UTILIZATION OF SWEET APRICOT KERNELS IN SOME DAIRY PRODUCTS 1- ICE CREAM

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Abstract

The chemical composition of sweet apricot kernel flower and protein isolates was determined. The flour contained about 48.76 % crude protein. The oil was extracted, characterized and evaluated for use in preparing Ice cream. The major amino acids, were phenylalanine + tyrosine, leucine and valine while that of fatty acids were oleic, linoleic and Palmitic. The protein solubility was increased by Nacl and NaoH. The digestibility of the protein was high when the pepsin-pancreatin system was used while being quite absorption and emulsification as well as foam capacity of flour and protein isolates were evaluated.

Sweet apricot kernel flour and protein isolates seem to be good sources of protein for good products. The evaluation of the crude apricot kernel oil and protein isolate added to different types of ice cream revealed excellent properties. This did not affect the flavor, color, body& texture, melting property and appearance of these products.

Seeking for lower cost products for ice cream, production sweet apricot proteins isolates were thought to replace tangible protein of fluid milk solid not fat in the mix.

The substitution of fluid milk solid not fat by sweet apricot proteins (90%) was implemented at levels of 5, 10 and 15 %in preparing ice cream mixes. The replacement by 5% level increased the pH value, specific gravity and viscosity. The increase of sweet apricot proteins and the decrease in the total titratable acidity and overrun of the resultant in ice cream was achieved. Melting resistance gradually increased by the increase of sweet apricot protein isolates level. The replacement by 10 % showed the highest total sensory scores and melting quality.

The analytical data reveal the possibility of using sweet apricot protein isolates up to 15 % which gave a satisfactory ice cream making.

It could be recommended that the use of light heat treatment to the apricot protein isolate ice cream mixture is necessary to ascertain hygienic ciramstances for the consumers.

Key words: Kernels Apricot, Apricot protein isolate , Ice Cream

INTRODUCTION

Apricot fruits are considered among the most popular fruits grown in Egypt. The average total annual areas cultivated with apricot trees in Egypt are about 5981 feddans producing about 25720 tons of fruits (Anonymous, 1997). Wastes of food

processing could be considered as serious sanitary problem that needs to be solved. At present, much effort has been made for converting these waste materials into valuable products, (Rahma and Abd El-Aal 1988).

In Egypt, large amounts of apricot kernels representing the by-products, accumulating after processing of apricot juice, nectar, jam, pulp in brine or in syrup and sheets or used fresh. Apricot kernels represent up to 16% of the weight of the whole fruits. Several studies were carried out in order to utilize apricot kernels in food industry. Apricot kernels cake contained 41.5 and 50% total protein and oil, respectively which could be used as a good source of protein, fixed oil and macaroni paste production (Abd El-Aal *et al.,* 1986b).

Besides, these by-products contained high levels of oil, protein and carbohydrates which could be used as food and feed source, Lordanidou *et al.,* (1999). Plant proteins are used in food as functional ingredients to improve stability and texture as well as to raise the nutritional quality of the product (Makri, Papalamprou&Doxastakis, 2005).

Plant proteins to be effectively and successfully utilized in different food applications, are usually referred to as functional properties of proteins may affect shape and conformation. The method and condition of isolation of fat was also reported to affect the functional properties of protein (Finley, 1989).

This work was designated to study the physico-chemical functional properties and in vitro-digestability of the raw, defatted and protein isolate of apricot kernel.

MATERIALS AND METHODS

Materials:

Representative samples of apricot (*Prunus armeniacol*) kernel were obtained from El-Nasr company for food processing (Kaha), Egypt. These wastes were dried at 40°C in a drying oven, and then stored at room temperature (25 ± 2°C) for further uses.

Methods:

Preparation of apricot kernel samples:

Apricot kernels were cleaned and washed twice with tap water, then left to dry in the air. The dried apricot kernels were weighed and cracked to release the kernels which were weighed. After removing the brown skin from apricot kernels. The kernels were individually hammered to obtain the kernels, of which the brown skins were removed by hand after soaking in warm water (40±2°C) for 10-15 minutes as recommended by Zabert *et al.,* (1986).

Preparation of sweet apricot kernel protein isolate:

The defatted apricot kernel flour was extracted with water at pH value 12 using a ratio of 1:10 of flour to the solvent then stirring for 1 hr. at room temperature. The pH value was adjusted by the addition of 0.5 M NaOH solution. The suspension was centrifuged at 4000 rpm for 20 min. and the pH value of the clear supernatant was adjusted to 4 by the addition of 0.5 M HCL solution. The whole mixture was kept at 4°C for 1 hr. for complete precipitation of the protein, and then separated by centrifugation. The isolate was washed twice with acidified distilled water and twice with 70 % ethyl alcohol. The isolated protein was dried in a forced drought air oven at 40°C for overnight, then kept at 4°C until used for analysis.

