Review Article

Packaging of Fruits and Vegetables in India: A Review

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Abstract

India is the second largest producer of fruits and vegetables. However, the export potential of fruits and vegetables is very negligible. This is because of improper knowledge to the farmer about handling, harvesting, packaging and storage. The package must be capable of protecting the product from the transport hazards; preventing the microbial and insect damage; minimising the physiological and biochemical changes and losses in weight. Present review deals with different methods of packaging of fruits and vegetables with their advantages and disadvantages. In the present scenario there is a need to search out proper packaging for export of fruits and vegetables. All the basic requirement of packaging which are suitable for export of fruits and vegetables has been dealt in order to boost the export of fruits and vegetables.

Keywords: Packaging, cardboard boxes, characteristics, paper and mesh bag

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Introduction

India's is a country with wide agro-climatic conditions as results of which we have got different climatic condition in different parts of country throughout the year. Because of this reason the production of fruits and vegetables is available in the country throughout the year in one or another part. As a result, India ranks second in fruits and vegetable production in the world after china. As per NHB database during 2014-2015, India produced 86.602 million metric tonnes of fruits, 169.478 million metric tonnes of vegetables [1]. The area under cultivation of fruits in 2014-15 was 6.110 million hectares whereas the area under vegetables was 9.542 million hectares [1].

In spite of such a large production consumer pays a high price in off season in one part of the country whereas in other part of country the same produce is being sold at throw away prices. Farmers of the country also face biggest problem as they cannot fetch proper prices for their produce in the production season However if these fruits and vegetables are properly distributed throughout the country, both producer as well as consumer will be benefitted. For this purpose there is a need of packaging of these fruits for long distance transportations.

In this process of handling the losses in different fruits ranges between 20-40%. These high post-harvest losses are due to improper transportation, improper storage and low processing capacity. The increased production of fruits and vegetables and other agricultural produce will be fully realised only when they reach the consumer in good condition and at a reasonable price. The post-harvest losses could be considerably reduced by adopting improved packaging, handling and efficient system of transport.

Packaging is one of the important considerations in vegetable and fruit market to reduce post-harvest losses and to make attractive to consumers. The use of properly designed containers for transporting and marketing of fruits and vegetables can maintain their freshness succulence and quality for longer period. The package must be capable of protecting the product from the transport hazards; preventing the microbial and insect damage; minimising the physiological and biochemical changes and losses in weight. Packaging is required not only for preservation and protection but also for safe transportation of products during storage and handling. Packaging of fruits and vegetables is undertaken primarily to assemble the produce in convenient units for marketing and distribution.

In the beginning the concept of packaging was to take the produce of the farmers from the production centre up to the local mandis and for that purpose even the bamboos basket was sufficient and there was no need to take into consideration to various technologies required for packaging of fruits but looking into the export and taking the produce directly to consumers [2]. There dire need to think about the complete technology of packaging so that the fruit can reach with safety up to the consumers without loss of any kind. So, the modern packaging systems should have full fill all the steps from production and transportation to consumer. These are some of basic necessities of modern packaging.

The package must be capable of tolerating long distance transportation, multiple handling and the climate changes of different storage places, transport methods and market conditions [3]. In designing fruit packages one should

consider both the physiological characteristics of the fruit as well as the whole distribution network [4]. Careful packing of fruits and vegetables is necessary to keep the produce in place with minimum shaking. Fruits and vegetables are normally packed in layers in crates and in each layer products are packed alternately placing the beak of one in between the shoulders of two. This type of packaging is quick and easy. It also provides enough room to fruits without compressing it.

Considering the long-term needs of eco-systems and to achieve an overall economy, other alternatives available like corrugated fibre board boxes, corrugated polypropylene board boxes, plastic trays/crates /wooden sacks, moulded pulp trays/thermoformed plastic trays and stretched film and shrink wrapping would have to be looked into.

Characteristics of Ideal Packaging

- It must have sufficient mechanical strength and should be capable of providing efficient handling unit for customers and dealers.
- It should have convenient ware house or storage unit strength i.e. good compression strength and puncture resistance to tolerate the load of packages above it.
- It should be economical so that the fruit in a package should not become expensive to consumer.
- It should provide adequate ventilation to fruits and vegetables as fruits require aerobic respiration and exchange of gas to avoid decay and to maintain its identity.
- It should reduce the wastage of moisture loss as the freshness of fruits is lost with moisture loss which causes shrinkage of fruits and acceptability of consumers.
- It should have height adjustment in such a way that fruits of lower stack don't get pressed by upper stack.
- It should fulfill Govt. compliance problem, manufactures responsibility for safety and regard of consumer health and welfare.
- It should specify company, its product and image: package should identify its contents.
- It must be required to aid disposal, reuse or recycling.
- It should have retailer acceptance to increase turnover.
- It should be acceptable in all marketing areas.

