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SCOPE AND CHALLENGES IN FRUIT AND VEGETABLE PROCESSING FOR REDUCTION OF POST HARVEST LOSSES AND VALUE ADDITION

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ABSTRACT

Sustainable agriculture is the backbone of sustainable development .It is necessary for feeding the global population struggling with hunger. However, success of sustainable agriculture in terms of food production is incomplete, until it is available to the consumer in acceptable form. One of the major hurdle in its path is the post harvest losses which affects the quality as well as quantity of the produce. India, though ranks second in the world in production of fruits and vegetables, yet most of its population is deprived of its daily requirement of fruits and vegetables. A variety of strategies are suggested to reduce the losses. Processing of fruits and vegetables has been practicized since a long time. This serves a number of purposes such as making the produce available in off season ,reducing transportation and storage costs, enhancing shelf life, value addition and of course reduction in post harvest losses. Various methods are employed for processing, most of these with certain positive and negative aspects. Integrated approaches such as minimal processing involving the safety principles of GMP (Good Manufacturing Practices) and HACCP(Hazard Analysis and Critical Control Point) are beneficial from consumer as well as environment view point. In developing countries like India, a huge potential still exists to improvise the methods and techniques to achieve better results.

Keywords: Gmp, Haccp, Integrated Approach, Minimal Processing, Post Harvest Losses, Shelf Life, Sustainable Development, Value Addition.

I. INTRODUCTION

Presently, one of the major global challenges is to ensure the food security to the ever growing population whilst ensuring the sustainable development .According to FAO,70% increase in the food production is needed to make the food available to the world population which will reach 9 billions by 2050.There is an urgent need for an integrated and innovative approach to the global effort of sustainable food production as well as consumption[1],[2],[3].Huge amounts of food are lost every year world wide due post harvest damages caused due to physical factors (mechanical injuries), physiological factors (Wilting, shriveling, chilling injury) or some pathological factor(decay due to fungi or bacteria). These causes in many instances are inter related i.e. mechanical injury may promote the chances of post harvest decay in most of the cases. Post harvest losses are approximately 20-50% in developing countries and 10-15% in developed countries. A variety of factors such as poor sanitation measures, lack of proper storage and marketing facilities etc. are responsible for

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comparatively more losses in case of developing countries [4],[5].According to an estimate an agricultural produce worth Rupees 580 billion is wasted every year[6]. Even in the developed countries, research and development area in this direction is receiving a limited attention. A study conducted by University of California in 2010 reported that 95% of the research funds are directed at agriculture were focused on enhancement of the production, while just 5% was made available for the study of post harvest handling and infrastructure. All the efforts to increase yield of various crops are proving to be futile due to enormous post harvest losses. Moreover, hunger problem can not only be solved by developing agricultural technologies and practices. The need of the hour is to find some solution based upon cheap and locally available technologies combined with best of natural and human resources. [7], [8],[9],[10].

Although India is a major producer of horticultural crops, yet most of Indians are not able to get their daily requirement of fruits and vegetables resulting into low HDI-Human Development Index. Considerable amount of fruits and vegetables i.e. approximately 12 million tons of fruits and 21 million tons of vegetables are wasted annually due to decay caused by post harvest pathogens and improper handling practices. It is imperative to note that increase in yield is of significance only if the produce reaches to consumer in good, consumable condition at a reasonable price. Several strategies to reduce post harvest losses have been suggested time to time by different workers [11], [12]. Most of these strategies have their own plus and minus points. These strategies are applicable at different stages viz. harvesting, handling, sorting, packaging, storage and transportation and marketing etc. Processing is an important value added activity that stabilizes and diversifies food supply along with generation of employment and income opportunities [13], [14]. India's geographical location can be an additional benefit to promote the economical growth from the export of processed fruits and vegetables. Processed products have more stability, improved nutritional qualities and better shelf life. Thus, processing is of great significance in fruit and vegetable sector as it not only enhance the marketing opportunities, but also help in value addition as well as reduction of post harvest losses.

