II REVIEW OF LITERATURE

The literature pertaining to the study entitled, "**Processing and Packaging of Selected Value Added fruit products and their Promotion through Capacity Building Programme,** is reviewed under the following headings.

A. Need for value added fruit products
B. Processing techniques to extend the shelf life of fruits
C. Quality assessment - Organoleptic and nutritional quality
D. Suitability of packing material and shelf life of processed value added products and
E. Capacity building programme for entrepreneurship development of women and farmer.

A. Need for Value Added Fruit Products

The total production of fruit in the world is around 370 MT while there are almost 180 families of fruits that are grown all over the world. Citrus fruits constitute around 20 per cent of world's total fruit production (www.fruitvegetable.com. 2010).

FAO (2010) predicted that in developed countries, the United States (US) continues to dominate the international trade of fruits and is ranked number one as both importer and exporter, accounting for approximately 18 per cent of the $ 40 billion (USD) in fresh produce world trade. As a group, the European Union (EU) constitute the largest player, with 15 additional export and import commodities contributing about 20 per cent to total fresh fruit.

The United States is the fifth largest fruit producer and is the world's biggest exporter of fresh fruit, in terms of value and quantity. The value of US fresh fruit exports in 2003 was over $ 2.2 billion amounting to nearly three million metric tonnes. These exports amount to more than 20 per cent of the global export market value. Over nine per cent of total fruit production in the United States is for fresh export. The primary export products from the US are grapes, oranges and apples. The United States is the second largest exporter of grapes and the largest exporter of oranges and apples.

In Asian countries, production of citrus fruits is mainly consumed; domestic exports of fresh citrus fruits represent roughly 10 per cent of total productivity. The bulk of exports of fresh citrus fruits situated in the Northern Hemisphere, accounting for around 62 per cent of world fresh citrus fruits exports in 2003. The Mediterranean region plays a prominent role as fresh citrus exporter, providing nearly 60 per cent of global fresh citrus fruits exports (www.untad.org, 2010).

According to UNCTAD (2005) report world production of citrus fruit has experienced continuous growth in the last decades of the 20th century. Total annual citrus production was estimated at over 105 million tonnes in the period 2000-2004. Orange constitutes the bulk of citrus fruit production, accounting for more than half of global citrus production in 2004. The rise in citrus fruits production is mainly due to the increase in cultivation areas and the change in consumer preferences towards more health and convenience food consumption and the rising income (Yusuf and Falusi, 2005).

Demand prospects for fresh tropical fruits over the current decade are expected to be favorable with the forecast compound growth rate at nearly eight per cent over the projection period for major tropical fruits. Global imports are forecast to reach 4.3 million tonnes by 2010 with 87 per cent or 3.8 million tonnes destined for developed country markets. The European countries are expected to remain the world's largest import market, followed by the United States, together accounting for 70 per cent of import demand (FAO, 2010).

China is one of the earliest and most important centers of origin of cultivated plants in the world. In 1997, the total production of fruits in China was 50.89 million tonnes, out of which 17.22 million tonnes were apple and 6.42 million tonnes were pears. Fruit production in total or individually for apple and pear assumed the first place in the world (Long, 2009).

The world production of tropical fruits in 2004 was estimated at 67.7 million tonnes of which 98 per cent was produced in developing countries. The major tropical fruit produced and traded included mango, pineapple, avocado, and papaya, while minor fruits included rambutan, longan, mangosteen, lychees, guava, carambola and passion fruit (Guayaquil and Ecuador, 2010).

Kipe (2010) stated that Canada is the largest market for US fresh fruit exports, buys 47 per cent of all US fresh fruit exports, particularly strawberries, grapes and oranges. In 2003, the United States exported $ 827 million fresh fruit to Canada, which was 10 per cent increase from the previous year. The United States held a 5.1 per cent share of the Canadian market in 2003, down from 53 per cent of the previous year.

Banana is the second largest produced fruit after citrus, contributing about 16 per cent of the world's total fruit production. India is the largest producer of banana, contributing to 27 per cent of world's banana production.

World production of banana is estimated at 48.9 million tonnes out of which 10.4 million tonnes, is contributed by India. India ranks first position in production followed by Brazil (5.5 million tonnes), Indonesia (2.3 million tonnes), Philippines (3.8 million tonnes), China (1.9 million tonnes) and Australia (1.8 million tonnes) (http://nhb.gov.in/horticulture, 2011).

In the year 2006, India is the world's largest producer of banana accounting for about 23 per cent of global output, about three times the share of the next country (Brazil). The productivity per hectare in India is more than twice that of the world. The state of Maharashtra is the largest producer of banana in the country with 27 per cent of total Indian production and it has the highest productivity, 420 per cent higher than that of the world's average and 225 per cent higher than that of the country's average. After Maharashtra it is followed by Tamil Nadu (20 per cent), Gujarat (15 per cent), Karnataka (10 per cent) and Andhra Pradesh (10 per cent) (Ramesh and www.nabard.org/2007).

In Tamil Nadu banana is cultivated in 83,308 ha with an annual production of 2,782 million tonnes. The productivity in Tamil Nadu is 33.39 tonnes/ha compared to 38.1 tonnes/ha in Gujarat).

About 39 per cent of world's mango and 23 per cent of world's banana is produced in the country. The overall production of horticultural crops registered an increase of 8.0 per cent during 2004-05 as compared to 2003-04 (http://india.gov.in, 2011).

Guava stands fifth in production among the most important fruit crops of Bangladesh and can be grown all over the country. The annual production is about 45,000 metric tonnes in an area of about 10,000ha (www.banglapedia.org, 2011).

Guava is the fourth most widely grown fruit crop in India. Major guava producing states include Uttar Pradesh, Bihar, West Bengal, Maharashtra, Chhattisgarh, Tamil Nadu, Karnataka, Madhya Pradesh, Gujarat and Andhra Pradesh The area under guava is about 0.15 million ha producing 1.80 MT of fruits. The popular varieties of guava are Allahabad, Safeda, Lucknow-49, Nagpur seedless and Dharwar. Bihar is the leading state in guava production with 0.30 MT followed by Andhra Pradesh and Uttar Pradesh. The other states where guava is grown widely are Gujarat, Karnataka, Punjab and Tamil Nadu (www.bndes.gov.hr, 2010) (http://nhb.gov.in/horticulture, 2011).

