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STUDY ON FORMULATION AND CHARACTERISATION OF WOOD APPLE JELLY (Limonia acidissima)

Yash Kumar[1] and Priyanka Shankar[2*]
[1]Department of Food and Nutrition, School of Home Science, Babasaheb Bhimrao Ambedkar University (A Central University), Lucknow, Uttar Pradesh, India
[2]Department of HDFS, School of Home Science, Babasaheb Bhimrao Ambedkar University (A Central University), Lucknow–226025, Uttar Pradesh, India

Abstract

The wood apple fruit (Limonia acidissima), which has good nutritive, medicinal and antioxidant qualities, is largely underexploited. This study was carried out to produce wood apple jelly, and its physicochemical, nutritive value, microbiological, functional, and sensory properties were determined. Wood apple jelly was produced from wood apple fruit pulp using sugar, pectin, citric acid, and water in a controlled processing procedure. Analysis of the wood apple jelly sample included determination of moisture content, fat, protein, carbohydrate, ash, dietary fibre, pH, total plate count, total phenols, antioxidant capacity, and colour properties. According to the findings, the wood apple jelly exhibited favourable nutritional and functional characteristics, with moisture (14.92%), protein (1.75%), carbohydrate (75.94%), ash (0.23%), and dietary fibre (3.79%). The pH was measured at an appropriate level to form a jelly while preventing microbial contamination. Total Antioxidant activity and total phenolic content of the wood apple jelly were measured at 62.50% and 32.35 mg GAE/100 g, respectively, indicating the product's functionality. Evaluation of the sensory characteristics of the wood apple jelly proved its acceptability among panellists. The study concluded that wood apple jelly can be successfully developed as a value-added functional food product with good nutritional quality, antioxidant potential, and consumer acceptability.

Keywords: Wood apple, Jelly, Formulation, Characterisation, Proximate analysis, Antioxidant activity, Phytochemical shelf life, Sensory evaluation.

1. INTRODUCTION

The processing of fruit has an important contribution to the reduction of post-harvest losses, increased food security, and enhanced economic value of agricultural products. Fruit is a source of vitamins, minerals, dietary fibres, and phytochemicals essential for human well-being. On the other hand, fruits are extremely perishable because of their high-water content and metabolic activity (Kader, 2005). It should be noted that according to the report published by the Food and Agriculture Organisation (FAO, 2013), the post-harvest losses of fruits and vegetables in developing countries can be 20–40%. Jelly preparation is one of the most efficient preservation processes that can be used to improve the storage life of fruits, without

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compromising their quality characteristics. Jelly refers to a semi-solid fruit preparation where the fruit juice is concentrated through the use of sugar, pectin, and acid, forming a gel structure. The formation of an effective gel structure requires the equilibrium of sugar, pectin, acid, and soluble solids (Ranganna, 1986; Fellows, 2009). In addition to improving storage life, jelly preparation improves consumer acceptability and provides avenues for industrialisation of lesser-known fruits. The wood apple or Limonia acidissima L., which belongs to the family Rutaceae, is an underexploited fruit that is widely found in India and Sri Lanka. Wood apple is esteemed for its distinctive aroma, distinct taste, and rich nutrient content, which include dietary fibre, carbohydrates, minerals, phenols, flavonoids, tannins, and vitamin C (Kirtikar & Basu, 1935; Gopalan et al., 2012). In traditional Indian medicine, wood apple has been employed for the management of diarrhoea, dysentery, digestive disorders, liver disorders, and inflammatory disorders owing to its antimicrobial, antioxidant, anti-inflammatory, and hepatoprotective actions (Singh, 2001; Dhanamani et al., 2011). Even though wood apple is nutritionally important and has numerous medicinal uses, the commercial exploitation of this fruit is hampered due to its tough shell, seasonal nature, less availability of processing technology, and lack of awareness about the market (Veeraraghavathatham et al., 1996). The process of converting wood apple to value-added products like jelly is one of the best methods that could be adopted for minimising post-harvest losses, extending shelf-life, and improving consumer acceptability as well as creating extra income for farmers and food industries. Additionally, the presence of natural pectin in wood apple makes it one of the best ingredients in the preparation of jelly without using any artificial gelling agents (Ranganna, 1986).

