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Enrichment of ice cream produced with kernel flour and elderberry mantle

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ABSTRACT

In this research, mantle flour and elderberry kernel were used to increase the nutritional properties and fiber of ice cream. Elderberry mantle and core were separately converted into flour, added to ice cream at levels (2, 1, and 3%) and its physicochemical properties such as: viscosity, aurran, colorimetry were investigated and the best treatment was determined during the sensory evaluation. The physicochemical results of ice cream containing elderberry flour (shell and core) showed: increasing the percentage of elderberry core and mantle caused a decrease in pH. The lowest pH value was related to the sample containing 3% kernel flour and the highest pH value was related to the control sample. The highest amount of viscosity (1327.5 centipoise) was related to the treatment of 3% elderberry mantle flour and the lowest amount was related to the control sample. The highest specific weight (1.15) was related to the treatment of 2% and 3% of elderberry mantle flour and the lowest amount was related to the control sample. Also, the highest coefficient of volume increase was observed in the control sample (38.97%) and the lowest overrun was observed in the sample containing 3% of Sanjad mantle flour. With the sensory evaluation, the treatment containing 2% elderberry kernel flour was more acceptable than other treatments.

1. Introduction

Today, consumers prefer foods that have nutritional benefits in addition to being safe. Therefore, the production of functional products has become common among food manufacturers, and ice cream is not exception [1]. Ice cream is based on milk and is a frozen dairy dessert that consists of various ingredients such as: cream, egg yolk, sugar, milk and other ingredients [2]. Ice cream in its unfrozen state is a kind of emulsion, which is usually called as serum matrix, in which the continuous serum phase, i.e. fat molecules, is placed in the water-sugar-ice dispersion structure with air bubbles [3]. Due to its cooling and nutritious effect, ice cream is usually enjoyed by people of all ages and is very popular among consumers in many countries, and because it is a milk-based dessert, its value is high.[4]. Ice cream acts as a carrier of natural bioactive ingredients to provide a variety of healthy nutritional benefits, which are derived from milk, sucrose, stabilizers, and emulsifiers [5]. Elderberry flour has been used at different levels (1-2-3%) to prepare functional ice cream, which has an effect on the quality properties of ice cream. The addition of fiber increases the viscosity of the ice cream mixture and the use of 2% fiber is effective in the melting point of the mixture [6]. Elderberry is a shrub or small thorny tree with a height of 2 to 5 meters, silver-green branches and oval leaves. Its flowers are fragrant with having bell shape and cream color and are formed as single or cluster. The range of its fruit length is from 1.50 to 2.00 cm and fruit shape is usually oval with reddish-brown color. This plant species has ecological, pharmaceutical, and economic uses. In addition, this species has high tolerance to adverse soil conditions such as drought, high salinity, and alkalinity and thus it is suitable to protect the ecosystem in arid regions [7]. Elderberry fruit is used in food, pharmaceutical, perfumery and wood industries. The fruit is edible and sweet, although it has a dry, floury texture. Its kernel is used in the treatment of urinary diseases, diarrhea, nausea, vomiting, asthma and flatulence [8]. It has been reported in traditional Iranian medicine because of its anti-inflammatory and analgesic properties. Edible fruits are consumed fresh or dry [9]. Among the seven different organic acids identified, the level of citric acid was the highest, followed by malic acid, acetic and oxalic acids. The high nutritional content in elderberry flour showed that it is a good source of dietary fiber, micro minerals, fatty and organic acids. The water solubility (WS) and water absorption capacity (WAC) of elderberry flour make their use possible. The results show that elderberry flour can be used in some processed foods such as bakery products, dairy products (ice cream and yogurt), drinks and sweets. In addition, elderberry flour can be used in the preparation of low-fat and high-fiber diet products due to its high dietary fiber content. The abundance of palmitoleic acid (16:1) in the skin of the fruit and linoleic acid (18:2), palmitic acid (16:0) in the kernel, phospholipids and glycolipids in the fruit and elderberry flour as a functional element and also according to the structure of the flour, a special taste And functional properties such as dietary fiber, mineral content and phenolic compounds are used in the production of bakery products, yogurt, ice cream, baby food, chocolate, sweets, etc. [10]. Elderberry flour with high fiber content (20-30%) shows the potential to absorb more water and increase the effect on emulsion stability. It also has abundant amounts of fiber, potassium salts, magnesium, sodium, iron, calcium, and is also rich in tannins, and for this reason, it leads to the reduction of cholesterol, cytotoxic effects on human cancer cells. In addition, it contains significant amounts of flavonoid, terpenoid compounds, glucose, fructose, phenolic acid and caffeic acid. It is also used in traditional medicine as an anti-inflammatory and analgesic agent to reduce rheumatic joint pain [11].

