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Development and evaluation of Jamun *(Syzygium cumini)* fortified "Instant drink mix" by utilizing the spray drying technique

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Abstract
Jamun (*Syzygium cumini*) is seasonal fruit with best medicinal properties. We need to preserve by different processes or by manufacturing of a stabilized product. Therefore most important objective of this research is to develop Jamun fortified "Instant drink mix" in which the ratio of (JTC) Jamun: tamarind: Chili (60:30:10) by the spray drying at three inlet temperature (180˚ C, 170˚C, 160˚ C), Outlet temperature (90±5), feed flow rate (16ml/min) with two malt dextrin concentration (20%, 25%) with Jamun pulp powder (JPP) as control. Physicochemical properties (moisture content, water activity, pH, Total acidity, bulk density, tapped density, porosity/Carr Index, cohesiveness, color, solubility, powder morphology) and sensory properties evaluated. The study observed that moisture content decreases with the increase in temperature and malt dextrin concentration and water activity increases with the decrease in Malt dextrin. Color changes purple pink to light pink with the increase in Malt dextrin concentration. Overall acceptable powder sample is 25% MD at 170^0 C for instant drink mix with sensory score 8.25. Bioactive compounds like Total anthocyanin content (47.67mg/g), Total phenolic compound (3.87mg/g), Total flavonoid content (25.87mg/g), and Antioxidant activity (scavenged H_2O_2 (27.43%) and (scavenged nitric oxide (9.88%) were evaluated. This nutritional content was reduced after spray drying in JTC powder as compared to control Jamun pulp powder. All three pulp used has anti-diabetic, anticancer components. Further scope of the study is the effect of different packaging material in two different temperatures on powder.

Keywords: Syzygium cumini, instant drink mix, spray drying, Maltodextrin, physicochemical, Bioactive compound

1. Introduction
Jamun fruit (*Syzygium cumini*) produces in tropical and subtropical climates and it starts growing between May to end of August month. In its native India, fruit is also called Jambhul or Jaam. Fruit has extremely juicy pulp with sweet, tart and slightly astringent taste and contains minerals like calcium, sodium, iron, and vitamin C. Jamun, tamarind and chili are low in calories and consist of different bioactive compounds like anthocyanin which gives color pigment to product and total phenolic compound, total flavonoid content minimize risk of liver diseases, cancer. They also aid digestion, act as an anti-diabetic component, enhance blood purification and provide antioxidant activity. Tamarind (*Tamarindus indica L.*) gives thick and sticky pulp which contains non-starch polysaccharides (dietary fibers) which protect from cancer-causing chemicals by binding with toxins in food. Green chili (*Capsicum annum*) is immature chili pepper which contains phytochemical capsaicin/capsaicinoid responsible for hot sensation and pungency to the tongue (*Al-Sebaeai et al. 2017*) [12]. This protects from growing cancer cells in the human body reported by the American Institute of cancer research.
Jamun is highly perishable fruit therefore, the spray drying method was used to developed stabilize product like Jamun pulp powdered drink mix with tamarind and Chili. Instant drink mix is designed a product which has characteristic of fast reconstitution with water (*Jittanit et al. 2010*) [30]. Many types of drink mix are available in powder form as a health supplement for the sportsperson, children, old people, pregnant women, and patients. It is served with sugar or sugar-free.
The spray drying method produces a dry powder rapidly from the liquid sample by coming in contact with hot gases. This process basically involves a) Concentration b) atomization c)

droplet air contact d) droplet drying e) separation (*Muzaffar et al. 2018*) [1]. Thermally sensitive food is processed by spray dryer due to its rapid evaporation of solvent from droplets (*Re et al. 2007, Tontul et al. 2017*) [17]. Spray drying parameters like concentration of drying aid, inlet temperature, outlet temperature, feed flow rate, and feed characteristics are responsible for effective physicochemical properties of dried fruit pulp powder (Muzaffar *et. al. 2018* [1], *Lee et al. 2017*) [27]. Particle size and powder morphology of spray dried powder are based on the physical and chemical properties of feed, dryer design and operation (*Muzaffar et. al. 2018* [1], *Phisut et al. 2012*) [4]. To encapsulate the bioactive compounds and solve the problem of stickiness due to low molecular weight organic acid and fructose content in fruit and low glass transition temperature, we use maltodextrin which is common drying aid in spray drying technique (*Cynthia et al. 2014* [11]. Spray dried powder has good reconstitution properties which are beneficial for characteristics of instant drink mix which developed in this research study. Spray drying process provides a reduction in volume, transportation cost, and microbiological degradation and makes it easy to handle (*Avila et al. 2015* [18], *Fazaeli et al. 2012* [26] *and Lee et al. 2017*) [27]. This powder is low in water activity which gives better storage ability and longer shelf life (*Khuenpet et al. 2016*) [6].

