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Characteristics of functional low fat ice milk produced with seeds " flax, sunflower or pumpkin " powder and stevia

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ABSTRACT:

The aim of this study is to fortify low-fat ice milk with various seeds powder, such as flax, sunflower, and pumpkin by different percentages (1, 2, 3, 4 and 5 %), as well as stevia (5% w/w), to provide a functional product. Due to the presence of minerals, phenolic compounds, and antioxidant activity in this product, it has functional, nutritional, and health advantages. The chemical, physical and sensory properties of the resultant ice milk were studied compared with control free from any additives. The physicochemical properties of the resultant ice milk were significantly affected over the control. The preliminary experiments results showed that the pest added percents from flax, sunflower and pumpkin seeds powder were 2, 4 and 4% (w/w), respectively, also the added percentage of seeds powder to the ice milk mixes leads to an increase in fiber, total nitrogen, fat and minerals content of the final product. According to the sensory evaluation, the ice milk prepared with 4 % (w/w) pumpkin seeds powder was recorded the highest values of acceptance for flavor, melting quality, color & appearance, body & texture and overall acceptability comparing to the other addition (flax and sunflower seeds). Moreover, the obtained results revealed that the pH of different ice milk samples was affected by the type of addition. The control ice milk had the highest pH value; on the other hand, the pH values of the ice milk supplemented with different seeds powder noticed that it decreases. The overrun and melting resistance of the final ice milk product also decreased compared with control. Using of stevia (sucrose replacement) in ice milk mixes led to a decrease in the amount of calories compared to the control.

Keywords: Functional ice milk, flaxseeds, pumpkinseeds, sunflower seeds powders stevia, antioxidant activity, phenolic compounds, health benefits,physical and sensory evaluation.

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1- INTRODUCTION:

Ice cream is a dairy product widely consumed from all age groups in all over the world due to its taste characteristics, cooling effect as well as its good nutritional properties (Durmaz et al., 2020). Functional foods containing components that can positively affect the health conditions of consumers and recently, demand for a functional food has been growing rapidly (Halsted, 2003 and Scheinbach, 1998). Functional food can be defined as food ingredients that may provide physiological benefits and helps in preventing and/or curing of diseases (Al-Okbi, 2005). Consumers see naturalism as an important property and natural foods are considered to be safer and even healthier than artificial food (Bearth et al., 2014). So a healthy lifestyle through the diet is one of consumer's demands and interest to reduce the risk of disease and to maintain their state of health (Silva et al. 2018 and Garcia et al., 2019). There is much greater recognition. This has promoted the widespread development of functional foods (Silva et al. 2018; and Garcia et al., 2019). So, to accommodate the need of the consumers from the healthy ice cream; it is possible to make ice cream enriched with a series of components in order to improve its functional status. Man needs adequate food for growth, development, for active and healthy life (Noack and Pouw, 2015).

Flax seeds contain phytoestrogens, which are similar to the hormone estrogen. The seeds also contain soluble fiber, oil, and anti-oxidants, essential omega-3 fatty acid alpha-linolenic acid. It is used for diabetes, high cholesterol, high blood pressure, obesity, breast pain (mastalgia), and swelling (inflammation) of the kidneys in people with lupus and also many other conditions.

Pumpkin seeds are rich source of essential nutrients posing positive impacts on health (Adsul and Madkaikar, 2021) and nutraceuticals such as amino acids, phytosterols, unsaturated fatty acids, phenolic compounds, tocopherols and valuable minerals. All these bioactive compounds are important to a healthy life and well-being (Joachim and James 2020). Pumpkin seeds which are usually discarded by considering as waste material during processing are very healthy source of protein and oil. Also good source of macro and micro elements, vitamins, dietary fiber and mono unsaturated fatty acids, which play good role for keeping humans healthy. Pumpkin seeds are very nutritional and health protective and are getting attention of researchers and consumers due to their pharmacological effects like anti-diabetic, antimicrobial, antioxidant and anti-inflammation (Joachim and James 2020).

