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Utilization of Apricot kernels

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Abstract: Recently, more attention has been focused on the utilization of food processing by products and wastes, as well as under-utilization agricultural products. So this study was carried out to utilize of the Apricot kernel wastes for production of some nutritional products and economics such as Noga, Folea, Raw chocolate, Chocolate+Nescafe, Caramel+Nescafe, Caramel +Coconut, Salt+ vinegar and Salt+Lemon. As well as reduce environment pollution being from these wastes. Apricot seeds represent 15% 0f the fruits while kernel represent 40% of the Apricot seeds. Chemical and physical properties, mineral contents, amino acid and fatty acid composition of apricot kernels were determined in addition Amygdaline content, aninutritional Factors and Sensory evaluation. Apricot kernel were found to contain high lipids (47.8%) and protein (25.3%) while it contains 2.86% crude fiber, 2.32% ash, 5.76% total sugars and 15.62% total carbohydrates. However, Apricot kernel had relatively high content in Calcium (193.1), Potassium (1135), Phosphorus (487) and Magnesium (158.7 mg/100gm dry weight basis). Also it contains moderate amounts of iron (10.91), Zinc (7.61) and Sodium (9.2 mg/100gm dry weight basis). On the other hand Apricot kernel had the highest content of Lucine (7.76), followed by Lysine (4.25), phenylalanin (3.44), Isolucine (3.21), Thereonine (2.88), Valine (2.31), Tyrosine (2.19), Methionine (1.34) and Cystine (1.21g/100g protein). However Apricot kernel contained saturated fatty acids like Palmetic (4.82) and Stearic (0.34%), besides unsaturated fatty acids like Palmitoleic (0.95), Oleic (64.32) and Linoleic (27.41g/100g Apricot kernel oil). It was also found that total contents of saturated and unsaturated fatty acids were 5.25 and 92.68%, respectively. On the other hand Apricot kernel contained 3.61% amygdaline, Also found other antinutritional factors such as phytic acid, trypsin inhibitors, tannins and oxalate were 3.44, 1.43, 4.63 and 1.06 mg/100g dry weight respectively. So detoxification treatments were done to remove bitterness by boiling for 30 min. in 0.1% sodium bicarbonate and soaking for 48 min. in

distilledwater.

Keywords: Apricot Kernel, Folea, Noga, detoxification

Introduction

Apricot (Prunus armeniaca) is considered important stone fruit in Egypt, and there are many varieties of Apricot such as Amar, Hamawy, Fayoumy, Canino and a new variety called Prefection. There are several tasteful products which are well known to Egypt consumers, prepared from the fully ripe Apricots fruits, i.e. Apricot jam, syrup, pulp paste and dehydrated Apricot **(Abd Alla, 2001)** .

The Apricot crop is a major source of livelihood and is deeply associated with the tradition and culture of the region **(Dwivedi, 2007)** . The stones left after processing is thrown as a waste, which otherwise is a good source of edible oil and considered to be a good source of polyunsaturated fatty acids like linoleic and lenolenic acid and oleic acid as monounsaturated with a good natural importance **(Konchok Targais et al., 2011)**.

Apricot kernel constitutes 15-16% of Apricot fruit **(Ari, 1999 and El-Adawy, 1994)** and 31-38% of whole stone **(Rahma et al., 1994).** Apricot kernel is used by many industries including oil/fat, cosmetic, medicine and bakery (Ackurt, 1998). Protein and oil content of apricot kernel approximately ranged between 20-25%, respectively **(Beyer and Melton, 1990)**.

Therefore, utilization of Apricot pits will help in eliminating or reducing of pollution either inside the factory or the surrounding area with possibility of reducing the production costs. The amount of Apricot seeds remaining after processing are quiet large (11-16%) of the total fresh weight of Apricot fruit (**El-Adawy,1992)**.

an Apricot kernels (Paunus armeniaca, "Armenian plum" in Latin) refers to the kernel of a species of Prunes, classified with the plum in the subgenus Prunes. It is commonly known for containing amygdaline, a toxic cyanogenic glycoside, sometimes incorrectly

referred to as "vitamin B17". However, it is not regarded by the scientific community as a vitamin since it has not been proven to be essential to achieving or maintaining good health, as is the widely accepted scientific definition of a vitamin (**American Cancer Society, 2005).**
This study was carried out to investigate chemical composition of Apricot kernels, amino acids composition, fatty acids composition, removing antinational factors and preparation of some food products from Apricot kernels.

