Nutrients of Carob and Seed Powders and Its Application in Some Food Products

Higazy, M.M.E, EL. Diffrawy,A.A.M., Zeitoun,M.A.M., Shaltout,O.E. and Abou El-Yazeed,A.M.
Food Science Dept., Fac. Agric.(Saba Basha),Alex. Univ. Alexandria, Egypt.

ABSTRACT: The current study aimed to utilize carob pulp powder (due to its nutritional and healthy values) through substitution in various amounts (25, 50, and 75 %) in cocoa milk, brownies and chocolate cake as a cocoa replacer. Studying the impact of carob seed powder substitutions as a coffee replacer was also carried out. Sensory properties of all application were performed. In the present study the proximate chemical composition of Carob pods and seeds were analyzed for moisture, ash, fat, protein, carbohydrate and determination of tannins in pulp and seeds of carob. The most acceptable roasted carob powder was obtained by roasting kibbled carob at 150°C for 60 min. Carob pod powder contained high levels of carbohydrate (68.54± 0.31) appreciable amount of protein (6.83± 0.12), and low level of fat (0.24± 0.04) .They also contains appreciable amounts of minerals (mg/100g) such as phosphorus: (2255.21), potassium (8637.64) calcium (2123.00), selenium (1757. 80), iron (381. 80), zinc (24, 61). Carob pods and seeds contain 19.5 mg and 40 (mg of Gallic acid/ mg dry weight) of total polyphenols, respectively. Carob seeds contain higher percentages of protein (10.40± 0.20), fiber (76±0.05) and fat (1.67±0.05) as compared to pods, whereas pods contained higher percentages of carbohydrate than seeds. Sugars and amino acid composition were also determined. The carob pods powder was used because it possesses the advantage being free from caffeine and theobromine.

Keywords: Carob, Powder, Application, Food Products

INTRODUCTION

The carob tree (*Ceratonia siliqua L.*), also called algarroba, locust bean and St. John's bread, is a leguminous evergreen tree which grows throughout the Mediterranean region, mainly in Spain, Morocco, Italy and Portugal. (Yousif and Alghzawi, 2000 and Youssef *et al*., 2013).

Carob tree has been grown since antiquity in most countries of the Mediterranean basin, usually in mild and dry places with poor soils. It is an important component of the Mediterranean vegetation, and it's adaptation in argental soils of the Mediterranean regions is important environmentally and economically (Yousif and Alghzawi, 2000, Fearn, 2002 and Santos *et al*., 2005).The carob tree matures slowly and bares pods in the autumn but only in July every second year, and partially renews leaves in spring. The world carob production from the year 2012, Spain with 40000 tons was ranked the first, Italy with 30841 ton ranked the second, Portugal with 23000 tons ranked the third, and Turkey with 14218 tons ranked the sixth (Anonymous, 2014a). In 5119 hectares in Turkey in 2013 produced 14261 tons of carobs (Anonymous, 2014b).

The advantage of using carob as a chocolate substitute, resides in that carob is an ingredient free from caffeine and theobromine, carob pod provide two important products:a) Carob kernels or seed from which carob local bean gum is extracted b) Carob kibbles or the remaining pulp obtained after the removal of the seeds this can be used directly in animal and human nutrition or as new material for industrial processing. Carob pod is mostly used in food industry for carob bean gum and locust bean gum bean which are polysaccharides (galactomannos) contained in the endosperm of the seed **(**El Batal *et al*., 2013 and Rozylo *et al*., 2017). This added to a variety of products as a thickener, stabilizer or flavourant (Bouzouita *et al*., 2007and Nasar-Abbas *et al*., 2016).

Components of the carob pod have been used as a sweetener, as a food ingredient in the production of confectionary, beverages, bread and paste The nutritive value of carob pods was attributed to its high level of carbohydrate (67.48%)appreciable amounts of protein (6.64%) and low level of fat (2.24%) considering the minerals content of fruit (calcium, potassium, magnesium, sodium and iron)are abundant (Can *et al*.,2007 and Goulas *et al*., 2016), but it also contains a large amount of condensed tannins (16-20) %.

Carob is used in among Arab countries to make a popular drink which is consumed mainly in the month of Ramadan. Carob is also used in preparation of special traditional types of Arabic confectionery (Owen *et al*., 2005). In western countries carob powder is produced by deseeding of carob pods, yielding of kibbled carob followed by roasting and milling of the kibbled carob the product carob pod is sold in USA and other western countries in health food stores as substitute for cocoa (Bulca,2016 and Aydin and Ozdemir, 2017).

The aim of this study included: (1) Studying some chemical and technological aspects of carob as a functional food, (2) Using carob as chocolates substitute, (3) using of carob pod as a fiber enriching agent in cake to prolong its shelf life and (4)Mixing the seeds powder with coffee powder to reduce caffeine content.

MATERIALS AND METHODS

Materials

Five kg. of carob pods were purchased from a local market, in Alexandria city, Egypt.

Preparation of carob

Carob pods were collected, washed, cleaned, air-dried then crushed separated into pulp and seeds for further grinding to pass 25 mesh (very fine powder, then stored at room temperature in glasses kelners for further analysis.(Fig. 1)