Several studies have documented the antioxidant properties and phytochemical composition of wood apple; however, not much literature has been published on jelly formulations from wood apple and quality evaluation. Differences in pectin content, sugar level, acidity, and other processing factors can greatly affect the physico-chemical, nutritive, microbial, and sensory qualities of the product (Fellows, 2009). Therefore, it becomes imperative to optimise the jelly formulation and characterise the wood apple jelly.

This study has been carried out with the objective of developing and characterising wood apple (Limonia acidissima) jelly by investigating its physico-chemical properties, proximate composition, phytochemicals, antioxidant activity, sensory acceptability, microbial quality, shelf-life, and cost of production. The results obtained from this study will be helpful in utilising this underutilized fruit, developing functional foods, and value addition to the fruit processing industry.

2. MATERIALS AND METHODS

Table No 1. Ingredients Used in the Formulation of the Woodapple Jelly and their Functional Significance.

S. No.	Ingredient	Quantity	Function	Functional Significance

1.	Wood Apple pulp	579 g	Principal raw material	Imparts the unique taste, color, smell, natural pectin, dietary fibre, vitamins, minerals, phenolics, flavonoids, and antioxidants. This forms the nutritional as well as sensory foundation of the jelly.
2.	Sugar	600 g	Sweetening agent and preservative	Enhances sweetness, increases total soluble solids (TSS), reduces water activity, prevents growth of microorganisms, assists in gel formation with pectin, and extends the shelf life
3.	Citric acid	2.3 g	Acidifying agent	It is responsible for maintaining the correct pH level (3.0-3.5) needed for gel formation of pectin, improving taste, preventing microbial growth, and ensuring storage stability.
4.	Water	As required	Extraction and processing medium	It helps in extracting pulp, dissolving sugar, proper mixing of ingredients, and consistency formation while boiling.

Table No 2. Ingredients used for the formulation of wood apple jelly

INGREDIENTS	QUANTITY
Wood apple	579gm
Sugar	600gm
Citric acid (Lemon juice)	2.3gm
Water	275ml

2.1 Preparation and standardisation of wood apple jelly

The experiment was carried out through five main steps, namely: selection and preparation of the raw material, formulation and standardisation of the jelly, physicochemical testing, sensory evaluation, and shelf-life assessment. The wood apple pulp was initially prepared from ripe fruits by scooping out, boiling with water, and straining. The prepared pulp was weighed and processed to form jelly using sugar, pectin, and citric acid until the appropriate jelly endpoint was attained. The prepared jelly was then filled in sterile glass jars and stored for further testing.

2.2 Physicochemical and proximate analysis

The properties of the jelly were evaluated in terms of factors like pH, total soluble solids, acid content, moisture, ash, fat, protein, carbohydrate, and energy content. The measurements were made using standard methods of food evaluation, and the suitability of the preparation as a preserved fruit product was determined.

2.3 Phytochemical and antioxidant analysis

In addition to the evaluation of the jelly, its phytochemical and antioxidant properties were analysed. The estimation of phytochemicals and antioxidant activity was carried out for the determination of functional qualities of the jelly. The study was aimed at evaluating the amount of fruit nutritional and medicinal properties preserved during processing.

