*J. Agric. Res. Technol., 47 (2) : 233-238 (2022)* https://doi.org/10.56228/JART.2022.47220

# Development of Antioxidant Rich Ice Cream using Spray Dried Jamun Juice Powder

G. N. Shelke[1], V. P. Kad[2], G. B. Yenge[3], and S. R. Kakade[4]
Department of Agricultural Process Engineering,
Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 28.02.2022 Accepted : 15.03.2022)

## Abstract

This research aimed to evaluate the effect of spray-dried Jamun juice powder on the various quality attributes of the ice cream. The physicochemical properties of ice cream, such as overrun, hardness, melting rate, total soluble solids, fat, ash, titrable acidity, pH, and sensory analysis, were investigated at different concentrations of spray-dried Jamun juice powder (2, 4, 6, and 8%). Results showed that powder concentration exhibited a significant ($p < 0.05$) effect on all quality characteristics. The physical parameters of the produced ice cream viz., overrun and hardness were in the range of 50.22–58.90 %, 21.2-34.26 N, respectively. The chemical properties, including total soluble solids, fat, ash, titrable acidity, and pH, were in the range of 30-50%, 10.2-11.99%, 0.83 to 1.70%, 0.176 to 0.250%, 6.72 to 6.1. The functional attributes including total anthocyanin, total phenol content, and antioxidant activity were 0.088-2.1 mg $g^{-1}$, 0.00-8 mg GAE $100^{-1}$ g, and 0.00 to 74.07%, respectively. Based on the sensory analysis scores, 6% Jamun juice powder was found to be the best treatment. Spray-dried Jamun juice powder can be used for product development, improve the food's physical attributes, and enrich nutrition.

**Key words : Jamun juice powder, physico-chemical, functional ingredients, Ice cream**

Jamun fruit (*Syzygium cumini* L) is a minor tropical fruit relating to the Myrtaceae family, popularly known as jambul, java plum, jam, black plum, Indian blackberry and jambolan (Aslam *et al*., 2019; Ghosh & Pradhan, 2017; Pharate *et al*., 2018; Shelke *et al*., 2020). Jamun fruits have higher level of activity compared to other common fruits as guava, jackfruit, pineapple and papaya. The higher antioxidant capacity behavior mainly due to the presence of vital nutrients and polyphenols (Shelke *et al*., 2020). Jamun fruits is widely utilized by conventional practitioners over many years for the treating of a number of disorders due to presence of numerous pharmacological properties (Singh and Paswan, 2015).The production of jamun fruits is unorganized in India, with significant annual losses between 20 and 30 % after the harvest (Patil *et al*., 2012). Jamun fruits should be preserved and processed into valuable products to minimize post-harvest losses. A large number of food products are prepared from Jamun fruits. Fruit juices can only be stored for several weeks or months, while fruit juices powder can be stored for months or years. (Rezaul & Chen, 2017).Over the years, the demand for fruit juice powders has risen exponentially, since it is used as either raw materials for processing or the powder itself as the finished product (Oyinloye & Yoon, 2020). Fruit juice in powder form can be used to prepare various processed food products, such as cakes, bread, cookies and a variety of drinks. Fruit juice powder is becoming more and more popular due to the ease of packaging, transport and formulation of products (Braga *et al*., 2020). There is a great scope for the developmentof value added dairy products with this fruitnot only because of their exotic flavor butalso due to their nutraceutical importanceand therapeutic values. Thus, processing ofjamun

1. and 4. Ph. D. Scholar, 2 Associate Professor, 3. Assistant Professor.

fruit into value-added products resultin a wide variety of exotically flavoredproduct with better nutritional and sensoryqualities may unveil new market for export.

Ice cream is a cold dessert that is prepared by blending several ingredients such as milk, cream, milk solids non - fat (MSNF), sugars, stabilizer and emulsifying agents, as well as flavors and coloring agents (Hashim and Shamsi, 2016).Ice cream is an excellent source of food energy due to its high fat content, although a high dietary fat intake is associated with an increasing risk of health problems. That is why need is developing for minimal fat ice cream made with enhanced quality ingredients such as fruits and nuts. To meet the requirements, the dairy industry has contributed a variety of fat-free ice creams without changing the sensory qualities (Murtuza *et al*., 2004).Due to the active life-style of the consumer, the market for healthier ice cream continues to grow.The ice cream industry should also hold a closer focus on the emerging innovations and resources that can help to develop exactly what is needed. Plain ice cream does not contain polyphenols, antioxidant and vitamins. Therefore, fortification of fruit powder in the ice cream production can be increase the nutritional quality. The quality of finished ice cream can be influenced by the addition of substances that affect these properties.

