Post Harvest Storage and Processing of Agricultural Produce in Indian Arid Zone

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Though Indian arid zone is characterized by adverse climatic conditions and frequent droughts, it has a vast treasure of indigenous fruits and vegetables. Fruits and vegetables can be processed into several value added products. It is estimated that 10-15 percent of horticultural crops such as vegetables and fruits perish due to lack of proper methods of processing and storing. If better methods of processing and storage are adopted, the losses could be reduced to 2 to 3 percent and more food grains could be available to the people.

Indian agriculture sector contributes 14.5% to GDP and sustains 2/3 country’s population. The agriculture growth rate during 11th plan had been 3.5% and it is envisaged in the 12th plan that agricultural growth rate will exceed to 4%. The expenditure incurred on agricultural research and development is at present 1% of cost of GDP. Prime minister has assured to double the expenditure on agriculture research and development in the 12th plan for achieving higher growth rate in states and central sector. The agricultural research and education sector is being strengthened in country to meet future demand of food in proportion to population growth and food security bill.

The agricultural productivity and specially fruit and vegetable production levels of the country play a very important role in providing quality food to people. A major concern faced by the country is to ensure quality food with remunerative prices to the farmers for their produce. If the surplus production of cereals, fruits, milk, vegetable, fish, meat and poultry etc. are processed and marketed both inside and outside the country there will be greater opportunity for additional income of farmers and creation of markets for export of agro foods.

Food processing involves any type of value addition to agricultural or horticultural produce and also includes processes such as grading, sorting, packaging which enhance shelf life of food products. The Food Processing Industry sector in India is one of the largest in terms of production, consumption, export and growth prospects. India's food processing sector covers a wide range of products fruit and vegetables; meat and poultry; milk and milk products, alcoholic beverages, fisheries, plantation, grain processing and other consumer product groups like confectionery, chocolates and cocoa products, soya-based products, mineral water, high protein foods etc.

India has strengths in processing sector because:

- India is second largest food producer in the world
- India has diverse agro-climatic conditions and has a large and diverse raw material base suitable for food processing companies
• India is looking for investment in infrastructure, packaging and marketing
• India has huge scientific and research talent pool
• Well developed infrastructure and distribution network
• 50 per cent of household expenditure by Indians is on food items
• Strategic geographic location (proximity of India to markets in Europe and Far East, South East and West Asia).

Food Processing: A Woman Based Enterprise
It is a fact that origin of food processing lies in the culinary tradition of various communities carried forward by their women folk. Contribution of women is recognized at various levels by providing incentives for promotion of food processing. Women are engaged all over the world in food preparation and processing activities. Food processing sector strongly require gender based budgeting so that gender balance and equality are promoted. Incoming of machines into the processing sector has helped men to take over processing sector more aggressively than women. Though it is not claimed at any platform that women cannot handle machines but mere introduction of machines means men need to undertake the business henceforth. This complex thinking of social system biased towards particular gender needs to change. Formation of women SHG has ensured participation of women in the processing industry.

Meaning of Food Processing
The need for defining what should be construed as Food Processing was necessary because of different classifications by various departments/organizations. Ministry of Statistics and Programme Implementation, compiles the data from all sources, there was a need for conceptual clarity on food processing. If any raw product of agriculture, animal husbandry or fisheries is transformed through a process [involving employees, power, machines or money] in such a way that its original physical properties undergo a change and if the transformed product is edible and has commercial value, then it comes within the domain of Food Processing Industries and other Value-Added Processes if there is significant value addition (increased shelf life, shelled and ready for consumption etc.) such produce also comes under food processing, even if it does not undergo manufacturing processes.

Food processing aims at many important aspects of agriculture such as
• Better utilization and value addition to agriculture produce.
• Minimizing wastage at all stages in the food processing chains by developing infrastructure for storage, transportation and processing of agro products.
• Introducing the modern technology in food processing.
• Ensures R&D in food processing for products and process development.
• Capacity building of farming community in processing field.
• Create infrastructure from farmer to consumer for enhanced income.
• Generate additional income by processing raw food, fruits and vegetables.
Growing horticultural crops is therefore, an ideal option to improve livelihood security, enhance nutrition and livelihoods.