In this research, the main work is to develop Jamun fruit fortified "Instant drink mix" by optimizing with changing two parameters i.e inlet temperature and maltodextrin concentration. Others are outlet temperatures and feed flow rate kept constant and evaluated physicochemical, sensory and reconstitution properties, bioactive compounds in developed powder.

2. Material and Method

Jamun fruit, Tamarind, chili purchased from local market in Guduvancherry, India. Food grade Maltodextrin (DE < 20) used as drying aid. Tall type of spray dryer (S. M. Scientech, Kolkata, India) used. Prepare Jamun pulp manually and stored in the deep freezer for further process.

2.1 Sample preparation

Weigh Jamun pulp ground in the mixture. Weigh tamarind and added into hot water with temperature 45° C-50° C in the ratio (1:2.5) for soaking for 30 min. (*Muzaffar et al. 2015* [9], *Cynthia et al. 2014*) [11], then squeezed it and made pulp, keep this pulp in the refrigerator at 6°C for 20 min. Add 10-20 ml water in Chili and ground in the mixture for making pulp. All three pulps filtered by muslin cloth thrice separately and mix together in the ratio (60:30:10). Add Maltodextrin in two concentrations (20%, 25%) by (w/v %), mixed them till it completely dissolves and again filtered by muslin cloth.

2.2 Spray drying process

Spray drying was operated at three inlet temperatures (180° C, 170° C, 160° C), outlet temperature(90±5), Feed flow rate (16ml/min), feeding temperature of the sample was 28°C. Dried powder collected in a glass bottle from cyclone separator and the bottom separator and packed in High-density polythene bags and sealed after cooling and stored cold temperature.

3. Powder analysis

3.1 Moisture content in powder determined by the method described by (*AOAC 1999*) [3]. Where weigh 3gm sample and dried in Hot air oven at 105° C for 3 hours. Then take the weight of the dried sample and calculated by a formula

Moisture content (%) $= \frac{\text{Initial weight} - \textit{Final weight}}{\text{Initial weight}} \times 100$

3.2 water activity: water activity meter (LabSwift- a_w Novasina) (SRM University, India) was used to determine water activity (a_w) in the powder sample.

3.3 pH: Hydrogen Ion Concentration of the sample is measured by Digital pH meter at 25° C temperature.

3.4 Titratable acidity: Titratable acidity of the powder sample and fresh Jamun pulp was evaluated by titration method (*AOAC 1995*) [2] with some modifications. 1 ml sample diluted in 100ml distilled water. Then take 10 ml in a conical flask and add 2-3 drops of Phenolphthalein indicator. Titrate the sample against 0.1 N NaOH. Noted down burette reading after pink color occurred and calculated total acidity percent by the formula.

$$\textbf{\textit{Titratable acidity}} = \frac{\text{Titrate value} \times 0.1\text{N} \times \text{Equivalent weight of citric acid} \times 100}{200 \times \text{Weight of sample} \times 1000}$$

3.4 Bulk and Tapped density: Bulk density determined by the method used by (*Basu et al. 2018*) [7] with some modifications. Weigh 2g of powder sample and poured in 10ml measuring cylinder and height (cm) of the powder in cylinder noted down and Tapped density is determined by the same cylinder was tapped for 10-20 times till some changes occur in height of powder that was noted down and calculated by the formula mass divided by the volume of a circle.

3.5 Porosity (Ɛ) and Carr-Index: porosity used to measure no. Of voids present where sample filled and was calculated by using bulk and tapped density (*Basu et al. 2018*) [7]. Carr Index also calculated by the similar formula used for porosity which described by (*Carr 1965* [15] and it helps to check flow-ability of powder according to the following table.

