

## Physio-Chemical Characteristics of Ice Cream Prepared With Prickly Pear Juice before and after Enzymatic Treatment

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### ABSTRACT

*Opuntia ficus indica* is a tropical and subtropical plant. This plant is pointed out as relevant health promoting food with a great number of potentially active nutrients. In this study, ripe prickly pear fruit was selected from a local farm in Taif, KSA. This work aimed to study the physio-chemical characteristics of ice cream prepared with prickly pear juice before and after enzymatic treatment. The results showed that, enzymatic treatment increased the amounts of natural sugars. The concentration of reducing sugars was higher in the juices. In general, the quality of prickly pear juice was better in pectinase treated juice compared with untreated juice. For ice cream, it was clear that, ice cream with 10% treated prickly pear juice was better, while, ice cream with 30% untreated juice was the best.

**Key words:** Cactus fruits- Prickly pear- Pectinase enzyme- Enzymatic treatment- Physio-chemical characteristics.

### Introduction

Cactus fruits (*Opuntia ficus indica* L.), commonly called prickly pear or nopal cactus belongs to the dicotyledonous angiosperm *Cactaceae* family, a family that includes about 1500 species of cactus. *Opuntia ficus indica* is a tropical and subtropical plant. This plant is pointed out as relevant health promoting food with a great number of potentially active nutrients; the fairly high sugar content and low acidity of the fruit give it a delicious, sweet taste (Fatima *et al.*, 2014). Prickly pear fruit contains (80-95%) water, (3-7%) carbohydrates, (1-2%) fibre and (0.5-1%) protein (Zhao *et al.*, 2007). Also, (Tamer *et al.* 2011) mention that, cactus (*Opuntia macrohiza*) juice has desirable technological characteristics such as high content of vitamin C (50-55 ml / 100 ml), low pH value (3.6-3.8) and total soluble solids (approximately, 10.5° Brix). While, (Feugang *et al.* 2006) reported that, *Opuntia ficus indica* fruit's pulp exhibit a comparatively high pH value (5.5-6.5) and total soluble solids content ranging from 11 to 17° Brix. Moreover, the fruit of *Opuntia ficus indica* are a source of ascorbic acid (180-300 mg/kg of vitamin C). This content is higher than that found in other fruits like apple, banana or grape (Piga, 2004). Vitamin K is present in all parts of the fruit ranging from 0.5 to 1 g/ kg (Ramadan and Mörsel, 2003). Ice cream is a frozen foam that consists of air cells dispersed in an aqueous matrix (Marshall *et al.*, 2003). The three main structural components of ice cream are air cells, ice crystals and fat globules, which are distributed throughout a continuous phase of un frozen solution (serum).

The physical structure of ice cream affects its melting rate and hardness, although the specific relationship have not all been worked out. The melt-down rate of ice cream can be determined by placing a sample of ice cream on a wire mesh screen at warm temperatures and measuring the rate of fluid accumulation beneath the screen (Hartel and Muse, 2004). The aim of present study to investigate the physio-chemical characteristics of ice cream prepared with prickly pear juice before and after enzymatic treatment.

### Material and Methods

#### Material:

Prickly pear fruit (*Opuntia ficus indica* Mill.) collected during the season (September 2015) from Al-Mandah farm in Al-Taif, Kingdom of Saudi Arabia (KSA). All chemicals purchased from Faris

Althaghar Establishment Co. Jeddah, Saudi Arabia. Pectinase enzyme purchased from Acmatic for chemicals and lab. Equipments. Cairo, Egypt.

*Preparation of prickly pear juice:*

The cultivar used in this study was prickly pear in orange color. Only fruits without external injuries were selected, washed under tap water and the peel were removed manually after removing of uncoloured sides (top and bottom) prior to grinding. Fruit pulps (with seeds) were storage in plastic boxes in deep freezer (Hisense, type H340US) at -18°C until use. Fruit pulps were blended for five seconds in a blender (Braun, type JB 3010) then separated the seeds from the full pulp. Juice divided in two portions. The first portion was non-enzymatic treatment juice and the second portion was enzymatic treatment juice by pectinase enzyme in 2 mg per 1 L. of prickly pear juice for 4 h under heating. After enzymatic treatment, the juice was filtered twice usingstrainer. Both werepasteurized at 90°C for 5 min. Then, it were storageat 4°C until analysis.