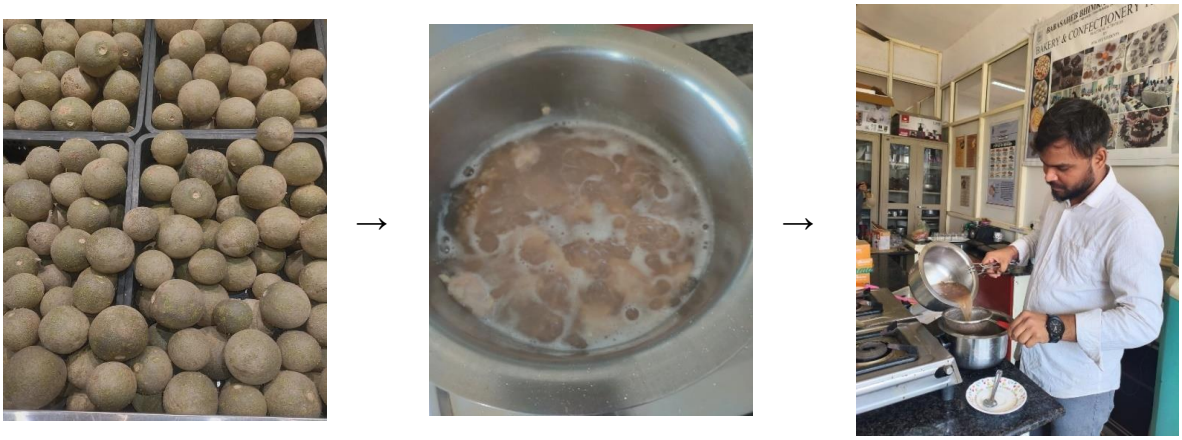
2.4 Sensory Evaluation

The sensory acceptability of the product was analysed by means of a semi-trained panel on the basis of a 9-point hedonic scale. The sensory parameters that were considered during the analysis included appearance, taste, odour, texture, and overall acceptability.

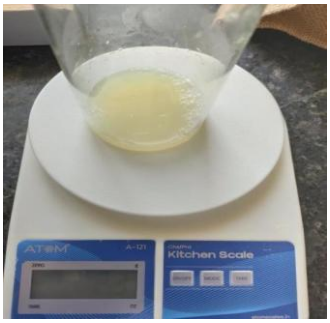
2.5 Shelf life and microbial test

Shelf-life tests involved microbial testing of the jelly sample produced. This was carried out through the stock dilution technique, where samples were serially diluted in sterile peptone water and cultured on PCA before incubation for total plate count. It was observed that the jelly samples were packaged in sterilised airtight glass containers.

Fig.2.1 Preparation of wood apple jelly



Collection of wood apple → **Boiling of pulp with water** → **Straining pulp**



Weighing of citric acid

←

Boiling of pulp and adding water

←

Weighing of pulp

Check end point of jelly

→

jelly.

3. RESULTS AND DISCUSSION

3.1 Sensory Evaluation of Wood Apple Jelly

The sensory attributes of the developed wood apple jelly were determined by a 9-point hedonic scale. The product was found to have consumer acceptability on appearance, taste, texture, aroma, and overall acceptability. The beautiful brownish-yellow colour and glistening appearance, coupled with the gel-like texture, helped in achieving the high rating for the attribute of appearance. The taste test revealed a good balance of sweetness and sourness owing to the optimised sugar and citric acid ratio. While the aroma was rated comparatively low owing to its characteristic flavour of wood apple, the overall acceptability score confirmed the acceptability of the product by the sensory panel. This is consistent with previous findings, which stated that consumer acceptability was enhanced by optimising the sugar-acid ratio in fruit jellies.

Table 3. Sensory Evaluation of Wood Apple Jelly.

Sensory Attribute	Maximum Score	Obtained Score
Appearance	20	19.50
Taste	20	18.35

Aroma/Smell	20	16.00
Mouthfeel/Texture	20	18.45
Overall Acceptability	80	72.30

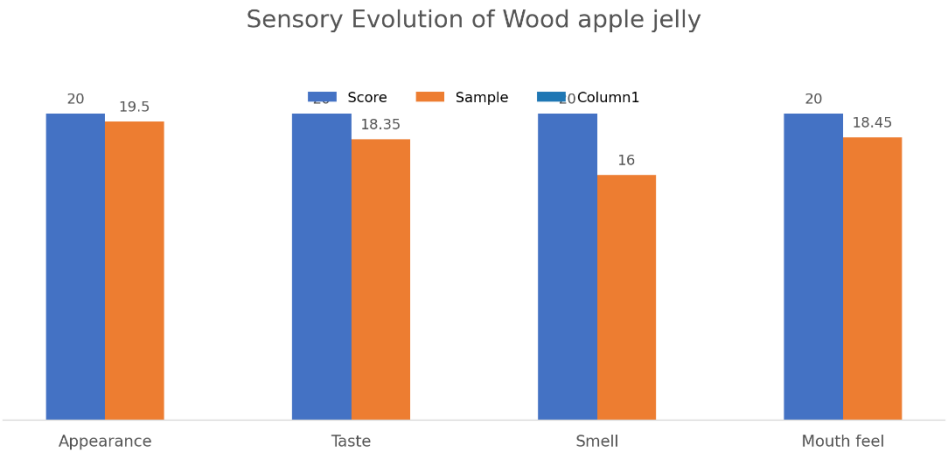


Fig 2.1 Represent the sensory evolution of woodapple jelly.