% Porosity (Ɛ) $= \frac{\text{tap density} - \textit{bulk density}}{\text{tap density}} \times 100$

Table 1: Classification for Flowability of powder

Carr-Index (%)	Flow ability
<15	Very good
15-20	Good
20-35	Fair
35-45	Bad
>45	Very bad

3.6 Cohesiveness: This property of powder was evaluated by Hausner's ratio (HR) which calculated by the formula followed by (*Hausner 1967* [16]. Following table helps to observe cohesiveness of the powder.

(Hausner's ratio) HR $= \frac{\text{tapped density}}{\text{bulk density}}$

Table 2: Classification table for Cohesiveness of powder

Hausner's Ratio	Cohesiveness
<1.2	Low
1.2-1.4	Intermediate
>1.4	High

3.7 Solubility: Solubility of powder was determined by the method described by (*Saikia et al. 2014*) [8] with some modifications. 1 gram of sample poured in 10 ml water and stirred continuously. Put the sample on a magnetic stirrer until powder is not completely dissolved. This sample centrifuge at 2500 rpm for 10 min and supernatant dried at 105° C in Hot air oven. Weigh the dried sample and calculate by the following formula.

$$\textbf{Solubility (\%)} = \frac{\text{weight of supernatant after drying}}{\text{weight of sample}} \times 100$$

3.8 Color: Color was analyzed by Hunter colorimetric spectrophotometer, where sample place in front of colorimeter hole and noted down digital readings of l^x (lightness), a^x (Red/green), b^x (yellow/blue) and ΔE^x (overall color change) from the computer screen

3.9 Powder morphology: Morphology like crystalline structure and crystal orientation of powder sample was analyzed by SEM (Scanning electron microscopy) at magnification range 500X to 10.00KX in the form of Images (Carl ZEISS, Model- Supra 5, Field Emission SEM).

4. Sensory analysis: Developed powder drink with sugar, salt, and water for all samples evaluated by 30 panelists based on five sensory parameters (color, taste, flavor, mouthfeel, overall acceptability) by using a 9-point hedonic scale.

5. Bioactive compound analysis

5.1 Total anthocyanin content (TAC): Anthocyanin content in powder sample was evaluated by using Spectrophotometric method described by *Kapoor et.al.2014* with some modifications. At first prepare solution of 95% ethanol and HCl (1.5 N) in the ratio 85:15. 0.5g of powder added into the prepared solution. Allowed to stand for 6-7 hours and taking absorbance in UV-Vis Spectrophotometer at 530nm and calculated from the following formula.

$$\textbf{Anthocyanin content}\ \frac{\text{Absorbance}\times\text{MW}\times\text{DF}}{\mathcal{E}\times\text{Weight of the sample}}\times 100$$

Where, MW= molecular weight of cyaniding 3 glucose chloride, DF= dilution factor, Ɛ=molar absorptivity.

5.2 Total phenolic content (TPC): 0.5g of sample extracted with 80% of methanol followed by the addition of extract in 2.5ml folin-ciocalteu reagent and allowed to stand for 5min. Then add 2ml of Sodium carbonate (7.5%). Again solution allowed to stand for 30 min and measured absorbance at 760nm against Gallic acid. Results expressed as GAEmg/g (*Muzaffar et.al.2015, Jebitta et.al.2016*).

5.3 Total Flavonoid content: (TFC) Total flavonoid content was analyzed by aluminum-trichloride method used by *Tran et.al.2018* with some modifications. Here, the measured extract was added to 75µl of 5% $NaNO_2$ solution. After 6 min, 150µl of aluminium-trichloride (10%) was added. Incubate for 5 min followed by addition of 0.5ml of NaOH (1M) and 2.5ml distilled water to make up the volume. Absorbance measured at 510nm in Spectrophotometer. Results expressed in Catechin Equivalent mg/g.

5.4 Antioxidant activity

A. Scavenged Nitric oxide: This was determined using Griess reagent. 2ml of 10mm sodium Nitroprusside dissolved in 0.5ml phosphate buffer saline (pH 7.4) was mixed with the 0.5ml sample at various concentrations (0.2-0.8mg/ml) and incubated at 25°C for 150 min, then withdraw 0.5ml of the incubated solution and mixed with 0.5ml of Griess reagent. Mixture incubated at the room temperature for 30 min and took absorbance at 546nm in UV-Vis Spectrophotometer (*Boora et al. 2014*) [33]. It is calculated by

% inhibition of nitric oxide = {A0 –A1}/ A0 × 100

Where A0 = absorbance before reaction and A1= after reaction occurred due to Griess reagent absorbance.