*Preparation of prickly pear ice-cream:*

Ice cream base mix were prepared to contain 15% skim milk powder (low heat), 25% fat (cream with 30% fat), 9% sucrose, 0.5% gelatine as stabilizer and cow milk (additive percentages at table (1). The concentrated pulp juice was added to the basic ice cream mixture at three levels for each portion (10, 20 and 30% of enzymatic treatment juice) and (10, 20 and 30% of non-enzymatic treatment juice) with keeping content of other ingredients at stable level. All mixes were pasteurized at 80°C for 30 second as given by (Arbuckile 1986). The mixes were cooled to 5°C and aged at that temperature for 4 hours prior to freezing. After aging, each batch was frizzed in Ice cream maker (DeLonghi, type GM6000). The resultant ice cream will be package in cups 50 ml and place in a deep freezer at -18°C for hardening according to Rothwell, (1976) for 24 hours.

**Table 1:** The ice-cream formula.

Samples Ingredients g/kg	Control	Prickly pear juice (10%)	Prickly pear juice (20%)	Prickly pear juice (30%)
Cream	250			
Skim milk powder	150			
Cow milk	500	400	300	200
Prickly pear juice	—	100	200	300
Sugar	90			
Stabiliser	5			

*Analytical Methods:*

Some physical and chemical characteristics of prickly pear fruit juice (before and after enzymatic treatment)

Moisture content, total soluble solids, total acidity, pH values and ash were determined according to (A.O.A.C. 2013).

*Determination of ascorbic acid:*

Ascorbic acid was determined as described in methods of vitamin assay (Romeu-Nadal *et al.* 2006).

*Determination of Total Betalaines:*

Pigment content measured in double beam UV-15-02, spectrophotometer by two methods: (1) In the first method, dilution was carried out by dist. water without any correction in the pH value of the original extract and measurement was carried out at wavelength of 535 nm and the quantification was expressed as mg betalains/100g using the following equation: (Castellar *et al.*, 2003)

$$BC = \frac{(A \times DF \times MW \times 1000)}{(\epsilon \times L)} \quad (1)$$

Where: A is the absorption value obtained at 535 nm as O.D; DF is the respective dilution value; L is the path length of cuvette (1cm);  $\epsilon$  the extinction coefficient for betalains 60,000 L /mol cm in H<sub>2</sub>O; at  $\lambda$  =535 nm and MW, is the molecular weight of betanin (550 g/mol).

(2) In the second method, original color extract was diluted with Mc Ilvaine buffer (pH 6.5) and absorption value was measured at 538 nm as described by (Stintzing *et al.* 2005). Pigment content was calculated as given in equation (1). Pigment content can also expressed as neobetanin equivalent using the same equation (1) but with replacing the extinction value of neobetanin ( $\log E=4.26$  as described by (Strack *et al.*, 1987). For samples containing vulgaxanthin I, pigment content was calculated also as vulgaxanthin I using  $\epsilon =48,000$  and MW of 308.

#### Total color density or color index:

Total color density (TCD) of prickly pear juice samples (1 gm was extracted by 10 ml water, then filtered and the color value was measured at 420, 520 and 700nm (Somers 1971, 1972).  $TCD = (Abs\ 420 + Abs\ 520) - 2 (Abs\ 700)$ .

#### Sugar Measurements:

The total sugars (Glucose, Fructose and Sucrose) content of the prickly pear juice (before and after enzymatic treatment) were quantified by hydrolysis with IMHCL at pH1 and 80-85°C for 30 minutes and neutralization with 1M NaOH. The 3,5-dinitrosalicylic acid (DNS) method (Miller, 1959) was used to determine the sugar content as glucose. Reducing sugar was determined by the same method but without hydrolysis. The standard curve was in the range of 0.1-1 (gL<sup>-1</sup>) glucose solution ( $R^2 = 0.98$ ).

#### Properties of Ice cream:

- Viscosity of ice cream mix was carried out using a rotary viscometer (RHEOTEST, type RV and Prue fgeraetewerk Medingn, Dresden) as described by (Toledo 1980).
- The specific gravity was measured according to (AOAC 2013). This work was carried out in the IDAC Merieux Nutri Sciences, Riyadh, Saudi Arabia.
- The melting resistance of the resultant ice cream was determined according to Hartel *et al.* (2003).

#### Organoleptic evaluation:

According to scale from one to ten points, 50 randomly persons evaluated two portions of juice (non-enzymatic treatment juice and enzymatic treatment juice). Also, they evaluated seven portions of ice-cream which is; control, (10, 20 and 30% of enzymatic treatment juice) and (10, 20 and 30% of non-enzymatic treatment juice). Evaluation parameters are color, test, odor, texture and overall acceptability. Sensory evaluation was carried out according to the procedures described by (Reitmeier and Nonnecke, 1991).