Guava is the third important fruit crop next to mango and banana in Tamil Nadu and is cultivated in about 9,700 ha with an annual production of 61.500 metric tonnes with a productivity of 4.56 ha^{-1} (www.ctahort.org, 2011).

Guava is the second most important fruit crop in UP and is currently grown in 15,600 ha, with a production of 140526 tonnes per year, with an average yield of nine MT/ha. As per National Horticulture Board (NHB) data guava ranks up fourth among all states, in terms of production as well as area under cultivation. However, it lays well behind the national average yield of 12MT/ha. Several states Chhattisgarh, Karnataka, Punjab and Andhra Pradesh have achieved productivity levels of over 15 MT/ha (www.nall.usda.gov, 2009).

Papaya is cultivated over 30 countries of the world. The total planted area under papaya in the world is not known but its annual production has been estimated of approximately 16, 00,000 metric tonnes. The major papaya producing regions are Asia, America and Africa.

Global production of papayas reached almost 6.5 million tonnes in 2004, registering a growth of 25 per cent between 1999 and 2004. Production has been continuously increasing over the past decade (http://www.eximbankindia.com/ agro.com, 2005).The world production of papaya (Carica papaya L.) in 2008 was estimated to be approximately 9.1 million tonnes (FAOSTAT, 2008).

Papaya is native to tropical America, from Southern Mexico through the Andes of South America. Worldwide 6,504,369 MT or 14 billion pounds produced in 54 countries on about 900,000 acres, United States 16,136 MT or 35.5 million pounds production only in Hawaii, on about 1400 acres. Yield is twice the world average at 28,000 Ibs/acre. Growers receive 20 to 60 c / Ib and the entire Hawaiin industry valued at just $ 12 million (FAO, 2004)((www.uga.edu. 2010).

Papaya is a major tropical fruit grown widely in the country. Country wise production of papaya is Brazil (27 per cent), Mexico (15 per cent), Nigeria (12 per cent), India (11 per cent), Indonesia (8 per cent) and Ethiopia (11 per cent) with the rest of the world (23 per cent) (www.uga.edu/fruit/papaya, 2010). World papaya production showed an upward trend between 1999 and 2003. Over this period production increased by almost 20 per cent from 53,011 million tonnes to 6,342 million tonnes. (www.extento.hawaii.edu, 2010).

Global papaya imports are forecast to grow 8.3 per cent, reaching 336000 tonnes over the projections period. Papaya is expected to account for the largest share of tropical fruit imports by developing countries with imports forecast at 99,000 tonnes or 29.5 per cent of total world trade for 2010.The Asia and the Pacific region are forecast to account for 87 per cent of developing country papaya imports. The United States is expected to remain the largest import market in the world, with forecast volume at 161,000 tonnes, accounting for 48 per cent of total globe trade (GIDS, 2010).

The area under papaya cultivation in India increased by 63 per cent from 45.2 thousand ha in 1991-92 to 73.7 thousand ha in 2001-02 and the production increased from 8 lakh tonnes to 26 lakh tonnes. Papaya is mostly cultivated in the states of Andhra Pradesh, Karnataka, Gujarat, Orissa, West Bengal, Assam, Kerala, Madhya Pradesh and Maharashtra (http://nhb.gov.in/Horticulture, 2011).

Department of Horticulture (2010) stated that Coimbatore has its current fruit production of approximately 318487.4 metric tonnes during 2009-10. Fruit wise production in Coimbatore is mango 6745.2 MT, banana 300795, sapota 5280 MT and amla 5667.2 MT.

Fresh fruits are inherently more liable to deterioration under tropical conditions characterized by high ambient temperature and humidities and a high incidence of pests and diseases. Consequently, post-harvest losses of fruit are extremely high in Nigeria (30-50 per cent), exacerbated by poor marketing distribution and storage facilities.

Estimates of the post-harvest losses of fruits in developing world from mishandling, spoilage and pest infestation are put at 25 per cent, this means that one-quarter of what is produced never reaches the consumer for whom it was grown and the effort and money required to produce it are lost forever (www.fao.org., 2010).

Post-harvest losses of fruits in most Asian countries are so high, and the causes of these losses are so diverse, that a great deal of research and training is needed if preventive measures are to be improved. Roy (2009) emphasised that there is need for improvement in developing countries since there is still a poor infrastructure and a lack of marketing facilities, post-harvest losses of fresh produce range from 20 - 50 per cent

The per capita availability of fruits even with this increase is lower at 107 g/day than the recommended level of 120g. One of the main reasons attributed to lower availability is the large quantity of post-harvest losses that occurs at various stages of marketing, which ranged from 15 to 50 per cent.

Rolle (2006) reported that the fruit sector has a vital role in farm income enhancement, poverty alleviation, food security and sustainable agriculture in Asia, especially in developing countries. This sector, however, suffers greatly from post-harvest losses, some estimates suggest that about 30-40 per cent of fruits are lost or abandoned after leaving the farm gate.

According to Panhwar (2006) worldwide post-harvest fruit losses are as high as 30 to 40 per cent and even much higher in some developing countries. Reducing post-harvest losses is very important ensuring that sufficient food, both in quantity and in quality is available to every inhabitant in our planet.

In agriculturally developed countries, such as Japan, the Republic of Korea and Taiwan province of China, it has been reported that the post-harvest losses for fruits are about 10 per cent (FAO, 2010).

In the Philippines, generally post-harvest losses could range from 15 to 35 per cent. However fruit like papaya was reported to suffer post-harvest losses of 30 to 60 per cent (www.uga.edu. 2010).

The Pakistan National Commission Agriculture estimated that defects and inadequate facilities in post-harvest handling, transportation, storage and marketing may cause a loss of 20 to 40 per cent (www.indianetzone.com, 2010).

India is the world's second largest producer of fruits next to China and has the potential of being the biggest in the world. But due to inadequacy in development of an integrated supply chain system across the country about 20-25 per cent of the fruits are lost due to spoilage at various post- harvesting losses (Dhingra, 2007).

Majority of 60 to 70 per cent of fruits produced in India are consumed domestically. Two per cent of fruits are being processed. Out of the total production only one per cent is being exported and post-harvest losses account to 20 to 30 per cent of the stored fruits.