Current fruit and vegetable cultivation in arid zone

<table>
<thead>
<tr>
<th>Particular</th>
<th>State (Rajasthan)</th>
<th>State (Gujarat)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Area(x000 ha)</td>
<td>Production(x000t)</td>
</tr>
<tr>
<td>Fruits</td>
<td>51.1</td>
<td>695</td>
</tr>
<tr>
<td>Vegetables</td>
<td>140</td>
<td>885</td>
</tr>
</tbody>
</table>

Rajasthan has 616 agro based industries that promote uptake of raw fruits and vegetables. Growing horticultural crops is therefore, an ideal option to improve livelihood security, enhance employment generation and attain food and nutritional security.

Post harvest Processing-Arid Zone Scenario

Though arid zones are characterized by adverse climatic conditions and frequent droughts it has a vast treasure of indigenous fruits and vegetables. People over centuries developed methods to process sour and bitter fruits in to safe and edible foods. Indigenous fruits and vegetables serve the purpose of nutrition and livelihoods.

Primary–Secondary-Tertiary Processing

Primary Processing relates to conversion of raw agricultural produce, milk, meat and fish into a commodity that is fit for human consumption. It involves steps such as cleaning, grading, sorting, packing etc. Secondary and Tertiary Processing Industries usually deal with higher levels of processing where new or modified food products are manufactured. Fruits and vegetables need one kind of treatment before processing where as cereals are processed by other method. Marine foods are processed differently than other meat foods. All processing levels are dealt by different stakeholders, none of the processors do all kind of processing at one place. It becomes expensive if one person is doing entire work, secondly benefits are shared in more people that creates a fiscal deficit.

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: Processing of primary processed raw material into product which is suitable for food uses or consumption after cooking, roasting, frying etc.

Tertiary processing: Conversion of secondary processed material into ready to eat form.

Processing and Storage of Cereals and Pulses: Some Important Points

Insect and larva start attacking seed grains even when the crops are in field. Therefore care of grains need to start before crop sowing. Care should be taken with following points:

- Either purchase new gunny bags for storage or wash old bags with approved anti microbial agent
- Repair old bags by stitching
- Dry bags in hot summer preferably in May for 15 days
- Prepare back wraps with new clothes for collecting shoots and pods from field
- Clean all grain very carefully
- Remove extraneous material, dust and cracked grains
To start it as household production unit, a practical training of process, ingredients, storage need to be taken. A very effective food processing, training is a key to success. Only effective methods are listed here for beneficiaries.

**Processing of Some Arid Fruits and Vegetables**

Fruits and vegetables can be processed into dried products, pickles, jams, jellies, squashes, murabba etc. To start it as house hold production unit, a practical training of process, ingredients, storage need to be taken. A very effective food processing, training is a key to success. Only effective methods are listed here for beneficiaries.
**Value added products of Ber (Zizyphus mauritiana)**

1. **Wash plum (1 kg) properly, peeled off & separate pulp**
   - Grind pulp with (500 ml) water
   - Muslin cloth is used for percolation of the juice
   - Boil 1200 gm of sugar with 400 ml water and keep it for 15 min.
   - Add 3.5 gm KMS, 10 gm citric acid with juice and syrup
   - Ber squash is ready to drink

**Value added products of Amla (Emblica officinalis)**

1. **Wash fruits (1 kg)**
   - Prick fruits till juice starts oozing
   - Soak fruits for 3 days in salty water or soak into lime water for 3 days. After 3 days rinse fruits for 4 times & boil
   - Add 1200 gm sugar in boiled fruits & keep it for 72 hours in shade.
   - After 2 days separate fruits from syrup and let it be condensed. After 1 day add 5 gm citric acid and fruits. Mix it adequately.

Amla (Indian gooseberry) pickle

Amla murabba
Stages of Grain and Seeds Post Harvest System

<table>
<thead>
<tr>
<th>HARVESTING HANDLING</th>
<th>CONSUMER PREFERENCES</th>
</tr>
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<tbody>
<tr>
<td>THRESHING</td>
<td>product evaluation, consumer education</td>
</tr>
<tr>
<td>DRYING, TRANSPORT AND DISTRIBUTION</td>
<td>MARKETING publicity, selling, distribution</td>
</tr>
<tr>
<td>STORING</td>
<td>PACKAGING weighing, labeling, sealing</td>
</tr>
<tr>
<td>PROCESSING</td>
<td>PRODUCT EVALUATION &amp; quality control: standard recipes</td>
</tr>
<tr>
<td>PRIMARY PROCESSING</td>
<td>SECONDARY PROCESSING mixing, cooking, frying moulding, cutting, extrusion</td>
</tr>
</tbody>
</table>

cleaning, classification, dehulling, pounding, grinding, packaging, soaking, winnowing, drying, sieving, whitening, milling
Main Elements of the Post-Harvest System

Harvesting: The time of harvesting is determined by the degree of maturity. With cereals and pulses, a distinction should be made between maturity of stalks (straw), ears or seedpods and seeds, for all that affects successive operations, particularly storage and preservation.