Because the consumption of milk in our country is low, osteoporosis is a major problem in the health status of people in the society. Elderberry, which contains raw fiber, fat, ash, protein and sugar, is used in traditional medicine to solve this problem. Therefore, in this research, the fibrous effects of elderberry were used in the preparation and formulation of

ultra-beneficial ice cream, as well as investigating its rheological, sensory and physicochemical properties.

2- Materials and methods

2-1- Materials

In this research, sterilized and homogenized milk (1.5% fat) and sterilized and homogenized cream (with 30% fat) were purchased from Kale Amel Dairy Company. Skim milk and salab gum made by Roysa Ghaemshahr company were prepared. Sucrose was purchased from Berlian Company in Tehran and vanilla was purchased from a local store. Elderberry fruit was also purchased from local market, Mazandaran, Babol.

2-2- Methods

1-2-2- Preparation of elderberry kernel and mantle flour

Elderberry purchased from local market were placed on a sieve and immersed in water for washing. Then it was dried in an oven (60°C, 30 minutes). Peeled with a plastic knife, the mantle and the core of the oleaster fruit were separated [13] At first they were powdered by local market mill (semi-industrial steel mill model 2000, made in Iran) and then by Molineux mill (made in France) and then it through a sieve with 180 microns mesh and again finer with porcelain mortar. The obtained elderberry flour was kept in a glass container inside the refrigerator at a temperature of 4°C until the time of the test [11].

2-2-2- How to make ice cream

The ice cream formulation was prepared based on 8% milk fat, 15% sucrose, 9% skim milk, 0.1% vanilla, 0.2% mono- and triglyceride emulsifier and 0.3% Salab (ice cream formulation based on 8% milk that Its fat obtained by Pearson's method from the combination of 1.5% fat milk and 30% fat cream). The studied variables were the replacement of the kernel and mantle of oleaster at the levels of (1-2-3%). Ice cream production was done according to the method of Akalin Wariber (2008). After weighing the raw materials, first the milk was heated to a temperature of 40-45 °C, then the milk and cream were mixed with a hand mixer (Black & Decker 250w) for 1 minute, then the solid components of the formula (milk powder, sucrose, 200 grams of flour and elderberry kernel in 3 concentrations of 1, 2, and 3% each for enrichment, stabilizers) was added to the heated liquid and the ingredients were mixed for 5 minutes with a mechanical stirrer (Pars Azma made in Iran) at a speed of 70 rpm. The prepared mixture was indirectly pasteurized at 70°C for 30 minutes in a water bath and immediately cooled to 5°C using ice and salt water. for passing the aging duration. The mixture was placed in the refrigerator at a temperature of 4-6°C for 24 hours and the mixture was frozen in a non-continuous ice cream maker (Cuisinart made in America) for 30 minutes at a temperature of -4°C (vanilla was also added to the mixture). The samples were packed and coded in 50gram plastic containers with sterile polyethylene lids and were transferred to a freezer at -18°C for 24 hours during the hardening period and performing tests [14].

3-2-2- Physicochemical tests of ice cream containing elderberry mantle and kernel flour

1-3-2-2- Ice cream mixed experiments

• pH

This method was performed on the ice cream mixture and after its aging. In each step of the test, buffer solution with 4 and 7 pH value was used to calibrate the device. The working method was that the pH value was recorded at a temperature of 25 °C using a digital pH meter (Janeway, UK) [15].

