UTILIZATION OF JAMUN FRUIT FOR THE DEVELOPMENT OF ANTI-OXIDANT RICH TABLETS

[1]Sinthiya R, [2]Arun kumar M, [2] Vinodha M, [2]Pandiyarajan S, [2]Meera S S

[1]*Assistant professor, Department of Food Technology, Sri Shakthi institute of engineering and technology, Coimbatore - 641062,*

[2]*Scholars of Food Technology, Department of Food Technology, Sri Shakthi institute of engineering and technology, Coimbatore – 641062*

ABSTRACT

In recent years, the conversion of natural fruits into stable, bioactive-rich products has gained significant attention. Among these, jamun (Syzygium cumini) has emerged as a promising candidate due to its abundance of flavonoids, polyphenols, anthocyanins, ellagic acid, and other potent antioxidants (Jebitta & Allwin, 2016). This study critically examines the potential of jamun fruit for developing antioxidant-rich tablets, with a particular focus on spray drying as an efficient processing and compression method. Spray drying method is used to convert the jamun juice into a fine powder while preserving its antioxidant properties. According to earlier studies, spray-dried jamun powder has outstanding stability, solubility, and shelf-life properties, which make it a good choice for tablet formation. Important process variables that affect powder quality include intake temperature, feed flow rate, and the use of carrier agents (such as gum arabic or maltodextrin) and antioxidant retention (Kumar & Anandharamakrishnan, 2015). This review compiles findings from various studies on spray-dried jamun formulations, evaluating their physicochemical properties, antioxidant profiles, and pharmacological relevance. Additionally, it highlights the challenges associated with standardizing bioactive compounds, optimizing tablet compression, and addressing regulatory perspectives (Patel & Goyal, 2020).

Keywords: Jamun fruit juice, Spray drying, Antioxidants, Optimization, Tablet formulation

INTRODUCTION

Jamun (Syzygium cumini), also known as Java plum or Indian blackberry, is a medicinally important fruit extensively studied for its diverse phytochemical profile and strong antioxidant potential. The fruit's overall pharmacological relevance and ability to scavenge free radicals are attributed to its abundance of bioactive substances, including flavonoids, anthocyanins, phenolic acids, ellagic acid, and tannins. Traditionally, Jamun has been valued in Ayurvedic and folk medicine for managing diabetes, gastrointestinal disorders, and inflammation, but modern scientific investigations have further validated its potential as a source of natural antioxidants with nutraceutical relevance.

Research in food technology and pharmaceuticals has recently placed a greater emphasis on creating innovative antioxidant delivery systems using extracts from jamun. For instance, Koka et al. (2021) successfully formulated microparticles from aqueous Jamun extract, which exhibited dose-dependent free-radical scavenging activity in the concentration range of 50–150 µg/mL. These results demonstrated not only the high antioxidative capacity of Jamun but also its suitability for incorporation into functional foods and dietary supplements. In a similar vein, Jebitta and Allwin (2016) discovered that jamun pulp powder contains significant levels of phenolic compounds, flavonoids, and anthocyanins, confirming its nutritional and therapeutic advantages. Collectively, such findings highlight the potential of Jamun as a natural source of bioactive compounds that can be stabilized and delivered in modern dosage forms.

One especially promising technique for enhancing the stability and utilization of antioxidants obtained from jamun is the manufacture of tablets. The conversion of fruit extracts into tablet dosage forms not only improves ease of consumption and portability but also ensures better dosage standardization, patient compliance, and commercial scalability. To ensure that the finished product satisfies pharmacopeial criteria of quality, safety, and efficacy, however, the development of such formulations necessitates rigorous optimization, encompassing extraction techniques, antioxidant activity retention, excipient selection, and compression parameters.

Therefore, the purpose of this study is to examine how jamun fruit extract can be used in the creation of tablets that are high in antioxidants. Specific attention is given to optimizing extraction techniques, evaluating antioxidant potency through standardized assays, assessing critical formulation and compression parameters, and ensuring quality attributes such as hardness, disintegration, friability, and stability. This work aims to provide a scientific basis for creating a plant-based antioxidant supplement that might be utilized as a nutraceutical and therapeutic aid by fusing traditional knowledge with contemporary processing methods.

MATERIALS AND METHODS

Jamun fruits were brought from the local market, Coimbatore, Tamil Nadu, India. The fruits were washed and sorted in normal tap water. Further the blanching process takes place (at 100^0 C) for few minutes. After blanching, the pulp and seed of the fruits were separated and were finely grounded into paste. Preservative (Sodium benzoate) is added to increase the shelf-life of the product. Maltodextrin (15 – 20 % w/w) was incorporated as a carrier agent and drying aid to improve the spray-drying efficiency and minimize phase separation.