Pre-harvest drying (mainly for cereals and pulses): Extended pre-harvest field drying ensures good preservation but also heightens the risk of loss due to attack (birds, rodents, insects) and moulds encouraged by weather conditions, not to mention theft. On the other hand, harvesting before maturity entails the risk of loss through moulds and the decay of some of the seeds.

Transport: Much care is needed in transporting a really mature harvest, in order to prevent detached grain from falling on the road before reaching the storage or threshing place. Collection and initial transport of the harvest thus depend on the place and conditions where it is to be stored, especially with a view to threshing.

Post-harvest drying: The length of time needed for full drying of ears and grains depends considerably on weather and atmospheric conditions. In structures for lengthy drying such as cribs, or even unroofed threshing floors or terraces, the harvest is exposed to wandering livestock and the depredations of birds, rodents or small ruminants. Apart from the actual wastage, the droppings left by these marauders often result in higher losses than what they actually eat. On the other hand, if grain is not dry enough, it is vulnerable to mould and can rot during storage. Moreover, if grain is too dry it becomes brittle and can crack after threshing, during hulling or milling. This applies especially to rice if milling takes place a long time (two to three months) after the grain has matured, when it can cause heavy losses. During winnowing, broken grain can be removed with the husks and is also more susceptible to certain insects (e.g. flour beetles and weevils). Lastly, if grain is too dry, this means a loss of weight and hence a loss of money at the time of sale.

Threshing: If a harvest is threshed before it is dry enough, this operation will most probably be incomplete. Furthermore, if grain is threshed when it is too damp and then immediately heaped up or stored (in a granary or bags), it will be much more susceptible to attack from micro-organisms, thus limiting its preservation.

Storage: Facilities, hygiene and monitoring must all be adequate for effective, long-term storage. In closed structures (granaries, warehouses, hermetic bins), control of cleanliness, temperature and humidity is particularly important. Damage caused by pests (insects, rodents) and moulds can lead to deterioration of facilities (e.g. mites in wooden posts) and result in losses in quality and food value as well as quantity.

Processing: Excessive hulling or threshing can also result in grain losses, particularly in the case of rice (hulling) which can suffer cracks and lesions. The grain is then not only worth less, but also becomes vulnerable to insects such as the rice moth (*Corcyra cephalonica*).
Marketing: Marketing is the final and decisive element in the post-harvest system, although it can occur at various points in the agro-food chain, particularly at some stage in processing. Moreover, it cannot be separated from transport, which is an essential link in the system.

Post Harvest Losses
Due to old and outdated methods of storage, transportation, and handling, we lose about ten percent of production. The traditional methods of storage are responsible for about six percent losses. If better methods of processing and storage are adopted, the losses could be reduced to 2 to 3 percent and more food grains could be available to the people. It is estimated that 10-15 percent of horticultural crops such as vegetables and fruits perish due to lack of proper methods of processing and storing. The loss in monetary terms is estimated to be about Rs. 20 crores annually. Proper methods of processing, storage, packaging, transport, and marketing are required for export of crops such as jute, tea, cashew nuts, tobacco, mango, litchi, nut, spices, and condiments. One of the attributes to the post harvest system, as it is now constituted, is the large amount of wastage it involves. In case of food grains, some estimates suggest that in developing countries as much as 1/4th to 1/3rd of total crop may be lost as a result of inefficiencies in the post harvest system. Losses of food crops refer to many different kinds of loss produced by a variety of factors. These include weight loss, loss of food values, loss of economic value, loss of quality or acceptability, and actual loss of seeds themselves.

Conclusion
The agricultural productivity, especially fruit and vegetable production levels of the country play a very important role in providing quality food to people. The perishable loss of horticultural crops due to lack of processing and storing can be reduced by food processing. Food processing of vast treasure of indigenous fruits and vegetables in Indian arid zone can be source of livelihood for many desert dwellers living in fragile ecosystem of the arid zone.