

## I INTRODUCTION

Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2001). Food security is necessary to meet up the growing food demands and it can be attained by meeting the four main elements of availability, stability, utilization and access. Availability of food can be increased by increasing the rural income which in turn raises the standard of living of the farmers. The food crops and plants have to be stabilized by biotechnological solutions such as genetic modifications and plant tissue culture to make sure that good quality products of high yield are cultivated and also to ensure that the effects of global climate is lessened. The food industries play the role of utilizing the products from the farm and making it accessible. This can be done by modern processing, preservation, value addition techniques and effective packaging.

The export market is growing largely due to increased consumption demand and the development of technology to facilitate trade in fresh fruits. The value of US fresh fruit exports in 2003 was over \$ 2.2 billion amounting nearly three million metric tonnes (MT). These exports amount to more than 20 per cent of the global export market value. The primary export products from the US are grapes, oranges and apples (www.fas.usda.gov, 2010).

According to Kipe (2010) Mexico is the fourth largest fresh fruit exporter by value, with over \$ 900 million in 2003. In quantity, Mexico is the world's seventh largest fresh fruit exporter, exporting 1.5 million metric tonnes in 2003. India's economy is predominantly agrarian. Agriculture constitutes 33 percent of GDP, supports 64 percent of workforce and earns 19 percent of the export. Though India produce more raw materials for food and reach self sufficiency, temporarily, India cannot ignore the projected population growth of 1500 million by 2030 AD and challenges in the areas of productivity and production. By converting all the agricultural and allied production into food or value added products, it is possible to feed another 117 million population (Devadas, 2010).

India with its current production of around 32 MT of fruit accounts for about eight per cent of the world's fruit production. Citrus fruits constitute around 20 per cent of world's total fruit production. Major Indian fruits consist of mango, banana, citrus fruits, apple, guava, papaya, pineapple and grapes ([www.fruitvegetable.com](http://www.fruitvegetable.com), 2010).

Banana is a globally important fruit crop with 97.5 million tonnes of production. It supports livelihood of millions of people with total production of 16.91 million tonnes from 1190.70 thousand hectares with national average of 33.5 T/ha. Banana contributes 37 per cent to total fruit production in India. Banana occupies 20 per cent area among the total area under crop in India. India ranks first in banana production, about 16.82 million tonnes, and corners 16.65 per cent of the total global production. But India exports only 10,876 tonnes, representing only 0.067 per cent of production. Mainly, Nendran variety of banana is exported, while the exports of table varieties are negligible. Exports are mainly to West Asia ([www.ltdjains.com/tissue/tissue culture.htm](http://www.ltdjains.com/tissue/tissue%20culture.htm), 2010). Banana is one of the major and economically important fruit crops of Maharashtra and ranks first in production with 60 T/ha. The total area under banana cultivation in Tamil Nadu is 88.114 hectares with an annual production of 44.06 lakh tonnes.

Guava is the fourth most widely cultivated crop in India with a production of more than 1.80 million tonnes in 0.15 million hectares ([www.actahort.org/books](http://www.actahort.org/books), 2010). Bihar is the leading state in guava production followed by Andhra Pradesh and Uttar Pradesh. The popular varieties of guava grown in India are Sardar, Allahabad Safeda, Halit, Pant Prabhat, Dhareedar, Arka Mridulakhap, Khafa (Bengal Safeda), Chittidar and Harifa. Hybrid varieties like Arka Amulya, Safed Jam and Johir Safeda had also been developed. However, Uttar Pradesh is by far the most important guava producing state of the country and Allahabad had the best reputation of growth of guava in the country as well as in the world. Maharashtra is the second largest producer of guava in the country. Maharashtra produces quality guava during rainy season which no other state does. India exported 2495 tonnes of guava produce worth Rs.11.17 crores during 2007-08. The major markets for Indian guava are Saudi Arabia, United Arab Emirates, Kuwait, Yemen and Nepal. Guava is the third important fruit next to mango and banana in Tamil Nadu and is cultivated

in about 9,706 hectares with an annual production of 61500 tonnes with a productivity of 4.56 / ha ([www.purdue.edu/newcrop/morton/guava.htm](http://www.purdue.edu/newcrop/morton/guava.htm), 2011)

Global production of papaya 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 .The world production of papaya (*Carica papaya* L.) in 2008 was estimated to be approximately 9.1 million tonnes .Significant increase in papaya production and yield was observed between 2004 and 2008 ([www.oecd.org](http://www.oecd.org), 2010).

India also leads the world in papaya production with an annual output of about three million tonnes.The areas 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 the fourth most important fruit of West Bengal after mango, banana and pineapple, covering an area of 7,540 hectares with an average production of 34.3 T/ha. In 2001-2002, the production has increased from eight lakh tonnes to 26 lakh tonnes ([www.actahort.org](http://www.actahort.org), 2010). Papaya production was increased to 96 per cent between 1992 and 2009 and with production level of almost 1.6 million tonnes. India is the largest producer of mango in the world and second amongst papaya producing countries .