#### Statistical analysis:

Statistical analyses were carrying out by using SPSS software, version 22. Unilabiate analysis of variance (one-way ANOVA test) was applied to determinate among the means of chemical data and sensory evaluation.

## Results and Discussions

### Some physio-chemical characteristics of prickly pear juice before and after the enzymatic treatment:

The favourite fruit prickly pear has a delicious taste and characterised aroma. In order to estimate the nutritive value of such popular fruits, analyses of the major constituents were carried out. Table

(2) shows the prickly pear juice (before and after enzymatic treatment) contents of the total solids (T.S.), total soluble solids (T.S.S.), ash, total acidity (as citric acid), pH-values, ascorbic acid content, total betalians, betacyanin, betaxanthin and color index.

From the above tabulated data, it could be observed that, the moisture content of prickly pear juices were  $86.24 \pm 0.2$  and  $87.06 \pm 0.2$  for the juice before and after enzymatic treatment, respectively, and consequently the total solids were  $13.47 \pm 0.2$  and  $12.94 \pm 0.2$ , respectively. The majority of the total solids (T.S.) of prickly pear juice were in the soluble form, since the total soluble solids (T.S.S.) were  $17.1 \pm 0.3$  and  $12.4 \pm 0.4$  Brix, respectively. Besides, the total acidity (as % citric acid) of two prickly pear juices were found to be  $0.011 \pm 0.08$  and  $0.19 \pm 0.01$ , respectively.

Furthermore, it was noticed from the same table that the pH-value of the juice before and after enzymatic treatment were  $5.04 \pm 0.06$  and  $3.56 \pm 0.07$ , respectively. Also, the same table (2) could be noticed that the ascorbic acid were 29.59 and 8.51%, respectively. Ash percent represents the total anions as well as cations. They are very essential factors from the nutritional point of view. Results from the same table indicate that the ash content was  $0.49 \pm 0.05$  in the prickly pear juice before the enzymatic treatment and  $0.26 \pm 0.08$  for the juice after the enzymatic treatment.

**Table 2:** Some physio-chemical analysis of prickly pear juice before and after the enzymatic treatment.

Components (%)	Juice before enzymatic treatment (%)	Juice after enzymatic treatment (%)
Moisture	$86.24 \pm 0.2$	$87.06 \pm 0.2$
Total solids (T.S.)	$13.47 \pm 0.2$	$12.94 \pm 0.2$
Total soluble solid (°Brix)	$17.1 \pm 0.3$	$12.4 \pm 0.4$
Ash	$0.49 \pm 0.05$	$0.26 \pm 0.08$
Total acidity (as % citric acid)	$0.11 \pm 0.08$	$0.19 \pm 0.01$
pH-value	$5.04 \pm 0.06$	$3.56 \pm 0.07$
Ascorbic acid	$29.59 \pm 2.64$	$8.51 \pm 0.16^{***}$
Betacyanin (mg/L)	$0.24 \pm 0.05$	$1.41 \pm 0.05$
Betaxanthin (mg/L)	$19.46 \pm 0.36$	$29.93 \pm 0.74$
Total betalains (mg/L)	$19.71 \pm 0.4$	$27.93 \pm 0.8$
Color index (O.D.)	$0.035 \pm 0.0005$	$0.031 \pm 0.002$

<sup>a</sup> Significant difference before and after enzymatic treatment at  $p < 0.05^*$  and  $p < 0.01$

Processing of prickly pear fruit juice using enzyme is important to produce high quality fruit juice that meets the consumer interest. Application of enzyme proved to increase the juice recovery, as well as, the juice physio-chemical characteristics (Nur-Aliaa *et al.* 2008). The pH-value and total acidity of the juice produced without enzymatic treatment were higher as compared to the juice after enzymatic treatment. According to (Acar *et al.* 1999), the juice was treated by enzyme become more acidic, which might be due to the formation of galacturonic acid by the enzymatic breakdown of pectin.