B. Scavenged H_2O_2: This was determined by the method followed by *Keser et al. 2012* [34]. A solution of H_2O_2 (40mm) is prepared in phosphate buffer (50mm pH 7.4). Absorbance took at 230nm using UV-Vis Spectrophotometer to estimate the concentration of Hydrogen Peroxide. Extract (20-60g/ml) in distilled water added to H_2O_2. Take absorbance at 230nm after 10 min against blank solution containing a Phosphate buffer. It is calculated by

% inhibition of H_2O_2 = (Ai – At) / A0 ×100

Where Ai = absorbance of control, At = absorbance of test, A0 = absorbance before reaction

6. Statistical analysis: Statically analysis of the triplicate value of results for physicochemical properties by Two-factor ANOVA analysis at 95% confidence level gives results in mean ± SD by using Excel version 2010.

7. Result and Discussion

Jamun fortified instant drink mix was developed by a spray dryer. After addition of Tamarind and chili in Jamun juice, astringent taste of Jamun was depressed and obtained an attractive pink color powder with the spicy, sour, sweet flavor. Maltodextrin concentration and inlet air temperature were parameters that show the effect on production quantity and its quality. Physicochemical properties of JTC powder sample and control are shown by table no. 3 and table no. 4 is showing the result for flowing properties of JTC powder and control.

7.1 Moisture content: According to Moisture content is an important property which responsible for crystallization behavior and stickiness and microbiologically safe product. Developed JTC powder contains moisture in between 2.88±0.02 % to 4.91±0.02 % shown by table 3. Low inlet air temperature has high moisture content and high temperature has low moisture content. The same result for effect of inlet temperature on moisture content was shown by for watermelon, *Chegini et al. 2005* [19] and *Sabhadinde et al. 2014* [28] for orange juice powder, *Ersus and Yurdagel 2007* [25] for black carrot juice powder. As per increase in maltodextrin concentration from 20-25%, moisture content is decreased in the powder sample. Same results for moisture content observed by Mishra for Amla powder, *Abadio et al 2004* [24] for pineapple juice powder.

7.2 Water activity: Water activity (a_w) of spray dried powder is necessary to check self-stability of product. Low Activity of free water present in powder is important to protect it from the deteriorative, microbial reaction and physicochemical reactions. Water activity in the JTC powder sample is below 0.4 which is better for the storage ability of product. Water activity increases with increase in temperature and decrease in maltodextrin concentration was shown by table no. 3 and same results expressed by Tonon for spray dried watermelon powder.

7.3 pH and Total acidity: Potential of Hydrogen is called pH, which analyzes to check acidity or alkalinity of the powder sample. Here 0-7 range of pH scale is considered as acidic nature and range from 7-14 is considered as basic or alkaline nature of the sample. From table 3 pH of developed JTC powder ranges from 3.11±0.02 to 3.38±0.01 which is less than pH of control Jamun pulp powder. These values consider that JTC and control both samples are acidic in nature. Total acidity is the amount of acid content in the powder sample. The higher amount of acid content is 0.554±0.03 in the sample in 20% at 160° C and the lowest acid content is 0.410±0.02 in sample 25% at 180° C. Amount of total acid content is more in JTC powder as compared to the control sample.

7.4 Solubility: Most important property for characteristics of instant drink mix is solubility. If the solubility of developed powder is more that enhances the flavor of the powder in water and gives proper taste. *Avila et al. 2015* [18] says that solubility of the powder increases when the maltodextrin content and inlet air temperature is high because of the hydrophilic nature of maltodextrin, thermal stresses of the process which facilitating solvation during reconstitution. Same results were shown by JTC powder where solubility is highest (90.13±0.03) in 25% at 180° C and lowest (82.13±0.11) in 20% at 160° C. Solubility in the control sample is 94.21±0.02 which is higher than JTC powder. Effect of inlet air temperature on the solubility of Jamun pulp powder was shown the same results by *Tran et al. 2018* [22] for lemongrass leaf extract powder.

