Effect of Lablab Bean Milk Seeds on Chemical, Physicochemical, Sensory Evaluation and Microbiological Aspects of Ice Cream Mix

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ABSTRACT:

Current work emphasizes on utilizing of Lablab bean milk (LBM) as a potential alternative of buffalos' milk in making ice cream at levels of 10, 20 and 30% LBM of buffalos' milk in standardized mixes containing; 9% fat, 11% SNF, 16% sugar and 0.5% stabilizer (CMC), a plain mix was used as control. Lablab bean seeds were analyzed for gross chemical composition (moisture, fat, protein, ash, lactose, T. carbohydrates & Folic acid), total phenols and fractionated phenolic compounds by HPLC. The data revealed highly superiority of essential and unessential amino acids compared to the FAO/WHO (1973). Aspartic, glutamic, glycine, isoleucine, proline, lysine, serine, threonine, valine, histidine and methionine were the most predominates. Fatty acids profile showed that, oleic acid had the highest value of all fatty acids. Total solids, protein, ash, pH and viscosity of ice cream mixes increased; while Fat, total carbohydrate, specific gravity and weight per gallon decreased by increasing of LBM. Moreover, overrun of resultant ice cream increased, while specific gravity and weight per gallon decreased by increasing of LBM. Meanwhile, increasing levels of LBM decreased the melt down value of prepared Lablab ice cream samples. Microbiologically, there were decreases of total bacterial and yeast & molds counts in resultant ice cream with increasing of LBM in all treatments. Sensory evaluation showed, resultant ice cream with LBM had lower flavor and total scores than that of control samples in all treatments, while L1 with 10% LBM had similar scores of appearances and melting quality. In addition, L1 and L2 had higher score of body & texture than that of other treatments. Generally, control samples had superior overall score followed by L1. Whilst, L3 had lower overall score followed by L2.

Keywards: Lablab bean milk; specific gravity; Weight per gallon in pound; Appearance; Melting resistance; Overrun.

INTRODUCTION

The importance of legumes will become greater in future becausethey provide nutrient profile, including; proteins, fibers, vitamins and minerals (Mitchell *et al*. 2009). Seeds contain from 16 to 50% of protein and provide one third of all dietary protein nitrogen (Graham and Vance, 2003).

Dolichos lablab, referred to as country bean is one such lesser-known legumes and is a popular vegetable in Northeast India, the seeds are also consumed. The mature seeds can be stored for long time. Evaluation of lesser-known legumes is, therefore, a priority area of work. The rich legume biodiversity of India with 167 genera and 1141 species holds great promise in this regard (Mao and Hynniewta, 2000). Therefore, one such legume that could be exploited to serve as an alternative source of nutrients in monogastric diets is the seeds of *Lablab purpuras* (Lablab). Though it has been reported to be of high nutritional value (Foyer *et al*., 2016 and Hossain *et al*., 2016), it is of limited economic importance in the global market.

Analysis of *Dolichos lablab* showed that it contained sugar, alcohols, phenols, steroids, essential oils, alkaloids, tannins, flavonoids, saponins, coumarins, terpenoids, pigments, glycosides, anthnanoids, wide range of minerals and many other metabolites. The preliminary pharmacological studies revealed that Dolichos *lablab* possessed antidiabetic, anti-inflammatory, analgesic, antioxidant, cytotoxic, hypolipidemic, antimicrobial, insecticidal, hepatoprotective, antilithiatic, antispasmodic effects and used for the treatment of iron deficiency anemia, Ali (2017).

The production of non-dairy food products has been pointed out as a novel trend in the production of functional foods (Kano *et al*., 2002). The market of food products containing functional ingredients such as: prebiotics, probiotics, dietary fiber, soy and derivatives grows approximately 5% per year worldwide and the selling of these products is expected to be over US$19.6 billion in 2013 (Granato *et al*., 2010). Soybean protein, due to its undigested pepsin fraction may affect the fecal excretion of bile acids or steroids and influence the cholesterol metabolism (Tomat *et al*., 2011).

Ice cream is one of the most popular dairy products all over the world, because it is usually accompanied by the feeling of fun and joy for children and adults and as a result, its production and consumption continues to increase as a part of the frozen dairy products industry (Elahi *et al*., 2002). So, this work emphasized on using Lablab bean milk (*Dolichos lablab L. var lignosus*) seeds as a potential alternative of buffalos' milk in making ice cream mix as an excellent source of high-quality proteins, but is devoid of lactose and cholesterol, it is a plentiful and inexpensive source of nutrition for milk allergy patients, lactose-intolerant individuals and for the vegetarians.