According to the Central Food Technology Research, India stands second in the world production of fruits and vegetables. The country actually produces about 50 million tonnes of fruits and 85 million tonnes of vegetables per year, but just about two per cent of this goes for processing, while over 25 per cent is spoiled due to improper handling and storage, and the rest is consumed in fresh form (http://www.eftri.com/department/fruit.htm, 2011).

Post-harvest diseases destroy 10 to 30 per cent of the total yield of crops and in some perishable crops especially in developing countries; they destroy more than 30 per cent of the crop yield .Fruits are highly perishable products, the quality is affected by post-harvest handling, transportation, storage and marketing (Kader, 2002).

Ro and Khurdiya (2010) estimated that 20 to 50 per cent of fruits produced in the country do not reach the consumer for want to proper technologies on harvesting, hovelling, packaging, transport, storage and marketing facilities. There is need to develop appropriate technology to reduce the post-harvest losses of perishable like fruits.

The magnitude of post-harvest losses for tomatoes was 19.4 per cent and 16.2 per cent in the Jordan Valley and Uplands, respectively.Post- harvest losses observed for tomatoes and egg plants in both growing areas were due mainly to mishandling of the produce and to inappropriate manipulation of the environmental conditions surrounding the produce.

Most losses of fresh produce between leaving the farm and reaching the consumer have been estimated to be 20 per cent of the total crop. These losses may be caused by complete wastage of the product or by lower prices due to a reduction in quality and the value of the product increases several fold from the farm gate to the final consumer. So in dollar terms post-harvest losses are even more significant (Panhwar, 2006).

Value added refers to some type of additional incentive or enhancement that is offered by a producer in order to attract the attention of consumers (www.wisegreek.com, 2003).Value addition takes place when enhancement is added to a product or service by a company before the product is offered to customers (www.fao.org/decrep, 1996).Value added products enable the farmers to increase sales by creating product diversity and to increase and stabilize income. The product diversity is about offering a range of products that differ from one another, satisfy the needs of different market sectors and involves differentiating products from those of competitions (FAO, 2010).

Value added fruit products offer opportunities to expand production as well as draw customers to the farm for a true agriculture experience (www.froghollow.com, 2011 and http://valueaddedag.tennerice.edu, 2011).

Value adding improves the economic situation, as well as adds value to the life. Value prevents spoilage of fruit, sustaining the interest of farmers (www.agroforesting.net/overstorage, 2011).

Many organizations, from both the government and non-government sectors, are actively promoting the processing of fruit and vegetables. The reasons for this include:

- Attempts to preserve seasonal gluts which often lie rotting on the roadside.
- Difficulties in storing large quantities of fresh produce without incurring heavy losses.
- Small local markets for the large quantities of fresh produce in season.
- Ineffective distribution and transportation to meet demand in other, often urban, areas
- So, to prevent this loss, many may be tempted to convert such gluts into value-added products to be sold in the urban areas (Fruitandvegetable.com, 2008).

B. Processing Techniques to Expand the Shelf Life of Fruits

Sun drying is only possible in areas where, in an average year, the weather allows foods to be dried immediately after harvest. The main advantages of sun drying are low capital and operating costs and the fact that little expertise is required. The main disadvantages of this method are as follows: contamination, theft or damage by birds, rats or insects; slow or intermittent drying and no protection from rain or dew that wets the product, encourages mould growth and may result in a relatively high final moisture content; low and variable quality of products due to over-or under-drying; large areas of land needed for the shallow layers of food; laborious since the crop must be turned, moved if it rains; direct exposure to sunlight reduces the quality (colour and vitamin content) of some fruits and vegetables. Moreover, since sun drying depends on uncontrolled factors, production of uniform and standard products is not expected.

Solar dryers have some advantages over sun drying when correctly designed. They give faster drying rates by heating the air to 10 -30^{0}C above ambient, which causes the air to move faster through the dryer, reduces its humidity and deters insects. The faster drying reduces the risk of spoilage, improves quality of the product and gives a higher throughput, so reducing the drying area that is needed. However care is needed when drying fruits to prevent too rapid drying, which will prevent complete drying and would result in case hardening and subsequent mould growth. Solar dryers also protect foods form dust, insects, birds and animals. They can be constructed from locally available materials at a relatively low capital cost and there are no fuel costs. Thus, they can be useful in areas where fuel or electricity are expensive, land for sun drying is in short supply or expensive, sunshine is plentiful but the air humidity is high. Moreover, they may be useful as a means of heating air for artificial dryers to reduce fuel costs (Fellows, 1997).

Drying was one of the most prevalent method of food preservation in early times using solar energy until the turn of 20^{th} century when mechanical drying replaced it. Continued efforts of the researchers have resulted in the development of novel techniques like osmotic, freeze, vacuum, spray, foam mat, microwave and other drying techniques for a large range of products (Kar, et al., 2003).

Maskan (2000) reported that hot air drying took the longest time to dry samples whereas with the microwave finish treatment, drying time was reduced by approximately 64.3 percent and it had little effect on colour and rehydration capacity of dried banana samples.

Banana slices could be dried by microwave assisted convective drying (MACD) at a microwave power level of 280w, air temperature of 65^0C and an air velocity of 0.5m/s in a modified domestic microwave oven. Nogueria and Park (1992) conducted microwave drying in a domestic microwave oven at 140w convective drying at 65c and air velocity 1.5 m/s and Kar (2001) conducted freeze drying at 50^0C and 5 mm of Hg.

Chu, et al. (2001) observed that by employing stepwise-varying drying air temperature with appropriate starting temperature and cycle time, it was possible to reduce significantly the drying time to reach the desired moisture content with improved product colour.

The variation in the product volume was equal to the volume of the evaporated water, accordingly mathematical models were proposed by Talla, et al., (2004). Calculated values were in good agreement. The results improved the modeling of the drying kinetics of products and the determination of their various characteristics.

Krokida, et al. (2001) investigated the effect of five different methods of drying: conventional, vacuum, microwave, freeze and osmotic drying on the colour of apple, banana, potato and carrot. Colour characteristics were studied by measuring lightness (L), redness (A) and yellowness (B) using Hunder lab chromatometer. Air, vacuum and microwave dried materials had extensive browning in the fruits and vegetables whereas osmotically pretreated samples did not brown as much as untreated samples and the value for lightness (L) decrease slightly, while redness and yellowness increase slightly. Freeze drying seemed prevent color changes, resulting in products with improved color characteristics.