II. MATERIALS AND METHODS

Fruits and vegetables have variable storage periods depending upon their nature, i.e. perishable or non-perishable. The former are more prone to decay due to the high moisture content in them and can be further classified on the basis of their shelf life.(TABLE 1) Some of the traditional methods for processing include dehydration, freezing, drying, thermal processing and fermentation etc. are used at various levels. Tropical juices, fruit pulps, purees and paste of different vegetables, dried mushrooms are some the examples of processed products of fruits and vegetables. Most of processing technologies lay stress on value addition along with the product diversification.

TABLE 1. Classification of various fruits and vegetables on the basis of their perishable nature and storage life

Relative perishability	Potential storage life(weeks)	Fruits/vegetables
Very High	Less than 2 weeks	Apricot, strawberry , peach, black berry, cherry, fig, ,tomato, beans, grapes

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High	2-4 weeks	Banana, guava, loquat, Bell pepper, papaya, melon, brinjal, okra, summer squash, beans, plum
Moderate	4-8 weeks	Apple, pear, orange, kiwi fruit, grape fruit, lemon, carrot, radish, sugar beet.
Low	8-16 weeks	Pumpkin, onion, potato,sweet potato, yam,garlic

In India, processing is an age –old, traditional method used for processing of fruits and vegetables in the form of pickles, chutneys, jams, jellies or juices. It is in practice at various levels i.e., Domestic level (43%), cottage scale (18%), small scale (17%), large scale(9%) and relabeling scale (14%).(Fig.1).

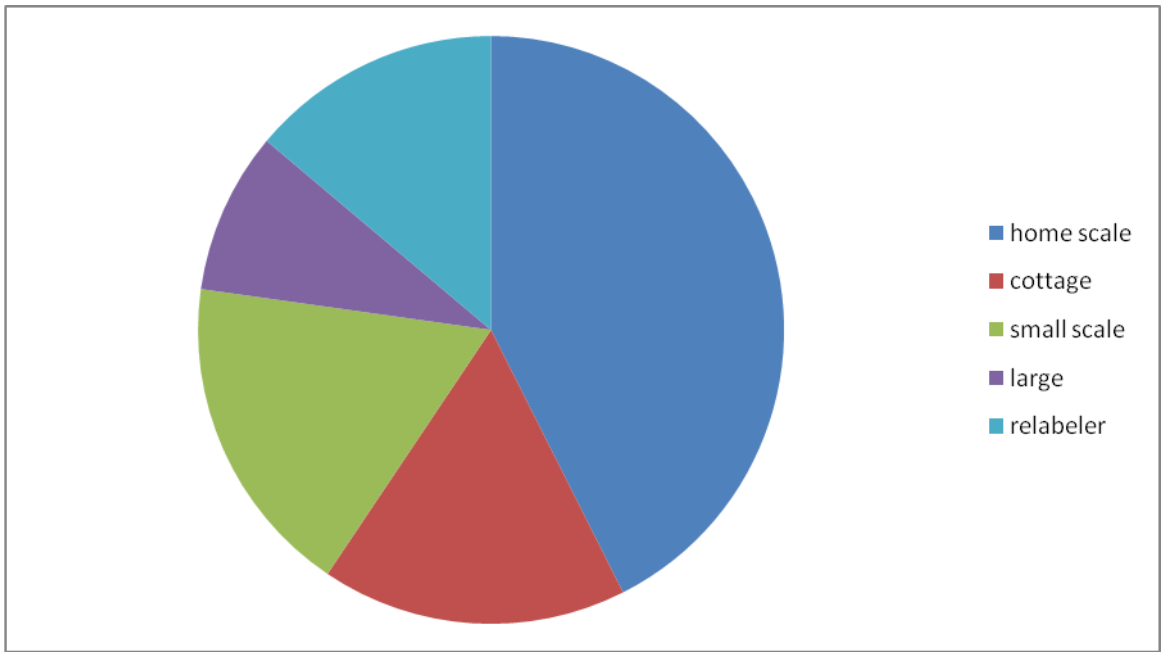

Fig. 1: Distribution of FPO Licences in India (Source: Maini and Anand,1996)

