REVIEW ARTICLE

Fruit Powders and Candies in value-added Products: a mini-review

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ABSTRACT

Fruits play an essential role in the human diet as the source of essential vitamins, minerals, and fibers. The USDA food guide pyramid suggests consuming 2 to 4 servings of fruits per day for optimum health. Recent studies indicate that the risk of cancer for persons with low dietary consumption of fruits and vegetable is double the risk of those with a high intake of these foods. Fresh fruits contain more than 80% water, which is responsible for their crisp and crunchy texture. However, their high-water content makes the fruits highly perishable, as does the fact that they are seasonal and reasonable products. To have good quality fruit available around the year, various processing and preservation techniques have been employed, and drying of fruits is one of them. Fruits powders have proven to be more versatile than purees, allowing for use in low moisture products.

Keywords: *Fruits; Nutrients; Value addition, Health; Self-life*

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INTRODUCTION

Fruits have long been valuing as a part of a nutritious and tasty diet. Fruits contain several essential vitamins and minerals that cannot be found in other types of foods, or they may have higher levels of these nutrients than other foods. They play a significant role in human nutrition, primarily as a source of vitamin C, A, thiamine, niacin, pyridoxine, folacin (also known as folic acid), vitamin E, and dietary fiber. India has emerged as the world's third-largest producer of fruits with production.

Fruits being perishable have a limited shelf life. Since the moisture content of fresh fruits and vegetables is more than 80%, so, they are classified as perishable commodities [1] Keeping the product fresh is the best way to maintain its nutritional value, but most storage techniques require low temperatures, which are difficult to maintain throughout the distribution chain. On the other hand, drying is a suitable alternative for harvest management; especially in countries like India where poorly established low-temperature distribution and handling facilities exists. It is noted that over 20% of the World's perishable crops are dried to increase shelf life and promote food security [2]. Fruits and their products are dried to enhance storage stability, minimize packaging requirements and reduce transport weight. Nonetheless, in India, hardly any portion of perishables are dried, which leads to an enormous loss in terms of money and labour besides a steep rise in prices of commodities during the off-season [30].

Guava is native of tropical America and belongs to family *Myretaceae*. It is the 5th important fruit crop in India, with 1.85 million tonnes from 1.60 lakh hectares [4]. It is mainly grown in Bihar, Uttar Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Haryana, and Tamil Nadu. Guava fruit also contains an appreciable quantity of β-carotene and fiber. Guava fruits have a moisture content of 75-85 percent at the time of harvest. They are seasonal and can be stored fresh for few days or a week. Hence, the processing of guava

fruit is essential. The excellent flavor and nutritive value of guava fruits show great potentiality for processing into valuable products. Guava fruits are processed and preserved in various products such as puree, jelly, cheese, toffee, juice, beverage, squash, syrup, nectar, concentrate, powder, and canned products. These products have good potential for internal as well as external trade [5].

Aonla, commonly known as Indian Gooseberry (*Emblica officinalis Gaertn*), finds a special place in India as it has got tremendous medicinal values. Aonla has been cultivated in India since time immemorial. Aonla is a rare example of an edible material, which is rich in tannins as well as ascorbic acid. The vitamin C content in aonla varies from 200 to 900 mg/100 g depending upon the variety and size of the fruit. Research shows that 8.75 mg of natural vitamin C complex from aonla is equivalent to 100 mg of the most commonly used synthetic vitamin C. Pectin and minerals like calcium, iron, and phosphorous are also found abundantly in the fruit. It is a potent antioxidant, hypolipidemic, antibacterial, antiviral, and antacid. It is a potent anti-inflammatory herb. Dried fruit is helpful in diabetes, jaundice, diarrhea and cough. Production of more and bitter aonla fruit alone is not enough. This nutritious fruit must be delivered to the ultimate consumer through the post-harvest system without nutritional and quality loss. The fresh fruits are generally not consumed as it is highly acidic and astringent; therefore, it is not such a popular table fruit. But it has got great potential in processed forms. . Moreover, 17% or more of the produced fruits are lost during transport, storage, and marketing [6]. So, modern technologies are needed to reduce the losses. Hence, attention has been focused on the preparation of different value-added products from aonla. Aonla can be made into various products such as powders, pickles, preserves (murabba), sauce, jam, jelly, candies, tablets, etc. Aonla candy has the beneficial effect of purifying blood. This also helps in reducing the cholesterol levels in the blood and in improving eyesight. It keeps a person healthy and energetic while enhances the stamina to work longer. It also assists in reducing wrinkles and makes the skin below (www.nclagrofoods.net). However, the use of preserve is often liked by many people, but there is difficulty in making preserve as it is time-consuming, and its transportation and storage is also troublesome. To increase the consumption of aonla products, aonla fruit can be used to make aonla candies and powder, which can be further incorporated in various value-added products. Candy is an intermediate moist food that is prepared after shade drying of drained fruits impregnated with cane sugar or glucose (preserve). Aonla candies are becoming more and more popular because of high acceptability, minimum volume, higher nutritional value, and longer shelf-life [7].