Studies on the production of a functional food ingredient from different fruit juice powder are available in the literature. However, no such studies on jamun juice powder fortification in dairy products are recorded as far as we know. The primary focus of this experiment was therefore to strengthen the nutrient content of ice cream, along with phenolic compounds from jamun juice powder using fortification techniques, in order to increase the texture of ice cream with health benefits and increased stability.

## Materials and Methods

Cow milk, cream, sugar, skim milk powder, stabilizer, and emulsifier were bought from the local market as raw materials. Chemicals and glassware were purchased for research from M/S Dodal Enterprises (Aurangabad, Maharashtra).

**Preparation of Jamun Juice powder :** Spray dried Jamun juice powder was produced using Labultima (model LU-222, Advanced) laboratory spray dryer. The spray dryer operates concurrently and has a spray nozzle, two-fluid atomizer with 0.7 mm diameter orifice. The inlet air temperature 160°C were used. Jamun juice was fed into the drying chamber using a peristaltic pump. The liquid feed rate to the dryer was 5 per cent and the aspirator rate was 50 per cent. The atomization air pressure was set to 3 kg $cm^2$ on the air pressure regulator. The product obtained was kept in aluminum laminated (0.02 mm) pouches. The pouches were then stored in a desiccator containing silica gel before used (Sonone *et al*., 2016).

**Formulation :** Ice cream blends were prepared in a quantity of 1 kg per treatment. The basic ice cream recipe was designed to comprise 10% fat, 11% SNF, 15% sugar, % stabilizer (CMC), 0.4% emulsifier (GMS) and jamun juice powder at various levels of 2-8 percent. Ice cream without jamun powder T0 (control) and ice cream with jamun powder $T_1$, $T_2$, $T_3$ and $T_4$ (2%, 4%, 6%, and 8% w/w) were the five treatments with three replications.

**Preparation of ice-cream :** The methods described by Walstra, Wounters, and Geurts (2006) were used to make ice cream. The ice cream mixes were made in batches according to the treatment. Except for the jamun juice powder, all ingredients were weighed and blended well using a hand held blender (Ciclone 20, Naru Equipment, and Mumbai, India). The mixes were pasteurized at 72°C for 20 minutes

to kill disease - causing organisms and getting cooled to 5°C. The pasteurized mixes were then homogenized in a homogenizer (Sealtech Engineers, Pune, India) to produce and improve ice cream appearance. The homogenized ice cream mixture was aged at 4°C to improve product viscosity. Jamun pomace powder was put into ice cream mix after aging, and the entire combination was filled into a batch freezer ice cream machine (3 kg capacity; Jyoti Machinery, Varanasi, UP, India). At first, only the beater was turned on for two minutes. Beater and compressor were started jointly after two minutes, and the ice-cream position was checked after 20 minutes and drained by pulling the tripper. The required freeze time for the different mixtures was 20±5 min. Soft ice cream samples were collected from the ice cream machine outlet in 50 mL paper cups. The sample was labeled and stored in a deep freezer for hardening at -18°C to -20°C. After the ice cream hardened, the physicochemical and sensory qualities were evaluated.

## Physico-chemical analysis of ice cream

**Physical analysis :** Overrun was determined using standard methods(Azari-Anpar *et al*., 2017). The hardness of prepared ice creams was measured on the UTM at 25°C (Make: Shimadzu, model: AG-X). For hardness testing, a 2 mm stainless steel cylindrical probe was used. The penetration speed and depth were set at 2.0 mm s-1 and 15 mm, respectively. The peak compression force was used to calculate the sample's hardness (N) (Bahram Parvar *et al*., 2013; Pon *et al*., 2015).

