Journal of Food and Dietetics Research

Original Article

Development of fruit candies from wood apple (*Limonia acidissim*) and passion fruit (*Passiflora edulis*), nutritional and acceptability study during storage

Asna Urooj

Food Science and Nutrition, Asna Urooj, Dept. of Food Science Nutrition, University of Mysore, Manasagangotri, Mysore-570006, Karnataka, India

***Corresponding author:**
Asna Urooj
Food Science and Nutrition, Asna Urooj, Dept. of Food Science Nutrition, University of Mysore, Manasagangotri, Mysore-570006, Karnataka, India

asnau321@gmail.com

Received : 17-January-2021
Accepted : 13-February-2021
Published : 03-April-2021

DOI: 10.48165/JFDR.2021.1103

Quick Response Code:

ABSTRACT

Objectives: Fruit candies were prepared using Wood apple (*Limonia acidissima*) and Passion fruit (*Passiflora edulis*) and evaluated for the proximate composition, antioxidant activity, flavonoids and phenolics contents, sensory attributes, storage stability, and microbial load in the developed products. Wood apple and passion fruit are cheaper, highly nutritious and easily perishable, and seasonally available fruits. This study planned to make these fruits available through the year by preserving them as soft candies.

Material and Methods: Soft candies were developed stored and quality parameters were assessed for a period of 90 days. The candies were evaluated by a panel for sensory attributes using 9 point hedonic scale.

Results: The acid content of the preserved products remained the same during the entire storage. The moisture content in both the products was > 12% and the protein content ranged from 1.4% to 2.34%. As expected, the fat and crude fiber contents were low. The total phenolics and flavonoids were present in appreciable amounts. The developed products showed acceptable sensory attributes and were microbiologically safe at the end of the storage period and fit for consumption.

Conclusion: Hence the study concluded that, the developed wood apple jam and fruit bar in this study was safe and fit for consumption. The seasonal fruits can be exploited for preparation of fruit candies.

Keywords: Candies, Proximate analysis, Antioxidant, Sensory acceptance, Microbial analysis, Storage stability

INTRODUCTION

Most of the fruits and vegetables are seasonal and available in surpluses during specific months of the year in different regions and are wasted in large quantities due to the perishable nature of the commodity, absence of facilities and know-how for proper handling, distribution, marketing, and storage. Furthermore, huge amounts of the fruits and vegetables produced during a particular season results in a glut in the market and become scarce during other seasons. Being highly perishable in nature, large quantities of harvested fruits are wasted due to improper post-harvest handling and storage. Quality of fruits in pre- and post-harvest influences the consumer acceptance. The changes that occur in various physical and chemical characteristics determine the quality and in turn the economic returns to the producers and processors.[1] Fruits and vegetables which require simple technologies for processing, preservation, and transport to various places of need, suffer post-harvest losses, estimated to nearly 35%. Only 1% of the total fruits and vegetables produced are processed in about 3000 food industries in India.[2] Preservation of food contributes to the conservation and better utilization of fruits and vegetables in order to avoid the glut and utilize the surplus during the off-season. It is necessary to extend storage life for better distribution and also processing techniques to preserve them for utilization in the off-season in both large scale and small scale. Fruits play an important role in the preparation of preserves,

in cooking and in fermented beverage production. Processing of fruit is necessary where it ensures fair returns to the growers to improve their economic conditions. It also helps to mitigate the problem of under-employment during off-seasons in the agricultural sectors. According to the estimates, nearly 30% of the fruits are lost due to spoilage, handling, transportation, and lack of cold storage and processing techniques.[3] Processing of fruits into candies by an osmotic process is quite popular and reported by many researchers.[4-8]

The Wood apple (*Limonia acidissima*) is the only species of its genus, in the family *Rutaceae*. Another related species, *Feronia limonia* popularly known as kathbel (elephant apple) is a fruit in demand. The wood apple is native and common in dry plains of India and Sri Lanka. Wood apple is used in the preparation of chutneys and for making jelly and jam.[9] Wood apple has got high medicinal value. Every part of the fruit has got its medicinal property. In India, the fruit is used as a liver and cardiac tonic and when unripe, as a means of treating diarrhea and dysentery and also as an effective treatment for hiccups, sore throat, and disease of the gums.[9]