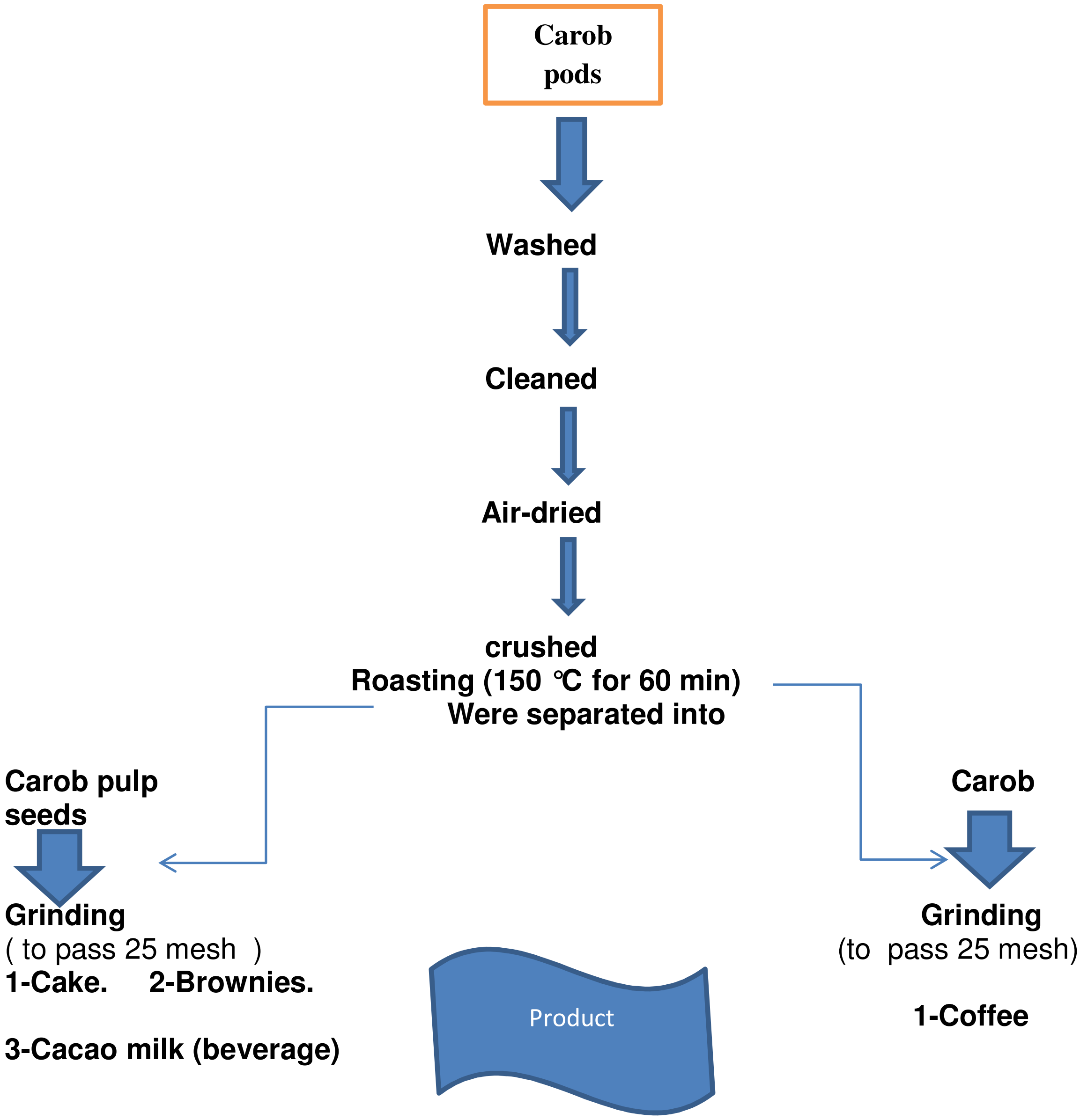


Fig. (1). Preparation of carob

Preparation of carob pulp powder and seeds for food production:

- Cake

Cakes were processed according to the method of El -Sayed *et al*., (2014). The formulation of cake consisted mainly of: One hundred gram flour, 100g sugar, 100g butter, 100g egg, 2.5g baking powder, 3g vanillin. Carob pulp powder was used to replace 25, 50 and 75 of sugar.

-Brownies

Brownies were processed according to the method of Williams ,(1995). The formulation consisted mainly of: 50 gram flour and 50 gram cocoa, 100g sugar, 100g butter, 100g egg, 0.5g baking powder, 3g vanillin. Carob pulp powder was used to replace 25, 50 and 75% of cocoa powder

- Coffee

Roasting treatment was used to roasted Carob seed (CS) (150℃ for 60 min.) The powderwas used to replace 25, 50 and 75 % of instant coffee. The drink was prepared by the commonway of preparing coffee drink and compared with control any addition of carob (100% instantcoffee).

- Cocoa milk

Roasting of Carob pods (CS) at 150℃ for 60 min was performed. The powder and used to replace 25, 50 and 75 % of cocoa milk. The drink was prepared by the common way of preparingcocoa milk drink and compared with control (milk & cocoa) as reported by Bulca (2016).

Methods

Determination of Gross Chemical Composition:

Moisture, crude protein, crude fat, and ash contents were determined according to the procedures described in the AOAC (2000).

Determination of total and reducing Sugar:

Extraction of total sugar:

A sample of 10 gram was extracted with water in the presence of calcium carbonate to prevent inversion. The extraction was under taken in water bath at 100 C^o for30 min. the extract clarified with lead acetate and finally deleaded by potassium oxalate prior to completion to a known volume (250 ml) in volumetric flask according to the method of Plummer (1978).

b) Determination of total Sugar:

Total sugar were determined by phenol –sulphoric acid method (AOAC, 2000).The intense yellow-orange colour resulted was measured at 490 nm with a spectrophotometer (model#2380, Perking Elmer, England).

Total sugars were calculated from the following equation:

Total sugar (%) = (O.D. x Dilution factor x 100) /K x 10^6

Where: O.D. Is the reading in spectrophotometer and (K) is the slop of the stander curve.

c) Determination of reducing and non-reducing sugars

Reducing sugars were determined as glucose by Nelson Arsenate-molybdate colorimetric method (Egan *et al.,* 1987).

