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Review Article

A review on value-added goodies from different major and minor fruits from the perspective of India

Sukhwant Singh
Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara - 144411 (Punjab), India
Mani Salaria*
Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara -144411 (Punjab), India
Nilesh Talekar
Department of Plant Breeding, School of Agriculture, Lovely Professional University, Phagwara- 144411 (Punjab), India
Anjana Suresh
Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara 144411 (Punjab), India

*Corresponding author : E-mail: manusalaria1617@gmail.com

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Abstract
Nutrition and health are gaining significant focus as people seek convenient, nutrient-rich food options. Food processing must be efficient, cost-effective, and durable to meet these demands. Transforming fruits into diverse products using affordable technology can boost the economy for farmers and the nation. Fruit-based goods with high potassium and low salt offer substantial dietary benefits, making them valuable to health-conscious consumers.The present study aimed to study different value-added products from fruits and to increase their shelf life. Perishable fruit has losses during postharvest changes. Different strategies are required to avoid such losses. One method is to transform fruits into value-added goods. The transition of a raw resource or commodity into a processed product by combining raw materials, labour, time, and technology to produce a higher financial return is known as value addition in fruit processing. It focuses on ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture. Value-added fruit products can contribute to food security by achieving sustainable goals of good health and well-being. The study concluded that value-added fruit products play a vital role in the food industry, benefiting both producers and consumers. They reduce food waste, provide economic opportunities for farmers, and offer consumers convenient, nutritious, and flavourful options. The value-added fruit product market will likely further,contributing to the agricultural sector's sustainability and worldwide consumer well being. This review details the value-added products in fruits.

Keywords: Fruits, Major, Minor fruits, Processing, Product, Value addition

INTRODUCTION

Fruits are a great source of vitamins and minerals in general. Utilising a variety of seasonal fruits helps people stay healthy and strong by meeting their diverse needs (Lopes *et al.,* 2023). There are, however, a handful of underappreciated fruits with excellent therapeutic properties (Mutlu-Ingok *et al.,* 2020). Future studies into the benefits of these fruit trees for treating human ailments will be enriching. The demand for nutrient-rich, finely flavoured, aesthetically pleasing, and naturally appealing meals with high therapeutic value may be largely met by tropical fruits, which are now underutilised (Ganesh *et al.*,2022). Fruits that are less well known and less often used have historically been used as a staple food for therapeutic purposes (Aqilah *et al.,* 2023). Due to their therapeutic qualities, fruits, including Jackfruit (*Artocarpus heterophyllus*), Lasoora (*Cordia myxa*), Custard Apple (*Annona reticulata*), Bael (*Aegle marmelos*), Aonla (*Phyllanthus emblica*), and Phalsa (*Grewia asiatica*) are of considerable importance. In certain pharmaceutical firms, just a few of these fruits are used. Since they constitute the poor's primary source of dietary fibre, these fruits are crucial in the fight against malnutrition (Shrestha *et al.,* 2021). The world's fruit output is rising. Inadequate postharvest management results in a substantial percentage of fruit being lost or discarded despite rising worldwide fruit output (Etefa *et al.,* 2022). Focusing research efforts on diversifying and promoting such underutilised fruit crops is an urgent necessity. This might be done by developing suitable processing and marketing techniques for these underutilized fruits, turning them into marketable items (Aqilah *et al.,* 2023; Shrestha *et al.,* 2021). Processing is the most effective way to use excess fruit output during seasonal gluts. Processing's benefits include enabling the transformation of perishable fruit into a valuable form. Different strategies are required to avoid such losses (Osabohien,2022) . To decrease postharvest losses and encourage the consumption of fruits, one strategy is to process fruits into value-added products. Fruits that are very challenging to eat by hand can be processed into various highly palatable fruit products, reducing waste by adding value (Kumar *et al.,* 2020). The underutilised fruits have a lot of potential for food processing and value addition to various goods such as jam, jelly, preserved squash, sweets, pickles, dried goods, etc. A value chain approach is used to find potential avenues for increasing the value of food exports. Fruits are among the earliest foods ingested by humans prehistorically (De Corato *et al.,* 2018). Fruits, whether fresh, dried, or processed, have long been a component of the human diet. Developing nations are urged to expand the variety of food items they export by creating new ones and enhancing the value of current ones. Changing production and processing technologies is only one aspect of expanding the value of food exports; another is connecting to the right marketing networks (Kumar *et al.,* 2020; De Corato *et al.,* 2018). Fruits are undeniably crucial for nutritional security and have a strong potential for value addition and foreign exchange gains. All products that increase the value of raw materials. As a result, the market value rises. A simple physical modification has been used to boost the market value of raw agricultural goods. Cleaning, cutting, drying, packing, smoking, freezing, and preserving are examples of usual value additions. Fruit is not a byproduct but a seasonal product (Srivastava *et al.,* 2017). So, the development of the plant produces fruit. In the fruit processing industry, value addition refers to converting a raw material or commodity into a processed good by utilizing a combination of labour, technology, time, and raw materials that yields a higher profit. Value-added goods include pulp, jams, jellies, pickles, chutneys, fruit juices and concentrates, canned and dried goods, and juice concentrates. Here are some suggestions for adding value to farms. Nowadays, adding value to agricultural goods is common. Using agricultural goods, producers may produce value-added products in addition to jams and jellies (Gupta *et al.,* 2018). Fruit farmers may fry the fruit and use it to make wines, juices, vinegar syrups, and preserves. Grain farmers may also manufacture cereal combinations and infant food. Fruit value addition reduces post-harvest losses of fresh products, increases the storage time of fresh produce, and has fruits throughout the offseason (Sharma *et al.,* 2017). The present work highlights value-added fruit products, which have health benefits and are available during all seasons.

PRODUCTION STATUS, PROCESSING AND MARKET POTENTIAL

India ranks behind China as the world's second-largest fruit grower. Fruits are accessible in all seasons due to the country's diversified geography and temperature. In 2018-19, India produced 107.10 million tonnes of fruits (NHB, 2019). In 2021-2022, fruits were 7.09 million hectares and vegetables were 11.28 million hectares. In addition, India is the world leader in banana (*Musa spp*), papaya (*Carica papaya*), mango (*Mangifera indica*) and guava (*Psidium guajava*) production. Indian fruit production and exports have grown recently (Kumar *et al.,* 2020). India exported fresh goods of US$1.527.60 million in 2021 and 2022, of which US$750.7 million was spent on fruits and US$767.01 million was spent on vegetables. The majority of India's exports go to its neighbours, particularly the UAE, Bangladesh, Pakistan, Saudi Arabia, Sri Lanka, and Nepal. India only makes up around 1% of the global market, but its horticulture products are becoming more and more popular because of advancements in cold chain infrastructure, research, contemporary postharvest technologies, supportive governmental regulations, and quality control techniques (Komesu *et al.,* 2023; Sánchez *et al.,* 2021). According to the Food and Agriculture Organization of the United Nations (FAO, 2019), India was the world's second-largest fruit grower. The largest fruit-producing states in India include Andhra Pradesh, Maharashtra, Madhya Pradesh, Uttar Pradesh, Tamil Nadu, Karnataka, and Gujarat. India's fruit output will increase at a CAGR of 3.0% from 97.97 million tonnes in 2018–19 to 107.10 million tonnes in 2021–22 (FAO, 2019). Table 1 represents the production of major and minor fruits. India has enormous export potential because of its huge industrial base. It exported fresh commodities at Rs. 11,412.50 crore (US$ 1,527.60 million) in 2021 and 2022, including fruits valued at Rs. 5,593 crore (US$ 750.7 million). The primary fruits exported are oranges (*Citrus sinensis*), bananas (*Musa spp*), pomegranates (*Punica granatum*), mangoes (*Mangifera indica*), and grapes (*Vitis vinifera*) (Sánchez *et al.,* 2021).

Horticulture crops produced around 314.67 million

Table 1. Statistics on production of major and minor fruits in India

Major fruits	Production (000 MT)
Mango	20912
Pineapple	1706
Grapes	2920
Banana	30808
Citrus fruits	12546
Pomegranate	2845
Papaya	5989
Orange	3266
Guava	4054
Minor fruits	Production (000 MT)
Avocado	401
Jackfruit	1764
Palm	89
Aonla	1075
Phalsa	196
Total Fruits	96447

Source: FAO, 2019

tonnes from an area of 25.87 million hectares in 2018-19. According to the National Horticulture Board's National Horticulture Database, the total area under fruit cultivation is 6664.17 Mha, with a production of 99069.26 million tonnes in 2018-19 (NHB, 2019). Table 1 and Figure 1 show the statistical output of major and minor fruits.