Bananas shrunk by about 43-47 percent of their original diameter during drying. Therefore, the shrinkage assumption in the model provided greater reliability on the calculated diffusion and convective coefficient.

The Infra Red (IR) drying had much higher drying rate compared to the hot air drying. Its drying rate increased remarkably with the increase of the radiation intensity. The banana chips dried with Sequential Infrared Radiation and Freeze Drying (SIRFD) had much crisper texture and golden colour appearance than the regular freeze-dried products. The IR pre-dehydration did not reduce the required drying time during the subsequent freeze-drying process. It also resulted in more shrinkage of finished product compared to regular freeze-dried products. However, the acid dipping treatment was an effective treatment method for improving the colour appearance and reducing the freeze-drying time and the shrinkage. Even though the drawback of acid dipping was reduced crispness of finished products compared to undipped products, the products produced with SIRFD plus acid dipping still had similar or higher crispness with much whiter colour compared to regular freeze-drying. Therefore, food industry may use SIRFD alone to produce high crispy product or add dipping treatment to improve the product colour.

Mota, et al. (2000) prepared green banana flour by freeze drying the pulp and it was rich in starch granules and the flour production was easier and faster than isolation of starch. It was concluded that it would be practical and less expensive to banana flour rather than starch in some food applications.

C. Quality Assessment- Organoleptic and Nutritional Quality

Sensory evaluation has been defined as a scientific method used to evoke, measure, analyse and interpret those responses to products and perceived through the senses of sight, smell, touch, taste and hearing (Dzung and Dzuan, 2010). Sensory evaluation offers the opportunity to obtain a complete analysis of the various properties of food as perceived by human sense. Sensory evaluation is an important and best method for evaluating new products developed which provide quality measure and production control (Vidhya and Narain, 2011). Hedonic tests are routinely used to assess the acceptance of food products. Two groups of 41 panelists were tested with either the 9-point hedonic scale or Labeled Affective Magnitude scale {LAM scale}. Panelists received a food neophobia questionnaire and were subsequently classified to neophobic, neophilic, or neutral Ten foods, including 5 novel and 5 familiar, were used. In each session, 5 to 6 foods were served twice/week for 4 wk. Serving frequency ranged between 1 and 8 times (1, 2, 4, 6, 8). Data analyses were performed 3 times, using either absolute acceptability scores or relative scores, that is, the difference between absolute scores and scores for either the reference (cracker, RELFAM) or a novel food (pickled-ginger, RELNOV) served in every session. The 3 analyses (absolute, RELFAM, and RELNOV) generated similar results with respect to the number of significant differences between foods. There was no major drift in acceptability scores with sessions. Both scales were equally sensitive with some advantages for LAM over the 9-point hedonic scale.

The short shelf life and increased production necessitates development of nonconventional products from banana. This laboratory has developed a bench level technology for extracting almost 60 – 70 percent of the total soluble materials of banana in the form of its juice and the left over pulp can be dried into a fine powder. Taste panel studies showed general acceptability of nonconventional products developed from banana. The dry powder can be used as an additive in confectioneries, milkshakes and baby foods. Other products developed from ripe banana powder in the laboratory include biscuits, cake and baby food (Mitra, 2003).

Matsura et al. (2004) identified that different papaya nectar formulations showed an increase in sensory acceptance with increasing pulp content (up to 40 percent). Mixed nectars of papaya and mango pulps were studied and products with equal amounts of both pulps and a total of 30 percent or 40 percent pulp in the formulation were best accepted, as compared to those with lower levels of mango pulp. Another study involving mixed nectar formulations containing papaya pulp and passion fruit juice showed better sensory acceptance to nectars containing higher proportions of papaya

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examined through the evaluation of colour, water activity, rehydration ratios and nutrient content.

Water activity is the main factor of numerous important food processing operation such as microbial growth, toxin formation, enzymatic and non-enzymatic reaction that determines the shelf life of food products.

As per Giovanelli et al. (2002) in order to find out the drying kinetics of tomato slices the physiochemical parameters such as colour retention, water activity, dehydration capacity and ascorbic acid retention can be evaluated The studies carried out by IIHR (2010) suggested that process has been standardized for preparation of osmotically dehydrated pineapple slices. Organoleptically, slices were acceptable to highly acceptable category mainly due to the improvement in product quality in terms of colour, texture and flavor by processes of osmotic dehydration. This process has a greater scope for utilization of pineapple fruits.

Dong et al. (2004) stated that litchi pulp is very perishable and thus has a short shelf life with marketers and consumers alike desiring a longer period. The results showed that application of chitosan coating effectively maintained quality attributes and extend shelf life of the peeled fruit.

A research study by Bakshi et al. (2005) revealed that calcium is proved to be associated with post-harvest life and ripening process of fruits. Application of calcium in pre and post-harvest phase has successfully been used to lower the incidence of much physiological disorder of fruit and extend their post-harvest life.

Han et al. (2004) proved that chloride dioxide gas treatment is an effective decontamination technique for improving the shelf life of strawberries while extending shelf life.

Research study by Sagar et al. (2000) showed that ripe mango powder packed in 4000 LDPE (Low Density Poly Ethylene) pouches could store at low temperature (7°C) up to 6 months and 4 months at room temperature (33-35°C) without losing its colour, flavour and texture. Low temperature helped in retaining higher level of ascorbic acid and carotenoids in the fruits. Fan et al. (1999) reported that Methyl Cyclo Propane (MCP) treated apple fruit had longer shelf life up to six months stored at 0°C and when fruits were held at 20-24°C for up to 60 days and also proved that MCP treatment help reduced ethylene production and respiration and extended their shelf life.

Alonso and Alique (2004) stated that an edible coating based on derivatives of fatty acid and polysaccharides in alcohol solution reduce the respiratory metabolism, control of transportation and maintained the post-harvest quality of picota cherries. The edible coating fruits were shiner, more turgid and more attractive and they may constitute an alternative technology to modified atmosphere packaging as currently used.

It was found by Satbhai and Masalkar, (2004) that kagzi lime fruits when give post-harvest dip of wax emulsion (6%), and bavistin (0.1%) and kept in 200 gauge polyethylene bags having 0.5 per cent vents treatment retain the quality of parameters such as acidity, juice content, vitamin C at maximum and reduced the physical weight loss and decay loss.

Lu (2004) found a research study to predict fruit firmness by developing and evaluating a multispectral imaging system for real time acquisition of scattering images from apple fruit. This study proved that neural network gave firmness prediction to the apple. It is a suitable technique for export purposes.

