

EFFECT OF JELLOSE AND PASSION FRUIT CONCENTRATE ON SOME OF PHYSICAL PROPERTIES AND SENSORY CHARACTERISTICS OF PASSION FRUIT GELATO ICE CREAM

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Abstract

The aim of this research was to study the effect of jellose substituted to guar gum as stabilizer on some physical properties and sensory evaluation to develop recipe for passion fruit gelato ice cream. The experiment was designed to 3x3 factorial in Completely Randomized Design. There was 2 factors, jellose : guar gum 100 : 0, 50 : 50 , 0:100 (w/w of total solid, db) and passion fruit concentrate 18 °Brix at level 10% , 15 % and 20% (w/w of overall principal composition, wb). Gelato ice cream has to be inspected mixed viscosity, overrun, melting rate and hardness. Selected passion fruit gelato ice cream have overrun < 10% and low melting rate for gelato characterization. And then sensory test with Just About Right (JAR) and 9-point Hedonic scale for acceptance attributes and flavor test, respectively, with untrained 30 panelists. Furthermore chemical analysis and microbiological test were done. The results showed that gelato ice cream using jellose: guar gum 100:0 (w/w of total solid, db) as stabilizer and mixed with passion fruit concentrate (28 °Brix) 10% (w/w overall principal composition, wb) was the highest acceptance score and >70% of panelists' acceptance all attributes of ice cream. Passion fruit gelato ice cream with mixed viscosity (7958.50 cP), overrun (6.67%), melting rate (0.62 mL/min) hardness (2591.10 g Force). and lightness (L*) (86.68), redness (a*) (-1.89), yellowness (b*) (12.94), hue angle (81.02) and the total solid (% w/w, db) of ash (4.07%), fat (30.89%), protein (13.83%), crude fiber (7.68%) and total carbohydrate (43.53%), vitamin C (0.28 mg/g) and vitamin A (135.17 IU). Total plate count inspection, the results revealed that there was 1.2×10^4 CFU/g.

Keywords : Jellose, Guar gum, Passion Fruit, Gelato ice cream

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Introduction

Gelato is ice cream made in an Italian style. Gelato has little or no overrun, the air added to frozen dessert products to increase volume (Marshall *et al.* 2003), whereas ice cream overrun varies from 30% or less for super premium ice cream to 95-100% for other types. Gelato is made using 4-8% butterfat. (Luciano, 2005)

Tamarind kernels are used to obtain tamarind kernel powder (TKP). It is a galactoxyloglucan isolated from seed kernel of Tamarind. It came into commercial production in 1943. It possesses properties like high viscosity, broad pH tolerance and adhesivity. This led to its application as stabilizer, thickener, gelling agent, and binder in food and pharmaceutical industries. It's a rich source of proteins and amino acids, a good source of gelling polysaccharides called "polyose" or "Jellose" and it has been used in confectionary salad dressings and mayonnaise frozen desserts such as ice cream, ice milk, water ice and sherbet. (Marathe *et al.*, 2002)

Guar gum is a galactomannan polymer extracted from the seed of *Cyanmopsis tetragonolobus*. Guar gum is one of the important gum being used as stabilizer in ice cream manufacturing. Guar gum is a complex carbohydrate obtained from a legume crop, guar.

The main advantages for using guar are its low cost, easy availability and capacity to form viscous solutions and gels at low concentration. Guar gum is one of the most extensively investigated polysaccharides; its rheological behavior enables it to contribute to good sensory qualities, including mouth-feel and flavor release in ice cream. (Sangle Jagdish K *et al.*, 2015)

Passion Fruit is two main types, purple and yellow varieties. Purple passion fruit is preferred for consumption as fresh juice, whereas the yellow passion fruit is considered better suited for processing. In this experiment used yellow passion fruit that is widely grown and consumed in Thailand such as Rayong, Trat, and Prachinburi. Furthermore, passion Fruit have highly nutritional value and a rich source of vitamins C and vitamins A about 30 mg per 100 g., 1274 IU per 100 g. respectively. (USDA National nutrient data base)

The aims of this experiment was to study the effect of jellose substituted to guar gum as stabilizer on some physical properties and sensory evaluation to develop recipe for passion fruit gelato ice cream.