DIFFERENT FRUIT PARTS USED FOR VALUE-ADDED PRODUCTS

Different fruit parts are used to add value to new, innovative products. The different parts of fruits include whole fruit, peel, juice, seed, and pulp. etc. These different portions of fruits have health benefits and antioxidant activities. The whole fruit has vitamins, minerals and active compounds that provide health benefits (Ganesh *et al.,* 2022). The whole fruit is utilized to make different value-added products such as jam, jelly, preserves, candies, and cakes. etc. The peel portion of fruit is rich in vitamins, antioxidants, and minerals and is used to have value-added products, including candies, marmalade, chips, and juice powder (Sodhi et al., 2022). The juice part of the fruit is utilized to produce different value-added juice products, ready-to-serve beverages, and syrups. The pulp and seed portion is utilized to make jam, jellies, candies, and preserves (Komesu *et al.,* 2023; Sánchez *et al.,* 2021). These different portions of fruits are comprised of vitamins, antioxidants, minerals, and active constituents and provide health benefits.

VALUE ADDED PRODUCTS OF FRUITS

Fruits are divided into major and minor fruit crops based on their added value. Major fruit might be considered the most significant category of fruit. Minor fruits or minor fruit crops are the other significant group of fruit crops. The other important group of fruit crops is minor fruits or minor fruit crops. The most consumed fruits are major and minor fruits are less utilized (Sodhi *et al.,* 2022). Examples of major fruits include mango (*Mangifera indica*), apple (*Malus spp*), banana (*Musa spp*), papaya (*Carica papaya*), peach (*Prunus persica*), and pear (*Pyrus communis*). etc. Minor fruits include Aonla (*Embilica officinalis*), Custard Apple (*Annona squamosa*), Avocado (*Persea americana*). etc. The classification of different fruits on the major and minor basis with their value-added products are explained below

MAJOR FRUITS

The main fruit crops produced in India are significantly significant to the Indian economy. The primary fruit varieties are Mango (*Mangifera indica*), Banana (*Musa spp*), Pineapple (*Ananas comosus*), Guava (*Psidium gujava*), Orange (*Citurs sinensis*), Strawberry (Fragaria × ananassa), Grapes (*Vitis vinifera*), Papaya (*Carica papaya*), Cherry (*Prunus avium*), And Passion Fruit (*Passiflora edulis*). In industrial orchards, these fruit trees are raised on a large scale (Sodhi et al., 2022). In India, there are a lot of orchards with a huge number of fruit plants. Major fruits are important and grown to have value-added products that provide nutrients and improve human health (Trigo *et al.,* 2022). Some of the

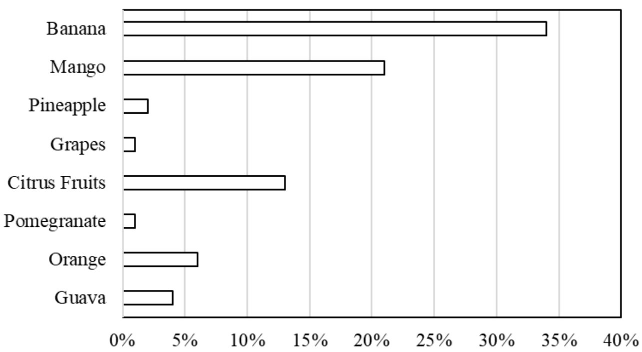

Fig 1. *Different major fruits statistical output* (Source:NHB 2019)

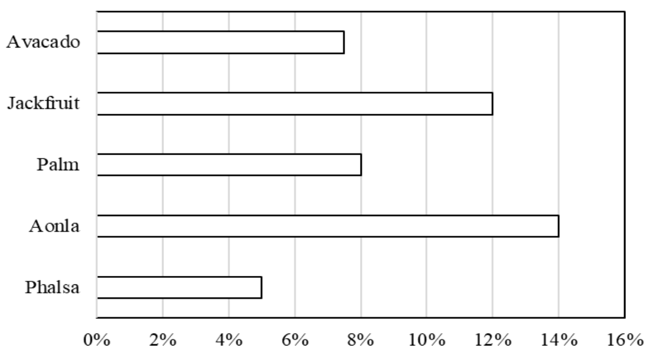

Fig 2. *Different minor fruits' statistical output* (Source:NHB 2019)

Table 2. Leading producers of major and minor fruits

Major fruits	**Producing states**
Mango	Karnataka, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Bihar, Gujarat, Telangana
Pineapple	Kerala, West Bengal, Assam, Karnataka, Tripura, Bihar
Grapes	Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Mizoram
Banana	Andhra Pradesh, Karnataka, Gujarat, Tamil Nadu, Maharashtra
Citrus fruits	Andhra Pradesh, Telangana, Maharashtra, Madhya Pradesh, Punjab
Pomegranate	Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Telangana
Papaya	Andhra Pradesh, Karnataka, Gujarat, Orissa, West Bengal, Assam, Kerala, Madhya Pradesh and Maharashtra
Orange	Maharashtra, Karnataka, Rajasthan, Madhya Pradesh
Guava	Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra
Minor fruits	Producing states
Avocado	Tamil Nadu, Kerala, Maharashtra, Karnataka
Jackfruit	Kerala, Tamil Nadu, Andhra Pradesh, Goa, Maharashtra, Assam, Bihar
Palm	Andhra Pradesh, Tamil Nadu, Telangana
Aonla	Madhya Pradesh, Uttar Pradesh, Tamil Nadu, Maharashtra
Phalsa	Punjab, Haryana, Rajasthan, Uttar Pradesh, Madhya Pradesh

(Source:NHB 2019)

major fruits with value-added products are explained in Table 3 and below:

Mango (*Mangifera indica*)

Mango has mostly been utilized as a value-added product, such as drinks and as a source of delectable pulp for jams, pickles, chutneys, juices, and wines, among other products. In order to add value to mangoes, it is necessary to properly manage the fruit after harvest, process all of its waste, and export it for high returns (Ballesteros-Vivas *et al*., 2019). Kids love mango ice cream and mango toffees so much. Vitamins A and C are abundant in mangos. Any period between harvest and the finished product can be used to increase value. A common summertime beverage, "mango pana" is produced from green mangoes and is a thick concoction of sugar, salt, citric acid, and spices (Kaur *et al.,* 2022). Mango leather, created by mixing mango pulp with deep sugar, is widely considered extremely dry. Mango trash may also be turned into goods with value-added. Examples include kernel flour, pectin enzyme from the peel, kernel starch, and the ability to make biogas from the peel (Singh *et al.,* 2021).

Banana (*Musa spp*)

There are several banana products with value added. Some of these include banana wine, jam, chips, and juice (Mengstu *et al.,* 2021). Making flour is likewise seen as a banana manufacturing byproduct. For stomach discomfort and pain, banana flour is helpful. All around the world, people like banana jam. Other processed banana items include banana sauce, powder, and drinks (Sogi *et al.,* 2020).

Pineapple (*Ananas comosus*)

Pine apples are often eaten fresh or in cans. The globe currently consumes pineapple through concentrated juice, dehydrated sugar, tinned slices, dry chips, cocktails, wine, etc (Aruna *et al.,* 2019). Canned pineapple, dried pineapple, nectar, juice, sauce, jam, vinegar, and toffees are a few examples of pineapple value-added goods (Chaudhary *et al.,* 2019).

Guava (*Psidium gujava*)

This is mostly consumed as fresh fruit. As value-added goods, guavas come in a broad range. Jelly, juice, concentrate, cheese, toffee, and other value-added guava items include these (Gavhane *et al.,* 2022). Other value -added goods include guava wine, powder, and ice cream toppings. Vitamin C is abundant in guavas, which have a delicious flavour and significant nutritional value (Islam *et al.,* 2022).

Orange (*Citurs sinensis*)

Citrus fruits, like oranges, have several added-value products that have numerous advantages. Cold-pressed orange oil plays a significant role. Pressing the orange peel removes this. Another byproduct of the juice extraction process is dried orange peel, which is used in sauces, baked goods, and cereals (Cypriano *et al.,* 2018). As a byproduct of obtaining juice, the orange pulp is frozen. These can be processed to create items for animal feed. By fully smashing fresh fruits, the orange puree is created. These are used in baking meals and making frozen sweets. Alcohol is present in orange wine. For dessert wines, it is used worldwide (Zacarías-Garcia *et al.,* 2023).