The results of the study of Tiwari et al. (2006) showed that aonla pulp treated with 1000 ppm of SO_2 and stored in glass bottles with or without in bottle pasteurization could be utilized successfully in making RTS beverage, squash and jam of acceptable quality of more than nine months of ambient storage.

Dehydrated banana slices prepared using solar and electric driers baring three common treatments viz. steeping banana slices in 0.5 per cent Potassium meta bi sulphate (KMS) plus 0.5 per cent $CaCl_2$, syrup plus 1.0 per cent $CaCl_2$ and exposing to SO_2 fumes. Shobana et al. (2006) concluded that the low population of microorganism observed under electric drying followed by solar drying could be attributed to the intensity of continuous heat received by the slices. The solar drying was found to be the best to check the load of fungal spores.

Shah and Nirankarnath (2006) reported that a number of preservative methods have been used for minimally processed fruits and vegetables like addition of texture improvers, antibrowning agents, acidulates, antimicrobial agents, reduction in water activity and mild heat treatment combined with modified atmosphere packaging and refrigerated storage.

Rathore et al. (2006) observed that solar tunnel dryer is techno economical feasible option for drying aonla on a commercial basis. The maximum drying rate of aonla at economical cost is obtained, though solar tunnel drier and retention of vitamin C was 43.55 per cent.

A research study by Alandes et al. (2006) showed that calcium lactate treatment on fruits strengthens the structure of fresh cut Fuji apple cell wall and outer cut, increased activity of both pectin methyl esterase (PME) and polygalatouronase (PGase) enzyme. Therefore it is advisable to treat product with calcium lactate to improve its structural stability. At a macroscopic level this calcium lactate treatment maintains the texture for at least 3 weeks of storage at 4°C.

Evelinmary et al. (2007) found that banana powder had a shelf life of one year under ambient conditions, when packed in aluminium foil laminated pouches. Among air, vacuum, N_2 and O_2 packing, N_2 packing was found best in terms of quality and organoleptic characters. Spray dried banana powder would be used as food ingredient and natural flavoring agent.

Costa et al. (2006) reported that mild heat pre-treatment when applied to firm ripe kiwi fruit at temperature below 45°C less than 25 minutes improve the quality mainly the firmness, colour being only marginally affected. It may be used to maintain the post-harvest freshness of the fruit.

Wani et al. (2007) stated that hard and unripe pear fruit was precooled and subjected to gamma irradiation in range of 0.1 to 2.5 KGY. The irradiation doses of 2 to 2.5 KGY resulted in reduced microbial load and delayed ripening.

Studies have proved that the onset of rancidity may be delayed substantially by fortification with antioxidants. Retention of natural antioxidants present in each raw material can be done by using membrane technology. So Anandhi et al. (2010) proved that membrane technology is exclusively used in processing of fruits and vegetable to prevent the loss of antioxidants and to extent shelf life.

The pH, total solid soluble (TSS) and ascorbic acid content of sauce prepared using papaya pulp were found to decrease and titratable acidity increased during storage for 90 days. The sensory score for colour, appearance, flavour, texture and overall acceptability were found in acceptable range up to 90 days storage (Chanhan and Chatterjee, 2005).

The study by Agarwal, 2010 reveals that in guava (psidium guava L.) sugars are major constituents in total solid soluble (TSS) of the fruits. The total sugar showed a positive significant correlation with reducing and non-reducing sugar. Thus, it is clear from the study that there was an inter-relationship between the chemical characters viz., TSS, reducing sugars, non-reducing sugar and total sugars in increasing or decreasing the quality of the fruit.

The study showed that fruits and vegetables were good sources of dietary fibre and vitamin C, while the energy value and fat contents were generally low, However, the content of these nutrients could be affected by cooking and preparation methods (www.cfs.gov.uk, 2007).

Lohidas (2010) noted that the total carbohydrate and soluble sugar occupied the maximum proportion of 240 mg/g and 86 mg/g respectively in the nendran fruit. The biochemical analysis of this study revealed that the nendran fruit constituted of 0.0028mg/g of thiamine, 0.0016 mg/g of riboflavin (Vitamin B_2) and 0.012 mg/g of niacin vitamin B_3.

The antioxidant abilities of various parts of eight common fruits and vegetables produced in Taiwan were investigated. Squash, wax gourd, tomato and guava seeds showed the highest antioxidant activity in thiobarbituric acid assay. The results of this study could be used for development of merchandise with potential health benefits from agricultural products (Huanghuiyu et al., 2005).

The antioxidant activity of the insoluble MRPs (Mailard Reaction Products) was not significantly affected by processing conditions, but severe treatments increased the ratio between insoluble and soluble matters. The contribution of insoluble matters to total antioxidant activity was limited for fruits and vegetables, but it was relevant for cereal-based foods and increased over 50 per cent for dietary-fiber-rich ingredients.

The study was carried out to investigate the effect of different modified atmosphere packaging (MAP) techniques for extending the shelf-life of fresh-cut jackfruit (Artocarpus heterophyllus L) bulbs kept under low temperature conditions. On the basis of sensory quality attributes, the shelf-life of pretreated jackfruit bulbs packaged in gas mixture flushed polyethylene (PE) bags, in polyethylene terephthalate (PET) jars with silicon membrane window and in polyethylene bag were 35, 31 and 27 days respectively (Saxena et al., 2008).

Qdai (2007) observed that a specific class of antioxidant found in fruit juice could stay off Alzheimer’s disease. Non-vitamins antioxidant polyphenols are abundant in the skin and peels of fruits. They are also present in teas and wines. Lab trial shows that polyphenol can have a potent effect on health with the potential to significantly delay the onset of serious cognitive impairment.

Craig (2006) stated that as per the report from American Cancer Society (ACS), vitamin C plays a vital role in preventing and inhibiting the formation of cancer forming substance in the stomach. The report goes on to suggest that people with diet rich in vitamin C are less likely to get cancer of the stomach and esophagus than those with vitamin C deficient diet.

Value addition takes place when enhancement is added to a product or service by a company before the product is offered to customer, this incorporation of value into other secondary products that have higher net worth, so that each unit of the product can be sold at a higher price and achieves a higher return (FAO, 2010).