Materials and Methods

Materials

Yellow passion fruit bought from a local market in Santi Asoke market, Bangkok, Thailand. Jellose (Pinphet Co.,LTD, Phetchaboon province of Thailand, its' moisture content was $4.42 \pm 21\%$. Guar gum (Vistacafé, Bangkok, Thailand, its' moisture content was $8.50 \pm 23\%$. Skim milk (Meji,CP-Meji Co.,LTD, Thailand), whipping cream (Anchor, Fonterra, Newzeland), skim milk powder (Cathay dairy, Netherland, Import to Phonix gold consortium.Co.,LTD,

Samutsakhon, Thailand), sucrose syrup (Mitrphol, Mitr Phol Suger Corp., Ltd, Bangkok, Thailand) and salt (Prung Thip, Thai Refined Salt Co., LTD, Nakhon Ratchasima, Thailand.) were used in this experiment.

Preparation of Passion fruit Gelato ice cream

Passion fruit Gelato Ice cream adapted following the formula of Warapa (2015) in Table 1

Table 1: Principle ingredients of Passion Fruit Gelato Ice cream.

Main Ingredient	Volume (g)
1. Skim milk	200
2. Whipping cream	100
3. Sucrose syrup	70
4. Salt	0.25
5. Skim milk powder	10
Volume of main ingredients	380.25

The experiment was designed to 3x3 Factorial in Completely Randomized Design (CRD). There was 2 factors. Factor 1 is the jellose : guar gum ratio; 100 :0, 50:50 and 0:100(%w/w of total solid, db). Factor 2 is Passion fruit concentrate at 3 levels of 10, 15 and 20 (% w/w of overall principle composition, wb).

Passion fruit was prepared cleaned, groped pulp and seed, juiced, boiled at 50°C for hour, cooled at room temperature (25±1°C) and stored in freezer at 5°C. Stabilizers were prepared Jellose dissolved at 80°C water for 20 minute and Guar gum dissolved at cool water for 2-3 min. Mixed Skim milk, Whipping cream, Skim milk powder, and salt to pasteurization in hot tub, at 70°C for 10 min. Cooled at room temperature (25±1°C). Separated the mixture in a half of milk, boiled with passion fruit and heated at 70°C for 30 second. And the remaining half of milk filled in blender (Imarflex, IF-317, Thailand). After that, added the mixture of milk and passion fruit with Stabilizers in blender were blended at 10 min. When the mixture homogeneously mixed to added sucrose syrup blended at 2 min. Taken Passion fruit Gelato ice cream mix to Mix Viscosity analysis using Brookfield Viscometer (Brookfield Viscometer, DV-III, United State), And aged at 4°C for 24 hours. Mixed using Nemox (Nemox, Creaserie, Gelato 5K, Italy) at -18°C for 22 min. Passion fruit Gelato Ice cream was collected into lidded polyethylene (PE) containers and stored freezer at -18°C for 24 hours. After that, analyzed the properties of passion fruit gelato ice cream.

Method

Physical properties measurements.

Mix Viscosity : Viscosity of the unfrozen mixes was evaluated according to Muse and Hartel (2004) methods. Viscosity was measured using Brookfield Viscometer (Brookfield Viscometer, DV-III, United State). Samples were putted small sample 15mL at $8\pm 1^{\circ}\text{C}$ and viscosity was measured using spindle #25 to take torque measurements at more than 90 rpm. The mix viscosity (Centipoise, cP) was recorded.

Overrun : Overrun measurement adapted following the method of Arbuckle., (1986). Passion fruit gelato ice cream mix filled plastic beaker. When mixed in Nemox, Passion fruit gelato ice cream filled primary plastic beaker. Measured the volume and calculated as follows.

$$\text{Overrun} = \frac{\text{Vol.of gelato}-\text{Vol.of mix used}}{\text{Vol.of mix used}} \times 100$$

Melting rate: Melting rate measurement adapted following the method of Arbuckle., (1986). Passion Fruit Gelato Ice cream samples (40g) were placed on a wire screen mesh under the cylinder at room temperature ($25 \pm 1^{\circ}\text{C}$). The volume of the melted material was record every 5 min for 60 min.

Hardness : The hardness of Passion fruit Gelato ice cream samples was determined using a Texture Analyzer (Texture analyzer, TA-XT2i, England) adapted following the method of Alfaifi and Stathopoulos (2010). Sample was measured at -10°C . The measurement was carried out using a 2 mm diameter Stainless Steel cylinder probe (P/2). Setting on Mode: Compression, Pre-test speed: 1.0 mm/s, Test Speed: 2.4 mm/s, Post-test speed: 7.0 mm/s, Target mode: Distance 10 mm, Trigger type: Auto – 20 g and Data Acquisition Rate:200 pps.