The common sunflower seed consumed worldwide, supplies a multitude of nutritious components including protein, unsaturated fats, fiber, vitamins (especially E), selenium, copper, zinc, folate, iron, and more. Edible seeds are a good source of antioxidants, such as: flavonoids, phenolic acids and trace elements (Pasko et al., 2009).The sunflower seed contain valuable antioxidant, antimicrobial, anti-inflammatory, antihypertensive, wound-healing, and cardiovascular benefits found in its phenolic compounds, flavonoids, polyunsaturated fatty acids, and vitamins (Fowler, 2006). It is used in ethno-medicine for treating a number of disease conditions including heart disease, bronchial, laryngeal and pulmonary infections, coughs and colds and in whooping cough (Bashir et al., 2015). Stevia being a natural, sweet-tasting calorie-free botanical is new promising renewable raw food stuff in the world market. Stevia is 250-300 times sweeter than sugar, and thus, have been applied as a saccharose-substitute or as an alternative to artificial sweeteners (Goyal & Goyal, 2010 and Anton et al., 2010). Stevia is reported to exert beneficial effects on human health, including antihypertensive, anti-hyperglycemic, anti-inflammatory, anti-tumoral, anti-diarrhoeal, diuretic, non-cariogenic and immuno-modulatory effects (Lee et al., 2001and Anton et al., 2010).

According to the above mentioned knowledge this study aimed to make a functional low fat ice milk with flax, sunflower and pumpkin seeds powders, as well as stevia to investigate the suitability of using percentage of each kind for making the functional ice milk as a source of nutritional benefit, phenolic compounds and antioxidant activity and also assessing the chemical, physical and sensory properties of the resultant ice milk.

2- MATERIALS AND METHODS:

Materials

Fresh raw buffalo's milk was obtained from faculty of agriculture farm, Fayoum, Egypt., flaxseeds, pumpkinseeds and sunflower seeds were purchased from (Abu-Auf Company), Stevia powder and skim milk powder, vanilla and sugar were obtained from local market. All chemicals and reagents that used for this study were of analytical grades and were obtained from Sigma and Merck Companies.

Methods

Preparation of flax, sunflower and pumpkin seeds powder

The flaxseeds, pumpkinseeds and sunflower seeds powder were prepared by using a grinder to obtain the powder, which sealed in bags and stored at 4$\pm$2ºC until used.

Experimental procedure:

All experimental ice milk treatments were conducted in the Dairy Dept., Fac. Agric., Fayoum Univ., Egypt.

1-Preliminary experiments were carried out using levels of 1, 2, 3, 4 and 5% of seeds powder and stevia 2, 3, 4, 5 and 6% to select the best ratios of addition. The best ratios of addition were 2, 4, and 4% of the ' flax, sunflower and pumpkin' seeds powder, respectively, 5% of stevia

2- Main experiments: five ice milk mixes were prepared according to the method described by Marshall *et al.* (2003). Preparation of basic ice milk mixes were done according to the Egyptian standards of ice milk (2005). Ratios of the ingredients and the different formulations are shown in Table (1).

Table . Ingredients and formulations of all ice milk mixture

Ingredients	Treatments				
	Control 1 (C1)	**Control 2 (C2)**	**T1**	**T2**	**T3**
Milk	Skim milk (0.05% fat)	Full-fat milk (6%)	Skim milk (0.05% fat)	Skim milk (0.05% fat)	Skim milk (0.05% fat)
Sweetener	Sucrose (18%)	Sucrose (18%)	Stevia (5%)	Stevia (5%)	Stevia (5%)
Skim milk powder	5%	5%	5%	5%	5%
Vanilla	0.01%	0.01%	0.01%	0.01%	0.01%
Flaxseed powder	--	--	2%	--	--
Sunflower seeds Powder	--	--	--	4%	--
Pumpkin seeds powder	--	--	--	--	4%

Control 1(C1): Plain low fat ice milk without additives made from fresh skimmed milk.

