated. The processed cycas seed flour was found to be rich in carbohydrate and macro and micro minerals with ideal sodium - potassium ratio. The alkaloid content in processed cycas flour was found to be low. Significant decrease in the constituents like starch, total carbohydrate, crude fibre, fat and crude alkaloids were noticed during storage. A gradual increase in the microbial count was observed during storage. Insect infestation was not detected in cycas seed flour throughout the period under study.

Five products namely puttu, ada, pathiri, biscuit and chapathi were prepared by incorporating cycas seed flour in different proportions along with the main ingredient for respective products. The products were evaluated organoleptically for different quality attributes like appearance, colour, texture, flavour, taste and overall acceptability using score card. Rice was used as the main ingredient for the preparation of puttu, ada and pathiri. For chapathi and biscuit, wheat flour and maida were used respectively as the main ingredients. The product prepared with 100 per cent main ingredient was taken as the control. The cycas flour was incorporated into the basic ingredient at 30 to 70 per cent for the preparation of the products. All products were prepared exclusively with cycas seed flour also.

Among the different products prepared by supplementing cycas seed flour, except chapathi, all products were found to be acceptable to the judges. The nutritive value of the products prepared by supplementing cycas seed flour was computed per serving. In puttu, ada and pathiri, the nutrients like protein, crude fibre, fat and calcium content increased with increase in the quantity of cycas seed flour. In the case of biscuit and chapathi, increased supplementation of cycas seed flour improved the crude fibre and fat content. Incorporation of cycas flour at the rate of 30 to 50 per cent with rice flour and maida was found to be ideal for the preparation of acceptable products.

42. Nutritional Evaluation of Cycas Seed Flour (*Cycas circinalis* L.)

Name of the Student: Anitha S. (2009-16-107)
Name of the Major Advisor: Dr. V. Indira

Nutritional and antinutritional constituents of cycas seed flour prepared from seeds collected from forest and non forest areas and the effect of processing on the chemical constituents of the cycas flour was carried out.

The cycas seeds collected were sun dried for 8 to 10 days and pooled separately as forest and non forest samples. The samples were processed by six different methods. The processing methods selected were soaking the seeds in cold water for 12 (T_1) and 24 (T_2) hours, soaking in boiling water for 2 hours after cold water treatment for 12 (T_3) and 24 (T_4) hours and washing of powdered flour of T_1 and T_2 for three times in water (T_5 & T_6). The flour prepared from unprocessed seed was taken as the control (T_0). The processed seeds and the control were powdered and dried in a cabinet drier at 60 ± 5° C to a moisture level of 10 to 12 per cent. The prepared flour was analysed for different constituents like moisture, protein, starch, total carbohydrate, crude fibre, fat, calcium, phosphorous, sodium, potassium, iron, zinc, crude alkaloid, and hydrocyanic acid.

The flour of cycas seeds collected from forest area was found to be relatively high in starch, total carbohydrate, crude fibre and minerals when compared to the flour prepared from seeds collected from non forest area. The crude alkaloid content was found to be relatively low in forest samples. During processing, the rates of nutrient loss from cycas seed flour increased gradually with advancement in the duration of soaking and increase in the temperature of soaked water. Among the different processing methods, maximum retention of nutrients was noticed in cycas flour prepared from seeds soaked in cold water for 12 hours. The percentage loss of protein, starch, total carbohydrate, crude fibre and fat varied from 2 to 48 per cent. Among minerals, the leaching of potassium was found to be very high. Maximum loss of nutrients was observed in the flour prepared by soaking the seeds in cold water for 24 hours and washing thrice in water. The mean crude alkaloid content in unprocessed cycas flour was 1.58 mg $100g^{-1}$ and it reduced to 0.60 mg $100g^{-1}$ during processing. Hydrocyanic acid was not present in the unprocessed as well as processed cycas flour prepared from seeds collected from forest and non forest areas.

The cycas flour prepared from the seeds collected from forest area was found to be more nutritious. The processing of cycas seed could reduce the antinutritional constituents with considerable loss in nutrients.

II. COMMUNITY NUTRITION

ASSESSMENT OF NUTRITIONAL STATUS OF DIFFERENT GROUPS

A. Preschool Children

43. Nutritional Profile and Mental Functions of Preschool Children Belonging to Agricultural Labourer Families in Thrissur District

Name of the Student: Shyna P.K. (1993-16-06)
Name of the Major Advisor: Dr. V. Usha

The nutritional profile and mental functions of preschool children in the age group of 4-6 years belonging to agricultural labourer families of Thrissur district was undertaken. The association between the nutritional profile and mental functions of preschool children was also ascertained. The study was conducted by selecting 120 agricultural labourer families having at least one child in the age group of 4 to 6 years from the three agricultural sub divisions of Thrissur district namely Irinjalakuda, Thrissur and Wadakanchery. A baseline survey to elicit information on the socio economic and cultural background and a dietary survey to assess the food consumption pattern of the selected families were carried out using pretested questionnaires. The nutritional status of the preschool children was assessed by measuring various anthropometric indices and determining the actual food and nutrient intake by conducting one day food weighment survey. Mental functions of selected children were measured by determining their IQ using Mathew's Test of Mental Abilities.

The socio economic details indicated predominance of nuclear family system among the selected households with better housing and living facilities. Immunization and other health care facilities were better utilised by the families. Dietary pattern mainly comprised of the staple rice, coconut, coconut oil, vegetables and pulses. The inclusion of green leafy vegetables and fruits was found to be negligible. Food and nutrient intake among the selected preschool children were found to be lower than the suggested requirements. The nutritional profile of preschool children on the basis of height for age indicated normal nutritional status among half of the children. On the basis of weight for age, 43 per cent boys and 19 per cent girls had normal nutritional status. Grade I and II malnutrition were noticed among 40 percent and 17 percent boys respectively, and among girls these were found to be 72 per cent and 9 per cent. On the basis of head and chest circumference ratio and mid upper arm circumference 73 to 87 per cent of children were graded as having normal nutritional status. Thus, severe grades of malnutrition were not observed among children.

Mental functions of children ascertained on the basis of IQ indicated that 56.7 per cent had an average IQ in between 90 to 109 while 28.3 per cent were in the border line. Significant correlation was not seen between the individual nutrient intake and IQ of children. However, 53 per cent of the variation in IQ could be attributed to the overall nutrient intake of children especially the intake of energy, protein and iron. The rest of the variation could be due to other non nutritional factors.

44. Nutritional Status and Intelligence of Pre School Beneficiaries of ICDS and Non- Beneficiaries of Thrissur District

Name of the Student: Merly Mariam Mathen (1994-16-05)
Name of the Major Advisor: Smt. Norma Xavier

The nutritional status and intelligence of the preschool ICDS beneficiaries and non beneficiaries of Thrissur district was assessed. The ICDS beneficiaries (Experimental group) were selected from 16 anganwadi centers of eight ICDS blocks and non- beneficiaries (Control group) were selected from 14 balwadi centers of seven non ICDS blocks of Thrissur district. The study comprised of collecting data on socio economic back ground, food consumption and dietary pattern of the families, details of index child, nutritional status of the children through anthropometric measurements, actual food and nutrient intake, clinical examination and biochemical estimation of blood and intelligence. The association between intelligence and nutritional status was also ascertained.

Most (56%) of the families in experimental group were of joint type while in control group 57 per cent were of nuclear type with an average family size in the range of three to eight members in majority of the families. The parents of experimental group were found to be better educated compared to non ICDS group. Housing and living facilities of both groups were satisfactory. Most of the families included cereals, pulses, other vegetables, milk and milk products, nuts and oil seeds and fats and oils in their daily diet. However, the inclusion of green leafy vegetables was found to be substantially low.

Details regarding the index child revealed that 50 per cent of the children were in the first birth order. Most of them had birth weight above 2.5 kg with the experimental group children performing better than the control group. The appraisal of the ICDS programme implemented in the study area revealed that supplementary nutrition, non formal preschool education and nutrition and health education for mothers were the major persuading factors for participation among the ICDS group. Behavioural problems were found to be less among the ICDS beneficiaries. The intake of all food groups except other vegetables, roots and tubers, flesh foods and milk and milk products was found to be far below the recommended allowances in both groups. The nutrient intake of the ICDS beneficiaries was found to be on par with RDA, except for energy. In the non ICDS group, only the protein intake was found to be satisfactory. Thus, the nutrient intake of the ICDS group was found to be significantly better than the non ICDS group.