Karonda *(Carissa carandas L.)* fruits are dark purple, seemingly black, when ripe. The fruits are enjoyed whole without peeling. The fruits are used to make pickles, jam, candy, etc. The fruit candy is used in fruit salads, added to gels, and used as topping for cakes, puddings, ice-cream, and pieces of bread [8]. Karonda is an indigenous protective fruit held in high esteem in the Indian diet. It is a rich source of carbohydrates, iron, and vitamin C required for good human health [9].

Among citrus fruits, mandarin is placed at the first position with respect to area and production, which is followed by sweet orange and limes. Mandarin oranges of all kinds are primarily eaten as such, or the sections of fruits are utilized in fruit salads, gelatins, puddings, or in cakes. Oranges are an excellent source of vitamin C (69.69 mg) and fiber (3.13 g). In addition, oranges are a good source of vitamin B, including vitamin B_1 (0.11 mg) and folate (39.69 mcg) as well as vitamin A (268.55 IU), calcium (52.40 mg), and potassium (237.11 mg). Arguably, the most crucial flavonone in oranges, hesperidin has been shown to lower high blood pressure as well as cholesterol in animal studies and to have strong anti-inflammatory properties. Notably, most of this phyto-nutrient is found in the peel and inner white pulp of the orange, rather than in its liquid, so thiis processing of oranges too often releases this useful compound into juice. A class of compounds found in citrus fruit peels called polymethoxylated flavones (PMFs) has the potential to lower cholesterol more effectively than some prescribed drugs, and without side effects, according to a study carried out by U.S. and Canada (www.whfood.com). Nutritionally, orange peel is used in herbalism as a distributor in the body for other herbs because it contains bioflavonoid, strengthening blood capillaries by increasing their ability to distribute oxygen and nutrients throughout the body. Because orange peel acts as a tonic to the entire cardiovascular system, it makes it antibacterial and antiviral (www.quail.blogspot.com). Candied citrus peel is so appealing because it combines two opposing flavors, i.e., bitter and sweet. Orange peel candy acts as a cholesterol fighter. It is very effective in controlling cholesterol levels in the body. It is also beneficial in protecting against cancer, heart disease, and inflammation (www.nclagrofoods.net).

Lemon fruit is only utilized for pickle making, culinary purposes, and blending with other fruit juices for squash preparation at a small scale and leftover pomace and peel of fruit after juice extraction is discarded as waste. For the citrus processing industry, disposal off the peel and other residual material is a big problem. Peel that constitutes 25-35% of fruit weight is quite nutritious but goes waste and does not fetch any economical price to the industry [10]. Besides the utilization of residual waste as cattle feed, some helpful

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by products of commercial importance like citrus oil, citric acid, and pectin, etc., could be prepared. But their isolation involves highly specialized and sophisticated technologies that increase the cost of production manifold, thereby making it a costly venture. The other useful option is to utilize waste peel for the preparation of peel candy. This does not necessitate complicated types of equipment and technology. Hence, the citrus processing industry can easily opt for making candied peel which finds a ready market in confectionery. The peel candy can be consumed as such or in the form of value-added products like steamed pudding etc. where it can be incorporated to improve consumer's acceptability of such products. The candied citrus peel is used in the baking industry in the preparation of cakes, cookies, and fruit pieces of bread. These can be marketed as mixed candied fruits and can be consumed as such. The judicious processing of waste peel into candy will not only add to the income of the processing industry, but it will provide remunerative prices to growers as well [11].