Betalains, water soluble nitrogenous pigments are found in many plants such as cactus fruits. They comprise purple to red betacyanins and yellow to orange betaxanthins. Therefore, in the present study, betacyanin impact of prickly pear fruits was evaluated in its juice before and after enzymatic treatment. It was recorded  $0.24 \pm 0.05$  and  $1.41 \pm 0.05$  mg/L in the juice before and after the treatment, respectively. While, betaxanthin was recorded  $19.46 \pm 0.36$  and  $29.93 \pm 0.74$  in the same two juices, respectively. Then, the total betalains in the same two juices amounted to about  $19.71 \pm 0.4$  and  $27.93 \pm 0.8$  mg/L, respectively. Betalains are pigments located in the cell vacuole and synthesized from the tyrosine amino acid into two structural groups: betacyanins and betaxanthins (Gandia-Herrero *et al.*, 2010). The content of betalains in the prickly pear juice is variable, high concentrations, especially in red prickly pear fruit. Our results were agreement with (Saenz *et al.* 2009). Betalains are recognized for their antioxidant activity and anti carcinogenic (Stintzing and Carle, 2004). Also, data in table (2) show the optical density of the juice. In general, optical density represents the water soluble and insoluble pigments (O.D.). Color index (O.D.) was found to be  $0.035 \pm 0.0005$  and  $0.031 \pm 0.002$  nm in prickly pear juice before and after the enzymatic treatment, respectively.

**Total sugars content in prickly pear juice before and after enzymatic treatment:**

From Table (3), it could be noticed that, the total sugars content of the juice before and after enzymatic treatment amounted to about 11.21 and 13.02%, respectively. About 8.99 and 10.10% of which are in the reducing form, while the rest are in the form of non-reducing sugars (2.66 and 2.92% respectively). Enzymatic treatment increased the amounts of natural sugars in the prickly pear juice. These results were similar to those found by (Fang *et al.* 1986) and (Arsad *et al.* 2015), where the concentration of reducing sugars concentration was higher in the juices pasteurized at higher temperatures. During enzyme treatment the number of reduction groups increased according to the increase in galacturonic acid and oligosaccharides (Demir *et al.* 2001) and Landbo *et al.*, 2007).

**Table 3:** Total sugar contents in prickly pear juice before and after enzymatic treatment

Contents (%)	Juice before enzymatic treatment	Juice after enzymatic treatment
Reducing sugars	8.99 ± 0.67	10.10 ± 0.53 <sup>a*</sup>
Non-reducing sugars	2.22 ± 0.15	2.92 ± 0.58
Total sugars	11.21 ± 1.01	13.02 ± 0.59 <sup>a*</sup>

<sup>a</sup> Significant difference before and after enzymatic treatment at  $p < 0.05^*$  and  $p < 0.01^{**}$

**Some physio-chemical characteristics of ice cream:**

The chemical components of ice cream formulas are demonstrated in table (4). It is obvious from the data that, there are lower differences between all ice cream with prickly pear juice (before and after the enzymatic treatment) in moisture content compared to ice cream without prickly pear juice (control sample). The moisture content in the control sample was  $62.36 \pm 0.46$ . While, in ice cream with prickly pear juices moisture content ranged between 62.70 and 67.29%. Also, there were slight differences in the total solid content (T.S.) of the formulas. It ranged from 32.71 to 37.30%. The T.S. content of the all formulas are within the Saudi standard (2014).

**Table 4:** Some physio-chemical characteristics of ice cream.

Components % Samples		Moisture	Total solid (T.S.)	Ash	pH-value	Total acidity (as citric acid)	Color density (TCD)
Ice cream without juice	Control	62.36 ± 0.46	37.64 ± 0.46	1.92 ± 0.20	6.19 ± 0.01	0.224 ± 0.00	0.008 ± 0.01
Ice cream with prickly pear juice before the enzymatic treatment	10%	66.64 ± 0.75	33.36 ± 0.75	1.32 ± 0.19	6.24 ± 0.02	0.245 ± 0.02	0.008 ± 0.01
	20%	64.01 ± 0.29	35.99 ± 0.29	1.35 ± 0.13	6.24 ± 0.01	0.181 ± 0.02	0.008 ± 0.01
	30%	67.29 ± 0.27	32.71 ± 0.27	1.47 ± 0.42	6.25 ± 0.01	0.192 ± 0.00	0.009 ± 0.01
Ice cream with prickly pear juice after the enzymatic treatment	10%	64.33 ± 0.55	35.67 ± 0.55	1.66 ± 0.32	6.22 ± 0.005	0.170 ± 0.02	0.009 ± 0.01
	20%	62.70 ± 2.25	37.30 ± 2.25	1.72 ± 0.06	6.25 ± 0.02	0.234 ± 0.02	0.010 ± 0.01
	30%	64.85 ± 1.88	35.15 ± 1.88	1.70 ± 0.21	6.24 ± 0.01	0.202 ± 0.02	0.010 ± 0.01

Same litters mean no significant difference at  $p < 0.05$ .