• viscosity

The viscosity of the ice cream mixture was measured using a Brockfield rotary viscometer (ProDV+ model, made in America) at a temperature of 5 °C for 20 seconds on an ice cream mixer spindle LV-3(63) at 60 rpm [2]. After conducting the

preliminary tests and determining the desired spindle, the temperature of the mixture was set constant by the mixture of water and ice, and the test was performed with the spindle (LV-3(63) at 60 rpm), which showed a torque higher than 10%.

• Specific gravity

This method was performed on the ice cream mixture after the aging period by pycnometric method at a temperature of 25 °C. The working procedure was as follows: the weight of dry and empty pycnometer (G), the weight of pycnometer and distilled water (G1), the weight of pycnometer and sample (G2) were measured and finally, the specific gravity was calculated according to the following formula: [16]

G) / (G1 – G) - G_2 (specific gravity=

2-3-2-2- ice cream tests

• Color evaluation

It was done using a colorimeter (IMG-Pardazesh, CAM model). L* index, black/white color and parameter a*/-a* red/green color and b*/-b* also show blue/yellow color. [11]

• First dripping time

30 grams of ice cream sample prepared at a temperature of 25°C was placed in the opening of the bucher and on a grid metal plate in the incubator, and the time of the first melted drop was recorded [17].

• Total solid

This test was performed 3 days after keeping the ice cream at -18°C. The procedure was that 2 grams of the ice cream sample was weighed in the plates that had already reached a certain weight and heated in a water bath for 30 minutes. In the next step, the plates were heated in an oven at 105 °C for 2 hours and after cooling in a desiccator, they were weighed and the percentage of total solid was calculated with the following formula: [18]

Total solid percentage = W2-W1/P*100

W1 = plate weight

W2 =plate weight + Total solid

P = sample weight

• overrun

To determine the percentage of overrun, after weighing an empty bucher (M0), a specified amount of ice cream (5 cc) was poured into the bucher and its weight (M1) was recorded. After the complete melting of the ice cream, the bucher and its contents were weighed (M2). Then, the increase of ice cream volume was calculated according to the following formula:

*١٠٠M1 /M1- (M2-M0) overrun=

• Sensory evaluation

The ice cream samples were randomly coded and given to 10 panelists (students, professors, employees who have experience in evaluating university theses). The assessors drank water before the sensory evaluation test. The sensory evaluation of the samples after one day of storage at -18°C and with a 5-point hedonic test (excellent-bad) was given to 10 judges (8 women and 2 men) for evaluation. The investigated attributes were color, taste, smell, texture and overall acceptance [14].

4-2-2- Statistical analysis

The effect of different concentrations of elderberry kernel and mantle flour (3 levels) was analyzed by factorial test. The independent variables included the concentration of elderberry kernel and mantle flour (1.2%, 2%). Dependent variables included ice cream tests. All the results related to the data obtained from the ice cream tests were done in a completely random design. Data analysis was done using software (SPSS 26) and Excel version 2016 was used to draw graphs. Significant differences were determined using one-way analysis of variance (ANOVA). The investigated variables were the addition of kernel flour and elderberry mantle at levels (1, 2, 3%) to the ice cream.

3- Results and Discussion

1-3- Physicochemical tests of ice cream enriched with elderberry kernel and mantle flour

1-1-3- Ice cream mixed tests

• pH

The pH level is related to the contents of the composition [19]. According to table (4-8), the pH value of the samples was calculated by adding different percentages of mantle and kernel of elderberry to ice cream and in three repetitions. According to the results of table (4-8), the sample containing 1% and 2% core and the treatment containing 1% and 2% mantle have no significant difference (p>0.05), but the pH of the other treatments has significant difference (p<0.05). According to the results, the increase in the percentage of mantle and kernel of elderberry led to a decrease in pH. The lowest pH value was related to the sample containing 3% kernel and the highest value was related to the control sample. Saraf et al. (2017) using elderberry flour in donuts, and also Songol et al. (2014) reached similar results by examining flour and elderberry shell [13]. Since the mantle and kernel of elderberry contain fatty acids: palmitic, linoleic, palmitoleic, flavonoid and phenol, and the kernel alone contains protein (albumin-globulin-amino acid, hydroxybenzoic acid), this decrease in pH is reasonable [8].