Strawberry (Fragaria x Ananassa)

Fruits are consumed fresh, canned, or processed into jams, juices, milkshakes, and cake decorations. This is used as a flavour agent and in the cosmetics sector also. Because they contain keratin, they are often utilised in face masks and lotions (Kumar *et al.,* 2022). Strawberry jam, strawberry smoothies, and strawberry milkshakes are examples of some value-added products.

Grapes *(Vitis vinifera)* and Papaya *(Carica papaya)*

Value-added goods include raisins, wine, juices, vinegar, jelly, jam, marmalade, and dried items. These value-added products help to control diabetes, cure anaemia, and boost bone health, and dental care (Muhlack *et al.,* 2018). Nectar and mixed beverages are made from papaya pulp. For later usage, pulp is concentrated, canned, and frozen. Papain is made from the dried latex of immature papaya fruits (Trejo-González *et al.,* 2021). In addition to chewing gum, papain is used to create dietary supplements, meat tenderizers, cosmetics, and medications. Some value-added goods include marmalade, sweets, pickles, chocolate, canned papaya, and freeze-dried papaya. Cosmetics are also manufactured. Papaya removes dead and damaged skin cells. Some value-added items are fruit juices and cane juice. etc (Kumar *et al.,* 2019).

Cherry *(Prunus avium)* & Passion fruit *(Passiflora edulis)*

Cherries can be enhanced in a variety of ways. Fresh, frozen, canned, wine and juices are all options. Over 75% of food is uncooked and 25% is consumed as goods with value added. Cakes are decorated with cherries (Kannah *et al.,* 2020). It is an exotic fruit with bioactive components, antioxidants, and minerals. Some value-added products of passion fruit include passion fruit juice, chocolate, passion fruit tea, and sweets such as ice cream, cordial, jam, and cake (Biswas *et al.,* 2021).

MINOR FRUITS

Minor fruits are those that, while still edible to humans, are substantially less appealing than other common fruits, have lower market demand, are often cultivated to a limited degree and without the use of inputs, and are not usually grown in organized plantations (Kandegama *et al.,* 2022). These fruits are also referred to by other names, such as lesser-known, underutilised, less attractive, underexploited, prospective, stray, wild, etc. Minor fruit species are tolerant of living in adverse climate conditions and operate as life-support species in extreme environmental circumstances and vulnerable environments (Viswanath *et al.,* 2018; Ranjan *et al.,* 2022). Minor food crops may help with food security, nutrition, health, revenue creation, and environmental services if they are used effectively. Minor fruits include Avocado (*Persea americana*), Wood Apple (*Limonia acidissima*), Jackfruit (*Artocarpus heterophyllus*), Palm (*Areca spp*), Karonda (*Carissa carandas*) , Aonla (*Embilica officinalis*), Phalsa (*Grewia asiatica*), And Custard Apple(*Annona squamosa*) (Meena *et al.,* 2022). Some of the minor fruits with value-added products (Table 4) are explained below:

Avocado (*Persea americana*)

The use of avocado oil is popular worldwide. It is used in cooking and cosmetics. Ripe avocados' flesh is used to make avocado oil. Briquettes are an alternative to charcoal. These are made of various compressed waste materials (Páramos et al., 2020). The peels from avocados make a great product. Another byproduct with usage is avocado seeds. They might be made into a powder. In the cosmetics sector, this powder is used. The avocado paste may be used to produce smoothies and drinks (Rodríguez-Martínez *et al.,* 2022).

Wood apple (*Limonia acidissima*)

It is also known as Bael, and it is a prominent indigenous fruit of India that belongs to the *Rutaceae* family. Bael fruit is a subtropical deciduous tree with globose fruit and a grey or yellowish hard woody shell (Kumar *et al.,* 2022). Within this is a delicate yellow or orange mucilaginous flesh with many seeds. These can even be eaten uncooked. Jujubes, sweets, juice, sauce, and other value-added items are examples of wood apples (Mohapatra *et al.,* 2022).

Jackfruit (*Artocarpus heterophyllus*)

It is an essential underutilised fruit, sometimes referred to as the poor man's fruit due to its low cost and abundance during the season. The fruit helps impoverished people's lives since it may be gathered from wild or locally accessible trees. Furthermore, planting in agroforestry and home garden systems can potentially improve local revenue (Mandhare *et al.,* 2022). The fruit is high in carotene, potassium, carbohydrates, and a small amount of ascorbic acid. It also includes minerals such as calcium and potassium and vitamin B complexes such as thiamin, riboflavin, and Niacin (Zhang *et al.,* 2022; Khang *et al.,* 2020). Chips and pickles made from unripe jackfruit are value-added goods. Pickles are made from unripe jackfruit. Bulb and seed are used to make small pieces, combined with oil, salt, and spices and packed (Antonisamy *et al.,* 2022). Unripe jackfruit was also available as a brined product and jackfruit that was ready to cook (RTC). Ripe Jackfruit is used to make jelly from the rind. Fully ripe jackfruit is used to make jackfruit leather. The jackfruit's pulp is used to make nectar (Pathak *et al.,* 2022). The pulp may also be used to flavour ice cream, custard, beverages, and baked goods and to make various value-added products

Table 3. Major fruits value-added products and their nutrient composition

Fruits	Value added products	Nutrient Composition	References
Mango (Mangifera indica)	Beverages, Mango jams, Mango pickles, Mango chutney, Mango juices Mango wines, Mango toffees, Mango ice cream, Mango pana	Lipid 0.38g Protein 0.82g Carbohydrate 14.98g Dietary Fibre 1.6g Energy (Kcal) 60	Kaur *et al*., 2022; Aggarwal *et al.,* 2017; Cheng *et al*., 2022; Musyoka *et al.,* 2020
Banana (Musa spp)	Banana wine, Jam, Chips, Juice, Banana sauce, Powder, Drinks	Fat 0g protein 1g carbohydrate 28g Sugar 15g dietary fibre 3g Potassium 450 mg.	Mengstu *et al*., 2021; Sogi *et al.,* 2020; Gupta *et al*., 2022; Liu *et al*., 2023
Pineapple (Ananas comosus)	Concentrated juice, Tinned slices, Dry chips, Cocktails, Canned pineapple, Dried pineapple, Nectar, Juice, Sauce, Jam, Vinegar, Toffees	Fat 0.1g Protein 0.5g Carbohydrate 13g Dietary Fibre 1.4g Sugar 15g Energy (Kcal) 50	Aruna *et al*., 2019; Dhar *et al*., 2023; Abraham *et al*., 2023; Sarangi *et al.,* 2022; Rico *et al.,* 2020
Guava (Psidium gujava)	Jelly, Juice, Concentrate, Cheese, Toffee, Guava wine, Powder, Ice cream toppings	Fat 1.6g Protein 4.2g Carbohydrate 23.6g Dietary Fibre 8.9g Sugar 14.7g Energy (Kcal) 112 Vit C 376g Potassium 688mg	Gavhane *et al*., 2022; Pathak *et al*., 2020; Bandaru and Bakshi, 2021; Angulo-López *et al*., 2021; Pereira *et al.,* 2021
Orange (Citurs sinensis)	Sauces, Baked goods, Juice, Orange puree, orange wine, Dessert	Fat 0.2g Protein 1.3g Carbohydrate 16.5g Dietary Fibre 2.8g Sugar 10g Energy (Kcal) 73	Zacarías-Garcia *et al.,* 2023; Cypriano *et al*., 2018; Pereira *et al.,* 2021; Mohsin *et al.,* 2022
Strawberry (Fragaria×ananassa)	Juices, Strawberry jam, Strawberry smoothies, Strawberry milkshakes	Fat 0.3g Protein 0.67g Carbohydrate 7.68g Dietary Fibre 2g Sugar 4.89g Energy (Kcal) 32	Kumar *et al.,* 2022; Salimi *et al.,* 2022; Bandaru and Bakshi, 2021; Shrestha *et al.,* 2021
Grapes (Vitis vinifera)	Raisins, Wine, Juices, Vinegar, Jelly, Jam, Marmalade	Fat 0.2g Protein 0.7g Carbohydrate 18.1g Dietary Fibre 0.9g Sugar 15.5g Energy (Kcal) 69	Muhlack *et al.,* 2018; Sindhu *et al*., 2019; Ilyas *et al.,* 2021; Kokkinomagoulos, and Kandylis,2023.
Papaya (Carica papaya)	Marmalade, Sweets, Pickles, Chocolate, Canned papaya, Juices, Cupcakes.	Fat 0.26g Protein 0.47g Carbohydrate 10.82g Dietary Fibre 1.7g Sugar 7.82g Energy (Kcal) 43	Kumar *et al.,* 2019; Abdel-Hameed *et al*., 2023; Fontes-Zepeda *et al*., 2023; Madhuvanthi *et al*., 2022.
Cherry (Prunus avium)	Fresh, Frozen, Canned Juices, Wine, Cakes	Fat 0.3g Protein 1g Carbohydrate 12.2g Dietary Fibre 1.6g Sugar 8.5g Energy (Kcal) 50	Adlakha *et al.,* 2022; Kannah *et al*., 2020; Dumitrascu *et al*., 2020.
Passion fruit (Passiflora edulis)	Fruit juice, Chocolate, Passion fruit tea, Sweets such as ice cream, Cordial, Jam, Cake	Fat 0.7g Protein 2.20g Carbohydrate 23.38g Dietary Fibre 10.4g Sugar 8.5g Energy (Kcal) 97	Biswas *et al.,* 2021; Ding *et al*., 2023; Kobo *et al*., 2022; Ganesh *et al.,* 2022

