IV RESULTS AND DISCUSSION

The results of the study entitled "**Processing and Packaging of Selected Value Added fruit products and their Promotion through Capacity Building Programme"** are discussed under the following four phases:

PHASE I

A. Production scenario of banana, guava and papaya

B. Market survey on the availability of processed fruit products

C. Study on consumer preference

PHASE II

Processing of banana, guava and papaya by dehydration, pulping and pickling techniques

PHASE III

Quality analysis and shelf life study of dehydrated fruits and formulated fruit products and

PHASE IV

Capacity building programme on fruit processing to Self Help Group women and Farmers.

PHASE I

A. Production Scenario of Banana, Guava and Papaya

1. Global production scenario
2. National production scenario

1. Global Production Scenario of Banana, Guava and Papaya

Banana: Bananas were introduced to the Americas by Portuguese sailors who brought the fruits from West Africa in the 16th century.

The word banana is of West African origin, from the Wolof language, and passed into English via Spanish or Portuguese. Bananas and plantains constitute a major staple food crop for millions of people in developing

countries. Bananas are among the most widely consumed foods in the world. Most banana farmers receive a low price for their produce as grocery companies pay discounted prices for buying in enormous quantity. Price competition among grocers has reduced their margins, leading to lower prices for growers. In 2009, India led the world in banana production, representing approximately 28 per cent of the worldwide crop, mostly for domestic consumption. The six leading exporting countries together accounted for about two-thirds of exports, each contributing more than 6 million tonnes, according to Food and Agriculture Organization statistics given in Table 1 and Figure 4.

Table 1: Global Production of Banana

Country	Production MMT
India	26.2
Philippines	9.0
China	8.2
Ecuador	7.6
Brazil	7.2
Indonesia	6.3
Mexico	2.2
Costa Rica	2.1
Colombia	2.0
Thailand	1.5
World total	95.6

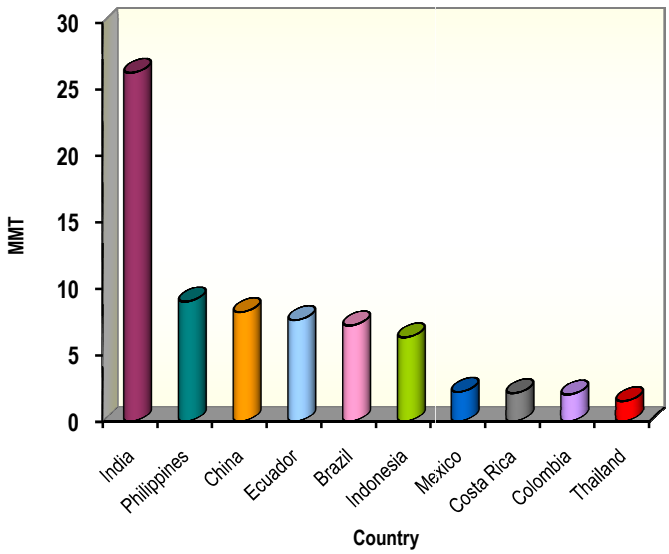


Figure 4: Global Production of Banana

Source: 2009: Food and Agriculture Organization of the United Nations* Countries use 2008 FAO data

It is obvious from the table that in 2009, world production of bananas reached an estimated 97.3 million metric tonnes (MMT), grown on 4.9 million hectares. The 2009 crop represented an increase in production of 49 percent from the 65.1 MMT recorded in 2000. The top five banana-producing countries of India, the Philippines, China, Ecuador, and Brazil accounted for 61 percent of global banana production in 2009, up from 56 percent in 2000.

In addition, there were noticeable production increases in India and the Philippines (Figure 4).

Guava

They are native to Mexico, Central America, and Northern America. Guavas are cultivated in many tropical and subtropical countries. Several species are grown commercially; apple guava and its cultivars are those most commonly traded internationally. Guava fruit, usually 4 to 12 centimeters (1.6 to 4.7 in) long, are round or oval depending on the species. The outer skin may be rough, often with a bitter taste, or soft and sweet. Varying between species, the skin can be any thickness, is usually green before maturity, but becomes yellow, maroon, or green when ripe. Guavas are now cultivated and naturalized throughout the tropics and subtropics in Africa, Southeast Asia, the Caribbean, subtropical regions of North America, and Australia. The global production of guava is shown in Table 2 and Figure 5.

Table 2: Global Production of Guava

Country	Production (MMT)
India	163.37
China	43.66
Thailand	25.50
Pakistan	17.84
Mexico	16.32
Indonesia	13.13
Brazil	11.88
Bangladesh	10.47
Philippines	8.25
Nigeria	7.90
Total	**318.37**

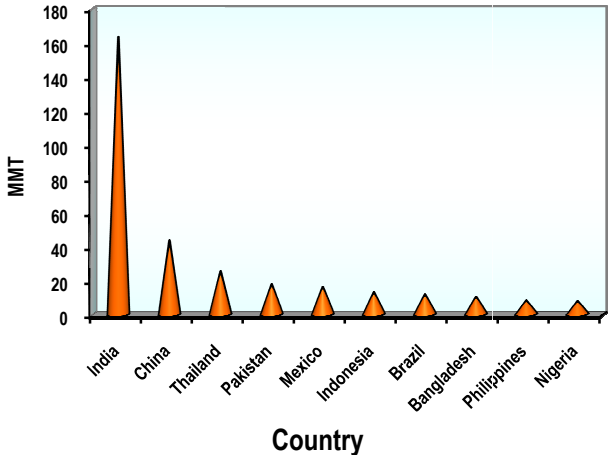


Figure 5 : Global Production of Guava

Source: 2009: Food and Agriculture Organization of the United Nations*

Countries use 2008 FAO data

The secondary data revealed that India is being the top producer of guava in the world with the production of 163.37 Million Metric Tons{MMT} followed by Pakistan, Taiwan and China with the production of 17.84, 25.50

and 43.66 MMT respectively. Among the guava producing nations Nigeria holds the tenth position with the production of 7.90MMT.

Papaya

The papaya (from Carib via Spanish), papaw, or pawpaw is the fruit of the plant Carica papaya, the sole species in the genus Carica of the plant family Caricaceae. It is native to the tropics of the Americas, and was first cultivated in Mexico several centuries before the emergence of the Mesoamerican classical civilizations. Carica papaya plants, and their fruits, are generally known as papayas. Originally from southern Mexico (particularly Chiapas and Veracruz), Central America, and Northern South America, the papaya is now cultivated in most tropical countries. In cultivation, it grows rapidly, fruiting within 3 years. It is, however, highly frost sensitive, limiting papaya production to tropical lands. The global papaya production is listed in table 3 and Figure 6**.**

Table 3: Global Production of Papaya

S.No.	Country	Production (MMT)
1	India	39
2	Brazil	18
3	Indonesia	8
4	Nigeria	8
5	Mexico	7.5
6	Ethiopia	3
7	Congo	1.8
8	Thailand	1.8
9	Guatemala	1.8
10	Colombia	1.8
	Total	90.7

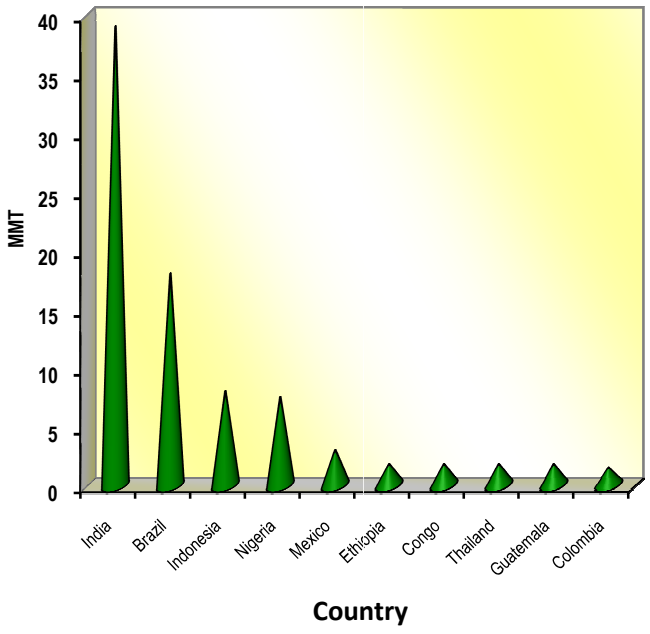


Figure 6: Global Production of Papaya

Table 3 indicates that India is the top producer of papaya in the world with the production of 39 million metric tonnes. Brazil produces 18 million metric tonnes and Indonesia, Nigeria and Mexico produces up to 18 million

metric tonnes of papaya. Ethiopia, Congo, Thailand and Guatemala produce less than two million metric tonnes of papaya worldwide.

2. National Production Scenario of Banana, Guava and Papaya

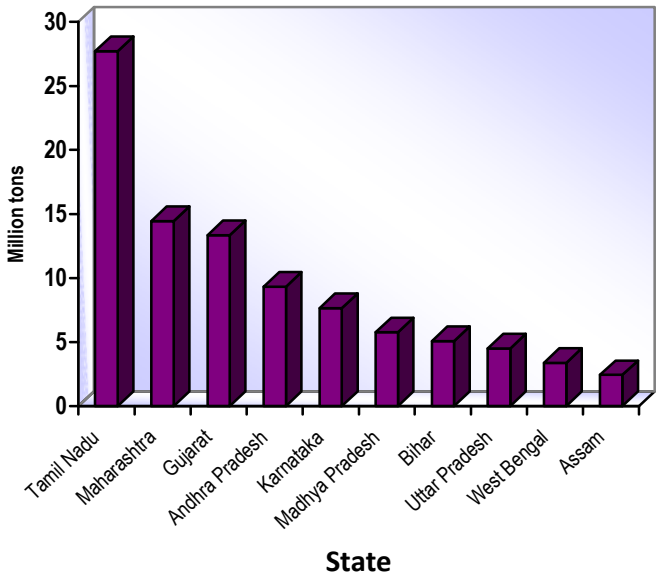
The statistical data furnished above in global production scenario of banana, guava and papaya clearly indicates that India is the top producer of these tropical fruits worldwide. The state wise production scenario of these fruits in India is shown below.

Banana

In 2009, India led the world in banana production, representing approximately 28 per cent of the worldwide crop, mostly for domestic consumption. Most producers are small-scale farmers either for home consumption or local markets. Because bananas and plantains produce fruit year-round, they provide an extremely valuable food source during the hunger season (when the food from one annual/semi-annual harvest has been consumed, and the next is still to come). Bananas and plantains are therefore critical to global security. The Indian production of banana is depicted in Table 4 and Figure 7.

Table 4 and Figure 7: National Production of Banana

State	Production (MT)
Tamil Nadu	8,253.00
Maharashtra	4,303.00
Gujarat	3,978.02
Andhra Pradesh	2,774.76
Karnataka	2,281.58
Madhya Pradesh	1,719.58
Bihar	1,517.11
Uttar Pradesh	1,346.05
West Bengal	1,010.15
Assam	723.57
Total	**27,906.82**



Source: National Horticulture Board (NHB) 2010-2011.

Figure 7: National Production of Banana

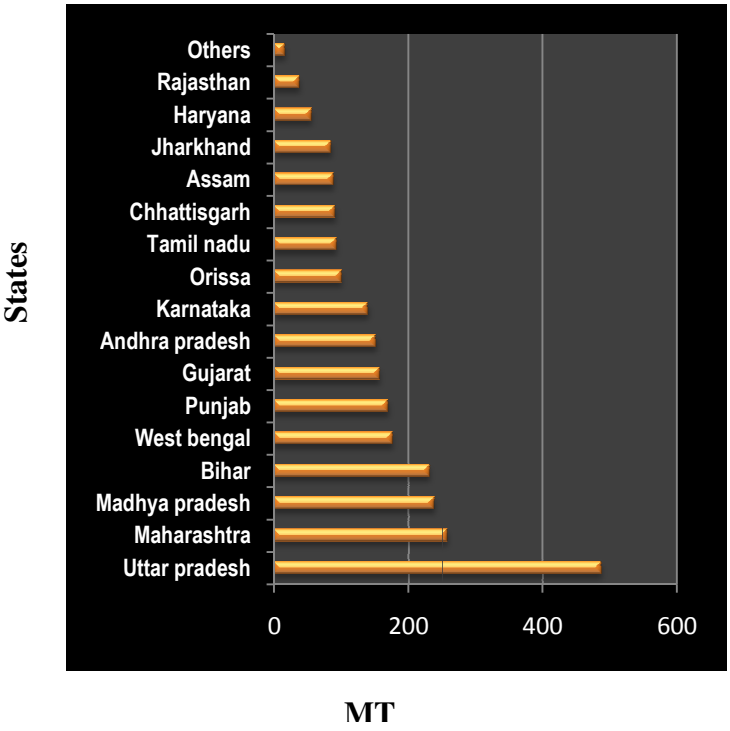
The 4 table reveals that at national level Tamil Nadu is the top producer of banana with the production of 8.25 Metric tonnes whereas Maharashtra and Gujarat hold the second and third place in banana production with 4.3 and 3.9 Metric tonnes per annum.

Guava

Guava is known as the apple of the tropics. It is grown all over the tropics and subtropics. Guava is a very popular fruit. It is available throughout the year except during the summer season. Being very hardy, it gives an assured crop even with very little care. Its cost of production is also low because its requirements for fertilizer, irrigation and plant protection are not much. Further its nutritive value is very high. Therefore, it is ideal fruit for the nutritional security. Guava is also grown as a backyard fruit to great extent in India, the best quality guavas are produced in Uttar Pradesh, particularly in Allahabad region. The gross production value of guava in India is shown in Table 5 and Figure 8.

Table 5 and Figure 8: National Production of Guava

State	Production (MT).
Uttar Pradesh	486.7
Maharashtra	258
Madhya Pradesh	238.5
Bihar	231.5
West Bengal	175.7
Punjab	169.3
Gujarat	156.6
Andhra Pradesh	150.8
Karnataka	138.8
Orissa	100.0
Tamil Nadu	92.5
Chhattisgarh	90.8
Assam	88.2
Jharkhand	84.5
Haryana	55.8
Rajasthan	37.5
Others	16.1
Total	**2571.3**



Source: FAOSTAT, 2011

It is obvious that Uttar Pradesh is the top guava producing state with 486.7 million tons followed by Maharashtra, Bihar, West Bengal and Punjab with the production of 258,231.5,175.7 and 169.3 Million Tonnes. Tamil Nadu ranks 10th in the production of guava with 92.5 Million Tonnes.

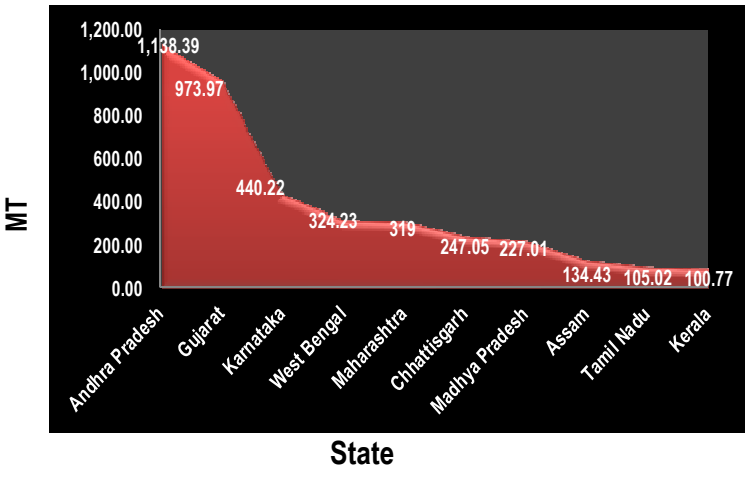
Sujatha and Eswaraprasad (2008) stated that the losses of fresh produce in post-harvest is 30 per cent of the production in the state by field level (10%), transport (5%), packaging (2%), storage (9%) and processing (4%). Though there is an increase in the production of fruits the post-harvest losses are not minimized. There is a need for processing to overcome the post-harvest losses and make the fruits available throughout the year.

Papaya

Papaya is a table fruit in most of the tropical countries cultivated mainly for fresh fruit consumption. Papaya grows well almost everywhere, except at altitudes higher than 1,500 meters. It is grown all over India and is available round the year in the country. However, Karnataka, Orissa, Assam, West Bengal and Gujarat provide ideal climatic conditions for its growth. Today India is a leading producer of papaya in the world. The state wise production of papaya is listed in table 6 and Figure 9.

Table 6 and Figure 9: Indian Production of Papaya

State	Production (MT)
Andhra Pradesh	1,138.39
Gujarat	973.97
Karnataka	440.22
West Bengal	324.23
Maharashtra	319.00
Chhattisgarh	247.05
Madhya Pradesh	227.01
Assam	134.43
Tamil Nadu	105.02
Kerala	100.77
Total	**4,010.09**



Source: National Horticulture Board (NHB) 2010-2011.

As far as the fruit papaya production in the year 2010-2011. Andhra Pradesh was leading with 11.38 MT whereas Gujarat and Karnataka

contributed 9.73 and 4.40 MT respectively to the national production of papaya. India is by far the most important papaya producer worldwide, and exports to the Middle East. Almost all the states of India grow papaya, but Andhra Pradesh, Karnataka, Gujarat and Orissa are the most important.

B. Market Survey on the Availability of Processed Fruit Products

An analysis of availability of processed fruits and its market potential were done by the market survey, which creates new opportunities for developing the fruit products so as to minimize the post-harvest losses .The results are discussed below.

Availability of Fruit Products in the Market

The market survey yielded information on the availability of major fruit products of banana, guava and papaya which is shown in Table7.

Table 7: Availability of Fruit Products in the Market

(N=33)

Fruit products	Availability in per cent					
	Banana		Guava		Papaya	
	No.	%	No.	%	No.	%
Jam	14	43	12	37	6	18
Jelly	4	11	6	18	–	-
Candy	3	9	4	12	5	14
RTS/Juice	–	–	13	41	8	23
Sauce	–	–	–	-	–	-
Squash	9	27	11	32	1	4
Chutney	–	–	–	–	–	-
Pickle	–	–		–	–	-
Frozen puree	7	21	3	9	1	4
Glazed fruits	–	-	–	-	–	-
Canned fruits	4	12	6	17	7	21
Fruit bar	2	6	4	11	–	-

Major fruit products available in the selected market included departmental stores and Pazhamudir Nilayam outlets were banana jam 43 percent and guava Ready to serve (RTS)/juice 41 percent, whereas guava jam and squash were available in 31 percent and 32 percent of outlets respectively. None of the fruit products were available in more than 43 percent outlets. The products such as fruit sauce, chutney, pickle, and glazed fruits were not available in the market. Hence these products were focused to

develop and make available in the market in this study. The papaya squash and puree were available only at four percent of outlets whereas banana jelly and guava jelly were available in 11 percent and 18 percent of the market respectively.

Preferences of Consumers for the Fruit Products

The preferences of the consumers on the fruit products are depicted in Table 8.