Non –reducing sugar were calculated by difference from the following equation:

Non –reducing sugar (%) =Total sugar (%) – reducing sugar (%) at dry weight basis

Minerals Contents:

Elements concentration (K, P, Mg, Ca, Na, Fe, Cu, Zn, and Mn) were determined using an Atomic Absorption Spectrophotometer (Perkin Elmer2380, Perkin Elmer Ltd ,and USA).A flame photometer (Gallenkamp flame analyzer, FGA 330)was used for the determination of Na and K as reported by AOAC (2000).Total phosphorus was assayed colorimetrically at 630 nm using a Spekol Spectrophotometer (Carl Zeiss,Jena32-G34)as reported by Ranganna,(1977).

Crude fiber content:

Crude fiber content was determined as described by the AOAC (2000). Defatted carob (2g) were digested using 200ml H_2SO_4 (1.25N) for 30 min. The digested seeds were consequently filtrated and washed. Using boiling water and ethanol, respectively. The digested seeds were re-digested again using 200ml NaOH (1.25N) for 30 min., then filtrated and washed again. The digested sample was, then, put in a crucible and dried at 105°C for 12 h. then cooled. The crucible, with the residues inside was quickly weighed and placed in an electrical muffle at 500°C for 3 h. then left to cool and weighed again. The crude fiber content was calculated from the following equation:

$$\text{Crude fiber content (\%)} = \frac{(A-B)}{C} \times 100$$

Where:

A =weight of the crucible with dry residue.

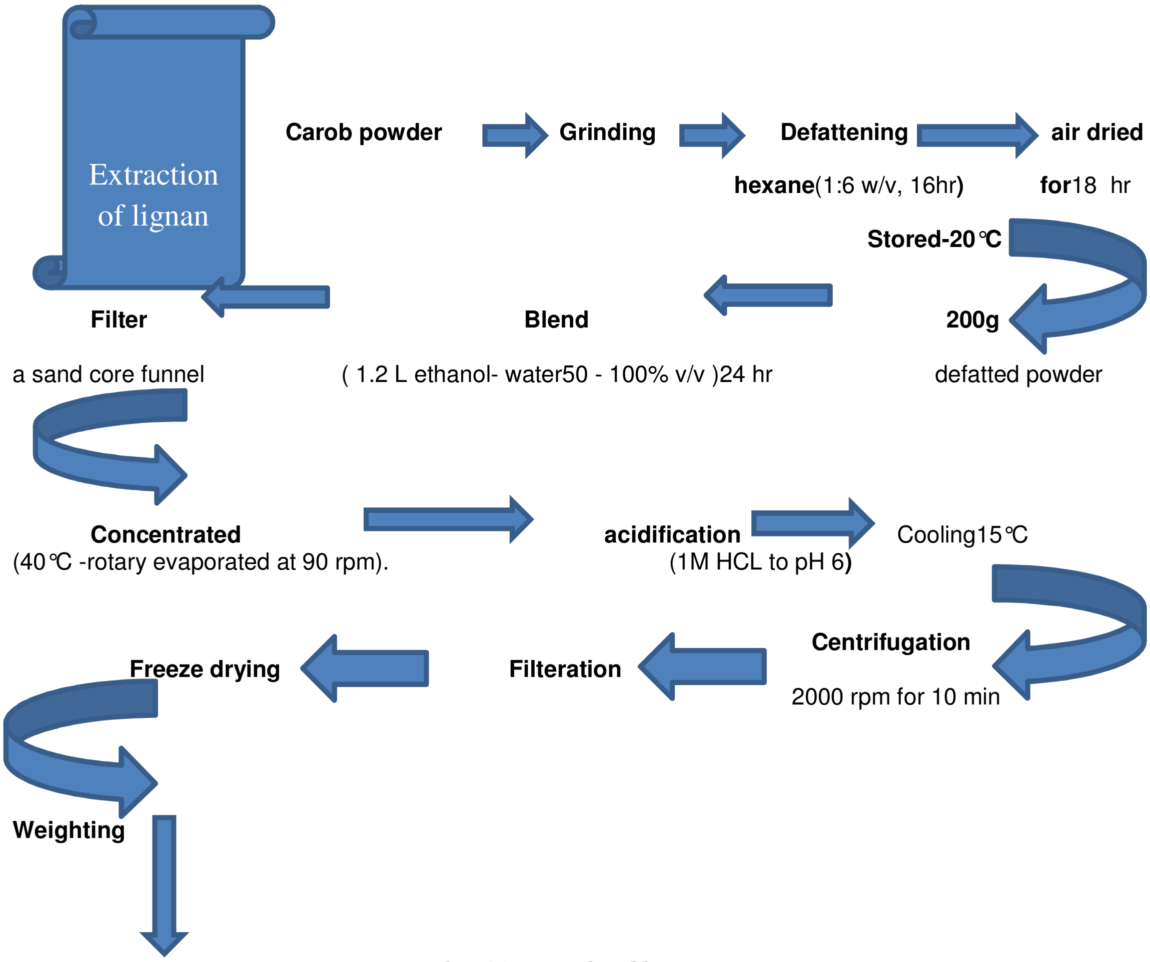
B= Weight of the crucible with ash.

C= Weight of sample.

Lignans determination:

Carob powders were ground in a coffee grinder to obtain a fine powder. The samples were defatted by blending the ground materials with hexane (1:6 w/v)and soaked for, 16hr at room temperature. The defatted powder was air dried for 18 hr and stored at -20 °C for the later use.