**Chemical and functional analysis :** Total soluble solids (TSS) of Ice cream were measured using a hand Refractometer (Erma, Tokyo, Japan) as degree Brix (°Bx) (AOAC, 2000). The ash content was determined using (AOAC 2000) procedure by igniting the organic matter and expressed as percentage. The ice cream fat content was determined using Soxtron (Sox-2, Tulin Equipments Koyambedu, Chennai, Tamil Nadu). The titrable acidity was measured using the (AOAC 2000) method. Also, the pH of the juice was measured using a pH meter (ELICO Ltd., Hyderabad, India). Total phenolic, anthocyanin content and antioxidant activity of ice cream were determined according to the methods proposed by (Singh *et al*., 2019).

**Sensory analysis of ice-cream :** The ice creams were evaluated according to protocol (Bahramparvar *et al*., 2014). All samples were served in 30 mL paper cups and examined under clear white lighting at 24 1 °C. Panelists were chosen from among students and professors at Mahatma Phule Agricultural University's Department of Agricultural Process Engineering in Rahuri. The ice creams was evaluated for sensory qualities using a 9-point hedonic scale, which spans from strongly like to extremely dislike for various parameters, by panels of eleven semi-trained judges. Color, texture, taste, aroma, and overall acceptability mean values were observed (Gabbi, Bajwa and Goraya, 2017).

**Statistical analysis :** SAS 9.1 (SAS Institute Inc., Cary, NC, USA) was used to perform analysis of variance (ANOVA) on the experimental data. A significant difference between treatments was determined using Turkey's technique at a level of significance ($P < 0.05$). Each measurement was carried out three times.

## Results and Discussion

**Effect of jamun juice powder incorporation on physical properties :** The amount of air in ice cream is critical since it affects the quality and profitability of the product. As a consequence, in order to achieve the maximum overrun, it was needed to assess both economic and customer approval as per national regulations (Azari-Anpar *et al*., 2017). It was observed that the level of jamun juice powder in

the ice cream increased, the overrun value increased significantly ($p < 0.01$). Control ice cream sample $T_0$ had a higher overrun value (50.22%), while treatment $T_4$ had a lower overrun value (58.90 %) (Table 1). The increased overrun values were probably due to maltodextrin and gum Arabica based juice powder alternatives, by raising viscosity during blending and freezing process, air is effectively dispersed throughout the texture and thus lead to higher sample overrun. Comparable findings also reveal that the use of maltodextrin (Azari-Anpar *et al*., 2017) and modified starch as a fat replacer in the ice cream composition to higher overrun. The peak force reached during probe penetration was characterized as ice cream hardness (Ghandehari Yazdi *et al*., 2020).The hardness was affected significantly ($p<0.01$) due to addition of jamun pomace powder (Table 2).The findings indicated a decrease in hardness due to addition of jamun pomace powder. The control sample had a hardness of 34.26 N, which decreased to 21.2 N for sample with 8 % addition of jamun pomace powder. This was due to increased overrun with addition of jamun pomace powder.

**Effect of jamun juice powder incorporation on chemical analysis :** The chemical findings indicated that the total soluble solids, ash, titrable acidity increased significantly ($P > 0.05$) while the fat content and pH, decreased significantly ($P > 0.05$) with 2 to 8 % of jamun juice powder incorporation. The observations of chemical analysis are described in Table 1. The highest values of TSS (50.01), Ash (1.70%) and titrable acidity (0.250%) were found at treatments $T_4$ (8% JJP), while highest value of fat (11.99) and pH (6.72) were found at treatment $T_1$ (control). On the other hand lowest value of TSS (30.23), Ash (0.83%) and titrable acidity (0.170%) were found at treatments $T_1$ (control), while lowest value of fat (10.2) and pH (6.12) were found at treatments $T_4$ (8% JJP).Increase in the total solids content of the ice creams due to the high total solid content of the jamun juice powder. The fat content of ice cream decreased significantly, was due to the jamun juice powder has a low fat content. Fruits contain less fat so that their inclusion contributes to a reduction in fat content. Ash content significantly increased due to the higher amount of ash in added powder.