Food fortification is the public health policy of adding micronutrients (essential trace elements and vitamins) to foodstuffs to ensure that minimum dietary requirements are met (http://en.wikipedia.org/wiki/foodfortification, 2009).

The study which was conducted in Jakarta, Indonesia by Sari, Bloom et al. (2001) showed that iron-fortified candies were effective for improving the iron status of young children and might be an affordable way to combat iron deficiency in children of low-to-middle income group.

According to Almedia and Crott et al. (2003) consumption of iron-fortified orange juice is an adequate strategy to complement iron intake in preschool children, and therefore, to treat and prevent iron-deficiency anemia.

Many epidemiological studies have confirmed that high fruit and vegetable consumption is associated with a lowered incidence of degenerative diseases due to their high vitamin, secondary plant metabolite (SPM) and fiber contents that act in synergy. However, fruit and vegetables are complex chemical matrices that are highly perishable; challenging their handling and trade. Thus, the development of value-added products is an excellent multidisciplinary strategy to overcome these problems (http://webcache.googleandcontent.com. 2011).

Threlfall et al. (2007) stated that value added fruit products are suitable for production by small scale farmers. The nutraceutical components of blueberries, peaches, and strawberries of the local dried fruit were higher than those of commercial dried fruit purchased at a natural food store. In addition to nutraceutical benefits consumer acceptable value added products that could represent an avenue for small-scale farmers to add value to surplus fruit.

According to Marwaha (2007) the aim of food preservation or value addition is to prevent undesirable changes in the wholesomeness, nutritive value and sensory quality of food by commercial methods which control growth of microorganisms, reduce chemical, physical and physiological changes of an undesirable nature and obviate contamination.

Appropriate value addition processing management is crucial for the success and profitability of any agri-food ventures. On today's business environment where consumers are not only demanding value for money but also expect corporate to show concern for society and environmental large and at the same time perform and remain competitive while maintaining good profitability for shareholders (Sardana, 2007).

D. Suitability of Packing Material and Shelf Life of Processed Value Added Products

Consumers now expect 'fresh' fruits and vegetables produce throughout the year. Modified Atmospheric Packaging {MAP} has the potential to extend the safe shelf life of many fruits and vegetables. Packaging fresh and unprocessed fruit and vegetables possesses many challenges for packaging technologists, unlike other chilled perishable foods, fresh produce continues to respire after harvesting. The products of aerobic respiration include CO_2 and water vapour. In addition, respiring fruits and vegetables produce C_2H_4 that promotes ripening and softening of tissues. The latter if not controlled will limit shelf life. Respiration is affected by the intrinsic properties of fresh produce as well as various extrinsic factors including ambient temperature. It is accepted that the potential shelf life of packed produce is inversely proportional to respiration rate. Respiration rate increases by a factor of 3-4 for every 10°C increase in temperature. Hence the goal of modified atmosphere packaging for fruits and vegetables is to reduce respiration to extend shelf life while maintaining quality (Mullan, 2002).

The shelf life of blackberries is relatively short, 2–3 days at 0 °C.This study compares the blackberry retail shelf life performance of different packaging materials, stored at 3°C and 85 per cent Rh for three weeks. The results showed that blackberries in both oriented polystyrene and oriented polylactic acid containers met the "US standard No. 1" grade for commercialization for more than 12 days at 3°C (Lewandowski et al., 2010).

Attempts have been made to study the effect of precooling and low temperature storage on shelf life of grapes. Uncle et al., (2004) observed that grapes were pre-cooled by forced air were packed in 300 gauge polyethylene bags and stored at cold temperature shows the maximum shelf life upto 58 days with minimum weight loss.

In order to estimate the shelf-life of Fuji apples, they were kept at 20°C in a normal atmosphere until consumption following seven months refrigerated storage (1°C), in a controlled atmosphere. Consumer acceptability and descriptive sensory analysis for storage periods of up to 28 days at 20°C indicated that the greatest quality loss was associated with increased mealiness, ripe taste and alcoholic taste and odor (Varela, 2005).

Smoothie-type beverages are usually preserved by mild pasteurization (Mp) but combining moderate heat (H) and pulled electric field (PEF) could represent an alternative technique achieving similar, or better, microbiological safety and shelf life and possibly lowering the thermal impact on physical and sensory product properties (Noci et al., 2010).

The study by Roberts et al {2006} indicated that both the length of shelf life and type of spoilage were related to fruit species. Minimally processed fruit had longer shelf life at 4°c than at temperature recommended for whole fruit when there were greater than 4°C. Spoilage of 4°C-stored kiwi fruit, papaya and pineapple pieces were not a consequence of microbial growth.

The sensory analysis carried out by Harper et al. (2006) showed slight difference between fresh and MAP mango and no difference between fresh and modified atmosphere packaging pineapple. Modified atmosphere packaging could be used as a technology to extend the shelf life of mango and pineapple.

The nutrient contents as well as some important physico-chemical parameters of the irradiated Bananas and the control Bananas were analyzed quantitatively at an interval of 24 days. A minor decrease in the ascorbic acid content was the only adverse effects observed in irradiated bananas and no other major changes occurred in nutritional and organoleptic qualities. Treated bananas were found to be acceptable upto 26 days at room temperature whereas in the case of control the fruits were spoiled within 6 days (Zaman and Paul, 2007).

Chandru and Prasad, {2006} found that guava (Psidium guajava) candies could be stored safely for two months under ambient condition(20-30°C) while at refrigeration temperature the shelf-life was four months.

The shelf life of the papaya cereal flakes stored at room temperature and 37°C was found to be 40 days each but in case of 4°C stored samples, the shelf life of the product was found to be 60 days (Rai and Chauhan, 2008).

The study by Zaman Paul et al. (2007) showed that control bananas ripened within six days, while the gamma irradiated bananas ripened within 26 days indicating that the shelf life of banana was extended by 20 days thereby delaying banana ripening.

Sarker (2003) stated that shelf life does not necessarily reflect the physical condition of a product; it may reflect the productive or marketable life of a product as well as in a competitive emerging market.

Roivoness (2004) suggest that a water/volatiles absorbent such as natural clay used in this study, could be useful in prolonging the shelf life and improving the quality of modified atmosphere packaged red raspberries grown in a wet climate.

On the basis of sensory quality attributes, the shelf-life of pretreated jackfruit bulbs packaged in gas mixture flushed polyethylene bags, in polyethylene teraphthalate jars with silicon membrane window and in polyethylene bag were 35, 31 and 27 days respectively (Saxena et al., 2008).

