Research Article

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Studies on comparative economic analysis of beverages and preserves of arid fruits

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ABSTRACT

This study presents a comparative economic analysis of beverages and preserves made from arid fruits, aiming to enhance the profitability of underutilized and lesser-known fruit varieties. It is evident from the results that the benefit: cost ratio from beverages was 3.93 in bael juice, 2.11 in bael squash, 2.07 in bael syrup, 2.21 ber while preserves of ber, aonla and bael have 2.76, 2.94 and 2.67, respectively. The value addition of fruits resulted in generation of income, employment as well as eliminate/ minimize malnutrition problem and post-harvest losses.

Introduction

Processed fruit products are delicious, acceptable to consumer with more shelf life without losses in taste and quality. The increased fruit production needs to be supplemented by proper utilization that would be achieved through processing (Kumar *et al*., 2020). Fruits and vegetables are rich source of vitamins, minerals and dietary fibre, but there are highly perishable. They need to be preserved and processed into various value-added products. It is estimated that about 22 percent of fruits and vegetables lost or get wasted in the chain from grower to consumer, whereas 76 per cent of fruits and vegetables are consumed fresh (Acharya, 2007 and Kumar *et al*., 2013).

In the present scenario, the dietary habit of human being is drastically changing from cereals to delicious nutritive food. Hence the demand of fruits and vegetable based nutritive food is increasing all over the globe and in India as well (Kumar *et al.,* 2015). The fluctuation in fruits and vegetable prices in the market can also ease out by value added products and farmers may get more profit (Kumar *et al.,* 2017). These also contribute in nutritional security by supplying quality products for human consumption (Baloda *et al*., 2018).

As per Assocham study, "India incurs post-harvest fruits and vegetable losses worth over Rs. 2 lakh crore each year largely owing to the lack of modern cold storage facilities food processing units and a callous attitude towards tackling the grave issue of post-harvest losses" (Anonymous, 2020). ICAR-Central Institute of Post-Harvest Engineering and Technology (CIPHET) reported that the wastage of fruits and vegetable in India varied from 4.6% to 15.9% annually (Anonymous, 2017), due to lack of awareness, modern harvesting practices

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and inadequate cold chain infrastructure. The processing of fruits and vegetables in Indian was about 2% and export share in the global market was 1.3% during 2015 according to CIPHET report (Anonymous, 2019). This programme was structured with the aim to avoid the outbreak of food borne illness due to contaminated food.

Bael (*Aegle marmelos* Corr.) belongs to family Rutaceae is one of the arid, minor, underutilized, medicinal, indigenous fruit crops of India. The fruits of bael are rich in minerals, vitamins (specially riboflavin), anti-oxidants and with importance in medicinal remedies. It contains 61.5 g moisture, 1.8 g protein, 0.3 g fat, 209g fibre, 31.8 g carbohydrate, 12.7 to 19.0 g mucilage, 1.7 g mineral, 55 mg carotenes, 0.13 mg thiamine, 0.03 mg riboflavin, 1.1 mg niacin, 186 IU vitamin A and 8-19 mg vitamin C per 100 g of pulp (Pal *et al.,* 1993 and Singh *et al.,* 2016). The plant parts of bael tree (root, bark, leaves, branches and fruits) are consumed in the form of '*Panchang*' for curing various diseases like ulcer, dysentery, and diarrhea, etc. It has marmelosin content in fruits which protects our stomach from various stomach diseases (Nagar *et al.,* 2017). The ripe fruits are aromatic, sweet and astringent, which helps in regeneration of skin, coolant, laxative, febrifuge and good source for the heart, brain and in dyspepsia (Raju *et al.,* 2014 and Nagar *et al.,* 2018). Bael fruits can be processed into squash, jam, nectar, RTS, fruit slice and toffee. Bael squash is a poplar drink for its refreshing and cooling effect (Kumar *et al*., 2013).