MATERIALS AND METHODS

Materials:

The fresh buffaloe's, skim milk and cream (45% fat) were obtained from Dairy Department, Faculty of Agriculture, Kafr El-Sheikh University.

Skim milk powder and carboxy methyl cellulose (CMC) were obtained from local market.

Indian bean (*(Lablab purpureus L. Sweet*) seeds was obtained from the local market of Riadh region (Saudi Arabi).

All chemicals were purchased from El-Nasr pharmaceutical & chemicals Company, Cairo, Egypt.

Glass bottles, glass jars and plastic cupswere purchased from local market.

Methods:

Technological treatments:

Preparation of Dolichos lablab milk:

Dolichos Lablab beans were washed thoroughly in cold running tap water (100 g), then washed in de-ionized wateruntil cleaned beans were soaked in 1 L of water for 14 hr. at 4°C. The swollen Lablab beans were drained, dehulled and blended with 1 L of boiled water in a blender at low speed for 5 min. The slurry was heated for 10 min at 80°C. The hot mixture was filtered through four layers of cheese cloth and the filtrate (˜850 g) was collected. The Lablab milk was cooled at room temperature and then kept at 4°C (Pathomrungsiyounggul *et al*., 2010).

Preparation of ice cream mix with lablab bean milk (LBM):

Ice cream was prepared according to Bueno *et al*. (2018). The mixes of ice cream were standardized to contain 9% fat, 11% SNF, 16% sugar and 0.5% stabilizer (CMC). Lablab Bean milk were added to 10, 20 and 30% from the used buffalo's milk.

The processing method was used as follows (Fig 1): the required amounts of skim milk powder were mixed with CMC and sucrose, and then added slowly to the liquid ingredients (milk, LBM & cream). Mixes were homogenized and heated up to 85°C for about 15 min., then rapidly cooled to 5°C and aged at the same temperature for 12 hr. After aging, mixes were frozen in batch freezer system, the frozen soft ice cream was packed in plastic cups (100 ml). The resultant ice cream product was tested for pH, specific gravity, weight per gallon, melting resistance, overrun. Organoleptic properties of the product were also evaluated by ten panelists from the staff members of Dairy science and technology departments, Faculty of Home Economics and Faculty of Agriculture, Kafr EL-Sheikh University. Three replicates were carried out for each treatment and data obtained were statically analyzed. The processing of ice cream mixes was produced using the traditional method and the LBM-based ice cream, in which the buffalo's milk was replaced by the LBM according to the formulation described in Table 1.

Analytical methods:

Moisture, Protein, Total lipids, Crude fibers and Ash contents were determined as described by A.O.A.C. (2010).

Fat content (dairy ingredients and products):

Fat content (dairy ingredients) was determined using Gerber tube for milk according to Ling (1963).

Determination of carbohydrates:

Carbohydrate content was calculated according to Tadrus (1989) by the following equation:

(%) =100 - the sum of (% protein+ % fat+ % ash+ % Crude Fiber)

Determination of lactose content:

Lactose content was determined according to Michel *et al*. (1956).

Determination of minerals content:

Minerals: potassium (K), sodium (Na), phosphorus (P), magnesium (Mg), calcium (Ca) and heavy metals, Zinc (Zn), Copper (Cu), Iron (Fe) of lablab flour was determined according to A.O.A.C. (2000).

pH value

pH values were measured using a Fischer universal glass pH electrode (Acumet Portable AP61, Fisher Scientific), after pH calibration with standardized solutions to pH 4 and 7 at 24±1ºC.

Determination of amino acid content:

Amino acids were determined by acid hydrolysis indicated by Block *et al.* (1958).

Determination of phytochemical compounds:

Total polyphenols content (TPC) was estimated by the folin-ciocalteu method as reported by El-Falleh *et al.* (2009). From each sample, 0.5 ml of methanolic solution to 0.5 ml of Folin-ciocalteu (Prolabo) reagent was added and sodium carbonate (1 ml) using a water bath at 45ºC, and then put in a cold-water bath. The reading of the absorbance was made at 765 nm using a UV spectrophotometer. Total polyphenols of each fraction were converted into µg gallic acid /g dry weight (µg GAE/g DW).