Passion fruit (*Passiflora edulis*) is a tropical fruit produced worldwide with distinctive aromas and flavors making it popular additive to many tropical fruit juice blends. Primarily two fruit types are commercially produced, yellow and purple, and both are commonly consumed throughout the world. Yellow Passion fruits are thought to be hybrids of purple varieties[10] and are most commonly used for processed juice, due to the more acidic taste and higher juice yield. Purple varieties are typically consumed fresh due to the sweeter taste. Yellow passion fruit juice is popular as an integral flavor component in tropical juice blends due to its unique flavor but it is commonly consumed sweetened and diluted due to its acidic taste.

Jam, jellies, fruit bar, soft candies, and preserves are manufactured as one of the important fruit byproduct in industries and based upon the high solids-high acid principle. Not only are such fruit concentrates an important method of preserving fruits, but it is an important utilization of fruits. In addition to the pleasing taste of such preserved fruits, they possess substantial nutritive value utrit Consumer interest in natural products is now a global trend.

The present work is an attempt to utilize wood apple and passion fruit for the preparation of candies and studying the product for proximate composition, selected antioxidant components and antioxidant activity, sensory acceptability, and shelf life studies.

MATERIAL AND METHODS

Selection of fruits

The fresh fruits from plants of different regions – Passion fruit from Nasik region of Maharashtra of Western India, Wood apple from Shamli region of Uttar Pradesh of Northeast India and also from Mysore region of Karnataka of South-western India were collected. Ripe wood apple *(Limonia acidissima)* with hard shell, fairly large, and globular shaped with soft, fleshy, yellowish edible pulp was selected for the study.

Sample preparation

Wood apple fruits were first washed to remove the dirt, de-shelled and pulp was extracted manually, homogenized in a mixer to obtain fine pulp adding a little amount of water and strained using strainer. Passion fruits were cut into two halves and squeezed to obtain juice and kept frozen at –70°C until they were used for the product development.

METHOD OF PREPARATION

Preparation of passion fruit soft candies

Passion fruit juice and water in 1:1 ratio was taken in a pan and boiled up to 110°C with constant stirring.

⇩

Addition of Pectin powder along with same amount of sugar powder and boiled to 108°C.

⇩

Rest of sugar powder was added to the above boiling mixture.

⇩

The mixture was poured into the moulds of desired shape.

⇩

The mixture was left for 3–4 hours at room temperature.

Preparation of wood apple soft candies

Wood apple pulp was blended in a grinder with addition of water in 1:1 ratio and boiled for 5 minutes at 80°C.

⇩

1:1 ratio of sugar powder and pectin were mixed and added to the boiling mixture of juice and water with constant stirring.

⇩

Once the smooth mixture of sugar, pectin and juice was obtained rest of sugar powder and citric acid were added to it and boiled to 108°C.

⇩

The setting consistency was checked using spoon.The mixture was poured into the moulds and left for 3–4 hours at room temperature and later rolled into sugar powder.

METHODOLOGY

Sensory acceptability of soft candies

The sensory evaluation was done using a score card. A panel of 15 members evaluated the products at an interval of 30 days and for a period of 90 days.

Analytical methods

Moisture, protein, ash, crude fiber, and fat content in the products were analyzed as per AOAC methods.[12]

Moisture analysis

The sample is dried in a vacuum oven at temperature between 100°C and 105°C and the moisture content is calculated from the weight loss due to the evaporation of moisture.

Ash content

It was the measure of fruits and fruits juice or food stuff content. A low ash content of food stuff represents the inorganic residue remaining after the destruction of organic matter.

Fat estimation

Fat content in foods in terms of free lipid or petroleum ether extractable lipids are estimated by using Soxhlet extractor, with continuous refluxing for 14 to 16 hrs**.**

Total carbohydrates

The total carbohydrate content of samples was calculated by difference.