Ash content recorded clear differences between the control sample and the other formulas. The control sample recorded  $1.92 \pm 0.20\%$ , while the formulas which contain prickly pear juice before the enzymatic treatment recorded  $1.32 \pm 0.19$ ,  $1.35 \pm 0.13$  and  $1.47 \pm 0.42\%$  when the juice was added by 10,20,30%, respectively. Ice cream with prickly pear juice after the enzymatic treatment recorded  $1.66 \pm 0.32$ ,  $1.72 \pm 0.06$  and  $1.70 \pm 0.21$  for the same adding percentages, respectively.

Concerning pH-values, it was clear that, all formulas have a pH-values from pH 7. It was ranged between  $6.22 \pm 0.005$  to  $6.25 \pm 0.02$  for the ice cream with prickly pear juice after the enzymatic treatment, while the control sample recorded  $6.19 \pm 0.02$ . On the other hand, the total acidity was

recorded 0.224 for the control sample and  $0.245 \pm 0.02$ ,  $0.181 \pm 0.02$  and  $0.192 \pm$  for the ice cream with prickly pear juice without enzymatic treatment, as well as  $0.170 \pm 0.02$ ,  $0.234 \pm 0.02$  and  $0.202 \pm 0.02$  for the ice cream with prickly pear juice with enzymatic treatment. For color density (TCD), there are no differences between all ice cream formulas. It ranged between  $0.008 \pm 0.1$  and  $0.010 \pm 0.01$ .

**Properties of Ice cream:**

Table (5) shows the viscosity (C.P.), specific gravity and melting resistance after 15, 20, 25, 30 and 35 min. For ice cream mixes with different ratios (10, 20 and 30% juice) from prickly pear juice (before and after enzymatic treatment). As expected, the ice cream mixing with prickly pear juices had a high viscosity (C.P.) compared to the control sample. Also, Ice cream mixing with prickly pear juices, and treated by enzyme, had a high viscosity (C.P.) compared to ice cream, which contains prickly pear juice before the enzymatic treatment. Ice cream which contains prickly pear juice (after enzymatic treatment) by ratio 20% recorded the highest C.P. (167).

**Table 5:** The viscosity (C.P.), specific gravity and melting resistance after 15, 20, 25, 30 and 35 min.

Property	Control without prickly pear	Ice cream with prickly pear juice before the enzymatic treatment			Ice cream with prickly pear juice after the enzymatic treatment		
		10%	20%	30%	10%	20%	30%
Viscosity (C.P)	95	100	119	162	125	167	104
S.G. (gm/cm <sup>3</sup> )	1.0078	1.0645	1.0153	1.0273	1.0068	1.0134	1.0560
M.R. after:							
15 min.	1.90	1.83	1.15	1.97	1.07	1.17	1.91
20 min	7.47	3.71	2.84	3.21	2.11	2.47	3.48
25 min.	10.27	6.25	7.43	8.37	7.40	9.99	8.88
30 min.	15.36	12.44	11.53	13.26	10.97	16.41	17.53
35 min.	19.49	18.20	14.95	14.81	13.22	18.01	19.75

*Specific gravity (S.G), Melting resistance (M.R)*

Furthermore, the specific gravity for ice cream increases whenever the addition ratio of prickly pear juice (before and after the enzymatic treatment) goes up compared to the control sample. As for the ice cream by prickly pear juice before the enzymatic treatment, an addition by 30% recorded (1.0273 gm/cm<sup>3</sup>) the highest amount. Also, regarding ice cream by the same juice after the treatment, the specific gravity recorded (1.0560 gm/cm<sup>3</sup>), The highest amount for the same ratio (30%).

The effect of different addition ratios from prickly pear juice, for ice cream on melt down property, is shown in the same table (5). After 15 min. there was almost the same quality collected from the control sample. At the same time, there was no milting in the 30% prickly pear juice (non-enzymatic treatment and enzymatic treatment). It recorded 1.90 gm in the control sample and 1.97 gm in the ice cream by untreated prickly pear juice, as well as 1.91gm for the ice cream by prickly pear treated enzymatically.