Polyphenol fractions by HPLC Analysis:

Phenolic compounds were fractionated and identified by HPLC according to the method of Goupy *et al.* (1999). Five g of the sample were mixed with methanol and centrifuged at 10.000 rpm for 10 min under cooling temperature. The supernatant was filtered through a 0.2 μm Millipore membrane filter, then 1-3 ml was collected in a vial for injection into HPLC (Hewllet Packared Series 1050) equipped with auto sampling injector, solvent degasser, ultraviolet (UV) detector set at 280 nm and quarter HP pump (Series 1050). The column temperature was maintained at 35ºC. Gradient separation was carried out with methanol and acetonitrile as a Mobil phase at flow rate 1 ml/min. Phenolic acids standard from Sigma Co. were dissolved in a mobile phase and injected into HPLC. Retention time and peak area were used for calculation of phenolic compounds concentration by the data analysis of Hewllet Pakared software.

Physicochemical properties:

Ice cream mixes:

The viscosity of ice cream mixes was carried out as described by Toledo (1980) with some modifications using Brookfield DV-viscometer. Apparent viscosity measurements of the samples were carried out at room temperature (25±2ºC) using Brookfield Programmable Viscometer DV-II+ (Brookfiled Laboratories, Inc., Middleboro, Mass., U.S.A.) equipped with spindle No. 0 at 20 rpm.

Determination of melting resistance of ice cream:

The melting resistance of produced ice cream was determined as described by Akin *et. al.* (2007).

Physical properties of ice cream:

Measurement of specific gravity:

Specific gravity of different ice cream mixes and final frozen products was determined according to Winston (1958).

Calculation of weight per gallon (IP):

The weight per gallon in pound of ice cream mixes and final products was calculated according to Kessler (1981) by multiplying the specific gravity by the factor 8.345.

Calculation of overrun percentage:

The overrun percentage was calculated as mentioned by Akin *et.al*. (2007) from the figure obtained for the specific gravity of the mix and resultant ice cream using the following equation:

Overrun % = (sp.gr. of mix-sp.gr.of frozen resultant/ sp.gr. of frozen resultant) x 100

Total bacterial count:

The total bacterial count as cfu/g of the tested samples were determined using nutrient agar as described by FAO (1992). Several dilutions (from 10^1 to 10^{-4}) of samples homogenate using buffered peptone water media, and at 37°C for 48-72 hr. Incubated, dishes showed convenient numbers of colonies that were counted as cfu/g.

Molds and yeasts counts:

Molds and yeasts counts were determined using plate count method as described by FAO (1992) by using potato extract dextrose agar media, incubation at 20-25°C for 5 days.

Organoleptic properties:

It was assessed by members of the department according to the following score card (Marshall and Arbuckle, 1996)):

Flavor: 30, Body and texture: 30, Appearance: 20, Melting quality: 20 and Total score: 100

RESULTS AND DISCUSSION

Proximate Chemical composition and nutritive value of Lablab seeds, fresh buffalo's milk and skim milk powder:

In this work, Lablab bean milk (*Lablab purpuresusl L.*) seeds is used as a potential alternative of buffalos' milk in making ice cream mix owing to its high-quality proteins but is devoid of lactose and cholesterol, it is also an inexpensive source of nutrition for milk allergy patients, lactose-intolerant individuals, and the vegetarians.

Data presented in Table 2 illustrate the gross chemical composition of the fresh dehulled lablab seeds (*Lablab purpuresusl L.*); moisture, crude fat, crude protein, ash, T. carbohydrates and Folic acid achieved 82.54, 0.66, 5.98, 0.98, 9.82% and 164.749 (µg/g); respectively. Meanwhile, skim buffalo´s milk contained; 89.3% moisture, 0.40% crude fat, 3.98% crude protein, 0.91% ash and 5.40% lactose. Also, skim milk powder contained; 3.52% moisture, 0.50% crude fat, 34.40% crude protein, 7.78 % ash and 53.52 % lactose. These results were in agreement with the finding of Ali (2017), who found that of *Dolichos lablab* contained 33% starch as the major component, protein (25%), a very low-fat content (0.8%) and high dietary fiber (7.2%). Meanwhile, Barnali *et al*. (2010) found that protein content of mature seeds varied from 23.99 to 35.51%, while the range for carbohydrate was 28.18 to 48.41%, lipid content varied from 0.76 to 1.93% and crude fiber contents varied from 10.52 to 16.77%. The variation for ash content was 5.13 to 9.19%.