Control 2(C2): Plain ice milk without additives made from fresh full fat milk (6%fat).

T_1: low fat ice milk made from fresh skimmed milk supplemented with 2% flaxseeds owder.

T_2: low fat ice milk made from skimmed milk supplemented with4% sunflower seeds powder.

T_3: low fat ice milk made from skimmed milk supplemented with 4% pumpkinseeds powder.

Analytical methods

All mixes of the resultant low fat ice milk samples and controls were evaluated for their physical and chemical properties as well as the sensory quality attributes. The samples of each treatment were analyzed in three replicates for each parameter.

Chemical analyses of the raw materials and ice milk samples

The moisture and total nitrogen contents of different samples were determined using oven drying method, Kjeldahl method, respectively as described in AOAC (2012). For fat content Soxhelt method (Min and Ellefson, 2010) and for fiber content the method of AOAC (2012) was followed. The pH values of the raw materials, different treatments samples were tested by using laboratory pH meter with a glass electrode Model pH -Thermo Scientific Orion Star (A214). Each sample was mixed thoroughly and the pH was recorded.

Antioxidant capacity (DPPH method) was determined by radical scavenging ability using stable DPPH• radical as described by (Akowuah *et al* 2005).

The total polyphenols were quantified using the colorimetric method of Folin–Ciocalteau reagent as described by Jagadish et al. (2009) with some modifications.

Determination of minerals

An Agilent atomic absorption spectrometer (Agilent 55B AA) equipped with Agilent single-element hollow cathode lamps and a 10-cm air–acetylene burner was used for the determination of the minerals.

Calculation of the energy

Calculation of the energy content of experimental ice milk depends on three steps (FAO, 2004). First, determining the components that provide energy (protein, fat and carbohydrates) by analytical methods as described in chemical analysis.

The quantity of each individual component must be converted to food energy using a fixed factor (energy value) that expresses the amount of available energy per unit of weight. The energy values for protein, fat and carbohydrates (include fibers) is 4.00, 9.00 and 4.00 Cal./g, respectively. Finally, energies of all components must be added together to represent the nutritional energy value of the product for humans.

Physical properties

Melting resistance

Melting characteristics of the samples were evaluated according to the method given by Moeenfard and Tehrani (2008), with some modification , thirty gram of sample was placed on a mesh wire screen (1.5 mm × 1.5 mm) which located on top of a beaker in at room temperature (25±2°C) to determine the first drop time and melting resistance. The time (min) elapsed to obtain the first drop was registered as a standup time. To calculate the melting resistance the dripped weight of melted samples was recorded over a period of 45 min. and was expressed as percent of the initial ice cream block weight.

Overrun

Overrun of different treatments samples were estimated according to the method given by Akin *et al.* (2007). A known volume of different treatments mix was weighed accurately and the same volume of low fat ice milk and full fat ice cream was weighed. The overrun was calculated using the following formula:

$$\text{Overrun (\%)} = \frac{\text{Weight of unit volume of mix - weight of unit volume of frozen ice cream}}{\text{Weight of unit volume of frozen ice cream}} \times 100$$

Specific gravity

Specific gravity was determined according to Winton (1958) by means of filling a cool cup (with known weight and volume), with the resultant ice cream samples then weighted.

Specific gravity (g/cm^3) = Weight of ice cream/ Cup volume.

Weight per gallon

Weight per gallon of ice cream mixes and the final frozen products were calculated (Kg) according to Arbuckle (1986) by multiplying the specific gravity by the factor 3.345.

Statistical analysis

All results were analyzed using General Linear Models (GLM) procedure of statistical package for social sciences (SPSS, 2008), Version 17.0.0 software. Duncan (1955) multiple range tests were used to compare between the means.

