

Fruit based nutri-bars for rural and urban nutrition security

The ICAR-Central Institute for Subtropical Horticulture (CISH) has developed advanced technologies for raw mango, ripe mango, guava nutri bites, and jamun fruit bars aimed at improving nutritional content and facilitating fruit utilization. These products utilize the abundant antioxidant, vitamin, and mineral composition of these fruits, providing nutritious and convenient snack options. This technology enhances shelf life, minimizes postharvest losses, and facilitates value addition for agricultural producers. It additionally fosters entrepreneurship and sustainable agriculture via scalable processing techniques. These advancements improve food security and deliver nutritious, commercially viable products for consumers.

Keywords: Bioactive compounds, Fruit-based snacks, Nutritional security, Shelf-stable bars Value-addition

THE conversion of perishable fruits like mango, guava, and jamun into shelf-stable bars effectively prolongs their usability, thereby reducing waste at both farm and market stages. Drying and dehydration-based value-added products not only mitigate environmental impact but also strengthen nutritional security for at-risk groups, including rural women and children, who frequently experience malnutrition due to restricted access to fresh produce. Nutrient-dense fruit-bars, which are abundant in vitamins, antioxidants, and minerals, provide a practical and portable solution to improve dietary diversity and address deficiencies within these populations. These fruit-bars can be incorporated into the Govt. Nutrition Programmes such as Mid-Day Meal Programme and Balwadi Feeding Programme, as around 33% of our pre-school and school-going children are stunted and 66% are anemic (NFHS-5).

The global fruit snacks market, which includes fruit bars, is expected to increase from USD 6.7 billion in 2025 to USD 13.8 billion by 2035, reflecting a compound annual growth rate (CAGR) of 7.4%. This growth is attributed to the rising number of health-conscious consumers and the availability of innovative products. In parallel, the snack bar segment in India is projected to expand from USD 29.82 million in 2025 to USD 56.26 million by 2030, with a CAGR of 13.54%.

Fruit-bars are formulated using a single fruit or a combination of two or three fruits, optimized to take into account their taste, texture, flavour, and colour attributes. The primary objective of combining multiple fruits is to enhance the nutritional profile, visual appeal, texture, flavour, and shelf life. Fortified fruit-bars are occasionally formulated through the incorporation of protein, vitamins, and mineral sources to enhance their nutritional profile. Food fortification refers to the process of incorporating essential nutrients that may be deficient or lost during the stages of preparation and processing. A variety of

fruit-bars have been developed at ICAR-Central Institute for Subtropical Horticulture, especially for at-risk groups, including rural women and children.

Guava nutri-bar

Guava nutri-bar was developed using different combinations of guava pulp, aonla pulp, and beetroot puree along with some complementary ingredients. The physical and chemical transformations occurring during the production of the guava fruit-bar were examined, and a panel of 10 experts employed the 9-point hedonic scale to assess the sensory attributes of the product. The shelf life of this fruit bar is six months when stored at room temperature. This bar contains a higher concentration of Vitamin C, making it appropriate for preschool and school-aged children to enhance iron absorption, which is a significant issue in developing nations, particularly in India.

Ripe mango-bar

Mango nutri-bars represent a convenient and nutrient-rich snack that integrates the tropical sweetness of mango with associated health benefits. Mangoes are abundant in vitamin C, which enhances immune function and



facilitates iron absorption. Rich in dietary fiber, these substances facilitate digestive processes and contribute to the regulation of blood glucose levels. Compounds such as beta-carotene and mangiferin exhibit anti-inflammatory effects and may possess potential anti-cancer properties. These bars represent a low-calorie, fulfilling substitute for processed snacks, contributing positively to overall health, and the shelf life of this mango bar is six months.

Raw mango-bar

Raw mango-bars exhibit a spicy and tangy profile, integrating the zesty, tart characteristics of unripe mangoes with various spices, resulting in a robust and nutritious snack option. Rich in vitamin C, these substances contribute to the enhancement of immune function and the maintenance of skin health. Rich in dietary fiber, these bars facilitate digestive processes and enhance feelings of fullness, contributing to effective weight management. Raw mango fruit-bars is prepared from raw mango fruit pulp, sugar, salt, some condiments, and pectin. The bar measured TSS as 57.7°B, acidity as 1.88, and pH as 7.67. The vitamin C content was found to be 16.02 mg, which is very high. The sweet-salty taste of this bar is unique and preferred by the majority among all the bars prepared. The shelf life of this bar is six months. This bar, characterized by its low caloric content and high nutrient density, serves as a colourful and guilt-free substitute for processed snack options.