Amino acids contents:

Data presented in Table 3 demonstrates the fractionated amino acids of the studied lablab seeds, which showed that both essential and non-essential amino acids (NEAA) content of this legume had highly superiority compared to the FAO/WHO (1973). It could also be noticed that, aspartic, glutamic, glycine, isoleucine, proline, lysine, serine, threonine, valine, histidine and methionine are the most predominant ones of all amino acids in dehulled Lablab bean seeds; giving values; 67.046, 60.721, 50.721, 50.473, 46.377, 32.942, 27.210, 26.931,18.753, 16.320 and 15.511 ppm/g; respectively. This finding agrees with the work of Shaahu *et al*. (2015), who found that the natural limiting amino acid lysine in cereals is satisfactorily high (mean value is above FAO reference pattern) in lablab seed. The mean values of the essential amino acids (lysine, histidine, valine, methionine, isoleucine, leucine, and phenylalanine) in lablab seed are higher than the values reported for FFSB. This suggests that lablab seed can be exploited in feed formulation as an excellent source of amino acid. Amino-acid composition of lablab purpureus grown in Al-Gassim region of Saudi Arabia revealed high contents of glutamic and aspartic acids, leucine, and lysine (Al-Othman, 1999).

Fatty acids:

Obtained data in Table 4 revealed the fractionated fatty acids in Lablab bean seeds. Palmitic, stearic and myristic acids were the most predominant among the saturated fatty acids, recording the values 28.80, 13.60 and 11.20%; respectively. On the other hand, oleic acid achieved the highest value of the unsaturated and saturated fatty acids giving 30.1%. The total saturated fatty acids excelled the unsaturated ones representing 62%; meanwhile, the total unsaturated fatty acids were 37% of all fatty acids.

Fatty acids profile for the seeds of *Lablab purpureus* grown in Al-Gassim region of Saudi Arabia showed that the oils composed of 24.2% saturated fatty acids, 18.42% monounsaturated fatty acids, 57.38% polyunsaturated fatty acids, and linoleic acid (44%) were the major constituents of fatty acids (Al-Othman, 1999).

Mineral contents in Lablab seeds:

Grain legume seeds are also an important source of 15 type of essential minerals required by man **(**Wang *et al.,* 2003). The investigated of Somulung, *et al* (2012) revealed that, the effectiveness of *Dolichos lablab* beans extract in iron deficiency in rats.

Data presented in Table 5 demonstrate mineral's content in lablab seeds, obtained data showed that lablab seeds contained the essential menials (Ca, K, Mg, Na and P) found at levels of 163.25. 181.125, 506.43, 185.75 and 127.26 mg/100 g on dry basis reprising the meager minerals, Meanwhile Fe, Cu and Mn were the minors of these minerals giving the values of 53.50,10.95 and 14.25 mg/100 g; respectively. These results were in agreement with the report of Deka and Sarkar (1990), who mentioned that Lablab bean is a good source of minerals (Ca, Fe, Mg, S, Na & P). However, Deka and Sarkar (1990) found that the mature seeds of five cultivars of dolichos bean (*Dolichos lablab*) contained the amounts of calcium, phosphorus, phytate phosphorus and iron ranged from 36.0 to 53.5, 388 to 483, 282 to 380 and 5.95 to 6.90 mg/100 g; respectively.

Phenolic compounds:

Phytochemicals are compounds released in plants, they have many biological properties and acts as antioxidants, antimutagenic, anti-inflammatory, anti-carcinogenic and anti-microbials (Gropper *et al*., 2009). Data presented in Table 6 revealed the profile of polyphenolic compounds extracted from dehulled Lablab bean seeds, and the total phenols using HPLC (High preformed liquid chromatography). The analyzed dehulled Lablab seeds showed that it contained 1.68 µg/100 g total phenols. Recorded data in the same Table also revealed the fractionated poly compounds which illustrated that; catechin, protocatechuic, P-hydroxy benzoic, cinnamic and syringic were the most dominant phenolic compounds followed by ferulic, quercetin and chrysin; that registered the values 7.188, 5.527, 5.248, 4.706, 4.240, 2.235, 1.928 and 1.246 mg/g; respectively. Meanwhile; caffeic, vanillic, chlorogenic and sinapic were the minor identified compounds, which recorded the numbers 0.871, 0.620, 0.557 and 0.384 mg/g. On the other hand, the compounds, Garlic, Gentisic, p-coumaric, Rutin, Rosmarinic, Apigenin-7-glucoside, Apigenin and kaempferol are not detected.