Analytical methods:

Moisture content, total protein, ether extract, total ash, crude fiber and minerals were determined according to the A.O.A.C. (2005) methods. Total carbohydrates were calculated by difference. Determination of Amygdalin was performed according to the acidic titration method (A.O.A.C., 2005).

Determination of the essential amino acid:

Essential amino acids were determined according to the method of Becker et al.,(1981).

Functional properties of defatted apricot kernel:

Essential amino acids:

Essential amino acids were dtermined according to the method of Becker et al., (1981).

Water and oil absorption:

Water and oil absorption were determined according to the methods of Sosulski *et al.,* (1962), and Sosulski *et al.,* (1976), respectively.

Emulsification capacity:

Emulsification capacity was measured by the method of Yasumatsu *et al.,* (1972). Refined corn oil was used for absorption and emulsifying capacity studies.

Foaming properties:

Foam capacity and stability were measured by the method of Huffman *et al.,* (1975).

Utilization of apricot protein isolates in ice cream preparation:

The blend for preparing this product contained 5, 10 and 15% apricot protein isolates 16% sucrose, 4% fat (from fresh milk cream), 4% apricot oil,0.5% CMC (as stabilizer) and 0.02% vanillin. The product was evaluated organoleptically for colour, texture and flavour by comparative testing according to Meyer (1973).

Physico chemical characteristics of oil:

The oil of ground sweet apricot kernel was extracted with hexane in a soxhlet apparatus. The extracted oil, after removing hexane, was immediately analyzed for refractive index, melting point, acid value, peroxide number, iodine, saponification value and unsaponifable matter by the standard methods recommended by the AOAC (2005).

Preparation of the fatty materials for methylation:

The methyl esters of apricot kernel oil were prepared using benzene: methanol: concentrated sulfuric acid (10:86:4 and methylation was carried out at 70°C for 24 hrs. according to the method described by Ludy *et al.,* (1988).

Determination of the fatty acid methyl esters:

Gas-liquid chromatography (Pye-unicam PRO-GO) was used for fractionation and determination of fatty acid methyl esters according to methods described by Zygadlo *et al.,* (1994).

Physical analysis of ice cream:

Specific gravity:

Specific gravity of ice cream mixes and the final frozen product were measured according to Winton (1958).

Calculation of weight per gallon:

The weight per gallon of ice cream mixes and final frozen products was calculated according to Kessler (1981) by multiplying the specific gravity of the mix by the factors 8.34.

$$\text{Sp. gr. of mix.} = \frac{\text{Weight per volume of mixes}}{\text{Weight per volume of water}}$$

Weight per gallon of mixes = sp. gr. of mix. X 8.34

$$\text{sp. gr. of ice cream} = \frac{\text{Weight per volume of ice cream}}{\text{Weight per volume of water}}$$

Weight per gallon of ice cream = sp. gr. of ice cream X 8.34

Calculation of the overrun:

The overrun percent was calculated as mentioned by Wild and Clark (1996). From the figures obtained for the specific gravity, (sp.gr.) overrun was calculated using the following equation.

$$\text{Overrun (\%)} = \frac{\text{(sp. gr. of mix. – sp. gr. of ice cream)}}{\text{sp. gr. of ice cream}} \times 100$$

Determination of the melting resistance:

Meltdown of frozen ice milk was determined according to Arndt and Wehling (1989), by carefully cutting the foamed plastic cups from the ice cream samples (250 gm), placing the samples into wire mesh over a glass funnel fitted on conical flask, and weighing the amount of ice cream drained into the conical flask at 30°C every 10 min. until the entire sample had melted.

Organoleptic properties:

Samples of ice cream after 24 hour hardening at -18°C were evaluated by the dairy staff at Food Tech. Research Institute. ARC. The organoleptic properties were evaluated in a room lighted with several florescent lamp at a temperature adjusted to 20°C. The samples were scored for flavour (50), body and texture (40), melting property (5) and appearance (5) as suggested by Arbuckle (1986).

Statistical analysis:

Data of these experiments were analyzed using the statistical analysis system SAS (1998).