The shelf life of black berries is relatively short, 2-3 days at 0°C. This study compares the black berry retail shelf life performance of different packaging materials, bio-based versus petroleum-based using the same packaging design. Black berries in both oriented poly styrene and oriented polylactic acid containers met the “US standard No.1” grade for commercialization for more than 12 days at 3°C (Lewandowski et al., 2010).

Flexible plastic packaging in the fresh product has functioned in the past to facilitate product handling and provide brand identification. Individual film-wrapping represents a rediscovery of an old technique that was applications in prevention of shrinkage and altering ripening patterns. Modified atmosphere packaging and value added products represent other new technologies that use packaging to extend shelf-life (Barmore, 2007).

Survival analysis proved to be an effective methodology for the estimation of the sensory shelf life of avocado and mango pulp processed with high hydrostatic pressure, with potential applications for other pressurized products (Parra et al., 2010).

The main theme of the world packaging organization (WPO) is “better quality of life through better packaging for more people”. Value added in packaging can contribute significantly to everyday quality of life. Packaging can also help reduce starvation in developing countries; where between 3 and 50percent of all food is destroyed during transportation (www.packing. gateway.com, 2005-2011).

According to Marsh and Bugusu (2007) packaging maintains the benefits of food processing after the process is complete, enabling foods to travel safely for long distances from their point of origin and still be wholesome at the time of consumption.

The goal of food packaging is to contain food in a cost-effective way that satisfies industry requirements and consumer desires, maintains food safety and minimize environmental impact. Food packaging can retard product deterioration, retain the beneficial effects of processing, extend shelf-life and maintain or increase the quality and safety of food. In doing so, packaging provides protection from three major classes of external influences: chemical, biological and physical (Coles, 2003).

The study which was carried out in UK (United Kingdom) shows that there are opportunities to improve packaging and packages can actually add value to the products (Petterson et al., 2004).

Breene (2006) states that when properly processed, packaged and stored, a given fruit or vegetable can be a healthful, or more so, than a fresh or processed products in the home or institution can have further adverse effects on their healthfulness.

The study indicated that packaging of banana in 400 gauge polythene bags with coir pith extended the shelf-life of “Rasthali” banana upto 22 days as against 12 days in control without loss in quality of fruits (Mustaffa, 2005).

The Principle Component Analysis (PCA) indicated that fruits stored in perforated plastic boxes (PPB) and low density polyethylene (LDPE) film sealed cartons differed significantly with respect to mango flavour, firmness and development of defective spots. While those in chitosan film sealed cartons retained the desirable qualities for a longer period (upto 20 days) without developing defective spots (Srinivasa, 2004).

A studyby Ramasingh and Jayewardene (2005) revealed that treatment with emulsion of cinnamon oils combined with MAP packaging can be recommended as a safe, cost effective method for extending the storage life of ‘Embul’ bananas up to 21 days in a cold room and 14 days at 28 plus or minus 2°C without affecting the organoleptic and physio-chemical properties.

In the United States, the following codes represent the seven categories of plastic used in nearly all plastic containers and product packaging:

PET or **PETE** (Polyethylene terephthalate) is a clear, tough polymer with exceptional gas and moisture barrier properties. PET's ability to contain carbon dioxide (carbonation) makes it ideal for use in soft drink bottles.

Examples: Soft drink bottles, detergent bottles

HDPE (High Density Polyethylene) is used in milk, juice and water containers in order to take advantage of its excellent protective barrier properties. Its chemical resistance properties also make it well suited for items such as containers for household chemicals and detergents. **Most five gallon food buckets are made from HDPE.**

Examples: Milk bottles, shopping bags

Vinyl: Polyvinyl chloride (PVC) provides excellent clarity, puncture resistance and cling. As a film, vinyl can breathe just the right amount, making it ideal for packaging fresh meats that require oxygen to ensure a bright red surface while maintaining an acceptable shelf life.

Examples: Plastic food wrap, shrink wrap, garden hoses, shoe soles

LDPE :(Low Density Polyethylene) offers clarity and flexibility. It is used to make bottles that require flexibility. To take advantage of its strength and toughness in film form, it is used to produce grocery bags and garbage bags, shrink and stretch film, and coating for milk cartons.

Examples: Squeeze bottles, dry cleaning bags

PP: Polypropylene has high tensile strength, making it ideal for use in caps and lids that have to hold tightly on to threaded openings. Because of its high melting point, polypropylene can be hot-filled with products designed to cool in bottles, including ketchup and syrup. It is also used for products that need to be incubated, such as yogurt. Many Cambo, Tupperware and Rubbermaid food storage containers are made from PP.

Examples: Bottle caps, take-out food containers, drinking straws

PS:Polystyrene in its crystalline form, is a colorless plastic that can be clear and hard. It can also be foamed to provide exceptional insulation properties. Foamed or expanded polystyrene (EPS) is used for products such as meat trays, egg cartons and coffee cups. It is also used for packaging and protecting appliances, electronics and other sensitive products.

Examples: Plastic foam, packing peanuts, coat hangers.

Other denotes plastics made from other types of resin or from several resins mixed together. These usually cannot be recycled.

Another important type of plastic is polycarbonate, a clear shatter-resistant material used in restaurant food storage containers and the Rubbermaid Premier line of stain-resistant home food storage containers.

The right packaging material can be the difference between successfully shipping a fragile item and having it arrive in pieces. Some factors that should be considered when choosing a packaging material include the strength of the item being packed, its weight, and the value of the item and whether the package will be subjected to moisture and other adverse conditions. The commonly used packing materials are:

***Plastic**: Plastic is the most frequently used type of packaging material because of its low cost and light weight. It can be manufactured in a variety of sizes and shapes, allowing companies to make convenient packages for the use of a particular item.*

Boxes: Cardboard boxes have been used for packaging since their introduction in 1817. Cardboard was cheaper to manufacture and easier to handle than the traditional wooden crates that had been previously used. Today's boxes are usually made out of corrugated fiberboard to add strength and stability without increasing the box's thickness or weight.

Metal: It is appropriate for packaging foods (canned foods). For drinks, such as soft drinks beers, aluminium is often used. Tin plate is solid, heavy steel covered with tin to protect it against rust. It is used to package canned foods. Aluminium is attractive, light and strong at the same time, requires a lot of raw materials energy to make it.