3- RESULTS AND DISCUSSION:

1. Analysis of raw materials

1.1. Gross chemical composition of the raw materials

The chemical compositions of the raw materials used in the manufacture of functional ice milk were determined **(Table 2)**. The Moisture, fat, total nitrogen (TN), and fiber contents of the flax seeds powder (FSP) were 4.80, 26.75, 4, 36 and 6.30, respectively. On the other hand**,** the gross chemical composition of the sunflower seeds powder (SSP) was 2.43, 44.24, 3,08 and 4.07 respectively. Regarding pumpkin deeds powder (PSP) it contains, moisture 2.40, fat 40.82, total nitrogen 3.12, and fiber 2.17%.

Table. **Gross chemical composition of the raw materials**

Raw materials	Composition (%)			
	Moisture	Fat	Total nitrogen	Fibers
Flax seeds powder (FSP)	4.80	26.75	4.36	6.30
Sunflower seeds powder (SSP)	2.43	44.24	3.08	4.07
Pumpkin seeds powder (PSP)	2.40	40.82	3.12	2.17

1.2. Minerals content of the raw materials

Minerals content in different raw materials (FSP, SSP and PSP) used in experimental ice milk making are shown in Table (3). The highest elements in milk sample are calcium (1024.5 mg/ Kg) and phosphorus (1051 mg/ Kg), while the least one is Iron (3.21 mg/ Kg). These results are close to what reported by Abd El-Salam and El-Shibiny (2011) and Han *el al.* (2012). The highest element content in FSP was potassium (7230 mg/kg), while the lowest element was zinc (44.06). Sample of SSP was highest in Calcium content (570 mg/ Kg) while the lowest element was Iron (43.17). Moreover content of PSP sample was the highest in phosphorus.

1.3. Phenolic compounds of the raw materials

These results indicated that SSP had the highest total phenolic content (2343.45 mg/kg) followed by FSP (719.05 mg/kg) and finally PSP (86.90 mg/kg). The IC_{50} values of FSP was 0.13 ml/ g while that of SSP was 0.01 ml/ g but the IC_{50} value of the PSP 0.55 ml/ g was the highest.

Table . Minerals content in the different raw materials

Elements (mg/Kg)	Raw materials*			
	Milk	FSP	SSP	PSP
Iron (Fe)	3.21	72.26	43.17	76.83
Potassium (K)	609	7230	5910	6270
Magnesium (Mg)	113.6	3190	2940	4860
Zinc (Zn)	6.10	44.06	59.65	76.33
Phosphorus (P)	1051	560	11580	11740
Calcium (Ca)	1024.5	258	570	520

*See Table (2)

1.4. The antioxidant activity

The antioxidant activity of different extracts from FSP, SSP and PSP were determined according to (Akowuah *et al.*, 2005). The effect of different samples extracts concentration on remain ratios are represented in Table (4), the free radical scavenging activity of FSP, SSP and PSP extracts were evaluated at different concentrations against the stable free radical DPPH. It was noticed that the remaining percentage of DPPH is decreases as the concentration of sample extracts were increased. The percentage of remain ratio of DPPH and the inhibition ratio is depending on the type and amount of used sample

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Table. Effect of phenolic methanol extracts concentrations for the different raw materials on the inhibition ratio and remains ratio of DPPH.

Raw Materials* extracts	Conc.(ml)	Inhibition ratio (%)	Remain ratio (%)
FSP	0.00	0.00	100
	0.05	25.12	74.8
	0.1	44.29	55.71
	0.2	68.86	31.14
SSP	0	0.00	100
	0.005	41.78	58.22
	0.01	78.33	21.67
	0.025	81.30	18.7
	0.05	83.57	16.43
PSP	0	0.00	100
	0.2	18.15	81.85
	0.4	35.76	66.24
	0.5	44.84	55.16

DPPH: 1, 1-diphenyl-2-picryl hydrazyl *See Table (2)

2. Analysis of different functional ice milk

2.1. Gross chemical composition of different functional ice milk

The results indicate that, increasing the fiber content in the additives (FSP, SPS and PSP) caused an increase in the content of the Moisture for treatments T1, T2 and T3 (82.53,82.00 and 83.54) respectively (table 6**).** The results describe the difference in total nitrogen TN contents of different ice milk treatments. The highest

TN content was found in T_2 (2.42%), while the lowest nitrogen content was determined in control sample C1 (1.25%). Addition of SFP (T2) 4% leads to an increase of total nitrogen (2.42), fat (1.77%) and fiber content (0.16%) comparing to other treatment and C1. While, the results of TN for samples that contain either FSP or PSP were 2.34 and 2.32%, respectively.