**Table 1.** Effect of jamun Juice incorporation on physico-chemical properties of ice cream

| **Properties** | **Treatments** | | | | |
|---|---|---|---|---|---|
| | **$T_1$ (Control)** | **$T_2$ (2%)** | **$T_3$ (4%)** | **$T_4$ (6%)** | **$T_5$ (8%)** |
| TSS °B | 30.23 ±0.80$^e$ | 36.82 ±1.26$^d$ | 41.23 ± 1.9$^c$ | 44.69 ± 2.61$^b$ | 50.01 ±1.74$^a$ |
| Fat % | 11.99 ±0.01$^a$ | 11.20 ±0.02$^b$ | 10.70 ±0.05$^c$ | 10.40 ± 0.04$^d$ | 10.2 ±0.02$^e$ |
| Ash % | 0.83 ±1.53$^e$ | 0.98 ±2.52$^d$ | 1.36 ±4.51$^c$ | 1.55 ± 1.53$^b$ | 1.70 ±2.00$^a$ |
| Titrable acidity % | 0.176 ±0.84$^e$ | 0.190 ±0.67$^d$ | 0.210 ± 0.64$^c$ | 0.235 ±1.06$^b$ | 0.250 ±0.85$^a$ |
| pH % | 6.72 ±0.22a | 6.65 ± 0.79$^b$ | 6.35 ±0.25$^c$ | 6.23 ±0.18$^d$ | 6.12 ±0.51$^e$ |
| TAC (mg 100-1 g) | 0.088 ± 1.35$^e$ | 1.20 ±0.93$^d$ | 1.60 ± 0.56$^c$ | 1.92 ± 0.83$^b$ | 2.1 ± 0.97$^a$ |
| TPC (mg GAE 100-1) | - | 4.33 ±1.50$^a$ | 6.21 ± 1.12$^d$ | 7.42 ±1.65$^e$ | 8.00 ±1.52$^b$ |
| AA (%) | - | 55.33 ± 2.47$^d$ | 60.24 ± 1.85$^c$ | 66.23 ± 0.86$^b$ | 74.7 ± 1.40$^a$ |
| Hardness N | 34.26 ± 0.95$^c$ | 33.2 ± 1.01$^d$ | 29.4 ± 0.76$^c$ | 25.4 ± 1.11$^b$ | 21.2 ± 1.03$^a$ |
| Overrun % | 50.22 ± 0.04$^a$ | 51.21 ± 0.05$^b$ | 56.33 ± 0.43$^c$ | 57.22 ±0.10$^d$ | 58.90 ±0.08$^e$ |

n=3, Means ±SD with different lower-case letters in the same line are significantly different ($P < 0.05$). TAC, Total anthocyanin content; TPC, Total phenolic content, AA, Antioxidant Activity. $T_0$ - Control ice cream without jamun juice powder (JJP); $T_1$ - ice cream with 1% jamun juice powder (JJP); T2 - ice cream with 2% jamun juice powder (JPJP); $T_3$ - ice cream with 3% jamun juice powder (JJP) and $T_4$ - ice cream with 4% jamun juice powder (JJP)

**Table 2.** Effect of jamun juice powder incorporation on sensory characteristics of ice cream

| Treatment | Level JPP% | Colour | Texture | Taste | Aroma | Overall acceptability |
|---|---|---|---|---|---|---|
| $T_0$ | 0 | 7.0 ± 0.32$^e$ | 6.8 ± 0.99$^e$ | 6.0 ± 0.41$^e$ | 5.0 ± 0.68$^e$ | 6.1 ± 0.43$^e$ |
| $T_1$ | 2 | 7.3 ± 0.12$^d$ | 7.6 ± 0.47$^d$ | 7.1 ± 0.49$^d$ | 6.7 ± 0.38$^d$ | 7.0 ± 0.22$^d$ |
| $T_2$ | 4 | 7.7 ± 0.28$^c$ | 7.9 ± 0.38$^c$ | 7.6 ± 0.73$^c$ | 7.8 ± 0.92$^c$ | 7.5 ± 0.38$^c$ |
| $T_3$ | 6 | 8.6 ± 0.32$^b$ | 8.9 ± 0.12$^a$ | 8.9 ± 0.63$^a$ | 8.5 ± 0.13$^b$ | 8.9 ± 0.78$^a$ |
| $T_4$ | 8 | 8.9 ± 0.42$^a$ | 8.0 ± 0.33$^b$ | 8.1 ± 0.42$^b$ | 8.7 ± 0.48$^a$ | 8.0 ± 0.62$^b$ |

n=10. Least Squares Means ±SD with different lower-case letters in the same line are significantly different ($P < 0.05$).