Table 3: Physical and chemical properties of JTC powder with (mean±SD) at P< 0.05

Parameter (JTC powder)	180° C		170° C		160 °C	
	20%	25%	20%	25%	20%	25%
Moisture content (% wet basis)	3.05±0.036	2.88±0.02	4.74±0.044	3.18±0.02	4.91±0.02	3.81±0.02
Water activity	0.362±0.004	0.347± 0.002	0.340±0.008	0.336±0.002	0.338±0.004	0.328±0.007
pH	3.16± 0.02	3.11± 0.02	3.25± 0.01	3.197±0.02	3.38± 0.01	3.357±0.03
Total acidity %	0.45±0.04	0.410±0.02	0.513±0.05	0.471±0.02	0.591±0.06	0.554±0.03
Solubility (%)	89.86±0.03	90.13±0.03	86.09±0.08	88.25±0.04	82.13±0.11	86.28± 0.28
Bulk density (g/cm^3)	0.233±0.001	0.263± 0.004	0.295±0.004	0.297±0.003	0.313±0.002	0.354±0.001
Tapped density (g/cm^3)	0.379± 0.004	0.384±0.001	0.392±0.003	0.393±0.003	0.400±0.003	0.441±0.002
Porosity/ Carr-Index	38.52±2.02	31.51±0.76	24.74±0.74	24.42±4.52	21.75± 0.81	19.73 ± 2.07
Hausner's ratio	1.63± 0.006	1.46± 0.007	1.33± 0.01	1.32± 0.07	1.28± 0.01	1.25± 0.02

Table 4: Physical and Chemical properties of Control sample with (mean±SD) at P< 0.05

Control sample	Moisture content	Water activity	pH	Total acidity %	Solubility (%)	Bulk density	Tapped density	Porosity/ Carr-Index	Hausner's ratio
JPP (Jamun pulp powder)	3.90± 0.02	0.333±0.002	3.45± 0.04	0.65±0.05	92.01±0.02	0.323±0.007	0.385±0.003	16.27±1.04	1.18± 0.02

7.5 Bulk and Tapped density: Bulk density (with voids) and tapped density (without voids) are intrinsic properties which determine to check powder's ability to function as structural support, water movement and aeration in powder. Table 3 shows bulk density and tapped density decreased as per increase in inlet air temperature which is also shown by Mishra for bulk density of Amla juice powder. Powder sample 25% at 160° C has the highest bulk density (0.354±0.001) and 20% at 180° C has the lowest bulk density (0.233±0.001). JTC powder has the highest tapped density (0.441±0.002) in 25% at 160° C and lowest (0.379± 0.004) in 20% at 180° C.

7.6 Porosity: Porosity is property to determine the quality of powder to being porous means full of tiny holes. Porosity is calculated by a formula related to bulk and tapped density followed by (*Basu et al. 2018*) [7]. The porosity of JTC powder ranges from 19.73±2.07 to 38.52±2.02 which is high as compared to control Jamun pulp powder (16.27±1.04).

7.7 Carr-Index: Carr-Index is calculated by the same formula used for porosity which is followed by (*Saikia et al. 2014*) [8]. Carr- Index classification table given by (Carr 1965) [15] helps to observe flow-ability of the powder sample. From table no. 1 and table no. 3 we observed that powder sample (25% at 160° C) has good flow-ability with Carr-Index value 19.73±2.07 and sample (20% at 180° C) has bad flow-ability with value 38.52±2.02. Control sample has very good flow-ability with 16.27±1.04 as compared to JTC powder.

7.8 Cohesiveness: Hausner's ratio (HR) gives cohesiveness which helps to observe sticky behavior or agglomeration in the powder sample. Table no.2 shows classification cohesiveness level according to HR values followed by (*Hausner 1967*) [16]. All JTC powder sample has intermediate cohesiveness except sample 20%, 25% at 180° C. It has the highest cohesiveness with HR value 1.63±0.006, 1.46±0.007 respectively.