Though, severe grades of malnutrition was not noticed among the children of the ICDS and non ICDS groups, as per the weight/height^2 ratio, majority of the children (80 to 83%) in both groups belonged to the moderately malnourished category. The blood haemoglobin level of the ICDS beneficiaries was found to be significantly better than the non ICDS

group. Seventy five per cent of children in experimental group had acceptable haemoglobin level while in control group 86 per cent had deficient haemoglobin level. Clinical symptoms of anaemia were also noticed among non beneficiaries.

Intelligent quotient of ICDS beneficiaries was significantly better than the non ICDS group with 85 per cent children in the ICDS group belonging to average and above average IQ levels. It was also seen that 62 per cent variation in IQ could be explained by the intake of nutrients and 18.4 per cent of variation in IQ could be explained by the anthropometric measurements. Thus, it was seen that nutritional status had a strong influence on the IQ of children.

45. Maternal Employment and Nutritional Status of Preschool children

Name of the Student: Mini P. Jose (1996-16-11)
Name of the Major Advisor: Dr. V. Indira

The study was undertaken with the objective of assessing the impact of maternal employment on the nutritional status of preschool children. A total of 120 preschool children in the age group of four to five years were selected on the basis of maternal employment, namely casual labourers (CL), employed (EM) and housewives (HW) equally and randomly from Ollukkara block of Thrissur district. Socio economic, cultural background and food consumption pattern of the families were collected using pretested questionnaires. Nutritional status of the children was assessed using anthropometric methods, food weighment survey and clinical examination. Knowledge, Attitude and Practice (KAP) of mothers with respect to health and nutrition were also assessed using pretested questionnaire.

The socio economic details of the families indicated that most of the families of EM (62.5%) and HW (55%) followed joint family system having up to eight members while 58 per cent of the CL families followed nuclear system with up to four members. Though, most of the parents in the three groups were educated, majority (77%) of the male members in the CL group worked in the unorganized sector and those in the EM (82%) and HW (63%) groups worked in organized sector. Majority in CL and HW groups had their own houses while most of the EM families lived in rented houses. Advance meal planning was highest in EM families and cereals, pulses, other vegetables, milk and milk products, fats and oils and sugar were included in the diet frequently by all the three groups.

Majority (70 to 80%) of children in the three groups had a normal birth weight of 2.5 kg. On the basis of weight, height and weight/height^2, majority of children in all the three groups

were malnourished. On the basis of weight for age only 35 per cent of children in HW category had normal nutritional status compared to 30 per cent in the EM and 25 per cent in the CL group. On the basis of height for age 40 to 47.5 per cent children in the three categories had normal nutritional status. Weight / height^2 data indicated that 60 percent (CL) and 82.5 percent (EM& HW) children in the three categories had different grades of malnutrition. However, on the basis of mid upper arm circumference more than 95 per cent children in all categories had normal nutritional status. Based on head and chest circumference ratio also 68 to 88 per cent had normal nutritional status.

Dietary profile of preschool children revealed inadequate intake of all food groups except flesh foods. Among nutrients also, the intake of all nutrients except protein was found to be lower than the suggested RDA. The clinical manifestations like phrynoderma, xerosis of the eyes and dental caries were present in all the three groups of children. The KAP of mothers indicated that the mothers of EM group had better knowledge, attitude and practice on health and nutrition. The results also indicated that maternal employment had no significant positive or negative impact on the nutritional status of preschool children.

46. Nutritional profile of preschool children of fishermen

Name of the Student: Aneena E.R. (2001-16-03)
Name of the Major Advisor: Dr. V. Usha

Nutritional profile of preschool children of fishermen community was conducted among 100 children in the age group of 4-5 years residing in the coastal areas of Thrissur district. Socio economic conditions, food consumption pattern of the families and nutritional status of the selected children were ascertained.

Information regarding socio economic conditions of the families indicated that majority of the families were Hindus and belonged to Dheevara community. Joint family system was found in most of the families. Housing conditions of most of the families were found to be poor. Environmental hygiene was found to be poor with no proper drainage system around their houses. Most of the head of the families were engaged in fishing and other related activities and earned Rs.1500 to Rs. 3000 per month. Greater part of their income was spent on food by most of the families.

Dietary habits of the families revealed that all the families were habitual non vegetarians and their daily diet comprised of staple rice, fish, roots and tubers, and fats and oils. Consumption of green leafy vegetables, other vegetables, meat and eggs were found to be negligible.

Among the selected preschool children, majority belonged to first and second birth order. Most of them had birth weight between 2 kg and 3 kg. Majority were completely immunized. The birth spacing of the index child with their siblings was found to be 1-2 years. Morbidity pattern revealed low incidence of infectious diseases among these children for the past one year. Health care facilities through primary health centers were better utilised by majority of families.

Dietary profile of preschool children indicated that the intake of all food groups except pulse and fish were far below the suggested recommendations. The nutrient intake of the preschool children showed that the intake of protein, thiamine and riboflavin, was satisfactory among boys and girls. Energy intake was below 70 percent of RDA among both groups. The intake of iron and niacin was significantly low among girls. Other nutrients like calcium, vitamin A and vitamin C were also found to be significantly low. Clinical examination of the preschool children revealed that about 14 per cent had mild Vitamin A deficiency as indicated by pigmentation of the eyes. Dental caries was also prevalent in almost all children.

The anthropometric profile of preschool children was interpreted by comparing with the Indian as well as NFI standards. When compared with Indian standards, all measurements viz. height, weight, head, arm and chest circumferences were significantly low. More than 40 percent of both boys and girls were having severe height deficit for their age. But, when children were distributed based on different anthropometric indices such as weight for age, wt/ht^2 ratio, head/chest circumference ratio etc to find out the degree of malnutrition prevalent, most of the children were found to be having moderate malnutrition.

I. School Children

47. Nutritional and Health Impact of Substituting Green Gram by Soya Products in School Lunch Programme in Thrissur District

Name of the Student: Latha Devi (1996-16-12)
Name of the Major Advisor: Dr. V. Usha

The study was undertaken to assess the acceptability, feasibility, nutritional and health impact of substituting soya grits/chunks for green gram in school lunch programme in selected schools of Thrissur educational district. Children in the age group of 7 to 9 years from the three schools of Ollukkara block were selected and categorized as Group 1- usual school lunch (ESL), Group II- school lunch with soya (SSL) and Group III- no school lunch (NSL). Fifty children from each category were selected for the study constituting a total sample size of 150 children. Socio economic and food consumption pattern of the families, details of

school lunch programme, acceptability of soya grits/chunks and impact of supplementing soya by assessing the nutritional status of the children were carried out.

Nuclear family system with up to four members was found in most of the families. Majority of the parents were educated and their housing and living facilities were found to be satisfactory. Dietary profile of the children revealed that the intake of all food items except green leafy vegetables met the daily requirement. The intake of all nutrients except thiamine and riboflavin was above the recommended level.

Majority of the mothers expressed a positive opinion about the school lunch programme. Acceptability studies conducted at the laboratory level by substituting soya grits/chunks for green gram at 10 to 100 per cent level indicated that soya grits at 20 per cent replacement level was the most acceptable combination and thus selected for supplementation in the school lunch programme. This was given to children in SSL group (Group II) for a period of four months and the other two groups served as the control. The impact of soya was studied by assessing the nutritional status of children before and after supplementation.

The nutritional status of children assessed through anthropometry revealed an increase of 0.55kg in mean body weight of SSL group, while in ESL and NSL categories the body weight decreased by 0.8 kg and 4.5 kg respectively during the supplementation period. Positive increment in height and MUAC of children in all the three groups was observed. On the basis of weight for age, an improvement in the body weight of children in the SSL group was noticed after supplementation. On the basis of height for age, 30 per cent increase was noticed among children with normal nutritional status in the SSL group when compared to 20 per cent in ESL and six per cent in NSL groups. On the basis of weight /height^2 ratio, children with normal nutritional status increased in the SSL and ESL groups with SSL showing a greater degree of increase. The most common nutritional deficiency disease observed among children was anaemia which got reduced from 10 to six per cent in SSL group and from 12 to 10 per cent in ESL group during the supplementation period.