Various packages used for packaging of fruits and vegetables are as follows

Wire-Bound Crates

Wooden-wire-bound crates are used for packaging of those vegetables which require hydrocooling [5]. Because, these are sturdy rigid with high stacking strength and are not affected by water (**Figure 1**) these are helpful for hydrocooling because of sufficient ventilation.

Merits: Easy for empty boxes transportation as it can be dissembled.

Demerits:

- Labelling of these boxes is very tough which decreases its value.
- Consumption of wood for the preparation of these boxes is not advisable.
- Cost is very high so cannot be used for cheap vegetables.

Figure 1 Wire-Bound Crates (Source: Web)

Wooden Crates and Lugs

These are generally used for costly fruits i.e. apples, stone fruits especially by Himachal Pradesh and Jammu Kashmir (**Figure 2**). This is very sturdy and durable even for rough conditions.
Merits:

- It has a good stacking strength which is required during long distance transportation.
- Easy for handling because of durability.

Demerits:

- Very high cost and also leads to deforestation.
- Back transportations of these materials are not possible.
- Labelling of these boxes also is not attractive which is not acceptable to consumer.
- These are totally replaced by others types of packaging.

Figure 2 Wooden Crates and Lugs (Source: Web)

Wooden Baskets and Hampers

These are generally made up of veneer of different sizes and generally used for highly perishable commodities (**Figure 3**).
Merits:

- These are durable and can be easily nested for transportation when empty.

Demerits:

- Very costly and labelling is not possible.

Figure 3 Wooden Baskets and Hampers (Source: Web)

Corrugated Fiber board

This is the most accepted with different styles and weights and is made up of paper-board manufactured by Kraft process (**Figure 4**). Paper board is generally 0.020 cm thick and is generally made from unbleached pulp with a characteristic brown colour. Different types of paper board are made up of different grades. These are differentiated by thickness and weight [6]. In addition to virgin wood fibres, Kraft paper may have some portion of synthetic fibers for additional strength, sizing, and other materials to give it wet strength and printability. Most fiber board contains some recycled fibres. Tests have shown that cartons of fully recycled pulp have about 75 percent of the stacking strength of virgin fibre containers. The use of recycled fibers will inevitably lead to the use of thicker walled

containers. These are generally available in market as 3 ply, 5 ply, and 7 ply in which both the outer side are similar. Where as sandwhich layer are in the form of pipe lines which gives them more strength and cushioning. In 5 ply we have three smooth layers and alternating with pipelines which gives it more firmness and cushioning.

Merits:

- Cost effective as it consumes waste material of either wood or agricultural waste.
- Labelling of these boxes is very easy which attract to consumer.
- Easy to handle to the consumer.
- Stacking strength is good enough.
- It can be easy folded and retransported when empty.
- Light in weight.

Demerits:

- It cannot be used for hydrocooling
- Not fit for high humid fruit.

Figure 4 Corrugated Fibreboard (Source: Web)

Double-faced corrugated fibreboard

Double-faced corrugated fiberboard is the predominant form used for produce containers (**Figure 5**). It is produced by sandwiching a layer of corrugated paperboard between an inner and outer liner (facing). Corrugated fiberboard manufacturer give certificates on the bottom of containers to certify certain strength characteristics and limitations. Certificate indicate minimum bursting strength and minimum edge crush test (ETC) strength [5]. Edge crush strength is a much better predictor of stacking strength than is bursting strength. For this reason, users of corrugated fiberboard containers should insist on ECT certification to compare the stackability of various containers. Certificates give a maximum size limit for the container (sum of length, width, and height) and the maximum gross weight of the contents.

Both cold temperatures and high humidity reduce the strength of fiberboard containers. Unless the container is specially treated, moisture absorbed from the surrounding air and the contents can reduce the strength of the container by as much as 75 percent. New anti-moisture coatings (both wax and plastic) are now available to substantially reduce the effects of moisture.