Lablab bean ice cream:

Chemical composition of ice cream mixes supplemented with different level of LBM:

Fat content:

Data presented in Table 7 demonstrate the fat content of ice cream supplemented with different levels of LBM. This Table illustrate that all treatments and control samples showed very close values. The registered average values ranged from 8.70 to 8.86%, therefor, the few changes in fat percentage of different ice cream mixes could be related to the low-fat content in Lablab bean milk. Results regard to fat agreed with those obtained by Nugroho *et al*. (2019), who reported that the use of 75% mung bean flour reduced fat content to 3.30%, describing that the fat content can lower the ice cream quality standard.

Total solids content (TS):

Data in the same Table revealed irregular behavior showing decrease in TS, ranged between 33.71-34.29%. Control sample possessed the highest value (34.29%) of TS, meanwhile, the treatment L3 possessed the lowest value (33.71%). Total solids content for the treatments L2 was 33.81.

Protein and ash contents:

Data in in the same Table showed that both protein and ash contents of ice cream mixes are increased with the increasing of LBA in all treatments. Moreover, the control samples had lover values than that of other treatments. Treatment L3 recorded the highest average values for the same categories (4.91% & 0.81%) as affected by adding LBM. Obtained values of total protein for the control and the treated samples, 10, 20 & 30% were 4.38, 4.79, 4.83 & 4.91%; whilst, the ash contents were 0.78, 0.79, 0.80 & 0.81%; respectively for the control and the treatments. The higher ratio of protein was in treatment (L3) than that of control, L1 and L2. Similarly reported by Abdullah *et al*. (2003) and Atallah & Barakat (2017), reported that the ash content increased in treatments containing higher amounts of soy milk.

Total carbohydrate content:

From recorded data in the same Table, it could be observed that there is a progressive decrease in total carbohydrates as the replacement with LBA increased. The T. carbohydrate content of LBM samples varied from 20.03 to 19.13% as similarly reported by Abdullah *et al*. (2003). Total carbohydrates content of the control ice cream mixes registered the value 20.03%, while it was 19.80, 19.33 and 19.13 % for the treatments L1, L2 and L3; respectively.

pH values:

Data in in the same Table illustrates the change in pH values of ice cream mixes as affected by adding Lablab bean milk compared to the control samples. Values of pH in LBM mixes of ice cream were 6.7, 6.7 and 6.8 for treatments with 10, 20 and 30% LBM; respectively. Meanwhile the control samples achieved the lowest value (6.6). This was in line with the results reported by Gracas Pereira *et al*. (2011) and Atallah & Barakat (2017), they reported that with increasing the substituting skim milk with soymilk extract, pH values of ice cream mixture increased.

Physical properties of ice cream mixes supplemented with different level of LBM:

Data presented in Table 8 show the physical properties of ice cream mix prepared using three levels of LBM. They were affected by adding different ratios of LBM. The obtained data observed that there were decreases of specific gravity as well as weight per gallon in bound with increasing of LBM in all treatments. These results agreed with the results of Salama (2012), who found that, specific gravity values were significantly decreased with adding soybean milk in mixes of ice cream milk. Whilst the relative viscosity values were increase with increasing of LBM in all treatments. These results agreed with those of Bisla *et al*. (2012), who stated that ice milk treatments containing soy milk increased the total solids content because of increasing the total solids of soy milk that increased the viscosity. Viscosity of ice cream mixture containing soy milk increased due to higher content of soy protein and capacity of soy protein for interaction and binding with water. Moreover, soy proteins have higher water holding capacity (Atallah & Barakat, 2017). Moreover, Lablab beans proteins have higher water holding capacity; this ability is one of the most important functional properties of Lablab beans-based ingredients (Shaahu *et al*., 2015). These results are also agreed with Abdullah *et al*. (2013), who reported that the viscosity increased by increasing soy-flour. In general, the control samples had higher and lower values of specific gravity & weight per gallon and viscosity than that of ice cream mix prepared using LBM; respectively in all treatments.