Aonla also called as Indian gooseberry (*Phyllanthus emblica* L syn. *Emblica officinalis* Gaertn) belongs to family Phyllanthaceae, it is native to India, Malaya and China. It is rich source of vitamin C and fair source of source of minerals, carbohydrates, carotene and thiamin. Vitamin C content in aonla is not degraded in the processed fruits. It has medicinal and therapeutic properties which encourage the farmers' towards cultivation of aonla in wasteland (Singh *et al*., 2017). Aonla can be processed into various processed products *viz*., dried fruits or powder have been reported to be useful in anaemia, cough, diarrhea, dysentery, jaundice and haemorrhages. *Chavanprash* and *trifla* are well known indigenous products prepared from aonla fruits. A number of other products namely chuntey, candy, *murabba*, pickle, sauce, dried chips and shampoo can be prepared from aonla fruits (Kumar *et al*., 2013).

Ber (*Ziziphus mauritiana* Lamk.) is a king of arid zone fruits. It can be grown easily in the area where other crops cannot survive easily. It is rich in nutritive value, popular and cheap, hence is often called as a poor man's fruit. It is rich source of vitamin C (90-120 mg/100g) (Kumar *et al*., 2009). In fact, its vitamin C content is higher than apple, citrus and mango. Ber fruits are very rich in protein and minerals such as phosphorus and calcium. Consumption of one ber fruit in a day would meet the diet requirements of vitamin C and vitamin B complex of an adult man as recommended by WHO (Kumar *et al*., 2016). Ber fruits are used to prepare processed products *viz*., preserve, dehydrated fruit, canned fruit, juice, pulp, squash and wine (Kumar *et al*., 2009a). These products having acceptability in the consumers and one can fetch good price in the market. This helps to ease out fluctuation in the market price and farmers may get better returns and consumers get value added products (Kumar *et al*., 2021).

Material and Methods

The ripe fruits were collected from local market and orchard CCS Haryana Agricultural University, Regional Research Station, Bawal, Haryana. The products were prepared during ELP and training on fruits and vegetable preservation conducted at COA, Bawal during 2022 to 2024. The objective of the training was to improve the livelihood of the rural people. The fruits were processed for demonstration with the aim earning while learning and understanding about the preparation of products. The participants were awaked about value addition and income generation from different fruits. It is very difficult to get good quality/ unadulterated products from the local market. This programme was organized to make the rural people self-reliance, improve their livelihood, living standard and live better life by good earning with more benefit.

Flow chart for bael squash/ syrup

Ripe fruits → grading →washing →peeling /cutting → extract pulp → put in hot water (temp. 68°C) →remove seeds and fibre →filter or separation of juice → prepare sugar syrup (add water+ sugar+ citric acid) → cool syrup → add juice → add preservative* → add colour if needed→ filtering →bottling → sealing → labeling (Srivastava and Kumar, 2017).

*No preservative required in syrup

Select the ripe fruits of bael, harvest after completion of litter fall. Keep them in a bag or covered with paper for proper ripening, the detached stem portion during storage was considered that the fruits are ready for processing.

Flow chart for bael juice

Ripe fruits → grading →washing →peeling /cutting → extract pulp → remove seeds and fibre →filter or separation of juice → prepare sugar syrup (add water+ sugar+ citric acid) → cool syrup → add juice → add preservative* → add colour if needed→ filtering →bottling → sealing → labeling (Srivastava and Kumar, 2017).

*Preservative was not required for fresh consumption.

Flow chart for ber murabba/ candy

Ripe fruits → grading →washing →pricking → blanching → make sugar syrup (add water + sugar+ citric acid) → cool it →add blanched fruits →increase concentration of syrup to 66°B by adding sugars 3-4 times at 2 to 4 days interval →always add fruits in cold syrup (never boil the syrup with fruits) → (dehydrate for candy) canning → sealing → labeling (Srivastava and Kumar, 2017).

The ber fruit were collected when fruit starts turning yellowish with brownish ting, avoid fully ripe and immature fruits.

Flow chart for aonla murabba

Ripe fruits → grading →washing →pricking (removing astringency by adding fruits in 2, 4, 6 and 8 % salt solution at 24 hr interval) → washing→ blanching → make sugar syrup (add water + sugar+ citric acid) → cool it →add blanched fruits →increase concentration of syrup to 66°B by adding sugars 3-4 times at 2 to 4 days interval →always add fruits in cold syrup (never boil the syrup with fruits) →canning → sealing → labeling (Srivastava and Kumar, 2017).

