Volume 3 - Issue 9– September,2023
SABUJEEMA
An International Multidisciplinary e-Magazine

Minimal Processing of Fruits & Vegetables

[Article ID: SIMM0294]

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Primary processing

Primary processing is the conversion of raw materials to food commodities. Milling is an example of primary processing. Purification of raw materials by removing foreign matter, immature grain and then making the raw material eligible for processing by grading in different lots or conversion of raw material into the form suitable for secondary processing.

Secondary processing

Secondary processing is the conversion of ingredients into edible products - this involves combining foods in a particular way to change properties. Baking cakes is an example of secondary processing.

Tertiary processing:

Conversion of secondary processed material into ready to eat form.

- Food items are marketed in different forms as raw, primary processed, secondary processed and tertiary processed. The farmers in general prefer to sell their agricultural produce immediately after harvest leaving a part for own consumption and seed purposes.
- It has estimated that the farmers retain 44 per cent of the total wheat and 48 per cent of the paddy. Mandies and grain traders procure the balance for processing and / or for marketing.
- The food processing sector in India has gained importance due to consumers preferences for ready to cook (RTC) and ready to eat (RTE) foods, besides increased demand for snack foods and beverages. As much as 42 per cent of the food industry is in the organized sector and 33 per cent in the small scale, tiny and cottage sectors.

- **Fruits and vegetable processing**
- India is the world's second largest producer of fruits and vegetables. It has potential to grow all types of temperate, sub - tropical and tropical fruits and vegetables because of varied agro - climatic diversity.
- The total production of fruits and vegetable is over 45 million tones and 85 million tonnes respectively.
- The losses are estimated to the extent of 20 -30 per cent due to lack of proper harvesting, processing and storage facilities, which is valued at Rs. 230 billion.
- The processed products from fruits and vegetables are beverages, jams, jellies, candies, preserves, canned fruits and vegetables, dehydrated fruits and vegetables, pickles, soup mixes, sauces and ketchups.
- Products that have growing demand, especially in the Middle East countries include pickles, chutneys, fruit pulps, canned fruits and vegetables, concentrated pulps and juices, dehydrated vegetables and frozen fruits and vegetables.
- People generally prefer fresh fruits and vegetables in India due to abundance of seasonal fruits throughout the year available at low price.
- The production of pickles and chutneys has traditionally been rural level cottage industrial activity.
- However, in the recent years, processed foods in the form of

canned fruits such as pineapple, mango slices and pulps, grapes, apple, peaches etc have increased considerably.

- The uses of fruits in the form of concentrated juice, dry powder, jam and jelly have also increased. The percentage production of processed fruits and vegetables are fruit juice and fruit pulp - 27, jams and jellies - 10, pickles -12, ready to serve beverages -13, synthetic syrups - 8, squashes - 4, tomato products - 4, canned vegetables- 4 and others -18.
- The main fruits that enter the export market are mangoes, grapes, apples, citrus but other fruits identified for export are bananas, sapota, litchis etc. The main destinations for export of fruits being Middle East, U.K., Europe and to some extent Singapore, Malaysia etc.
- The important vegetables exported are potatoes (28.0%), onions (7.1%), cauliflower and cabbage (4.0 % each), okra (3.0%), peas (3.0%) and others (50.0 %).
- The exports are limited to Middle East, Europe, U.K and Singapore etc.
- At rural level solar assisted dehydrators could be promoted for preparation of ethnic food products like raisins, onion flakes and powder, chips, vegetables etc.

Minimal Processing of Fruits & Vegetables

"Minimally processed" horticultural products are prepared and handled to maintain their fresh nature while providing convenience to the user.

Producing minimally processed products involves cleaning, washing, trimming, coring, slicing, shredding, and so on.

Other terms used to refer to minimally processed products are "lightly processed," "partially processed," "fresh processed," and "preprepared. “

Minimally processed fruits and vegetables

1. Peeled and sliced potatoes;
2. Shredded lettuce and cabbage;
3. Washed and trimmed spinach;
4. Chilled peach, mango, melon, and other fruit slices;
5. Vegetable snacks, such as carrot and celery sticks, and cauliflower and broccoli florets;
6. Packaged mixed salads; cleaned and diced onions;
7. Peeled and cored pineapple; fresh sauces; peeled citrus fruits; and microwaveable fresh vegetable trays.

- Whereas most food processing techniques stabilize the products and lengthen their storage and shelf life, light processing of fruits and vegetables increases their perishability.
- Because of this and the need for increased sanitation, preparation and handling of these products require knowledge of food science and technology and post harvest physiology.
- Growth in demand has led to increased marketing of fresh horticultural products in lightly processed form.
- An industry dedicated to this type of food processing has been established, and the National Association of Fresh Produce Processors was recently formed.

Physiological Responses

- Minimal processing generally increases the rates of metabolic processes that cause deterioration of fresh products.
- The physical damage or wounding caused by preparation increases respiration and ethylene production within minutes, and associated increases occur in rates of other biochemical reactions responsible for changes in color (including browning), flavor, texture, and nutritional quality (such as vitamin loss). The greater the degree of processing, the greater the wounding response.