Fruits and vegetables undergo a number of changes after harvesting and these may not be necessarily desirable ones. Though, these undesirable changes can not be stopped, yet can be slowed down by certain appropriate methods [15]. These post harvest treatments not only minimize the chances of post harvest decay but also extend their storage and market life. Commonly employed post harvest treatments include washing with Chlorine, treatment with Calcium Chloride or Calcium Nitrate to reduce post harvest decay as well as enhancing the shelf life by controlling certain undesirable physiological changes. This also maintains nutritional quality and firmness of the produce.

Different methods used for post harvest treatment or processing are employed depending upon the type of commodity i.e. perishable or non-perishable one [16], [17] .The kind of processed product is also taken under consideration (TABLE 2). Low temperature reduced post harvest losses by retarding the metabolic rate and inhibiting the activity of microbes responsible for the decay.

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TABLE 2. Comparison between perishable and non-perishable crops.

Perishable crops	**Non –Perishable crops**
Available almost through out the year	Mostly seasonal crops
Short storage period	Longer storage period
Moisture content high (50-80%)	Low moisture content (10-15%)
High respiration rate, accompanied by heat emission	Low respiratory rate with little heat emission
Soft tissue, vulnerable to injuries	Hard tissue, less prone to injuries
Losses during storage due to endogenous as well as exogenous factors.	Losses during storage due to exogenous factors

Most of the techniques used mainly focus on improvement of quality of the product by reducing the chances of decay and value addition. Some techniques like vacuum drying, though costly, yet ensure to maintain texture, colour, flavour of the processed fruit or vegetable. Some of commonly employed techniques are discuused below.

2.1.Pre-cooling: The main purpose of the pre –cooling is to make the produce free from field heat .A variety of methods are adopted for this purpose as Room cooling, Hydrocooling, Vacuum cooling, Forced air cooling or package icing etc.

2.2. Thermal Processing: This is widely used method applied at different levels from cottage to industrial scale production of jams, jellies, canned fruits and vegetables. Use of aseptic processing systems involving practice of sterile laminated packaging is recent development in the sector. This leads into better quality of fruit, at a higher price.

2.3. Thermal Treatment: Fruits and vegetables are dipped in hot water. This is helpful to improve appearance of the produce and reducing the chances of infection by certain fungal pathogens as well.

2.4. Dehydration Treatment: Dehydration treatments like salting, brining or candying of fruits facilitate the removal of water with minimal exposure to high temperature. It can also be combined with other methods like freezing and drying to reduce the cost. If accompanied by refrigeration, also enhances shelf life of the commodity. Vacuum impregnation technology i.e. combining dehydration with vacuum conditions improves appearance as well as texture of the product. It involves the principle of osmosis. Fruit or vegetable is immersed into a solution having high osmotic pressure leading to impregnation of solute over them.

2.5. Freezing: A variety of fruits and vegetables can kept fresh upto 12 months, if frozen properly and stored at a temperature of -18*C. However, due to high energy expenditure involved in freezing operations and storage, this is a little bit costly procedure. India ranks second after China in frozen vegetable production.

2.6. Drying: Drying is an advantageous method as it not only helps to preserve the product but also results into reduction in weight, thereby reducing the transportation charges and making it easy. The major drawback is that most of conventional drying techniques for preservation of fruits and vegetables result into loss of colour, flavor, aroma, texture, or nutritional value. Commonly used during techniques vary from simple conventional sun drying to state of the art technologies like freeze drying ,drum drying or spray drying etc.

2.7. Fermentation**:** It is one of the oldest processing technology in the world .It employs the use of microbes or some microbial products for the bioconservation of the food product. A variety of fruits and vegetables are

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fermented in different parts of the world. In India, fruits and vegetables are mainly fermented to pickles. Most of the fermented products have a limited shelf life. Due to lack of unavailability of post fermentation treatments.