Increased titrable acidity of ice cream may be owing to greater acidity and high phenolic content of jamun juice powder, such as galic and elagic acid.The findings of this analysis are compatible with Shelke *et al*. (2020), Ayar *et al*. (2018), Goraya and Bajwa (2015)

**Effect of jamun juice powder incorporation onfunctional analysis :** The anthocyanin and phenols are essential substances in Jamun fruit (Shelke *et al*., 2020). The functional attributes, including TAC, TPC and AA of the ice cream, were significantly ($p<0.05$) influenced by Jamun juice powder concentrations. The highest values of TAC (2.1 mg $100^{-1}$ g), TPC (8.00mg GAE/100) and AA (74.7 %) were observed at treatment $T_4$ (8% JJP), whereas, lowest were found at treatment $T_1$ (control). Increased phytochemicals percentage of ice cream may be owing to greater high phenolic content of jamun juice powder, such as galic and elagic acid. Similar results were reported by (Hashim and Shamsi, 2016; Jazić *et al*., 2019).

**Sensory analysis of ice-cream :** Sensory analysis results indicate that the panelists recognize substantial variation in color, texture, flavour and overall of the ice cream sample. There was a significant ($p < 0.05$) difference in the sensory score of color, texture, taste, aroma and overall acceptability (Table 2). The color score of treatment $T_4$ (8.9) was greater for ice cream with 8% jamun powder than for other samples. The strength of purple color was reported to be dependent on the amount of jamun juice powder. The texture values were the highest (8.9) for ice cream incorporating 6% jamun juice powder. The taste scores of treatment $T_3$ (8.9) was maximum for ice cream with 6% jamun powder. Increase in powder more than 6%, the taste of ice cream was degraded due to the pungency of jamun powder. Aroma scores were greatest for ice cream with 8% jamun powder. The results of ice cream ($T_3$) manufactured with 6% jamun juice powder was liked very much in aspects including texture, taste, aroma and overall acceptability.

## Conclusion

The Physico-chemical analysis of Jamun Pomace powder incorporated ice cream revealed that the total solids, ash, acidity, TAC, TPC, AA and overrun increased whereas fat content, pH, hardnessdecreased significantly at augmented level of powder. Jamun pomace powder 6% (w/w) found to be a suitable source for enrichment of ice cream without affecting adversely the organoleptic properties.Spray dried jamun juice powder can be used as natural sweetener, colorant andflavoring agent to produce ice cream with unique color and aroma.

## Acknowledgment

Author acknowledges the financial assistance provided by the Mahatma Phule Krishi Vidyapeeth, Rahuri and Chhatrapati Shahu Maharaj Research Training and Human

Development Institute (SARTHI), Pune, Maharashtra, India to carry out this research work.

## References

Aslam, A., Zahoor, T., Khan, M. R., Khaliq, A., Nadeem, M., Sagheer, A., Chugtai, M. F. J. and Sajid, M. W. 2019. Studying the influence of packaging materials and storage on the physiochemical and microbial characteristics of black plum (*Syzygium cumini*) jam. Journal of Food Processing and Preservation, 43(5), 1-11. https://doi.org/10.1111/jfpp.13941

Azari-Anpar, M., Khomeiri, M., Ghafouri-Oskuei, H. and Aghajani, N. 2017. Response surface optimization of low-fat ice cream production by using resistant starch and maltodextrin as a fat replacing agent. Journal of Food Science and Technology, 54(5), 1175-1183. https://doi.org/10.1007/s13197-017-2492-0.

Bahram Parvar, M., Razavi, S. M. A., Mazaheri Tehrani, M., and Alipour, A. 2013. Optimization of functional properties of three stabilizers and κ-carrageenan in ice cream and study of their synergism. Journal of Agricultural Science and Technology, 15(4), 757-769.