- Control of the wound response is the key to providing a processed product of good quality.
- The impact of bruising and wounding can be reduced by cooling the product before processing.
- Strict temperature control after processing is also critical in reducing wound-induced metabolic activity.
- Other techniques that substantially reduce damage include use of sharp knives, maintenance of stringent sanitary conditions, and efficient washing and drying (removal of surface moisture) of the cut product.

Microbiological Concerns

- Fruits and vegetables are ecological niches for a diverse and changing micro flora, which usually does not include types pathogenic to humans.
- Intact fruits and vegetables are safe to eat partly because the surface peel is an effective physical and chemical barrier to most microorganisms.
- In addition, if the peel is damaged, the acidity of the pulp prevents the growth of organisms, other than the acid tolerant fungi and bacteria that are the spoilage organisms usually associated with decay.
- On vegetables, the micro flora is dominated by soil organisms. The normal spoilage flora, including the bacteria *Erwinia* and *Pseudomonas,* usually have a competitive advantage over other organisms that could potentially be harmful to humans.
- Changes in the environmental conditions surrounding a product can result in significant changes in the micro flora.
- The risk of pathogenic bacteria may increase with film packaging (high relative humidity and low oxygen conditions), with packaging of products of low salt content and high cellular pH and with storage of packaged products at too high temperatures (>5°C or 41°F).
- Food pathogens such as *Clostridium*, *Yersinia*, and *Listeria* can potentially develop on minimally processed fruits and vegetables under such conditions.
- With minimally processed products, the increase in cut damaged surfaces and availability of cell nutrients provides conditions that increase the numbers and types of microbes that develop.
- Furthermore, the increased handling of the products provides greater opportunity for contamination by pathogenic organisms.
- Microbial growth on minimally processed products is controlled principally by good sanitation and temperature management. Sanitation of all equipment and use of chlorinated water are standard approaches.
- Low temperature during and after processing generally retards microbial growth but may select for psychotropic organisms such as *Pseudomonas*.
- Moisture increases microbial growth, therefore removal of wash and cleaning water by centrifugation or other methods is critical.
- Low humidity reduces bacterial growth, although it also leads to drying (wilting and shriveling) of the product.
- Low oxygen and elevated carbon dioxide levels, often in conjunction with carbon monoxide, retard microbial growth.

- Plastic film packaging materials modify the humidity and atmosphere composition surrounding processed products and therefore may modify the microbial profile.

Product Preparation

- Minimal processing may occur in a "direct chain" of preparation and handling in which the product is processed, distributed, and then marketed or utilized.
- Many products are also handled in an "interrupted chain" in which the product may be stored before or after processing or may be processed to different degrees at different locations. Because of this variation in time and point of processing, it would be useful to be able to evaluate the quality of the raw material and predict the shelf life of the processed product.
- Minimally processed products may be prepared at the source of production or at regional and local processors.
- Whether a product may be processed at source or locally depends on the perishability of the processed form relative to the intact form, and on the quality required for the designated use of the product.
- Processing has shifted from destination (local) to source processors as improvements in equipment, modified atmosphere packaging, and temperature management have become available.
- In the past, processed lettuce operations often salvaged lettuce remaining in the fields after harvesting for fresh market. It is now recognized that first-cut lettuce should be used for maximum processed product quality.
- After trimming and coring, piece size may be reduced with rotating knives or by tearing into salad size pieces. Damage to cells near cut surfaces influences the shelf life and quality of the product.
- For example. shredded lettuce cut by a sharp knife with a slicing motion has a storage life approximately twice that of lettuce cut with a chopping action. Shelf life of lettuce is less if a dull knife is used rather than a sharp knife.
- Washing the cut product removes sugar and other nutrients at the cut surfaces that favor microbial growth and tissue discoloration.
- Because of differences in composition and release of nutrients with processing, some products such as cabbage are known as "dirty" products.
- It is desirable to maintain separate processing lines, or thoroughly clean the line before another product follows cabbage.
- Free moisture must be completely removed after washing. Centrifugation is generally used, although vibration screens and air blasts can also be used.
- The process should remove at least the same amount of moisture that the product retained during processing.
- It has been shown that removal of slightly more moisture (i.e., slight desiccation of the product) favors longer post processing life.

Quality of Minimally Processed Products

- The nature of the demand for minimally processed products requires that they be visually acceptable and appealing.
- The products must have a fresh appearance, be of consistent quality throughout the package, and be reasonably free of defects.

- Field defects such as tipburn on lettuce can reduce the quality of the processed product because the brown tissue is distributed throughout the packaged product.
- In mixed salads, the quality of the total product is only as good as that of the most perishable component. This also applies to cleaned and washed spinach and other products where differences in leaf age or physical damage to leaves may yield a product of no uniform perishability.
- Quality assurance programs, long regarded as essential in the processed food industry, are difficult to apply to horticultural crops and the corresponding minimally processed products. Fresh horticultural products have not yet been subjected to the same sanitation, labeling, and shelf-life requirements as other processed foods

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