Table 8: Preferences of Consumers for the Fruit Products

(N=300)

Fruit	Type of Consumers					
	Children		Adolescents		Adults	
	No.	%	No.	%	No.	%
Jam	129	43	123	41	48	16
Jelly	156	52	126	42	18	6
Candy	138	46	96	32	66	22
RTS/Juice	63	21	99	33	108	36
Squash	96	32	126	42	78	26
Frozen puree	-	-	132	44	168	56
Canned fruits	-	-	138	46	162	54
Fruit bar	174	58	126	42	-	-

The table evinces that the major consumers of RTS/Juice (36%), squash (26%) and frozen fruits (56%) were adults, whereas the major consumers of fruit jam were 43 percent of children, 41 percent of adolescent and 11 percent of adults. Fruit bars and fruit jelly were consumed by children at the highest level of 58 and 52 percent respectively. The major consumers for frozen and canned fruit were only adolescent at 44 and 46 percent and adult by 56 and 54 percent respectively.

Major Market Outlets of Fruit Products

The survey showed a particular type of market outlet for the purchase of the fruit product among the consumers which is shown in table 9.

Table 9: **Major Market Outlets of Fruit Products**

(N=300)

Fruit Products	Major Market outlet					
	Retail shop		Departmental stores		Wholesale	
	No.	%	No.	%	No.	%
Jam	204	68	96	32	-	-
Jelly	168	56	126	42	6	2
Candy	174	58	114	38	12	4
RTS/Juice	162	54	135	45	3	1
Squash	138	46	132	44	30	10
Frozen puree	-	-	285	95	15	5
Canned fruits	-	-	246	82	24	8
Fruit bar	114	38	171	57	15	5

The products jam, jelly candy and Ready to Serve (RTS) beverages were purchased from retailers by 68, 56, 58 and 54 percent whereas 95 and 82 percent of frozen puree and canned fruits were purchased from the departmental stores by the consumers. The type of retailers included ranged between small, medium and large based on their investments. Wholesaler played a small role in marketing of processed fruit products.

Satisfactory Levels of Consumer on the Quality and Price of Fruit Products Quality and Price of Products

The details on consumers view on the price and the quality of the fruit products were collected. A 10 point Score card was used to identify the qualitative data including consumer perception, satisfaction and expectations. The rating of score was expressed as satisfied (8-10), dissatisfied (1-4) and convinced (5-8) as given in following Table 10.

Table 10: Satisfactory Levels of Consumer on the Quality and Price of Fruit Products

(N=300)

Attributes	Satisfied		Dissatisfied		Convinced	
	No.	%	No.	%	No.	%
Price comparability	156	52	108	36	36	12
Quality comparability	195	65	15	5	90	30
Affordability	177	59	99	33	24	8
Product labeling	237	79	-	-	63	21
Product packing	249	83	18	6	33	11
Innovative	153	51	36	12	111	37
Safety of the product	243	81	21	7	36	12

Table 10 highlights that all the attributes of price comparability, quality comparability, affordability, product labeling, packing, innovation and safety of the products scored not below 50 percent. The consumers with 79 and 83 percent were satisfied with packing and labeling of fruit products respectively.

Consumer Expectations on Fruit Products

Finding out the consumer expectations is utmost important to market any product. A list of questions which possess the scores on which the consumer reactions were analysed is given in following Table 11.

Table 11: Consumer Expectations on Fruit Products

(N=300)

Expectations of the consumers	Agree		Disagree	
	No.	%	No.	%
Like to buy a minimally processed fruit product	192	64	108	36
Interested to buy a innovative product of locally available fruits	207	69	93	31
Like to purchase a certified product only	81	27	219	73
Ready to buy a quality product at reasonable price	273	91	27	9
Feel comfortable to buy a convenience fruit product	99	33	201	67

(Scores 8-10 Agree; score 5-7 don't know; scores1 -4 Disagree)

It is evident from the table 11 that 91percent preferred to buy a quality product at reasonable price whereas 64 percent agreed that they would like to buy a minimally processed fruit product. Locally available new fruit products were expected by 69 percent of the consumers.

C. Preferences of Target Consumer for Product Formulation

The reasons for preferring fruit products by the consumers are shown in Table 12.

Table 12: Reasons for the Preference of Fruit Product

Criteria	Children		Adolescents	
	N=200	%	N=200	%
Availability of fruit product				
Highly available	30	15	74	37
moderate	82	41	78	39
Less available	88	44	48	24
Not available	–	–	–	–
Most preferred new fruit product				
Fruit candy	82	41	66	33
Fruit juices	60	30	74	37
Fruit sauce	52	26	60	30
Fruit bars	6	3	–	–
Quality attributes preferred				
Taste	122	61		51
Energy	34	17		11
Healthy	42	21		19
Refreshment	2	1		19
Most preferred fruit product				
Banana	46	23	42	21
Guava	78	39	66	33
Papaya	56	28	92	46
Place of purchase				
Departmental stores	94	47	110	55
Retail shops	106	53	90	45
Whole sale shop	–	–	–	–
Factors considered while purchasing				
Packing	62	31	60	30
Labeling	66	33	72	36
Advertisement	24	12	12	6
Peers opinion	44	22	46	23
Price	4	2	10	5

It is observed that 44 and 24 percent of children and adolescents expressed the availability of fruit products were less respectively. Preferences

for fruit products by 37 percent of adolescent and 15 percent children for its high availability. The survey also revealed that 41percent of children and 33 percent of adolescent preferred candy, 30 and 37 percent of children and adolescent respectively preferred fruit juices while 26 and 30 percent of children and adolescent preferred fruit sauces respectively. Only three percent of children preferred fruit bar.

Higher preferences for taste was expressed by 61percent (children) and 51percent (adolescent) and 17 percent (children) and 11 percent (adolescent) showed energy giving snack as the reason and 21 percent children and 19 percent adolescent healthy food as the reason. Only 19 percent of adolescent group preferred for refreshment. Based on these information fruit products such as fruit candy and fruit sauce were selected for the formulation of value added products.

It is obvious that both children and adolescent group considered thats labeling of the product was essential as expressed by 33 percent and 36 percent respectively. The second consideration was given to packing by 31 and 30 percent of the children and adolescent respondents respectively. The third priority was given to peers opinion by 22 to 23 percent of the children and adolescents respectively. Price is the least considered factor among the selected group.

Three hundred and eighty students eight were asked which packaging attributes influence their choices when deciding which fruit juice to purchase. Results showed that functionality, shape, capacity, general look and ecological aspect were the most important attributes that determined consumer choice of packaging.

PHASE II: Processing of Banana, Guava and Papaya by Dehydration, Pulping and Pickling Techniques

A. Processing of Fruits by Dehydration

1. Edible Portion of Banana, Guava and Papaya

The details regarding the varieties and initial weight of the selected fruits, time taken to dry and yield of the dried fruits are given in Table 13.

Table 13: Edible Portion of Banana, Guava and Papaya

Name of fruit	Weight (g)			Edible portion (%)
	Whole fruits	Pulp	Waste	
Red banana	1000	704	296	70
Poovan	1000	772	228	77
Nendran	1000	696	304	70
Rasthali	1000	720	280	72
Ney poovan	1000	776	224	78
Robusta	1000	760	240	76
Guava (country)	1000	957	43	96
Guava (hill)	1000	955	45	96
Papaya (red)	1000	832	170	83
Papaya (yellow)	1000	833	170	83

The table clearly explicit that irrespective of the varieties, the edible portion of banana was found to be 70 to 78 percent which was due to the skin thickness. There were no differences in the edible portions of two varieties of guava and papaya but they are differentiated only by the colour. The edible portion of guava and papaya were 96 and 83 percent. This variation may be attributed to the content of skin weight in papaya whereas in guava the removal of the seed amounting to 43-45g.

2. Colour and Texture of the Dried Fruits

The changes in colour and texture of fruits after dehydration by sun drying, microwave drying, cabinet drying and osmotic dehydration are shown in Table 14.

Table 14: Colour and Texture of Dehydrated Banana, Guava and Papaya

Dried fruits	Colour				Texture			
	sundry	Microwave dry	Cabinet dry	Osmotic dehydration	Sundry	Microwave dry	Cabinet dry	Osmotic dehydration
Red banana	Deep brown	Deep brown	Light brown	Dark brown	Breakable	breakable	breakable	pliable
Poovan banana	Deep yellow	Light brown	Light brown	Deep yellow	Breakable	Breakable	Breakable	Breakable
Nendranbanana	Deep yellow	Deep yellow	Deep yellow	Deep yellow	Hard	Hard	Hard	Hard
Rasthalibanana	Deep yellow	Deep brown	Deep yellow	Deep yellow	Breakable	Breakable	Breakable	Breakable
Ney poovan banana	Light brown	Light brown	Light brown	Light brown	Pliable	Pliable	Pliable	Pliable
Robusta banana	Light brown	Light brown	Light brown	Light brown	Hard	Hard	Hard	Hard
Guava -country	Olive green	Dark Olive green	Olive green	Olive green	Hard	Hard	Hard	Pliable
Guava-hill	Olive green	Dark Olive green	Olive green	Olive green	Hard	Hard	Hard	Pliable
Papaya-red	Deep brown	Deep brown	Deep brown	Deep red	pliable	Pliable	Pliable	Pliable
Papaya yellow	Light brown	Deep yellow	Deep brown	Deep yellow	Pliable	Pliable	Pliable	Pliable

It is evident that due to the removal of moisture and oxidation changes with atmospheric air during the dehydration the colour and texture of the fruits were changed. With reference to banana red, glucose, nendran and rasthali varieties the colour changed to deep yellow on osmotic dehydration. Whereas Ney poovan and Robusta banana turned into light brown colour on all drying methods. Regardless of the variety, guava turns into olive green while in papaya the yellow changed into deep yellow colour in dehydration. The texture of red and yellow papaya and country and hill guava changed into pliable texture in all methods. The rasthali, red and poovan banana changed into breakable texture and nendran and Robusta variety changed into hard texture. The texture of neypoovan changed into pliable.

While compared to the varieties country and hill banana the light green colour changed into olive green in sun drying, cabinet drying and osmotic dehydration whereas the colour changed into dark olive green in microwave drying. The red colour of papaya turned into deep brown in sun drying, cabinet drying and microwave drying and deep yellow in osmotic drying. The yellow colour of the papaya changed into deep yellow in microwave and osmotic drying light brown and deep brown in sun drying and cabinet drying.

In a study conducted by Kanchana et al. (2012) the colour value of the sun dried guava pulp samples was measured by chromameter and the values were expressed as L, a, b and are given in Table 2. From the Table, it is observed that as the bed thickness increased the intensity of the darkness also increased. The L, a and b values of 2mm bed thickness in sun dried sample were 44.57, 8.34 and 10.01.The retention of colour might be due to the shorter exposure of the samples to the radiation. In 9mm bed, the L, a and b values were 52.21, 11.83 and 13.42. When statistically analysed the colour values showed significant effect on the bed thickness and method of drying.

3. Drying Time and Temperature for Dehydration of Banana, Guava and Papaya by dehydration

The time taken for dehydration was noted and temperature was maintained for microwave and cabinet drying**.** The time taken to dry the six

varieties of banana, two varieties of guava and papaya using four methods of drying is given in Table 15.

Table 15: Time and Temperature for Dehydration of Banana, Guava and Papaya

Types of Banana	Drying time and temperature					
	Sun drying (hrs)	Microwave drying		Cabinet drying		Osmotic Dehydration (hrs)
		Hrs.	^{0}C	Hrs.	^{0}C	
Red banana	48	6.45	45	8	105	24
Poovan banana	36	6.30	45	6	105	24
Nendranbanana	48	7	45	8	105	24
Rasthali banana	36	6.	45	7	105	24
Neypoovan	48	7.4	45	8	105	24
Robusta banana	48	7.3	45	7	105	24
Guava-hill	36	2	45	9	105	24
Guava country	36	2	45	9	105	24
Papaya-red	48	1.3	45	9	105	24
Papaya-yellow	48	1.3	45	9	105	24

The table reveals that the drying time taken for sun drying of banana was 36 hours and for poovan, rasthali, red banana, nendran, ney poovan and robusta. Irrespective of the variety guava and papaya took 36 and 48 hours on sun drying respectively. The temperature maintained in cabinet drying for banana was 300^{0}C. In osmotic dehydration all the fruits were kept in osmotic solution for 24 hours to maintain the colour and flavour.

Drying by microwaves is faster, more uniform and energetically more efficient as compared to the conventional process. Moisture removal is accelerated, since heat is generated internally by means of friction amongst molecules, not being strongly dependent on the external convective conditions created by the heated air. It should also be taken into consideration that for the same energetic expenditure, only 20 to 35 percent of the physical space is required for the microwave equipment as compared to the conventional process alone (Maskan, 2000}In tune with this results the present study showed that microwave drying took maximum of 3 hours for drying banana and minimum of 1.30hrs for drying papaya.

B. Processing of Fruits by Pulping

Fruit pulp is the inner contents of the peel. From the outer wrapping to the core, this section is known as pulp. When this portion is mashed, squeezed, or pulverized, the fruit will yield its moisture content and one gets juice.

1. Yield of the Banana, Guava and Papaya fruit pulp by Pulping Method

In the pulping process of fruits there may be wastage of peel or seed in the selected fruits .The details of initial weight of the fruit, wastage and yield of the banana, guava and papaya fruit pulp are stated in Table 16.

Table 16: Yield of Banana, Guava and Papaya Fruit Pulp

Name of the fruit pulp	Initial weight of the fruit (g)	Wastage (peel / seed)		Yield of the fruit pulp	
		(g)	(%)	(g)	(%)
Red banana	1000	296	30	704	70
Poovan banana	1000	228	23	772	77
Nendranbanana	1000	304	30	696	70
Rasthalibanana	1000	280	28	720	72
Neypoovan	1000	224	22	776	78
Robusta banana	1000	240	24	760	76
Guava-hill	1000	43	4	957	96
Guava country	1000	44	4	956	96
Papaya-red	1000	170	17	832	83
Papaya-yellow	1000	170	17	833	83

The table indicates that edible portion of fruit pulp for banana ranges between 70 and 78 percent and for guava and papaya were 96 and 83 percent respectively. Irrespective of the varieties the fruits guava and papaya, the wastage were 4 and 17 percent respectively. The wastage of banana, guava and papaya attributed by peel and stem, only seed and peel and seeds respectively. The wastage of peel in banana ranged from 20-30 percent which was maximum when compared to guava and papaya.

C. Processing of Fruits by Pickling

Pickling is a method of preserving food in an edible anti-microbial liquid. Table 17 shows the yield of mixed fruit pickle.

Table 17: Yield of Mixed Fruit Pickle

Variations	Raw weight of the fruits (g)	Dried weight (g)	Drying time (hours)	Yield of the product	
				(g)	(%)
1	400	260	8	355	88.74
2	450	350	8	415	92
3	500	365	8	460	92

The result of the study evinced that the per cent of yield of mixed fruit pickle in variation 2 and 3 was high, as 92 per cent which may be due to the additional quantity of fruit. A trial carried out to incorporate more quantity of fruit.

PHASE III: Quality Analysis and Shelf Life Study of Dehydrated Fruits and Formulated Fruit Products

Quality is a customer determination based upon a customer's actual experience with a product or service, measured against his or her requirements -stated or unstated, conscious or merely sensed, technically operational or entirely subjective -and always representing a moving target in a competitive market. The details of quality analysis are given below.

A. Quality analysis of dehydrated fruits stored in various packing material
B. Quality analysis of formulated fruits products

A. Quality analysis of dehydrated fruits for stored in various packing material

1. Sensory evaluation of dried fruits

Table 18 highlights the sensory evaluation scores of dried fruits obtained from various drying methods.

a. Mean Scores of Banana, Guava and Papaya by Sun Drying

Table 18 shows the mean scores of banana, guava and papaya by sun drying.

Table 18: Mean Scores of Banana, Guava and Papaya by Sun Drying

Attributes	Red Banana				Poovan				Nendran				Rasthali				Ney poovan				Robusta			
Storage days	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**
Appearance	4.5	4.0	3.2	2.8	4.4	4.3	3.1	2.5	4.6	4.1	3.0	2.7	4.3	3.9	3.6	2.9	4.4	4.0	3.3	2.9	4.5	3.9	2.2	2.9
Colour	4.4	3.9	3.0	2.5	4.3	4.1	3.6	2.3	4.4	4.0	2.9	2.5	4.2	3.5	3.3	2.8	4.3	3.9	3.0	2.9	4.4	3.8	3.1	2.8
Flavor	4.3	3.8	2.9	2.5	4.2	4.0	3.5	2.3	4.5	4.0	2.8	2.6	4.1	3.2	3.3	2.7	4.2	3.8	2.9	2.8	4.3	3.7	3.0	2.9
Texture	4.4	3.9	2.8	2.6	4.4	4.1	3.2	2.4	4.6	4.1	2.9	2.7	4.0	3.8	3.2	2.5	4.4	3.9	2.9	2.7	4.4	3.7	3.0	3.1
Taste	4.3	3.8	2.7	2.5	4.4	4.1	3.3	2.5	4.6	4.0	2.8	2.7	4.0	3.7	3.1	2.5	4.4	3.8	2.9	2.6	4.3	3.6	3.0	2.9
Total	**21.9**	**19.4**	**14.6**	**12.9**	**21.7**	**20.6**	**16.9**	**12.0**	**22.7**	**20.2**	**14.4**	**13.2**	**20.6**	**18.3**	**16.5**	**13.4**	**21.7**	**19.4**	**14.0**	**17.9**	**21.9**	**18.7**	**15.3**	**14.6**

Attributes	Guava country				Guava hill				Papaya red				Papaya yellow			
Storage days	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**
Appearance	4.4	3.9	3.1	3.0	4.5	4.0	3.6	2.8	4.4	4.1	2.2	3.1	4.6	3.9	3.6	2.5
Colour	4.6	3.8	3.1	3.3	4.4	3.9	3.3	2.5	4.3	4.0	3.1	3.3	4.4	3.8	3.3	2.3
Flavor	4.5	3.7	3.5	2.9	4.4	3.8	3.3	2.5	4.2	4.0	3.0	3.3	4.5	3.7	3.3	2.3
Texture	4.6	3.7	3.2	2.9	4.3	3.9	3.2	2.6	4.4	4.1	3.0	3.2	4.6	3.7	3.2	2.4
Taste	4.6	3.6	3.3	2.9	4.1	3.8	3.1	2.5	4.4	4.0	3.0	3.1	4.6	3.6	3.1	2.5
Total	**22.7**	**18.7**	**16.1**	**14.0**	**21.7**	**19.4**	**16.5**	**12.9**	**21.7**	**20.2**	**15.3**	**16.1**	**22.7**	**18.7**	**16.5**	**12.0**

The mean organoleptic score of the stored sun dried banana for three months showed slight differences. Though the total mean score ranged between 13- 14 on 90 days storage the acceptability was satisfactory. In general, dried banana stored for three months did not show any quality changes. Among the varieties of banana red and nendran banana scored high as 21.9 out of 25. Since there are many products developed by banana powder it was withdrawn. Where as in hill and country guava the initial scores were 22.7 and 21 7 and in papaya red and papaya yellow the initial scores were 21.7 and 22.7.

Based on the research study conducted by Mahendran and Prasannath (2008) *on* Influence of Pre-treatments on Quality of Dehydrated Ripe Banana, the results of the sensory evaluation revealed that the preference rating of colour of the blanched fruits was found to be significantly higher than that of blanching was not involved. Combined blanched and frozen bananas before drying improved their overall acceptability as a result of inactivating the enzymes responsible for browning. Therefore, combined blanching and freezing could be used as a pre-treatment to produce high quality dried banana where the banana fruits are produced in surplus annually.

b. Mean Scores of Banana, Guava and Papaya by Microwave Drying

Mean scores of banana, guava and papaya by microwave drying are shown in Table 19.

