INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

IMPORTANCE OF PURE AND APPLIED TECHNOLOGICAL IMPLEMENTATIONS IN FEED PROCESSING FOR REDUCTION OF POST HARVEST AGRICULTURAL LOSSES WITH HIGHLIGHT ON THE MODERN CONCEPT OF NUTRACEUTICALS: A SPECIALIZED AND EXCLUSIVE REVIEW OF IMPORTANCE

SUBHA GANGULY

ASSOCIATE EDITOR, IJPRET

AICRP on Post Harvest Technology (ICAR), Department of Fish Processing Technology, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, 5, Budherhat Road, P.O. Panchasayar, Kolkata - 700094, WB, India.

IJPRET-QR CODE

PAPER-QR CODE

Accepted Date:

20/08/2013

Publish Date:

01/09/2013

Keywords

Food,

Loss,

Processing,

Quality

Corresponding Author

Dr. Subha Ganguly

Abstract

Losses incurred at post-harvest are quite common and enormous leading to valuable food loss. At every stage of post-harvest practice, agricultural products are deprived from quality due to physical, chemical, biological and mechanical factors. Te prevent and reduce the huge bulk of food spoiled due to improper and uncontrolled storage conditions. It is necessary to formulate advances methods and techniques for effective food preservation by processing. In this extensive review, a thorough discussion has been laid down on the major and common reasons for post-harvest food losses.

INTRODUCTION

Post-harvest losses of vegetables, fruits and fisheries are difficult to predict, the major agents producing deterioration mostly being attributed to microbiological causes and physiological damages.[1] Post-harvest losses may be grouped broadly into food losses after harvesting and food losses due to social and economic reasons.

As a result of increasing world population, the need for increased food supply has become an urgent and important consideration in many developing countries. Considerable efforts made in agricultural research and extension has resulted in increased crop yield resulting to increased food production.

The losses at each stage of harvest and post-harvest practices due to improper handling can be large enough to result in a total loss of millions of food commodities every year.[2] It is believed that a 50% reduction in post-harvest food loss in developing countries will reduce the need for food importation in these countries and will cause an increase in the food supply to meet the food demands[3]. Also loss is far less than the amount of money that will be used to produce the same amount food.

However, it has been discovered that increased food production only is not the final solution if it is not complemented with adequate harvest and post-harvest practices. This is because good harvest and post-harvest practices will lead to reduction in the amount of food losses during and after harvest. The food moved from the farm, through the delivery system to the consumer must be presented in the good and acceptable from with little food loss during the movement. This is the ultimate goal of any food supply chain and not increased food production alone.[4]

Primary Causes of Post Harvest Damages to crop produce and feed

Food losses after harvesting may include deterioration by biological or microbiological agents and mechanical damage due to unfavourable climate, cultural practices, poor storage conditions, and inadequate handling during transportation all of which can lead to accelerated product decay. Food losses also can either be due to the reduction in

weight of food meant for consumption or it could be due to damage of physical spoilage which is usually reported as a percentage of the food sample since it is difficult to measure it.[5]

Improper harvest and post-harvest practices expose the food commodity to many deterioration agents which lead to food spoilage. There are various types of losses depending on the post harvest practices and deterioration agent. Losses are caused mainly by mechanical damage during transportation.[6] Food losses lead to a loss or reduction in quantity, quality, nutritional and economic value of the food produce. These losses could either be primary, secondary or tertiary.

Agricultural crops contain 65-95% water, and they continue their living processes post-harvest also. Their post-harvest life depends on the rate at which they use up their stored food reserves and their rate of water loss. When food and water reserves are exhausted, the produce dies and decays. Anything that increases the rate of this process may make the produce inedible before it can be used. The principal causes of loss are therefore discussed below, but in the marketing of fresh produce they all interact, and the effects of all are influenced by external conditions such as temperature and relative humidity.[7]

Primary Losses

These are the losses that affect the food produce directly[4]. They are during the food delivery chain. They include:

Losses occur as a result of the action of micro-organisms e.g. bacteria, mould and fungi. During the packing of vegetables, fruits and fishes into boxes, crates, baskets and trucks after harvesting, they are mostly subjected to cross-contamination by spoilage. These agents produce toxic substances (like mycotoxins) which causes food commodities to rot. These losses are more of loss in nutritional value than loss in weight. This occurs mostly during storage and marketing stages.

Chemical losses are as a result of the reaction of the naturally present chemical constituents in the stored food to cause loss of colour, flavour, nutritional value and texture.

Sometimes, undesirable reactions occur which prove to be harmful for intermediate and final products. These can lead to significant loss of nutritional

value such as rancidity and agro-chemical contamination and in most cases the whole vegetable, fruit and fish is lost. On the other hand, they are losses as a result of the reaction of chemical and biological constituents of the stored food. These losses give rise to discolouration and softening which leads to reduction of nutritional and economic value of the food product.