Lignans were extracted using the method described by Shan *et al*. (2007), (Fig 2).



$$\text{Acquired ratio of lignans} = \frac{\textbf{Weight of freeze−dried lignans}}{\textbf{Weight of defatted carob powder}} \times \mathbf{100}$$

Fig (2). Flow sheet of lignan extraction and determination

Amino acid composition:

Total amino acids (TAAs) were determined according to the methods described by Moore *et al*., (1958) as follows: sample of 20-25mg was placed in glass hydrolysis tube containing 10ml of 6 N HCL with 0.1% mercaptoethanol. The tube was sealed and heated in an oven at 110 ℃ for 24 hrs. the hydrolyzed sample was then cooled to room temperature and filtered through whatman No.1 filtered paper. The tube and precipitate on the paper was washed with distilled water and the filtrates were then completed to 25 ml H_2O in a volumetric flask. Five ml of the filtrates were transferred to a 25 ml beaker and placed under vacuum in a desiccator over potassium hydroxide. the resulted dried residue was dissolved in one ml of sodium citrate buffer of pH 2.2 and stored at 4℃ until analyzed by Amino Acid Analyzer LC3000 Eppendrof Germany. The results obtained were expressed as g/100g protein (on dry wt. basis).

Determination of total phenolic content:

Extracts were prepared as follows: 1 g of carob powder was mixed with 20 ml of water and 20 ml of acetone in a reactor at room temperature (20 –22℃, 30 min).

Total phenolic content of carob extract was determined with the Folin-Ciocalteu (F C) reagent as previously described by (Velioglu *et al.,* 1998). The extract (100 ml) dissolved in methanol were mixed with 750 ml of FC reagent (previously diluted 10 -fold with distilled water) and allowed to stand at 22℃ for 5 min; 750 ml of Na_2C0_3 (60 g/l) solution was added to the mixture. After 90 min, the absorbance was measured at 725nm. (LKB. Biochrom, Cainbridge England Model 4050). Results were expressed as Gallic acid equivalents (mg of Gallic acid/ mg dry weight extract).

Tannins Content:

Tannins content were determined colorimetrically as tannic acid by Folin - Denis reagent method after extracting with 70 % ethanol as described by Ranganna, (1977). Standard curve was prepared using standard tannic acid solution (1%). From 0-10 ml of aliquot of standard tannic acid solution were pipetted into 100ml volumetric flasks containing 75 ml of water and 5 ml Folin --- Denis reagent and 10 ml Na_2CO_3 solution were added into each flask and made up to the volume. The mixture were mixed well and its color was measured after 30 min at 760 nm using spectrophotometer (LKB. Biochrom, Cainbridge Engiland Model 4050).

Samples were prepared by transferring 5g of the sample to a 500 - ml volumetric flask, diluted to mark with H_2O shacked well and filtered. This aliquot was used and preceded as in standard. Tannic acid (as mg) was obtained from the standard curve.

Statistical analysis:

Analysis of variance of the sensory quality tests (appearance, flavor, texture, and overall acceptability) of carob products; Brownies, cake and beverages were evaluated by the aid of 5 trained panelists. Judges scored each property on a 10 point hedonic scale with higher values denoting better quality according to procedure of MacFice *et al.* (1989) as the follows:
8.5-10 (Like extremely), 7.5-8.5 (like very much), 6.5-7.5(Like), 5-6.5(Moderately Like), 0-5 (Dislike)

RESULTS AND DISCUSSION

Proximate Chemical composition:

Moisture, fat, protein, ash, crude fiber and nitrogen free extracted are shown in table (1) .The carob powder samples contained low level of fat (mean value 0.24± 0.04) % and an moderate amount of protein (6.83± 0.12)%. The crude fiber content (11.52± 1.51) % was not high compared to the carbohydrate content

(68.54± 0.31)% which was extremely high. These results were in agreement with the result reported by (Bouzouita *et al*.,2007; Dakia *et al*.,2007). Fat amount of pulp powder is low, being under 1 % of carob composition. Similar values were found by Sigge *et al*., (2011) and Khlifa *et al*., (2013) but Youssef *et al*., (2013) found a higher value of fat that approached 2 %. Ash amount comply with the literature limits of 2 to 3 % (Sigge *et al*., 2011, Khlifa *et al*., 2013,Youssef *et al.,* 2013). According to literature reports, the fiber amount of carob powder vary from 7 to 40 % (USDA, 2006, Khlifa *et al*., 2013), and from the data obtained, it can be seen that the roasted carob content of fibers is within the limits.

El-Shatnawi and Ereifej,(2001) compared the nutritional composition of pods and seeds, they showed that carob seeds contain higher amount of protein, fiber, fat than pod carob, whereas free seed contained higher amounts of carbohydrates.

Table (1). Proximate Chemical composition of carob pod and seeds products

Treatment / Parameters %	N C P	R C P	CS
Moisture	10.11± 0.13	9.04± 0.03	8.42± 0.45
Crude protein	6.83± 0.12	7. 80±0.12	10.40± 0.20
Crude fat	0.24± 0.04	0.74± 0.02	1.67 ± 0.05
Total fiber	11.52± 1.51	11.46±0.04	66.92± 0.04
Ash	2.76±0.22	2.48± 0.01	5.82± 0.03
carbohydrate*	68.54± 0.31	68.48± 0.01	6.76± 0.05

Mean values of triplicate ± SD * Calculated by different

N R P: Non-roasted carob Powder., **R C P:** Roasted carob powder., **CS:** Carob seeds.

The Sugar in carob pulp powder

Results in Table (2) show that the total sugar content of Carob pulp powder is 50%, of carob pulp powder whereas, the reducing sugar content of carob pulp is 15.6 % and non-reducing sugar content is 34.4% .These results were similar to Karababa and Coskunder, (2013) who reported that Carob pulp is high in total sugar content (48 – 56%) that include many sucrose, glucose, fructose and maltose. In addition it contains about 18% cellulose and hemi cellulose. The sugars are around 50 %, being the major constituent of roasted carob. Ayaz *et al*., (2007) found an amount of 88 % sugars, Youssef *et al*., (2013) of 76 % and Khlifa *et al*., (2013) a lower value of only 45 %. Kumazawa *et al*., (2002) and Biner *et al*., (2007) state that the sugars which can be found in carob pods are mostly glucose, fructose and sucrose.