Multi-layered mango-jamun-bar

The combination of mango and jamun in the bars results in a distinctive flavour profile, merging the sweetness of mango with the tangy, astringent characteristics of *jamun*, thereby providing a nutritious snack option. High in vitamin C, these substances enhance immune function. Rich in dietary fibre derived from various fruits, these components contribute to the enhancement of digestive health and assist in the regulation of blood glucose levels.

Quality parameters of fruit-based bars

Parameter	Ripe mango-bar	Mango-jamun-bar	Raw mango-bar	Jamun-bar	Guava nutri bite
TSS (°Brix)	64.3	65.23	57.7	50.2	70
Acidity (%)	1.33	5.63	1.88	0.83	1.088
Vitamin C (mg/100g)	9.97	12.92	16.02	21.97	42.24
pH	4.17	4.87	6.67	4.11	5.26
Water activity (Aw)	0.677	0.77	0.612	0.67	0.68
Shelf life (Months)	6.0	5.0	6.0	4.0	6.0

The antioxidants present in Jamun, such as anthocyanins, along with those found in mangoes. The bar showed the TSS content of 65.22°B, acidity of 5.6, water activity value of 0.77 and pH was measured 4.87. The Vitamin C content was found to be 12.92 mg, which was higher than that of the bars prepared from individual fruits which directly claims that fortification of fruits enhanced the nutrient richness in the bar.



Jamun-bar

Jamun-bars contain a high concentration of bioactive compounds, including anthocyanins, flavonoids, and gallic acid, which are known to exhibit significant antioxidant and anti-inflammatory properties. These compounds facilitate the neutralization of free radicals, thereby diminishing the likelihood of chronic diseases such as cancer and cardiovascular conditions. The alkaloids present in *Jamun*, including jamboline, contribute to the regulation of blood sugar levels, thereby providing advantages for the management of diabetes. The elevated fiber content facilitates digestive processes, supports gastrointestinal health, and increases feelings of fullness, contributing to weight management. Furthermore, the presence of iron and vitamin C in *jamun* enhances haemoglobin synthesis and immune function, providing a nutrient-dense, health-enhancing snack.



Mango-millet-bar

The combination of ripe mango pulp and finger millet powder is a very unique for nutrition point of view. Ripe mango pulp and roasted finger millet powder and other ingredients are mixed in different combinations to get best one in regards to taste flavour, colour and nutritive value. The mango pulp provides natural sugars

for energy, vitamin A and C, antioxidants like polyphenols which combat oxidative stress. Finger millet, high in calcium (344mg/100g supporting bone health), iron (3.9mg/100g) and dietary fiber (3.6g/100g) making the bar a nutrient-dense snack for all age groups, including children and adult. The TSS of this bar is 48 Brix, acidity 0.512 and vitamin C is 27.7mg/100g. The overall acceptability is 8.3 and shelf life is three months. This is a good iron and calcium supplement for Anganwadi and Mid-day-Meal Programme.



nutritional security and minimizing postharvest losses. These bars harness the rich bioactive compounds of fruits, providing antioxidant, anti-inflammatory, and anti-diabetic benefits. Their high vitamin C content supports immunity and enhances iron absorption, which is critical in addressing anaemia. The abundant dietary fiber aids digestion, regulates blood sugar, and supports weight management, while the low-calorie profile makes them a healthier alternative to processed snacks. These innovations help reduce economic losses, promote sustainable agriculture and entrepreneurship, and offer a practical addition to national nutrition programs aimed at combating malnutrition and stunting in vulnerable populations.

CONCLUSION

The ICAR-CISH has developed a range of fruit-based nutri-bars, marking a significant step toward improving

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SUCCESS STORY

Cashew apple bagasse and arecanut fibre-based leather products

Cashew apple bagasse and arecanut fibre are by-product from their crops and remained unutilised for so long. ICAR-NINFET developed a technology to extract fibres from cashew apple bagasse and arecanut fibre and utilised them as reinforcement in development of biodegradable engineered leather. Cost of developed leather-based product is lesser than natural leather. This flexible composite can be used to develop purse, wallet, life style items and footwear items. The technology is licensed to M/s Parna Creation Pvt. Ltd. of Shivamogga in Karnataka. Agri-entrepreneurship initiative of its CEO, Shri S R Suresh, on production of various products using arecanut byproducts, was telecasted in the programme “*Mann Ki Baat*” of Hon’ble Prime Minister Shri Narendra Modi on 25th December 2022. The firm standardized the vegan leather technology from areca fibre with the technical support of NINFET scientific team after signing a Memorandum of Understanding (MoU) through Agri-Innovate. The unit manufactures vegan leather from various natural fibres such as cotton, pineapple, viscose, sisal and arecanut etc., having a capacity of 1,000 square meters per month. Vegan leather technology is in good demand in India and abroad due to sustainable, cruelty free, pollution free and biodegradable leather products.