Post-harvest losses of fruit in most Asian countries are so high, and the causes of these losses are so diverse. The need for improvement is shown by the fact that in developing countries where there is still a poor infrastructure and a lack of marketing facilities, post-harvest losses of fresh produce range from 20 to 50 per cent . Roy (2009) stated that 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.

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

(www.google.com, 2010). In India, nearly 30 per cent of fruit production spoils before sale, much higher than the 10 per cent spoilage in other Asian countries, such as Japan, China. In spite of the largest production of fruits and vegetables in India hardly two per cent is processed as compared to 70 per cent in developed countries. Due to lack of infrastructure and post-harvest handling, quick transport and storage facilities about 25-30 per cent of the total harvested produce is wasted. Total fruits and vegetable products worth `270 crores are manufactured in about 5000 factories.

Tamil Nadu Agriculture University (TNAU -2010) reported that India is the world's second largest producer of fruits. The total production of fruits and vegetables is over 45 million tonnes and 85 million tonnes respectively. The losses are estimated to the extent of 20-30 per cent due to lack of harvesting, processing and storage facilities which is valued at `230 billion.

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%). Majority of 60 to 70 per cent of fruits produced in India are consumed domestically and 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 - 30 per cent of the stored fruits. Merchant (2008) reported that India's food processing industry is one of the largest industries in the country. It is ranked fifth in terms of production, consumption, export and expected growth. India is one of the world's major food producers but accounts for only 1.7 per cent (valued at US\$ 7.5 billion) of world trade in this sector. This share is stated to increase to 3 per cent (US\$ 20 billion) by 2015.

The food processing industry is one of the largest industries in India and ranked fifth in terms of production, consumption, export and growth prospectus. India which is the second largest food producer in the world lags far behind when it comes to food processing which is essential for increasing the shelf life of the produce and providing more benefit to the growers (www.mofpi.org., 2010).

According to McKingers and Company report Indian food industry value is ₹ 2,50,000 crores. By 2015, it will grow to ₹ 4, 80,000 crores. Worth of value added foods

produced from these industries will raise from ₹80,000 crores to ₹2,25,000 crores by 2015. The report also states that the food industry in India caught a vicious cycle which is typified by inefficiencies, wastages and value loss of order of ₹50,000 crores. This may be mainly due to the adoption of obsolete technologies, inefficient methods and operated by unskilled or non-technical persons. To overcome this, it is important to employ new technologies in the field of food processing industries with specialists in value addition and food process engineering. These technologies are not only going to increase the shelf life, but also improve the quality, preserve nutritional and sensory value of food material produce up to the point of consumption (Devadas, 2010).

In most developing countries areas of horticulture crops have been expanded, productivity increased and total production have been doubled or tripled. But very little emphasis is given to post-harvest technology which is a vital sector of this industry. The post-harvest losses of major fruits include banana 12-14 per cent, guava 3-15 per cent, mango 17-37 per cent, citrus (orange) 8-13 per cent, apple 10-25 per cent, pineapple 5-20 per cent and grapes 23-30 per cent of the total production (Kader, 2002 and Tadesse, 2009).

After harvest the biological produce can be either preserved or processed. Value addition is a terminology used to define the processing of biological produce through processing the value of the commodities can be increased by converting it to different products by using conventional or modern processing techniques; thereby the storage life of the produce is enhanced (www.fao.org, 2010).

Importance of post-harvest technology and value addition lies in the fact that it has capability to meet food requirement of growing population by eliminating avoidable losses, making more nutritive food items from low grade raw commodity by proper processing and fortification, diverting portion of food material being fed to cattle by way of processing and fortification, use of appropriate post-harvest technology to reduce the post-harvest and storage losses, add value to the products, generate employment in village and reestablishes agro industries in rural sectors (www.indiaagronet.com., 2010).

Drying is a method of food preservation that is simple, safe and most effective way of preserving foods. Drying is the removal of majority of water from food material

and provides maximum concentration and microbial safety, lower water activity for preservation, minimizes rate of biochemical reaction, stabilizes nutritional quality and increases the shelf life of products (Khetarpaul, 2005).

Drying of agricultural crops in order to preserve perishable products is an old and accepted techniques still widely used on a large scale proportion of the world's crops. Drying is essential for preserving agricultural products and sun drying, microwave drying, cabinet drying and osmotic dehydration can help to maintain and improve health by providing nutrients that might not be available throughout the year when certain foods are either scarce or expensive. Food that is being dried by these drying methods will retain a high proportion of its original food value, if the process is done correctly.