Carob pod is a cheap source of sugars and natural sweetener with flavor and appearance similar to chocolate; therefore it is often used as cocoa substitute. The advantage of using carob as a chocolate resides in that carob is an ingredient free from caffeine and theobromine (Fillet *et al*., (1998). Carob germ flour is used as dietetic human food (Bengoechea *et al.,* 2008).

Table (2). Total sugar content in pulp powder

Sugar	%
Total Sugars	50
Reducing Sugars	15.6
Non - Reducing Sugars	34.4

Elements Content

Data of elements content in carob powder are shown in Table (3). It is evident that carob powder may be considered as a good source of macro elements (Ca, Na, K, P and S) and micro elements (Fe, Cu, Zn) and Se act as cofactors of antioxidant enzymes to protect the body from oxygen free radicals that are produced during oxidative stress (Barakat, 2009). Results revealed that the carob powder is considered a rich source of Ca, S, K, Na, Fe, and P. The data are in good agreement with (El-Shatnawi and Ereifej, 2001 and Brahim *et al.*, 2017). Carob pulp is also used in Crete as a natural sweetener, and is considered a natural source of calcium. It contains three times more calcium than milk. It is also rich in iron, phosphorus, and natural fibers (Due to its strong taste, it can be found mixed with orange or chocolate) Aydin and Ozdemir, (2017).

Table (3). Elements content in carob powder (mg / kg)*

Micro Elements	mg / 100g.
Mn	10.28
Zn	24.71
Fe	381.80
Cu	4.84
Se	9.79
Macro Elements	
Na	2123.00
K	505.97
S	8637.64
Ca	2255.21
P	17577.80

*Calculated on dry weight basis

Total phenols, tannins and lignan in carob pulp powder and seeds

The phenolic and tannins compounds content of the carob powder are presented in Table (4). Results showed that total phenolic in Carob pulp are 19.5 mg of Gallic acid/ mg dry weight extract). Lignan content of carob seeds was revealed (20.1%) Moreno-Franco *et al., (*2011) reported that total lignan content (sum of secoisolariciresinol, matairesinol, lariciresinol, pinoresinol, syringaresinol and medioresinol) were 16742.4 µg/100g on wet basis for carob bean and the major contribution was given by secoisolaric iresinol (12965.7mg/100 g on wet basis), Youssef *et al*. (2013).

Table (4).Total phenols, tannins and lignan in carob pulp powder and seeds

Parameter	pulp powder	Seed powder
*Total phenols	19.5 mg/g	40.5 mg/g
*Tannins	2. 75 mg/g	16.2 mg/g
**lignan	-	20.1 %

3.6. Amino Acid Composition

Amino acids content in carob pulp are show in Table (5). Total of fifteen amino acids were detected in carob pulp in the present study, including eight essential amino acids. The major amino acid found is aspartic acid (18.28g/100g**)** while cysteine was the lowest amino acid being (0.80 g/100g) this result was in agreement with the result reported by(Silva *et al*. ,2007) who reported that eighteen amino acids were detected in pods sample. Aspartic (aspartic acid +asparagine), alanine, glutamic acid (glutamic acid +glutamine),leucine and valine together comprised ca.57% of the total amino acid content of the pods. Aspartic acid at a concenteration of 18.25g/100g dry weight protein (represents the predominant amino acid. The level of four amino acids, alanine, glutamic acid, leucine and valine ranged between 9.1-10.6g/100g dry weight protein (Ayaz *et al*., 2007).

Table (5). Amino acid pattern of carob pulp powder (g amino acid /100g dry weight protein)

Essential amino acids		FAO provisional * pattern
Leucine	9.30	2.80
Isoleucine	3.80	6.60
Methionine	1.40	2.50
Threonine	5.10	3.40
Lysine	4.20	5.50
Phenylalanine	3.10	6.30
Valin	9.05	3. 50
Non-essential amino acid		
Alanine	10.55	
Aspartic	18.25	
Glutamic	9.65	
Glycine	3.55	
Histidine	2.80	
Cysteine	0.80	
Serine	0.86	

* FAO / WHO / UNU (1985)

Sensory evaluation

Scores of different levels of substituted carob pulp powder on sensory of brownies are shown in Table (6).

Table (6). Effect of different levels of substituted carob pulp powder on sensory attributes of brownies

sensory attributes / Parameters	Colour	Flavor	Texture	Over acceptable
Control	8.60± 0.49a	7.60± 0.45ab	7.60± 0.58a	7.60± 0.45ab
C25	7.80± 0.24a	6.80± 0.24b	7.00 ±0.21a	7.20± 0.13b
C50	7.80 ±0.38a	7.60 ±0.26ab	7.40± 0.16a	8.20± 0.24a
C75	8.20± 0.38a	7.80 ±0.24a	7.20 ±0.13a	8.00 ±0.21ab

Mean values in a column having different letters are significantly different at ($P<0.05$)
Cont. Brownies with no add carob powder
C25 25% add carob powder
C50 50% add carob powder
C75 75% add carob powder

Results of sensory evaluation showed that there were no significant differences between treatments and control .This result suggest the fact that substitution at 75% level can be used in brownies production without affecting sensory attributes. These results suggest that substitution with carob powder may lower the cost of the final product and may increase its nutritional value.