Then homogenize the juice carrier for uniformity. For spray-drying operation parameters include inlet air temperature as 165o C (Ravindran et al., 2022) and outlet temperature of 75oC. Atomization influences the particle size, solubility, and bulk density. For storage condition the powder is hygroscopic, so the powder was packed in moisture proof materials (aluminium foil laminates and vacuum pouches).

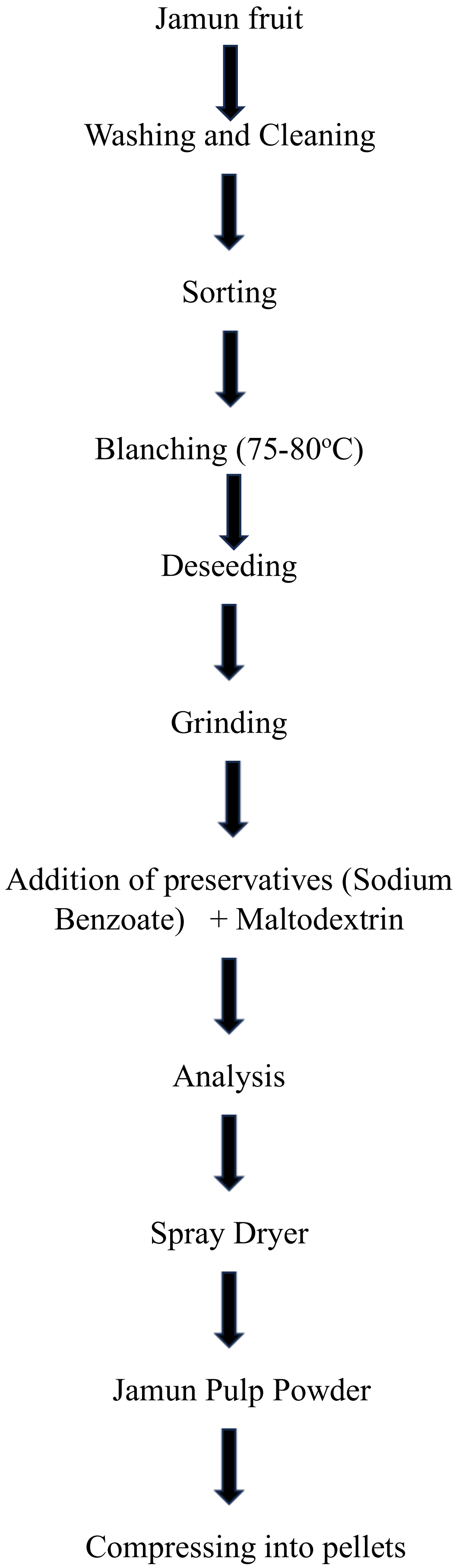

Fig. 1. Flow Chart for the production of anti-oxidant rich tablets.

The powder was stored at low temperature and low humidity to preserve anthocyanins. (*shelke et al.,2023*).

Finally, the powder was compressed into uniform tablets, making it convenient for use as a natural, antioxidant-rich health supplement *(Kaur & Aggarwal 2023*).

RESULTS AND DISCUSSION

Samples without preservatives showed visible spoilage within three days of storage, confirming the highly perishable in nature. In contrast, juice treated with preservative (Sodium benzoate) exhibited no signs of microbial spoilage, discolouration, even after 2 weeks. By using Spray drier operations atomization influences particle size, solubility, and bulk density. The use of higher maltodextrin gives better yield less stickiness, lighter colour, which is common challenges in high sugar fruit juices.

Solubility was significantly improved in formulations containing maltodextrin compared to those without, highlighting its role as an effective carrier and stabilizer. The obtained powder retained the natural purple coloration indicating the stability of anthocyanin pigments under controlled drying conditions. By using optimized drying parameters, it is ensured that the minimal degradation of heat sensitive bioactive compounds was obtained while yielding a stable powder suitable for storage and for further use.