Color : Color was measured by Chroma Meter (Chroma Meter, Konica Minolta, CR-400, Thailand) Instrumental color data was provided in accord with the CIE system in terms of L^* (lightness), a^* (redness and greenness) and b^* (yellowness and blueness) and cacalculated Hue angle following equation;

$$\text{Hue angle} = \tan^{-1}(b^*/a^*)$$

Sensory Evaluation : Selected passion fruit gelato ice cream had the most properties of gelato ice cream, which overrun lowest 10% and Melting rate was lowest. The acceptance of passion fruit gelato ice cream was judged by 30 untrained panelists using Just about Right as 3 level (not enough ,enough and too much) and a 9-point Hedonic Scale (1=Extreme dislike, 9= Extreme like) for color, odor, flavor, texture and overall acceptance. After that, the most

acceptance of passion fruit gelato ice cream was chemical analyzed with proximate analysis, and detected the total plate count was done too.

Proximate Analysis: The Percent Moisture, ash, fat, protein, crude fiber and carbohydrate were determined by the standard method of AOAC (1995). Vitamin C was determined by method described by AOAC (2000). Vitamin A was analyzed using UV-Vis Spectrophotometer (Thermo, Genesys10Vis,Thailand). Sample (1g) filled test tube. Putted Acetone:Haxane 10 mL. Vortexed for 10 min.Taken clear solution measured at wave length 663, 645, 505, and453 nm. (Kamonpat el al., 2015) Bata-carotene calculated following equation;

$$\text{Bata-carotene(mg/100 FW)} = 0.216A_{663}-1.22A_{645}-0.034A_{505}+0.452A_{453}$$

Microbiological Test :Total plate count was determined by method described by AOAC (2000).

Statistical analysis :A completely randomized design (CRD) were used physical analysis. Data were analyzed by analysis of variance (ANOVA). Mean were compared by Duncan's multiple range test at a significant level $p < 0.05$, Correlationcoefficient (r) and Linear regression. Analysis were used SPSS version 23.0 Programs (License for King Mongkuts Institute of Technology Ladkrabang, Bangkok, Thailand)

Results and Discussion

Physical properties evaluation

Mix viscosity (cP)

Figure 1 shows the mix viscosity of passion fruit gelato ice cream. The ice cream mixed has increased viscosity. When jellose increased effect to mixed viscosity of passion fruit gelato increased but when guar gum increased effect to mixed viscosity of passion fruit gelato decreased significantly. Treatment 1 jellose:guargum 100: 0 passion fruit concentrate 10% had the highest viscosity of 7958.5 ± 69.30 cP. Due to jellose has the ability to absorb water well. This will affect to movement of particles to slow down and when jellose increased need more force move the particle. Thus, mix viscosity of the ice cream increased. (Warapa., 2558) Gelato ice cream is smooth and softness. (Marshall and Arbulkle., 1996) viscosity of the conventional ice cream was in the range of 50-300 cP. So mix viscosity all treatment of passion fruit gelato ice cream are higher than conventional ice cream

Overrun

Figure 1 shows overrun of passion fruit gelato ice cream. When jellose increased effect to overrun of passion fruit gelato decreased and when guar gum increased effect to overrun of passion fruit gelato increased. Overrun in treatment 1 jellose:guargum 100: 0 passion fruit concentrate 10% and treatment 4 jellose:guargum 100: 0 passion fruit concentrate 15%

had $6.67 \pm 0.00\%$ and $10.00 \pm 0.00\%$, respectively. From Marshall et al., (2003). Gelato had 0 - 10% or no overrun. (Muse and Hartel., 2003) the conventional ice cream had 50-60% overrun

Melting rate

Figure 1 shows melting rate of passion fruit gelato ice cream. When jellose increased effect to melting rate of passion fruit gelato decreased and when guar gum increased effect to melting rate of passion fruit gelato increased. From (Piyanoot., 2004) found that ice cream with high water content in the mixture resulted in ice crystal dissolved faster. Treatment 1 jellose:guargum 100: 0 passion fruit concentrate 10% had lowest melting rate of 0.41 ± 0.19 (mL / min) best solubility resistance. (Muse and Hartel., 2003) ice cream using more stabilizer can increase stability Melting rate increased as ice crystal size increased. This can be related to the flow path of melted and viscosity of ice cream. When ice cream has a higher viscosity effect to slower melting rate. Conform to (Patomporn., 2548) viscosity effect on the structure of ice cream to stick and ice cream slower melted down.