• Viscosity

Viscosity is an important physical characteristic of ice cream that has a major effect on its sensory quality and especially on the evaluation of texture, and it affects the mixture reactions in the mouth and the resistance of ice cream to mechanical forces created by the tongue, palate and teeth, determines the overall perception of the ice cream texture [20]. As shown in table (4-8), with the increase in the percentage of elderberry flour (mantle and kernel), the viscosity of the samples at 60 rpm and 100 rpm increased significantly (P<0.05). The results indicate that the increase of viscosity in the sample containing elderberry mantle flour is more than the treatment containing elderberry kernel flour. The control sample showed the lowest viscosity (378/13) and the sample containing 3% elderberry mantle showed the highest viscosity (1327/5). It seems that the main reason for the increase in viscosity is related to the presence of high amounts of dietary fiber (20-30%) in the ice cream mixture containing elderberry mantle and kernel. Therefore, the presence of these compounds justifies the increase in viscosity through bonding with water and forming a gel network. Similar results have been observed in the studies of Samahi and colleagues in ice cream containing cactus pulp. Soluble fibrous polysaccharides play an essential role in coagulation, gel formation time, and the rate of hard clot formation [13].

• Specific gravity

This test was carried out on the ice cream mixture after aging phase by the pycnometric method and at a temperature of 25 ℃. According to the results of Table 8-4, the average of specific gravity of the samples is between 1.103 and 1.143. Considering the increase in the overrun, the decrease in specific gravity can be justified. Therefore, as seen in the table: The Specific gravity of the samples containing the mantle by 2% and 3%. Is higher than the sample containing the kernel by 2% and 3%. There is no significant difference between the sample containing 1% kernel and 1% mantle as well as the treatment containing 2% and 3% mantle as well as the sample containing 2% and 3% kernel (P>0.05). But the rest of the samples showed a significant difference (p<0.05). In a report by Nasa Ghaibi et al. (2016) in the investigation of specific gravity of ice cream, they stated: Specific gravity had an inverse relationship with stevia replacement and a direct relationship with inulin replacement [14].

Table 2- The results of the ice cream mix tests

pH	Viscosity (cp) و ٦٠ rpm	rpm Viscosity (cp) ١٠٠	specific gravity	Treatment
6.67±0.05[a]	397.06±1.65[g]	378.13±0.7[g]	1.12±0.03[d]	Control
6.43±0.05[b]	554.20±0.10[d]	423.16±0.3[e]	1.13±0.02[c]	T_1
6.45±0.5[b]	1170.96±0.95[b]	907.20±0.3[b]	1.15±0.01[a]	T_2
6.21±0.03[d]	1327.50±0.5[a]	1241.83±0.3[a]	1.15±0.01[a]	T_3
6.36±0.17[c]	479.423±0.5[f]	405.34±0.32[f]	1.13±0.02[c]	T_4
6.32±0.01[c]	539.23±0.58[e]	465.21±1.65[d]	1.14±0.01[b]	T_5
6.15±0.01[e]	562±0.1[c]	485.33±0.32[c]	1.14±0.01[b]	T_6

The letters shown in each column indicate a statistically significant difference (P<0.05) among the treatments)control ،(T_1) :mantle 1، (%T_2) :mantle 2 ، (%$_{T3}$) :mantle 3 ، (%T_4) :kernel 1 ، (%T_5) :kernel 2 ، (%T_6 (%3 kernel)

2-1-3- Ice cream tests

• overrun

overrun is an important physical characteristic that affects the quality of the product, and it is an indication of the increase in the volume of ice cream compared to the volume of the mixture due to the mixing and aeration process, which is due to the entry of air during the freezing process. As shown in Table 9-4, increasing the percentage of elderberry flour (mantle and kernel) in ice cream compared to the control sample significantly reduced overrun (38.05) and different treatments showed a significant difference (p< 0.05). It seems that the main reason for the reduction of overrun is the increase in viscosity. Because the higher the viscosity, the more shear force is required for mixing, freezing and aeration, and the air bubbles are constantly disintegrated and distributed inappropriately within the tissue. The results are in accordance with the report of the researchers who said: adding whey protein isolate increases the viscosity of ice cream samples. As a result, a smaller amount of air enters the ice cream texture during the whipping and freezing process and the amount of overrun decreases [15].