TABLE 1

Results from Jamun Fruit Juice to Antioxidant Tablets

Parameter/ Ingredients	Quantity/ Result	Standard/ Reference value	Methods Used	Interpretation
Jamun fruit juice powder (%)	60	55 - 65	Formulation	Rich source of antioxidant
Maltodextrin (carrier, %)	20	20	Formulation	Improves yield and solubility
Sodium Benzoate (%)	0.1	≤ 0.1	Formulation	Ensures storage stability
pH	3.6	3 – 4	Digital pH meter	Suitable acidic range
Titratable Acidity	0.8	0.7 – 1.0	Titration method	Stable organic profile
Total Soluble Solids (° Brix)	14.5	12 – 15	Hand refractometer	Natural sweetness retained
Moisture Content (%)	3.8	<5	Hot air oven	Good storage stability
Powder Yield (%)	72.4	70 – 80	Spray drying calculation	Efficient yield
Solubility	92.6	90	Gravimetric method	Better reconstitution
Tablet Hardness (%)	4.5	4 – 6	Hardness tester	Optimum mechanical strength
Disintegration Time	3.2	<5 mins	Disintegration tester	Rapid solubility
Antioxidant Activity (DPPH)	78.5	>70	DPPH radical scavenging assay	High antioxidant capacity
Overall Acceptability (Sensory)	8	≥ 8	Sensory evaluation panel	Good acceptance

TABLE 2

Process Parameters for the

Production of Jamun Pulp Tablets

Basic Equipment		Spray Drier
Operating Temperature	Inlet	165℃
	outlet	90℃
Feed rate		3 – 4 ml/min
Compressed air pressure		2.0 – 3.0 bar
Additives	Sodium benzoate	0.1%
	Maltodextrin	15% - 20%

Storage studies indicated that the powder remained stable for up to three months under ambient conditions when packed in polyethylene pouches, with no rancidity, lumping, or phase separation observed. These findings are in agreement with earlier studies on the use of additives in jamun fruit pulp spray drying, but demonstrate the novelty of using plant-based fortificants which improve both nutritional value and stability.

CONCLUSION

The present study demonstrated the potential of jamun fruit in the development of nutraceutical products. Jamun juice, which is otherwise highly perishable and available only during a short season, was effectively converted into a fine, stable powder through spray drying. The use of maltodextrin as a carrier agent improved powder yield, reduced stickiness, and helped maintain the natural purple coloration and bioactive compounds such as anthocyanins and phenolics. Sodium benzoate played a crucial role in extending the microbial stability of the juice prior to drying and improves the shelf life.

The spray-dried powder was further compressed into tablets that were uniform in size, had good hardness and friability, and showed rapid solubility when reconstituted in water. This work not only demonstrates a sustainable approach to utilizing jamun fruit but also addresses issues of post-harvest losses and seasonal unavailability. The study confirms that jamun-based anti-oxidant rich tablets can serve as a convenient, year-round health supplement.

ACKNOWLEDGEMENTS

The authors sincerely thank the Department of Food Technology for providing laboratory facilities and technical guidance throughout this project. Special thanks are extended to the faculty members and laboratory staff for their continuous support and encouragement. The authors also acknowledge the contribution of team members who assisted during raw material preparation, spray drying trials, and data collection

REFERENCES

1. Ravindran et al., 2022-Spray drying of Syzygium cumini colorant optimized at 165 "C inlet temperature and 25% solids, good anthocyanin retention and -67% yield. (PubMed, 36193350).

2. Shwetha & Preetha, 2017-Compared spray drying (110 °C) vs. freeze drying of Jamun juice with maltodextrin/gum arabic; found carrier and temperature strongly affect anthocyanin stability. (Asian J. Chem.). Kadam et al., 2017-Reviewed spray drying of fruit/vegetable juices, for Jamun, MD+GA blend (23%), 160 °C inlet, 14.5°Brix gave optimum results. (Critical Review, ResearchGate).

3.Shelke et al., 2023-Studied physical and functional stability of Jamun powder with different carriers; moisture, solubility, and anthocyanin retention varied with carrier type. (J. Texture Studies)

4. Baliga, M. S., et al. (2011). Scientific validation of the ethnomedicinal properties of Syzygium cumini. Food Research International, 44(7), 1776–1789.2.

5. Sharma, P., et al. (2012). Nutritional and therapeutic potential of Syzygium cumini: A review. Journal of Pharmacognosy and Phytochemistry, 1(3), 16–20.3.

6. Gupta, A., et al. (2017). Effect of drying methods on physicochemical and antioxidant properties of Syzygium cumini pulp powder. Journal of Food Science and Technology, 54(1), 156–164.4.

7. Singh, A., et al. (2015). Development and evaluation of jamun powder-based tablet formulation. International Journal of Pharmaceutical Sciences Review and Research, 33(1), 81–86.5.

8. Ramesh,G., et al. (2020). Advances in nutraceutical delivery systems: A focus on tablets and capsules. Journal of Functional Foods, 68, 103881.