Bruises, cuts and excessive peeling of fruits are responsible for mechanical losses of crop produce and food products. Mechanical damage is mainly due to in appropriate methods used during harvesting (careless handling), packing and inadequate transportation, which can lead to splitting, thus rapidly increasing water loss and the rate of normal physical breakdown. Skin breaks and other forms of mechanical damages also decay and promote the growth of pathogenic microorganisms.

An increase in the rate of loss because of normal physiological changes is caused by conditions that increase the rate of natural deterioration, such as high temperature, low atmospheric humidity and physical injury. Abnormal physiological deterioration occurs when fresh produce is subjected to extremes of temperatures, atmospheric modification or by contamination. This may cause unpalatable flavours, failure to ripen or other changes in the living processes of the produce, making it unfit to use. Physiological losses on the other hand, refer to the aging of products during storage due to natural reactions. They are as a result of the respiration of food products even after harvesting. This respiration causes a loss of weight and it produces heat which makes the food susceptible to micro-organism attack. Also physiological changes make the food product susceptible to mechanical damage.

Insect pests and parasites

These losses are as a result of the action of biological agents like rodents, insects, birds etc. the agents usually consume the food during storage and causes a reduction in weight and quality of the food. Fresh produce can become infected before or after harvest by diseases widespread in the air, soil and water. Some diseases are able to penetrate the unbroken skin of produce: others require an injury to cause infection. Damage so

produced is probably the major cause of loss of fresh produce.

Physical losses

These losses are mainly caused by the effect of temperature on foods. In closely confined storage, wrong environmental condition can result in microbiological losses.

Secondary Losses:

These are losses that do not affect the produce directly, but presents favourable conditions for the actions of primary losses. They are incurred during the delay in food processing and delivery chain. They are usually as a result of inadequate harvesting, packaging, transportation, storage and drying or processing facilities and poor quality control practices.[4]

Tertiary Losses:

These losses are usually caused by the consumer due to unhygienic and careless handling of the foodstuff which can lead to wastage or loss. Various surveys have been carried out to assess the losses of food crops. A qualitative assessment must be made in order to know the post-harvest practices to prevent huge losses. The type of measures required to reduce the losses and the manner in which the measures should be adopted and applied also needs to be judged properly and with adequacy. A general assessment for food commodities cannot be made because the losses for different commodities differ significantly. The losses depend on the harvest and post-harvest practices which depend on the type of produce, final use, climate, harvesting practices and the social and cultural practices of the consumers.[4]

Post Harvest Losses

Physical damages to fresh produce can come from variety of sources, the most common being:

The high moisture content and soft texture of vegetables, fruits and fishes make them susceptible to mechanical injury, which can occur at any stage from production to retail marketing.[4]

Adversity from excessive temperature and heat stress

All fresh produce is subject to damage when exposed to extremes of temperature during chilling and freezing. Commodities vary considerably in their temperature tolerance. Their level of tolerance to low temperatures is of great

importance where cool storage is concerned.[4]

Feed processing like extrusion technique, pelleting of fish feed which includes various processing steps like grinding, mixing, coating etc. involving high-temperature processing (upstream/ downstream processing), whenever performed in large quantities is comparatively cheaper than processing and modification of individual ingredients.[8]

As food processing decreases the population or load of pathogenic microorganisms in food and neutralizes the harmful mycotoxins, if present therein. So, it reduces the microbial load and deleterious microorganisms and incidences of mycotoxicoses (majorly, aflatoxicosis, ochratoxicosis and zearalenone) due to prolonged improper storage of feed.

Processing involves various methods among which cooking is a very popular and widely used method which involves the modification by blending etc. of naturally available unprocessed food ingredients. Feed processing also involves fortification with addition of supplements *viz.*, probiotics, prebiotics, certain important vitamins and mineral elements within standard permissible limits which are rather present in natural food in very scarce quantity.

There exist certain limitations of food processing also. For example, during processing by heating the concentration of vitamin C is reduced, as it is heat-sensitive. Generally, food processing techniques reduce the nutritional quantity in very negligible amount of nearly 5-20%. Food processing involves many mechanisms like mixing, grinding, chopping and emulsifying during the whole process of production, which indirectly increase the chances of contamination and admixtures with undesirable foreign elements. Sometimes, packaging containers also pose a threat for contamination when exposed to thorough procedures of continuous processing by leaching of the chemical components from the containers into the food item to be processed.[8]

A Review on other economically feasible technological aspects of food preservation and long term storage

Fermentation is brought about by the conversion of sugars into ethanol chemically[8]. The fermentation technology

applicable to food processing sector is also popularly known as zymology or zymurgy. Fermentation is an important and popular technique in food processing technology. It is resulted from the chemical reaction resulting from the breakdown of higher carbohydrates to alcohols and organic acids or alcoholic derivatives.