Thus, the study indicated that incorporation of soya grits at 20 per cent level in the noon meal programme is beneficial for the growth of children. There was better weight gain and height increment when 20 per cent soya grits was substituted in the noon meal instead of green gram. The high protein content and the ease with which soya grits blend in the noon meal as well as its acceptability by the children makes the soya grits an easy vehicle to enhance the dietary protein intake and to bring better growth and development among school children.

48. Influence of Amla (*Emblica officinalis* Gaertn.) Products on the Nutritional and Health Status of SOS Children in Thrissur District

Name of the Student: Jissy George (1996-16-13)
Name of the Major Advisor: Dr. V. Indira

The impact of amla products on the health and nutritional status of children in the age group of 4 to 6 years and 7 to 9 years were conducted among SOS children. A total of 50 children in each age group was selected and were categorized into control and experimental group comprising 25 children in each age category. The functioning pattern of SOS, dietary habits and food consumption pattern of children were assessed. Seven amla products namely preserve, candy, jam, squash, shred and soft drink were prepared using the Chambakad local variety of amla of 7-8 month maturity. Acceptability of the prepared products and chemical constituents of fresh amla, amla products and stored amla products were estimated and the most acceptable product was selected. The impact of amla product on the health and nutritional status of children was conducted by supplementing their diet with the most acceptable product among the experimental group children so as to meet one third of the requirement of vitamin C per day. The feeding trial was conducted for a period of six months and the health and nutritional status of children in the experimental group and control group were assessed before and after feeding. The behavioural pattern of children before and after the feeding trial was also determined.

The functioning pattern of SOS village indicated that the activities were carried out by an efficient panel of personnel. 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. All the families in the SOS village were found to be non vegetarians and maintained specific time schedule for taking meal. Among the seven amla products prepared, amla preserve was found to be the most acceptable. Most of the chemical constituents in the products were retained up to 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. Though, anaemia, anorexia and dental carries were present among children none of the child in the experimental group (amla fed group) showed symptoms of anaemia after the feeding trial. The behavioural trait with particular reference to inertia, activity and stability conducted using Mathews IAS rating scale did not show any significant variation between the control and experimental groups. Association between nutritional status and behaviour also did not reveal any significant relationship both in control and experimental groups.

49. Dietary Habits and Nutritional Profile of School Children Participating in the School Lunch Programme

Name of the Student: Mini P. Padikkal (1997-16-02)
Name of the Major Advisor: Dr. V. Usha

Food consumption pattern and nutritional status of children in the age group of 7 to 9 years who are the beneficiaries of school lunch programme was ascertained. A total of 80 beneficiary children (Experimental group) and 80 children who are not participating in the school lunch programme (Control group) from the Ollukkara block of Thrissur district were selected for the study. Socio economic details and food consumption pattern of the families were collected using two separate questionnaires. Nutritional status of the selected children was assessed through anthropometry, clinical examination and food weighment method of dietary survey.

Socio economic details of the families indicated that majority of the families (86 to 95%) were nuclear type with satisfactory living and housing conditions. Most of the parents in both groups were literate with permanent employment.

The nutritional status of children assessed through anthropometry revealed that the height and weight of children in both groups were lower when compared to Indian standards. Height for age distribution of children revealed more prevalence of malnutrition among children in the control group when compared to experimental group. On the basis of this criterion 36 per cent of children in control group and 40 per cent in experimental group had normal nutritional status. On the basis of weight for age and weight/height^2 also, children in the experimental group had better nutritional status. Based on weight for age, only 12.5 percent children in control group had normal nutritional status against 26.25 per cent in experimental group. On the basis of weight/height^2, 65 per cent children in control group had moderate malnutrition while in experimental group this was noticed among 56.25 per cent children. Severe malnutrition was not observed in both groups.

Actual food and nutrient intake of children assessed through weighment survey revealed deficit in the intake of most of the food groups and nutrients in both categories of children. The intake of all food groups except flesh foods was lower than the suggested requirement. However, when compared to control group, the intake of cereals, pulses, other vegetables, roots and tubers, flesh foods and sugar and jaggery was found to be significantly high in experimental group children. The intake of almost all nutrients except vitamin A and riboflavin was also found to be lower than the recommendations in both groups. Here also, the intake of energy, calcium, iron, protein, vitamin C and thiamine was higher in the experimental group.

C. Adolescents

50. Effect of Amaranth on the Health and Nutritional Profile of Adolescents

Name of the Student: Suman K.T.(1997-16-06)
Name of the Major Adviser: Smt. Omana Pavunny

Effect of amaranth on the health and nutritional profile of adolescents was conducted among 120 adolescents in the age group of 13 to 15 years. The samples were selected from juvenile home and orphanage in Trichur district on the basis of occurrence of anaemia and divided into three groups (40 in each group) namely control and two experimental groups.

Food consumption pattern of the samples were collected using a pretested interview schedule. From the 20 amaranth recipes, ten highly acceptable recipes were selcetd for feeding trial. The nutrient composition of fresh amaranth and amaranth recipes was estimated. The control group was served the basal diet and the experimental groups I and II were given the amaranth recipes for a period of six months so as to meet two third and full RDA of leafy vegetables. Nutritional status of the subjects was assessed through anthropometry, clinical examination, monitoring actual food intake and biochemical estimation of blood for haemoglobin, RBC count and packed cell volume before and after feeding trial. The functional performance of the subjects was also assessed by Harvard step test before and after the feeding trial.

Food consumption pattern of the subjects revealed that all were non vegetarians and the daily used food items included cereals, pulses, roots and tubers, other vegetables, milk, fats and oils and sugar. Among the amaranth recipes cheera minced meat thoran obtained the highest score in acceptability. The nutrient analysis of fresh amaranth and amaranth recipes indicated that the protein content of the recipes were higher than the fresh amaranth. All the recipes had higher starch and soluble carbohydrate content than fresh amaranth. The fibre content of cheera thoran, cheera vada, cheera curry and cheera green gram thoran were higher than the fresh amaranth. Cheera green gram thoran and cheera curry had higher iron content also. All the recipes showed lower calcium, beta carotene and vitamin C compared to amaranth.

After supplementation, significant increase in the anthropometric measurements was noticed in all the three groups with greater increase in experimental groups compared to control group. Similar trend was also observed in haematological indices and functional performance. The number of anaemic adolescents decreased in all the three groups after the supplementation.

The nutritional status of adolescents showed improvement after the six months supplementation study. Although, none of the adolescents could achieve normal nutritional

status, they showed improvement in nutritional status after the study with greater improvement in full RDA and two third RDA groups compared to control group. Thus, it was seen that amaranth supplementation has got a positive effect on the nutritional status of adolescents.

51. Food Habits and Nutritional Profile of Adolescents

Name of the Student: Shiji Paul (1998-16-03)
Name of the Major Advisor: Dr. V. Usha

The food consumption pattern, nutritional status and the attitude of adolescents and their parents towards eating habits were undertaken among 100 boys and 100 girls in the age group of 16-18 years. Socio economic details and food consumption pattern of the families were collected using pretested questionnaires. The attitude towards the eating habits of adolescents and their parents were assessed using Likert's scale. Nutritional status of adolescents was assessed through anthropometry, clinical examination, food weighment survey and biochemical estimation of blood for haemoglobin.

The socio economic details of the families indicated nuclear family system among 80.5 per cent and they had good housing and living facilities. The educational status of parents was high. Majority (82%) of the families were non vegetarians and followed three major meal pattern.

All adolescents preferred non vegetarian items. Cereals, milk and milk products, fats and oils and sugar and jaggery were used daily and processed foods were used to a lesser extent. Most of the families preferred rice and rice based preparations for breakfast, lunch and dinner and fried foods were preferred for evening tea. Boys preferred branded soft drinks and girls preferred chocolates. Majority of the adolescents took their breakfast regularly and took packed lunch. Consumption of foods like green leafy vegetables, milk and milk products and roots and tubers and nutrients like iron, retinol and riboflavin were found to be low among both adolescent boys and girls.