Fruits are highly seasonal and available in plenty at particular times of the year. During peak season, the price decreases, and a glut in the market may result in the spoilage of large quantities [12]. To avoid this glut spoilage the fruits can be processed into various products like fruit powder, candy, jelly, jams, etc. Fruit powder can also be used as a ready to drink product or as a flavoring material for the beverage, bakery, confectionery, and traditional products. Fruit powder used in products provides therapeutic as well as nutritional value. In addition, they also have excellent flavor and beautiful colors.

Further, the addition of fruit powder, will help to alleviate the malnutrition problem. Fruit can also be used to make candies which increase the acceptability of baked products. The preservation of fruits and vegetables through drying dates back many centuries and is based on sun and solar drying techniques. The poor quality and product contamination lead to alternate drying technologies [13]. The most applicable drying method includes freezing, vacuum, osmotic, cabinet or tray, fluidized bed, spouted bed, ohmic, microwave, and the combination thereof [14]. Although some of the work has been done on the development of fruit powder and candy less work has been undertaken for the development of fruit powder by utilizing different concentrations of potassium metabisulphite (KMS) and candy by using different blanching periods.

Development of Fruit Powders and Candies

Traditionally fruits were bought and consumed primarily for flavor and appearance rather than for nutritional value. Now fruits are recognized as contributors of certain nourishing, particularly vitamin C and A, and some essential minerals, such as magnesium, potassium, and iron. Because most fruits contain very little fat, they are also helpful as a healthy source of energy. Besides being rich in vitamins, minerals, and other nutrients, the fruit also has a high level of moisture which makes them prone to spoilage by endogenous metabolism as well as microorganisms. The drying of fruits is one of the oldest techniques of food preservation known to man. It's essential feature is that the moisture content is reduced to a level (below 5%) below which microorganisms cannot grow.

Citrus peel, which is considered a waste, is more nutritious than juice and pulp and can be processed into candies. [15] prepared citrus peel candy after extraction of juice from three citrus varieties, namely the loose jacketed mandarin *(cirtrus reticulata)* variety 'blood-red and the lemon *(Citrus limon)* variety 'villafranca'. After the separation of rags and seeds, the peels were placed in 2.0 percent standard salt solution, the strength of which was increased by 2.0 percent every 24 hours till 8.0 percent. On the fifth day, the peels were washed and placed in a freshly prepared 8.0 percent standard salt solution containing 0.2 percent potassium metabisulphite and 1.0 percent calcium chloride and stored for one month. These peels were washed thoroughly and boiled for softening. The peels were then covered with cold sugar syrup of 30º Brix in a vessel and left for 48 hours. On the third day, the ^{0}Brix was raised by 10^0 Brix by boiling the syrup for about 5 minutes. The process was repeated until 60^0 Brix was reached. At this stage, citric acid (0.15 percent of the weight of the peel) was added. The strength of the syrup was then raised to 75º Brix. The peels were left in the syrup for three weeks. Finally, they were drained and dried at room temperature for eight days and then dried at 50^0C for 2 hours in a cabinet drier till stickiness was lost.

[16] prepared mango powder by dipping the slicing in an equal weight of 70º Brix sugar syrup, containing 0.1% potassium metabisulphite (KMS) and then heated for 2 min at 90º C and soaked overnight in the same solution. Then the slices were drained and loaded on aluminum trays and dried in a cabinet dryer at 58-60º C to a moisture level of 5%. Dried slices were then ground to pass through 30 mesh sieve.. [17] prepared two types of Karonda candy from pink karonda and green karonda. The mature fruits were pricked and blanched for 1 to 1½ minutes. Sugar syrup was prepared using 500 g sugar in 1 litre water and 1 g citric acid and boiled for 5to7minutes.Karonda fruits were placed in the sugar syrup and left for 2 days. The next day, TSS was raised to 60% TSS by adding 250g sugar, and the process was repeated till the TSS reached70%. The fruits were kept for 20 days, and then TSS was raised to 75% by boiling the sugar syrup.