Material

Representative samples of Apricot kernels were obtained from juice extraction unit of the pilot plant of the Food Technology Research Institute - Agriculture Research Center, Giza, Egypt. These wastes were dried at 40ºC in a drying oven then stored at room temperature for further use.

Methods

Preparation of Apricot kernels samples: The Apricot kernels were washed with water, and then sun dried for 3 weeks, then crushed by manual cracking. The kernels were boiled for 30 min. in 0.1% sodium bicarbonate, then soaked for 48 min. in distilled water to remove bitterness (detoxification) and shelled the brown skin. The kernels was dried in a forced draught air oven at 50ºC.

AnalyticalMethods:

Chemical analysis: Moisture content, protein, ether extract, ash, crude fiber, total carbohydrates (by difference), total sugar were determined according to **A.O.A.C. (2005).**

Minerals content: Sodium, potassium, calcium, magnesium, iron, copper and zinc contents were determined by using Perkin Elmer Atomic Absorption Spectrophotometer **(3300)**

Determination of amino acids and chemical score (CS): Amino acids composition of Apricot kernels were analyzed using Amino Acid Analyzer, Backman7300, according to the method of **Anon, 1987.** Chemical score (CS) of essential amino acids was calculated in relation to **FAO/WHO (1993)** reference pattern.

Identification and determination of fatty acids:Preparation of fatty acids methyl esters: The methyl esters of fatty acid were prepared by using benzene, methanol, and sulphuric acid (10:86:4) with oil sample, then methylation was carried out for an hour at 80-90ºC according to **Stahl (1967). Identification of fatty acids** methyl esters by GLC, a Hewlett packed gas liquid chromatography grasps (model 5890) equipped with a flame ionization detector and coiled glass column (1.8 M × 2 M M ID) packed with 10 % DEGS (diethylene glycol succinate)

and supported on chromos or W-HB 100-120 mesh used. The samples (1 ml.) were injected into the column using a Hamilton microcyringe. The gas chromatographic conditions used for isothermal analysis were: Temperature of column 170 ºC, detector 300 ºC and injector 250ºC flow rates: hydrogen 33 ml. minute, nitrogen 30 ml. min. and air 330 ml. min. Also, peak areas were measured using a Hewlett Packard Integrator Model 3392a. The fatty acid percentage was calculated from the following equation:

$$\text{Fatty acid \%} = 100 \times \frac{\text{Area of each peak}}{\text{Overall area of the peak}}$$

Determination of Amygdaline content (as hydrocyanic acid):

Hydrocyanic acid was extracted from sample (raw or after detoxification) according to **Cruess (1958)** as follows: 10 grams of crushed sample were placed into a flask (250 ml.) with 4-5 volumes of water at 40-50 □ C for 24 hours, and the flask was connected to a condenser, the condenser end was dipped in 90 ml. distilled water in a flask then the contents were distilled till a 100 ml. of distillate is collected and hydrocyanic acid was determined according to A.O.A.C. (1990) as follows: 25 ml. of extracted hydrocyanic acid solution was placed into a small flask, then 5 ml. freshly precipitated Mg (OH)2 solution was added and titrated with 0.1 Ag NO3 solution using K CrO4 as indicator. Hydrocyanic acid was calculated as the following equation

1 ml. of 0.1 N Ag NO3 □ 0.0027 g HCN

Amygdalin % was estimated using the following equation:

$$\text{Amygdalin \%} \square \text{ Hydrocyanic acid} \times \frac{\text{Molecular weight of amygdalin (457)}}{\text{Molecular weight of hydrocyanic acid(27)}}$$

Amygdalin % □ Hydrocyanic acid × 16.9259

aninutritional Factors: Phytic acid was determined according to the method of **Wheeler and Ferrel (1971)**. Tannins were determined by method described by **Price et al. (1978)**. Trypsin inhibitor activity was determined according to the method of **Kakade et al. (1974)**, while oxalate was determined according to the method described by **Falade et al. (2004)**.

Preparation of products:

1-Noga

a- Ingredients of Noga (as common oriental sweet):

The basic Noga mix contains 400gm glucose honey, 180gm sugar, 120gm distilled water, 5ml. lemon juice, 0.5 vanilla, 250gm honey and two white egg. All the aforementioned ingredients were added to 300gm Apricot kernels.

b-Processing procedure:

The required amount of sugar was added with glucose honey and distilled water and leave it on gently heat to boiled for 35min. Also honey heated gently for 20 min. in other bowl. White egg, lemon juice and little salt were mixed well till creamy texture then honey added gradually with constant stirring till color yellow and heavy texture then honey glucose, vanilla and syrup mixture were added with stirring till double size of the mixture three times and the color becomes bright white. Finally prepared Apricot kernels were added with stirring and poured on a marble surface (previously covered lightly with oil) and left for cooling to ambient temperature. The mass was extended with a rolling pin to 1.5 cm. thickness and cut with a knife into bars which were packed in tightly closed cellophane pouches.