Table (7). Effect of different levels of substituted carob pulp powder on sensory attributes of cake

sensory attributes / Parameters	Colour	Flavor	Texture	Over acceptable
Control	7.40± 0.33b	7.60 ±0.16b	8.40 ±0.54b	7.40 ±0.16c
C25	7.40 ±0.16b	8.00± 0.21ab	8.80± 0.38a	8.20± 0.24ab
C50	8.00± 0.21b	8.20± 0.13ab	7.60± 0.16b	7.80± 0.13bc
C75	9.00 ±0.36a	8.60 ±0.45a	7.80± 0.13ab	8.60 ±0.16a

Mean values in a column having different letters are significantly different at ($P<0.05$)
Cont cake with no add carob powder
C25 25% add carob powder
C50 50% add carob powder
C75 75% add carob powder

The data in Table (7) show that the substitution with carob pulp powder improved the colour of the cake positively where mean score reached (9.00) compared to control in Table (7). The substitution with the different concentration showed no significant different in flavor compared to control which got the least scores (7.60) compared to the other treatments, which ranged between (8.20-8.61) .No significant difference was observed in texture of the cakes. As a matter of fact, C25 were scored higher value (8.8) than all treatments (7.8-8.4).The overall acceptance of cake was directed to the 75% substituted cake with carob pulp powder. Due to its sweetness and flavor similar to chocolate, the pods milled into flour are used in the Mediterranean region as cocoa substitute for sweets, biscuits, and processed drinks production Lecumberri *et al*. (2007). Youssef *et al*., (2013), studied the nutritional value of wheat biscuits and fortified wheat biscuitswith carob pod powder. The data revealed that both 10% and 20% of carob pod powder fortified biscuits (CPFB) improved all studied sensory and physical characteristics of all studied biscuits. Carob flour is vital for a wide variety of industrial procedures of foodstuffs as cakes, drinks, icecream, and candies, and it is made by kibbling, roasting, and grinding of carob pods. It is knownas a likely sweetener with appearance and flavour alike to cocoa; thus, it is broadly used as acocoa substitute (Aydin and Ozdemir, 2017). Additionally, textural properties of wheat bread with carob fiber were studied. The maximum acceptable of bread can be obtained through adding up to 2% of carob. (Siastała *et al.,* 2014, Rozylo *et al*., 2017).

Table (8). Effect of different levels of substituted carob pulp powder on sensory attributes of cacao beverage

sensory attributes / Parameters	Colour	Flavor	Consistency	Over acceptable
Control	9.20 ±0.53a	9.20± 0.24a	9.40± 0.26a	9.20± 0.24a
C25	8.40 ±0.33a	8.20 ±0.24b	7.40 ±0.33b	7.60± 0.16b
C50	6.60 ±0.33b	7.20 ±0.24c	7.40± 0.33b	6.80± 0.32c
C75	6.60 ±0.26b	6.40± 0.33d	7.20± 0.32b	6.60 ±0.26c

Mean values in a column having different letters are significantly different at ($P<0.05$)
Control drinking with no adds carob powder
C25 25% add carob powder
C50 50% add carob powder
C75 75% add carob powder

Results in Table (8) showed that the substitution of different concentrations of carob pulp powder to cacao beverage was significantly different than control ,where the control processed the highest scores in all sensory attributes .As a matter of fact, the flavor of different treatments was accepted moderately by panelists within a score ranging between (6.4-8.2). No significant difference was observed concerning the effect of substitution levels of treatments and Consistency of the beverage(7.2-7.4).It can be see that ,the incorporation of different concentration carob pulp powder to cacao beverage did not appeal much to panelists as compared to control but it was accepted moderately at 25% substitution level .

Table (9). Effect of different levels of substituted carob seeds powder on sensory attributes of coffee

sensory attributes / Parameters	Colour	Flavor	Texture	Over acceptable
Control	7.60 ±0.33a	8.60 ±0.16a	6.80 ±0.24b	8.20 ±0.24a
C25	8.40 ±0.33a	7.20± 0.38b	7.00 ±0.21ab	7.20± 0.24b
C50	8.00 ±0.29a	7.00± 0.21b	7.40± 0.16ab	7.40 ±0.33ab
C75	8.00± 0.36a	8.40 ±0.26a	7.60 ±0.26a	8.00 ±0.21ab

Mean values in a column having different letters are significantly different at (P<0.05)

Control coffee with no add carob seeds
C25 25% add carob seeds
C50 50% add carob seeds
C75 75% add carob seeds

Results in Table (9) show that panelists liked the flavor of the coffee up to 75% concentration which was not significantly different from control but different than the other treatments.

It may be concluded that panelists accepted the substitution of carob pulp powder up to the highest concentration. The score of the overall acceptance ranged between (7.20-8.20).

No significant difference was observed by panelists concerning colour .Whereas, of all substitution levels texture of C75 was significantly different (7.60) than control (6.80).It may be concluded that the coffee drink at its highest substitution level was highly accepted as compared to control, This may be of value and beneficial for people who suffer from hypertension as well as reducing the prices of such a high price commodity.

The current study agreement with (Salem and Fahad, 2012) were studied the substituting of cacao by carob pod powder in milk chocolate manufacturing. Moreover, Carob has a nutty, chocolate-like flavor (Medeiros and Lannes, 2009, 2010). In the Mediterranean region, softly grind carob pods are treated to cocoa-like flour which is sold as a “carob cocoa” in markets. The grind flour is frequently added to hot or cold milk for drinking. (Bulca, 2016)

CONCLUSION

The Results of the present study showed that carob pod contains high levels of carbohydrates, appreciable, contains to fiber and protein but low levels of fat. Carob pod contains an important amount of potassium, calcium and polyphenols. Therefore, it plays a significant role in human health, and can be used to substitute, processed food products.

REFERENCES

Anonymous, (2014a). FAOSTAT (Food and Agriculture Organization of The United Nations) (http://faostat.fao.org/).

Anonymous, (2014b). TÜİK (Turkey Statistical Institute) (http://tuikapp.tuik.gov.tr/).

AOAC, (2000). Official Methods of Analysis 16th ed. Association of Official Analytical Chemists International Arligton, Virginia, USA.

Ayaz, F. A., Torun, H., Ayaz, S., Correia, P. J., Alaiz, M., Sanz, C., Gruz, J.and Strnad, M. (2007). Determination of chemical composition of Anatolian carob pod (*Ceratonia siliqua L.*): sugars, amino and organic acids, minerals and phenolic compounds.Journal of Food Quality,30(6), 1040-1055.