Boys were found to be more conscious about their body weight than girls and had more favourable attitude than girls towards their own eating habits. Boys preferred exercise where as girls preferred walking to maintain their body weight. However, parents of adolescent girls had more favourable attitude towards the eating habits of their daughters.

Mean body weight of adolescent boys and girls was below the Indian standards but mean height of girls was found to be above the standard height. On the basis of weight for age, 60 per cent girls and 40 per cent boys had normal nutritional status. Prevalence of grade I and grade II malnutrition was noticed more among boys when compared to girls. Chronic Energy

Deficiency was observed among 60 per cent girls and 60 per cent boys. Only 16 per cent boys and 18 per cent girls had normal Body Mass Index. Anaemia was noticed among 80 per cent boys and 100 per cent girls on the basis of haemoglobin level of blood.

52. Nutritional Profile and Endurance Capacity of Adolescent Girls

Name of the Student: Seeja Thomachan Panchikkaran (1999-16-01)
Name of the Major Advisor: Dr. V. Usha

A study was conducted among 150 adolescent girls in the age group of 13 to 15 years to ascertain their nutritional profile and endurance capacity. Information regarding socio economic conditions and food consumption pattern of the families were collected using pretested questionnaires. The nutritional status of the adolescent girls was assessed by anthropometry, clinical examination, biochemical estimation of blood for haemoglobin and food weighment survey. Endurance capacity was assessed by Harvard step test.

Socio economic details indicated that 67 per cent of the families were nuclear type with satisfactory housing conditions and living facilities. Food consumption survey revealed that rice was the staple food and all of them were habitual non vegetarians.

The prevalence of malnutrition of various grades on the basis of weight for age was found among 62 per cent of adolescent girls. On the basis of height for age, only 18.67 per cent were malnourished. Only 10 per cent had normal Body Mass Index and Chronic Energy Deficiency was noticed among 80 per cent of girls. The most common nutritional deficiency disease observed among adolescent girls was anaemia. Only 46 per cent had acceptable haemoglobin levels.

Consumption of cereals, green leafy vegetables, other vegetables, roots and tubers, fruits, milk and milk products, fats and oils, meat, fish and egg and sugar and jaggery were lower than the RDA. In case of nutrient intake, only energy intake was found to be adequate.

Endurance capacity measured using Harvard step test indicated that none of the adolescent girls had good or excellent physical condition. Low average endurance capacity was found to be more among girls who had grade I and grade II malnutrition. Consistent increase in the endurance capacity of the girls was noticed with an improvement of nutritional status. A linear relationship between haemoglobin level and endurance capacity was also observed. Girls with acceptable haemoglobin levels had high average endurance capacity. More girls with high average endurance capacity showed adequate energy intake. Habitual physical activities like walking and participation in sports and games also influenced the endurance capacity.

D. Women

53. Food Consumption Pattern and Nutritional Status of Farm Women in Thrissur District

Name of the Student: Udaya P.K. (1993-16-05)
Name of the Major Advisor: Dr. V. Indira

A study was conducted to assess the food consumption pattern of farm families and nutritional status of farm women. For the study, 120 farm families were selected from the three sub divisions of Thrissur district namely Trichur, Wadakancherry and Irinjalakuda. A baseline survey to monitor the socio economic conditions and a dietary survey to assess the food consumption pattern of the families were conducted. The nutritional status of farm women in the age group of 18 to 45 years was assessed through anthropometry, food weighment survey, clinical examination and biochemical estimation of blood for haemoglobin.

The results of the study indicated that 63 per cent of the families were of nuclear type with an average family size of 5.37 and sex ratio in favour of female members. Majority (92%) of the adult members were literate and agriculture was found to be their main occupation with a monthly income in the range of Rs. 1000 to 4000/-.

Most frequently used food items included cereals, milk and milk products, nuts and oil seeds. The intake of cereals, pulses, green leafy vegetables and flesh foods was found to be significantly lower than the suggested ICMR requirements. However, the farm women included vegetables, fruits, milk and milk products, fats and oils and sugar and jaggery to higher extent.

Nutritional status of farm women computed on the basis of Body Mass Index indicated that only 38.33 per cent had normal nutritional status. Chronic Energy Deficiency with a BMI less than 18.5 kg/m^2 was noticed among 19 per cent women.

The nutritional quality of the diet on the basis of the nutrient intake indicated that their diet was deficient in almost all nutrients except calcium, niacin and vitamin C. On the basis of haemoglobin level of blood 66.67 per cent of women were anaemic. However, clinical manifestations of nutritional deficiencies like xerosis of the conjunctiva, mild angular stomatitis, pale tongue and dental caries were noticed only among 8.33 per cent women.

54. Food Consumption Pattern and Nutritional Status of Women Agricultural Labourers of Ollukkara Block, Thrissur District

Name of the Student: Smitha K.E. (1996-16-14)
Name of the Major Advisor: Smt. Omana Pavunny

The socio economic status and food consumption pattern of the families of agricultural labourers and nutritional status of women agricultural labourers within the age group of 18 to 45 years was conducted by selecting one hundred and fifty families from the three panchayats of Ollukkara block of Thrissur District. Socio economic details and food consumption pattern of the families were collected using pretested questionnaires. Nutritional status of the women was assessed through anthropometry, weighment method of diet survey, clinical examination and biochemical estimation of blood for haemoglobin. Knowledge, Attitude and Practice of the women towards health and nutrition was also assessed using pretested schedules.

The socio economic details of the families indicated that majority were of nuclear type with patriarchal family system and a family size in between 4 to 6 members. All the families owned a house with satisfactory drinking water, lavatory and electricity facilities. Though, all families were non vegetarians, most frequently used food items were cereals, other vegetables, fats and oils and sugar. Pulses, roots and tubers and fish were included to a moderate extent and green leafy vegetables, milk and milk products, egg, meat and fruits were included to a lesser extent in the diet.

The body weight of the respondents was found to be lower than the standard body weight suggested for women. Grade I and II Chronic Energy Deficiencies were found among 21.33 per cent women. Normal nutritional status on the basis of Body Mass Index was noticed among 51 per cent women. Mild and severe dental caries were also noticed. On the basis of haemoglobin level, 60 per cent of women had anaemia.

The intake of all food groups except cereals and other vegetables were found to be lower than the suggested requirements. The intake of all nutrients except niacin and thiamine were lower than the suggested recommendations. When the energy intake was compared with the energy expenditure, all women had negative energy balance. The scores obtained for knowledge and attitude with respect to health and nutrition among women was found to be satisfactory. However, nutrition and health related practices existed among women were found to be unsatisfactory.

55. Nutritional Profile of Women Labour in Rice Cultivation

Name of the Student: Jyothi R. (2000-16-03)
Name of the Major Advisor: Dr. V. Indira

Food consumption pattern and nutritional status of women labourers engaged in rice cultivation was conducted in Palakkad district. Details on socio economic conditions of the families, working and energy expenditure pattern of women labourers were also collected. Majority (80%) of the families were of nuclear type with four to six members. Most of the male (60%) and female (78%) members were literate. Maximum portion of the income was spent to purchase food items. All families owned a house with satisfactory drinking water, electricity and recreational facilities. However, drainage and lavatory facilities were unsatisfactory.

All the respondents worked in agricultural operations for 7½ hours in a day. Most of them used to get 20 to 25 days of work during summer season and up to 10 days during rainy season with a daily wage in the range of Rs. 40 to 50/-. Transplanting and weeding were the main tasks performed by women, while men and women performed harvesting, threshing and winnowing.

All families were non vegetarians with rice as their staple food. Most frequently used food items were cereals, fats and oils, and sugar and jaggery. Nutritional status of women agricultural labourers indicated that 87 per cent had a lower body weight than the suggested reference body weight. Chronic Energy Deficiency on the basis of Body Mass Index was noticed among 43 per cent women. Actual food and nutrient intake of women revealed deficient intake of all food groups except other vegetables. The intake of all nutrients was also found to be lower than the RDA. Negative energy balance was noticed among all women due to heavy manual work. Clinical examination indicated symptoms of nutritional deficiencies like diffuse pigmentation in face, angular stomatitis, skeletal deformities, goiter, xerosis in skin, pale conjunctiva, koilonychia and dental caries among most of the women. The blood haemoglobin level was found to be lower than the normal level of 12g/dl indicating anaemia among 100 per cent of women.