Bahramparvar, M., Salehi, F. and Razavi, S. M. A. 2014. Predicting total acceptance of ice cream using artificial neural network. Journal of Food Processing and Preservation ISSN, 38, 1080-1088. https://doi.org/10.1111/jfpp.12066

Braga, V., Guidi, L. R., de Santana, R. C. and Zotarelli, M. F. 2020. Production and characterization of pineapple-mint juice by spray drying. Powder Technology, 375, 409-419. https://doi.org/ 10.1016/j.powtec.2020.08.012

Ghandehari Yazdi, A. P., Barzegar, M., Ahmadi Gavlighi, H., Sahari, M. A. and Mohammadian, A. H. 2020. Physicochemical properties and organoleptic aspects of ice cream enriched with microencapsulated pistachio peel extract. International Journal of Dairy Technology, 0(2018), 1-8. https://doi.org/10.1111/1471-0307.12698

Ghosh, P. and Pradhan, R. C. 2017. Physicochemical and Nutritional Characterization of Jamun (*Syzygium Cuminii*). Current Research in Nutrition and Food Science, 5(1), 25-35.

Hashim, I. B. and Shamsi, K. S. Al. 2016. Physiochemical and sensory properties of ice-cream sweetened with date syrup. MOJ Food Processing and Technology, 2(3), 91-95. https://doi.org/10.15406/mojfpt.2016.02.00038

Jazić, M., Kukrić, Z., Vulić, J. and Četojević-Simin, D. 2019. Polyphenolic composition, antioxidant and antiproliferative effects of wild and cultivated blackberries (*Rubus fruticosus* L.) pomace. International Journal of Food Science and Technology, 54(1), 194-201. https://doi.org/10.1111/ijfs.13923

Murtuza, M. A., Nuzahat Huma, G., Mueendin, M. A. S. and Shaid, M. 2004. (PDF) Effect of Fat Replacement by Fig Addition on Ice Cream Quality. International Journal of Agriculture and Biology, March 2015, Vol. 6, No.1. https://www.researchgate.net/publication/242235179_Effect_of_Fat_Replacement_by_Fig_Addition_on_Ice_Cream_Quality.

Oyinloye, T. M. and Yoon, W. B. 2020. Effect of freeze-drying on quality and grinding process of food produce: A review. Processes, 8(3), 1-23. https://doi.org/10.3390/PR8030354

Patil, S. S., Thorat, R. M., & Rajasekaran, P. (2012). Utilization of Jamun Fruit (Syzygium cumini) for Production of Red Wine. Journal of Advanced Laboratory Research in Biology, 3(3), 200–203. https://e-journal.sospublication.co.in/index.php/jalrb/article/view/126%0Ahttp://files/368/Patil *et al*. - 2012 - Utilization of Jamun Fruit (*Syzygium cumini*) for P.pdf

Pharate, K., Shubham, B., Holkar, K., Katariya, T. and Pharata, M. 2018. A Review on Syzygium cumini - A Valuable Fruit. Journal of ready to eat food, 7(9), 527-534. https://doi.org/10.20959/wjpps20189-12270.

Pon, S. Y., Lee, W. J. and Chong, G. H. 2015. Textural and rheological properties of stevia ice cream. International Food Research Journal, 22(4), 1544-1549.

Rezaul, M. S. I. and Chen, W. 2017. Trends of spray drying: A critical review on drying of fruit and vegetable juices. Trends in Food Science and Technology, 65, 49-67. https://doi.org/10.1016/j.tifs.2017.05.006

Shelke, G., Kad, V., Yenge, G., Desai, S. and Kakde, S. 2020. Utilization of jamun pomace as functional ingredients to enhance the physico-chemical and sensory characteristics of ice cream. Journal of Food Processing and Preservation, 44(10), 1-8. https://doi.org/10.1111/jfpp.14736

Singh, C. S. and Paswan, V. K. 2015. Process Optimization for Development of Jamun (*Syzygium Cumini* L.) Enriched Shrikhand. Int. J.Curr. Microbiol, 4(12), 73-81.

Singh, C. S., Paswan, V. K. and Rai, D. C. 2019. Process optimization of spray dried Jamun (*Syzygium cumini* L.) pulp powder. Food Science and Technology, 109, 1–6. https://doi.org/10.1016/j.lwt.2019.04.011

Sonone, V. S., Unde, P.A. and Kad, V. P. 2016. Effect of spray dryer parameters on different properties of fruit juice powder. International journal of advanced engineering, management and science (UAEMS), 2(8): 1301-1312.