Figure 5 Double-Faced Fibreboard (Source: Web)

Waxed Fiberboard Cartons

Waxed fiberboard cartons (the wax is about 20 percent of fiber weight) are used for many produce items that must be either hydrocooled or iced (**Figure 6**). The main objection to wax cartons is disposal after use— wax cartons cannot be recycled and are increasingly being refused at landfills. Several states and municipalities have recently taxed wax cartons or have instituted rigid back haul regulations. Industry sources suggest that wax cartons will eventually be replaced by plastic or, more likely, the use of ice and hydrocooling will be replaced by highly controlled forced-air cooling and rigid temperature and humidity maintenance on many commodities.

Figure 6 Waxed Fibreboard Cartons (Source: Web)

Styles of Corrugated Fibreboard

There are two common styles of corrugated fiberboard containers [7] i.e. regular slotted container (RSC) and the two piece, full telescoping container (FTC) (**Figure 7**). The RSC is the most popular because it is simple and economic. However, the RSC has relatively low stacking strength and therefore must be used with produce, such as potatoes, that can carry some of the stacking load. The FTC, actually one container inside another, is used when greater stacking strength and resistance to bulging is required. Bliss box is the third types which is constructed in three pieces and is used when maximum stacking strength is required.

Figure 7 Regular Slotted Container (RSC) and Full Telescoping Container (FTC) (Source: Web)

In recent years, even tripled walled fibre corrugated boxes [8] have been used for bulk transportation and shipping. In all the containers, top and bottom are sealed by glue, staple are interlocking septa. So that it become safe enough for handling. Ventilation in these boxes is very easy as these can be easily cut. Ventilation of desired percentage can be done as per the need of community. Labels of these containers can have full information of the commodity along with good photograph which attract to consumers. There are basically two methods used to print corrugated fiberboard containers:

Post Printed

When the liner is printed after the corrugated fiber board has been formed, the process is known as post printing. Post printing is the most widely used printing method for corrugated fiber board containers because it is economical and may be used for small press runs. However, post printing produces graphics with less detail and is usually limited to one or two colors.

Pre printed

Pre- printing of generally of high quality but its cost is 15% higher. The quality of the package gives the first impression to the buyer, it is one of the best printing for export purposes where the cost can be compensated.

Paper and Mesh Bags

Consumer packs of potatoes and onions are about the only produce items now packed in paper bags (**Figure 8**). The more sturdy mesh bag has much wider use. In addition to potatoes and onions, cabbage, turnips, citrus, and some specialty items are packed in mesh bags. Sweet corn may still be packaged in mesh bags in some markets. In addition to its low cost, mesh has the advantage of uninhibited air flow. Good ventilation is particularly beneficial to onions. Supermarket produce managers like small mesh bags because they make attractive displays that stimulate purchases. Bags of any type have several serious disadvantages. Large bags do not palletize well and small bags do not efficiently fill the space inside corrugated fiberboard containers. Bags do not offer protection from rough handling. Mesh bags provide little protection from light or contaminants.

Figure 8 Paper and Mesh Bags (Source: Web)

Plastic Bags

These are the predominant material for almost all commodities (**Figure 9**). These are easily affordable and excepted by the consumers. It is also called polyethylene film. Film bags are clear, allowing the easily inspection of the materials.

Figure 9 Plastic Bags (Source: Web)

Merits:

- From economical point of view, as these are available in different sizes as per the demand of customers. The desire material can be packed.
- Consumer feels it very easy to handle these bags.
- These are available in various and grades.
- These can be recycled and reused.
- Shelf life of the produce is also enhanced as they restrict the physiological processes of commodity.

D*emerits*:

- Environmental pollution is the biggest hazard as they spoil the soil, the water and even the guts of domestic animals are blocked.

Plastic Stretch film

These films are generally used for consumer packaging as they can be stretched retains its elasticity (**Figure 10**). It protects the package from the lost of moisture and keep it fresh for longer times. These types of films can be used for primary processed products and also helps to give rural employment as the farmer itself will do that packaging and will make available directly to consumers. Primary processing will also reduce the pollution and bulk transportations of commodities. This will also helps urbanites to fulfil their needs of perishable commodities in easily handled way.

Figure 10 Plastic Stretch Flim (Source: Web)

Nylon Bags

These are commonly used for consumer packaging with good strength (**Figure 11**). These can be reused and recycled [9]. These are available in different sizes with different strength and mesh. These are good enough for storage and packaging with less water content i.e. onion, elephant fruit and arbi etc.

Figure 11 Nylon Bags (Source: Web)

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