Crude fiber estimation

Crude fiber is loss on ignition of dried residue remaining after sequential digestion of sample with 1.25% H_2SO_4 and 1.25% NaOH solution specific conditions. The method makes it possible to determine fat-free organic substances in feeding stuffs which are insoluble in acid and alkaline media and are conventionally described as crude fiber.

Protein estimation

Protein in foods is generally estimated by the nitrogen content. Nitrogen content is estimated on the basis of determination of the amount of reduced nitrogen. The various nitrogenous compounds are converted into ammonium sulphate by boiling with concentrated sulphuric acid. The ammonium sulphate formed is decomposed with a strong alkali (NaOH) and the ammonia liberated is absorbed in excess of neutral boric acid solution and then titrated with standard HCL

Antioxidant analysis

Antioxidants (polyphenolics and flavonoids) are defined as substances that even at low concentration significantly delay or prevent oxidation of easy oxidizable substrates. When antioxidant reacts with Reactive oxygen species, the antioxidant is itself often transformed into an "antioxidant radical." Although the resulting radical has a reduced ability to react with vital cellular targets, it can still cause damage.[11] The "antioxidant radical" needs to react with another antioxidant to bring the reduction potential and there activity further down. These antioxidant reactions can continue in a stepwise fashion, involving a large number of antioxidant molecules, until the "antioxidant radical" is no longer a threat to the cell, simply because it has been reduced to a product which does not contain enough reduction potential to react with lipids, protein, DNA, and other important cellular molecules.

DPPH assay (2, 2-diphenyl-1-picrylhydrazyl)

The radical scavenging activity of different extracts was determined by using DPPH assay according to the method as described by Chang et al.[13]

Color measurement

Color measurements of products are usually made using a portable CR-400 tristimulus colorimeter (Minolta Chroma Meter CR 400, Osaka, Japan) and Spectra-Match software, set to L*, a*, b* mode. Color changes are documented over the duration of the experiment. L* values indicate lightness (black [L* = 0] and white [L* = 100]), a* values indicate redness-greenness (red [a* = 100] and green [a*= {–100}]), b* values indicate yellowness- blueness (yellow [b* = 100] and blue [b* = {–100}]).

Texture characterization

Texture parameters of candies were measured using TAHDi texture analyzer (TPA) (Stable Microsystems, UK) equipped with 25 kg load cell.

Determination of microbial load

Contamination of food by molds and bacteria is common. Hence, their presence in the finished products is considered unfit for consumption. In order to find the presence of bacterial load, standard pour plate method on nutrient agar was carried out.[12] The results were analyzed and interpreted.

RESULTS AND DISCUSSION

Organoleptic evaluation of the prepared fruit candies

Sensory evaluation offers the opportunity to obtain a complete analysis of various properties of food as perceived by human

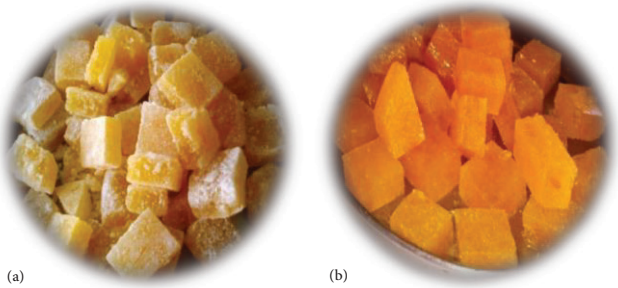

Figure 1: Passion fruit soft candy (a) with sugar coating and (b) without sugar coating.

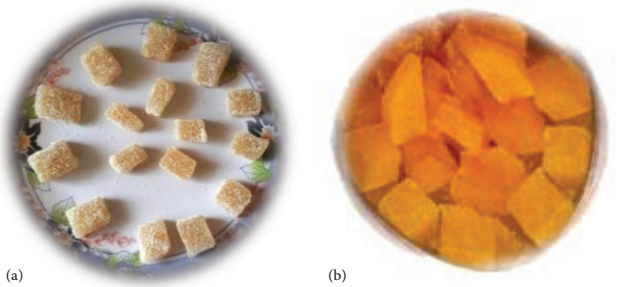

Figure 2: Wood apple soft candy (a) with sugar coating and (b) without sugar coating.

sense. Sensory evaluation is an important and best method for evaluating new products developed which provide quality measure and production control. The fruit candies were prepared and stored for analysis Figures 1 & 2. The samples were evaluated organoleptically on 0th and 90th day.