RESULTS AND DISCUSSION

Chemical composition

Data in table (1) show the chemical composition of sweet apricot kernels "whole apricot kernels, defatted flour and isolated protein ". The data show that the protein isolate had the higher protein content and total ash (90.12, 7.61%) respectively. Meanwhile, whole apricot kernels had the lowest protein content and total ash (26.37, 2.79%) respectively. Crude oil was the higher level in whole apricot kernels 51.98% as compared to level in defatted flour and protein isolate 5.11, 1.10% respectively. On the other hand crude fiber and nitrogen free extract were higher in defatted flour 6.12%, 35.25% respectively than the whole apricot kernels being 3.71%, 15.15% respectively while the protein isolate had nil and 1.17% respectively. However, amygdalin was not detected in the apricot kernels. These results are in accordance with the findings of Abd El-Aal *et al.,* (1986b).

Table 1. Chemical composition of sweet apricot kernels, defatted flour and protein isolated (g/100g dry weight basis).

Constituents %	whole Apricot kernel	Defatted flour	Protein isolates
Total protein	26.37	48.76	90.12
Crude oil	51.98	5.11	1.10
Total ash	2.79	4.76	7.61
Crude fiber	3.71	6.12	ND
Nitrogen free extract	15.15	35.25	1.17
Amygdaline	ND	ND	ND

ND = Not detected.

Results in table (2) show that macroelements and microelements contents of whole apricot kernels, defatted flour and protein isolate, proved to be a good source of some minerals such as Ca, P, Mg, K, Fe, Zn, Cu and Mn. Protein isolate had higher values for all minerals than that of the whole apricot kernels and defatted flour. Also, it could be observed that all kinds were poor in Cu and Mn. Generally, these values are slightly lower than that reported by Abd El-Aal *et al.,* (1986b).

Table 2. Mineral contents of whole apricot kernels, defatted flour and protein isolates (mg/100g dry weight basis)

Minerals / Samples	Macro elements					Micro elements			
	Ca	P	Mg	K	Na	Fe	Zn	Cu	Mn
Whole apricot kernels	146	104	190	570	7.0	2.6	3.0	0.8	0.6
Defatted flour	220	146	280	910	12.0	4.1	5.0	1.6	1.2
Protein isolates	270	165	317	1020	16.0	7.2	9.0	2.5	1.4

Physico-chemical characteristics of apricot kernels oil are shown in table (3). From the results, it could be noticed that refractive index, melting point, acid value, peroxide value, iodine value, Saponification value and unsaponifable matter were 1.4668, -45, 0.10, 0.80, 105, 190 and 0.72 % respectively. Also, it could be noticed that the type of apricot kernels oil could be related to semi dried oils having iodine value ranging between 90-130. These results are in agreement with those reported by El-Adawy and El-Kadousy (1995).

Table 3. Physico-chemical characteristics of apricot kernels oil.

Properties	Value
Refractive index (25°C)	1.4668
Melting point (°C)	-45
Acid value	0.10
Peroxide value	0.80
Iodine value	105
Saponification value	190
unsaponifable matter %	0.72

The fatty acids compositions of apricot kernels oil were identified by gas liquid chromatography and the obtained data are shown in table (4). From these data, it could be noticed that Oleic acid (C18:1) was the major unsaturated fatty acid as it reached 71.40% followed by Linoleic acid 16.98%. meanwhile Palmitic acid (C16:0) was considered as the major saturated fatty acid as it reached 5.85% followed by Myristic acid (C14:0) 2.12%

Table 4. Fatty acids composition of apricot kernels oil.

Fatty acids		Percentage
Lauric	12:0	0.91
Myristic	14:0	2.12
Palmitic	16:0	5.85
Palmitoleic	16:1	1.26
Stearic	18:0	1.48
Oleic	18:1	71.40
Linoleic	18:2	16.98
Linolenic	18:3	ND
Total saturated		10.36
Total unsaturated		89.64

Similar results for the fatty acid composition of apricot kernels oil were also reported by Femenia *et al.,* (1995).

The essential amino acids pattern of sweet apricot kernel flour and human requirement pattern are presented in table (5). Results show that the sample contained high amounts of all essential amino acids. The data in the same table, also indicate that the sample of sweet apricot kernel flours had either high or equivalent amounts of all the essential amino acids compared to the suggested pattern of human requirements. The total essential amino acids from sweet apricot kernel flour were higher than pattern of human requirements mentioned by the FAO/WHO/UNU (1995).

Table 5. Essential amino acids contents of Sweet apricot kernels.