such as squash, ready-to-serve (RTS) drinks, chutney, and toffee. Ripe jackfruit bulbs are also used to make ready-to-eat (RTE) products (Kalse *et al.,* 2022).

Palm (*Areca spp*)

The palm tree is highly significant and plays a significant part in the daily lives of impoverished and landless farmers. To make fresh juice (sweet toddy), fermented beverages (toddy, wine, and arak), syrup (sometimes known as "honey"), brown sugar (jaggery), or refined sugar, palm trees have been tapped for generations (Sarma *et al.,* 2022). The majority of tapped palm trees are multifunctional (producing edible fruits, construction materials, fuel, fibres, wax, etc.), and for the rural poor, their socioeconomic value may be enormous. It is a good source of iron, calcium, and phosphorus (Diyanilla *et al.,* 2020). Some vitamins include vitamin A, niacin, thiamin, and riboflavin. Toddy, palm sugar, palm honey, toddy palm wine, palm spread, palm toffee, palm burfi, palm pickle, and canned palm are examples of value-added palm goods. Pulp from mature palm fruit may also be turned into jam, soft drinks, and other delectable foods and treats (Sarma *et al.,* 2022).

Karonda (*Carissa carandas*)

It is an indigenous fruit that is widely used as a medicinal plant by tribal people in India. It is well-liked in several traditional medical systems, including Ayurveda, Unani, and homoeopathy. It also makes a tasty appetizer (Sankaran and Dinesh 2020). Karonda fruits are high in iron and high in vitamin A, C, and B complex, fibre, carbs, and minerals. However, it has a lot of promise in processed forms. When mature, the fruits can be consumed as a dessert or used to make fruit goods like sweets, jam, squash, and chutney (Rawat and Das, 2020). Furthermore, due to its fragile skin and high moisture content, karonda has a relatively short storage life. When collected at maturity, unripe fruit may be kept at room temperature for 5 to 7 days, but when it is ripe, it can only be kept for 2 days (Rafique *et al.,* 2023).. Despite recent value added commercial preparations developed for local consumption and export by food processing firms, the plant has remained an underutilised species. Karonda has a lot of potential for value addition, and both unripe and mature fruits may be used to make various value-added goods (Rawat and Das, 2020). Karonda sweets, karonda jam, karonda pickles, karonda powder, karonda drinks, karonda syrup, canned karonda, karonda-flavoured ice cream, and karonda-flavoured milk are a few examples of value-added karonda goods. It is also a natural colourant (Mamoona *et al.,* 2023).

Aonla (*Embilica officinalis*)

The fruit is very nutritious and a good source of pectin and polyphenols, apart from ascorbic acid. Aonla fruits are sour and tangy and have long been used to produce juices, jams, and pie fillings. The medicinal properties of Aonla fruits are widely established (Jat *et al*., 2021). Additionally, it includes essential vitamins like thiamine, riboflavin, and niacin as well as minerals like calcium, phosphorus, and iron (Hingba, and Chaurasiya, 2023). On the other hand, fruits are perfect for processing into value-added goods since they have significant nutritional and therapeutic worth. Because of its very acidic and astringent quality, the fruit is unsuitable for consumption fresh or as a table fruit. It is also a key component of *chyavanprash* and *triphala* powder (Jat *et al.,* 2021;). However, Aonla fruits are also used to make a variety of culinary items, including preserves, sweets, jam, toffee, pickles, sauce, squash, juice, RTS (ready-to-serve) beverage, cider, shreds, dry powder, *ladoo*, and others (Kour *et al.,* 2018).

Phalsa (*Grewia asiatica*)

It is an indigenous member of the *Tiliaceae* family. The fruits of the phalsa plant are acidic, an excellent source of ascorbic acid and vitamin A, and abundant in other nutrients (Mehmood *et al.,* 2020). Fruit must be used within 24 hours of being picked since it is extremely perishable. The appealing colouration of phalsa fruit, which ranges from crimson red to dark purple and its delicious flavour are the main reasons for its popularity. When extracted, the juice is highly regarded and has a rich blood-red to dark purple hue. It is well-regarded in the local medical system (Khan *et al.,* 2019). The juice is thought to have a cooling effect and is incredibly refreshing, especially in the summer heat. Fruits have an edible portion that ranges from 69 to 93 % and includes 50 to 60 % juice. Its fruits are often eaten raw. The fruit has stomachic and astringent properties. Phalsa fruit is said to reduce inflammation when it is unripe and is used to treat blood, pulmonary, and heart conditions and lower fevers. Fruits are used to make delicious juice, squash, syrup, and crush that have a cooling impact on the body (Khan *et al.,* 2019; Ray and Bala, 2019).

Custard apple (*Annona squamosa*)

It is one of the most delicious tropical and subtropical fruit trees. The fruits are mostly consumed by the lowest and middle classes in India. Custard apple is picked in stages, but the optimal time to harvest is when the hard fruit begins to acquire colour (Sharma *et al.,* 2020). It is normally harvested when the segments become pale yellow and begins to fracture somewhat. Custard apples are perishable and cannot be preserved for an extended time. The sugar content of the ripe fruits is high. Its pulp is around 13% moisture, 14.5% sugars, 0.3% fat, 1.0% iron, and 0.7% mineral content (Jain *et al.,* 2019). It has a high calcium, phosphorus, and iron content. The fruit is very sweet and tasty; thus, it is utilised in cooking. It is soft to the touch and readily taken out when completely ripe (Jain *et al.,* 2019; Pielak *et al.,* 2020). The meat can be scooped off the skin and eaten on its own or with light cream and sugar sprinkled on top. Custard apples may be used to make shakes, smoothies, and even natural ice cream. It is frequently squeezed through a sieve and blended into milkshakes, custards, or ice cream. Blending the seeded flesh with mashed banana and a little cream yields a lovely sauce for cakes and puddings (Kumar *et al.,* 2018).