Results in Table (5) also show the pH values of different treatments. These results are disagreed with the results of Marshall *et al.* (2003) as they reported that the pH values in ice cream are generally ranged between 6.3 and 6.5 and this approximates what we got in the present study). Moreover, the obtained results revealed that the pH of different ice milk samples was affected by the type of addition. C1 had the highest pH value (6.73), on the other hand, the pH values of the ice milk supplemented with different seeds powder noticed that it decreases the pH values compared to C1. The values were 6.65, 6.61 and 6.63 of T_1, T_2 and T_3 respectively; these results were disagreement with findings of Younis (2012). Carbohydrates contents of T1, T2 and T3 were 2.43, 1.1 and 0.19%, respectively.

2.2. Minerals content of the ice milk mixes

Milk samples show some different in minerals content (Table, 6). It was noticed that the ice milk sample (T_3) is rich in Mg, P and K (0.41, 0.34, and 0.17 mg/g respectively) compared to the other ice milk samples and controls. Zinc and Fe elements were higher in T1, T2 and T3, comparing to controls.

The highest elements in C1and C2 sample are calcium, while the lowest one were iron and zinc. These results are close to that reported by Han *el al.* (2012). Also similar data was reported by Abd El-Salam and El-Shibiny (2011). The highest element content in T1 was Magnesium, while the lowest element was iron. Sample of T3 was highest in K, Mg and P content than the other samples T1 and T3.

Table. Chemical composition, calories and pH values of controls and functional ice milk treatments with seeds powders

parameters	Treatments*					Sig.	SE±
	C1	C2	T1	T2	T3		
Moisture (%)	75.70^{c}	74.95^{c}	82.53^{b}	82.00^{b}	83.54^{a}	***	0.22
Fat (%)	0.05^{d}	6.00^{a}	0.54^{c}	1.77^{b}	1.64^{b}	***	0.03
TN (%)	1.25	1.24	2.32	2.42	2.34	***	0.02
Protein (%)	7.81^{b}	7.75^{b}	14.50^{a}	15.12^{a}	14.62^{a}	***	0.02
Carbohydrates (%)	16.48^{a}	11.30^{b}	2.43^{c}	1.10^{d}	0.19e	***	0.01
Fibers (%)	0.00^{c}	0.00^{c}	0.14^{a}	0.16^{a}	0.09^{b}	***	0.01
Calories	97.20^{b}	130.20^{a}	72.58^{d}	80.85^{c}	74.04^{d}	***	0.33
pH	6.73	6.63	6.65	6.61	6.63	NS	0.15

a, b,…. and d: Means having different superscripts within each row are significantly different ($p<0.001$).

*See Table (1)

Table. Minerals content in the mixes of different functional ice milk

Mineral (mg/g)	Treatments*					Sig.	SE±
	C1	C2	T1	T2	T3		
Fe	0.00^{b}	0.00^{b}	0.01^{a}	0.01^{a}	0.01^{a}	***	0.001
K	0.13^{d}	0.25^{a}	0.13^{d}	0.15^{cd}	0.17^{b}	***	0.02
Mg	0.27^{d}	0.32^{c}	0.42^{a}	0.37^{b}	0.41^{a}	***	0.02
Zn	0.00^{b}	0.00^{b}	0.01^{a}	0.01^{a}	0.01^{a}	***	0.001
Ca	0.29^{b}	0.31^{b}	0.28^{b}	0.72^{a}	0.28^{b}	***	0.01
P	0.28^{c}	0.29^{bc}	0.30^{b}	0.33^{ab}	0.34^{a}	*	0.01

a, b,…. and d: Means having different superscripts within each row are significantly different ($p<0.001$).