The samples were graded by numerical scoring, on a nine-point scale. The organoleptic evaluation shows, gradual reduction in the mean score for overall acceptability after 90 days of storage. Consistency remained same and the taste declined. Flavor change was observed, which showed a correlation with the study reported by Ashwah et al. in fruit juices.[13] A reduction in appearance and taste of fruit products on storage has been reported.[14] Hence, maximum storage period of 60 days, at room temperature may give a better acceptability.

Though there was reduction in the mean scores, statistical tests proved that the changes were not significant in any of the products, over the entire period. Sensory evaluation of fruit candies revealed higher deterioration in color, appearance and texture on 90th days of storage at room temperature.[15]

Analytical parameters of the prepared soft fruit candies

Proximate composition: Table 1 represents the data on proximate composition of prepared fruit candies (dry weight basis). PFSC (Passion fruit soft candy) was found to be a good source of protein (2.20%) as well as fat (1.11%), WASC (Wood apple soft candy) showed protein and fat content, 1.3% and 0.20%, respectively. The energy and carbohydrate were found to be similar in both.

Total polyphenolic content: Total phenolic contents were expressed as mg of gallic acid equivalent/100 g of sample. Fruit candies, i.e., PFSC and WASC, showed total polyphenolic content of 0.877 µg and 2.29 mg GAEq:/100 g respectively. The total polyphenolic content value of both fruit candies was significant. This may be due to the presence of fruit as a major ingredient.

Total flavonoids content: Total flavonoids contents were expressed as µg of quercitin equivalent/g of the sample. PFSC contained 0.13 µg of quercitin equivalent/g of the sample and WASC contained 0.11 µg of quercitin equivalent/g of the sample. The total flavonoids content value of both fruit candies was significant.

DPPH radical scavenging assay: The scavenging effects on DPPH radicals were determined measuring the decay in absorbance at 517 nm, due to DPPH radical reduction, indicating the antioxidant activity of the compounds. The DPPH activity of the sample was measured using BHA as standard. The radical scavenging activity of the samples was 47.5% and 55% and the IC_{50} values for standard BHA for passion fruit candy and wood apple candy were 157.89 µg/g and 136.36 µg/g, respectively.

pH value: Fruit products are being effectively preserved at low pH.[16] The pH estimation was done in order to find out whether a low pH was maintained throughout the study which could be an effective preservation. There was no change in the pH during the entire storage. Similar observation was seen by Sidhu et al. (1984) in the tomato juice on storage of 90 day, i.e., 4.40.

Ash value: Natural ash content is due to the minerals like calcium, phosphorus, and iron. According to Ranganna[15],

Table 1: Proximate composition of prepared fruit candies.

Samples	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	Total Carbohydrate (%)
PFSC	12.68 ± 1.98	2.2 ± 0.10	1.1 ± 0.05	0.18 ± 0.01	2.30 ± 0.02	81.3 ± 0.64
WASC	15.58 ± 1.47	1.3 ± 0.06	0.20 ± 0.00	0.05 ± 0.00	2.60 ± 0.02	80.1 ± 0.01

PFSC – Passion fruit sugar candy; WASC – Wood apple sugar candy. Results are mean of three independent determinations

ash content of a foodstuff represents inorganic residue remaining after destruction of organic matter. The ash value is a measure of the amount of added minerals. The ash values of both the developed products ranged from 0.01% to 0.20%.

Microbial load of the prepared fruit candies: By following serial dilution method, the microbial content in the prepared products was observed. There were no microbial colonies observed at initial day and at the end of the storage period.