Conclusion

Fruits are used not only as a stable food source but also for their desirable additional health advantages. Though fruits suffer substantial quantitative and qualitative losses during postharvest marketing, processing,

Table 4. Minor fruits value-added products and their nutrient compositions

Fruit	Value added products	Nutrient Composition	References
Avocado (Persea americana)	Smoothies, drinks, Juices, Bakery goods, Food powder	Fat 29g Protein 2g Carbohydrate 8.55g Dietary Fibre 6.7g Sugar 1g Energy (Kcal) 160	Rodríguez-Martínez *et al.,* 2022; Páramos *et al.*, 2020
Wood apple (Limonia acidissima)	Jujubes, Sweets, Juice, Sauce, Cakes, Pies, Puddings	Fat 1.45g Protein 8g Carbohydrate 7.45g Dietary Fibre 4g Energy (Kcal) 134	Mohapatra *et al.,* 2022; Afifah *et al.*, 2023; Shravanabelagola *et al.*, 2022
Jackfruit (Artocarpus heterophyllus)	Chips, Pickles, Brined product, Jelly, Nectar, Flavour ice cream, Custard, beverages, Baked goods, Squash, Ready-to-serve (RTS) drinks, Chutney, Toffee, Ready-to-eat (RTE) products	Fat 1.1g Protein 2.8g Carbohydrate 38.3g Dietary Fibre 2.5g Sugar 32g Energy (Kcal) 157	Pathak *et al*., 2022; Aswin *et al.,* 2022; Hamid *et al.,* 2020; Srivastava, and Singh, 2020
Palm (Areca spp)	Sweet toddy, Fermented beverages (toddy, wine, and arak), Syrup, Palm sugar, Palm honey, Toddy palm wine, Palm spread, Palm toffee, Palm burfi, Palm pickle, Canned palm, Palm Jam, Soft drinks	Fat 0.20g Protein 8.3g Carbohydrate 38.3g Dietary Fibre 8.1g Sugar 1.78g Oil 49	Sarma *et al*., 2022; Diyanilla *et al.,* 2020; Sakulkit *et al.,* 2020; Diyanilla *et al.,* 2020; Ahmad *et al.,* 2020
Karonda (Carissa carandas)	Dessert, Squash, Karonda sweets, Karonda jam, Karonda pickles, Karonda powder, Karonda drinks, Karonda syrup, Canned karonda, Karonda-flavoured ice cream, Karonda-flavoured milk	Fat 2.9g Protein 1.1g Carbohydrate 2.9g Dietary Fibre 2.5g Sugar 32g Energy (Kcal) 42	Rawat and Das, 2020; Sankaran, and Dinesh 2020; Rafique *et al.,* 2023
Aonla (Embilica officinalis)	Juices, Jams, Pie fillings, Preserves, Sweets, Toffee, Pickles, Sauce, Squash, RTS (ready-to-serve) beverage, Cider, Shreds, Dry powder, Ladoo	Fat 0.1g Protein 0.5g Carbohydrate 14g Dietary Fibre 3.4g Sugar 8.8g Energy (Kcal) 40	Jat *et al.,* 2021; Kour *et al.,* 2018; Garg *et al.,* 2022; Meena *et al*., 2022; Devi *et al.,* 2020
Phalsa (Grewia asiatica)	Delicious juice, Squash, Syrup, Crushers	Fat 0.1g Protein 1.6g Carbohydrate 21.1g Dietary Fibre 5.53g Sugar 5g Energy (Kcal) 72	Mehmood et al., 2020; Khan et al., 2019; Ray and Bala, 2019
Custard apple (Annona squamosa)	Milkshakes, Custards, Ice cream, Sauce, Cakes, Puddings, Seed oil	Fat 0.7g Protein 1.6g Carbohydrate 17.7g Dietary Fibre 3g Sugar 20.6g Energy (Kcal) 75	Jain *et al.,* 2019; Kumar et *al.,* 2018; Kumari,2020; Panadare *et al.,* 2020

and storage, individuals' health and diet are receiving much attention these days. Consumers today seek food items that are both wholesome and practical to use. Food items with added health advantages have received more attention than regular goods. Food powders can be used as natural food additives since they have a natural flavour and health advantages compared to artificial food flavourings. Food is processed in ways that consumers favour, have a long shelf life, and are inexpensive to produce. Appropriate processing at times of gluts may benefit farmers and make nutrients available to Indian diets, ensuring the population's nutritional security. Value-added products that align with the Sustainable Development Goals (SDGs) are a powerful way to address global challenges while promoting economic growth and innovation. By focusing on sustainable practices and resource efficiency, value-added products contribute to SDGs related to environmental sustainability. This includes reduced waste, lower carbon footprints, and responsible materials sourcing. Value-added products provide health benefits and provide important nutrients to the body.Value addition of fruits is a valuable technique for producing fruit products for a long time, even during the off-season.

Conflict of interest

The authors declare that they have no conflicts of interest.

REFERENCES

1. Abdel-Hameed, S. M., Abd Allah, N. A., Hamed, M. M. & Soltan, O. I. (2023). Papaya fruit by-products as novel food ingredients in cupcakes. *Annals of Agricultural Sciences*, *68*(1), 60-74. https://doi.org/10.1016/j.aoas.2023.05.003
2. Abraham, R. A., Joshi, J. & Abdullah, S. (2023). A comprehensive review of pineapple (*Ananas comosus*) processing and its by-product valorization in India. *Food Chemistry Advances*, 100416. https://doi.org/10.1016/j.focha.2023.100416
3. Adlakha, K., Koul, B. & Kumar, A. (2022). Value-added products of Aloe species: Panacea to several maladies. *South African Journal of Botany*, *147*, 1124-1135. https://doi.org/10.1016/j.sajb.2020.12.025
4. Afifah, D. N., Ayustaningwarno, F., Rahmawati, A., Cantikatmaka, D. N., Wigati, N., Noer, E. R. & Hastuti, V. N. (2023). Characteristics of wood apple (*Limonia* acidissima L.) and soybean powder jelly for emergency food alternatives. *Scientific Reports*, *13*(1), 15161.
5. Ahmad, N., Ahmad, N., Maafa, I. M., Ahmed, U., Akhter, P., Shehzad, N. & Javaid, M. (2020). Conversion of polyisoprene based rubber to value-added chemicals and liquid fuel via ethanolysis: Effect of operating parameters on product quality and quantity. *Energy*, *191*, 116543. https://doi.org/10.1016/j.energy.2019.116543
6. Angulo-López, J. E., Flores-Gallegos, A. C., Torres-León, C., Ramírez-Guzmán, K. N., Martínez, G. A. & Aguilar, C. N. (2021). Guava (*Psidium guajava* L.) fruit and valorization of industrialization by-products. *Processes*, *9*(6), 1075. https://doi.org/10.3390/pr9061075
7. Antonisamy, A. J., Marimuthu, S., Malayandi, S., Rajendran, K., Lin, Y. C., Andaluri, G. & Ponnusamy, V. K. (2022). Sustainable approaches on industrial food wastes to value-added products–a review on extraction methods, characterizations, and its biomedical applications. *Environmental Research*, 114758.
8. Aqilah, N. M. N., Rovina, K., Felicia, W. X. L. & Vonnie, J. M. (2023). A Review on the Potential Bioactive Components in Fruits and Vegetable Wastes as Value-Added Products in the Food Industry. *Molecules*, *28*(6), 2631. https://doi.org/10.3390/molecules28062631
9. Aruna, T. E. (2019). Production of value-added product from pineapple peels using solid state fermentation. *Innovative Food Science & Emerging Technologies*, *57*, 102193. https://doi.org/10.1016/j.ifset.2019.102193
10. Aswin, G., Bhasin, A. & Mazumdar, A. (2022). Utilization of jackfruit by-products and application in food industry. *Pharma Innov. J*, *11*, 2293-2299.
11. Ballesteros-Vivas, D., Álvarez-Rivera, G., Morantes, S. J., del Pilar Sánchez-Camargo, A., Ibáñez, E., Parada-Alfonso, F. & Cifuentes, A. (2019). An integrated approach for the valorization of mango seed kernel: Efficient extraction solvent selection, phytochemical profiling and antiproliferative activity assessment. *Food Research International*, *126*, 108616. https://doi.org/10.1016/j.foodres.2019.108616
12. Bandaru, H. & Bakshi, M. (2020). Fruit Leather: Preparation, packaging and its effect on sensorial and physico-chemical properties: A review. *Journal of Pharmacognosy and Phytochemistry*, *9*(6), 1699-1709. https://doi.org/10.22271/phyto.2020.v9.i6y.13192
13. Bandaru, H. & Bakshi, M. (2021). Effect of different drying conditions on the quality of apple and guava fruit leather. *Pharma Innov J*, *10*(8), 233-7.
14. Biswas, S., Mishra, R. & Bist, A. S. (2021). Passion to profession: A review of passion fruit processing. *Aptisi Transactions on Technopreneurship (ATT)*, *3*(1), 48-57. https://doi.org/10.34306/att.v3i1.143
15. Chaudhary, V., Kumar, V., Singh, K., Kumar, R. & Kumar, V. (2019). Pineapple (*Ananas cosmosus*) product processing: A review. *Journal of pharmacognosy and Phytochemistry*, *8*(3), 4642-4652.
16. Cheng, Y. J., Wu, Y. J., Lee, F. W., Ou, L. Y., Chen, C. N., Chu, Y. Y. & Kuan, Y. C. (2022). Impact of storage condition on chemical composition and antifungal activity of pomelo extract against Colletotrichum gloeosporioides and anthracnose in postharvest mango (*Mangifera indica*). *Plants*, *11*(15), 2064. https://doi.org/10.3390/plants11152064
17. Cypriano, D. Z., da Silva, L. L. & Tasic, L. (2018). High value-added products from the orange juice industry waste. *Waste Management*, *79*, 71-78. https://doi.org/10.1016/j.wasman.2018.07.028
18. De Corato, U., De Bari, I., Viola, E. & Pugliese, M. (2018). Assessing the main opportunities of integrated biorefining from agro-bioenergy co/by-products and agroindustrial residues into high-value added products associated to some emerging markets: A review. *Renewable and Sustainable Energy Reviews*, *88*, 326-346. https://