*See Table (1)

2.3.1. Overrun of the ice milk treatments

Overrun is one of the most critical parameter in ice cream production. In this study the overrun was determined in the ice milk samples and given in Table (7) the overrun values were 92.9, 86.1 and 93.86% in ice milk treatment T_1, T_2 and T_3 respectively compared with (C1) 102.9% and (C2) 100.4%. This is might be related to increasing the solids ratio, which reduces the whipping ability and therefore decreases the overrun. These results were in agreement with Khalil and Blassey (2016).

2.3. Some Physical properties of different functional ice milk

2.3.2. Melting resistance

Melting resistance of functional ice cream treatments and control samples are shown in Table (7). The ice milk that supplemented with seeds powder have first dripping of 19.6, 23.3 and 20.8 min. for T_1, T_2 and T_3 treatments, respectively. These previous samples take longer time at the beginning of the melting than samples of control, C_1 and C_2 treatments, which recorded 10.2, and 13.4 min., respectively. Time required to melt the frozen ice milk has increased in the different treatment compared control. The presence of seeds powder in the ice milk caused a marked increase in the melting resistance compared to those without seeds powder (control 1 and 2) these results agreed with the results obtained by Anant et al. (2017).

The potential cause of the low melting resistance of the control sample may be due to the difference in the heat transfer rate because of the presence of lower percentage of air Temiz and Ahmet (2010), Balthazar et al. (2015), Vega and Goff (2005). Similar findings are reported by Muhammet (2006).

2.3.3. Specific gravity (g/cm^3) and Weight per gallon

Results of specific gravity and weight per gallon of functional ice milk treatments and control were presented in table (7). The highest specific gravity value (0.84g/cm^3) was recorded for the ice milk treatment that contains FSP (2 %), while the lowest value (0.625 g/cm^3) recorded for C1. The values of weight per gallon for the ice milk treatments were, 2.8, 2.64 and 2.44 Kg for T2, T3 andT1, respectively compared with 2.09 Kg for C1.

Table. Some Physical properties of different functional ice milk

parameters	Treatments*				
	C1	C2	T1	T2	T3
Overrun (%)	$102{,}9^{a}$	100.4^{a}	92.9^{b}	$86.\ 1^{c}$	93.86^{b}
Melting resistance (min)	10.2^{d}	13.4^{c}	19.6^{b}	23.3^{a}	20.8^{b}
Specific gravity (g/cm^3)	0.625^{b}	0.653^{b}	0.73^{ab}	0.84^{a}	0.79^{a}
Weight per gallon	2.09^{d}	2.71^{ab}	2.44^{c}	2.8^{a}	2.64^{b}

a, b,…. and d: Means having different superscripts within each row are significantly different ($p<0.001$).

*See Table (1)

3. Organoleptic properties of different functional ice milk treatments

The effect of adding different FSP, SSP and PSP on sensory properties of functional ice milk treatments and control are presented in Table (8). In general, addition of seeds powder effect on all sensory parameters of the resultant ice milk samples compared with control. Flavor and body & texture points for ice milk samples with 4% added PSP (T3) were 45.50 and 29.90, respectively, which were higher than samples with T_1 or T_2. The evaluation of melting quality was the highest with addition of 4% PSP (T3) comparing with the other treatment and control. According to Schmidt and Smith (1992), the improvement in melting quality and body & texture could be attributed to the increase in viscosity and/or overrun, which inhibits the development of ice crystals in the frozen ice cream. The PSP ice cream treatments; T3 is higher in color points comparing with T1 and T2 treatments as it recorded 9.20, 8.91, 8.60 and 8.20, respectively. These results were in agreement with what reported by Khalil and Blassey (2016). Generally the samples of the functional ice milk treatments were appreciative from the panelist and they admired precisely the samples that supplemented with PSP (T3).