2-Folea:

a- Ingredients of Folea : 300gm prepared Apricot kernels, 1gm citric acid, 60 ml. water and 125gm sugar .

b- Roasted was done according to **Mattuk (1997).**

3- products covered with Chocolate :

a- Chocolate raw: 100gm roasted Apricot kernels, 200 chocolate raw

b-products covered with Chocolate and Nescafe: 100gm roasted Apricot kernels, 200 chocolate raw, 40gm Nescafe **Processing procedure:** Roasted Apricot kernels were added to hot melted chocolate with stirring then dump these mixture in foil plate and put it in refrigerator.

4-Caramelizedproducts:

a- With Nescafe taste:

200 sugar + 25gm water + 5gm Lemon juice . all ingredient were heated to make syrup. 20gm Nescafe dissolved in a few of water then add to the previous mixture till caramel degree. Finally all the aforementioned ingredients were added to Apricot kernels.

b-With Coconut: like previous product replacing Nescafe with coconut.

5-Saltedproducts:

a-Salt and vinegar: 100gm prepared Apricot kernels, 200gm vinegar, 4gm table salt**,** 2gm shatta .

b- Salt and Lemon: 50ml Lemon juice, 150ml water, 4gm table salt, 2gmShatta.

Processing procedure: Roasted Apricot kernels were added to the

previous solution and soaked for 15 min. then splitter filter and dried in the oven.

Organolepticevaluation:

Ten panelists from Food Technology Research Institute, Agric. Research Center were asked to evaluate color, texture, taste, odor and overall acceptability according to the method of **Claughton and Pearce (1989).**

Statisticalanalysis:

The obtained data in this research has been statistically analyzed using the statistical analysis system **SAS (1996)**.

ResultandDiscussion:

Chemical Constituent of Apricot: Apricot fruit were examined to determine the percent of pulp, seeds and kernels

Table (1): the percent of pulp, seeds and kernels of Apricot

Constituents%	Apricot
85	Pulp
Seeds	15
Shell	60
Kernel	40

Table (1) showed that seeds and kernels percent of Apricot fruit were higher (15 and 40 % respectively), this result is agreement with **El-Adawy (1992) and Hallabo (1972).** Also it could be seen that pulp and shell percentages were 85 and 60 % respectively.

Table (2): Chemical composition of Apricot kernels

Components %	Apricot kernels	
	Wet weight basis	Dry basis
Moisture	6.1	93.9
Ash	2.32	2.47
protein	25.3	26.9
Lipids	47.8	52
Total sugars	5.76	6.1
Total carbohydrates	15.62	16.2
Total fiber	2.86	3.2

Table (2) revealed that chemical composition of Apricot kernels per 100 gram sample. The obtained results showed that protein, ash and lipids were 25.3%, 2.32% and 47.8% respectively. While total carbohydrates, total sugar and total fiber were 15.62%, 5.76% and 2.86% respectively, however the moisture content of kernels was 6.1%. These results were close to those found by **Abu El Naga (1980) and Hallabo et al. (1975)** From results in table (2) it could be noticed that Apricot kernels had a higher content of protein. This finding may focus the interest of utilizing Apricot kernels as a good protein source in some food productions **El-Adawy (1992).**

Minerals content in Apricot kernels:

Table (3): Minerals content in Apricot kernels (as mg/100g dry weight basis)

Minerals content	Apricot kernels
Zinc	7.61
Iron	10.91
Magnesium	158.7
Copper	1.2
Calcium	193.1
Phosphorus	487
Potassium	1135
Sodium	9.2

Table (3) reported that Apricot kernels had relatively high content in Calcium (193.1), Potassium (1135), Phosphorus (487) and Magnesium (158.7 mg/100g dry weight basis). On the other hand Apricot kernels contained moderate amounts of Iron (10.91), Zinc (7.61) and Sodium (9.2 mg/100g dry weight basis) .

Results of minerals content of Apricot kernels agree with previous findings by **El-Adawy (1992)** who reported that Apricot kernels proved

to be good sources for some minerals like phosphorus, Calcium, Potassium and Magnesium .