Physical properties of ice cream supplemented with different level of LBM:

The values of specific gravity and weight per gallon in the resulted ice cream is affected by several factors such as specific gravity of raw materials and ability of the mix to retain overrun. The data presented in Table 9 show the physical properties of ice cream prepared using three levels of LBM. They were affected by adding different ratios of LBM. The obtained data observed that there were decreases of specific gravity as well as weight per gallon in bound with increasing of LBM in all treatments. Whilst the overrun values increased with increasing of LBM in all treatments. A group of researchers mentioned that overrun in ice cream increased with higher viscosity (Zhang and Goff, 2005 and Goff, 2006). These results are perfectly in match with the findings of this study. In general, the control samples had higher and lower values of specific gravity & weight per gallon and viscosity than that of ice cream mix prepared using LBM; respectively in all treatments.

***Melting resistance of ice cream samples*:**

Melting resistance of different ice cream samples was expressed as the loss in weight percent of the initial weight of the examined samples. Melting resistance is affected by fat destabilization, ice crystal size and the consistency coefficient of the mix. The melting resistance of the samples was taken from the hardened ice cream. The melting resistance of resultant ice cream as affected by adding of LBM are shown in Table 10. The results showed that the melting after 10 min at 37ºC being 15.61, 13.23 and 12.61% for the ice cream containing 10, 20 and 30% LBM; respectively. Whilst these values were 40.24, 38.21 and 37.32% after 40 min. Moreover control samples recorded; 17.14 and 42.37% after 10 and 40 min; respectively. Finally, it was observed that increasing levels of LBM decreased the melt down value of prepared Lablab ice cream samples. These results are similar to those obtained by **Gracas Pereira *et al.* (2011)**, who indicated that increasing levels of soy milk decreased the melt down value of prepared soy ice milk.

Microbiological evaluation of resultant ice cream supplemented with different levels of LBM:

The data showed that the total bacterial and yeast & molds counts of resultant ice cream were affected by addition of LBM. Data presented in Table 11 illustrates the total bacterial and yeast & molds counts resultant ice cream prepared using three levels of LBM. Generally, the data revealed that there were decreases of total bacterial and yeast & molds counts in resultant ice cream with increasing of LBM in all treatments. This may be due to the fact that the effect of LBM on total count and yeast and molds. While control samples had higher counts of total bacteria and yeast & molds than that of resultant ice cream with LBM in all treatments. Moreover, the control samples had higher counts of both total bacterial and yeast & molds than that of ice cream mix prepared using LBM; respectively in all treatments.

Sensory evaluation of resultant ice cream replacing with different levels of LBM:

Scoring for resultant ice cream samples was carried out by 12 of staff members of the dairy department according to the scoring sheet previously mentioned in the methodology and based on that described by Marshall and Arbuckle (1996). Flavor was given 30 points, body & texture 30 points, appearance 20 points and melting quality 20 points.

Data in Table 12 showed that the organoleptic properties such as; flavor, body & texture, appearance and melting quality of ice cream were affected by addition of LBM. The data observed that resultant ice cream with

LBM had lower flavor and total scores than that of control samples in all treatments. Moreover, L1 with 10% LBM had similar scores of appearance and melting quality. In addition, L1 and L2 had higher score of body & texture than that of other treatments. In general, control samples had superior overall score followed by L1. Whilst L3 had lower overall score followed by L2.

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Table 1: Recipes of different ice cream mixes kg / 100 kilogram.

Components	Control	10%	20%	30%
Skim milk powder	1.50	1.50	1.50	1.50
LBM	-	6.38	12.65	18.98
Sugar	16.00	16.00	16.00	16.00
CMC	0.25	0.25	0.25	0.25
Vanilla	0.25	0.25	0.25	0.25
Fresh Milk	63.25	56.93	50.60	44.28
Cream	18.78	18.78	18.78	18.78

Table 2: Gross chemical composition of dehulled Lablab bean seeds milk, fresh skim buffalo's milk and skim milk powder (g/100 g).

Component %	Moisture	Crude fat	Crude protein	Ash	Lactose	T. Carbohydrates	Folic acid (µg/g)
LBM	82.54	0.66	5.98	0.98	0.00	9.82	164.749
Skim Buffalo's milk	89.3	0.40	3.98	0.91	5.40	5.40	-
SMP	3.52	0.50	34.40	7.78	53.52	53.52	-

Table 3: Amino acid fractionation and scores of dehulled Lablab bean (seeds).