Aonla fruits were harvested after attaining maturity when the skin colour changed from light green to dull green yellow and seed colour changed from creamy white to blackish.

Flow chart for bael murabba

Mature fruits → grading →pealing/ cutting → remove pulp → slicing pulp →remove seeds and gum in seed sac →washing →pricking → blanching → make sugar syrup (add water + sugar+ citric acid) → cool it →add blanched fruits →increase concentration of syrup to 66°B by adding sugars 3-4 times at 2 to 4 days interval →always add fruits in cold syrup (never boil the syrup with fruits) →canning → sealing → labeling (Srivastava and Kumar, 2017).

For preparation of bael *murabba* fruit should be harvested at maturity when fruits attained full size or it takes about 150 to 180 days after fruit set or shed its leaves.

Results and Discussion

The products prepared from different fruits were bael juice, bael squash, bael syrup, bael *murabba*, aonla *murabba* and ber *murabba*. The processed products were analysed for B:C ratio. The major cost involved in the products was fresh fruits (bael, ber, aonla), sugar, preservative, citric acid, cooking gas, packaging and labeling charges. The total cost incurred during the processing of one-kilogram fruit/ pulp preparation of different beverages was Rs. 61 inbael juice, Rs. 141 in bael squash, Rs. 155 in bael squash (Fig. 1; Table 1) while the preserves of ber, aonla and bael had Rs. 145 in ber *murabba*, Rs. 136 in aonla *murabba* and Rs. 150 aonla *murabba* each (Fig. 2, Table 2).

The market rate of the bael fruits was Rs. 30/ kg, ber and aonla Rs. 20 each. Gross income from the products was Rs. 240 in bael juice, 298 in bael squash, Rs. 321 in bael syrup, whereas Rs. 400 in *murabba* of bael, ber and aonla each. Net profit per kilogram of raw fruits was Rs. 180 in bael juice, Rs. 157 in bael squash, 166 in bael syrup while Rs. 255, 264 and 250 were received from *murabba* of ber, aonla and ber, respectively. It shows form the results that the benefit: cost ratio from the processed products varied as 3.93 in bael juice, 2.11 in bael squash, 2.07 in bael syrup, while preserves of ber, aonla and ber had 2.76, 2.94 and 2.67, respectively.

The trainees who made these products have earned good income for their livelihood. The glut of the fruits in the market can be managed/ avoided by utilization in processed supplemented products (Kumar *et al*., 2009b).

The processing could not save only the post-harvest losses of the fruits but also helpful in increasing the availability of quality food, good earning and save Indian economy of about Rs. 2 lakh crore per annum. For better earning the products should be made during the main season of the fruits to be used as raw material. The trainees have started to prepare the products at the home scale. The home scale production of these products not only save the pocket money but provide the quality food which helps to avoid malnutrition. Improvement in processing industry require study of consumers interest in the product, required quantity/ container or packaging and how the products compete with existing local market products and need unfulfilled demands of consumers, strong local or regional demand at premium price.

The products prepared were judged by the jury of local consumers and modify the recipes as per their demand for community support. For successful entrepreneurship a product cycle from grower to the last consumer is required. It will not only provide quality input or raw materials (fruits and vegetable), but also ensure the availability of quality products at cheaper rate all over the year. This approach may be a way to good returns from special recipes from organically grown produce. The registration under FPO can be done onhttp://www.trademarkregistrationindia.com/ for trademark, patent, copyright, company registration, IPR services, brand registration, logo registration, LLP registration and other services are also available online. It is concluded from the study that the processed fruits not only avoid market glut and post-harvest losses but also give higher income and taste of fruits and vegetables during off season. This will help to strengthen business, reduce your risk, and support local farmers.