Table 19: Mean Scores of Banana, Guava and Papaya by Microwave Drying

Attributes	Red Banana				Poovan				Rasthali				Robusta				Neypoovan				Nendran			
Storage days	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**
Appearance	4.6	4.3	3.2	2.9	4.6	4.1	3.4	3.0	4.7	4.3	3.2	2.9	4.5	4.0	3.8	3.2	4.2	4.1	3.5	3.2	4.6	4.0	3.3	3.0
Colour	4.5	4.0	3.1	2.8	4.6	4.2	3.8	2.5	4.7	4.1	3.0	2.6	4.3	3.8	3.5	3.1	4.5	4.0	3.2	3.0	4.5	4.0	3.2	3.0
Flavor	4.5	3.1	3.0	2.6	4.3	4.1	3.9	2.5	4.9	4.2	3.0	2.7	4.2	3.5	3.4	2.9	4.3	4.0	3.1	2.9	4.0	3.9	3.3	2.9
Texture	4.6	3.0	2.7	2.6	4.5	3.0	3.5	2.6	4.8	4.0	3.0	2.7	4.0	3.8	3.2	2.5	4.5	3.5	3.0	2.7	4.4	3.7	3.0	3.1
Taste	4.4	3.8	2.7	2.5	4.5	4.1	3.4	2.5	4.8	4.0	2.9	2.7	4.0	3.9	3.1	2.5	4.4	3.5	2.9	2.6	4.3	3.6	3.0	2.9
Total	**22.6**	**18.2**	**14.7**	**13.4**	**22.5**	**19.5**	**18.0**	**13.1**	**23.9**	**20.6**	**15.1**	**13.6**	**21.0**	**19.0**	**17.0**	**14.2**	**22.0**	**19.1**	**15.7**	**4.4**	**21.8**	**19.2**	**15.8**	**14.9**

Attributes	Guava country				Guava hill				Papaya red				Papaya yellow			
Storage days	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**
Appearance	4.5	4.0	3.6	2.8	4.6	3.9	3.6	2.5	4.4	3.9	3.1	3.0	4.4	4.0	3.1	2.8
Colour	4.4	3.9	3.3	2.5	4.4	3.8	3.3	2.3	4.6	3.8	3.1	3.3	4.3	3.9	3.1	2.5
Flavor	4.4	3.8	3.3	2.5	4.5	3.7	3.3	2.3	4.5	3.7	3.5	2.9	4.2	3.8	3.5	2.5
Texture	4.3	3.9	3.2	2.6	4.6	3.7	3.2	2.4	4.6	3.7	3.2	2.9	4.4	3.9	3.2	2.6
Taste	4.1	3.8	3.1	2.5	4.6	3.6	3.1	2.5	4.6	3.6	3.3	2.9	4.4	3.8	3.3	2.5
Total	**21.7**	**19.4**	**16.5**	**12.9**	**22.7**	**18.7**	**16.5**	**12.0**	**22.7**	**18.7**	**16.1**	**14.0**	**21.7**	**19.4**	**16.1**	**12.9**

Scores: 20-25 Excellent; 15-19-Highly acceptable; 13-14-Acceptable; 10-12-Fairly acceptable; Less than 10-Not acceptable

The mean organoleptic score of the microwave dried banana stored for three months showed slight differences. The mean score for flavor and texture was ranged between 2.5 to 2.9.When compared to the varieties rasthali banana scored the maximum in microwave drying at 23.9 percent. It may be attributed by the high sucrose content. Among the attributes the flavor and appearance got the high scores of 4.9 and 4.7 out of 5. The acceptability score for guava country and papaya yellow was only 12.9 on 90^{th} day storage as against 22.7 on initial day score. However, it was found to be acceptable.

Medeni Maskan (2000) observed that the microwave finish drying reduced the convection drying time by about 64.3 percent. A physical model was employed to fit the experimental data and gave good fit for all experimental runs except microwave finish data. Microwave finish dried banana was lighter in colour and had the highest rehydration value.

c. Mean Scores of Banana, Guava and Papaya by Cabinet Drying

Table 20 reveals mean scores of banana, guava and papaya by cabinet drying.

Table 20: Mean Scores of Banana, Guava and Papaya by Cabinet Drying

Attributes	Red Banana				Poovan				Rasthali				Robusta				Neypoovan				Nendran			
Storage days	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**
Appearance	4.5	4.3	3.2	2.9	4.6	4.1	3.3	3.0	4.7	4.3	3.2	2.9	4.5	4.0	3.8	3.1	4.5	4.1	3.5	3.2	4.6	4.0	3.3	3.0
Colour	4.5	4.0	3.2	2.8	4.5	4.2	3.7	2.5	4.5	4.1	3.0	2.6	4.3	3.8	3.5	3.0	4.5	4.0	3.1	3.0	4.5	4.0	3.2	3.0
Flavor	4.4	3.0	3.0	2.6	4.3	4.1	3.8	2.5	4.6	4.1	3.0	2.7	4.2	3.5	3.4	2.8	4.3	4.0	3.0	2.9	4.0	3.7	3.3	2.9
Texture	4.5	3.0	2.7	2.6	4.5	3.0	3.5	2.5	4.5	4.0	3.0	2.7	4.0	3.8	3.2	2.5	4.5	3.5	3.0	2.7	4.4	3.7	3.0	3.1
Taste	4.3	3.8	2.7	2.5	4.4	4.1	3.3	2.5	4.6	4.0	2.8	2.7	4.0	3.9	3.1	2.5	4.4	3.8	2.9	2.6	4.3	3.6	3.0	2.9
Total	**22.2**	**18.1**	**14.8**	**13.4**	**22.3**	**19.5**	**17.6**	**13.2**	**22.9**	**20.5**	**15.3**	**13.6**	**21.4**	**19.3**	**17.3**	**13.9**	**22.2**	**19.4**	**15.5**	**14.9**	**21.8**	**19.3**	**15.8**	**14.9**

Attributes	Guava country				Guava hill				Papaya red				Papaya yellow			
Storage days	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**
Appearance	4.4	3.9	3.1	3.0	4.4	4.0	3.1	2.8	4.6	3.9	3.6	2.5	4.5	4.0	3.6	2.8
Colour	4.6	3.8	3.1	3.3	4.3	3.9	3.1	2.5	4.4	3.8	3.3	2.3	4.4	3.9	3.3	2.5
Flavor	4.5	3.7	3.5	2.9	4.2	3.8	3.5	2.5	4.5	3.7	3.3	2.3	4.4	3.8	3.3	2.5
Texture	4.6	3.7	3.2	2.9	4.4	3.9	3.2	2.6	4.6	3.7	3.2	2.4	4.3	3.9	3.2	2.6
Taste	4.6	3.6	3.3	2.9	4.4	3.8	3.3	2.5	4.6	3.6	3.1	2.5	4.1	3.8	3.1	2.5
Total	**22.7**	**18.7**	**16.1**	**14.0**	**21.7**	**19.4**	**16.1**	**12.9**	**22.7**	**18.7**	**16.5**	**12.0**	**21.7**	**19.4**	**16.5**	**12.9**

Scores: 20-25 Excellent; 15-19-Highly acceptable; 13-14-Acceptable; 10-12-Fairly acceptable; Less than 10-Not acceptable

In cabinet drying the maximum acceptability score of banana on initial day was 22 and was reduced to 13 to 14on 90th day. While only in papaya red the total score was reduced from 22.7 to 12 indicating that the product is fairly acceptable.

Suresh Kumar (2006) concluded that it would be economical to dry the osmo dried slices with the tray load of 0.40 g/cm2in cabinet and vacuum drier, though with less tray load faster drying was achieved. A tray load less than optimum might not be economically viable and more than this increases the drying time. However, under low temperature drier, since the osmo dried slices tend to shrink due to more time for drying with high tray load, it was advisable to select optimum tray load of 0.35 g/cm^2. Tray load and drier has the profound influence on the dehydration characteristics of fruit slices. Therefore, during setting up the drying industry on large scale, tray load, drying time and drier types are the process variables, which are to be monitored carefully so as to get good quality of products.

d. Mean Scores of Banana, Guava and Papaya by Osmotic Dehydration Method

Mean scores of banana, guava and papaya by osmotic dehydration method is shown in Table 21.

Table 21: Mean Scores of Banana, Guava and Papaya by Osmotic Dehydration Method

Attributes	Red Banana				Poovan				Rasthali				Robusta				Neypoovan				Nendran			
Storage days	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**
Appearance	4.5	4.0	3.8	3.1	4.5	4.1	3.5	3.2	4.6	4.0	3.3	3.0	4.6	4.1	3.3	3.0	4.5	4.3	3.2	2.9	4.7	4.3	3.2	2.9
Colour	4.3	3.8	3.5	3.0	4.5	4.0	3.1	3.0	4.5	4.0	3.2	3.0	4.5	4.2	3.7	2.5	4.5	4.0	3.2	2.8	4.5	4.1	3.0	2.6
Flavor	4.2	3.5	3.4	2.8	4.3	4.0	3.0	2.9	4.0	3.7	3.3	2.9	4.3	4.1	3.8	2.5	4.4	3.0	3.0	2.6	4.6	4.1	3.0	2.7
Texture	4.0	3.8	3.2	2.5	4.5	3.5	3.0	2.7	4.4	3.7	3.0	3.1	4.5	3.0	3.5	2.5	4.5	3.0	2.7	2.6	4.5	4.0	3.0	2.7
Taste	4.0	3.9	3.1	2.5	4.4	3.8	2.9	2.6	4.3	3.6	3.0	2.9	4.4	4.1	3.3	2.5	4.3	3.8	2.7	2.5	4.6	4.0	2.8	2.7
Total	**21.4**	**19.3**	**17.3**	**13.9**	**22.2**	**19.4**	**15.5**	**14.9**	**21.8**	**19.3**	**15.8**	**14.9**	**22.3**	**19.5**	**17.6**	**13.2**	**22.2**	**18.1**	**14.8**	**13.4**	**22.9**	**20.5**	**15.3**	**13.6**

Attributes	Guava country				Guava hill				Papaya red				Papaya yellow			
Storage days	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**	**0**	**30**	**60**	**90**
Appearance	4.6	3.9	3.6	2.5	4.4	4.0	3.1	2.8	4.5	4.0	3.6	2.8	4.4	3.9	3.1	3.0
Colour	4.4	3.8	3.3	2.3	4.3	3.9	3.1	2.5	4.4	3.9	3.3	2.5	4.6	3.8	3.1	3.3
Flavor	4.5	3.7	3.3	2.3	4.2	3.8	3.5	2.5	4.4	3.8	3.3	2.5	4.5	3.7	3.5	2.9
Texture	4.6	3.7	3.2	2.4	4.4	3.9	3.2	2.6	4.3	3.9	3.2	2.6	4.6	3.7	3.2	2.9
Taste	4.6	3.6	3.1	2.5	4.4	3.8	3.3	2.5	4.1	3.8	3.1	2.5	4.6	3.6	3.3	2.9
Total	**22.7**	**18.7**	**16.5**	**12.0**	**21.7**	**19.4**	**16.1**	**12.9**	**21.7**	**19.4**	**16.5**	**12.9**	**22.7**	**18.7**	**16.1**	**14.0**

Scores: 20-25 Excellent; 15-19-Highly acceptable; 13-14-Acceptable; 10-12-Fairly acceptable; Less than 10-Not acceptable

The total mean score awarded for 90 day storage of nendran, red and poovan banana ranged from 13.9-14.9 while neypoovan, robusta and rasthali had a score range of 13.4-13.6. This indicates that acceptability level was 67-75 per cent. All the selected varieties of banana processed by osmotic dehydration method stored till 90 days was acceptable through the mean sensory. The acceptability score was reduced to 12 to 14 percent in guava and papaya varieties, it is acceptable.

Osmotic dehydration proved to be a good quality method to get modestly processed fruits due to the much sensory resemblance between the natural and dehydrated fruits.

2. Nutrient content of fresh and dehydrated fruits

Banana:

Nutrient content of fresh and dried banana varieties are given in Table 22.

Table 22: Nutrient Content of Fresh and Dried Banana

Parameters	Red Banana					Poovan					Rasthali				
	Fresh banana	1	2	3	4	Fresh banana	1	2	3	4	Fresh banana	1	2	3	4
Energy (kcal)	380	381	361	370	394	390	390	367	369	392	390	382	360	388	390
Fat (g)	0.18	0.12	0.10	0.10	0.22	0.18	0.12	0.11	0.11	0.24	0.25	0.11	0.11	0.22	0.24
Carbohydrate (g)	80.21	78.49	75.88	75.10	82.80	88.50	80.21	76.98	75.55	81.70	83.50	80.21	74.14	81.44	81.01
Protein (g)	9.16	9.12	9.19	9.22	9.30	10.00	9.16	9.37	9.40	9.34	9.50	9.01	9.95	9.28	9.32
Moisture (%)	70.4	7.74	12.12	12.48	5.80	77.20	7.74	10.64	10.50	5.40	72	9.00	12.82	6.89	5.50
Total ash (%)	2.50	2.28	3.11	3.30	1.90	2.70	2.28	2.89	3.21	1.94	2.10	8.59	3.08	2.16	1.97
Dietary fibre (g)	5.0	5.0	5.0	5.0	4.89	5.25	5.21	5.0	5.20	4.40	5.20	0.01	5.10	4.38	3.30
Potassium	376	1470	1477	1489	1491	375	1482	1479	1486	1477	373	1478	1481	1478	1482
Vitamin A	85.5	239	245	244	244	86	243	245	244	244	86.1	239	244	243	241
Vitamin C	12	6.8	7.5	7.0	7.0	12.3	6.9	7.5	6.8	6.9	12.6	7.0	7.8	6.8	6.8
Total Antioxidant activity	6	65.0	80.0	79.0	79	6	67.0	80	79	78	6	67	79	73	77

Parameters	Robusta					Neypoovan					Nendran				
	Fresh banana	1	2	3	4	Fresh banana	1	2	3	4	Fresh banana	1	2	3	4
Energy (kcal)	378	372	370	350	390	380	377	366	363	383	390	370	385	390	390
Fat (g)	0.30	0.30	0.20	0.30	0.24	0.18	0.10	0.09	0.09	0.22	0.14	0.10	0.11	0.13	0.24
Carbohydrate (g)	79	77.71	76.20	78.40	81.01	78.50	79.62	75.68	34.15	79.30	80.50	74.18	80.3	80.24	81.01
Protein (g)	9.20	9.04	9.14	9.16	9.32	10	8.54	9.87	9.44	9.31	10.0	9.99	9.24	9.25	9.32
Moisture (%)	76	10.80	11.20	10.02	5.50	77.60	9.54	11.44	13.24	5.5	69.6	12.66	7.44	6.20	5.50
Total ash (%)	2.30	2.44	2.90	2.10	1.97	2.50	2.17	2.88	2.83	1.89	3.20	3.30	2.89	2.40	1.97
Dietary fibre (g)	5.45	5.40	5.50	5.35	3.30	5.0	4.90	5.15	5.0	5.51	5.25	5.10	5.35	5.25	3.30
Potassium	376	1470	1477	1489	1491	375	1482	1479	1486	1477	373	1478	1481	1478	1482
Vitamin A	85.5	239	245	244	244	86	243	245	244	244	86.1	239	244	243	241
Vitamin C	12	6.8	7.3	7.0	7.1	12.3	6.9	7.5	6.8	6.9	12.3	7.0	7.8	7.0	6.8
Total Antioxidant activity	6	65.0	79.0	73.0	79	6	65.0	80	75	78	6	63	79	77	79

The potassium content was increased in all varieties of banana dehydrated by various methods of drying. It was found maximum in cabinet drying. Vitamin A content increased to nearly 3 times more than fresh banana. Vitamin C content was reduced in all method of dehydration. The total antioxidant activity was increased in dried banana when compared with fresh in all varieties. Among the drying methods the antioxidant activity microwave drying was maximum.

Fatemeh (2012) reported that Banana flours prepared from pulp and peel of Cavendish variety had higher antioxidative compounds than those prepared from the Dream variety. In most of the cases the antioxidative compounds were generally higher in the peel than in the pulp and in the green than in the ripe components.

The fat value in fresh banana was 0.18g which reduced to 0.10g after drying process. The carbohydrate value in fresh banana was 80g whereas it was only 75g in cabinet drying. The protein values varied from 9g to10g showing variation in microwave and cabinet drying. The moisture content of fresh banana was reduced to a great extent from 70g to 12g after drying. The dietary fibre was not affected by drying.

Dietary fibers in foods are also beneficial for good health. Physiological impacts of insufficient dietary fiber intake are constipation, increased risk of coronary heart disease, and increased fluctuation of blood glucose and insulin levels (AACC, 2001; Jenkins et al., 1998). The National Research Council (2002) set Dietary Reference Intakes for the first time for dietary fiber determining that “Adequate Intakes” (AI) for dietary fiber be based on 14 grams dietary fiber per 1,000 calories. The FDA (1993) set a Daily Reference Value on food labels for fiber at 25 grams for a 2,000-calorie diet. Five g or more fiber per serving is considered a significant amount.

Vinson et al. (2006) proved that processing to produce the dried fruit significantly decreases the phenols in the fruits on a dry weight basis. Compared with vitamins C and E, dried fruits have superior quality antioxidants with figs and dried plums being the best.

Guava

The nutrient content of fresh and dried guava is depicted in following Table 23.

Table 23: Nutrient Content of Fresh and Dried Guava

Parameters	Guava-Country					Guava-Hill				
	Fresh	1	2	3	4	Fresh	1	2	3	4
Energy (kcal)	75	372	**370**	**363**	**390**	**76**	**371**	370	**367**	384
Fat (g)	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Carbohydrate (g)	63	85	87	86	86	64	84	87	85	86
Protein (g)	3.0	7.2	7.1	7.2	7.1	3.0	7.1	7.2	7.1	7.2
Moisture (%)	89	12	12.5	12.3	12.5	90	12.1	12	12	12.3
Total ash (%)	0.7	1	1	1	1	1	1	1	1	1
Dietary fibre (g)	6	7	7	7	7	6.1	7.2	7	7.1	7
VitaminA (iu)	624	1526	1541	1540	1540	624	1524	1540	1540	1538
Vitamin C (mg)	224	115	135	134	136	220	135	136	136	135
Antioxidant activity (□g)	140	1300	1350	1300	1290	140	1390	1385	1300	1300

The protein content of dried guava is increased in all drying methods. The vitamin c content was reduced from to 115 to 136 mg. since it is water soluble. Although losses have occurred during the process, the vitamin C content retained in the sun drying, microwave drying, cabinet drying and osmotic dehydration and characterizes these products as a valuable source of vitamin C. The retention of dietary fiber observed in all drying methods.

Papaya

The nutrient content of fresh and dried red and yellow pulp papaya is highlighted in following Table 24.