Food quality is the sum of all desirable attributes which make a food acceptable for consumption. Quality attributes of a product may be divided into three major categories such as sensory, hidden and quantitative. The sensory attributes are colour, glossiness, size, shape, defects, odour and taste. The hidden attributes are nutritive values, presence of dangerous contaminants and poisonous material. The quantitative parameters are those which contribute to the overall food quality such as yield of the product (Kerkhofs, 2003).

Value added food products are raw or pre-processed commodities whose value has been increased through the addition of ingredients or processes that make them more attractive to the buyer and/or more readily usable by the consumer. It is a production/marketing strategy driven by customer needs and perceptions. About 15,000 new value added products are introduced each year. However, getting a new product into the highly competitive retail market is very difficult. USDA estimates that at least two out of every three new food products introduced into the market fail, due to lack of customer appeal. Only one in five new businesses succeeds for more than five years. The average time spent on developing new food products is about two years. Product development is not limited to creating new and unique food items. It also includes product repositioning, line extension, and reformulating existing products. Every type of produce developed consists of five stages: screening feasibility, costing, prototyping/test marketing and commercialization (Michigan State University Extension, 2009).

Fruits and vegetables, being composed of organic materials, are perishable and have a limited shelf life. The term “shelf life” is the time span from the moment fruits and vegetables are plucked to the moment they are fit for consumption. They undergo permanent changes with passing time, after which, they are no longer considered fit for eating. The shelf life of foods can be extended using food preservation processes. Technological advancements have led to development of several food preservation processes and techniques using Carbon Dioxide. Factors responsible for spoilage of fruits and vegetables vary with the conditions of storage. The major factors that affect food spoilage include water activity, exposure to light and oxygen, pH, temperature and chemicals inherent in the food item. Often, several factors act together and the cumulative impact results in complete decay of the food item. These can be prevented by cryogenic freezing, controlled atmosphere and modified atmosphere packaging ([www.show.com/about](http://www.show.com/about), 2011).

The principal roles of food packaging are to protect food products from outside influences, damage and to provide consumers with ingredients and nutritional values. 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 minimises environmental impact.

Fruits and vegetables are an important supplement to the human diet as they provide the essential minerals, vitamins and fibre required for maintaining health. The fruits and vegetables preservation industry at present is able to utilize less than one per cent of the total production for conversion into products as against 110 per cent in developed countries. Thus, there is considerable scope for expansion of the industry by developing and exporting value added products and earn more foreign exchange. In this way, preservation of food also helps in stabilizing the prices of the food by making seasonal foods available throughout the year.

The major cultivated fruits such as banana, guava and papaya can be processed to formulate value added products to enhance their nutritive content and can be developed into various health products which could be of use to the general public.

These fruits in spite of being one of the best sources of antioxidants, fibre, vitamin C and vitamin A can also be fortified with iron.

Consumer demands for high quality, minimally processed products have increased remarkably in recent years. Preferences have shifted towards the fresh, healthy and rich flavored ready-to-eat foods with an enhanced shelf life. Such a situation further necessitates the development of value added products. The value added products may contribute macro and micro nutrients and consuming of this high nutritional value added products may help in controlling nutritional deficiency disorders. Drastic changes have occurred in the socio economical status of the whole rural Indian population since 2000. Women are the most vulnerable to poverty and discrimination due to their reduced level of income, social exclusion, their lack of professional skills and limited access to over productive assets. In the context of increasing unemployment, poverty, psychological problems, destruction of property and crops and land, women are faced with the challenge of financially supporting the household and finding alternative income generating opportunities in order to cope with the household economic insecurity.

Women have the problems of low family income which contributes to household food insecurity as well as malnutrition and the low capacity to develop value chains around available foods due to lack of technical skills, equipment and packaging materials, and low marketing skills. Food processing can be a good source of income for small community based production groups as well as to community based women empowerment groups such as Women Self Help Groups (SHG). The training programmes to women on fruit processing needs to be emphasized at present.

Education and training on fruit processing helps to motivate the farmers for more production, facilitates the consumer to use the fruits during off season and offers an opportunity to raise the economy of independent entrepreneur. The market openings for value added fruit products offer new opportunities to villagers, especially the women who have been so far excluded from all income generating activities. The objective of promotion should support and enable Self Help Groups to reach autonomy in their fruit processing techniques, marketing, and eco-finance for a sustainable income, self-confidence and impulse social innovative dynamic.

#### **OBJECTIVES OF THE STUDY:**

The study was undertaken with the broad objectives of developing value added products using selected fruits and focusing on promotion through Self Help Group women and farmers.

The specific objectives related to the present study are to

- Identify the production scenario of major cultivated fruits namely banana, guava and papaya
- Formulate value added products
- Evaluate the acceptability of formulated fruit products
- Analyse the nutrient content
- Compare various packing material for the formulated fruit product
- Study the shelf life of formulated value added products and
- Promote the developed fruit products through Capacity building programme to Self Help Group women and farmers for entrepreneurship.