doi.org/10.1016/j.rser.2018.02.041

19. Devi, S., Gupta, E. & Maurya, N. K. (2020). Development of a value added Amla product. *International Archive of Applied Sciences and Technology*, *11*(2), 90-93.
20. Dhar, P., Nickhil, C., Pandiselvam, R. & Deka, S. C. (2023). Pineapple waste-based-biorefinery for sustainable generation of value-added products. *Biomass Conversion and Biorefinery*, 1-22.
21. Ding, Z., Ge, Y., Sar, T., Kumar, V., Harirchi, S., Binod, P. & Awasthi, M. K. (2023). Valorization of tropical fruits waste for production of commercial biorefinery products–A review. *Bioresource Technology*, 128793. https://doi.org/10.1016/j.biortech.2023.128793
22. Diyanilla, R., Hamidon, T. S., Suryanegara, L., & Hussin, M. H. (2020). Overview of pretreatment methods employed on oil palm biomass in producing value-added products: a review. *BioResources*, *15*(4), 9935.
23. Diyanilla, R., Hamidon, T. S., Suryanegara, L. & Hussin, M. H. (2020). Overview of pretreatment methods employed on oil palm biomass in producing value-added products: a review. *BioResources*, *15*(4), 9935. DOI:10.15376/biores.15.4.Diyanilla
24. Dumitrascu, L., Stănciuc, N., Grigore-Gurgu, L. & Aprodu, I. (2020). Investigation on the interaction of heated soy proteins with anthocyanins from cornelian cherry fruits. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, *231*, 118114. https://doi.org/10.1016/j.saa.2020.118114
25. Etefa, O. F., Forsido, S. F. & Kebede, M. T. (2022). Postharvest Loss, Causes, and Handling Practices of Fruits and Vegetables in Ethiopia: Scoping Review. *Journal of Horticultural Research*, *30*(1), 1-10. https://doi.org/10.2478/johr-2022-0002
26. FAO, (2019). Food and Agriculture Organization, https://www.fao.org/home/en.
27. Fontes-Zepeda, A., Domínguez-Avila, J. A., Lopez-Martinez, L. X., Cruz-Valenzuela, M. R., Robles-Sánchez, R. M., Salazar-López, N. J. & González-Aguilar, G. A. (2023). The addition of mango and papaya peels to corn extrudates enriches their phenolic compound profile and maintains their sensory characteristics. *Waste and Biomass Valorization*, *14*(3), 751-764.
28. Ganesh, K. S., Sridhar, A. & Vishali, S. (2022). Utilization of fruit and vegetable waste to produce value-added products: Conventional utilization and emerging opportunities-A review. *Chemosphere*, *287*, 132221.
29. Ganesh, K. S., Sridhar, A. & Vishali, S. (2022). Utilization of fruit and vegetable waste to produce value-added products: Conventional utilization and emerging opportunities-A review. *Chemosphere*, *287*, 132221..https://doi.org/10.1016/j.chemosphere.2021.132221
30. Garg, N., Kumar, S., Vaish, S. & Singh, B. (2022). Utilization of sugar syrup waste of aonla processing industry for flavored spicy beverages. http://dx.doi.org/10.5958/2582-2683.2022.00038.7
31. Gavhane, A., Chopade, S., Dighe, P. & Kour, A. (2022). The nutritional and bioactive potential of guava and possibilities for its commercial application in value-added products.
32. Gupta, G., Baranwal, M., Saxena, S. & Reddy, M. S. (2022). Utilization of banana waste as a resource material for biofuels and other value-added products. *Biomass Conversion and Biorefinery*, 1-20.
33. Gupta, N., Trilokia, M., Sood, M., Dogra, J. & Singh, J. (2018). Utilization of Under-Utilized Fruits through Value Addition in Kandi Areas of Jammu Region. *Int. J. Curr. Microbiol. App. Sci*, *7*(5), 1965-1977. https://doi.org/10.20546/ijcmas.2018.705.231
34. Hamid, M. A., Tsia, F. L. C., Okit, A. A. B., Xin, C. W., Cien, H. H., Harn, L. S. & Yee, C. F. (2020, October). The application of Jackfruit by-product on the development of healthy meat analogue. In *IOP Conference Series: Earth and Environmental Science* (Vol. 575, No. 1, p. 012001). IOP Publishing. 10.1088/1755-1315/575/1/012001
35. Hingba, R. F. & Chaurasiya, A. K. (2023). Effect of blended fermented beverages from blood fruit and aonla with two types of organic sweetener. *Journal of Food Science and Technology*, *60*(5), 1505-1512.
36. Ilyas, T., Chowdhary, P., Chaurasia, D., Gnansounou, E., Pandey, A. & Chaturvedi, P. (2021). Sustainable green processing of grape pomace for the production of value-added products: An overview. *Environmental Technology & Innovation*, *23*, 101592. https://doi.org/10.1016/j.eti.2021.101592
37. Islam, M. S., Basri, R., Rahman, M. S., Uddin, M. N., Islam, M. S. & Hossain, S. A. A. M. (2022). Nutritional Assessment of Guava for Quality Jelly Production. *Malaysian Journal of Halal Research*, *5*(1), 24-32. Doi: 10.2478/mjhr-2022-0004
38. Jain, C., Champawat, P. S., Mudgal, V. D., Madhu, B. & Jain, S. K. (2019). Postharvest processing of custard apple (*Annona squamosa* L.): A review. *International Journal of Chemical Studies*, *7*(3), 1632-1637.
39. Jat, M. L., Shivran, J. S. & Jat, R. K. (2021). Commercial products of aonla fruits, increasing the value addition. *Journal of Pharmacognosy and Phytochemistry*, *10* (1), 1331-1337. https://doi.org/10.22271/phyto.2021.v10.i1s.13531
40. Kalse, S. B., Swami, S. B. & Jain, S. K. (2022). New Insights Into Postharvest Technology and Value Addition of Jackfruit (*Artocarpus heterophyllus*): A Review. *International Journal of Food and Fermentation Technology*, *12*(2), 121-137. DOI: 10.30954/2277-9396.02.2022.8
41. Kandegama, W. W. W., Rathnayake, R. M. P. J., Baig, M. B. & Behnassi, M. (2022). Impacts of Climate Change on Horticultural Crop Production in Sri Lanka and the Potential of Climate-Smart Agriculture in Enhancing Food Security and Resilience. In *Food Security and Climate-Smart Food Systems: Building Resilience for the Global South* (pp. 67-97). Cham: Springer International Publishing.
42. Kannah, R. Y., Merrylin, J., Devi, T. P., Kavitha, S., Sivashanmugam, P., Kumar, G. & Banu, J. R. (2020). Food waste valorization: Biofuels and value added product recovery. *Bioresource Technology Reports*, *11*, 100524. https://doi.org/10.1016/j.biteb.2020.100524
43. Kaur, B., Panesar, P. S., Anal, A. K. & Chu-Ky, S. (2022). Recent trends in the management of mango by-products. *Food Reviews International*, 1-21. https://doi.org/10.1080/87559129.2021.2021935
44. Khan, R. S., Asghar, W., Khalid, N., Nazir, W., Farooq, M., Ahmed, I. & Syed, Q. A. (2019). Phalsa (*Grewia asiatica* L) fruit berry a promising functional food ingredient: A