Table 24: Nutrient Content of Fresh and Dried Papaya

Parameters	Papaya-Red					Papaya-Yellow				
	Fresh papaya	1	2	3	4	Fresh papaya	1	2	3	4
Energy (kcal)	119	394	**393**	**394**	**390**	**120**	**388**	384	**380**	390
Fat (g)	1.20	0.5	0.5	0.6	0.5	1.2	0.5	0.6	0.6	0.5
Carbohydrate (g)	25	82	82	83	82	25	83	83	82	83
Protein (g)	1.0	2.0	2.1	2.2	2.0	1.0	2.0	2.0	2.1	2.1
Moisture (%)	69	15	12	13	13	69	15	13	12	13
Total ash (%)	4	0.4	0.39	0.39	0.4	4	0.39	0.37	.039	0.34
Dietary fibre (g)	2.8	3.30	3.0	3.2	3.2	2.8	3.0	3.3	3.3	3.2
Vitamin A(IU)	1066	1666	1869	1695	1699	1066	1665	1819	1690	1695
Antioxidant activity (□g)	49	500	530	500	495	49	500	545	510	500

1-Sundrying; 2-Microwave drying; 3-Cabinet drying; 4-Osmotic dehydration

Akpinar (2006) reported that moisture and fat content was low in sun dried tomato slices. The colour, rehydration ratio and ascorbic acid retention were comparatively higher in solar dried tomato slices.

This study also proved that the per cent of moisture and fat was very low for dried papaya dices than papaya fruit and the retention of other vital nutrient and vitamins were high in dried papaya dices. It is noted from the table that, the amount of energy, protein, fibre, vitamin A, carbohydrate and vitamin C content of dried papaya dices was found to be higher than the papaya fruit because of the concentrated component of the fruit. It is clearly noted from the study, that the preservation method definitely enriched the nutrient content of the processed fruit.

The antioxidant activity of dried banana, guava and papaya was increased nearly 10 times when compared to fresh fruit. It may be due to the concentration of the fruit constituents.

3. Total Plate Count of dehydrated fruits

The following Tables 25 to 28 project shelf life and acceptability of the dried banana stored in polyethylene (PE), air tight food grade plastic container (PVC) and aluminum foil.

Table 25: Total Plate Count of Dehydrated Fruits by Sun Drying and Packed in Various Packing Materials

Fruits / Storage days	Polythene bag (10^3 CFU)				Air tight container (10^3 CFU)				Aluminium foil (10^3 CFU)			
	0	30	60	90	0	30	60	90	0	30	60	90
Red banana	Neg	Neg	01	02	Neg	Neg	03	05	Neg	Neg	02	05
Poovan	Neg	Neg	04	05	Neg	Neg	02	05	Neg	Neg	04	07
Rasthali	Neg	Neg	03	05	Neg	Neg	02	05	Neg	Neg	05	10
Robusta	Neg	Neg	04	05	Neg	Neg	03	04	Neg	Neg	02	05
Neypoovan	Neg	Neg	02	04	Neg	Neg	04	05	Neg	Neg	05	09
Nendran	Neg	Neg	02	04	Neg	Neg	02	03	Neg	Neg	07	10
Guava(country)	Neg	Neg	02	04	Neg	Neg	02	04	Neg	Neg	02	04
Guava (hill)	Neg	Neg	03	04	Neg	Neg	03	04	Neg	Neg	02	08
Papaya (red)	Neg	Neg	02	04	Neg	Neg	02	03	Neg	Neg	03	09
Papaya (yellow)	Neg	Neg	02	04	Neg	Neg	02	03	Neg	Neg	02	06

Neg-Negative

This table shows that initial bacterial count of six varieties of sun dried banana stored in three different packaging materials namely polythene bag,

air tight container and aluminium foil was negative. The microbial count was increased in red banana, poovan, rasthali, robusta, ney poovan, nendran which was found to be 01(10^3 CFU), 04(10^3 CFU), 03(10^3 CFU), 04(10^3 CFU), 02(10^3 CFU),02 (10^3 CFU) respectively on 60th day of storage and followed by this the microbial content was 02 (10^3 CFU), 05 (10^3 CFU), 05 (10^3 CFU), 05 (10^3 CFU) , 04 (10^3 CFU), 04 (10^3 CFU) respectively stored on 90thday in polythene bag.

Similarly in air tight container on 60th day the microbial count was noted in red banana, poovan, rasthali, mourish, ney poovan, nendran which was found to be 03 (10^3 CFU), 02 (10^3 CFU), 02 (10^3 CFU), 03 (10^3 CFU), 04 (10^3 CFU), 02 (10^3 CFU) and followed by 90thday 05 (10^3 CFU), 05(10^3 CFU), 05(10^3 CFU),04(10^3 CFU), 05(10^3 CFU),03(10^3 CFU) respectively.

The bacterial count of banana varieties red banana, poovan, rasthali, robusta, ney poovan, nendran stored in aluminium foil on 60th day was increased and found to be 02(10^3 CFU), 04(10^3 CFU), 05(10^3 CFU), 02(10^3 CFU),05(10^3 CFU), 07(10^3 CFU) and followed by 90thday 05 (10^3 CFU), 07(10^3 CFU)1, 0(10^3 CFU),05(10^3 CFU), 09(10^3 CFU), 10(10^3 CFU) respectively.

Table 26: Mean Score of Banana Candy using Score Card

Fruits / Storage	Polythene bag (10^3				Air tight container (10^3				Aluminium foil (10^3			
	0	30	60	90	0	30	60	90	0	30	60	90
Red banana	Neg	Neg	01	02	Neg	Neg	07	09	Neg	Neg	05	09
Poovan	Neg	Neg	01	03	Neg	Neg	04	08	Neg	Neg	06	09
Rasthali	Neg	Neg	01	03	Neg	Neg	04	05	Neg	Neg	05	10
Robusta	Neg	Neg	01	05	Neg	Neg	06	09	Neg	Neg	05	08
Ney poovan	Neg	Neg	01	02	Neg	Neg	06	09	Neg	Neg	05	07
Nendran	Neg	Neg	01	03	Neg	Neg	04	06	Neg	Neg	07	09
Guava	Neg	Neg	01	05	Neg	Neg	04	08	Neg	Neg	08	09
(country)	Neg	Neg	01	04	Neg	Neg	07	08	Neg	Neg	09	10
Guava (hill)	Neg	Neg	01	04	Neg	Neg	07	09	Neg	Neg	09	09
Papaya (red)	Neg	Neg	01	04	Neg	Neg	07	09	Neg	Neg	08	09
Papaya (yellow)												

Neg - Negative

Table 26 shows that bacterial count of six varieties of banana dehydrated by microwave method and stored in three selected package materials on 0 day and 30 th day was negative. On 60th day microbial count of red banana, poovan, rasthali, robusta, ney poovan, nendran stored in polythene bag was 01(10^3 CFU), 01(10^3 CFU), 01(10^3 CFU), 01(10^3 CFU), 01(10^3 CFU), 01(10^3 CFU) and followed by 90thday it was 02(10^3 CFU), 03(10^3 CFU), 03(10^3 CFU), 05(10^3 CFU), 02(10^3 CFU),03(10^3 CFU) respectively.

On 60th day the microbial count red banana, poovan, rasthali, robusta, ney poovan, and nendran stored in air tight container was found to be 07(10^3 CFU), 04(10^3 CFU),04(10^3 CFU), 06(10^3 CFU), 06(10^3 CFU), 04(10^3 CFU) and followed by 90th day 09(10^3 CFU), 08(10^3 CFU), 05(10^3 CFU), 09(10^3 CFU), 09(10^3 CFU), 06(10^3 CFU) respectively.

In aluminium foil storage the microbial count was noted from 60 days of storage in red banana, poovan, rasthali, robusta, ney poovan, nendran and was found to be 05(10^3 CFU), 06(10^3 CFU), 05(10^3 CFU), 05(10^3 CFU), 05(10^3 CFU), 07(10^3 CFU) and followed by 90thday it was 09(10^3 CFU), 09(10^3 CFU),10(10^3 CFU), 07(10^3 CFU), 09(10^3 CFU), 10(10^3 CFU) respectively.

Table 27: Mean Score of Banana Candy using Score Card

Fruits / Storage days	Polythene bag (10^3 CFU)				Air tight container (10^3 CFU)				Aluminium foil (10^3 CFU)			
	0	30	60	90	0	30	60	90	0	30	60	90
Red banana	Neg	Neg	Neg	03	Neg	Neg	Neg	02	Neg	Neg	Neg	03
Glucose	Neg	Neg	Neg	04	Neg	Neg	Neg	05	Neg	Neg	Neg	04
Rasthali	Neg	Neg	Neg	03	Neg	Neg	Neg	02	Neg	Neg	Neg	02
Mourish	Neg	Neg	Neg	03	Neg	Neg	Neg	03	Neg	Neg	Neg	03
Karpooravalli	Neg	Neg	Neg	04	Neg	Neg	Neg	03	Neg	Neg	Neg	04
Nendran	Neg	Neg	Neg	04	Neg	Neg	Neg	03	Neg	Neg	Neg	03
Guava	Neg	Neg	Neg	02	Neg	Neg	Neg	04	Neg	Neg	Neg	04
(country)	Neg	Neg	Neg	02	Neg	Neg	Neg	05	Neg	Neg	Neg	02
Guava (hill)	Neg	Neg	Neg	03	Neg	Neg	Neg	05	Neg	Neg	Neg	03
Papaya (red)	Neg	Neg	Neg	02	Neg	Neg	Neg	05	Neg	Neg	Neg	06
Papaya (yellow)												

Neg - Negative

Table 27 shows that initial and 60th day's bacterial count of six varieties of cabinet dried banana is negative. The microbial count was noted on 90th day red banana, poovan, rasthali, robusta, neypoovan and nendran which was found to be 03(10^3 CFU), 04(10^3 CFU), 03(10^3 CFU), 03(10^3 CFU), 04(10^3 CFU), 04(10^3 CFU) respectively.

In air tight container initial bacterial value in banana varieties is negative. The increase in microbial count in red banana, poovan rasthali, mourish, ney poovan, nendran were 02(10^3CFU), 05 (10^3CFU),2(10^3 CFU), 03(10^3 CFU), 03(10^3 CFU), 03(10^3CFU) respectively on 90th day.

In aluminium foil storage initial bacterial value in banana varieties was negative. The increase in microbial count in red banana, poovan rasthali, robusta, neypoovan, nendran found to be between 03(10^3 CFU) and 04(10^3 CFU) on 90th day.

Table 28: Mean Score of Banana Candy using Score Card

Fruits / Storage	Polythene bag (10^3 CFU)				Air tight container (10^3 CFU)				Aluminium foil (10^3 CFU)			
	0	30	60	90	0	30	60	90	0	30	60	90
Red banana	Neg	Neg	Neg	02	Neg	Neg	Neg	04	Neg	Neg	Neg	05
Poovan	Neg	Neg	Neg	03	Neg	Neg	Neg	04	Neg	Neg	Neg	05
Rasthali	Neg	Neg	Neg	02	Neg	Neg	Neg	04	Neg	Neg	Neg	05
Robusta	Neg	Neg	Neg	02	Neg	Neg	Neg	04	Neg	Neg	Neg	05
Neypoovan	Neg	Neg	Neg	02	Neg	Neg	Neg	04	Neg	Neg	Neg	06
Nendran	Neg	Neg	Neg	02	Neg	Neg	Neg	04	Neg	Neg	Neg	07
Guava (country)	Neg	Neg	Neg	02	Neg	Neg	Neg	04	Neg	Neg	Neg	04
Guava (hill)	Neg	Neg	Neg	02	Neg	Neg	Neg	04	Neg	Neg	Neg	08
Papaya (red)	Neg	Neg	Neg	04	Neg	Neg	Neg	03	Neg	Neg	Neg	09
Papaya (yellow)	Neg	Neg	Neg	04	Neg	Neg	Neg	03	Neg	Neg	Neg	06

Neg-Negative

Irrespective of the packaging materials up to 60th day of storage the dried bananas of all varieties were safe without microbial count. However on 90th day the microbial count in three storage packages namely polythene bag, air tight container and

aluminium foil were 01(10^3 CFU), 02(10^3 CFU) and 04(10^3 CFU) respectively. So, the keeping quality of osmo dried fruits were highly acceptable till 60 days of storage.According to prevention of Food Adulteration rules, (PFA) 1956 the permissible limit for dried fruits are not more than 40,000/gm which should be identified by Total plate count and it should not exceed10^3 CFU. (PFA-appendix d table 2 microbiological requirements food products).

B. Quality analysis of Formulated Fruits Products

a. Sensory evaluation of banana candy

i. Mean score of banana candy using score card

The sensory evaluation was done using 5-point rating score for appearance, colour, flavour, taste and texture. The skilled panel members evaluated and the mean scores of banana candy using score card and hedonic scale are presented in Tables 29 and 30.

Table 29: Mean Score of Banana Candy using Score Card

Attributes	Mean ± SD Score for Variations					
	V_1	V_2	V_3	V_4	V_5	V_6
Appearance	3.93±1.04	4.26±0.69	3.9±1.12	3.43±1.13	3.43±1.07	3.50±1.10
'r' value	1	0.168	0.82	0.46	0.24	0.23
Colour	4.50±0.62	4.26±0.82	3.43±0.97	3.26±1.08	3.26±1.17	3.23±1.35
'r' value	1	0.33	0.02	0.65	0.42	0.54
Flavour	4.06±0.94	3.43±0.98	4.03±0.96	3.66±0.99	3.66±1.15	3.80±0.99
'r' value	1	0.07	0.11	0.06	0.17	0.08
Taste	3.80±1.06	3.90±0.88	3.63±1.09	3.16±0.91	3.53±0.93	3.46±0.97
'r' value	1	0.23	0.11	0.28	0.11	0.46
Texture	4.50±0.33	4.33±0.75	3.33±1.37	3.03±0.66	2.63±0.92	1.88±1.10
'r' value	1	0.06	0.00	0.38*	0.38*	0.17

V= Variation

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

As far as the appearance is concerned the maximum of 40 per cent of panel members stated that variation 3 was found to be very appealing. It is observed that 56 per cent, 40 per cent and 33 per cent of them stated as appealing for V_2, V_1 and V_5 respectively. However, the appearance of all the variations in general was appealing. The mean score for appearance was between 3.93 and 4.26. Variation 1 and variation 2 was attributed as cocoa brown by 56 and 46 per cent respectively whereas 36 per cent and 33 per cent of the panels scored dark brown for V_2 and V_1 respectively. Thus the variation 1 and 2 obtained maximum mean score of 4 indicating a dark colour.

Flavour of variation 1 and 3 was highly acceptable by 40, 43 and 40 per cent while only one per cent did not like the candy. However the mean score was between 3.4 and 4.06. The flavour of variation 1 was highly acceptable with a mean score of 4.

Taste was found to be excellent for 30 per cent and 26 per cent for variation 3 and 2. Variation 2 was identified as very good for 13 panel members while 53, 46 and 43 per cent stated that variation 5, 6 and 3 were good respectively. As far as the mean score is concerned variation 1 and 2 was found to be very good.

Out of 18 members, 60 per cent scored as hard for variation 1. Variation 2 was identified by 33 per cent as breakable, 43 per cent as semi-soft for variation 5 and 53 per cent stated as soft for variation 6. The score of texture for variation 1 and 2 was 4.5 and 4.2 respectively.

The total mean value obtained for appearance, colour, flavour taste and texture were between 3.5 and 4.5 and the ‘r’ value also indicated that variation 1 is highly and positively correlated. The variation 1 with 5 g of banana pulp was found to be highly satisfied since the banana candy had a desirable attributes.

ii. Mean hedonic rating scale for banana candy

Table 30: Mean Hedonic Rating Scale for Banana Candy

Attribute	Score	V_1		V_2		V_3		V_4		V_5		V_6	
		N=30	%	N=30	%	N=30	%	N=30	%	N=30	%	N=30	%
Like extremely	9	9	30	10	33.33	5	16.6	5	16.6	7	23.3	4	13.3
Like very much	8	10	33.33	16	53.3	11	36.6	5	16.6	3	10	7	23.3
Like moderately	7	5	16.6	2	6.6	10	33.33	9	30	8	26.6	12	40
Like slightly	6	4	13.3	1	3.33	4	13.3	7	23.3	10	33.33	6	20
Neither like nor dislike	5	-	-	-	-	-	-	3	10	-	-	-	-
Dislike slightly	4	1	3.33	1	3.33	-	-	1	3.33	-	-	-	-
Dislike moderately	3	1	3.33	-	-	-	-	-	-	1	3.33	-	-
Dislike very much	2	-	-	-	-	-	-	-	-	1	3.33	1	3.33
Dislike extremely	1	-	-	-	-	-	-	-	-	-	-	-	-
Mean ± SD	-	7.56 ± 1.50		8.06 ± 1.04		7.56 ± 0.93		6.96 ± 1.35		6.90 ± 1.64		7.13 ± 1.35	
'r' value	-	1		0.52		0.15		0.35		0.38		0.53**	

V – Variation.

Table 30 revealed that 33, 30 and 23 per cent of the panel members scored as like extremely for variation 2, 1 and 5 respectively. Variations 3 and 4 were scored by 33-53 per cent as like very much. Ten per cent scored as neither like nor dislike and the lowest score was given for variation 1, 2 and 4 by 3 per cent as dislike slightly.

b. Nutrient content of banana and banana candy

The nutrient content of banana and banana candy is shown in Table 31 and Figure 10.

Table 31: Nutrient Content of Banana and Banana Candy

Parameters	Banana fruit (100 g)	Banana candy (100 g)	Difference
Energy (Kcal)	141	428	287
Protein (g)	1	6	5
Fat (g)	0.3	12	12.7
Carbohydrates (g)	32	66	34
Iron (mg)	0.36	0.8	7.64
Ash (%)	0.5	7	6.5
Acid insoluble Ash (%)	0	0.02	0.02
Dietary fibre (g)	1	1	-
Total sugar (g)	58	38	-20

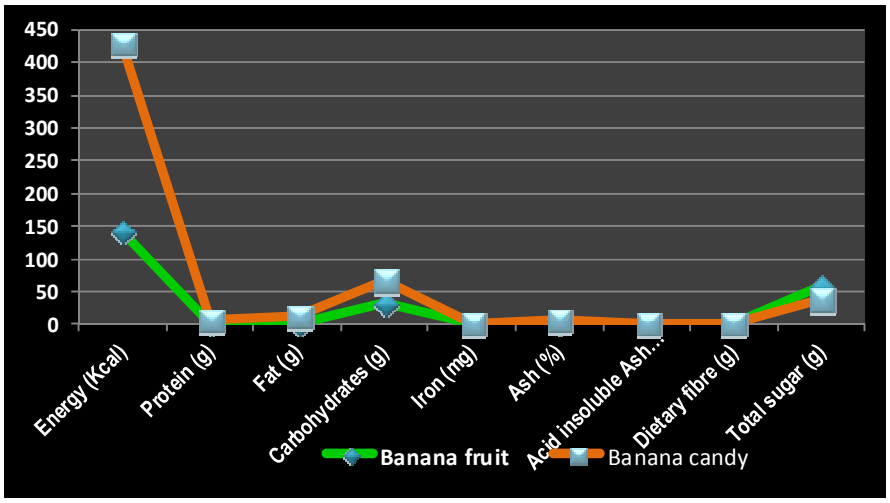


Figure 10: Nutrient Content of Banana and Banana Candy

The Table 31 shows that there was a difference in nutrients content between raw and processed fruits. It was seen that nutrients like energy (287g), protein (5g), fat (12.7g), carbohydrates (34g), iron (7.64mg), ash (6.5 per cent), acid insoluble ash (0.02 per cent) were higher in banana candy. The total sugar of banana fruit was more than banana candy since only 5 g of pulp was included in 100g of banana candy.