2.8. Minimal Processing**:** Boom in the demand for consumer safe fruits and vegetables of high quality and "fresh like attributes" has led to diversified technologies involving minimal processing. This approach involves little product transformation accompanied by value addition. Minimal processing involves an integrated approach, including proper handling, processing and packaging and distribution with the application of appropriate safety principles of Good Manufacturing Practices and Hazard Analysis and Critical Control Point.

To enhance the microbial stability of the processed fruits or vegetables, a hurdle approach is generally applied .Low temperature storage, control of water activity, control of redox potential or application of some preservative re some of the commonly employed hurdles in minimal processing of fruits and vegetables. Minimal processing applications involving hurdle concept are economical and energy efficient for preservation of fruits and vegetables.

2.9. Non- thermal Processing: High hydrostatic pressure, high intensity pulsed electric fields, high intensity pulsed light and irradiation are some the non –thermal technologies for minimal processing. But costly infrastructure is the major hinderance in its path in case of developingcountries .

III. RESULTS

Different methods used for post harvest treatment or processing are employed depending upon the type of commodity i.e. perishable or non-perishable one .The kind of processed product is also taken under consideration. Low temperature minimizes post harvest losses by retarding the metabolic rate and inhibiting the activity of microbes responsible for the decay. Dehydration result into decrease in water content from 80-90% to approximately 40%. A combination of more than one technique also yields better results. Most of the techniques used mainly focus on improvement of quality of the product by reducing the chances of decay and value addition. Some techniques like vacuum drying, though costly, yet ensure to maintain texture, colour, flavour of the processed fruit or vegetable. Techniques like minimal processing hold a better promise to maintain the health of consumer as well as environment.

IV. DISCUSSION

Post harvest losses of fruits and vegetables vary in extent depending upon the kind of produce and certain biotic and abiotic factors. Traditionally, post harvest science is mainly focused on the physiological aspects of produce to increase shelf life and maintain the quality. Post harvest practices for preservation of different fruits and vegetables are known to mankind since ancient times. However, with the better understanding of molecular changes occuring during the post harvest phase has led to new dimensions into it. In the modern times, biochemical and molecular aspects are widely considered while analyzing the post harvest issues. Though the basic principles of processing of fruits and vegetables have undergone a minor change over the last few years, yet a remarkable improvement has been observed in handling practices, equipment used for processing of huge quantities of produce along with maintaining their desirable qualities [18-25]. The

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techniques like minimal processing adapt an integrated approach to value addition, promoting shelf life, safety of the consumer and combating the losses due to post harvest decay[26],[27].

V. CONCLUSION

Sustainable agriculture forms the base of sustainable agriculture. The main target of sustainable agriculture is to achieve food security for the ever growing population in combination with social and economical viability and no or minimal possible adverse effect on the environment. Fruits and vegetables are mainly consumed for their nutritional value. Despite of huge production of fruits and vegetables, a major part of the population is not able to get the appropriate share of their balanced diet due to number of factors. Large population size, poverty, unawareness etc. may be few of the reasons behind it. But one of the main reason is the post harvest decay resulting into loss of quality as well as quantity [28]. A variety of efforts are put to minimize these losses by employing suitable post harvest management practices These include cleansing, washing, disinfection, drying, packing and storing. For enhancement of shelf life and value addition, the produce is generally processed by using different techniques. Fruits and vegetables are processed since the times immemorial. It makes the various fruits and vegetables available through out the year, which are otherwise seasonal ones. It is also helpful for the reduction of post harvest losses as well as value addition. But consumer concern over the safety of the produce along with its improved quality urges to develop better strategies to cope with the issue. There is a need to devise more efficient processing techniques to add value to the crop as well as minimization of the post harvest losses. This would also be helpful to ensure the economic stability to the developing nations. Countries like India, may also have an additional benefit of its connectivity to the most parts of the world for export or import purposes. However, there should be technology upgradation, quality management and firm adherence to export commitments to maintain global standards. In India, processing of fruits and vegetables sector has a vast scope with future perspectives, but at the same time number of challenges to compete globally.

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