Table. Sensory evaluation of functional ice milk made with seeds powder additives

Treatments*	Flavor (50)	Body and texture (30)	Melting quality (10)	Color & Appearance (10)	Total score (100)
C1	45.50^{b}	25.30^{d}	7.00^{d}	9.50^{ab}	87.30^{d}
C2	49.20^{a}	27.60^{c}	8.50^{c}	10.00^{a}	95.30^{a}
T1	42.00^{d}	28.00^{b}	9.20^{b}	8.20^{d}	87.40^{d}
T2	43.30^{c}	28.50^{b}	9.60^{a}	8.60^{c}	90.00^{c}
T3	45.50^{b}	29.90^{a}	9.60^{a}	9.20^{b}	94.20^{b}
Sig.	***	***	***	***	***
SE±	0.30	0.27	0.02	0.02	0.20

a, b,…. and d: Means having different superscripts within each column are not significantly different.
*See Table (1) SE: standard error Sig: Significance

Conclusion:

The outcome of this study revealed that using the flax, sunflower and pumpkin seeds in powder form at ratio of 2, 4 and 4% to be successfully used in ice milk production, and improved the rheological and textural characteristics of ice milk with respect to melting resistance and overrun, and increase the T.N., minerals, fiber, fat content and hence increase the nutritional value. Our findings are relevant for the functional dairy industry, as we demonstrated the effects of using flax, sunflower and pumpkin seeds on different qualities of ice milk which has not been widely explored. Therefore, it is possible to develop ice milk fortified with seeds powder.

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الملخص العربي

المثلجات اللبنية الوظيفية منخفضة الدهن المنتجة بإستخدام مسحوق

بذور "الكتان، عباد الشمس أوالقرع" والإستيفيا

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تهدف هذه الدراسة إلى استخدام أنواع مختلفة من مسحوق بذور كلا من الكتان، عباد الشمس أو القرع بنسبة 2، 4 و 4٪ وزن / وزن على التوالي، والإستيفيا بنسبة 5٪ وزن / وزن (بديل السكروز) فى تصنيع المثلجات اللبنية منخفضة الدهن لإنتاج منتج وظيفي له فوائد وظيفية وغذائية وصحية لاحتوائه على معادن ومركبات فينولية دهنية ونشاط مضاد للأكسدة. تمت دراسة الخواص الكيميائية والفيزيقية والحسية للمثلجات اللبنية الناتجة مقارنة بالكنترول المصنع من لبن فرز طازج وكذلك كنترول مصنع من لبن جاموسى كامل الدسم. وقد دلت النتائج على تأثر الخواص الفيزيقية والكيميائية للمثلجات اللبنية الناتجة معنويا بالأضافات المختلفه. حيث أظهرت النتائج افضل نسب للاضافة كانت (4, 2 وكذلك 4 %) من بذور الكتان وعباد الشمس والقرع علي التوالي كما اظهرت النتائج أن النسبة المضافة من مسحوق البذور إلى خلطات المثلجات اللبنية منخفضة الدهن تؤدي إلى زيادة محتوى الألياف والنيتروجين الكلي والدهون والمعادن في المنتج النهائي. علاوة على ذلك، أوضحت النتائج المتحصل عليها أن الأس الهيدروجيني لعينات المثلجات اللبنية المختلفة قد تأثرت بنوع الاضافة مقارنة بالكنترول. ووفقًا للتقييم الحسي، حصل المثلج اللبني المحضر بمسحوق بذور القرع بنسبة 4٪ (وزن / وزن) على أعلى قيم قبول للنكهة ومقاومة الذوبان واللون والمظهر والقوام مقارنة بالعينات المحتويه على الإضافات الأخرى (مسحوق بذور الكتان وعباد الشمس 2 و 4٪ وزن / وزن على التوالي). كما أدى استخدام 5٪ إستيفيا في خلطات المثلج اللبني إلى انخفاض كمية السعرات الحرارية مقارنة بالكنترول.

الكلمات الدالة:
مسحوق بذور، المثلجات اللبنية، مضاد الأكسدة، إستيفيا، السعرات الحرارية ، الخواص الكيميائية والفيزيقية.