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The excess of sugar syrup was removed and dried at 50º c for two days. [18] prepared bael fruit powder by drying the pulp after adding 2000 ppm SO_2 in a thin sheet to 10 percent moisture. The sheets were then cut into pieces and further dried to below 4 percent moisture in a cabinet drier at 60+5^{0}C. The components were ground to pass through 30 mesh sieves.

Date powder was prepared from California Date fruits by [19] in Australia. Date flesh was minced in laboratory-scale mincer (1400w, MG450/ MG470 Kenwood Limited, Hampshire, UK) to make a smooth paste. Date paste of about 200g along with the required amount of maltodextrin (dextrose equivalent, DE 6) was mixed using a laboratory-scale mixer (K45SS, 250W, Kitchen Aid, Inc., MI). Three batches of four different proportions (35:65, 40:60, 45:55, and 50:50) of maltodextrin were used in the production of date powders. The mix was then spread on a Teflon-coated tray to a thickness of 5mm and kept inside an oven dryer at 70ºC for about 18 hours. The dry product was ground in a hammer mill to produce date powder. The powder was immediately collected in plastic pouches to avoid moisture pick-up from the air.

[20] prepared amla powder using different drying methods. The amla fruits were cleaned and cut into small pieces and immediately pressed to obtain juice using a small laboratory manual press. For the preparation of spray dried powder, the juice was evaporated to 50% using a rotary evaporator. Maltodextrin (5%w/v of initial juice) was added to the concentrated juice and stirred for 5 minutes using a mechanical stirrer followed by spray drying at 200ºC inlet and 150ºC outlet temperature and 40% aspiration speed to dry the sample. For freeze-drying 200 ml of juice was subjected to freezing at -35ºC for 3 hours followed by freeze dehydration in a freeze dryer at 60ºC for 16 hours. Sun-dried powder was prepared from grated amla dried under the sun followed by grinding in a mixer grinder and filtration using muslin cloth. The powder was also prepared by drying the grated amla in a vacuum oven at 50ºC and in a tunnel drier at 70ºC followed by grinding and filtration.

Effect of Processing on Fruit Quality

Blanching

Blanching is the partial cooking in steam or hot water. It is the primary step in the preservation of fruits by canning, freezing, and dehydration. It serves as an effective method of preservation by reducing the microbial load, inactivating enzymes responsible for spoilage, retaining the original color of fruits, and removing air entrapped in fruit tissues. Blanching, however, may result in the loss of certain nutrients.

The effect of blanching and lye peeling on nutritional quality of six aonla cultivars viz. Chakaiya, Lakshmi, Kanchan, Krishna, NA-6, and NA-7 was studied by [21] and reported that the effect of blanching was less severe than that of lye peeling on the nutritional quality of aonla. A marked decrease in acidity, ascorbic acid, tannins, and reducing sugars was noted down due to lye peeling. The loss in ascorbic acid ranged from 11.7 to 21.4% and 25.2 to 40% in blanched and lye peeled fruits, resp. The candy prepared from lye peeled fruits of four aonla cultivars showed a decreased content of ascorbic acid than blanched fruit candy.

[22] found that blanching done before the processing of aonla preserve had a marked effect on all the physio-chemical constituents of the aonla. Ascorbic acid content during the process of blanching reduced significantly from 563.12 mg/100 g (before blanching) to 434.95 mg/100g (after blanching), showing a loss of 19 to 20 percent in ascorbic acid. Similarly, total sugars, reducing sugars, non-reducing sugars, and moisture showed a loss of 4.95, 5.83, 2.45, and 2.2 percent, respectively. [23] recommended blanching of aonla fruits in boiling water in 1: 2 ratios of fruits to boiling water for 10 minutes followed by cooling in cold water to separate the segments easily.