56. Nutritional Profile of Fisher Women

Name of the Student: Saleena K. (2002-16-05)
Name of the Major Advisor: Smt. Omana Pavunny

Nutritional profile of fisher women was conducted by selecting 100 families from the coastal areas of Thrissur district. Socio economic details and food consumption pattern of the families were collected using pre tested questionnaires. Nutritional status of women was assessed through anthropometry, clinical examination, food weighment survey and biochemical estimation of blood for haemoglobin.

Majority of the families belonged to Araya (47%) and Mukkuva (43%) communities and followed nuclear family system (96%) with a family size in between three and five among 69 per cent of families. Most of the male (92%) and female (86%) members were literate and engaged in fish related work. Maximum portion of the income was spent on food items. Majority of the families had own houses (97%) with satisfactory drinking water, electricity and lavatory facilities. However, drainage facilities were unsatisfactory. All families were non vegetarians and most frequently used food items were cereals, fish, fats and oils and sugar. The intake of all food groups except fish was found to be far below the suggested allowances. Except protein, the intake of all nutrients was also far below the recommendations. The nutritional profile of women indicated that the body weight of 33 per cent and height of 24 per cent were lower than the reference body weight and height suggested for Indian reference women. Chronic Energy Deficiency was noticed among 13 per cent women. On the basis of waist hip ratio, ninety seven per cent of women had femoral gluteal obesity and three per cent had abdominal obesity. None of the respondents showed normal waist hip ratio. Clinical symptoms related to nutritional deficiencies like lack of luster of hair (14%), thin sparse hair (10%), pale conjunctiva (56%), angular stomatitis (24%), dental caries (30%), spongy bleeding gums (28%) and xerosis in skin (12%) were noticed among 10 to 56 per cent women. On the basis of haemoglobin level of blood 35 per cent women were anaemic.

57. Nutritional Profile and Physical Fitness of Sports Women

Name of the Student: Reena C. (2003-16-01)
Name of the Major Advisor: Dr. V. Indira

Nutritional profile and physical fitness of sports women in the age group of 18 to 25 years who were engaged in various sports activities were assessed. The respondents for the study were selected from the two colleges with hostel facilities of Sports Council of India and also from one institution of Sports Authority of India.

Details pertaining to the socio economic variables, dietary habits and food consumption pattern of the families of selected respondents and nutritional status, energy balance and physical fitness of the respondents were collected.

Nuclear family system with a family size of four to six members was found in 89 per cent of the families. Monthly income of 56 per cent of the families varied from Rs. 1000 to Rs. 5000 and per capita income of 81 per cent were below Rs. 500/-.

About 35 per cent of the respondents belonged to first birth order and birth interval was found to be two years among 28 per cent of the respondents. About 28 per cent of the respondents were athletes and rest participated in various sports activities like basket ball, swimming, kabadi, judo, weight and power lifting, hand ball, cricket and hockey. All the respondents participated in district and state level competitions and 71 per cent participated in national level competitions also.

All the respondents practiced regular physical exercise and the duration was found to be four to five hours per day. Seventeen per cent of the respondents practiced yoga also. Majority of the respondents participated in coaching camps conducted at state level. The duration of coaching camps varied from less than 10 days to more than 25 days. Daily activity pattern of the respondents indicated strict time schedule in all the three institutions with five hours of practice in sports. About 41 per cent of the respondents used to undergo periodic medical checkup.

Food consumption pattern of the respondents indicated that all the respondents surveyed were non vegetarians with rice as their staple food. All of them preferred both vegetarian and non vegetarian foods. Cereals, other vegetables, fruits, nuts and oil seeds and sugar were the most frequently used food items. All the respondents had three major meals daily and all of them included raw foods in their diet. About 30 per cent of the respondents consumed food and nutrient supplements daily. Pre game meal was consumed by 73 per cent of the

respondents. Diet modification during competition was observed among 93 per cent. Details of post game meal revealed that 58 per cent of the respondents consumed post game meals/ foods.

The comparison of mean nutrient intake with RDA indicated that the intake of energy, fat, thiamine, calcium and beta-carotene was lower than the RDA suggested for sports persons. Contribution of energy from carbohydrate, protein and fat was found to be 73.50 per cent, 15.91 per cent and 10.59 per cent respectively.

The nutritional profile of the respondents indicated that the body weight varied from 42 kg to 94 kg with a mean weight of 52.24 kg and the height varied from 150 cm to 177 cm with an average height of 162.36 cm. Only 36 per cent of the respondents had a normal Body Mass Index (BMI). It was seen that basket ball, kabadi, weight/power lifting, swimming, cricket and hockey players had normal BMI while the respondents participated in athletics and judo had a lower BMI.

Triceps skin fold thickness of 54 per cent of respondents was found to be lower than the standard. Waist hip circumference ratio of 97 per cent of the respondents was found to be ideal and only three per cent had a ratio more than 0.85 indicating abdominal obesity. Most of the respondents (77%) had a body fat percentage below that of standard. Here also, it was seen that swimmers and weight and power lifters had a high body fat percentage and judo players and athletes had a low body fat percentage. Lower Lean Body Mass (LBM) was noticed among the respondents participated in cricket and hockey and highest LBM was observed among weight and power lifters.

Clinical examination showed symptoms related to nutritional deficiencies like pale conjuctiva, chelosis, thin and sparse hair, spongy bleeding gums, slight enlargement of thyroid gland and knock-knees among 3 to 13 per cent of respondents. On the basis of haemoglobin level of blood only 16.67 per cent had anaemia.

Endurance capacity of the respondents measured by Harward's step test revealed that 14 per cent had excellent physical capacity and the endurance capacity of 39 per cent was found to be poor.

Daily energy expenditure pattern of the respondents indicated a positive energy balance among athletes, hand ballers, weight/power lifters, judo players, swimmers and cricket and hockey players. Negative energy balance was observed only among basket ball and kabadi players.

58. Nutritional Profile of Women Labour in Coir Sector

Name of the Student: Deepa R. (2006-16-103)
Name of the Major Advisor: Dr. V.Indira

Nutritional status of women coir workers of organized and unorganized sectors in Alappuzha district was conducted by selecting 60 each from two sectors. The details on socio economic status and food consumption pattern of the family and working pattern, nutritional status, energy balance and occupational hazards of women coir workers were collected.

Most of the families in organized and unorganized sectors were Hindus and belonged to backward caste with a family size of four to six members. Majority of the family members in organized and unorganized sectors were literates. The monthly income of the families varied from Rs.1000 to 5000.

All the families in organized sector had their own houses with brick as the wall material and tiles as the roofing material with three to four rooms. Drinking water, electricity, recreational and lavatory facilities were found to be satisfactory.

All the families in both groups were non vegetarians and consumed rice as their staple food. Food expenditure pattern of the families revealed that in both sectors maximum amount of the income was spent on cereals. Majority of the families purchased food items from PDS and nearby shops on a weekly basis. The most frequently used food items were cereals, other vegetables, fats and oils, spices and condiments, sugar and fish in both the sectors. All the respondents in organized sector worked for six days in a week for seven to eight hours in a day from 8.30 am to 5.30 pm with specific time for interval in the morning, noon and evening. In unorganized sector the respondents worked for 3 to 6 days in a week without any specific time schedule. All respondents in both sectors used to get their wages on weekly basis. In organized sector, the wage of most of the respondents varied from Rs 300 to Rs 400 per week and in unorganized sector it varied from Rs 200 to 300 in a week.

Details of morbidity pattern among the respondents for the past one year revealed chikungunia as the most important epidemic and 53 per cent of the respondents in organized and 65 per cent in unorganized sectors suffered from chikungunia during 2006-2007. Asthma, allergy, skin lesions and pain in the hands and legs as well as back pain were the prominent occupation related problems noted among the respondents of both organized and unorganized sectors.