Brick carton: A light, strong air-tight packaging material is ideal for transporting storage. Its complex composition makes it difficult to recycle. It is becoming the main packaging material used for basic foodstuffs.

Glass: It is ideal material for foods, especially liquids. It is unalterable, strong easy to recycle. It is the traditional vessel in the home (jars, glasses, jugs, etc.). Its weight and shape may involve some difficulties for transport storage.

Bubble Wrap: It is one of the few packaging materials that can also be a source of entertainment long after the items are unpacked.

Shrink Wrap: It is commonly used on commercial products where tamper-protection is a high priority, such as CDs or DVDs.

Textiles: Textile containers have poor gas and moisture barrier properties and have a poorer appearance than plastics. Woven jute sacks, which are chemically treated to prevent rotting and to reduce their flammability, are non-slip, have a high tear resistance, and good durability. They are used to transport a wide variety of bulk foods including grain, flour, sugar and salt.

Cotton: Calico is usually a closely woven, strong, plain, cotton fabric which is inexpensive and is satisfactory as a wrapper for flour, grains, legumes, coffee beans and powdered or granulated sugar. It can be re-used as many times as the material withstands washing and is easily marked to indicate the contents of the bag(http://www.show.com/about5386733different_types_packaing materials.html #xzz19mjmbwBz, 2011).

According to Irwandi and Yusof (2000) a study on storage stability of durian leather was carried out at room temperature using four types of packaging materials – laminated aluminium foil (LAF), high density polyethylene (HDPE), low-density polyethylene (LDPE) and polypropylene (PP) films for 12 weeks. Analysis on physiochemical, microbiological and sensory characteristic was conducted at weeks 0, 2, 4, 8 and 12. Analysis for sugar, fat and caloric contents was conducted at the beginning and the end of storage period. Moisture contents and water activity (AW) fluctuated during storage but tended to decrease after week 8. Non-enzymatic browning increased significantly ($P<0.05$) for all samples in packaging materials used: the highest increases were observed in LDPE-packed leather. The increases were related to the changes in colour of samples during storage. The pH, although it fluctuated in the first week, slightly increased at the end of the storage period, while the hardness for each sample gradually increased during storage. Microbial analysis showed that total mesophilic bacterial (TMB) and total mould and yeast (TMY) count were low, while after 12 weeks storage TMB and TMY were less than 60 and 150 cfu g^{-1} respectively.

Organoleptically, for all attributes evaluated, all samples were acceptable by panelists during the 12 week storage period.

Shelf-life does not necessarily reflect the physical condition of a product; it may reflect the productive or marketable life of a product as well in a competitive emerging market.

E. Capacity Building Programme for Entrepreneurship Development of Women and Farmer

Capacity building refers to as capacity development, is a conceptual approach to development that focuses on understanding the obstacles that inhibit people, government, international organizations and non-governmental organizations from realizing their developmental goals while enhancing the abilities that will allow them to achieve measurable and sustainable results. Capacity building also referred to actions that improve effectiveness, actions that improve access to income generation. has become a successful model for development in all sectors. SHGs helped in wom

Self Help Group (SHG) en empowerment, improving the quality of life and income. Food processing sector is a very attractive destination for the SHGs to contribute and grow in order to sustain the momentum they got in other small business models. The Indian SHGs also proved that they are confident groups in eliminating poverty from the society and thus make their members as individual income earners and even some of them turn out becoming big entrepreneurs. The future role of the SHGs will be on improving the awareness of their members on various aspects including setting up of their own Food Processing Centers (Balasubramaniam, 2010).

The research studies should pave ways to contribute to mitigating food insecurity amongst rural small farm holder households by reducing post-harvest losses and empowering them with entrepreneurial skills. The problem of food security is the result of low productivity on small farm holders due to inadequate inputs as well as increasing burden of deficiency disorders. Women entrepreneurs receive less training than their male counterparts, and as a result are less able to take advantage of opportunities for growth. Women's access to food processing technology at the household level may have positive dietary benefits during the pre-harvest lean season when households are most stressed from food shortages and higher energy expenditures from agricultural work (Silva-Barbeau et al., 2005).

Although both rural women and men each have different and complementary roles in guaranteeing food security at the household and community levels, women often play a greater role in ensuring nutrition, food safety and quality. In much of the developing world, women produce most of the food that is consumed in their homes, and are generally responsible for processing and preparing food for their households. Women tend to spend a considerable part of the cash income that they generate from marketing activities on household food requirements.

Recognizing women's and men's distinct role in family nutrition is a key to improving food security at the household level. To tackle this issue, FAO bases its approach to nutrition on the economic and cultural context of the area concerned, and considers that food security depends not only on the availability of food, but also on access to food, as well as on food adequacy and acceptability to consumers. Other underlying causes of malnutrition must also be addressed. These include dietary intake and diversity, health and disease, and maternal and child care - areas in which women play decisive roles. Another key issue is respecting the knowledge of traditional communities, particularly women, about the nutritional value of local crops and foods gathered from their locality.

As part of an FAO project in Vietnam, some 12 000 poor households, each with at least one malnourished child under the age of five years, received training and grants to establish home gardens. Interviews and evaluation confirmed that home gardens had a greater productive impact when men and women understood their nutritional and economic benefits. The project resulted in measurable gains for the poorest, most food-insecure households: 82 percent of participating households improved their food availability, and children increased their daily consumption of vegetables and fruits. The project was credited with reducing the rate of malnutrition by 12.8 percent within just two years (http://www.fao.org/docrep/005/y3969e/ y3969e03.htm).

A research study focused on small-scale women entrepreneurs in several regions of Tajikistan with the objectives of analyzing the impact of their businesses on themselves, their households, and their communities; understanding best practices and barriers to their business success; and exploring the influence of migration on their entrepreneurship. Three-quarters of the 53 in-depth interviews conducted were in food businesses (processing or selling) because of its economic centrality and ease of entry for women. The study gives a picture of the importance of small-scale women entrepreneurs to Tajikistan's everyday household economy and local vitality, and suggests policies that will help them to continue and develop their contributions (Rosenberger, 2011).

Food processing contributes to food security by regularly assuring a diversity of diet, minimizing waste and losses and improving the marketability of foods, thereby enabling women to participate in the trade of food products. In developing countries, women carry out most food processing activities, which often create a heavy workload (www.FAO.org-2009).