• Total solid

The content of solids in ice cream is very important in improving the nutritional quality, viscosity and texture of ice creams [20]. Based on the results listed in Tables 4-9, the maximum Total solid was related to the sample containing 3% kernel and the control sample showed the lowest amount of total solid. In the present statistical analysis, the sample containing 1% and 2% mantle and the sample containing 1% kernel have no significant difference (p>0.05), but the rest of the samples showed a significant difference (p<0.05). Therefore, the nutritional value of ice cream was increased by adding the mantle and kernel. Other researchers also stated that the highest number of total solids in the sample containing 3% of elderberry flour and the lowest one was in the control sample, and flour and elderberry shell respectively have higher total solid content compared to the control samples [13]. Also, the increase in the total solid of ice cream containing elderberry flour can be considered due to the low moisture content in elderberry flour, so that in this report, with the increase in the amount of mantle and kernel of elderberry, the moisture content of the sample is low and finally its total solid increases. Elderberry flour has a high amount. Carbohydrate is more than protein. The main chemical components of extracted elderberry powder are polysaccharides [21].

• First dripping time

Ice cream melting is related to heat and mass transfer, heat penetrates the ice cream and causes the ice to melt. Then, the crystals diffuse into the serum phase, creating unstable fat globules and entrapped air cells, leaving the ice crystals and defrost ice cream, which melting of the ice crystals determines the first melting drop. The speed of melting is influenced by various factors. Factors such as: composition of

materials, water in the product, nature of ice crystals and fat globules formed in the freezing process [21]. According to table (4-9), there is a significant difference between samples containing core and mantle and control ($p<0.05$). However, no significant difference was observed in elderberry samples with different percentages ($p>0.05$). The maximum time of the first melting drop corresponds to T3 and the maximum value corresponds to the control sample. So, the addition of elderberry kernel and mantle has an effect on the first dripping time of ice cream. So, all the effective mechanisms that increase viscosity and stability of the emulsion, affect the ice cream melting process.

Table3- The results of the ice cream test

Dry Matter	Overrun (%)	First Dripping Time (Second)	Treatment
34.22±0.29^{d}	38.05±0.5^{a}	36.5 ± 0.05^{a}	control
35.06±0.02^{c}	26.5±0.5^{d}	28.33±0.4^{b}	T_1
35.133±0.01^{c}	25.7±0.25^{d}	20.57±0.5^{b}	T_2
35.72±0.07^{b}	21.5±0.5^{e}	18.5±0.5^{b}	T_3
35.046±0.03^{c}	35.97±.04^{a}	35.16±0.7^{c}	T_4
35.863±0.05^{ab}	30.83±0.7^{b}	28.5±0.5^{c}	T_5
6.043±0.25^{a}	25.5±0.5^{d}	20.5±0.5^{c}	T_6

The letters shown in each column indicate a statistically significant difference ($P<0.05$) among the treatments contro
)control ،(T_1) :mantle 1، (%T_2) :mantle 2 ، (%$_{T3}$) :mantle 3 ، (%T_4) :kernel 1 ، (%T_5) :kernel 2 ، (%T_6) kernel 3(%

• Colorimetry (L*a*b*)