Body Mass Index showed that about 58.33 per cent in organized and 51.67 per cent in unorganized sector had normal BMI in the range of 18.5 to 22.9kg/m^2. Among the respondents

who were undernourished, 85.72 per cent in organized sector and 80 per cent in unorganized sector were found to be having mild malnutrition.

The food and nutrient intake of the respondents indicated that the intake of most of the food groups were lower than the suggested requirements. The intake of other vegetables, roots and tubers and flesh foods were found to be higher than the recommended allowances in both sectors. The intake of most of the nutrients was also lower than the RDA.

Clinical examination showed symptoms like conjunctival xerosis, mild angular stomatitis chalky teeth, dental caries, loss of luster in hair and pale but coated tongue among the respondents of organized (15 to 40%) and unorganized (25 to 45%) sectors. Biochemical estimation of blood for haemoglobin indicated anaemia among 70 per cent of respondents in organized sector and 85 per cent in unorganized sector. All the women coir workers had negative energy balance when their daily energy intake and daily energy expenditure were compared.

59. Nutritional Profile of Women Participating in Kudumbasree Programmes

Name of the Student: Shiji N. (2006-16-101)
Name of the Major Advisor: Dr. V. Usha

Nutrtional profile of women in the age group of 20 to 40 years participating in kudumbasree programmes (KM) in Nadathara panchayat of Thrissur district was conducted and compared with a control group of non kudumbasree (NM) members.

Information regarding the socio economic conditions and food consumption pattern of the families and activity pattern of women were collected. Nutritional status of women was assessed through anthropometry, weighment method of dietary survey, clinical examination and biochemical estimation of blood for haemoglobin.

Most of the families in both KM and NM were nuclear type with a family size of three to five members. Majority in both groups were literates. Monthly income of the KM families varied from Rs.2001 to 4000 whereas in NM families it was Rs.1001 to 3000.

Details of the activities of KM respondents revealed that they were engaged in seven different types of activities in different units with a monthly income ranging from Rs.3000 to 10,000. Clay work and garment making were the two activities with more units. Highest income was for convenient food making unit and lowest income was observed for chocolate making unit, banana product making unit and one papad making unit.

Monthly expenditure of KM families was significantly higher than the NM families on various aspects except for expenditure for health and fuel. Maximum proportion of income was spent on food items in both groups.

Majority of the families in both groups had their own houses with brick walls and tiled roof but number of rooms were more in KM families (3-5 rooms). Wood and LPG were used as fuel in most of the KM families whereas NM families used only wood for cooking foods.

Food consumption pattern of the families indicated that majority of the families were non vegetarians. Cereals, other vegetables, roots and tubers, oils and fats, spices and condiments and fish were consumed most frequently by the KM families while, NM families consumed all the above food items except roots and tubers. About 40 per cent of KM respondents used packed lunch during working days and rice and pulses were the main items included for lunch.

Nutritional status of the respondents on the basis of Body Mass Index showed that 43 per cent of KM and 40 per cent of NM respondents had normal nutritional status. Prevalence of mild and moderate malnutrition was found more among NM respondents. Mean intake of all foods except flesh foods was significantly lower than the RDA among KM and NM respondents. The nutritional quality of the diet revealed that the intake of nutrients like protein, fat and riboflavin were significantly high in KM and NM respondents. The intake of iron, thiamine, niacin and vitamin C was also found to be satisfactory among KM respondents.

Clinical examination showed symptoms like xerosis, pigmentation and functional night blindness in the eyes, fluorosis and dental carries among both groups of respondents. Biochemical estimation of blood for haemoglobin showed anaemia among 53 per cent of KM respondents with a haemoglobin level below 12g/dl as against 90 per cent in NM respondents. The study has highlighted the emerging trend that rural women at the subsistence level have high potentials as economic providers for their households and could act as promoters of health and nutrition of families.

E. ELDERLY

60. Nutritional Profile of the Elderly

Name of the Student: Rosemol Jose (1999-16-04)
Name of the Major Advisor: Dr. V.Indira

Assessment of nutritional status of elderly in the age group of 60 to 75 years residing in institutions (Institutionalized group) and in houses (Non institutionalized group) was

conducted. Socio economic profile, personal information's, dietary pattern, nutritional status and factors affecting nutritional status were collected from the selected respondents.

Majority of the elderly were from joint families and were literate but had no income of their own. About 85 per cent of the institutionalized elderly were either unmarried or widowed where as in non institutionalized group majority were married and lived with their spouse. Past occupational status indicated that most of the elderly women were unemployed while men were employed in different sectors. The housing conditions and hygiene of elderly in both groups were found to be good. Seventy six per cent of non institutionalized elderly had a separate room where as in institutions one room was shared by more than two members. The unhealthy habits were found more among non institutionalized elderly and majority in both groups did some sort of physical exercise.

Majority of the elderly in both groups were non vegetarians and followed a dietary pattern of three meals in a day. The institutionalized group had a specific time for food intake and they had their meals along with other members. In non institutionalized group, majority did not have a specific time schedule for food intake and they had their meals alone.

Different grades of Chronic Energy Deficiencies and upper body obesity were found in both groups. Twenty nine per cent of institutionalized and 22 per cent of non institutionalized elderly had different grades of Chronic Energy Deficiencies. Eighty per cent of the male and 88 percent of the female elderly in institutionalized group had upper body obesity on the basis of waist to hip ratio while this was found only among 46 and 74 of the male and female elderly of non institutionalized group.

Among institutionalized group, the intake of foods except cereals, pulses and flesh foods was found to be lower than the recommended values among females while all food groups except pulses was lower than the RDA among males. In non institutionalized group, only the requirement of pulses, sugar and flesh foods was met by male and female elderly. The intake of all nutrients was lower than the recommended levels in both groups.

Visual disturbance, loss of teeth, chewing and hearing problems and anaemia were the health problems noticed among the elderly. Majority of the elderly in both groups had an increased heart rate and various degrees of hypertension. None of the socio economic factors as well as place of residence had any influence on the nutritional status of the elderly. Hence, proper care, feeling of security and conducive psycho social environment are suggested to improve the nutritional status of the elderly.

F. FAMILIES

61. Traditional Food Habits of Different Communities in Thrissur District

Name of the Student : Shyna K.P. (1999-16-04)
Name of the Major Advisor : Dr. V.Indira

A study on traditional food habits of six community's viz. Ezhava, Christian, Nair, Namboothiri, Tamil Brahmin and Muslim in Thrissur district was conducted. Details on socio economic status, dietary pattern, traditional food habits, position of traditional foods in their dietary pattern, traditional food practices followed by older generation and Knowledge, Attitude and Practice (KAP) on traditional foods among younger generation were collected from a total of 180 families.

Majority of the families of different communities except Ezhava were of nuclear type with an average family size of 3.9 for Tamil Brahmins and 5.2 for Christians. Except Tamil Brahmins and Namboothiri communities, all the families of other four communities were non vegetarians. Three meals a day pattern was observed in five communities and Tamil Brahmins had four major meals in a day. All families irrespective of communities included cereals, other vegetables, milk and milk products, fats and oils and sugar in their daily diet. Purchase of prepared foods from outside was found to be more common among Muslim and Christian families. Families of different communities still prepared and consumed traditional foods in their daily diet especially for breakfast, lunch and dinner one to four times in a week. Most of the families in six communities gave preference to include their respective traditional food items in their diet. Only very few families in different communities prepared traditional foods during specific months for the improvement of health and purchased instant food mixes and traditional foods available in the market. However, most of the families in the six communities prepared some medicinal preparations for lactating women. KAP on traditional food habits among the younger generation indicated that there is a tendency to develop traditional food practices for those who have attitude towards traditional foods. Though, the older generations were aware about the various traditional food practices and preparations of their respective communities, the younger generation of the different communities did not follow such practices.

62. Household Food Security and Nutritional Status of Women Agricultural Labourers

Name of the Student: Lincy Lawrence (2001-16-01)
Name of the Major Advisor: Dr. V.Indira

A study was conducted among women agricultural labourers belonging to organised and unorganised sectors to assess their household food security and nutritional status.The determinants of household food security and the influence of household food security on the nutritional status of women were also ascertained. Data on socio economic status, food consumption pattern, food adequacy and household food security of the families were collected. Nutritional status of women agricultural labourers were assessed through anthropometry, food weighment survey and clinical examination.