Essential amino acids	Percentage	FAO/WHO/UNU	
		Children	Adults
Iso leucine	10.69	2.9	1.3
Leucine	18.35	4.6	1.9
Lysine	7.09	4.6	1.6
Methonine + Cystine	3.37	2.3	1.7
Phenylalanine + Tyrosine	22.89	2.3	1.9
Threonine	7.49	2.9	0.9
Valine	12.53	2.6	1.3
Histidine	6.14	1.8	1.6
Total E.A.A	88.55	23.90	12.40
Daily requirement %	----	370	714

Table (6) shows the differences in vitro digestibility between the defatted flour, protein isolate and casein. It showed that the casein had slightly higher values compared to the defatted flour and isolated protein. It was 35.60, 73.90, 96.20 and 99.20 for pepsin, trypsin, pancreatin and pepsin-pancreatin respectively. And it was 33.70, 68.80, 96.20 and 98.60 respectively for protein isolate, while for apricot flour it was 31.90, 32.60, 37.40 and 96.70 respectively. These results are in agreement with Rahma and Abd El-Aal (1988).

Table 6. Invitro-digestibility of apricot flour, protein isolates and casein by different enzyme systems.

Enzyme system	Apricot flour	Protein isolates	Casein
Pepsin	31.90	33.70	35.60
Trypsin	32.60	68.80	73.90
Pancreatin	37.40	96.20	96.20
Pepsin-pancreatin	96.70	98.60	99.20

The functional properties of defatted apricot flour and protein isolate were measured and are shown in table (7). The protein solubility index of the studied flour was similar among the two studied defatted flour and protein isolate with different solvents (distilled water, 5% sodium chloride and0.02 M sodium hydroxide). The protein solubility index increased with the utilization of sodium chloride and sodium hydroxide solutions compared to that of distilled water for all samples. These results agree with those mentioned by Rahma and Abd El-Aal (1988) and (Hungend zayas, 1992). The functional properties of defatted apricot flour, protein isolate and their treatments are represented in table (7). The results show that water and oil absorption of apricot flour and protein isolate showed the same trends. The values of protein isolate were higher than those of apricot flour samples. The high values of the protein isolate may be due to the occurrence of carbohydrates, which could absorb both water and oil. The emulsification capacity of defatted apricot flour protein was the highest than the protein isolate. The same trend was observed for foaming stability. The foaming properties of both treatments were fairly good and would be suitable for preparing ice cream. The foaming capacity of apricot flours was lower than those of protein isolate, (Abd El-Aal *et al.,* 1986a).

In general the protein isolates had promising functional properties which may be used to give benefits to produce many products, such as bakery products, meat products, soft drinks and dairy products.

Table 7. Functional properties of apricot flour and protein isolates.

Functional properties		Apricot flour	Protein isolates
Protein solubility index using :			
Distilled water		79.60	25.30
5% NaCl		86.70	48.60
0.05MNaOH		94.90	96.80
Water absorption (g H2O/100g. sample)		280.00	90.00
Fat absorption (ml oil/100g sample)		260.00	189.00
Emulsification capacity (ml oil/g sample)		116.00	4500
Foam capacity in H2O (% volume increase)		70.00	55.00
Foam stability in H2O			
At	00.0	52.00	28.00
after	15.0	35.00	20.00
"	30.0	30.00	18.00
"	45.0	28.00	16.00
"	60.0	25.00	10.00

The effect of using apricot protein isolates on physico-chemical properties of ice cream are shown in table (8). The total acidity slightly decreased when the apricot protein isolate increased, and pH value was at the opposite direction of total acidity. Specific gravity slightly increased when the addition of apricot protein isolate was increased. The increases of the addition of apricot isolate had increased the weight per gallon (Lb). Meanwhile, these additions gave more increase in viscosity. It was 10.85, 12.21, 16.19 and 19.82 for control, 5, 10and 15 respectively. These increases were proportionally related to the periods (6, 12 and 24 hr). These results are in agreement with those reported by Marshall *et al.,* (2003) and Heba Salama *et. Al.,* (2007).

Table 8. Effect of apricot protein isolates on physico-chemical properties of ice cream mixes.

Properties		Control	5%	10%	15%
Total acidity (as lactic acid)		0.24	0.23	0.22	0.20
pH value		6.65	6.70	6.75	6.80
Specific gravity		1.0732	1.0811	1.0833	1.0885
Weight per gallon (Lb)		8.953	8.974	9.070	9.106
Viscosity(centipoise)	Zero time	10.85	12.21	16.19	19.82
after	6 hrs	59.25	112.13	136.26	151.34
"	12 hrs	160.22	249.52	317.76	428.19
"	24 hrs	330.65	451.59	510.87	681.21

Meanwhile, the effect of apricot protein isolates on the overrun and melting resistance of ice cream by prolonging storage period is shown in table (9). The overrun decreased with increasing the added amount of apricot protein isolates. Also, the melting resistance decreased with increasing the added amount of apricot protein isolates. Also, the data show that the storage period (zero time, 7, 14 and 21 days) had affected the melting resistance which decreased with storage. These results are in accordance to the finding of Arbuckle, (1986) and Heba Salama *et. al.*, (2007).