Amino acid	FAO/WHO (1973)	ppm	%
Essential Amino acids (EAAs)			

Threonine	4.00	26.931	673.275
Valine	5.00	18.753	375.060
Methionine	2.20	15.511	705.045
Leucine	7.00	8.463	120.900
Isoleucine	4.00	50.473	1261.825
Tyrosine	-	23.756	-
Phenylalanine	2.80	5.069	181.036
Lysine	5.50	32.942	598.945
Histidine	-	16.320	-
Arginine	-	9.876	-
(TEAAs)	30.50	208.094	682.275
Non-Essential Amino Acids (NEAAs)			
Aspartic	-	67.046	
Glutamic	-	60.721	
Serine	-	27.210	
Proline	-	46.377	
Alanine	-	24.150	
Glycine	-	50.721	
(TNEAA)	-	276.225	
Ammonia	-	54.210	

Table 4: Fatty acids composition in dehulled Lablab seeds (g/100 g).

SFA	Symbol	%	USFA	Symbol	%	USFA/SFA
Caprylic	C8:0	2.16	Palmitoleic	C16-1	2.90	1.34
Capric	C10:0	2.88	Oleic	C18-1	30.10	10.45
Loric	C12:0	2.20	Linoleic	C18-2	2.42	1.10
Myristic	C14:0	11.20	Linolenic	C18-3	1.88	0.17
Palmitic	C16:0	28.80		-	-	-
Stearic	C18:0	13.60		-	-	-
Arachidonic	C20:0	1.10		-	-	-
Docosanoic	C22:0	0.93		-	-	-
Total SFA	-	62.87	Total USFA	-	37.30	0.59

SFA= Saturated fatty acid, USFA=Unsaturated fatty acid

Table 5: Minerals content in Lablab seeds basis on dry powder (mg/100 g).

Mineral	Value	Mineral	Value
Ca	163.25	P	127.26
K	181.125	Fe	53.50
Mg	506.43	Cu	10.95
Na	185.75	Mn	14.25

Table 6: Profile of polyphenolic compounds of dehulled lablab bean seeds (µg/g).

Compound	µg/g	Compound	µg/g
Garlic	ND	Sinapic	0.384
Protocatechuic	5.527	p-coumaric	ND
p-hydroxybenzoic	5.248	Rutin	ND
Gentisic	ND	Rosmarinic	ND
Catechin	7.188	Apigenin-7-glucoside	ND
Chlorogenic	0.557	Cinnamic	4.706
Caffeic	0.871	Quercetin	1.928
Syringic	4.240	Apigenin	ND
Vanillic	0.620	Kaempferol	ND
Ferulic	2.235	Chrysin	1.246

Table 7: Chemical composition of ice cream mixes with different levels of LBM.

Treatment	Parameters %					
	TS	Protein	Fat	Ash	T. carbohydrate	pH
Control	34.29	4.38	8.86	0.78	20.03	6.6
L1	34.19	4.79	8.85	0.79	19.80	6.7
L2	33.81	4.83	8.81	0.80	19.33	6.7
L3	33.71	4.91	8.70	0.81	19.13	6.8

L1: 10% LBM, L2: 20% LBM, L3: 30% LBM

Table 8: Physical properties of ice cream mix replacing with different levels of LBM.

Treatments	Parameters %		
	Specific gravity	Weight per gallon (Ib)	Viscosity (cp)
Control	1.09	9.10	1031
L1	1.05	8.76	1514
L2	1.03	8.60	1920
L3	1.02	8.51	2356

Table 9: Physical properties of ice cream replacing with different levels of LBM.

Treatments	Parameters %		
	Specific gravity	Weight per gallon (Ib)	Overrun (%)
Control	0.79	6.59	37.97
L1	0.72	6.01	45.83
L2	0.71	5.92	47.14
L3	0.69	5.76	49.37

Table 10: Melting resistance of ice cream products with different level of LBM.

Loss percentages after	Control	Treatments		
		L1	L2	L3
10 min	17.14	15.61	13.23	12.61
20 min	21.23	18.53	17.41	15.32
30 min	37.46	34.21	31.65	29.98
40 min	42.37	40.24	38.21	37.32

Table 11: Effect of different levels of LBM on microbiological analysis (count$\times 10^4$).

Microbial type	Control	Treatments		
		L1	L2	L3
Total bacterial	72.5	40.0	38.5	29.0
Yeast & molds	5.6	3.2	2.8	1.9

Table 12: Sensory evaluation of ice cream replacing with LBM.