Majority of the families were of nuclear type with a family size in between four to six. Most of the male and female members in both the sectors were literate. All the families in the unorganised sector and 98 per cent in the organised sector had their own houses with brick as the wall material and with tiled or concrete roof with four to five rooms. Drinking water, electricity, recreational and lavatory facilities were found to be satisfactory. However, drainage facilities of the houses in both sectors were inadequate. Majority of the respondents in the unorganised sector got work for three to five days in a week with seasonal variation in the working days, while all the respondents in the organised sector worked for six days.

Most of the families in the organised sector purchased most of the food items in bulk on monthly basis while in the unorganised sector most of the families purchased different food items either daily or weekly. Most frequently used food items included cereals, pulses, other vegetables, milk and milk products, fats and oils and sugar in the organised sector while in the unorganised sector all the above food items except pulses and milk and milk products were found to be the most frequently used food items.

The percapita food and nutrient intake indicated that cereals, pulses, green leafy vegetables, fruits, milk and mlilk products and fats and oils were significantly lower than the recommended levels in both groups. The intake of all nutrients was also lower than the recommended levels. The nutritional profile of women revealed different grades of Chronic Energy Deficiency among 22 per cent and 32 per cent in organised and unorganised sectors respectively. Nutritional status index of women was higher in the organised sector and a positive correlation existed between food security and nutritional status index.

Majority (88%) of the households in the organised sector were food secure as against 27 per cent in unorganized sector. None of the families in the organised sector experienced food

insecurity with hunger. However, in unorganized sector, 33per cent and 40 per cent were found to be food insecure without hunger and with moderate hunger respectively. Food insecurity was found to be more in the households with children in both sectors. Better food security was found in the organised sector mainly due to their better purchasing power. Food expenditure, monthly income, family size and type of family were found to be the important factors influencing food security.

63. Prevalence of Hypertension and Assessment of Risk Factors among Agricultural Labourers

Name of the Student: Archana S.S. (2005-16-105)
Name of the Major Advisor: Dr. V.Indira

Prevalence of hypertension and assessment of risk factors among agricultural labourers was conducted. An initial assessment of blood pressure of 200 labourers in the age group of 35 to 60 years working in the different farms of Kerala Agricultural University was measured. These agricultural labourers were further classified according to sex and also on the basis of their blood pressure as non hypertensive (control) and hypertensive (experimental) groups. From this, 50 male and 50 female labourers who are hypertensive and 25 male and 25 female labourers who are non hypertensive were selected for the study.

The details on socio economic status and food consumption pattern of the families and personal habits, working pattern, and nutritional status of the respondents were collected.

Information regarding socio economic condition of the families revealed that most of the families in control and experimental groups belonged to forward caste with a family size of four to six members. Educational status of respondents showed that majority in both groups was literate.

Most of the families in control and experimental groups had their own houses with brick as the wall material and tiles as the roofing material with two to three rooms. Drinking water, electricity, recreational and lavatory facilities were found to be satisfactory. Majority of the families in both groups used wood as a source of fuel.

Twenty four per cent of the male respondents in control and 64 per cent in experimental groups had the habit of smoking. Tobacco chewing was noticed among 12 to 24 per cent male and female respondents in control group and 46 to 50 per cent in experimental group. Majority of respondents in both groups did not take regular physical exercise. Majority of the respondents in both groups worked for six days in a week for 6 to 7 hours daily.

Most of the respondents in both groups were non vegetarians and consumed rice as their staple food. The most frequently used food items were cereals, pulses, other vegetables, milk and milk products, fats and oils, sugar and fish in control group while in experimental group all the above food items except pulses were used most frequently.

Majority of the respondents with hypertension used coconut oil for cooking and used pickle, pappad, dried fish and fried food items daily. None of the respondents neither included nor restricted food to control hypertension.

Body Mass Index showed that 60 per cent male and 48 per cent female respondents in control group and 30 per cent male and 64 per cent female respondents in experimental group had normal BMI in the range of 18.5 to 22.9 kg/m^2. Grade 1 obesity was observed among 27 per cent of respondents in experimental group and 24 per cent in control group. Nearly 22 per cent respondents in experimental group and 16 per cent in control group were found to be at risk for obesity. It was seen that 84 per cent female respondents with hypertension had a waist hip ratio above 0.85 when compared to 64 per cent in non hypertensive group and were at risk for cardiovascular diseases. However, among male respondents only eight percent in control and two per cent in experimental group had a ratio of more than 0.95 associated with risk. The mean intake of all food items and all nutrients was lower than the recommended allowances among male and female respondents of both groups.

Among the respondents in experimental group 90 per cent male and 98 per cent female respondents had systolic blood pressure in the range of 140 to 159 mm Hg. Diastolic pressure of 70 per cent male and 42 per cent female respondents were in between 91 to 99 mm Hg. It was seen that 90 per cent male and 98 per cent female respondents had stage 1 hypertension and the rest were categorized as pre hypertensive.

Type of family, family size, use of pickle, pappad, fried food items, smoking, tobacco chewing, alcohol consumption, lack of regular physical exercise, personality traits, family history of hypertension, body mass index and waist hip ratio were identified as the risk factors for hypertension among agricultural labourers.

64. Food Security in Farm Labour Households of Kuttanad

Name of the Student: Anusha S. (2008-16-107)
Name of the Major Advisor: Dr. V.Indira

A study was undertaken to assess the extent of food security and to identify the factors influencing the food security of farm labour households of Kuttanad. From the seven agro ecological zones of Kuttanad, 140 farm labour households were selected equally and randomly for the study. The food security of the selected households was ascertained by assessing the three dimensions of food security namely access, availability and utilisation of food. Food access and availability were determined by assessing socio economic status, food consumption pattern, and food purchase inventory and food adequacy of the households. Utilisation was determined by assessing the nutritional status of family members. Overall food security was also determined using the food security module suggested by USDA.

Nuclear family system with four to six members was noticed among most of the households. Most of the adult family members were educated up to high school level and 71.89 per cent men and 54.51 per cent women were working as agricultural labourers. The monthly income of the households was found to be very low and they spent above 50 per cent of their income for the purchase of food materials. The housing and living conditions were found to be poor with no drainage and drinking water facilities.

The food consumption pattern of the households indicated that all were non vegetarians and followed three meal a day pattern. Most frequently used food items included cereals, vegetables, fish and fats and oils. Milk and milk products, meat and egg were used to a lesser extent by the households. Food expenditure pattern of the households indicated that 67 per cent spent 10 to 35 per cent of food expenditure for the purchase of cereals and 10 to 28 per cent did not spent any money for the purchase of milk and milk products, egg, meat and fish. Food purchase inventory of the households revealed that all items were purchased to a lesser extent compared to the actual requirement of the households. Food adequacy in terms of food intake per consumption unit indicated inadequacy of all food groups except flesh foods. The per capita intake of all nutrients was also found to be lower than the recommended levels.

The nutritional status of family members through anthropometry indicated that 25 to 47 per cent preschool children, 35 percent school children, 41 per cent adolescents and 47 per cent elderly had different grades of malnutrition. However, the nutritional status of adult members was found to be better with 72 per cent of adults having a normal BMI. The actual food and nutrient intake of women and preschool children were found to be far below the RDA for

most of the food groups and nutrients. Anaemia was prevalent among 90 per cent of women.

Food security status of the households indicated food insecurity among 51 per cent of the households. Only 49 per cent of the households were food secure on the basis of overall food security. On the basis of food access, availability and utilisation, food security was observed only among 25 per cent of the households. Better food security was observed in the households without children. Among the different factors affecting food security, family size was found to be the most important one followed by income, food expenditure and energy intake.