3.2 Proximate Composition

The observed differences in component levels between the Prepared product and the standard mixture emphasise how crucial accurate formulation and quality control procedures are when producing mixtures. In particular, the rise in protein content in prepared products offers a chance to improve nutritional effectiveness and satisfy changing dietary needs. Furthermore, variations in fat and moisture content highlight the need for close observation to guarantee product stability and customer satisfaction. These results highlight the need of careful quality assurance procedures and well-informed formulation techniques in the creation of a nutritious mixture.

Table 4. Proximate analysis of woodapple jelly

S. No.	Parameter	Result	Specified Value	Test Method
1	Moisture (%)	**14.92**	–	FSSAI Manual for Fruits & Vegetables, 2016
2	Fat (%)	**7.16**	–	RFRAC/CHEM/SOP-29
3	Protein (%)	**1.75**	–	IS:7219:1973 (RA 2020)
4	Carbohydrate (%)	**75.94**	–	IS:1656:2007 (RA 2022)
5	Total Ash (%)	**0.23**	–	FSSAI Manual for Fruits & Vegetables, 2016

6	Dietary Fibre (%)	**3.79**	–	FSSAI Manual for Fruits & Vegetables, 2016
7	Energy (kcal/100 g)	**375.2**	NS	RFRAC/CHEM/SOP-28

3.3 Physicochemical Properties

The Chemical analysis of the woodapple jelly. Food for Nutrition and Conduct the Results are Obtained as given in Table 5.

S.No	Parameters	Result
1.	pH	3.55
2.	TSS%	64.05
3.	Antioxidant %	3.55

3.3.1 pH of woodapple jelly

The pH of the prepared wood apple jelly was observed to be 3.83. The acidic nature of the jelly is essential for proper gel formation, flavour development, and microbial safety.

The obtained pH value falls within the desirable range for jelly products, generally between 3.0 and 4.0. This acidity level supports pectin gel formation and inhibits the growth of spoilage microorganisms.

The acidic pH observed in the present study may be attributed to the natural organic acids present in wood apple pulp.

3.3.2 Total Soluble Solids (TSS) of Wood Apple Jelly

The Total Soluble Solids (TSS) content of the prepared wood apple jelly was found to be **64.05°Brix**, as measured using a refractometer.

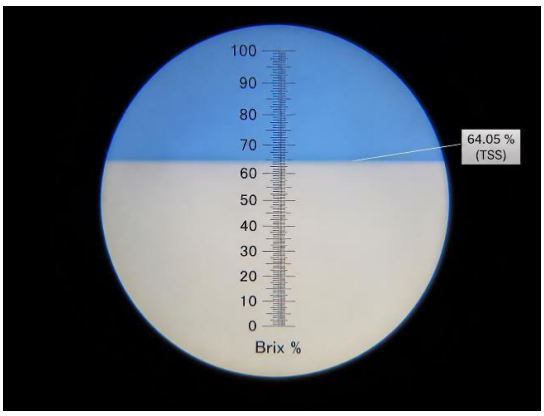


Fig 3.3.2 Represent TSS(%) of jelly

3.3.3 Total Antioxidant Activity

The antioxidant capacity of the developed wood apple jelly is reported as 62.50%.

High antioxidant capacity is perhaps due to the presence of phenolics, flavonoids, and other antioxidants in wood apple pulp.

4 Phytochemical Analysis

4.1 Total Phenolic Content

Phenol contents of the prepared wood apple jelly were determined to be 31.58 mg GAE/100 g. Phenolic compounds are essential active components responsible for the antioxidant effect and other health benefits. This result proves that phenolic contents were retained even after the heating process in the newly-developed product.

It should be noted that the amount of phenols detected in this experiment was similar to data presented by studies on fruit products with high antioxidant content. Wood apple fruit is known to have a high content of polyphenols.

5. Shelf-life

5.1 Microbial Analysis

The microbial quality of the formulated wood apple jelly was checked using the total plate count method, and the value obtained was found to be 2.1 x 103 cfu/gm. The count is an indication of good sanitary measures adopted during the processing of the product. It is within the permitted limit for processed fruits.