Color is the most important parameter in the customer's choice of ice cream. Visual color using a Hunter colorimeter (Hunter Associates Laboratory, Reston, VA, USA) in terms of L* brightness from black (0) to white (100), a*: redness (+) to green (-), b*: Indicates yellowness (+) to blue (-). The color parameter was investigated in order to estimate the effect of different percentages of elderberry mantle and kernel in ice cream samples and the color numbers (L*, a*, b*) of the samples are shown in Table 10-4. As shown in the table, L* numbers were significantly reduced in all samples compared to the control sample. The highest and lowest values of a* were observed in the sample containing 3% of elderberry kernel and the control sample, respectively. The b* values of the ice cream color are slightly yellow, which can be justified considering the color of the elderberry, and they do not have a significant difference with each other ($p>0.05$). The results are consistent with the reports of Segdik et al. (2012), who analyzed the colorimetry of the sample containing elderberry shell and mantle, and they stated the cause of these color changes to be the phenolic content of elderberry flour, and also according to the report of Saraf et al.[22] , with the increase of elderberry flour, the L* parameter shows a decrease in brightness, a* red and green color and b* yellowish blue

Table 4- Colorimetry of ice cream treatments containing different concentrations of elderberry flour

L*	a*	b *	Treatment
78.87±0.56[a]	[f] 0.05± - 2.8	[b] 0.2±13.37	control
69.44±0.41[b]	-1.03±0.02[e]	12.84±0.02[d]	T1
67±0.01[c]	-0.17±0.01[d]	13.53±0.02[c]	T2
65.73±0.24[g]	0.37±0.01[c]	14.08±0.015[a]	T3
65.27±0.01[d]	0.35±0.05[c]	12.30±0.15[e]	T4
64.020±0.01[e]	1.12±0.05[b]	11.48±0.01[f]	T5
63.56±0.32[f]	2.07±0.06[a]	11.23±0.02[g]	T6

The letters shown in each column indicate a statistically significant difference (P<0.05) among the treatments
)control ،(T_1) :mantle 1، (%T_2) :mantle 2 ، (%$_{T3}$) :mantle 3 ، (%T_4) :kernel 1 ، (%T_5) :kernel 2 ، (%T_6) kernel 3(%

• Sensory evaluation

According to the results of table (4-11), it was found that the sample of ice cream containing 2% kernel was more acceptable than the other treatments, which according to the panelists, the reason for this choice was the special taste and the similarity of the taste of the sample to the taste of coffee and the mild taste. Statistically, all treatments have significant differences with each other (p<0.05). The color of the sample containing 2% kernel has the highest score and the sample containing 1% mantle has the lowest score. Statistically, the sample containing 3% mantle with 1% mantle and 2% mantle have no significant difference with each other (p>0.05), but the rest of the samples have significant differences (p<0.05). The texture of the treatments is another index that was investigated. According to the panelists, the control sample has the best texture and the sample containing 3% mantle has the weakest texture. Statistically, except for the sample containing 1% kernel and the control sample, the rest of the treatments have significant differences with each other (p<0.05).

Table 5- Sensory evaluation results of ice cream containing different concentrations of elderberry flour

overall acceptability	Texture	Flavor	Odor	Color	Treatment
3.76±0.01[d]	3.84±0.01[a]	3.54±0.01[f]	3.82±0.01[a]	3.73±0.01[d]	control
3.48±0.01[g]	3.63±0.01[c]	3.43±0.01[g]	3.73±0.01[a]	3.62±0.01[f]	T_1
4.04±0.01[b]	3.42±0.01[e]	3.98±0.01[b]	3.71±0.01[a]	3.63±0.01[e]	T_2
3.72±0.01[f]	3.33±0.01[f]	3.73±0.01[e]	3.73±0.01[a]	3.62±0.01[ef]	T_3
3..81±0.01[c]	3.83±0.01[a]	3.86±0.01[c]	3.83±0.01[a]	3.92±0.01[b]	T_4
4.24±0.01[a]	3.56±0.01[d]	4.12±0.01[a]	3.83±0.01[a]	3.98±0.01[a]	T_5
3.74±0.01[e]	3.81±0.01[b]	3.82±0.01a	3.83±0.01[a]	3.80±0.01[c]	T_6

The letters shown in each column indicate a statistically significant difference (P<0.05) among the treatments
)control ،(T_1) :mantle 1، (%T_2) :mantle 2 ، (%$_{T3}$) :mantle 3 ، (%T_4) :kernel 1 ، (%T_5) :kernel 2 ، (%T_6) kernel 3(%

According to the results obtained from the experiments related to the first dripping time, overrun and sensory evaluation, the treatment related to ice cream containing 2% elderberry kernel was selected as the best treatment.