comprehensive review. *Journal of Berry Research*, *9*(2), 179-193. DOI:10.3233/JBR-180332
45. Khang, V. C., Thanh, V. T., Nhan, N. P. T., Nhi, T. Y., Nguyen, D. T., Luu, T. T. & Quoc, N. T. (2020, December). Physico-chemical evaluation of jackfruit seed starch and its application in cupcake. In *IOP Conference Series: Materials Science and Engineering* (Vol. 991, No. 1, p. 012031). IOP Publishing. **DOI** 10.1088/1757-899X/991/1/012031
46. Kobo, G. K., Kaseke, T. & Fawole, O. A. (2022). Microencapsulation of phytochemicals in passion fruit peel waste generated on an organic farm: effect of carriers on the quality of encapsulated powders and potential for value-addition. *Antioxidants*, *11*(8), 1579. https://doi.org/10.3390/antiox11081579
47. Kokkinomagoulos, E. & Kandylis, P. (2023). Grape pomace, an undervalued by-product: industrial reutilization within a circular economy vision. *Reviews in Environmental Science and Bio/Technology*, *22*(3), 739-773.
48. Komesu, A., da Silva Martins, L. H., Pandey, P., Kuila, A., Penteado, C. F. A., Penteado, E. D. & de Oliveira, J. A. R. (2023). Fruit and Vegetable Waste An Economic Alternate to Costlier Raw Materials for Value Added Products. In *Waste Management* (pp. 60-82). CRC Press.
49. Kour, S., Bakshi, P., Sharma, A., Wali, V. K., Jasrotia, A. & Kumari, S. (2018). Strategies on conservation, improvement and utilization of underutilized fruit crops. *Int J Curr Microbiol App Sci*, *7*(03), 638-650. https://doi.org/10.20546/ijcmas.2018.703.075
50. Kumar, A., Ram, D. & Verma, A. K. (2022). Comparative physico-chemical evaluation of Bael (*Aegle marmelos* (L.) Correa) genotypes.
51. Kumar, C. S., Ali, A. & Manickavasagan, A. (2020). Health benefits of substituting added sugars with fruits in developing value-added food products: a review. *International Journal of Nutrition, Pharmacology, Neurological Diseases*, *10*(3), 75-90. *DOI:* 10.4103/ijnpnd.ijnpnd_34_20
52. Kumar, N., Sharma, H. K., Bhargavbhai, C. K. & Prem, M. (2018). Processing and Value Addition of Custard Apple. In *Technologies in Food Processing* (pp. 285-308). Apple Academic Press.
53. Kumar, S., Kumar, J., Tripathi, J., Gupta, S. & Gautam, S. (2022). Secondary product from strawberry (*Fragaria ananassa*) fruit for extended preservation and value addition. *Journal of Food Science and Technology*, *59*(4), 1598-1609.
54. Kumar, V., Singh, J., Chandra, S., Kumar, R., Chaudhary, V., Singh, K. & Kumar, P. (2019). Postharvest technology of papaya fruits and its value added products-a review. *Progressive Agriculture*, *19*(2), 199-208. http://dx.doi.org/10.5958/0976-4615.2019.00044.9
55. Kumari, T. (2020). Quality analysis of peels of selected fruits and vegetables and development of value added products.
56. Liu, Z., de Souza, T. S., Holland, B., Dunshea, F., Barrow, C. & Suleria, H. A. (2023). Valorization of food waste to produce value-added products based on its bioactive compounds. *Processes*, *11*(3), 840. https://doi.org/10.3390/pr11030840
57. Lopes, M., Coimbra, M. A., Costa, M. D. C. & Ramos, F. (2023). Food supplement vitamins, minerals, amino-acids, fatty acids, phenolic and alkaloid-based substances: An overview of their interaction with drugs. *Critical Reviews in Food Science and Nutrition*, *63*(19), 4106-4140. https://doi.org/10.1080/10408398.2021.1997909
58. Madhuvanthi, S., Selvapriya, K., Nirmala, R. A., Agalya, A. & Jeya, N. (2022). Extraction and characterization of pectin derived from underutilized papaya seeds as a value-added product. *Journal of Applied and Natural Science*, *14* (1), 127-132. https://doi.org/10.31018/jans.v14i1.3269
59. Mamoona, T., Rafique, N., Zubair Khan, M., Shafique Ahmad, K., Bashir, S., Ali Shah, T. & Bourhia, M. (2023). Phytonutritional and Sensorial Assessment of a Novel Functional Beverage Formulated from an Underutilized Fruit of Carissa spinarum L. *ACS omega*. https://doi.org/10.1021/acsomega.3c03386
60. Mandhare, A., Banerjee, P., Pande, A. & Gondkar, A. (2020). Jackfruit (*Artocarpus heterophyllus*): a comprehensive patent review. *Current Nutrition & Food Science*, *16* (5), 644-665.
61. Meena, V. S., Gora, J. S., Singh, A., Ram, C., Meena, N. K., Rouphael, Y. & Kumar, P. (2022). Underutilized fruit crops of Indian arid and semi-arid regions: Importance, conservation and utilization strategies. *Horticulturae*, *8*(2), 171. https://doi.org/10.3390/horticulturae8020171
62. Mehmood, A., Ishaq, M., Usman, M., Zhao, L., Ullah, A. & Wang, C. (2020). Nutraceutical perspectives and value addition of phalsa (*Grewia asiatica* L.): A review. *Journal of Food Biochemistry*, *44*(7), e13228. https://doi.org/10.1111/jfbc.13228
63. Mengstu, A., Bachheti, A., Abate, L., Bachheti, R. K. & Husen, A. (2021). Health-Promoting Benefits, Value-Added Products, and Other Uses of Banana. *Non-Timber Forest Products: Food, Healthcare and Industrial Applications*, 339-364.
64. Mohapatra, P., Acharya, G. C., Mohanty, P., Kar, D. S., Lenka, J. & Pattanaik, K. (2022). Value addition in wood apple (*Limonia acidissima* L.).
65. Mohsin, A., Hussain, M. H., Zaman, W. Q., Mohsin, M. Z., Zhang, J., Liu, Z. & Guo, M. (2022). Advances in sustainable approaches utilizing orange peel waste to produce highly value-added bioproducts. *Critical Reviews in Biotechnology*, *42*(8), 1284-1303. https://doi.org/10.1080/07388551.2021.2002805
66. Muhlack, R. A., Potumarthi, R. & Jeffery, D. W. (2018). Sustainable wineries through waste valorisation: A review of grape marc utilisation for value-added products. *Waste management*, *72*, 99-118. https://doi.org/10.1016/j.wasman.2017.11.011
67. Musyoka, J. K., Isaboke, H. N. & Ndirangu, S. N. (2020). Farm-level value addition among small-scale mango farmers in Machakos County, Kenya. *Journal of Agricultural Extension*, *24*(3), 85-97.DOI: https://doi.org/10.4314/jae.v24i3.8
68. Mutlu-Ingok, A., Devecioglu, D., Dikmetas, D. N., Karbancioglu-Guler, F. & Capanoglu, E. (2020). Antibacterial, antifungal, antimycotoxigenic, and antioxidant activities of essential oils: An updated review. *Molecules*, *25*(20), 4711. https://doi.org/10.3390/molecules25204711
69. NHB (2019). National Horticulture Board, https://www.nhb.gov.in/.
70. Osabohien, R. (2022). Soil technology and postharvest losses in Nigeria. *Journal of Agribusiness in Developing and Emerging Economies*.