Essential amino acids composition of Apricot kernel:

Table (4):Essential amino acids composition of Apricot kernels (g/100g protein)

Amino acids	Apricot kernel	FAO/WHO (1993)	Amino acids scores
Leucine	7.76	4.9	158.47
Isoleucine	3.21	4.2	76.43
Methionine	1.34	2.2	60.91
Phenylalanine	3.44	2.8	122.86
Lysine	4.25	4.2	101.19
Threonine	2.88	4.0	72
Tyrosine	2.19	4.1	53.41
Valine	2.31	4.2	55
Cystine	1.21	-	-

The protein quality of tested kernel flours was evaluated according to its content of essential amino acids composition in comparison to the reference protein pattern of **FAO/WHO (1993).**

From the obtained data it could be observed that Apricot kernels contain adequate amount of leucine, isoleucine, phenylalanine, tyrosine and valine. comparing with **FAO/WHO** protein pattern reference. Concerning methionine, lysine and theroenine were deficient as compared with FAO/WHO protein pattern reference. These results were in agreement with the foundations of **El-Adaway & Taha (2001) and Azouz et al. (2009).**

Determination of fatty acids:

Table (5): The composition of fatty acids of Apricot kernels oil

Fatty acids %	Apricot kernels oil
Unsaturated fatty acids	
Palmitoleic 16:0	0.95
Oleic 18:1	64.32
Linoleic 18:2	27.41
Total unsaturated fatty acids	92.68
Saturated fatty acids	
Palmitic 16:0	4.82
Stearic 18:0	0.43
Total saturated fatty acids	5.25

Table (5) illustrate both saturated and unsaturated fatty acids contents of Apricot kernels oil. Palmitic acid and Stearic acid and total saturated fatty acids were 4.82, o.43 and 5.25 respectively. On the other hand Palmitoleic, Oleic, Linoleic acids and total unsaturated fatty acids were 0.95, 64.32, 27.41 and 92.68 respectively.These results were in agreement with **Hallabo (1972) and Hallabo et al., (1975)**. They reported that Apricot kernels oil contained 65.22 Oleic acid, 29.32 % Linoleic acid, 94.54 total unsaturated fatty acids.

Determination of Amygdaline:

Table (6): Amygdaline and hydrocyanic acid percent in raw whole Apricot (gm per 100 gm on dry weight basis).

Kernels	Hydrocyanic acid %	Amygdaline %
Apricot	o.210	3.61

Amygdaline = HCN × 16.9257 (AOAC, 1990).

Results in table (6) revealed that hydrocyanic acid and Amygdaline contents (0.210 and 3.18 % respectively) were found in raw whole Apricot kernels. These results disagreement with **Hallabo et al., (1975) and El- Adawy (1992)** who found that the hydrocyanic acid in raw whole Apricot kernels were 0.176 and 0.16 % respectively.

Aninutritional Factors:

Table (7): Antinutritional factors of Apricot kernel flours (mg/100g dry weight)

Antinutritional factors	Apricot kernel flours
Phytic acid	3.44
Tannins	4.63
Trypsin inhibitors*	1.43
Oxalate	1.06

*TIU/mg protein

Antinutritional factors of studied kernels flours are shown in Table (7). Phytic acid, Tannins, Trypsin inhibitors and Oxalate were 3.44, 4.63, 1.43 and 1.06 respectively. These findings are in good agreement with those reported by El-Adawy and Taha (2001). The problem with phytic acid in foods is that it can bind some essential minerals nutrients in the digestive tract and can result in mineral deficiencies. On the other hand **Liener (1994**) revealed that Trypsin inhibitor is heat labile and can be inactivated by heat treatment such as steaming and extrusion cooking.

In general antinutritional factors and toxic substances found in nuts grains and seed can be minimized or eliminated by soaking. These inhibitors and toxic substances are enzyme inhibitors, phytates (phytic acid), polyphenols (tannins) and goitrogens as reported by **Bajpai et al. (2005)**.

Organoleptic evaluation: Sensory evaluation is considered as an important indicator of potential consumer preferences. In spite of its short comings it well remain one of the most reliable quality assessment technique for food products in general **(Meilgeard et al., 2006)**.