Properties	C	Treatments		
		L1	L2	L3
Flavor (30)	27.0	24.5	24.0	21.3
Body & texture (30)	24.9	27.0	27.9	24.9
Appearance (20)	18.1	18.0	16.4	14.4
Meting quality (20)	18.0	18.1	16.9	16.0
Overall scores (100)	88.0	87.6	85.2	76.6

Weighing ingredients and mixing
↓
Heated at 85°C\15 min
↓
Homogenization
↓
Cooling up to 5°C
↓
Aging of mix at 5°C\12hr.
↓
Adding vanilla powder
↓
Batch freezing\Whipping machine (air incorporation and freezing)
↓
Packaging in (100 ml) cups
↓
Hardened at -20°C /24hr.
↓
Storage at -8°C for use

Figure 1: Preparation ice cream supplemented with LBM.

تأثير استخدام لبن بذور اللبلاب على التركيب الكيماوي والخواص الكيموطبيعية والخواص الحسية والمكروبيولوجية للآيس كريم

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الملخص العربي:

استهدفت هذه الدراسة البحث عن بديل للبن الجاموسي في صناعة مخاليط الآيس كريم .تم تعديل مخاليط الأيس كريم تحت الدراسة لتحتوي على ٩% دهن , مواد صلبة غير دهنية ١١% و ١٦% سكر ٠,٥% مثبت (CMC) ، واستخدم لبن اللبلاب بمستويات استبدال ١٠ ، ٢٠ ، ٣٠% بديلا عن اللبن الجاموسي في المعاملات ومقارنتها بعينة المقارنة المستخدم فيها لبن جاموسي فقط، وتم تحليل بذور اللبلاب لمعرفة التركيب الكيماوي (الرطوبة ، الدهن ، الكربوهيدرات الكلية ، حمض الفوليك) ، الفينولات والمركبات الفينولية بجهازHPLC ، وتشير النتائج إلى تفوق كبير من الأحماض الأمينية مقارنة بنتائج منظمة الصحة العالمية(١٩٧٣) ، وقد أظهرت النتائج أيضا أن أحماض الأسبارتيك ، الجلوتاميك ، الجليسين ، الأيزوليوسين ، البرولين ، الليسين ، السيرين ، الثريونين ، الفالين ، الهيستيدين ، الميثيونين الأكثر تواجدا بين جميع الأحماض الأمينية ، وقد أظهرت نتائج الأحماض الدهنية أن حمض الأوليك كان الأعلى . وتشير النتائج في مخاليط الآيس كريم إلى زيادة كل من الجوامد الكلية والبروتين والرماد ورقم الحموضة واللزوجة في حين انخفضت نسبة كل من نسبة الدهن والكربوهيدرات الكلية والوزن النوعي ووزن الجالون بالرطل بزيادة لبن اللبلاب، أما بالنسبة للمنتج النهائي فكان هناك انخفاض في كل من الوزن النوعي ووزن الجالون بالرطل والمقاومة للانصهار في حين كان هناك زيادة في نسبة الريع بزيادة نسبة الاستبدال بلبن اللبلاب، وميكروبيولوجيا. كان هناك نقص في كل من العدد الكلي للبكتريا والخمائر والفطريات بزيادة نسبة الاستبدال بلبن اللبلاب ، أما بالنسبة للتقييم الحسي فتشير النتائج إلى زيادة قيم كل من النكهة ودرجات التقييم الكلي في عينات المقارنة عنها في العينات المحتوية على لبن اللبلاب ، وكانت المعاملة المحتوية على ١٠% لبن لبلاب متشابهة مع عينات المقارنة في كل من المظهر وجودة الانصهار ، وحصلت المعاملات المحتوية على 10 ، 20% لبن لبلاب على أعلى الدرجات في القوام والتركيب ، وعموما كانت عينات المقارنة الأعلى في درجات التقييم الكلي يليها المعاملة المحتوية على ١٠% لبن لبلاب ، بينما كانت المعاملة المحتوية على ٣٠% لبن لبلاب الأقل في درجات التقييم الكلي يليها المعاملة المحتوية على ٢٠% لبن لبلاب.

الكلمات الاسترشادية: لبن فول البلاب, الوزن النوعى, وزن الجالون, المظهر العام, مقاومة الانصهار, الريع.