Aydin, S. and Ozdemir Y. (2017). Development and characterization of carob flour based functional spread for increasing use as nutritious snack for children. Journal of Food Quality Journal of Food Quality. Volume (1)

Barakat, H. A. (2009). Efficiency of licorice and mustard extracts as anticancer, antimicrobial and antioxidant agents. Ph. D. Thesis. Faculty of Agriculture - Cairo university.

Bengoechea, C., Romero, A., Villanueva, A., M oreno, G., Alaiz, M., Millan, F., Guerrero, A.and Puppo, M.C. (2008). Composition and structure of carob (*Ceratonia Siliqua L.*) germ proteins. Food chem. 107 675 –683.

Biner, B., Gubbuk, H., Karhan, M., Aksu, M. and Pekmezci, M. (2007). Sugar profiles of thepods of cultivated and wild types of carob bean (*Ceratonia siliqua L.*) in Turkey. Food Chem., 100(4):1453–1455.

Bouzouita, N., Khaldi, A., Zgoulli, S., Cheli, L., Chekki, R., Chaabouni, M. M. and Thonart, P. (2007). The analysis of crude and purified locust bean gum: A comparison of samples from different carob tree populations in Tunisia. Food Chem., 101: 1508 – 1515.

Brahim, E., Rabah, S., Khalid, E., Mohammed, E., Zineb, N. (2017). Mineralcomposition of mature carob (*ceratonia siliqua* L.) pod: a study. International . Journal of Food Science and Nutrition Engineering, 7(4): 91 - 103.

Bulca, S. (2016). Some properties of carob pod and its use in different areas including foodtechnology. Scientific bulletin. Series f. biotechnologies, vol. (1), 142-147

Can, H., Artik N., Certel M., **(2007).** Components of nutritional interest in carobpods (*Ceratonia siliqua).* J. Sci. Food Agric. ,33:1319 – 1323

Dakia P. A., Wathelet B., and Paquot M. (2007). Isolation and chemical evaluation of carob *(Ceratonia Siliqua L.).*Food Chemistry, 102: 1368 – 1374

Egan, H., Kirk, R. S. and Sawyer, R.(1987). Pearson chemical analysis of food.Eight addition-long man scientific and technical Essex mzo.2TE, England.

El Batal, H., Hasib A., Ouatmane A., Boulli A., Dehbi F. and Jaouad A. (2013). Yield and composition of carob bean gum produced from different Moroccan populations of carob (Ceratonia siliqua L.). J. Mater. Environ. Sci.,4 (2) 309-314

El-Sayed,M.A., **Shaltout,O.E., EL-Diffrawy,E.A.,Osman.H.M and Abou –El-Naga,M..M (2014).**Production and evaluation of low fat Cake containing flaxseed and Okra gum as afat replacer . Alex. .Fd.Sci.and Techno,(11):1-8.

El-Shatnawi, M.K.J., and Ereifej, K.I., (2001). Chemical composition and livestock ingestion of carob (*Ceratoniasiliqua L.*) seeds. J. Range Manage, 54: 669-673.

FAO/ WHO/ UNU (1985). energy of protein requirment WHO Tech .Rep.ser.No. 724, ,G, wearld HealthOrganization,Geneva Switzeland.

Fearn, U. (2002). Carob. Agric. Food Chem. Jan 16, 50 (2). Pp 373 –7

Fillet, P.,Roulland, I. M . and Caroubin, A(1998). gluten-like protein isolate from carob bean germ. Cereal Chem.,75: 488 – 492.

Goulas, V., Stylos, E., Maria, V., Mavromoustakos, T. and Tzakos, A. G. (2016). Functional components of carob fruit: linking the chemical and biological space. Int. J. Mol. Sci., 17, 1875-1895.

Karababa, E. and Coskunder, Y. (2013). Physical properties of carob bean (*Ceratonia Siliqua L.*): An industrial germ yielding crop. Industrial crops and Products, 42: 440 – 446.

Khlifa, M., Bahloul, A. and Kitane, S,(2013). Determination of Chemical Composition of Carob Pod (*Ceratonia Siliqua L.*) and its Morphological Study.J. Mater. Environ. Sci., 4(3):348-353.

Kumazawa, S., Taniguchi, M., Suzuki, Y., Shimura, M., Kwon, M. S. and Nakayama, T. (2002). Antioxidant activity of polyphenols in carob pods.Journal of agricultural and food chemistry,50(2):373-377.

Lecumberri, E., Mateos, R., Izquierdo-Pulido, M., Rupérez, P., Goya, L., Bravo, L. (2007). Dietary fiber composition, antioxidant capacity and physicochemical properties of a fibre-rich product from cocoa (Theobroma cacao L.).Food Chemistry,104(3): 948-954.

MacFice, H.J., Bratchell,N.,Greenhoff,K. and Valis, L.V.(1989). . Designs to balance the effect of order of presentation and first order carry . over effects in hall tests Journal of sensory studies, 4:129-132,

Medeiros,M.L. and Lannes, S.C.(2009). Chemical evaluation of cocoa substitutes and study of formulated chocolate drink powder. Cienc .Tecnol, Aliment, 29(2):247–53

Medeiros,M.L. and Lannes, S.C.(2010). Physical properties of cocoa substitutes. Food Sci. Technol., (Campinas) 30(Suppl. 1):243–53.

Moore, S., Spechman,D.H. and Stein ,W.(1958). Chromatography of amino acid on sulphonate polystyrene resins, Anal . Chem , 30:11885-1187

Moreno,S., Scheyer, T., Romano, C., and Vojnov, A., (2011). Dietary alkylresorcinols band lignans in the 25 spanish dier: Development of the Aligania database. *J. Agric. Food Chem.*, 59: 9827-9834.