71. Panadare, D. C., Gondaliya, A. & Rathod, V. K. (2020). Comparative study of ultrasonic pretreatment and ultrasound assisted three phase partitioning for extraction of custard apple seed oil. *Ultrasonics Sonochemistry*, *61*, 104821. https://doi.org/10.1016/j.ultsonch.2019.104821
72. Páramos, P. R., Granjo, J. F., Corazza, M. L. & Matos, H. A. (2020). Extraction of high value products from avocado waste biomass. *The Journal of Supercritical Fluids*, *165*, 104988. https://doi.org/10.1016/j.supflu.2020.104988
73. Pathak, N., Singh, S., Singh, P., Singh, P. K., Singh, R., Bala, S. & Tripathi, M. (2022). Valorization of jackfruit waste into value added products and their potential applications. *Frontiers in Nutrition*, *9*. https://doi.org/10.3389/fnut.2022.1061098
74. Pathak, P. D., Mandavgane, S. A. & Kulkarni, B. D. (2020). Value□Added Products from Guava Waste by Biorefinery Approach. *Biorefinery Production Technologies for Chemicals and Energy*, 163-195. https://doi.org/10.1002/9781119593065.ch9
75. Pereira, B. S., de Freitas, C., Vieira, R. M. & Brienzo, M. (2022). Brazilian banana, guava, and orange fruit and waste production as a potential biorefinery feedstock. *Journal of Material Cycles and Waste Management*, *24*(6), 2126-2140.
76. Pielak, M., Czarniecka-Skubina, E. & Głuchowski, A. (2020). Effect of sugar substitution with steviol glycosides on sensory quality and physicochemical composition of low-sugar apple preserves. *Foods*, *9*(3), 293. https://doi.org/10.3390/foods9030293
77. Rafique, N., Mamoona, T., Ashraf, N., Hussain, S., Ahmed, F., Ali Shah, T. & Bourhia, M. (2023). Exploring the nutritional and sensory potential of karonda fruit: Physicochemical properties, jam production, and quality evaluation. *Food Science & Nutrition*. https://doi.org/10.1002/fsn3.3619
78. Ranjan, P., Brahmi, P., Tyagi, V., Ranjan, J. K., Srivastava, V., Yadav, S. K. & Singh, K. (2022). Global interdependence for fruit genetic resources: status and challenges in India. *Food Security*, *14*(3), 591-619.
79. Rawat, S. & Das, K. K. (2020). Value addition of underutilized fruits of arid region: A review. *IJCS*, *8*(4), 1655-1659.
80. Ray, A. B. & Bala, K. (2019). Bioactive compounds and health benefits of phalsa: an underutilized fruit. In *Food bioactives* (pp. 109-128). Apple Academic Press.
81. Rico, X., Gullón, B., Alonso, J. L. & Yáñez, R. (2020). Recovery of high value-added compounds from pineapple, melon, watermelon and pumpkin processing by-products: An overview. *Food Research International*, *132*, 109086.
82. Rodríguez-Martínez, B., Romaní, A., Eibes, G., Garrote, G., Gullón, B. & Del Rio, P. G. (2022). Potential and prospects for utilization of avocado by-products in integrated biorefineries. *Bioresource Technology*, 128034.
83. Sakulkit, P., Palamanit, A., Dejchanchaiwong, R. & Reubroycharoen, P. (2020). Characteristics of pyrolysis products from pyrolysis and co-pyrolysis of rubber wood and oil palm trunk biomass for biofuel and value-added applications. *Journal of Environmental Chemical Engineering*, *8* (6), 104561. https://doi.org/10.1016/j.jece.2020.104561
84. Salimi, A., Khodaiyan, F., Askari, G. & Hosseini, S. S. (2023). A zero-waste approach towards a sustainable waste management of apple: Extraction of value-added products and their application as edible coating. *Food Hydrocolloids*, 109304. https://doi.org/10.1016/j.foodhyd.2023.109304
85. Sánchez, M., Laca, A., Laca, A. & Díaz, M. (2021). Value□Added Products from Fruit and Vegetable Wastes: A Review. *CLEAN–Soil, Air, Water*, *49*(8), 2000376. https://doi.org/10.1002/clen.202000376
86. Sankaran, M. & Dinesh, M. R. (2020). Biodiversity of Tropical Fruits and their Conservation in India. *Journal of Horticultural Sciences*, *15*(2), 107-126. https://doi.org/10.24154/jhs.v15i2.894
87. Sarangi, P. K., Singh, T. A., Singh, N. J., Shadangi, K. P., Srivastava, R. K., Singh, A. K. & Vivekanand, V. (2022). Sustainable utilization of pineapple wastes for production of bioenergy, biochemicals and value-added products: A review. *Bioresource Technology*, *351*, 127085. https://doi.org/10.1016/j.biortech.2022.127085
88. Sarma, C., Mummaleti, G., Sivanandham, V., Kalakandan, S., Rawson, A. & Anandharaj, A. (2022). Anthology of palm sap: The global status, nutritional composition, health benefits & value added products. *Trends in Food Science & Technology*, *119*, 530-549. https://doi.org/10.1016/j.tifs.2021.12.002
89. Sharma, L., Burark, S. S., Kaushik, R. A. & Meena, G. L. (2020). Prospects of custard apple value chain development in Rajasthan. *Economic affairs*, *65*(2), 207-212. http://dx.doi.org/10.46852/0424-2513.2.2020.11
90. Shravanabelagola Nagaraja Setty, V. K., Goud, G., Peramanahalli Chikkegowda, S., Mavinkere Rangappa, S. & Siengchin, S. (2022). Characterization of chemically treated *limonia acidissima* (wood apple) shell powder: physicochemical, thermal, and morphological properties. *Journal of Natural Fibers*, *19*(11), 4093-4104. https://doi.org/10.1080/15440478.2020.1853925
91. Shrestha, S., Khatiwada, J. R., Sharma, H. K. & Qin, W. (2021). Bioconversion of fruits and vegetables wastes into value-added products. *Sustainable Bioconversion of Waste to Value Added Products*, 145-163.
92. Sindhu, R., Gnansounou, E., Rebello, S., Binod, P., Varjani, S., Thakur, I. S. & Pandey, A. (2019). Conversion of food and kitchen waste to value-added products. *Journal of environmental management*, *241*, 619-630. https://doi.org/10.1016/j.jenvman.2019.02.053
93. Singh, B., Pandey, V. K., Shukla, R. N., Singh, K. & Singh, S. (2021). Development and physico-chemical analysis of value-added mango leather packed in different packaging materials. *Journal of Postharvest Technology*, *9* (3), 29-39.
94. Sodhi, A. S., Sharma, N., Bhatia, S., Verma, A., Soni, S. & Batra, N. (2022). Insights on sustainable approaches for production and applications of value added products. *Chemosphere*, *286*,131623.https://doi.org/10.1016/j.chemosphere.2021.131623
95. Sogi, D. S. (2020). Value□added processing and utilization of banana by□products. *Handbook of Banana Production, Postharvest Science, Processing Technology, and Nutrition*, 191-206. https://doi.org/10.1002/9781119528265.ch10
96. Srivastava, A., Bishnoi, S. K. & Sarkar, P. K. (2017). Value addition in minor fruits of eastern India: an opportunity to generate rural employment. *Fruits for Livelihood: Production Technology and Management Practices. Agrobios.*
97. Srivastava, R. & Singh, A. (2020). Jackfruit (*Artocarpus*

heterophyllus Lam) biggest fruit with high nutritional and pharmacological values: A review. *International Journal of Current Microbiology and Applied Sciences*, *9*(8), 764-774. https://doi.org/10.20546/ijcmas.2020.908.082

98. Trejo-González, A. & Cantwell, M. I. (2021, October). Green papaya utilization: papain extraction and storage of the intact and fresh-cut immature fruit. In: *V International Conference on Postharvest and Quality Management of Horticultural Products of Interest for Tropical Regions 1340* (pp. 65-72). https://doi.org/10.17660/ActaHortic.2022.1340.10
99. Trigo, J. P., Alexandre, E. M., Saraiva, J. A. & Pintado, M. E. (2022). High value-added compounds from fruit and vegetable by-products–Characterization, bioactivities, and application in the development of novel food products. *Critical reviews in food science and nutrition*, *60*(8), 1388-1416. https://doi.org/10.1080/10408398.2019.15725 88
100. Viswanath, M., Venkataramudu, K., Srinivasulu, B., Gopal, K. & Lakshmi, K. S. (2018). Processing for value addition of minor fruits. *Journal of Pharmacognosy and Phytochemistry*, *7*(6), 1555-1559.
101. Zacarías-Garcia, J., Carlos, G., Gil, J. V., Navarro, J. L., Zacarías, L. & Rodrigo, M. J. (2023). Juices and By-Pproducts of Red-Fleshed Sweet Oranges: Assessment of Bioactive and Nutritional Compounds. *Foods*, *12*(2), 400. https://doi.org/10.3390/foods12020400
102. Zhang, Y., Wang, Q., Zhang, Y., Wu, G., Tan, L. & Zhang, Z. (2022). Effects of moisture content on digestible fragments and molecular structures of high amylose jackfruit starch prepared by improved extrusion cooking technology. *Food Hydrocolloids*, *133*, 108023. https://doi.org/10.1016/j.foodhyd.2022.108023