4- General conclusion

In this research, the effect of elderberry on the physicochemical properties of ice cream such as viscosity, specific gravity, calorimetry and sensory evaluation was investigated. Regarding the treatments containing elderberry kernel and mantle, the lowest pH was related to the sample containing 3% kernel (6.15) and the highest value was related to the control sample (6.67). With the increase in the percentage of elderberry flour (mantle and core), the viscosity of the samples increased and the highest value related to the treatment containing elderberry mantle was 3% (1327.5) and the lowest value (378.13) was related to the control sample. The lowest specific gravity of the treatments was related to the control sample, it was 1.12 and the highest number related to the mantle was 3% (1.15). The overrun of the treatments decreased with the increase of elderberry flour, so that the highest overrun was related to the control sample (38/05). The highest amount of total solid (36.043) related to the sample containing 3% kernel and the control sample showed the least amount of total solid (22.34). By increasing the amount of elderberry kernel and mantle flour, the melting speed increased and the first dripping time decreased, which showed the maximum time for the sample containing 3% mantle and the lowest value for the control sample 16.5. The L* numbers in all samples were significantly reduced compared to the control sample. The highest number regarding the L* index was related to the control sample (78/87) and the lowest value of the L* parameter was related to the ice cream containing 3% core (63/56). The highest and lowest values of a* were observed in the sample containing 3% of elderberry kernel and the control sample, respectively. Regarding the b* values, the color of the ice cream is slightly yellow. Regarding the sensory evaluation parameter, the treatment related to the ice cream containing 2% elderberry kernel was the best sample selected by the panelists. It seems that more research is needed regarding the use of elderberry kernel in dairy products.

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چکیده

بستنی محصولی پرمصرف در میان اکثر رده‌های سنی می‌باشد. بستنی موجود در بازار معمولاً از نظر مواد تغذیه ای چون فیبر ناکافی می باشد. لذا در این پژوهش به غنی سازی این محصول با استفاده از ترکیب تغذیه ای سالم سنجد و فیبر آن پرداخته شد. گوشته و هسته سنجد به صورت مجزا به آرد تبدیل شده، در سطوح (۱،۲ و۳٪) به بستنی افزوده شد و خواص فیزیکوشیمیایی آن از جمله: pH، وزن مخصوص، ویسکوزیته، زمان اولین قطره ذوب، ماده خشک، **افزایش حجم بستنی (اورران)** و رنگ سنجی بررسی شده و طی ارزیابی‌حسی صورت‌گرفته بهترین تیمار مشخص گردید. نتایج فیزیکوشیمیایی بستنی حاوی آرد سنجد (گوشته و هسته) نشان داد: افزایش درصد گوشته و هسته سنجد، باعث کاهش pH شد. کم‌ترین میزان pH مربوط به نمونه حاوی آرد هسته ۳٪ و بیش‌ترین مقدار pH مربوط به نمونه شاهد بود. بیش‌ترین میزان ویسکوزیته (۱۳۲۷/۵ سانتی‌پوآز) مربوط به تیمار ۳٪ آرد گوشته سنجد و کمترین میزان مربوط به نمونه شاهد بود. بیشترین مقدار وزن‌مخصوص (۱/۱۵) مربوط به تیمار۲٪ و ۳٪ آرد گوشته سنجد و کمترین میزان مربوط به نمونه شاهد بود. همچنین بالاترین ضریب افزایش حجم در نمونه شاهد (۳۸/۹۷٪) و کمترین اورران در نمونه حاوی آرد گوشته ۳٪ سنجد مشاهده شد. بر اساس نتایج حاصل از ارزیابی حسی انجام شده تیمار حاوی ۲٪ آرد هسته سنجد مقبولیت بیش‌تری نسبت به سایر تیمارها داشت.