Hardness

Figure 1 shows hardness of passion fruit gelato ice cream. When jellose increased effect to hardness of passion fruit gelato increased and when guar gum increased effect to hardness of passion fruit gelato decreased. However, passion fruit increased, resulting in decrease hardness because passion fruit is a source of high L-ascorbic acid (L-ascorbic acid) of about 1274 IU (Malaterre et al., 2016). Ascorbic acid from passion fruit juice has the effect of damaging the protein of milk and cream as ingredient. When increasing passion fruit effect to hardness of passion fruit gelato decreased. Treatment 1 jellose:guargum 100: 0 passion fruit concentrate 10% had the highest hardness 2591.10 ± 17.65 g / force. Corresponds to (Marshall and Arbuckle., 1996) ice cream had lowest overrun effect to hardness increased (Muse and Hartel., 2003) depends on the ice crystals size and overrun of ice cream.

Color

Color of passion fruit gelato ice cream shows in Figure 1 jellose does not effect on the color of ice cream. However, passion fruit increased effect on b^* (yellow) and Hue angle increase. L^* (Lightness) and a^* (red) decreased. Because passion fruit gelato ice cream color range is yellow $L^*(86.68)$, $a^*(-1.89)$, $b^*(12.94)$ and Hue Angle (81.02).

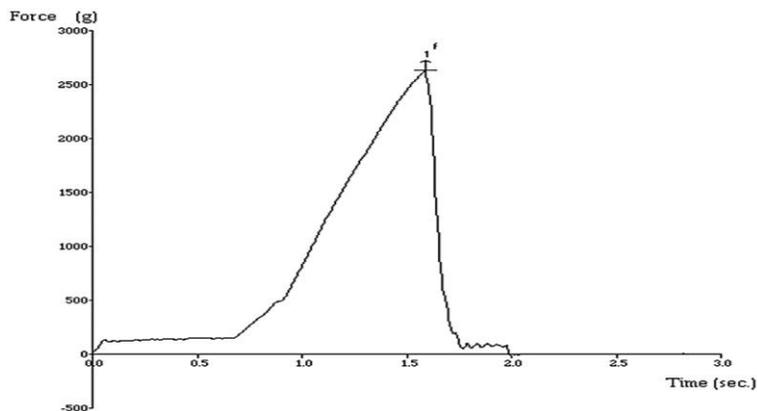


Figure 1 The hardness of passion fruit gelato ice cream jellose:guargum 100: 0 passion fruit concentrate 10%.