65. Food and Nutritional Security Scenario of BPL Families of Central Zone of Kerala

Name of the Student: Blossom K.L. (2010-24-102)
Name of the Major Advisor: Dr. V.Indira

A study was undertaken to assess the extent and determinants of food and nutritional security among the BPL families of Central Kerala and to study the impact of food security on the nutritional status of women and preschool children. All the four districts of Central Zone of Kerala namely Thrissur, Ernakulam, Palakkad and Malappuram were selected for the study. A total of 400 BPL families comprising 100 families from each district formed the sample for the study. Detailed study on nutritional status of women and preschool children as well as Participatory Rural Appraisal (PRA) were conducted among 60 women in the age group of 25 to 35 years and 60 preschool children in the age group of 3 to 5 years. The food security of the families was assessed by the three dimensions of food security namely food access, availability and absorption of nutrients. Access and availability were assessed by the socio economic status, food consumption pattern and food purchasing pattern of the families. Absorption was determined by assessing the nutritional status of the family members. Overall food security of the families was measured using USDA (2000) module and MSSRF (2008) index. Nutritional security of the families and family members were determined from the intake of nutrients.

Nuclear family system with four to six members was observed among most (70%) of the families. Most of the adult men (92%) and women (82%) were literate. Fifty one per cent of the family members above 18 years were working as labourers on daily wages. The monthly income of 72 per cent of families varied from Rs. 4001/- to 12,000/. The monthly expenditure pattern of the families revealed that 76 per cent spent up to 50 per cent of their income for food. Most of the families had own houses built with bricks, tiled roofing and cement flooring. Electricity and toilet facilities were present in almost all houses. Health care facilities were

found to be satisfactory and 82 per cent of families utilised the public health facilities available in their locality.

Three meals a day pattern was followed by 98 per cent of the families and they kept regular time schedule for taking meal. However, only 37 per cent planned their meal in advance and only 48 per cent of families included raw fruits and vegetables in their diet. Most frequently used food items were cereals, pulses, other vegetables, fats and oils, sugar and fish. Green leafy vegetables, roots and tubers, fruits, milk and milk products and eggs were used to a lesser extent. All families spent up to ten per cent of their food expenditure for the purchase of cereals. The quantity of vegetables, fruits and milk and milk products purchased by 74 to 87 per cent of the families satisfied less than 25 per cent of the requirement. Gross inadequacy in the intake of all food groups except non vegetarian items was noticed among the family members. The intake of macro and micronutrients was also found to be lower than the recommended dietary allowances suggested by ICMR among most of the age groups.

Different grades of malnutrition were noticed among children, adolescents and adult members. On the basis of anthropometric indicators, normal nutritional status was noticed only among 40 per cent children below six years, 39 per cent children aged 7 to 12 years, 45 per cent adolescents, 48 per cent adults and 49 per cent elderly. Gross deficit in the intake of all food groups except cereals, pulses, fruits and non vegetarian items and most of the nutrients was also noticed among women and preschool children. Mild form of nutritional anaemia was prevalent among 41 per cent women and 32 per cent preschool children. However, clinical signs of nutritional deficiencies were noticed only to a lesser extent among women and preschool children.

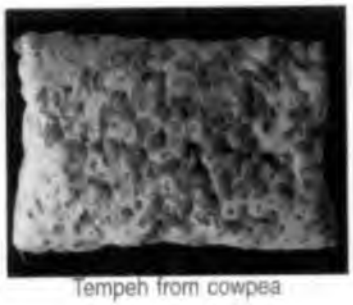
The overall food and nutritional security of the BPL families of Central Kerala indicated that only 16 per cent were food and nutritionally secure. Families without children had better food and nutritional security. Food insecurity without hunger and with moderate hunger was present respectively among 44 per cent and 36 per cent of the families. Only five percent of the families were found to be food insecure with severe hunger. Severe nutritional insecurity affected 23 per cent of the families. Among the different age groups, all children below three years, 7 to 12 years and adolescent boys and girls were categorized as nutritionally insecure on the basis of their nutrient intake. It was also seen that 67 to 96 per cent of adults engaged in different activities also experienced nutritional insecurity. Food security had a positive impact on the nutritional status of women and preschool children. Among the different factors affecting food security, family size was found to be the most important one.

INDEX

Meat analogue prepared with green gram, soybean and wheat

Temph and temph based products

Tempeh from green gram



Tempeh from cowpea

Tempeh from cowpea + wheat

Roast

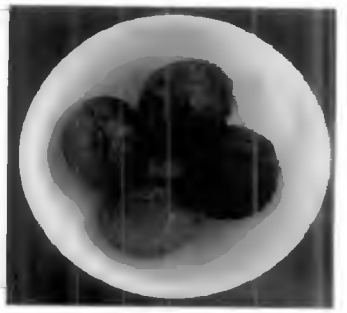
Flour

Soup mix

Bamboo rice based products

Bamboo rice

Murukku

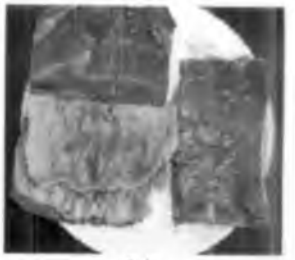


Unniyappam

Appam

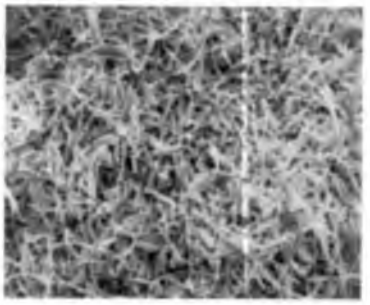
Puttu

Idiyappam



Ada

Germinated rice products



6 days germinated paddy

Cooked rice

Unniyappam

Puttu

Idiyappam

Kozhukatta

Rice based fermented dairy products

Rice based yoghurt

Rice based yoghurt enriched with Mango pulp

Rice based yoghurt enriched with pineapple bits

Pumpkin products

Sweet flakes

Salted flakes

Custard powder

Custard

Cashew apple products

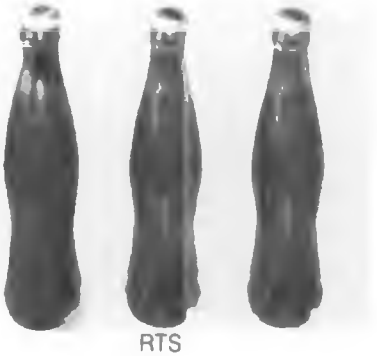
Candy

Tutty fruity

Product developed from West Indian Cherry

Sauce

Pickle



RTS

Preserve

Cashew apple blended RTS

Banana based probiotic food

Banana Wine

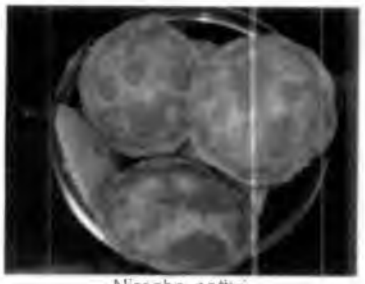
Fish based products

Katla

Cutlet

Stick

Traditional foods of central Kerala



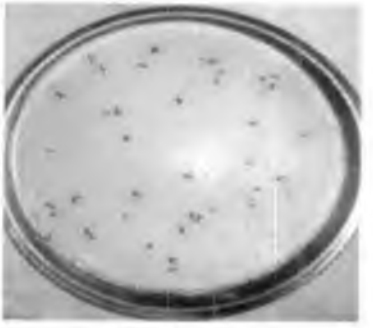
Niracha pathri

Kozhukatta

Ari kondattam

Kozhi ada

Kozhi pidi



Kinnathappam

Neyyappam

Mani Puttu

Avilundda

Traditional Beverages

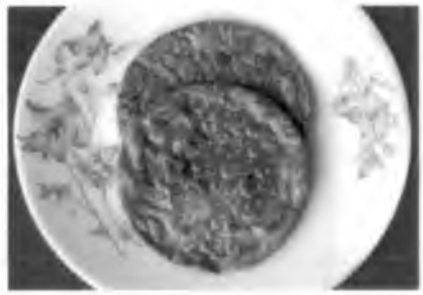
Products developed from grain amaranth

Grain amaranth

Weaning food

Biscuits

Puttu



Chappathi

Bamboo shoot based products

Vattal

Pickle

Products developed from cycas seed flour

Flour

Puttu

Chapathi

Pathiri

Ada