**Organoleptic evaluation:**

According to the scale from one to ten points, 58 randomly persons evaluated two portions of juice (non-enzymatic treatment juice and enzymatic treatment juice). In table (6) statistical analysis shows that non-enzymatic treatment juice was more acceptable. Also, Table (7) shows statistical analysis of seven samples of ice cream. Data showed that ice cream with an addition of 30% prickly pear juice before the enzymatic treatment, was more preferred. While, ice cream with addition of 10% prickly pear juice after enzymatic, treatment was more desirable.

**Table 6:** Organoleptic evaluation of prickly pear juice before and after enzymatic treatment.

Sensory properties	Control without prickly pear	Ice cream with prickly pear juice before the enzymatic treatment			Ice cream with prickly pear juice after the enzymatic treatment		
		10%	20%	30%	10%	20%	30%
Color	8.47±0.25 <sup>c</sup>	4.79±0.27 <sup>ab</sup>	7.47±0.27 <sup>ab</sup>	7.80±0.28 <sup>abc</sup>	7.00±0.30 <sup>a</sup>	7.02±0.35 <sup>a</sup>	8.00±0.00 <sup>bc</sup>
Odor	8.55±0.23 <sup>b</sup>	6.55±0.27 <sup>a</sup>	6.61±0.29	6.59±0.29 <sup>a</sup>	6.61±0.28 <sup>a</sup>	6.47±0.30 <sup>a</sup>	6.10±0.36 <sup>a</sup>
Taste	8.43±0.27 <sup>b</sup>	6.33±0.34 <sup>a</sup>	5.9±0.38 <sup>a</sup>	6.29±0.39 <sup>a</sup>	6.00±0.38 <sup>a</sup>	6.14±0.34 <sup>a</sup>	5.22±0.44 <sup>a</sup>
Texture	7.82±0.27 <sup>b</sup>	7.63±0.27 <sup>ab</sup>	7.14±0.30 <sup>ab</sup>	7.22±0.33 <sup>ab</sup>	7.33±0.29 <sup>ab</sup>	7.20±0.29 <sup>ab</sup>	6.80±0.35 <sup>a</sup>
Overall acceptability	8.61±0.21 <sup>b</sup>	6.94±0.29 <sup>a</sup>	6.63±0.33 <sup>a</sup>	7.00±0.31 <sup>a</sup>	6.84±0.27 <sup>a</sup>	6.51±0.33 <sup>a</sup>	6.18±0.38 <sup>a</sup>

Same litters mean no significant difference. at  $p < 0.05$ .

**Table 7:** Sensory evaluation of prickly pear ice cream before and after enzymatic treatment.

Sensory properties	Control without prickly pear	Ice cream with prickly pear juice before the enzymatic treatment			Ice cream with prickly pear juice after the enzymatic treatment		
		10%	20%	30%	10%	20%	30%
Color	8.47±0.25 <sup>c</sup>	4.79±0.27 <sup>ab</sup>	7.47±0.27 <sup>ab</sup>	7.80±0.28 <sup>abc</sup>	7.00±0.30 <sup>a</sup>	7.02±0.35 <sup>a</sup>	8.00±0.00 <sup>bc</sup>
Odor	8.55±0.23 <sup>b</sup>	6.55±0.27 <sup>a</sup>	6.61±0.29	6.59±0.29 <sup>a</sup>	6.61±0.28 <sup>a</sup>	6.47±0.30 <sup>a</sup>	6.10±0.36 <sup>a</sup>
Taste	8.43±0.27 <sup>b</sup>	6.33±0.34 <sup>a</sup>	5.9±0.38 <sup>a</sup>	6.29±0.39 <sup>a</sup>	6.00±0.38 <sup>a</sup>	6.14±0.34 <sup>a</sup>	5.22±0.44 <sup>a</sup>
Texture	7.82±0.27 <sup>b</sup>	7.63±0.27 <sup>ab</sup>	7.14±0.30 <sup>ab</sup>	7.22±0.33 <sup>ab</sup>	7.33±0.29 <sup>b</sup>	7.20±0.29 <sup>ab</sup>	6.80±0.35 <sup>a</sup>
Overall acceptability	8.61±0.21 <sup>b</sup>	6.94±0.29 <sup>a</sup>	6.63±0.33 <sup>a</sup>	7.00±0.1 <sup>a</sup>	6.84±0.27 <sup>a</sup>	6.51±0.33 <sup>a</sup>	6.18±0.38 <sup>a</sup>

Same litters mean no significant difference at  $p < 0.05$ .

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