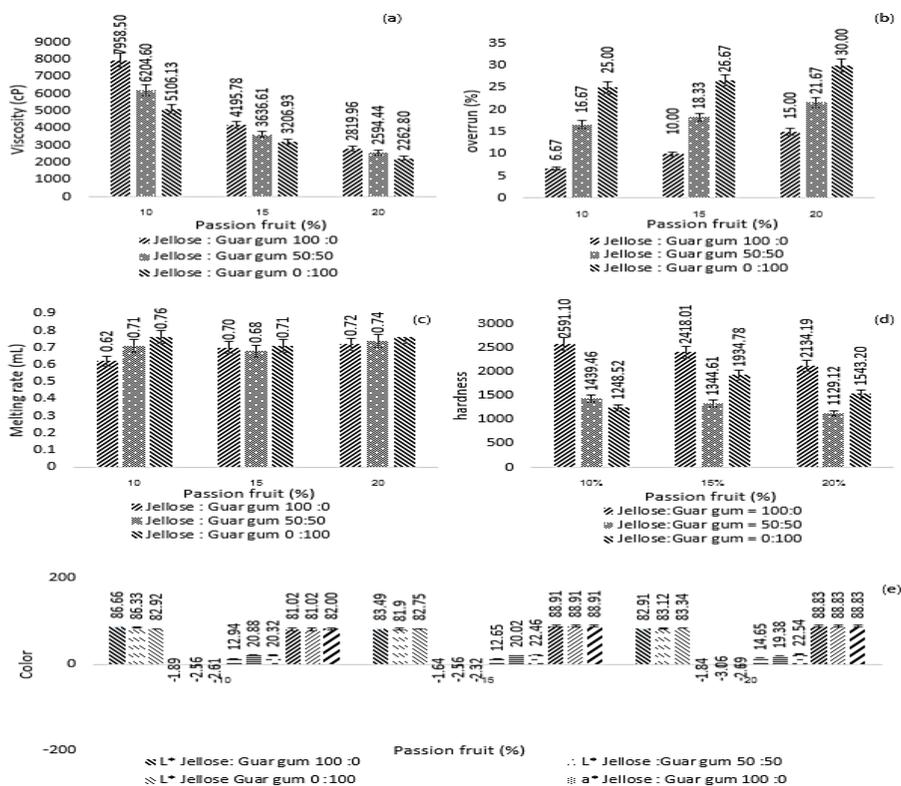


Figure 2 Physical evaluation: (a) viscosity; (b) overrun; (c) melting rate; (d) hardness; and (e) color.

Table 2 Correlation coefficient of passion fruit gelato ice cream.

factor	mix viscosity	melting rate	overrun	hardness	color			
					L*	a*	b*	Hue angle
jellose	0.886**	-0.587**	-0.925**	0.681 ^{ns}	0.209 ^{ns}	0.149 ^{ns}	-0.081 ^{ns}	-0.198 ^{ns}
passion fruit	-0.336 ^{ns}	0.419**	0.328 ^{ns}	-0.287 ^{ns}	-0.377 ^{ns}	-0.612**	0.086**	0.401*
jellose * passion fruit	0.657**	-0.329**	-0.731**	-0.516**	-0.023 ^{ns}	-0.040 ^{ns}	0.176 ^{ns}	-0.064 ^{ns}
Total	n = 27	n = 27	n = 27	n = 81	n = 27	n = 27	n = 27	n = 27

Correlation coefficient when increasing jellose ratio resulted in increased mix viscosity ($p < 0.01$) but melting rate and overrun were decreased ($p < 0.01$). Increasing guar gum ratio resulted in decreased mix viscosity ($p < 0.01$) but melting rate and overrun were increased ($p < 0.01$). Increasing passion fruit has effect increase melting rate and yellowness ($p < 0.01$), Hue angle ($p < 0.05$) However redness was decreased ($p < 0.01$). The interaction between the ratio of jellose and passion fruit resulted in increasing in mix viscosity ($p < 0.01$). In the other hand, decreasing in melting rate, overrun and hardness ($p < 0.01$).

Table 3 The physical evaluation of passion fruit gelato ice cream.