Table 1. Cost of product, net profit and B: C ratio of preparation of bael beverages

Products	Juice	Squash	Syrup
Fruit pulp	1 kg	1 kg	1 kg
Fruit price (Rs.)	34 (15% more for to remove peal)	34	34
Sugar + preservative + citric acid + cooking charge (Rs.) + packaging	27	107	121
Input cost (Rs.)	61	141	155
Product quantity (ml)	2400	2100	1500
Product rate/ litre (Rs.)	100	142	214
Gross income (Rs.)	240	298	321
Net profit (Rs.)	180	157	166
B: C ratio	3.93	2.11	2.07

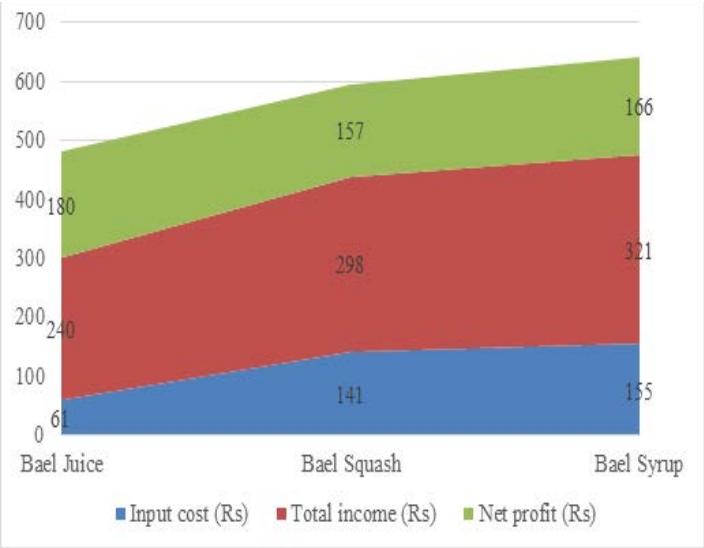

Fig. 1. Net profit (INR) from value added products of bael

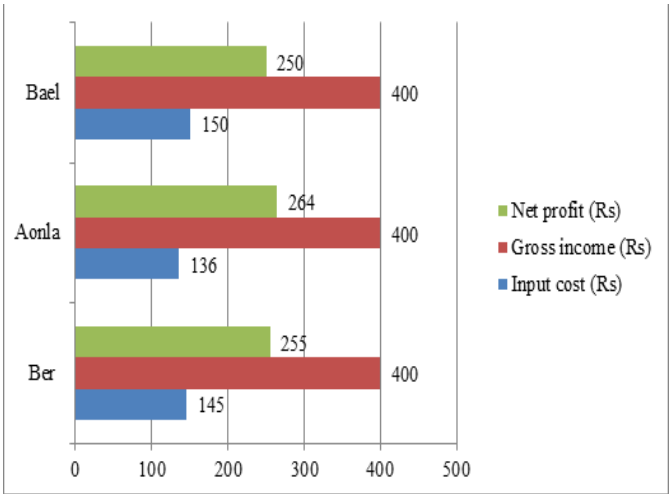

Fig. 2. Net profit from *murabba* of different fruits

Table 2. Cost of product, net profit and B: C ratio of ber, aonla and bael *murabba*/ preserves

Products	Ber	Aonla	Bael
Fresh Fruit	1 kg	1 kg	1 kg
Fruit price (Rs.)	20	20	34
Sugar + citric acid + cooking charge + packaging (Rs.)	125	116	116
Input cost (Rs.)	145	136	150
Product quantity (ml)	2.0	2.0	2.0
Product rate/ kg (Rs.)	200	200	200
Gross income (Rs.)	400	400	400
Net profit (Rs.)	255	264	250
B:C ratio	2.76	2.94	2.67

Conclusion

It is concluded from the study that the processed value-added preserves of arid fruits had 11.25, 11.25 and 6.67 times more value whereas beverages of juice, syrup and squash get 5.29, 4.62 and 4.88 times more value, respectively as compared to fresh fruits. At the same time the processed fruits may be kept for longer period or atleast 6 months however, fresh fruit can be kept only for 5 to 10 days.

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Conflict of Interest

The authors have no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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