

Pulp, paper and corrugated boxes from cotton stalks

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A rough estimate reveals that the losses of fruits and vegetables in Indian due to improper post-harvest handling, packaging, transportation, storage, etc. are to the extent of about 25% of the total produce, which in monetary terms is around Rs 20 million, annually. These losses can be minimized by introduction of improved methods of packaging.

To protect fruits and vegetables from bruising, vibration and pressure due to weight of other stacked containers during transportation to distant markets, adequate packaging is essential. Experiments were conducted at various research institutes all over India on various types of packaging materials such as wooden boxes, wire bound boxes, bamboo boxes, corrugated fibre board cartons, etc. to assess the relative performance in terms of storeability and suitability for long distance transportation. The study emphasis assessment of different properties, viz. ripening behaviour, per cent loss in weight, per cent decay loss of packed fruits and vegetables. Results showed that wooden boxes and corrugated cartons are most suitable for packaging of fruits and vegetables as compared to other type of packagings.

The corrugated boxes were more acceptable due to their lighter weight, easily foldable character and the resultant ease in storage. However, in spite of several advantages this packaging material also has not assumed popularity to the desired extent. The main reason being their higher cost compared to the wooden boxes. A 20 kg corrugated box is twice costlier than that of a similar size wooden box.

The conventional manufacturers of both wooden boxes and corrugated boxes are depending on forest resources, for their raw material requirements which are depleting at a high pace. Under such circumstances, recourse has to be taken to find out alternative sources or raw materials. As far as wooden boxes are concerned, forest timber is essential and hence, no alternative can be thought of. With regard to the corrugated boards, one can resort to non-conventional raw materials for manufacture boxes are generally prepared. One such raw material is the cotton plant stalk from which good quality pulp and paper can be prepared.

It is estimated that around 15 million tonnes of cotton plant stalk is generated in our country, annually. At present it is not being used for any commercial purpose, except as fuel by the rural people, while the bulk of stalk produced is disposed off by burning in the field itself. If this agro-waste is stored in the fields, it harbours several insects and pests which can damage the subsequent crop. Hence, it is imperative to lift this agro-waste as early as possible from the fields and put to better use rather than burning it off. Knowhow had been developed at CIRCOT to prepare pulp and paper from cotton plant stalks. Utilising the same knowhow, attempts have been made to prepare soda for preparation of corrugated boards and boxes.

Good quality kraft paper can be prepared by digesting cotton plant stalk chips of about 1.5 cm-2.0 cm size in a rotary digester with 17% kraft liquor, at 160°C temperature for a total period of 5½ hr at a material to liquor ratio of 1 : 2.5. The cooked material after washing thoroughly could be converted into pulp of desired freeness by mechanically beating it in a

valley beater. Kraft paper of 120g and 140g having desired quality parameters could be prepared on a Fourdrinier paper making machine.

Corrugation trials were successfully carried out with the kraft paper prepared from cotton stalks. Corrugated boxes of various ply, and dimensions suitable for packaging and transportation of mangoes and oranges were prepared. The quality of these boxes as well as their transport worthiness for fruits was evaluated at the Indian Institute of Packaging, Mumbai. The test results were quite satisfactory. The suitability of these boxes was also evaluated by conducting actual packaging and transportation trials after packing these boxes with Dushehari and Alphonso mangoes. The field trials on Dushehari mangoes was conducted in collaboration with the Central Institute for Sub-tropical Horticulture, Lucknow and the boxes with packed fruits were transported by road from Lucknow to New Delhi and back, covering a total distance of about 1000 km. The performance of these boxes was compared with nailed wooden boxes of same capacity. The condition of the boxes and the packed fruits before and after transportation trials were recorded. The trials were repeated for three consecutive seasons and from the results it is concluded that the 5 kg and 10 kg CFB boxes are ideally suited for transportation of Dushehari mangoes as the boxes and the packed fruits were found in sound condition after completion of the transportation trials. In general, the physical condition and ripening of fruits was better and uniform in CFB boxes as compared to nailed wooden boxes. There was no bruising on fruits in CFB boxes. In the case of wooden boxes the damage to fruits was about 20% as nails came out due to vibration and punctured the fruits. Similarly, the packaging and transportation trials on Alphonso mangoes were conducted in collaboration with Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri. The boxes, of two dozen capacity packed with Alphonso mangoes were transported from Dapoli to Mumbai and back, covering a total distance of about 460 km by road. The observations were recorded on the condition of the boxes and fruits before and after transportation trials and during storage along with those CFB boxes made from conventional raw materials. The results of trials of two seasons indicated that all the fruits were found in sound condition while, there was only a negligible damage noticed on the condition of the boxes. The storage behaviour of the fruits indicated that the shelf-life of the Alphonso mangoes was about 16 days and the fruits were highly palatable and showed better colour, flavour and texture. These boxes gave performance on par with those made from conventional raw materials. The CFB boxes of two dozen capacity made using cotton stalk kraft paper were recommended by the Konkan Krishi Vidyapeeth, Dapoli for transportation of Alphonso mangoes.

The packaging and transportation trials conducted on oranges in collaboration with National Research Centre for Citrus, Nagpur indicated that out of the various types of boxes used in the trials, the performance of the two-piece telescopic boxes of size 50 cm x 30 cm x 30 cm (5 ply + 5 ply) was excellent as there was no damage observed either to the boxes or to the packed fruits after completion of the transportation trials. The cold storage study conducted also indicated that the two-piece telescopic box was ideally suited for cold storage of oranges as there was absolutely no damage observed to these boxes even after 45 days at 90-95% RH.

The two-piece telescopic box of size 50 cm x 30 cm x 30 cm (5 ply + 5 ply) could match with the traditional wooden box in respect of size, cost and fruit-holding capacity and this box could be recommended for transportation and cold storage of oranges.

Cost of Production of Corrugated Boxes

Cost of one tonne kraft paper(in rupees)

Cost of production of pulp	=	4963
Cost of stock preparation (alum, rosin, dye and electricity)	=	513
Cost of conversion of pulp of paper	=	1275
Overheads	=	1303
Total	=	8054

Details of corrugated boxes

Dimension of boxes	=	265mm x 180mm x105 mm
Ply	=	3 ply

Cost of corrugated boxes (in rupees)

Number of corrugated boxes from one tonne kraft paper	=	2000
Cost of one tonne kraft paper	=	8050
Cost of corrugation and box making	=	4500
Total	=	12550
Cost of 100 boxes	=	628
Sale price of 100 boxes	=	Rs 900 (approx.)

CONCLUSION

The use of cotton stalks for manufacturing the CFB boxes will not only help in solving the disposal of this agro-waste but also fetch additional income to the farming community. Apart from minimizing the losses to fruits this will ease the pressure on the forest-based raw materials, which are being used at present by the packaging industry for transporting fruits and vegetables.