Treatment	Jellose : Guar gum	Passion fruit concentrate (%)	Mix viscosity (cP)	Overrun (%)	Melting rate (mL/min)	Hardness (g/force)	Color			
							L*	a*	b*	Hue Angle
1	100 : 0	10	7958.5 ± 69.30 ^a	6.67 ± 0.00 ^f	0.62 ± 0.00 ^e	2591.10 ± 17.65 ^a	86.68 ± 0.89 ^a	-1.89 ± 0.03 ^{ab}	12.94 ± 1.30 ^b	81.02 ± 1.96 ^c
2	50 : 50	10	4195.78 ± 40.37 ^d	16.67 ± 0.00 ^e	0.71 ± 0.03 ^{cd}	1543.20 ± 14.98 ^e	86.33 ± 0.24 ^a	-1.64 ± 0.10 ^a	12.65 ± 0.47 ^b	88.91 ± 0.23 ^{abc}
3	0 : 100	10	2819.96 ± 39.45 ^g	25.00 ± 2.36 ^{bc}	0.76 ± 0.04 ^{ab}	1439.46 ± 17.98 ^f	82.92 ± 5.77 ^a	-1.84 ± 0.12 ^{ab}	14.65 ± 1.41 ^b	88.83 ± 1.49 ^{abc}
4	100 : 0	15	6204.60 ± 62.95 ^b	10.00 ± 0.00 ^f	0.70 ± 0.02 ^{cd}	2418.01 ± 37.01 ^b	83.49 ± 1.51 ^a	-2.56 ± 0.26 ^{cd}	20.89 ± 1.50 ^a	82.87 ± 1.21 ^{abc}
5	50 : 50	15	3636.61 ± 2.30 ^e	18.33 ± 2.36 ^{de}	0.68 ± 0.01 ^d	1344.61 ± 12.03 ^g	81.90 ± 1.66 ^a	-2.56 ± 0.34 ^{cd}	20.02 ± 4.13 ^a	88.91 ± 1.95 ^{abc}
6	0 : 100	15	2594.44 ± 1.55 ^h	26.67 ± 0.00 ^{ab}	0.71 ± 0.02 ^{cd}	1934.78 ± 28.29 ^d	82.75 ± 2.85 ^a	-3.06 ± 0.29 ^d	19.38 ± 1.36 ^a	81.36 ± 0.84 ^c
7	100 : 0	20	5106.13 ± 5.43 ^c	15.00 ± 2.36 ^e	0.72 ± 0.02 ^{bcd}	2134.19 ± 14.50 ^c	82.91 ± 2.31 ^a	-2.61 ± 0.32 ^{cd}	20.32 ± 2.32 ^a	82.01 ± 0.88 ^{bc}
8	50 : 50	20	3206.93 ± 3.59 ^f	21.67 ± 2.36 ^{cd}	0.74 ± 0.01 ^{abc}	1129.129 ± 26.35 ⁱ	83.12 ± 1.77 ^a	-2.32 ± 0.42 ^{bc}	22.46 ± 1.68 ^a	88.91 ± 0.48 ^a
9	0 : 100	20	2262.80 ± 8.02 ⁱ	30.00 ± 0.00 ^a	0.76 ± 0.01 ^a	1248.52 ± 20.77 ^h	83.34 ± 2.15 ^a	-2.69 ± 0.44 ^{cd}	22.55 ± 2.43 ^a	88.83 ± 0.48 ^{ab}

Data shown as mean ± standard error

Means in row followed by different letter superscripts are significantly difference (p<0.05).

L* = lightness, a* = (redness>0, greenness<0), b* = (yellowness>0, blue<0) and Hue angle = $\tan^{-1}(b^*/a^*)$.

Sensory Evaluation The study of sensory acceptance by just about right method of passion gelato ice cream was acceptance with untrained 30 panelists. The ratio of jellose:guar gum 100: 0 passion fruit concentrate 10% (28 ° brix) acceptance in color, odor, flavor and texture >70% and 9-point Hedonic scale have overall acceptance was 7.48 ± 0.78, 6.83 ± 1.22, 7.38 ± 1.07, 7.48 ± 1.01 and 7.38 ± 1.32 respectively.

Table 4 Sensory evaluation by 9-point Hedonic scale and chemical composition and total solid of passion fruit gelato ice cream.*

treatment	jellose:guar gum (%w/w of total solid, db)	passion fruit (% w/w of overall principle composition, wb)	passion fruit Concentrate	sensory evaluation					Chemical composition (% db)	
				color	odor	texture	taste	total appearance	Total solid (%)*	
1	100:0	10	28°Brix	7.48±0.78	6.83±1.22	7.38±1.07	7.48±1.01	7.38±1.32	Ash	4.07 ± 0.01
									Fat	30.89 ± 0.63
									Protein	13.83 ± 0.14
									Crude fiber	7.68 ± 0.03
									Total carbohydrate	43.53 ± 0.29
									Vitamin C	0.28 ± 0.01 mg/g
									Vitamin A	135.17 IUc

*30 untrained panelists*Total solid 36.81 ± 0.16%

Proximate Analysis:The total solid (%w/w.db) of ash (4.07%), fat (30.89%), protein (13.83%), crude fiber (7.68%) and total carbohydrate (43.53%) Vitamin C (0.28 mg/g) and Vitamin A (135.17 IUc).

Microbiological Test:Total plate count inspection, the results revealed that there was 1.2×10^4 CFU/g.

Conclusions

passion fruit gelato ice cream used jellose and guar gum as stabilizer and passion fruit as flavor. Gelato ice cream has to be inspected mixed viscosity, overrun, melting rate, hardness and color. Selected passion fruit gelato ice cream have overrun < 10% and low melting rate for gelato characterization. And then sensory test with JAR and 9-point Hedonic scale was acceptance with untrained 30 panelists. The most appropriate final treatment is jellose:guar gum 100:0 (w/w of total solid, db) and 10% passion fruit concentrate 28°Brix (w/w overall principal composition, wb)

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