Table 9. Effect of apricot protein isolates on the overrun and melting resistance of ice cream by prolonging storage.

Properties		Control	5%	10%	15%
Overrun %		79.12	67.05	66.25	64.14
Melting resistance	Zero time	52.37	49.72	44.52	39.42
after	15 min.	48.29	46.36	42.24	37.16
"	60 min.	43.16	40.07	38.13	35.22
"	90 min.	37.87	36.29	34.81	33.28

The organoleptic properties and melting quality of ice cream are shown in table (10). From the data the control treatment showed significantly ($P<0.05$) highest scores (90.35 and out of 100 point) among all treatments. It seemed that, the manufactured ice cream prepared with 5, 10% apricot protein isolates ranked the [significantly ($P<0.05$)] highest score than the15% apricot protein isolate which ranked the lowest score (78.40 out of 100 points).

Table 10. Effect of added apricot protein isolates extract on the organoleptic properties and melting quality of ice cream.

Treatments	Flavor (50)	Body &Texture (40)	Appearance (5)	Melting quality	Total
Control	47	35	4.20	4.15	90.35
5%	45	33	4.0	4.50	86.25
10%	45	33	4.0	4.50	86.50
15%	40	30	4.0	4.40	78.40
L.S.D at P<0.05	0.20	0.24	0.32	0.24	

Finally, it could be concluded that the recipes containing 5, 10% sweet apricot protein isolate are recommended for manufacturing functional ice cream with high quality as compared with 15% sweet apricot protein isolates.

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الاستفادة بنوى المشمش الحلو في بعض منتجات الألبان
١- الآيس كريم

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تم دراسة التركيب الكيماوي لنواة المشمش الحلو والدقيق والبروتين المعزول منه وكانت نسبة البروتين بالدقيق حوالي ٤٨,٧٦ % . وتم استخراج الزيت وتقييمه للاستعانة بها في إعداد الآيس كريم. وكانت الأحماض الأمينية الرئيسية هي التيروسين + فينيل الأنين، ليسين والفالين. وتلك الدهنية فكانت الأوليك واللينوليك والبالمتيك، تزداد درجة ذوبان البروتين باستخدام كلوريد وهيدروكسيد الصوديوم. زاد هضم البروتين في نظام استخدام الببسين والبنكريتين وتدني إلي حد كبير عندما استخدم الببسين أو التربسين منفردين كلا علي حده. كانت قدرة البروتين المعزول من الدقيق علي امتصاص المياه والدهون مناسبة جدا كما كانت السعة الإستحلابية وسعة الرغوة جيدة.

يعتبر البروتين والبروتين المعزول من نواة المشمش الحلو مصدرا جيدا من مصادر البروتين ويمكن إضافته إلي منتجات عديدة كالآيس كريم وكذا يمكن استخدام زيت نواة المشمش والذي أعطت خصائص ممتازة لم تؤثر علي النكهة واللون والخواص الحسية.

بحثا عن إنتاج آيس كريم منخفض التكلفة تم استخدام البروتين المعزول من نوي المشمش الحلو في المخلوط وقد تم استخدام بروتين نوي المشمش بدلا من جوامد اللبن بمستوي إضافة ٥، ١٠، ١٥ % في مخاليط الآيس كريم المجهزة. وعند زيادة نسبة الاستبدال حتي ١٥ % أدي إلي زيادة في الرقم الهيدروجيني والوزن النوعي و اللزوجة وانخفاض في محتوي الحموضة الكلية والريع في الناتج وقد زادت مقاومة الآيس كريم للانصهار بالتدريج بزيادة مستوي الاستبدال ببروتين نوي المشمش وقد أعطت أفضل نسبة ١٠ % أعلي مجموع للقيم الحسية وجودة الانصهار وقد أوضحت النتائج إمكانية استخدام البروتين المعزول من نوي المشمش حتى نسبة ١٥ % بأمان في صناعة الآيس كريم. أيضا يمكن التوصية بإجراء المعاملات الحرارية المناسبة (البسترة).لمخلوط الآيس كريم المعد بإضافة البروتين المعزول من نوي المشمش الحلو لضمان الجودة الصحية لهذا المنتج الغذائي.