Sulphiting

The process of application of sulfur dioxide on or into the product is called sulfuring or sulfating. Sulfur dioxide may be applied by burning sulfur in gaseous form or by addition of salts of sulfurous acids, particularly the alkali or acid salts (sodium or potassium bisulfate or metabisulphite) or alkali neutral salts (sodium or potassium sulfate) to the liquid products. A low concentration of sulfur dioxide shows antimicrobial activities against some bacteria and molds. Higher concentrations (more than 200 ppm) have an inhibitory effect on yeasts.

[24] reported that dried mango slices prepared by dipping in potassium metabisulphite solution contained higher ash (0.51 %), and vitamin C (16.14 mg/100g) and A (145.21 µg/100g) as compared to control mango slices i.e., 0.27 percent, 13.74 mg/100g and 94.12 µg/100g respectively. [25] revealed that sulphation (350ppm SO_2) of aonla juice coupled with storage at low temperature (4+1^{0}C) minimized the loss of vitamin C and prevented non-enzymatic browning even after six months of storage.

Non-Enzymatic Browning in Fruits

Changes in the natural color in most the fruits occur readily during preparation, processing, or storage, resulting in the formation of dark brown substances and thus rendering the product brownish to black

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in appearance. Usually, changes in flavor, odor, and nutritional value accompany the discoloration of the product. This discoloration might be because of enzymatic and non-enzymatic browning during storage of fruit products are caused by three types of gender reactions, *i.e.* (i) nitrogenous compounds and sugar (ii) organic acids and sugar (iii) nitrogenous compounds and organic acids. Other factors affecting the browning of fruit products are ascorbic acid content, the temperature of storage, oxygen availability, moisture content, humidity, and sulfur dioxide treatment.

Ultilization Of Fruit Powders and Candies in Value Added Products

Fruit powders (apple, pear, and plum) used as fat-replacers in baked goods, namely cookies, brownies, and muffins, and studied the effect of blended fruit powders on shelf life of baked products. The cookies made with fruit powder remained soft over the length of the test period. The fat-free brownies without fruit powder were stickier, gummier, and had slightly less volume than did the brownies with pear, apple, plum powder and appeared slightly raw and wet. The cohesiveness measurement for the brownie with fruit powder showed a pattern similar to the full-fat product. The muffin containing fruit powder stayed significantly softer throughout testing. The muffin with pear/plum/apple powder had slightly less top stickiness.

The infused-dried fruits are soft and moist and, for food application, can be diced into pieces as small as 1.5 mm. They are free-flowing and retain all the natural fruit characteristics. Currently, infused-dried fruits are used in pieces of bread, bagels, muffins, dry mixes, snakes, pastries, candies, and trail mixes.

Shelf Life of Value-Added Products

Dehydrated aonla powder stored in high-density polyethylene bags showed better retention of ascorbic acid and organoleptic characteristics irrespective of the treatments and storage method. High-density polyethylene was better than ambient storage for maintaining the shelf-life of dehydrated aonla powder of 3 months. Other fruits papaya, guava, and pear powders and stored for 60 days at room temperature (30 + 2º C) in polyethylene bags. The mean scores for the overall acceptability of powders showed that fruit powders could be stored up to 45 days of storage without any change in sensory characteristics. Non-enzymatic browning of papaya, guava, and pear powder at 0 days was 0.057, 0.074, and 0.066, respectively, increasing with the storage period. The organoleptic quality of candy from pink Karonda was higher than candy from green karonda. The mean scores of candy prepared from pink karonda decreased with storage from 8.35 to 6.92, while the mean scores for candy prepared from green karonda was been reduced from 8.24 to 6.84 from 0 to 120 days of storage period.

CONCLUSION

Fruit powders and candies of fruit and peels can be incorporated into baked products. Biscuits blended with aonla and guava powder can be stored well up to 90 days. Processing these fruits can decrease the seasonal losses and increase their utilization for value addition in baked and other products. The present review welcomes a scope for the commercialization of various developed products. It further provides a platform for diversifying the use of powders and candies for other value-added products. Sincere efforts can be made to popularize the development of powders and candies and their use in value-added products.

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