CONCLUSION

The results proved the feasibility of preparing natural dietary candy from wood apple and passion fruit. As indicated by organoleptic evaluation, and microbial analysis noted for both fruit candies during initial and 90th day of storage. There was no microbial growth on storage for 90 days indicating both shelf stability and safety. No changes in pH, titrable acidity, and ash value were observed in the prepared product during storage when compared to the initial observations. Hence, the prepared wood apple jam and fruit bar was safe and fit for consumption. The seasonal fruits can be exploited for preparation of fruit candies.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

Dr. Asna Urooj is on the editorial board of this journal.

REFERENCES

1. Agarwal G, Mangaraj S. Studies on physic-chemical changes in selected fruits during storage. Beverages Food World 2005; 32:72–5.
2. Das A. Policy issues on processed food industry. Ind Food Industry 1991;10:14–25.
3. Singh C, Poonia GS, Toor MS. Distribution pattern of fruit processing industry in Punjab. Ind Food Packers 1994;18: 47–58.
4. Molla MM, Nasrin TAA, Islam MN, Rahman MAJ, Bhuyan MAJ. Preparation of fruits candy from jackfruit and mango using a mechanical dryer. Ecofriendly Agri J 2008;1:90–4.
5. Chauhan SK, Nayak P, et al. Development of calcium rich fruit candy and its nutritional and organoleptic study during storage. Paripex- Ind. J Res 2019;8:62–3.
6. Shamrez B, Aftab S, Junaid M, Ahmed A, Ahmed S. Preparation and evaluation of candies from citron peel. IOSR J Environ Sci, Toxicol Food Technol 2013;7:21–4.
7. Kale SJ, Nath P, Kaur C. Potentiality of freeze-thaw treatment to produce soft textured aonla (Emblica officinalis) candies. J Food Sci Technol 2019;56:3157–63.
8. Cano-Lamadrid M, Calín-Sánchez Á, Clemente-Villalba J, Hernández F, Carbonell-Barrachina ÁA, Sendra E, Wojdyło A. Quality parameters and consumer acceptance of jelly candies based on pomegranate juice "Mollar de Elche". Foods 2020;9:516.
9. Radia A, Boukhiar A, Kechadi K, Benamara S. Preparation of a natural candy from date (*Phoenix dactylifera* L.), olive (*Olea europaea* L.), and carob (*Ceratonia siliqua* L.) fruits. J Food Quality 2018 |Article ID 9565931 | https://doi.org/10.1155/2018/9565931.
10. Chavarria-Perez LM, Giordani W, Dias KOG, Costa ZP, Ribeiro CAM, Benedetti AR, et al. Improving yield and fruit quality traits in sweet passion fruit: Evidence for genotype by environment interaction and selection of promising genotypes. PLoS One 2020;15:e0232818.
11. Buettner GR. The pecking order of free radicals and antioxidants: lipid peroxidation, alpha-tocopherol, and ascorbate. Arch Biochem Biophys 1993;300:535–43.
12. AOAC (1990), Official methods of analysis of the Association of Official Analytical Chemists. Vol. 2. 15th ed. Washington, DC.
13. Chang ST, Wu JH, Wang SY, Kang PL, Yang NS, Shyur LF. Antioxidant activity of extracts from Acacia confusa bark and heartwood. J Agri Food Chem 2001;49:3420–4.
14. Ranganna S. Sensory evaluation general instruction for microbiological examination. 2nd ed. New Delhi (India): Tata McGraw Hill Publishing Co. Ltd; 1991; p. 670–86.
15. Sidhu SJ, Bhumbla VK, Joshi BC. Preservation of tomato juice under acid condition. J Food Sci Agri 1984;35:345–52.
16. Ashwah EI, Abd FA, Baki NM, Samahy SK, Abd EI, Fadeel MH. Effect on storage on the characteristics of the concentrated orange and lime juice. Agri Res Rev 1982;38:275–88.

How to cite this article: Urooj A. Development of fruit candies from wood apple (*Limonia acidissim*) and passion fruit (*Passiflora edulis*), nutritional and acceptability study during storage. J Food Diets Res 2021;1(1):14–8.