Table (8): Sensory characteristics scores of prepared Apricot kernels products

Products	Color	Texture	Taste	Odor	Overall acceptability
Noga	8.8^{ab}	7.8^{ab}	8.15^{ab}	8.35^{ab}	8.15^{b} □
Folea	8.5^{ab}	7.75^{a}□□	7.5^{b} □	8.25$^{ab\ c}$	7.65 □ □
Raw chocolate	8.7^{ab}	8.05^{ab}	7.95^{ab}	8.15^{ab} □	8.3^{b}
Chocolate +Nescafe	9.1^{a}	8.6^{a}	8.45^{a}	8.7^{a}	9.0 ^{a}
Caramel +Nescafe	7.7 □ □	7.3□□	8.95 □	7.75 □	7.4 □
Caramel +Coconut	7.0 □	6.9 □	6.05 □	7.1□	6.6 □
Salt + vinegar	8.3 ^{b} □	8.1^{ab}	7.65 □□	7.9^{b} □	7.6 □ □
Salt +lemon	8.1 ^{b} □	7.45^{b} □	.75^{ab}	8.1^{b} □	7.7 □ □
LSD	0.7867	0.8932	0.7796	0.5531	0.5624

From table (8) it could be observed that there were significant differences between products in color, texture, taste, odor and overall acceptability. while slightly differences was observed between Noga and Folea, also between saline products (Salt +lemon & Salt + vinegar). Chocolate +Nescafe record high score in all products, on the other hand the worst one was Caramel +Coconut followed by Caramel +Nescafe.

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الاستفاده من نوى المشمش

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الملخص:

تم اجراء هذا البحث للاستفاده من مخلفات المشمش لانتاج بعض المنتجات الثانويه مثل النوجا ، الفوليه ، نوى المشمش المغطى بالشيكولاته ، نوى المشمش المغطى بالشيكولاته والنيسكافيه ، نوى المشمش المغطى بالكراميل ، نوى المشمش المغطى بالكراميل وجوز الهند ، نوى المشمش بالملح والخل ، ونوى المشمش بالملح والليمون . بالاضافه للمساهمه فى حل المشاكل البيئيه أو تقليل تلوث البيئه الناتجه عن هذه المخلفات بجانب انتاج منتجات غير مكلفه اقتصاديا .

كما تم تقدير الخواص الطبيعيه والكيميائيه والوظيفيه لنوى المشمش بعد معاملتها بالنقع فى محلول 0.1 % بيكربونات صوديوم لازاله المراره .

كما تم فى هذا البحث تحليل كيميائى للنوى ، محتوى المعادن ، تقدير الاحماض الامينيه والاحماض الدهنيه والمواد المضاده للتغذيه ووجد أن نوى المشمش يحتوى على نسبه دهون عاليه (**47.8**%) وبروتين (25.3%) بينما يحتوى على 2.86% الياف ، 2.32% رماد ، 5.76% سكريات كليه ،15.62 % كربوهيدرات كليه. بينما نوى المشمش كان عالى نسبيا فى محنواه من الكالسيوم (193.1) ، والبوتاسيوم (1135)، والفوسفور (4**87**) والمغنيسيوم (15**8.7**محم/100جم على اساس الوزن الجاف). أيضا يحتوى على كميات معتدله من الحديد (10.91) ، زنك (**7**.61) والصوديوم (9.2محم/100جم على اساس الوزن الجاف).

من ناحيه اخرى وجد ان نوى المشمش ذو محتوى عالى من الليوسين (**7.76**)، يليه الليسين (4.25)، الفينيل الانين (3.44)، ايزوليوسين (3.21)، ثريونين(2.**88**)، فالين (2.31)، تيروزين (2.19)، ميثيونين (1.34) والسستئين (1.21جم/100جم بروتين). بينما احتوى نوى المشمش على الاحماض الدهنيه المشبعه البالمتيك (4.**8**2) والاستيارك (0.34%) يجانب الاحماض الدهنيه الغير مشبعه مثل البالميتوليك (0.95)، الاوليك (64.32) واللينوليك (27.41 جم/100جم زيت نوى مشمش). وبناء عليه فان المحتوى الكلى من الاحماض الدهنيه المشبعه والغير مشبعه كانت 5.25 ، **92.68** % على التوالى .

على الجانب الاخر وجد ان نوى المشمش يحتوى على 3.61 % اميجدالين. ايضا وجد عوامل مضاده للتغذيه مثل فيتيك اسبد ، مثبطات التربسين، التنبنات والاكسالات حيث كانت 3.44، 1.43، 4.63، 1.06 مجم/100 وزن جاف على التوالى .لذلك تم معامله نوى المشمش قبل البدء فى عمل المنتجات .