7.9 Color: Color is a point of attraction for the consumer of Instant drink mix. Table no.5 and Table no. 6 shows the value of L^* (lightness), a^* (redness) and b^* (blueness) of the JTC powder sample and control Jamun pulp powder sample respectively. The color of powder became lighter than the color of feed after spray drying at different temperature and addition of maltodextrin as compared to control Jamun pulp powder. Addition of tamarind and chili pulp in Jamun fruit pulp observed changes in the color of powder as compared to control Jamun pulp powder. Lightness increases as per increase in maltodextrin concentration and Redness is decreases with increase in maltodextrin concentration. Same result observed by *Muzaffar et al. 2016* [14] for pomegranate, *Oberoi et al. 2015* [20] for watermelon, *Suzihaque et al. 2015* [23] for pineapple powder. Blueness is increased with increase in maltodextrin and inlet air temperature was shown by table no. 5 and same result for blueness shown by Shanthalakshmy for Jamun fruit pulp.

Table 5: Color values of JTC powder with (mean±SD) at P< 0.05

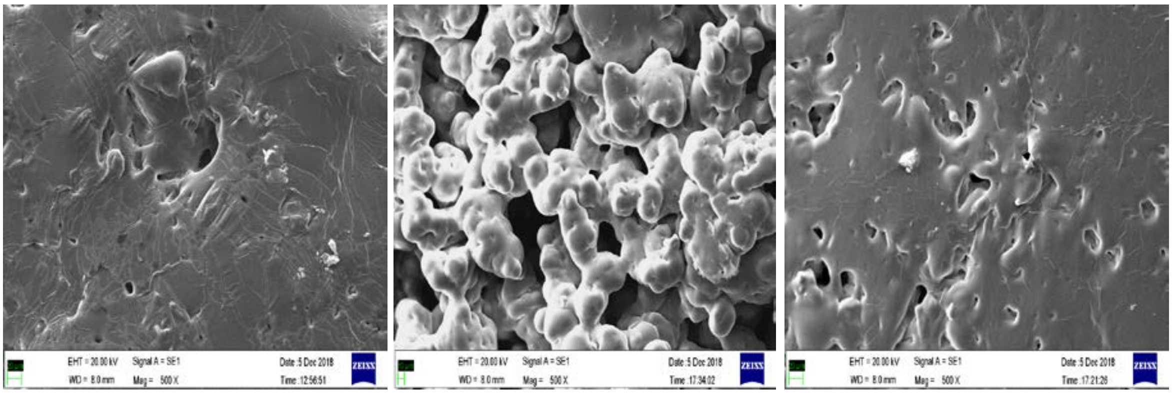
Color	180° C		170° C		160° C	
	20%	25%	20%	25%	20%	25%
L^x	67.62±0.006	76.94± 0.006	65.93±0.06	68.0± 0.02	66.73±0.01	67.59±0.02
a^x	25.15±0.05	19.41±0.00	27.21±0.05	26.38±0.04	26.47±0.03	26.21±0.02
b^x	-2.92± 0.03	-1.68± 0.04	-5.91± 0.02	-5.6± 0.07	-6.53± 0.02	-6.22± 0.03

Table 6: Color values of control Jamun pulp powder with (mean±SD) at P< 0.05

Control sample	L^x	a^x	b^x
Jamun pulp powder (JPP)	72.81±0.006	19.83±0.04	-12.89±0.006

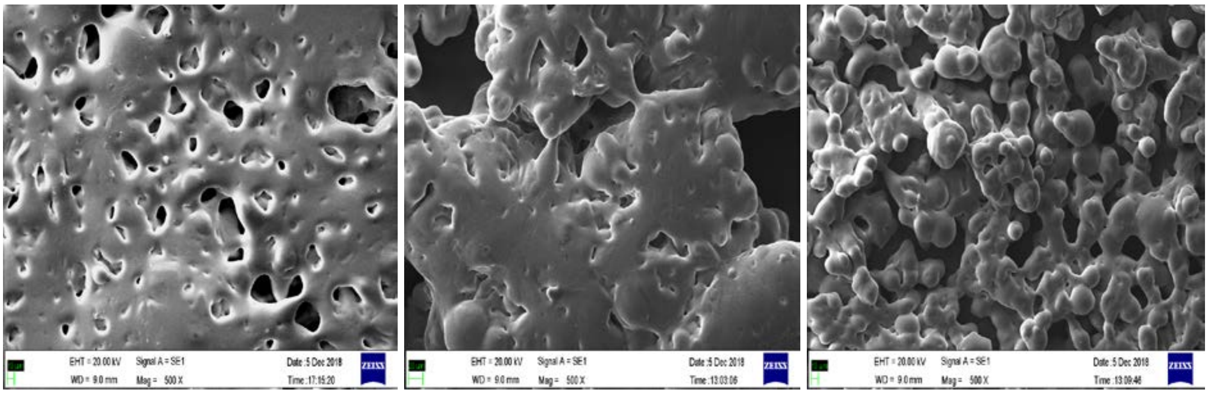
7.11 Powder morphology: Fig 1 showed surface morphology of JTC powder sample 20% at three temperature 180° C, 170° C, 160° C and fig 2 showed for JTC powder sample 25% at 180° C, 170° C, 160° C and fig 3 showed control Jamun pulp powder at magnification range 500X to 10000X which observed that JTC powder sample shows sticky behavior because of more agglomeration as compared to control sample. In the powder sample, the particle size are not uniform, different size particles were seen and smooth surface at the lower temperature, cracks and clots were observed at lower MD concentration.