Fermentation is a microbial technique and the reaction to be controlled in favourable and desirable conditions for food safety and quality after fermentation, especially in the production of alcoholic premium quality beverages like beer, wine and cider.[5,8] The same technology is employed in the bred manufacturing industries for leavening activity brought about by the production of carbon dioxide by the microbial or yeast activity. The preservation effect during fermentation is attributed to the production of lactic acid in sour foods such as yoghurt, dry sausages, pickles, sauerkraut and vinegar (extremely diluted acetic acid).[5]

The fermentation technology under controlled conditions is an age old practice both in households and industries for food processing and preservation, be it alcoholic beverage products of edible products derived from vegetable, fish and meat sources.[5,8] Louis Pasteur, the renowned French chemist is the world famous and first known zymologist in history, who in 1856 established the pivotal role of yeasts in fermentation. Pasteur originally defined fermentation as "respiration without air" after regular performances of lengthy experimental protocols. After observation of the breakdown of sugars to alcohols by the action of yeast, the pioneer concluded that the entire reaction is driven by the chemical catalytic action of certain forces called ferments inside the yeast cells. It was further observed that the yeast extracts can bring bout fermentation of sugars even also in the absence of viable yeast cells. In 1897, Eduard Buchner of Humboldt University of Berlin, Germany discovered that sugars are fermented in the absence of viable cells also in the fermentation mixture. The yeast cells secrete a chemical component called zymase. For his memorable contributions in research and discovery of cell-free fermentation, in 1907 Buchner was awarded with the prestigious Nobel Prize in Chemistry. In 1906, NAD^+ was discovered out of studies carried out from ethanol fermentation.

PRIMARY BENEFITS

Fermentation technology is primarily employed for the preservation of different food by production of acids and alcohols, biological fortification and enrichment of food items with potential biogenic products like essential amino acids, easily digestible proteins, essential fatty acids and useful vitamins, neutralization of anti-nutritional factors, to diversify and enrich the diet with various aromas, flavours and textures in food substrates and decrease in requirements of further processing techniques like cooking etc.[8]

FERMENTED FISH PRODUCTS AVAILABLE WORLDWIDE

Specifically, in the fish processing technological research aspect, Bagoong, Faseekh, Fishsauce, Garum, Hák arl, Jeotgal, Hentak, Rakfisk, Shrimp paste, Surströmming, Shidal and Ngari are the popular fermented fish products worth mentioning.[5]

PUBLIC HEALTH RISKS INVOLVED FROM CONSUMPTION

There are certain risks and health hazards associated with excess and regular consumption of fermented food products. In Alaska, since 1985, there has been increase in incidences of botulism exceeding the case reported in the Americas. This is mainly caused for the practice of allowing whole fish, fish heads and meat of animals like sea lions, walrus, whale flippers, birds, seal tallow, beaver tails etc. to ferment for prolonged periods before consumption by the resident Eskimos there. During this extended fermentation, if plastic wrappers or containers are used, then *Clostridium botulinum* gets a conducive condition to thrive in the micro-aerophilic condition inside the plastic containers.[6]

Alaska has witnessed a steady increase of cases of botulism since 1985. It has more cases of botulism than any other state in the United States of America. This is caused by the traditional Eskimo practice of allowing animal products such as whole fish, fish heads, walrus, sea lion, and whale flippers, beaver tails, seal oil, birds, etc., to ferment for an extended period of time before being consumed. The risk is exacerbated when a plastic container is used for this purpose instead of the old-fashioned, traditional method, a grass-lined hole, as the botulinum bacteria thrive in the anaerobic conditions created by the air-tight enclosure in plastic containers.[5]

Conclusion

The harvested produce should be properly processed and/or treated followed by proper handling and storing hygienically under conditions of optimum temperature and humidity. This improves the shelf-life of the stored agricultural produce until it reaches the consumers.

REFERENCE:

1. Food and Agricultural Organisation Report. www.fao.org, 2003.

2. Food and Agricultural Organisation. Expert consultation on planning the development of sun drying techniques in Africa. Food and Agricultural Organisation of the United Nation, Rome, 1985.

3. National Research Council, Commission on International Relation. World Food and nutrition study. The potential contributions of research. National Academy of Science, 1997.

4. Food and Agricultural Organisation. Structural Adjustment and Agriculture, 1990; 23: 37.

5. Ganguly S. Food Processing Technology. AV Akademikerverlag GmbH & Co. KG, Saarbrücken, Germany. LAP LAMBERT Academic Publishing, 2012a; ISBN 978-3-8383-8653-9.

6. Ganguly S. Post harvest losses of agricultural produce. Int J Agri Sci 2012b; 9(2): xx-xx. In press.

7. Olorunda AO, Tung MA. Simulated transit studies of tomatoes; effects of compressive load, container vibration and maturity on mechanical damage. International Journal of Food Science & Technology, 2007; 20 (6): 669-78, DOI: 10.1111/j.1365-2621.1985.tb01964.x.

8. Ganguly S. Food Processing and Quality Control. Narendra Publishing House [NPH], Delhi, India. 2013; Book Proposal Accepted and in processing.