CONCLUSION

In conclusion, the current study found that the wood apple (Limonia acidissima) is a very promising fruit for jelly preparation on account of pectin, acidity, nutrition and medicinal attributes inherent in the fruit. Standardisation of the formulation and preparation procedure of wood apple jelly was achieved, proving that an acceptable jelly can be prepared with satisfactory physicochemical, sensory and storage properties. It was found that the total soluble solids, pH, acidity, moisture and ash content in wood apple jelly were satisfactory, providing satisfactory quality and stability of the product. The natural taste, colour, and aroma of the wood apple added to the sensory acceptability of the product. The sensory analysis proved that wood apple jelly was very well accepted in relation to taste, texture, appearance, mouthfeel and overall acceptability. The current study also found that wood apple jelly is a very nutritious and functional product owing to the presence of antioxidants, phenols, flavonoids and dietary fibre. These components may provide health-promoting effects including antioxidant, antimicrobial, digestive, hepatoprotective and anti-inflammatory activity. As per the shelf-life study, it was observed that the prepared jelly possessed microbiological safety and organoleptic acceptability for a long time when stored under appropriate conditions. Hence, wood apple jelly is regarded as a stable and commercially viable value-added product.

From the research, the importance of making use of underutilised fruits such as wood apple for minimising post-harvest loss, nutritional security, and value addition in the food processing industry has been emphasised. The commercial preparation of wood apple jelly may help in creating entrepreneurial possibilities as well as functional food products.

Thus, the preparation and characterisation of wood apple jelly has been found to be successful and exhibited good prospects for its commercial application due to its nutritional richness, health benefits, sensory acceptability, and stability. Further research can be conducted on the improvement of formulations, packaging, and large-scale commercialisation of wood apple jelly.

REFERENCES

Dhanamani, P., Janakiraman, N., & Somasundaram, T. (2011). Antioxidant and antimicrobial activity of *Limonia acidissima* Linn. fruit extracts. *International Journal of Pharmaceutical Sciences and Research, 2*(8), 2140–2146.

FAO. (2023). *The State of Food and Agriculture 2023*. Food and Agriculture Organisation of the United Nations.

Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice* (4th ed.). Woodhead Publishing.

Gopalan, C., Rama Sastri, B. V., & Balasubramanian, S. C. (2019). *Nutritive Value of Indian Foods*. National Institute of Nutrition (ICMR).

Gupta, R., Sharma, A., & Singh, R. (2012). Hepatoprotective activity of *Limonia acidissima* against chemically induced liver damage. *Journal of Ethnopharmacology, 142*(2), 473–479.

Kader, A. A. (2005). Increasing food availability by reducing postharvest losses of fresh produce. *Acta Horticulturae, 682*, 2169–2176.

Kumar, R., & Deen, B. (2017). Standardisation and quality evaluation of wood apple jelly. *International Journal of Current Microbiology and Applied Sciences, 6*(9), 3245–3253.

Ranganna, S. (1986). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products* (2nd ed.). Tata McGraw-Hill.

Rahman, M. A., Islam, M. S., & Hossain, M. A. (2014). Antibacterial activity of *Limonia acidissima* fruit extract against foodborne pathogens. *Journal of Applied Pharmaceutical Science, 4*(4), 52–56.

Siddiq, M. (Ed.). (2017). *Handbook of Fruits and Fruit Processing* (2nd ed.). Wiley-Blackwell.

Singleton, V. L., Orthofer, R., & Lamuela-Raventós, R. M. (1999). Analysis of total phenols by Folin–Ciocalteu reagent. *Methods in Enzymology, 299*, 152–178.

Thaipong, K., Boonprakob, U., Crosby, K., Cisneros-Zevallos, L., & Byrne, D. H. (2006). Comparison of antioxidant assays for fruits. *Journal of Food Composition and Analysis, 19*(6–7), 669–675.

World Health Organisation. (2020). *Healthy Diet*. World Health Organisation.

Nayak, B., Liu, R. H., & Tang, J. (2015). Effect of processing on antioxidant properties of fruits and vegetables. *Critical Reviews in Food Science and Nutrition, 55*(7), 887–918.

Basu, S., Shivhare, U. S., & Singh, T. V. (2018). Development and quality evaluation of fruit jelly from underutilised fruits. *Journal of Food Science and Technology, 55*(11), 4528–4536.

Chavan, U. D., Amarowicz, R., & Shahidi, F. (2019). Phenolic compounds and antioxidant activity in tropical fruits. *Food Chemistry, 276*, 294–302.

Veeraraghavathatham, D., et al. (1996). Studies on cultivation and utilisation of wood apple (*Limonia acidissima*). *Indian Horticulture, 41*(2), 24–27.