Powder morphology of Instant drink mix and control sample images by Scanning electron microscope at magnification range 500X to 10000X.



(a) (b) (c)

Fig 1: Instant drink mix a) 20% (180), b) 20% (170) c) 20% (160)



(a) (b) (c)

Fig 2: Instant drink mix a) 25% (180), b) 25% (170), c) 25% (160)

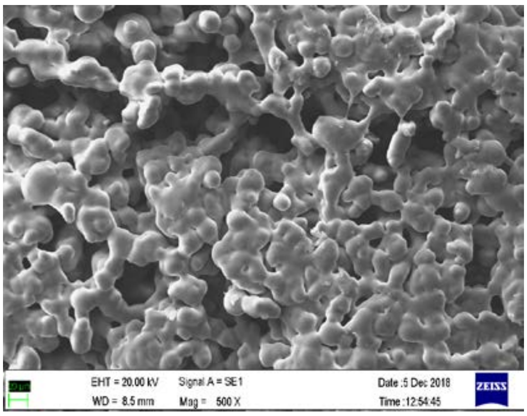


Fig 3: Control Jamun pulp powder

7.12 Sensory evaluation: Sensory analysis of six samples of JTC powder newly developed drink was done by 30 panelists from SRM-IST, Chennai campus and outside campus for five parameters color, taste, flavor, mouthfeel, overall acceptability which gave highest score for overall acceptability to sample D 25% at 170° C with score 8 by 9-point hedonic scale is shown by following web diagram.

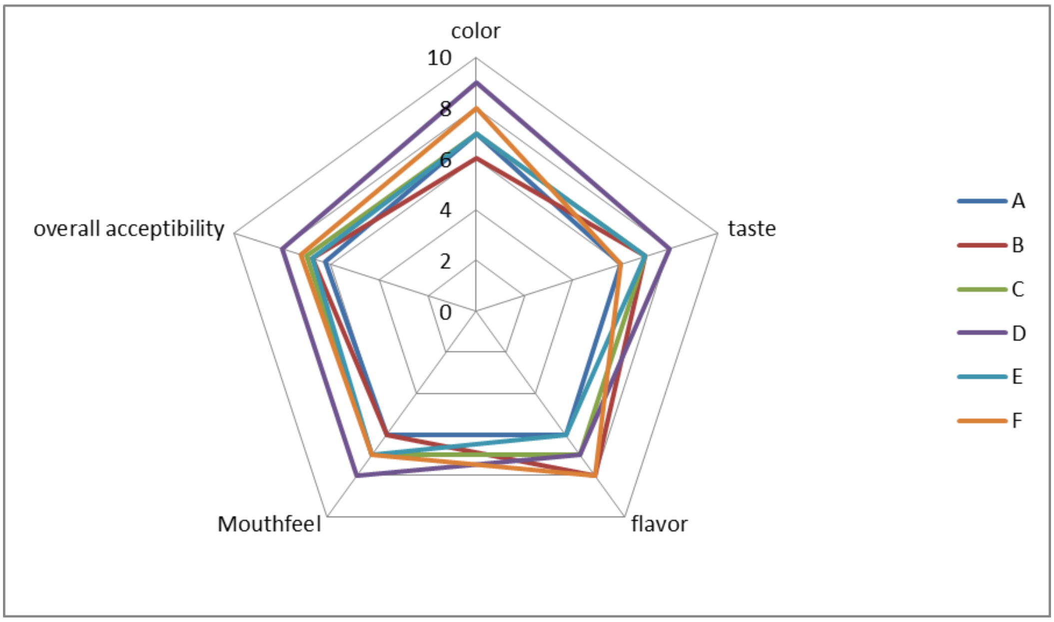


Fig 4: sample A 20% (180°C), B 25% (180°C), C 20% (170°C), D 25% (170°C), E 20%(160°C), F 25% (160°C)

7.13 Bioactive compounds: Bioactive compounds are also known as extra nutritional constituents present in small quantities but play a major role to protect from different diseases after consuming it by promoting good health. Spray dried JTC powder sample contains very less amount of bioactive compounds as compared to control Jamun pulp powder.