Moreover in 100g of banana candy jaggery and fat were included thereby energy, carbohydrates and fat content were enhanced and improved the value of the candy.

c. Shelf Life Study

i. Mean score of banana candy during shelf life study

The acceptability of banana candy was studied during the shelf life study and the mean score and hedonic ratings are given in Tables 32 and 33.

Table 32: Mean Score of Banana Candy during Shelf Life Study

Attributes	Mean ±SD score			
	0 day	30 days	60 days	90 days
Appearance	3.20±0.78	3.80±0.42	3.20±0.78	3.90±1.19
Colour	3.50±0.97	4.00±0.00	3.90±0.31	4.40±0.51
Flavour	3.70±0.48	3.70±0.48	3.60±0.69	3.70±0.82
Taste	3.30±0.67	3.50±0.97	3.10±0.56	3.20±0.78
Texture	2.80±1.54	3.70±0.94	2.60±1.50	3.90±1.10

The appearance of banana candy was scored as appealing by 80 and 50 percent for 15 and 0 day shelf life. Even after 60 days shelf life the sensory acceptability of papaya candy was highly acceptable by 40 per cent of panel members. Only 20 per cent scored as fairly appealing at 0 day and 60 days shelf life.

The colour cocoa brown remained even after 90 days shelf life of papaya candy whereas 100, 90 and 70 per cent of panel members scored as dark brown on 30.60 and 0 day storage respectively. Light brown colour was given for 0 day shelf life by 20 per cent. The least score was given by 10 per cent on 0 day storage as brown colour.

The flavour was highly acceptable by 10 per cent on 90 days storage. Seventy per cent each stated that papaya candy was acceptable until 60 days of storage period. The moderate score was given for 0, 30.60 and 90 days storage. Only 10 per cent pointed out that candy was slightly acceptable during 60 and 90 days storage periods.

Very good taste was identified by maximum of 40 to 60 per cent panel members on 30th day and 0 day storage. Good taste was scored by 70 and 50 per cent for 60 and 0 day storage whereas 10 per cent was given for banana candy during shelf life as fair taste.

The texture was traced as hard by 30 per cent of panel members on 90th day storage period. Ninety, 60 and 50 per cent scored as breakable on 0 30,and 90 days storage. The texture was found to be soft on 0 and 60 days storage as per 40 per cent of panel members.

Out of 25 score, the mean value of banana candy was 16.5 on 0 day, 15.2 on 30th day 16.4 on 60th day and 19.1 on 90th day which indicated that the overall attribute was highly acceptable by the panelist. The Table 32 also shows that there were no changes in attribute and the level of acceptability even after 90 days shelf life.

Table 33: Mean Hedonic Rating Scale for Banana Candy during Shelf Life Study

Attribute	Score	Days of storage							
		0		30		60		90	
		N=30	%	N=30	%	N=30	%	N=30	%
Like extremely	9	-	-	-	-	-	-	-	-
Like very much	8	3	10	15	50	15	50	3	10
Like moderately	7	24	80	15	50	15	50	24	80
Like slightly	6	3	10	-	-	-	-	3	10
Neither like nor dislike	5	-	-	-	-	-	-	-	-
Dislike slightly	4	-	-	-	-	-	-	-	-
Dislike moderately	3	-	-	-	-	-	-	-	-
Dislike very much	2	-	-	-	-	-	-	-	-
Dislike extremely	1	-	-	-	-	-	-	-	-
Mean ± SD	-	7.00 ± 2.47		7.50 ± 0.52		7.50 ± 0.52		7.00 ± 0.47	

The above table indicates that the maximum score of like very much was awarded by 50 per cent for 30 and 60 days storage. Like moderately was given by 80 per cent for 0 days and 90 days shelf life, ten per cent scored as like slightly for 0 and 90 days shelf life.

The sensory acceptability of the papaya candy was changed during shelf life study, this may be due to packaging material used and the technique used for preparation.

The mean value of banana candy during shelf life was between 7 and 7.5 which is the maximum score indicating that the value added product of banana candy was acceptable for consumption.

ii. Nutrient content of banana candy during shelf life study

The nutrient content of banana candy on 0day and 90th day is given in Table 34.

Table 34: Nutrient Content of Banana Candy during Shelf Life Study

Parameters	0 day	90th day	Difference
Energy (Kcal)	428	444	15
Protein (g)	5	5	-
Fat (g)	13	13	-
Carbohydrates (g)	66	69	3.65
Iron (mg)	8	8	-
Ash (%)	7.04	7.34	-
Acid insoluble Ash (%)	0.02	0.02	-
Dietary fibre (g)	1.5	1.5	-
Total sugar (g)	38	38	-

During storage period the nutritive value of protein, fat, iron, acid insoluble ash, dietary fibre remained the same after 60 days of storage period. However, the difference of 15 kcal of energy and 3.65 g of carbohydrates was noted at the end of three months period of shelf life.

This proved that there was no change in the nutrient content of the product when packed and stored in a proper manner.

2. Guava Candy

a. Sensory evaluation of guava candy with variations

i. Mean score of guava candy with variations

The details of mean score using score card and hedonic rating scale is presented in Tables 35 and 36.

Table 35: Mean Score of Guava Candy using Score Card

Attributes	Mean ±SD score					
	V_1	V_2	V_3	V_4	V_5	V_6
Appearance	4.16±0.91	4.10±0.95	4.03±1.09	4.03±1.09	3.70±1.11	2.96±1.35
'r' value	1	0.21	0.16	0.22	0.25	0.45
Colour	3.70±1.39	3.86±1.16	3.43±1.19	3.70±1.08	3.86±1.22	2.90±0.99
'r' value	1	0.61**	0.45*	0.10	0.31	0.10
Flavour	4.33±0.75	4.03±0.96	4.00±0.90	4.00±0.90	3.70±3.43	1.17±1.30
'r' value	1	0.55**	0.40*	0.40*	0.232	0.09
Taste	4.03±1.06	3.70±1.20	3.63±0.92	3.50±0.90	3.46±1.00	3.23±1.16
'r' value	1	0.42*	0.18	0.34	-0.01	-0.11
Texture	4.50±0.73	4.23±0.85	3.16±0.87	2.80±0.84	2.80±0.96	2.33±1.12
'r' value	1	0.57**	-0.03	-0.05	-0.14	0.00

V= Variation

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

The appearance is one of the most important attribute that one should detect through sight. It is noticed that 46 per cent and 43 per cent of panel members gave score for variation 1 and 3 respectively as very appealing, 46 per cent and 43 and 26.6 per cent respectively scored the variation 2, 4 and 1 as appealing and only minimum of three per cent scored the variations, 2, 3 and 4 as neither appealing nor appetizing. The mean score for the appearance of variation 1-4 was 4.03 to 4.16 and found to be appealing.One should determine colour as the first priority in product development. It is noted that 33 to 36 per cent stated that colour of variation 1, 2 and 5 as cocoa brown.

Dark brown colour was identified in variation 4 and 2 by 43 and 40 per cent of panel members respectively. There is not much difference in the mean score for all the variations except variation 6.Forty six and 33 per cent scored the variation 1 as highly acceptable flavour, 53 per cent, 43 and 40 per cent respectively scored the variation 2, 1 and 3 as acceptable and 3-13 per cent were not acceptable for the flavour of variations 6 and 2. The maximum of 4.33 score was noted for variation 1. The variation 2-4 also had a mean score of 4.It is observed that 43 and 23 per cent scored the variation 1 and 3 as excellent taste. Very good score was given by 46, 26 and 23 per cent for variation 2, 1 and 4 respectively. As far as the taste is concerned variation 1 had desirable taste with a mean score of 4**.**03.Variation 1 had hard texture as per 63 per cent whereas 38 and 23 per cent stated that variation 2 and 1 as breakable. The mean score obtained for texture was 4.5 and 4.3 for variation 1 and 2.The mean maximum score and 'r' value indicated that variation 1 was highly correlated at the higher level. Five grams of guava pulp was found to be highly satisfied since its appearance and texture was highly accepted when compared to other variations.

ii. Mean hedonic rating scale for guava candy

Table 36: Mean Hedonic Rating Scale for Guava Candy

Attribute	Score	V_1		V_2		V_3		V_4		V_5		V_6	
		N=30	%	N=30	%	N=30	%	N=30	%	N=30	%	N=30	%
Like extremely	9	8	26.6	3	10	10	33.33	6	20	5	16.6	6	20
Like very much	8	14	46.6	15	50	5	16.6	3	10	5	16.6	6	20
Like moderately	7	5	16.6	10	33.3	7	23.3	10	33.33	5	16.6	3	10
Like slightly	6	2	6.6	2	6.6	8	26.6	8	26.6	12	40	5	16.6
Neither like nor dislike	5	1	3.33	-	-	-	-	1	3.33	2	6.6	7	23.3
Dislike slightly	4	-	-	-	-	-	-	2	6.6	1	3.33	1	3.33
Dislike moderately	3	-	-	-	-	-	-	-	-	-	-	-	-
Dislike very much	2	-	-	-	-	-	-	-	-	-	-	2	6.6
Dislike extremely	1	-	-	-	-	-	-	-	-	-	-	-	-
Mean ±SD	-	7.86 ± 1.00		7.63 ± 0.76		7.56 ± 1.22		6.96 ± 1.40		6.86 ± 1.35		6.53 ± 1.99	
r value	-	1		0.20		0.09		0.21		0.03		0.02	

V- Variation.

Variation 1 and 3 was liked extremely by 26.6 and 33.3 per cent. Fifty and 46 per cent scored the variations 2 and 1 as like very much. Variation 6 was disliked very much by 6 per cent. It can be observed that the mean value of guava candy was between 6.5 and 7.5 and the 'r' value indicated that variation 1 was highly correlated by all the panel members since the overall attribute were highly acceptable.

b. Nutrient content of guava and guava candy

The value addition of guava candy as against guava is given in Table 37 and Figure 11.

Table 37: Nutrient Content of Guava and Guava Candy

Nutrients	Guava fruit (100 g)	Guava candy (100 g)	Difference
Energy (Kcal)	52	424	372
Protein (g)	0.90	4	3.1
Fat (g)	0.3	14	13.7
Carbohydrates (g)	11	65	54
Iron (mg)	0.33	11	10.6
Ash (%)	0	0.04	0.04
Acid insoluble Ash (%)	0.8	6	5
Dietary fibre (g)	8	2	-6
Total sugar (g)	59	34	-25

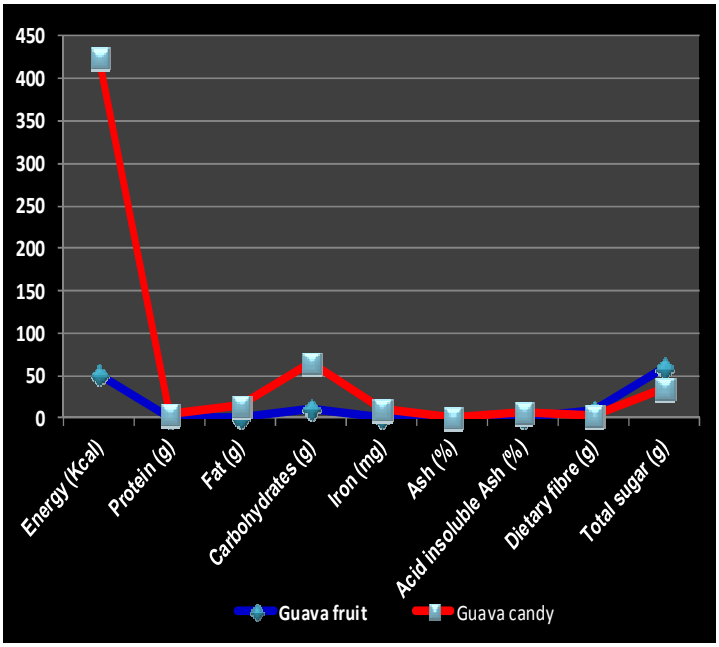


Figure 11: Nutrient Content of Guava and Guava Candy

The value of guava was improved in guava candy by the inclusion of other ingredients namely jaggery, fat and oats used to prepare guava candy. The table shows that there is an increment in energy (372 Kcal), protein (3.1g), fat (13.7g), carbohydrate (54 g), ash (0.04 per cent) and iron (10.6 mg) whereas dietary fiber and total sugar of guava candy was found to be lower than guava fruit.

This indicates that besides increasing the shelf life of guava, it also increased the nutrient value of guava candy and it is considered as value added guava candy.

c. Shelf life study

i. Mean score of guava candy during shelf life study

The mean score and hedonic scale of guava candy are predicted in Tables 38 and 39.

Table 38: Mean Score of Guava Candy during Shelf Life Study

Attributes	Mean ± SD score			
	0 day	30 days	60 days	90 days
Appearance	3.70±1.75	4.40±0.95	4.10±0.87	3.70±0.56
Colour	4.40±0.69	4.30±0.67	3.90±0.87	3.90±0.31
Flavour	4.10±0.56	3.90±0.73	4.20±0.63	4.10±0.31
Taste	3.60±0.96	3.80±0.73	3.50±0.97	3.30±0.48
Texture	5.00±0.00	4.60±0.51	3.90±0.73	3.60±0.84

The maximum score was given by 20 per cent of panel members as very appealing during 30 days storage, whereas cent percent stated that appearance of guava candy was appealing on 60 days storage.

The maximum score was given by 45 per cent of panel as cocoa brown members 0-30 days as storage. Dark brown was scored by 90 and 60 per cent on 60 and 30 days storage respectively. Ten per cent was scored for 0-60 days as light brown colour.

Flavor of the guava candy was scored as highly acceptable for 30 and 20 per cent on 30 days storage. Acceptable flavor was scored by 90 and 70 per cent of panel members on 60 day shelf life.

The taste of guava candy was excellent for 20 per cent as excellent on 0 and 30 days storage. Good taste was scored by 70, 50 and 40 per cent on 60, 30 and 0 days storage respectively. Only 20 stated as fair for 60 and and 10 per cent stated as fair for 30 days storage.

The texture of guava candy was hard on 0 day and 15 days as per 100 and 60 per cent of panel members respectively. Eighty per cent scored that on 30th and 60th day storage of guava candy was found to be breakable. On 60th and 30th day storage the guava candy was found to be semi-soft as per 10 to 20 per cent of panel members and the total mean score of guava candy was 20.8 on 0 day, 16.1 for 30th day and 18.6 for 60th day which was found to be at desirable stage.

Table 39: Mean Hedonic Rating Scale for Guava Candy during Shelf Life Study

Attribute	Score	Days of storage							
		0		30		60		90	
		N=30	%	N=30	%	N=30	%	N=30	%
Like extensively	9	-	-	-	-	3	10	-	-
Like very much	8	12	40	3	10	6	20	9	30
Like moderately	7	15	50	21	70	15	50	18	60
Like slightly	6	-	-	6	20	6	20	3	10
Neither like nor dislike	5	-	-	-	-	-	-	-	-
Dislike slightly	4	3	10	-	-	-	-	-	-
Dislike moderately	3	-	-	-	-	-	-	-	-
Dislike very much	2	-	-	-	-	-	-	-	-
Dislike extremely	1	-	-	-	-	-	-	-	-
Mean ± SD	-	7.10 ± 1.19		6.90± 0.56		7.10 ± 0.73		7.20 ± 0.63	

The evaluation of acceptability test by hedonic rating revealed that 10 per cent liked extremely during 30th day storage. On 0 day and 60th day storage, 40 and 30 per cent panel members liked very much. Sixty and 50 percent panel members scored as like moderately on 0 to 60 days storage. The least score was given for 60 days by 10 per cent as like slightly. The table stated that the overall attribute was highly acceptable as the mean value was between 7 and 7.5.

Guava candy can be stored safely for two months under ambient conditions (20-30^{o}C) (Chandu and Prasad, 2006).

ii. Nutrient content of guava candy during shelf life study

The nutrient content of guava candy on 0 day and 60th day storage was analysed and portrayed in Table 40.

Table 40: Nutrient Content of Guava Candy during Shelf Life Study

Parameters	0 day	90 days	Difference
Energy (Kcal)	424	424	-
Protein (g)	4	4	-
Fat (g)	14	14	-
Carbohydrates (g)	65	64	-1
Iron (mg)	5	5	0
Ash (%)	11.44	11.55	0.06
Acid insoluble ash (%)	0.04	0.04	-
Dietary fibre (g)	-	2	2
Total sugar (g)	34	34	-

From the Table 40, it can be inferred that there was not much change in the carbohydrate value and ash content whereas nutrient content of protein, fat, iron, acid insoluble ash, dietary fibre and total sugar in guava candy had no changes after 60th day storage.Therefore, nutrient content in fruit product may or may not change depending upon the preparation technique, the temperature used and the type of packaging material used.

3. Papaya Candy

a. Sensory evaluation of papaya candy with variation

i. Mean score of papaya candy using score card

Tables 41 and 42 show the sensory evaluation of papaya candy by the selected 30 panel members and rank correlation respectively.

Table 41: Main Score of Papaya Candy Using Score Card

Attributes	Mean ±SD score					
	V_1	V_2	V_3	V_4	V_5	V_6
Appearance	3.96±1.12	3.63±1.09	3.76±1.04	3.33±1.21	3.60±0.93	3.50±1.19
'r' value	1	0.26	0.55**	0.10	0.380*	0.11
Colour	4.46±0.62	3.83±0.83	3.93±069	3.53±1.00	3.30±0.96	3.00±1.10
'r' value	1	0.28	0.23	0.02	0.144	0.108
Flavour	4.26±0.78	3.90±0.71	3.63±1.03	3.30±1.05	3.56±1.13	3.73±1.10
'r' value	1	0.23	0.00	-0.05	-0.17	0.00
Taste	3.96±1.03	3.56±0.85	3.16±1.05	3.06±0.94	3.26±1.01	3.43±1.07
'r' value	1	0.33	0.25	0.14	0.17	0.23
Texture	4.70±0.83	3.46±0.81	3.00±0.18	2.66±0.99	2.63±1.03	2.13±1.19
'r' value	1	0.41	0.00*	-0.37	-0.45*	0.21

V – Variation

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Variation 1 was identified as very appealing to 40 per cent of panel members. Variation 5, 2 and 1 were appealing to 50, 36 and 33 per cent of panel members respectively. Thirty three and 30 per cent scored the variation 4 and 5 as fairly appealing and 3.33 per cent each stated as neither appealing nor appetizing for variations 1, 2 and 6. The mean score of 3.96 was noted for variation 1.

Fifty three per cent scored the variation 1 as coca brown colour whereas 53, 50, 43 and 40 per cent of the members stated that variations 3, 2, 4 and 1 respectively as dark brown in colour. Variation 5 was scored as light brown by 53 per cent. The colour of variation 1 was expressed as dark brown which was indicated by the mean score of 4.46.Flavour of variation 1 was highly acceptable to 46 per cent of panel members

whereas 60 per cent, 50 per cent and 43 per cent scored the variations 2, 3 and 1 respectively as acceptable. Moderately acceptable score was offered to variation 3 and 5 by 26 and 23 panel members respectively. The mean score for the variations were maximum of 4 compared to other variations.

Out of 30 panel members, 40 per cent scored the variation 1 as excellent taste. While 50, 33 and 30 per cent were scored for variations 2, 4, 5 and 6 as very good taste. Variation 4 was found to be fair and poor by 26 per cent and three per cent of panel members respectively.Maximum of 80 per cent scored variation 1 as hard, 53 per cent scored as breakable for variation 2, 53 and 33 per cent scored as sticky for variation 3, 2 and 4 and 40 per cent scored as soft texture for variation 6.

The Table 41 clearly shows that the mean score for each attribute, appearance, colour, flavour, taste and texture for variation 1 was between 3.6 and 5.0 and the 'r' value also indicated that variation 1 had the highest degree of correlation. Papaya candy with five grams of pulp was highly acceptable by all the panel members due to its taste, texture and colour.

Table 42: Mean Hedonic Rating Scale for Papaya Candy

Attribute	Score	V_1		V_2		V_3		V_4		V_5		V_6	
		N=30	%	N=30	%	N=30	%	N=30	%	N=30	%	N=30	%
Like extremely	9	8	26.6	4	13.3	1	3.33	1	3.33	2	6.6	11	13.3
Like very much	8	9	30	11	36.6	8	26.6	8	26.6	10	3.33	9	30
Like moderately	7	9	30	6	20	6	20	8	26.6	8	26.6	7	23.3
Like slightly	6	2	6.6	11	13.3	8	26.6	3	10	6	20	3	10
Neither like nor dislike	5	1	3.33	2	6.6	11	13.3	6	20	-	-	2	6.6
Dislike slightly	4	-	-	3	10	3	10	3	10	2	6.6	3	10
Dislike moderately	3	1	3.3	-	-	-	-	1	3.33	-	-	-	-
Dislike very much	2	-	-	-	-	-	-	-	-	2	6.6	1	3.33
Dislike extremely	1	-	-	-	-	-	-	-	-	-	-	1	3.33
Mean ± SD	-	7.56 ± 1.35		7.06 ± 1.50		6.50±1.38		6.40 ± 1.56		6.73 ± 1.76		6.66 ± 2.03	
'r' value	-	1		0.35		0.23		0.08		0.12		0.04	

V- Variation.

Table 42 indicates that 26 per cent like extremely the variation 1. Thirty six, 33 and 30 per cent was scored the variations 2, 5 and 1 as like very much. Variation 1, 4 and 6 were scored as like extremely by 30, 26 and 23 per cent. Twenty and 13 per cent was scored as neither like nor dislike for variations 4 and 3.

The mean value obtained for all the attributes ranged between 6.5 and 7.5 while the 'r' value was identified that variation 1 was highly acceptable and positively correlated amongst all the six variation because the overall attributes was highly acceptable.

ii. Rank correlation on hedonic rating scale of candies

Table 43 reveals the Rank Correlation on Hedonic Rating Scale of Candies.

Table 43: Rank Correlation on Hedonic Rating Scale of Candies

Criteria	V_1	V_2	V_3	V_4	V_5	V_6
Banana candy	1.000	0.218	0.072	0.216	0.190	0.347
Guava candy	1.000	0.088	0.011	0.190	0.065	0.094
Papaya candy	1.000	0.270	0.211	0.139	0.265	0.305

V – Variation.

It is proved by the rank correlation analysis that variation 1 with the addition of 5 g of banana, 5 g of guava and 5 g of papaya obtained the top most rank and was found to be positively highly correlated. This indicates that the variation 1 was highly acceptable among all varieties of candies using three different fruits.

b. Nutrient content of papaya and papaya candy

So as to ascertain the value of papaya candy, nutrient content of papaya fruit is also estimated and shown in Table 44 and Figure 12.

Table 44: Nutrient Content of Papaya and Papaya Candy

Parameters	Papaya fruit (100 g)	Papaya candy (100 g)	Difference
Energy (Kcal)	58	452	394
Protein (g)	0.90	6	5.1
Fat (g)	0.11	13	12.89
Carbohydrates (g)	12	68	56
Iron (mg)	0.8	5	4.2
Ash (%)	2	6	4
Acid insoluble Ash (%)	0	0.02	0.02
Dietary fibre (g)	2	2	-
Total sugar (g)	40	56	16

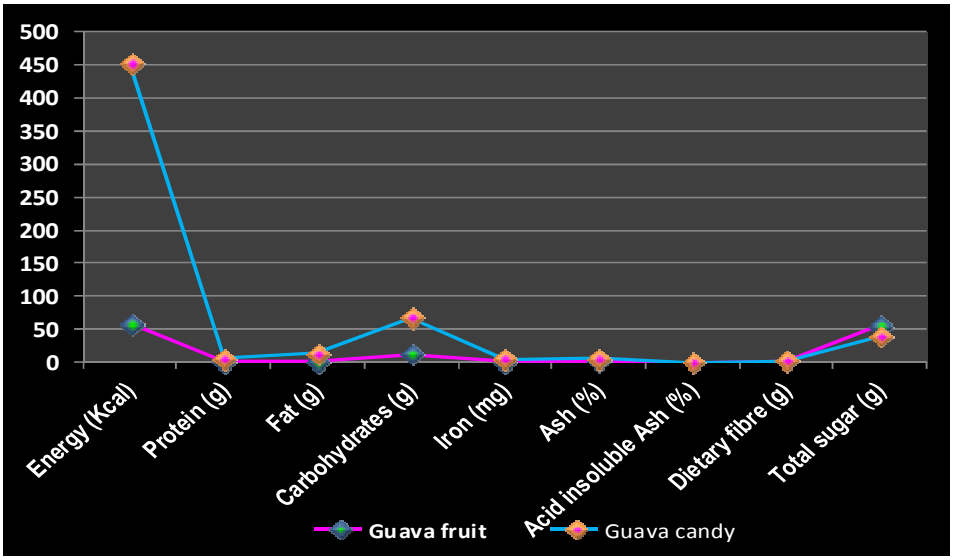


Figure 12: Nutrient Content of Papaya and Papaya Candy

The energy value of 100g of papaya candy was raised to seven times as compared to 100g of papaya fruit. The nutrients which fall under excess are energy (394 Kcal), protein (5.1g), fat (12.89g), carbohydrates (56g), iron (4.2mg), ash (4 per cent) and acid insoluble ash (0.02). There is no wide difference in the case of dietary fibre whereas there is slight difference in the total sugar (16g) of papaya candy.

This ascertains that the health benefits for consumer are achieved with the enhancement of nutritional value of papaya candy as against fresh papaya fruit.

c. Shelf life study

i. Mean score of papaya candy during shelf life study

Tables 45 and 46 portrays the acceptability status during shelf life study.

Table 45: Mean Score of Papaya Candy during Shelf Life Study

Attributes	Mean ±SD			
	0 day	30 days	60 days	90 days
Appearance	3.70 ± 1.15	4.40 ± 0.96	4.10 ± 0.87	3.90 ± 0.56
Colour	4.40 ± 0.69	4.30 ± 0.67	3.90 ± 0.87	3.90 ± 0.31
Flavour	4.10 ± 0.56	3.90 ± 0.73	4.20 ± 0.63	4.10 ± 0.31
Taste	3.60 ± 0.96	3.80 ± 0.63	3.50 ± 0.97	3.30 ± 0.48
Texture	5.00 ± 0.00	4.60 ± 0.26	3.90 ± 0.73	3.60 ± 0.71

The appearance of papaya candy was found to be appealing for 80, 50 and 40 per cent of 30, 90 and 0 days of storage respectively. Moderately was scored in 0, 60 and 90 days by 40 per cent whereas only 10 per cent stated that on 90^{th} day storage papaya candy was neither appealing nor appetizing.

Cocoa brown colour was scored by 40 per cent of panel members for 90 days shelf life. Thirty days shelf life was scored as dark brown colour by 100 per cent panel members. Similarly 70 per cent was scored as dark brown on 0 day shelf life. Brown colour was scored by 10 per cent on 0 day shelf life.

The flavour of the fruit candy was acceptable to 70 and 60 per cent of panel members for 0, 30 and 60 days while 30 per cent of panel members stated as moderately acceptable on 0 and 30 days storage. The least score was given to 90 days storage as slightly acceptable by only 10 per cent of panel members.

Excellent score was given by 10 per cent for 90 days storage. Seventy and 50 per cent scored as good for 90 and 0 day shelf life. Only 10 per cent scored as fair on 90^{th} day storage.

Papaya candy had hard texture for 30 per cent on 90 days shelf life whereas on 30 and 60 days shelf life candy was found to be breakable for 90, 60 and 50 per cent respectively.

The Table 45 above shows that the total mean score of papaya candy was ranged from 18 – 20 during 3 months storage and the overall acceptability score was at the highest level.

Table 46: Mean Hedonic Rating Scale for Papaya Candy during Shelf Life Study

Attribute	Score	Days of storage							
		0		30		60		90	
		N=30	%	N=30	%	N=30	%	N=30	%
Like extremely	9	-	-	-	-	-	-	-	-
Like very much	8	12	40	12	40	3	10	18	60
Like moderately	7	12	40	15	50	12	40	9	30
Like slightly	6	6	20	3	10	3	10	-	-
Neither like nor dislike	5	-	-	-	-	12	40	3	10
Dislike slightly	4	-	-	-	-	-	-	-	
Dislike moderately	3	-	-	-	-	-	-	-	
Dislike very much	2	-	-	-	-	-	-	-	
Dislike extremely	1	-	-	-	-	-	-	-	
Mean □ SD	-	7.10 ± 1.19		6.70 ± 0.56		7.10 ± 0.73		7.20 ± 0.63	

The Table 46 indicates that the maximum score was given by 60 and 40 per cent on 90 and 30 days shelf life as like very much. Like slightly was scored for 0 day shelf life by 20 per cent. But the only 40 per cent pointed out that candy was neither like nor dislike at 60 days shelf life.

Thus, the mean score of papaya candy was given at the upper limit, i.e., between 7 and 7.5 for all the attributes and it was highly acceptable by the panelist.Papaya candy can be stored well at room temperature (Aruna, 2000).

ii. Nutrient content of papaya candy during storage

The changes in nutrient content observed on 0 and 90th day storage is shown in Table 47.

Table 47 : Nutrient Content of Papaya Candy during Shelf Life Study

Parameters	0 day	90 days	Difference
Energy (Kcal)	433	452	18
Protein (g)	6	6	-
Fat (g)	12.80	13.10	0.3
Carbohydrates (g)	68	72	4
Iron (mg)	5.56	5.56	-
Ash (%)	5.99	6.02	0.03
Acid insoluble Ash (%)	0.02	0.02	0.02
Dietary fibre (g)	2.0	2.0	-
Total sugar (g)	40	40	-

From the Table 47, it is observed that the nutrients content of protein, iron, dietary fibre and total sugar were changed. Moreover, there is an increment in energy (18 Kcal), fat (0.3 g), carbohydrates (4 g) and ash (0.03) content of papaya candy after 90 days shelf life. Therefore, it is clearly seen that though some difference occurs during shelf life but that does not affect much to the value of the product.

4. Moisture content and total plate count of candies during shelf life study

In order to ensure the safety of the candies moisture content and total plate count are examined and presented in Tables 48 and 49.

Table 48: Moisture Content of Candies

Recipe Name	0 Day	30^{th} Day	60^{th} Day	90^{th} Day
Banana candy	6.94	7.04	7.24	8.88
Guava candy	4.70	4.66	7.44	9.02
Papaya candy	6.44	6.88	7.08	9.22

The moisture content of banana candy, guava and papaya candy was increasing during shelf life. The maximum moisture content was found in papaya candy by 9.22 per

cent which was followed by guava candy by 9.02 per cent and in banana candy by 8.88 per cent.

Table 49: Total Plate Count at 37^0C of Candies

Product Name	0 Day (cfu/g)	30th Day (cfu/g)	60th Day (cfu/g)	90thDay (cfu/g)
Banana candy	Absent x 10^3	Absent x 10^3	01 x 10^3	02 x 10^3
Guava candy	Absent x 10^3	Absent x 10^3	Absent x 10^3	02 x 10^3
Papaya candy	Absent x 10^3	Absent x 10^3	Absent x 10^3	02 x 10^3

The Table 49 clearly indicates that the number of microbial count of all the three candies were absent at 0 day and 15 day storage whereas the microbial count is increased in banana candy on 30th days shelf life by 0.01 x 10^3 cfu/g. Presence of micro-organism was found in all the three candies on 60th day. Though the microbial counts were observed at the end of 90 days it was at the desirable limit and the candies were also found to be acceptable. The attributes like taste, flavour and appearance were found at the accepted level of 10^5 .

5. Components, yield and cost of value added candies.

The composition of ingredients used, waste, edible portion and the cost of candies are shown in Tables 50 and 51.

Table 50: Variation of Fruit Candies

Ingredients	Amount of Ingredients (g)					
	V_1	V_2	V_3	V_4	V_5	V_6
Fruit pulp	5	10	15	20	25	30
Jaggery	35	35	35	35	35	35
Oats	2	2	2	2	2	2

Soya flour	2	2	2	2	2	2
Amla dry	0.5	0.5	0.5	0.5	0.5	0.5
Ghee	5	5	5	5	5	5

V – Variation.

The Table 50 shows that the amount of other ingredients for fruit candy preparation was same for all the six variations except the fruit pulp was altered. The amount of fruit pulp included for variations 1, 2, 3, 4, 5 and 6 are 5g, 10g, 15g, 20g, 25g and 30g respectively. It is noted that the minimum amount of five grams of fruit pulp was only identified as suitable to get a standard candy. The variation 1 was found to possess the required and desirable attribute and accepted by the panel members.

Yield and cost of fruit candies

Table 51: Yield and Cost of Fruit Candies

Recipe Name	Total Weight (g)	Weight per Portion (g)	No. of Portion	Total food Cost (Rs.)
Banana candy	2,400	12	200	2.34
Guava candy	2,420	12	202	2.31
Papaya candy	2,591	12	216	2.12

The present study reveals that the total weight of all the three candies were different which may be due to variation in temperature used and time of cooking. Number of portion was also different due to the difference in total weight in the final product. Food cost of various candies was different due to price differences of fruits but the weight per portion was same because size of the standardized candies was made uniform.

Sauces

1. Banana Sauce

a. Sensory evaluation of banana sauce

i. Mean score of banana sauce using score card

Tables 52 and 53 show the sensory evaluation of banana sauce by the selected 30 panel members.

Table 52: Mean Score of Banana Sauce using Score Card

Attributes	Mean ±SD scores		
	V_1	V_2	V_3
Appearance	3.93±0.82	3.73±0.86	3.62±1.32
'r' value	1	0.64**	0.47**
Colour	3.10±1.12	3.03±1.06	3.03±1.35
'r' value	1	0.88**	0.74**
Flavor	3.96±0.71	3.70±0.95	3.66±0.95
'r' value	1	0.48**	0.38*
Taste	3.76±0.89	3.53±0.93	3.50±1.13
'r' value	1	0.52**	0.28
Consistency	3.70±1.14	3.63±0.99	3.10±1.06
'r' value	1	0.62**	0.42*

V – Variation

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed

It is observed that very appealing score was indicated by 33 per cent, 26 per cent and 23 per cent of panel members for variations 3, 1 and 2 respectively whereas 43 and 30 per cent scored the variation 1, 2 and 3 as appealing. It is also noted that the variation 2 and 3 was found to be fairly appealing to the eyes of 43 and 23 per cent of panel members and the least three per cent of panel members scored the variation 3 neither appealing nor appetizing.

Majority of 33 and 30 per cent of them scored as pale yellow for variations 1, 2 and 3 whereas 10 per cent scored as light yellow for variations 1 and 3. From 26 and 23 per cent of panel members, the colour of variations 2 and 1 was found to be pale yellow and 20 and 60 per cent scored as pale brown for variation 3 and 1 respectively.

It is noted that 25 and 20 per cent scored the flavor as highly acceptable for variations 2, 3 and 1. Sixty per cent, 33 per cent and 30 per cent for variations 1, 2 and 3 as acceptable, 36 per cent and 33 per cent as moderately acceptable for variations 3 and 2 respectively.

Twenty three per cent, 20 per cent and 16 per cent scored as excellent taste for variations 3, 1 and 2 respectively, 40 per cent as very good and 50 per cent as good for variation two and three per cent for variation 3 as poor taste.

The texture of variation 1 was found to be smooth and pouring consistency for 40 per cent and 33 per cent stated as sticky consistency for variation 3 and 1 respectively.

It can be inferred that the mean score of variation 1 for appearance, colour, flavor, taste and texture was between 3 and 3.5 and the 'r' value shown that variation 1 was highly and positively correlated. Variation 1 with 100g of banana pulp was found to be highly acceptable and contains the desired attributes.

ii. Mean hedonic rating scale for banana sauce

Table 53: Mean Hedonic Rating Scale for Banana Sauce

Attribute	Score	V_1		V_2		V_3	
		N=30	%	N=30	%	N=30	%
Like extremely	9	3	10	5	16.6	5	16.6
Like very much	8	14	46.6	5	16.6	6	20
Like moderately	7	8	26.6	11	36.6	9	30
Like slightly	6	3	10	8	26.6	3	10
Neither like nor	5	-	-	1	3.3	4	13.

dislike					3		3
Dislike slightly	4	2	6.6	-	-	1	3.33
Dislike moderately	3	-	-	-	-	2	6.6
Dislike very much	2	-	-	-	-	-	-
Dislike extremely	1	-	-	-	-	-	-
Mean ± SD	-	7.36 ± 1.21		7.16 ± 1.11		6.80 ± 1.71	
'r' value	-	1		0.35		0.31	

V – Variation.

Forty six per cent scored the variation 1 as like very much. Thirty six and 30 per cent scored as like moderately for variations 2 and 3 respectively. The mean score obtained by variation 1 ranged between 6.5 and 7.5, whereas 'r' value got the highest degree of positive correlation.

b. Nutrient content of banana and banana sauce

Table 54 and Figure 13 indicates the nutrient content of banana and banana sauce.