Anthocyanin (TAC) is water soluble pigment that appears red, purple, blue found in the tissues of the higher plant. According to Ferreri anthocyanin retention in blackberry powder decreases with increase in maltodextrin concentration and same results shown by table no. 7 for JTC powder that observe anthocyanin content decreases as per increase in inlet temperature and decrease with a higher MD concentration. But JTC sample has low in anthocyanin content (61.31±0.15-71.06±0.35) compared to control (118.67±0.03). From table 7 showed a higher amount of Anthocyanin content (71.06±0.35) in sample 20% at 160° C.

Total phenolic (TPC) and flavonoid content (TFC) both are a large class of plant secondary metabolites which act as antioxidants. In JTC sample, these compounds present in ranges from 2.13±0.07 to 5.23±0.16 and 22.96±0.07 to 28.43±0.06 respectively which were reduced with an increase in inlet temperature and the decrease in maltodextrin concentration. Mishra showed results for effect of temperature on the phenolic compound in Amla juice powder and *Tran et al. 2018* [22] for TPC and TFC in the lemongrass leaf extract.

Antioxidant activity is inhibiting reaction of producing free radicals like NO, H_2O_2 which reduce the chance of oxidative spoilage. Results show higher antioxidant activity in control JPP than JTC powder sample. Inhibition % for NO is high (10.44±0.01) in 25% (160° C) and low (8.25±0.03) in 20% (180° C) and inhibition % for H_2O_2 is high (29.86±0.06) in 25% at 160°C and low (23.58±0.03) in 20% at 180°C. As per increasing inlet air temperature, the antioxidant activity decreases in JTC sample. Same results were shown by Mishra for Amla juice powder.

Table 7: Bioactive compound analysis of JTC powder

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Bioactive compounds in JTC Sample	180		170		160	
	20%	25%	20%	25%	20%	25%
Total anthocyanin content (mg/g)	67.87±0.1	61.31±0.15	69.68±0.12	62.29±0.15	71.06±0.35	65.410.12
Total phenolic content (mg/g)	2.13±0.07	3.05±0.45	3.13±0.03	3.87±0.45	4.12±0.28	5.23±0.16
Total flavonoid content (mg/g)	22.96±0.07	23.11±0.05	25.34±0.04	25.87±0.05	27.96±0.03	28.43±0.06
Scavenged NO radical %	8.25±0.03	8.43±0.01	9.74±0.08	9.88±0.03	10.20±0.02	10.44±0.01
Scavenged H_2O_2 radical %	23.58±0.03	24.17±0.03	26.75±0.04	27.43±0.01	29.05±0.03	29.86±0.06

Table 8: Bioactive compounds analysis of Control sample

Parameter	Total anthocyanin content (mg/g)	Total phenolic content (mg/g)	Total flavonoid content (mg/g)	Scavenged NO radical (%)	Scavenged H_2O_2 radical (%)
Jamun pulp powder	118.67±0.03	7.89±0.02	30.15±0.04	12.13±0.04	33.45±0.05

8. Conclusion: In this study, we conclude that Instant drink mix powder has better solubility and attractive color with mix flavor. Flow-ability is good because porosity also shows better shelf life for drink mix with low moisture content and water activity below 0.4. According to morphology, fine particle and smooth surface of powder at the lower temperature. Somewhere stickiness of powder is also seen by images. According to sensory parameters, 25% at 170°C powder is best for Instant drink mix characteristics which contains bioactive compounds that are available more at the lower temperature and high maltodextrin concentration which makes newly developed powdered drink mix more healthy to protect from diseases and more nutritive which can drink as a nutritive supplement. It can be used fortification in other value-added product to enhance their flavor and nutritional quality.

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