Table 54: Nutrient Content of Banana and Banana Sauce

Parameters	Banana (100 g)	Banana Sauce (100 g)	Difference
Energy (Kcal)	141	159	18
Protein (g)	1	0	-1
Fat (g)	0.3	0	-0.3
Carbohydrates (g)	32	38	6
Ash (%)	0.50	2	1.86
Acid insoluble Ash (%)	0	0.02	0.02
Dietary fibre (g)	5	7	2
Total sugar (g)	58	58	-
Vitamin C (mg)	190	120	-70
Antioxidant activity (□g)	6	5	-1
Iron (mg)	0.36	10	9.64
Sodium (mg)	34	0.90	-33.1

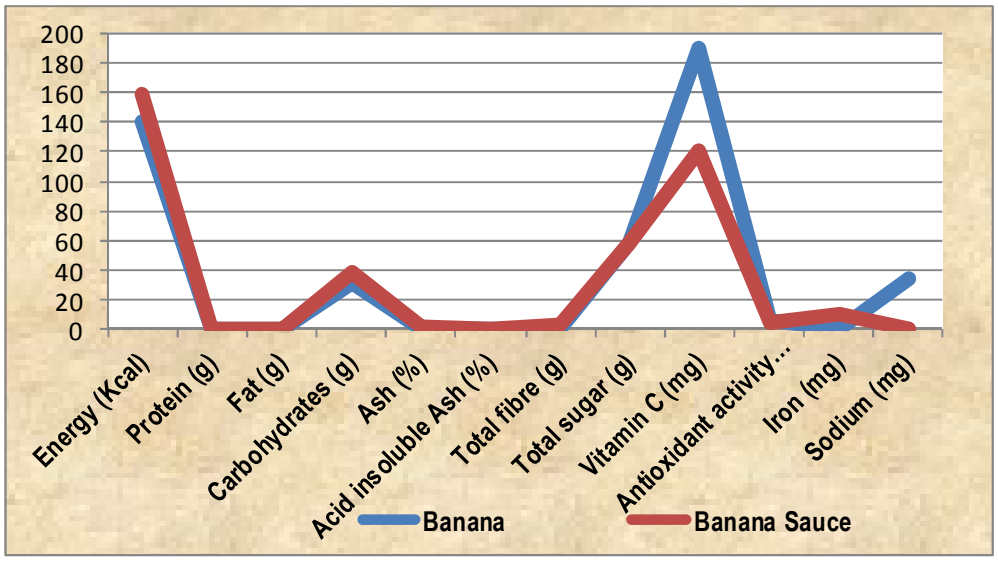


Figure 13: Nutrient Content of Banana and Banana Sauce

There is an increment of energy (18 Kcal), carbohydrates (6 grams), ash (1.86 per cent), acid insoluble ash (0.02 per cent), total fiber (2 g) and iron (9.64 mg) of banana sauce with the inclusion of sugar and 120g of banana pulp.

Thus, it is seen that most of the nutrient contents were not changed or decreased except protein, fat, vitamin C, sodium and antioxidant activity.

c. Shelf life study

i. Mean score for banana sauce during shelf life study

The results of sensory evaluation and nutrient content of banana sauce during shelf life study are depicted in Tables 55, 56 and 57.

Table 55: Mean Score for Banana Sauce during Shelf Life Study

Attributes	Mean ±SD scores			
	0 day	30 days	60 days	90 days
Appearance	3.50±0.70	3.00±1.56	4.20±0.78	-
Colour	3.20±	3.50±	2.70±	-
Flavor	3.40±0.96	3.30±0.94	4.10±0.73	-
Taste	3.10±0.87	3.00±0.81	4.10±0.73	3.80±0.63
Consistency	2.00±0.66	2.90±1.19	2.30±0.48	2.10±0.31

The appearance of banana sauce was very appealing on 60th day by 40 per cent. But the mean score was between 3.5–4.00 indicating that banana sauce was appealing to the eyes.

Light yellow colour was retained up to 30 days as for 10 percent of panel members. But 40-60 percent scored as pale yellow on 0 day and 60 days. But on 90th day the colour was turned to dull yellow as per 50-100 percent of panel members.

Highly acceptable flavor was noted by 30 and 10 per cent on 60th and 30 days. It is noted that all of them stated that banana sauce maintained appearance, flavor even after 90th day. Sixty and 50 per cent stated that the flavor was very good during 90 days shelf life. Sixty per cent, 40 per cent scored as good on 30thday. .

Smooth texture was retained at 30 days shelf life. Pouring consistency was observed on 60thand 90 days shelf life study. Even on the 90th day of storage the banana sauce was found to be good and can be consumed.

The total mean score of banana sauce out of 25 score was 15.2 for 0 day, 15.7 for 30 day, 17.4 for 60 days and 5.9 for 90 days.

The sensory score of sauce like appearance, texture, flavor and overall acceptability were found to be in acceptable limits up to 90 days storage (Chauhan et al., 2006).

ii. Mean hedonic rating scale for banana sauce during shelf life study

Table 56: Mean Hedonic Rating Scale for Banana Sauce during Shelf Life study

Attribute	Score	Days of storage							
		0		30		60		90	
		N=30	%	N=30	%	N=30	%	N=30	%
Like extremely	9	3	10	-	-	12	40	-	-
Like very much	8	-	-	6	20	6	20	15	50

Like moderately	7	21	70	9	30	6	20	15	50
Like slightly	6	3	10	9	30	6	20	-	-
Neither like nor dislike	5	3	10	6	20	-	-	-	-
Dislike slightly	4	-	-	-	-	-	-	-	-
Dislike moderately	3	-	-	-	-	-	-	-	-
Dislike very much	2	-	-	-	-	-	-	-	-
Dislike extremely	1	-	-	-	-	-	-	-	-
Mean ± SD	-	6.70 ± 0.67		6.50 ± 1.08		7.80 ± 1.22		7.50 ± 0.50	

The Table 56 indicated that the maximum score was given during 90 days shelf life by 40 per cent. Fifty and 30 per cent scored as like very much for 60 and 15 days like moderately was scored by 0 day shelf life at 70 per cent. Only 10 and 20 per cent for 0 and 30 day was valuable as neither like nor dislike.

The Table 56 above proved that the mean hedonic scale ranged for all the attribute between 6.5 to 7.5 on the 90th day which indicates that banana sauce was acceptable during shelf life study.

d. Nutrient content of banana sauce during shelf life study

Table 57: Nutrient Content of Banana Sauce during Shelf Life Study

Parameters	30th day	90th day	Difference
Energy (Kcal)	173.59	172.62	-o.97
Protein (g)	-	-	-
Fat (g)	-	-	-

Carbohydrates (g)	42.34	41.86	-o.48
Ash (%)	2.06	2.06	-
Acid insoluble Ash (%)	0.02	0.02	-
Total fibre (g)	3.0	3.20	0.2
Total sugar (g)	57.70	58.40	0.7
Vitamin C (mg)	53.99	54.59	0.6
Antioxidant activity (□g)	102.20	1.4.44	2.24
Iron (mg)	10.0	10.0	-
Sodium (mg)	0.82	0.82	-

The Table 57 indicated that there is an increment of antioxidant activity (2.24), total sugar (0.7) and total fiber (0.2) where as there are minimal changes in energy (-o.97) and carbohydrates (-0.48) content during storage. These changes may be due to the mechanical process of heating during preparation or due to the physical changes at the time of storage. Thus, the value of the banana sauce is dependent upon the preparation technique.

2. Guava Sauce

a. Sensory evaluation of guava sauce

i. Mean score of guava sauce using score card

The sensory evaluation of guava sauce by the selected 30 panel members are presented in Tables 58 and 59.

Table 58: Mean Score of Guava Sauce using Score Card

Attributes	Mean ±SD		
	V_1	V_2	V_3

Appearance	3.70±0.91	3.83±1.08	3.80±1.06
'r' value	1	0.60**	0.50**
Colour	4.03±1.49	3.73±1.55	3.83±1.53
'r' value	1	0.80**	0.91**
Flavour	3.63±0.80	3.66±1.60	3.36±0.85
'r' value	1	0.41*	0.55**
Taste	3.36±1.03	3.33±1.02	3.13±0.89
'r' value	1	0.72**	0.57**
Consistency	3.76±1.30	3.10±1.15	3.06±1.20
'r' value	1	0.61**	0.47**

V – Variation

*Correlation significant at 0.005 level (2 tailed)

**Correlation significant at 0.005 level (2 tailed)

It is clear that 30, 26 and 20 per cent of the panelists scored as very appealing for variations 2, 3 and 1. While 43 and 40 per cent scored as appealing for variations 3 and 2 respectively.

Variations 3, 2 and 1 scored as cream colour by 60, 56 and 20 per cent by the panelists. Thirty and 13 per cent of panelist scored the variations 2, 3 and 1 as pale brown.

Variation 1, 2 and 3 had acceptable flavor as per 46, 43 and 40 per cent of panel members. Thirty six and 33 per cent scored as moderately acceptable for variations 3 and 2. For variation 2, 26 per cent scored that the flavor of guava sauce was slightly acceptable and three per cent stated that the flavor not acceptable.

The taste of variation 1 was scored as excellent taste for 10 per cent. Fifty, 33 and 26 per cent scored the variations 2, 1 and 3 as very good. The taste of variation 3 and 2 for 40 per cent was found to be good. Variation 3 and 2 scored as fair for 26 and 23 per cent of panel members.

Forty three per cent scored as smooth consistency for variation 1 and 10 per cent scored as pouring for variation 1 and 3. Variations 2, 3 and 1 was found to be dropping in consistency for 20 to 30 per cent of panel members. Forty, 35 and 26 per cent for variation 2 and 3 scored thick and only three per cent scored as sticky for variation 3.

It is observed that variation 1 was scored as highly acceptable, based on mean attribute which fall between the value of 3.5 and 4.5and 'r' value of variation 1 was highly and positively correlated.

The variation 1 with 100g of pulp was found to be highly satisfied because all the attribute especially taste and texture was up to the expected level.

ii. Mean hedonic rating scale for guava sauce

Table 59: Mean Hedonic Rating Scale for Guava Sauce

Attribute	Score	V_1		V_2		V_3	
		N=30	%	N=30	%	N=30	%
Like extremely	9	3	10	4	13.3	3	10
Like very much	8	8	26.6	6	20	3	10
Like moderately	7	9	30	9	30	12	40
Like slightly	6	7	23.3	7	23.3	5	16.6
Neither like nor dislike	5	1	3.33	2	6.6	3	10
Dislike slightly	4	-	-	-	-	1	3.33
Dislike moderately	3	1	3.33	-	-	2	6.6
Dislike very much	2	1	3.33	2	6.6	1	3.33
Dislike extremely	1	-	-	-	-	-	-
Mean ± SD	-	6.86 ± 1.56		6.76 ± 1.71		6.36 ± 1.75	
'r' value	-	1		0.78**		0.50**	

V – Variation.

Amongst the 30 panel members, 13 per cent and 20 per cent scored as like extremely and like very much for variation 2. Twenty six per cent and 20 per cent was scored for variations 1 and 2 as like very much. Forty and 30 per cent scored for variations 3, 2 and 1 as like moderately. Twenty three per cent scored as like slightly for variations 1 and 2.

The mean hedonic value of guava sauce was between 6.00 and 6.5 and the value of 'r' indicated that variation 1 has got the highest degree of correlation since all the attributes were highly acceptable.

b. Nutrient content of guava and guava sauce

In comparison with 100 g of guava fruit, the nutrient content of guava is presented in Table 60 and Figure 14.

Table 60 : Nutrient Content of Guava and Guava Sauce

Parameters	Guava fruit (100 g)	Guava sauce (100 g)	Difference
Energy (Kcal)	52.0	97.58	45.58
Protein (g)	0.90	0.0	-0.9
Fat (g)	0.3	0.0	-0.3
Carbohydrates (g)	11.0	23.80	12.8
Ash (%)	0.33	0.57	0.24
Acid insoluble Ash (%)	0.0	0.02	0.02
Total fibre (g)	8.0	1.20	-6.8
Total sugar (g)	59.0	58.0	-1
Vitamin C (mg)	151	44	-107
Antioxidant activity (□g)	140	2.0	-138
Iron (mg)	0.8	7.23	6.43
Sodium (mg)	3.0	80	77

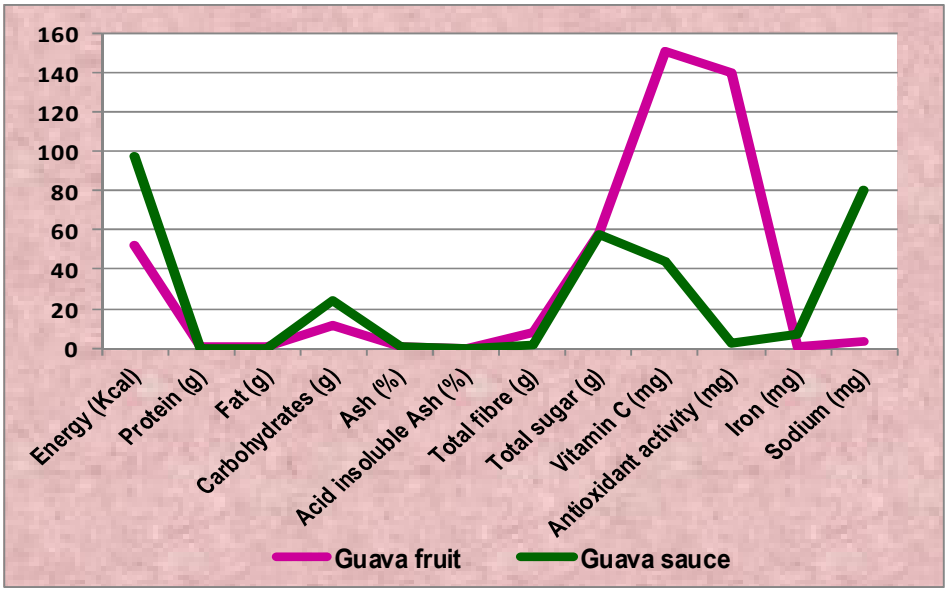


Figure 14: Nutrient Content of Guava and Guava Sauce

The fresh guava fruit is rich in vitamin C with 140mg/100g. Fiber content was eight grams which is at the higher level in guava. The antioxidant activity was also greater in guava which is found to be 151µmg.

The guava sauce prepared with the variation of 100g of guava was selected as acceptable by the panel members. So from the 100g of guava sauce energy value and carbohydrate were found to be more than the 100g of guava pulp. This increase may be attributed to the inclusion of sugar in the preparation of guava sauce. Thus, it can be inferred that the value of guava was enhanced with the increment of viral nutrient content in the processed guava sauce.

Besides raising the value of the guava sauce the study ascertained that the shelf life was improved and made available throughout the year especially during off season.

c. Shelf life study

i. Mean score of guava sauce during shelf life study

The acceptability scores and nutrient content of guava sauce during shelf life study period are presented in Table 61, 62 and 63.

Table 61: Mean Score of Guava Sauce during Shelf Life Study

Attributes	Mean ±SD scores			
	0 day	30 days	60 days	90 days
Appearance	4.10±0.56	3.30±1.33	4.30±0.67	4.40±0.96
Colour	3.80±1.22	4.10±1.52	1.90±0.31	-
Flavor	4.30±0.67	3.50±0.84	4.30±0.67	-
Taste	3.60±0.84	2.80±1.13	4.20±0.91	3.90±0.73
Consistency	3.90±0.98	3.7±0.90	3.50±0.39	3.90±0.31

The appearance of guava sauce was very appealing during 60 days shelf life as per 40 per cent of the panel members. One hundred and 70 per cent scored as moderately appealing for 90 and 0 days shelf life respectively.

The maximum score given for color by 70 per cent was cream colour on 15th and 60th day shelf life. Light brown colour was noted from 0-90 days by 20-30 per cent of panel members. Whereas 10 percent of panel members stated as pale brown on zero day shelf life.

Highly acceptable flavour was noted on 30 days storage by 40 per cent of panel members. One hundred, 70 and 50 per cent scored as acceptable for 90, 0 and 60 days shelf life. Twenty per cent was the least scored as slightly acceptable for30 days shelf life.

The taste was found to be very good for 50 per cent on the 30th and 90th day shelf life. Sixty percent (60%) of panel members judged taste as good on zero day. Also on zero day the consistency of guava sauce was smooth whereas 90 per cent stated as pouring consistency. Fifty per cent and 30 per cent scored as dropping on 30 and 60 days shelf life.

The total mean score of guava sauce was 19.7 on zero day, 17.4 on 30th day, 18.2 for 60thday and 12.2 for 90th day storage.

ii. Mean hedonic rating scale for guava sauce during shelf life study

Table 62: Mean Hedonic Rating Scale for Guava Sauce during Shelf Life Study

Attribute	Score	0day		30		60		90	
		N=30	%	N=30	%	N=30	%	N=30	%
Like extremely	9	3	10	3	10	15	50	-	-
Like very much	8	9	30	3	10	9	30	12	40
Like moderately	7	18	60	18	60	6	20	18	60
Like slightly	6	-	-	6	20	-	-	-	-
Neither like nor dislike	5	-	-	-	-	-	-	-	-
Dislike slightly	4	-	-	-	-	-	-	-	-
Dislike moderately	3	-	-	-	-	-	-	-	-
Dislike very much	2	-	-	-	-	-	-	-	-
Dislike extremely	1	-	-	-	-	-	-	-	-
Mean ± SD	-	6.70 ± 0.67		6.50 ± 1.08		7.80 ± 1.22		7.50 ± 0.52	

The Table 62 shows that 50 per cent scored as like extremely for 30 days shelf life whereas 60 per cent was scored as like moderately for 0, 15 and 60 days respectively. The lowest score was given as like slightly by 20 per cent for 30 days storage of guava sauce.

The mean value of guava candy was between 6.5 and 7.5 and it was found to be highly acceptable.

d. Nutrients content of guava sauce during shelf life study

Table 63: Nutrients Content of Guava Sauce during Shelf Life Study

Parameters	30 day	90 day	Difference

Energy (Kcal)	103.68	86.55	-17.13
Protein (g)	-	-	-
Fat (g)	-	-	-
Carbohydrates (g)	25.20	21.11	-4.09
Ash (%)	0.50	0.50	-
Acid insoluble Ash (%)	0.02	0.02	-
Total fibre (g)	1.0	1.30	0.3
Total sugar (g)	57.60	58.0	0.4
Vitamin C (mg)	1.89	2.09	0.2
Antioxidant activity (□g)	40.0	40.80	0.8
Iron (mg)	7.0	7.20	0.2
Sodium (mg)	78.89	79.11	0.22

The Table 63 indicates that the nutrient content of guava sauce was increased in small amount such as total fibre, total sugar, antioxidant activity, iron and sodium content but reduction was seen in energy and protein content of the sauce on 60 days shelf life. This change may be due to the mechanical and physical changes of the product during preparation and storage which affects the value of the product.

3. Papaya Sauce

a. Sensory evaluation of papaya sauce

i. Mean score of papaya sauce using score card

Table 64 shows the sensory evaluation of papaya sauce by the selected 30 panel members.

Table 64: Mean Score of Papaya Sauce using Score Card

Attributes	Mean ±SD		
	V_1	V_2	V_3
Appearance	4.03±0.99	3.90±0.99	3.90±0.92
'r' value	1	0.28	0.26
Colour	4.46±0.57	4.60±0.56	4.53±0.68
'r' value	1	0.70**	0.75**
Flavour	3.90±0.88	3.93±0.73	3.90±0.80
'r' value	1	3.50**	3.27

Taste	3.83±0.91	3.83±0.87	3.56±0.97
'r' value	1	0.35	0.22
Consistency	4.16±0.88	3.76±0.85	3.80±1.83
'r' value	1	0.58**	0.54*

V – Variation

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

The sensory evaluation revealed that variation 1, 2 and 3 were scored as very appealing by 36, 33 and 26 per cent. Forty six, 43 and 33 per cent scored as appealing for variation 3, 1 and 2. Twenty three per cent scored as moderately appealing for variation 2 and the minimum of 10 per cent of panelist stated that the variations 2 and 3 were the fairly appealing in appearance.

The colour of papaya sauce in variation 1, 2 and 3 were identified as orange colour by 50, 63 and 56 per cent while 46, 33 and 30 per cent scored as light orange for variation 1, 2 and 3 respectively. Variation 1 and 2 had highly acceptable flavor as stated by 20 to 26 per cent of panel members. Fifty six, 53 and 36 per cent scored as acceptable for variations 2, 1 and 3 respectively.

Twenty six per cent mentioned that variation 2 had excellent taste. Thirty and 20 per cent of panel members respectively scored as very good for variations 2 and 3. Variation 2 was scored as good by 33 per cent of panel members. Variation 3 was identified as poor due to poor taste and flavor. Variation got the highest score for consistency as per 43, 44 and 30 per cent. Thirty per cent scored as pouring consistency for variations 2 and 1. Forty per cent scored that the consistency of variation 2 and 3 as dropping and three per cent scored the variation 2 had thick consistency. The total mean score ranged between 4.00 and 4.5 and 'r' value of variation 1 was positively correlated at the higher degree. Variation 1 with 100g of papaya pulp was highly acceptable due to highly desirable and satisfaction by the panelist.

ii. Mean hedonic rating scale for papaya sauce

Table 65: Mean Hedonic Rating Scale for Papaya Sauce

Attributes	Mean ±SD scores

	V_1	V_2	V_3
Appearance	4.03±0.99	3.90±0.99	3.90±0.92
'r' value	1	0.28	0.26
Colour	4.46±0.57	4.16±0.56	4.53±0.68
'r' value	1	0.70**	0.75**
Flavor	3.90±0.88	3.93±0.73	3.90±0.80
'r' value	1	3.50**	3.27
Taste	3.83±0.91	3.83±0.87	3.56±0.97
'r' value	1	0.35	0.22
Consistency	4.16±0.80	3.76±0.85	3.80±1.86
'r' value	1	0.58**	0.44**

V – Variation

The Table 65 reveals that 30 and 10 per cent scored the variations 2, 1 and 3 as like extremely. Forty six and 33 per cent scored as like very much for variations 1 and 3. Thirty three and 30 per cent scored for variations 3, 2 and 1 as like moderately, three per cent scored the variations 1 and 3 as dislike moderately.

As far as acceptability is concerned, the above table shows that the mean hedonic score was between 7 and 7.4 and the 'r' value for variation 1 was highly and positively correlated because all the attributes like appearance, colour, flavor, texture and especially taste were scored at the highest level.

iii. Rank correlation of hedonic rating scale of sauces

The rank correlation of sauces for three variations was given in Table 66.

Table 66: Rank correlation of hedonic rating scale of sauces

Recipe name	V_1	V_2	V_3
Banana sauce	1.000	0.307	0.302
Guava sauce	1.000	0.631**	0.377
Papaya sauce	1.000	0.350	0.242

V – Variation.

It is clearly indicated that variation 1 was ranked as highly correlated for all the three sauces namely banana, guava and papaya sauce. It is also noted that variation 2 of guava sauce was significant at 0.01 level while guava sauce of variation 3 was significant at 0.05 level.

b. Nutrient content of papaya and papaya sauce

The nutrient content of papaya and papaya sauce is given in Table 67 and Figure 15.

Table 67: Nutrient Content of Papaya and Papaya Sauce

Parameters	Papaya (100 g)	Papaya sauce (100 g)	Difference
Energy (Kcal)	58.32	86.10	27.78
Protein (g)	0.90	0.0	-0.9
Fat (g)	0.11	0.0	-0.11
Carbohydrates (g)	12.0	21.0	-
Ash (%)	2.0	0.06	-1.94
Acid insoluble Ash (%)	0	0	-
Total fibre (g)	2.4	0.4	-2
Total sugar (g)	56	60	4
Vitamin C (mg)	340	70	-270
Antioxidant activity (□g)	49	14	-35
Iron (mg)	0.8	6.0	5.2
Sodium (mg)	6.1	140	134

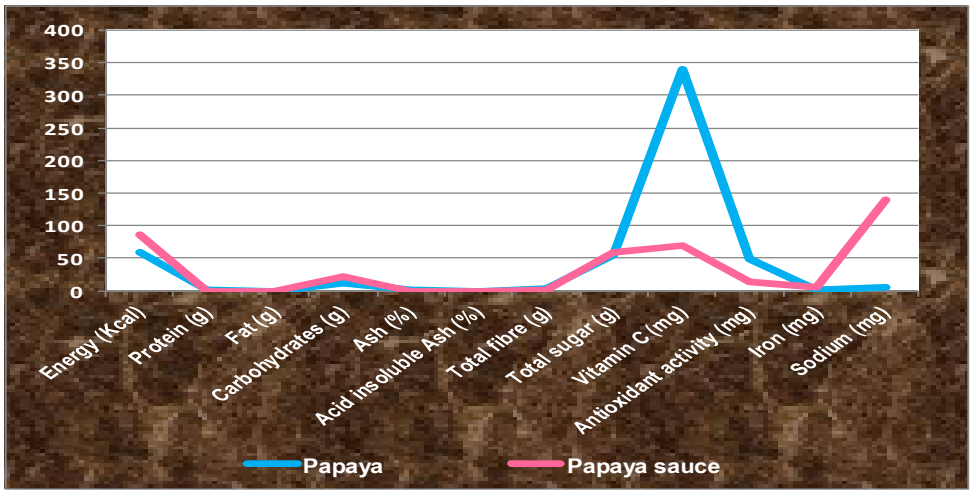


Figure 15: Nutrient Content of Papaya and Papaya Sauce

The nutritive value of 100 g of papaya was 58 Kcals of energy, 0.9 g of protein, 0.132 g of carbohydrates, 2.4 g of total fibre, 56 g of total sugar, 340 mg of vitamin c and 49 mg of antioxidant activity. As against this 100 g of papaya sauce had 86 Kcal of energy, 21 g of carbohydrates, 60 g of total sugar, 70 mg of antioxidant, 14 mg of vitamin C, six mg of iron and 40 mg of sodium. Here, again the value of papaya sauce had been enriched by the addition of ingredients like sugar, salt and fruit pulp in the preparation of papaya sauce.

c. Shelf life study

i. Mean score of papaya sauce during shelf life study

The details of acceptability study and nutrient content of papaya sauce during shelf life study are given in Tables 68 and 69.

Table 68: Mean Score of Papaya Sauce during Shelf Life Study

Attributes	Mean ± SD scores			
	0 day	30 days	60 days	90 days
Appearance	4.30±0.94	4.10±0.69	4.50±0.70	-
Colour	4.20±0.63	4.50±0.70	4.10±0.73	-
Flavor	4.40±0.51	4.20±0.78	4.10±0.87	-
Taste	4.30±0.82	3.60±1.17	4.00±1.05	4.10±0.99
Consistency	4.10±0.99	4.00±0,81	4.20±3.18	3.80±1.03

The appearance of papaya sauce was very appealing for 60 and 50 per cent of panel members after 60 and 30 days shelf life. It is moderately appealing to 100, 40 and 30 per cent of panel members for 30 and 60 days of storage respectively. Orange colour was scored by 60 and 30 per cent for 30, 0 and 60 days respectively. One hundred and 60 per cent of panel members scored as light orange on 90 and zero days.

Highly acceptable flavour was observed by 40 per cent of panel members on zero, 30 and 60 days storage. It is acceptable 100 and 60 per cent on 90 and 0 days storage. Moderately acceptable flavor was scored by 30 and 20 per cent of panel members for 60 and 30 days shelf life

Excellent taste was scored by 50 and 40 per cent for 0, 60 and 30 days respectively. Thirty per cent scored as very good for 0 and 30 days, 60 and 90 days was scored by 40 per cent as good. Fair taste was indicated by ten per cent of panel members on 30th and 90th day of storage of papaya sauce.Smooth texture was noted on 0 and 60 days by 40 per cent of panel members. The consistency of papaya was found to be of pouring state on zero to 90 days as stated by 40-70 per cent of panel members. Thirty and 20 per cent felt sauce was in dropping stage on 30th and 90th days of storage.

The total mean score of papaya sauce was 21.3 on zero day, 20.7 on 15th day, 20.9 on 30th day and 7.9 on 60th day. The sensory score for colour, appearance, flavour, texture and overall acceptability were found in acceptable range up to 90 days storage (Chauhan and Chatterjee, 2005).

Table 69: Mean Hedonic Rating Scale for Papaya Sauce during Shelf Life Study

Attribute	Score	0		30		60		90	
		N=30	%	N=30	%	N=30	%	N=30	%
Like extremely	9	9	30	9	30	12	40	-	-
Like very much	8	15	50	3	10	6	20	9	30
Like moderately	7	6	20	9	30	9	30	21	70
Like slightly	6	-	-	6	20	3	10	-	-
Neither like nor dislike	5	-	-	3	10	-	-	-	-
Dislike slightly	4	-	-	-	-	-	-	-	-
Dislike moderately	3	-	-	-	-	-	-	-	-
Dislike very much	2	-	-	-	-	-	-	-	-
Dislike extremely	1	-	-	-	-	-	-	-	-
Mean ± SD	-	8.10 ± 0.73		7.30 ± 1.41		7.90 ± 1.10		7.30 ± 0.48	

Though 70 percent like moderately, 30 percent mentioned that papaya sauce was liked very much on90th day storage, 40 per cent liked papaya sauce extremely well on 60th day of storage.

ii. Nutrient content of papaya sauce during shelf life study

Table 70: Nutrients Content of Papaya Sauce during Shelf Life Study

Parameters	Papaya (30 days)	Papaya sauce (90 days)	Difference
Energy (Kcal)	89.09	169.40	79.51
Protein (g)	-	-	-
Fat (g)	-	-	-
Carbohydrates (g)	21.73	41.32	19.59
Ash (%)	0.03	0.03	-
Acid insoluble Ash (%)	-	-	-
Total fibre (g)	0.38	0.44	0.06
Total sugar (g)	58.0	58.2	0.2
Vitamin C (mg)	13.59	14.09	0.5
Antioxidant activity (g)	66.0	68.2	2.2
Iron (mg)	5.80	6.0	0.2
Sodium (mg)	138.88	139.99	1.11

The nutrients content of papaya sauce was not found to be deficient in nutrients on the 60th day when compared to that of the 30th day storage. Nutrients like energy (79.51) and carbohydrates (19.59) were more whereas to total fibre (0.06), total sugar (0.5), antioxidant activity (2.2), iron (0.2) showed slight difference during storage of 30 and 60 days. Thus, the nutrient content of 30th and 60th days storage was different because of the different packaging material used and the kind of preparation technique.

4. Moisture Content and Total Plate Count of Sauces

The moisture and total plate count of the sauces are presented in Table 71 and 72.

Table 71: Moisture Content of Sauces

Recipe Name	0 Day	30th Day	60th Day
Banana Sauce	55.62	57.66	88.14
Guava Sauce	76.23	74.71	76.19
Papaya Sauce	79.64	78.27	58.68

The Table 71 reveals that the moisture content of banana, guava and papaya sauce with 100 g of pulp was increased on 60 days storage of banana sauce whereas the moisture content of guava sauce was decreased on 60 days shelf life. Moisture content of papaya sauce was also decreased significantly during 60 days storage but in spite of all the changes in moisture content the acceptability was found to be desirable at the highest level.

Table 72: Total Plate Count at 37^0c of Sauces

Recipe Name	0 Day (cfu/g)	30th Day (cfu/g)	60th Day (cfu/g
Banana Sauce	Absent x 10^3	Absent x 10^3	01 x 10^3
Guava Sauce	Absent x 10^3	Absent x 10^3	01 x 10^3
Papaya Sauce	Absent x 10^3	Absent x 10^3	01 x 10^3

The above Table 72 shows that the total plate count at 37^0C of all the three sauces was absent during 0 and 30 days. But present of micro-organisms was found at 01 x 10^3 cfu/gm during 60 days storage. Even though the microbial count was observed on 60th day shelf life it was found that the acceptability of all the sauces scored at the highest level by the panelist

PHASE IV: PROMOTION OF FORMULATED VALUE ADDED PRODUCTS THROUGH CAPACITY BUILDING PROGRAMME

The impact of the capacity building programme was assessed by a knowledge check list and the results are shown in Table 73.

Table 73: Impact of Capacity Building Programme on the Knowledge of Self Help Group Women and Farmers

(N: 107)

Parameters	Before capacity building programme								After capacity building programme							
Scores	**0**		**1 – 3**		**4 – 7**		**8 – 10**		**0**		**1 – 3**		**4 – 7**		**8 – 10**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
I. Prerequisites for fruit processing																
a. Scope of fruit processing	83	78	19	18	5	5	0	0	4	4	29	27	48	45	26	24
b. Equipment and machineries needed for fruit processing	78	73	29	27	0	0	0	0	2	2	8	8	39	36	58	54
c. Selection criteria for fruits and equipment	94	88	10	9	3	3	6	6	0	0	38	36	63	59	6	6
d. Lay out plan of fruit processing unit	93	87	3	3	5	5	0	0	3	3	13	12	68	64	23	22
Total	**348**	**326**	**61**	**57**	**13**	**13**	**6**	**6**	**9**	**9**	**88**	**83**	**218**	**204**	**87**	**106**
II. Financial planning																
a. Sources of finance to start a processing unit	0	0	18	17	76	71	13	12	0	0	0	0	79	74	28	26
b. Pricing of fruit products	9	8	57	53	17	16	24	22	7	7	21	20	69	65	10	9
c. Budget allocation	7	7	81	76	12	11	7	7	2	2	33	31	70	65	2	2
Total	**16**	**15**	**156**	**146**	**105**	**98**	**44**	**41**	**9**	**9**	**54**	**51**	**218**	**204**	**40**	**37**
III. Processing of fruits																
a. Processing techniques of fruits	96	90	9	8	2	2	0	0	0	0	0	0	79	74	28	26
b. Safe and hygienic practices in fruit processing unit	89	83	18	17	0	0	0	0	0	0	22	21	58	56	27	25
c. Standardisation of fruit products	14	13	67	63	23	22	3	3	4	4	18	17	83	76	2	2
d. Nutritional quality of fruit products	101	94	6	6	0	0	0	0	9	8	36	34	42	39	20	19
Total	**300**	**280**	**100**	**94**	**25**	**24**	**3**	**3**	**13**	**12**	**76**	**72**	**262**	**245**	**77**	**72**
IV. Marketing of fruit products																
a. Selection of packing materials	71	66	18	17	2	2	16	15	11	10	64	60	23	22	9	8
b. Identification of market outlets	0	0	66	62	10	9	31	29	0	0	77	72	21	20	9	8
c. Challenges and remedial measures in fruit processing	53	50	54	51	0	0	0	0	6	6	38	36	55	51	8	8
d. Certification required to run a fruit processing unit	105	98	2	2	0	0	0	0	31	29	37	35	30	28	9	8
Total	**229**	**214**	**140**	**132**	**12**	**11**	**47**	**44**	**48**	**45**	**216**	**203**	**129**	**121**	**35**	**32**

Before the capacity building programme 88 percent and 87 percent of the participants scored 0 which indicates they did not have any knowledge on selection criteria for fruits and equipment and lay out plan of fruit processing unit. Seventy eight percent scored 0 for the scope of fruit processing. It indicates the need for capacity building programme on fruit processing to the women and farmers. But it was observed that the scores was increased from 0 to 1-3, by 36 percent and 4-7 by 59 percent and 8-10 by six percent after the programme which was statistically significant at 0.05 level.

Fifty three and 76 percent of the participants were scored 1,2,3 before capacity building programme for the knowledge on pricing and budget allocation for fruit processing unit which was scored 4-7 by 65 percent after the programme and it was statistically significant.

All the participants of the capacity building programme had knowledge on the source of finance to start a fruit processing unit since they were a member in self help group (SHG). Seventy six and 12 percent of them scored 4-7 and 8-10 respectively before the programme.

The majority of 90 and 83 percent of the participant scored 0 and did not know the basic processing techniques of fruits and safe and hygienic practices in fruit processing unit which was increased to the scores of 4-7 by 74 and 56 percent respectively and 26 and 25 percent scored 8-10 for the same criteria after capacity building programme which was significant at 0.015 and 0.027 of p value.

Only 13 percent of the participants scored 0 for the criteria of standardization of fruit products and majority of 63 percent scored 1-3 which was increased to the scores of 4-7 by 76 percent after capacity building programme.

The maximum of 94 percent of the participants scored 0 for the criteria of nutritional quality of the fruit products before capacity building programme which was increased to 4-7 by 39 percent, 8-10 by 19 percent after the capacity building programme.

Before the capacity building programme 66 percent of the participant scored 0 for the criteria of selection of packing material for the fruit products which was increased to

1-3 by 60 percent and 4-7 by 20 percent after the capacity building programme. All the participants new about the identification of market uotleyts and 62 percent scored 1-3 ,29 percent scored 8-10 before the programme which was increased to the scores 1-3 by 72 percent,4-7 by 20 percent which showed statistical significance.

Ninety eight percent of participants scored 0 for the criteria of certification required to run a fruit processing unit but after the program it was identified that the scored increased to 1-3 by 35 prcent and 4-7 by 28 precent and 8-10 by nine percent.

The statistical significance of knowledge improvement emphasized the need and importance of capacity building programme to women and farmers.

CASE STUDY

Case 1, Mrs.Lakshmi aged 35, a member in Vidiyal-Women Self Help group participated in capacity building programme conducted at Department of Lifelong continuing education and extension, Avinashilingam University, Coimbatore. She was a house wife and having 2 children .Her daughter and son are studying 3rd and 1st standard respectively at Thai Lakshmi Matriculation School, Coimbatore. Her husband is a carpenter earning ₹8000 per month. They had constructed a small house with the help of government home loan with lots of difficulties. She studied 5th standard. She was planning to help her husband financially and seeking for an opportunity.

Case 2, Mrs. Kurshitha Banu aged 36, also a member of Vidiyal-Women Self Help group participated in capacity building programme conducted at Department of Lifelong continuing education and extension, Avinashilingam University, Coimbatore. She was a house wife and having 2 daughters. They are studying 7th and 2nd standard respectively at Vidhya vikashini Matriculation School, Coimbatore .Her husband Mr.Mubeer Ahamed is a goldsmith. They were searching for an opportunity to start a business.

Both case 1 and 2 were planned to start a home based business together at small level with little investment since they were close friends for a long time. It so happened that the right time, they were informed about the capacity building programme from the Vidiyal-Women Self Help group leader. They attended the programme with lots of expectation and interacted well and got clarified on all the topics

covered like scope, planning, and actual execution, sources of finance and challenges of the fruit processing business.

They started banana processing business at home level from November 2012 with the investment of₹5000.She procured poovan variety banana,5-10 thar which was weighing about 10-15 kg per thar, at the cost of ₹200-250 pre one large thar from plantain Mandy situated at rathinapuri and kannappa nagar, and polyethylene cover from Rishaba Poly packs, Coimbatore. She followed Osmotic dehydration method for processing. For sun drying the open space of her home taros was used. Weekly purchase was made. From a single procurement weighing 50-150Kg they could get 17-50 kg of the osmodried banana.

They procured only minor utensils and accessories for the business including stainless steel vessel, cutting board and slicer. The packing quantity starts from 250 g to 1 kg. They used stickers for the on the packets which indicates the date of packing and price. Their market outlets were small retail shops in north of Coimbatore city .They took the order through phone and deliver directly. They identified the retailers with the help of the Self Help Group initially. They maintain their customers by proper delivery and good rapport. Mr.Mubeer Ahamed helping in marketing of the banana product. They give free samples of 100g initially to the customer to get the feedback. Their monthly expenses was about ₹3000-3500 and the monthly income was ₹10, 000/-.