Morton, J., (1984). Carob, Fruits of Warm Climates, J. F. Morton (Ed.), Miami (1987). 3. P. Würsch, S. Del Vedovo, J. Rosset, M. Smiley, Lebensm. Wiss. Technol. 17 351–354.

Nasar-Abbas, S. M., Huma, Z., Thi-Huong V., Khan, M., K., Esbenshade, H.and Jayasena, V. (2016). Carob kibble: a bioactive-rich food ingredient. Comprehensive Reviews in Food Science and Food Safety Vol., 15, 63-72.

Owen, R. H., Haubner, R., Hull, W. E., Erben, G., Parvathy K. S., Susheelamma N. S., Tharanathan R. N.and Gaonkar A. K. (2005). Asimple non- aqueous method for carboxymethylation of galactomanans. Carbohydrate Polymer, 62: 137–141

Plummer, D.T. (1978). An introduction to practical biochemistry .Mergrow Hill Book Company (UK)Limited London**.**

Ranganna,S. (1977). Manual of Analysis of Fruit and vegetable product. Total raw Hill .publishing Company limited, New Dehlhi.P108.

Rozylo, R., Dziki, D., Gawlik-Dziki, U., Biernacka, B., and Ziemichod, A. (2017). Physical and antioxidant properties of gluten-free bread enriched with carob fiber. Int. Agrophys., 31, 411 -418.

Salem, E., M. and Fahad A., O. (2012). Substituting of cacao by carob pod powder in milk chocolate manufacturing. Australian Journal of Basic and Applied Sciences, 6(3): 572-578.

Santos, M., Rodrigues, A. and Teixeira, J.A. (2005). Production of dextran and fructose from carob pod extract and cheese whey by (*Leuconostoc mesenteroides*) NRRL B 512(f). Biochemical Engineering Journal, 25: 1 -6.

Siastała M., Dziki D., and Rozylo R. (2014). The influence of carob pod fiber on textural properties of wheat bread crumb (in Polish). Zeszyty Problemowe Postępów Nauk Rolniczych, 578, 111 -119.

Sigge, G. O., Iipumbu, L.,and Britz, T. J. (2011). Proximate composition of carob cultivars growing in South Africa.South African Journal of Plant and Soil, 28(1), 17-22.

Silva,B.M.,Casal,S.,Andrade,P.B.,Seapra,R.M.,oliveira,M.B.PP.andferreira,M.A .(2007). free amino acid composition of quincc (cydonia oblonga Miller) fruit (pulpand peel) and jam.J.Agric.Food Chem.,52:1201-1206.

Shan,Z. Dong Li, Li- Jun Wang, Necati Ozkanc, Xiao Dong Chena, Zhi-haui Mao and Hong-Zhi Yang.(2007). Optimization of ethanol-n Water extraction of lignans from flaxseed .separation and purification technology,57:17-24.

USDA (United States Department of Agriculture) (2016). Agricultural Research Service, National nutrient database, NDB no. 16055. 7 October 2016

Velioglu, Y .S., Mazza, G, L. and Oomah , B. D .(1998). Antioxidant activity and total phenolics in selected fruits, vegetables and grain products Journal of Agricultural and Food Chemistry, 46: 4113-4117.

Williams,M.M.(1995). Better Homes and Gardens Cakes. Hong Kong;Meredith Corporation, Des Noines,ZZIowa.P.126.

Yousif ,A.K.,and Alghzawi,H.M. (2000). Processing and characterization of carob powder. Food Chem., 69: 283–287.

Youssef, M. K. E., El-Manfaloty, M. M.and Ali, H. M (2013). Assessment of proximate chemical composition, nutritional status, fatty acid composition and phenolic compounds of carob (Ceratonia siliqua L.).Food and Public Health,3(6): 304-308.

الملخص العربى

المكونات الغذائية لبودرة الخروب وتطبيقاتها فى المنتجات الغذائية المصنعه

ماجدة محمود حجازي ، إنتصار عبد المحسن الدفراوى ، اميمة شلتوت ، محمد عبد الحميد زيتون
ايمن ابواليزيد
قسم علوم الاغدية - كلية زراعة سابا باشا- جامعة الاسكندرية

الخروب من الأغذية الغنية بالمركبات النشطة حيويًا التى تستخدم فى الوقاية من كثير الأمراض . والخروب غنى بالسكر والفينولات والألياف والمعادن الهامة من أجل الصحة أظهرت النتائج ان الخروب مصدر غنى بالمعادن حيث أنه يحتوى نسب عالية من الكالسيوم والفسفور والصوديوم والحديد كما تتواجد هذه العناصر بالتركيرات الآتية ٥٠٥.٩٧ ، ٨٠. ١٧٥٧٧ ، ٢١٢٣ ، ٣٨١.٨٠ ملليجرام / كجم على أساسي الوزن الجاف .أظهرت النتائج ايضا أن بذرة الخروب تحتوى على كمية كبيرة من البروتين والألياف والدهن والكالسيوم بينما الخروب منزوع البذور يحتوى على كمية كبيرة من الكربوهيدارات .كما أظهرت النتائج أن الخروب يحتوى على ١٥ حمض أمينى منهم ٨ حمض أمينة أساسية وأكثر الأحماض الأمينية تواجدًا هو الحمض الأمينى (اسبارتيك). وكذلك تحتوي بذور الخروب علي التانينات واللجنان. كما ان الخروب لا يحتوي علي مواد ضارة توثر علي صحة الانسان كالكافيين والثيبورومين وكذالك لا يوثرعلى امتصاص الكالسيوم كما فى حالة الكاكاو وعليه قامت الدراسة لتقييم استبدال الكاكاو ببودرة الخروب بعد إزالة البذور منه على الخواص التغذوية والحسية وكذلك استبدال القهوة ببودرة بذور الخروب بنسب مختلفة (٢٥% ، ٥٠% ، ٧٥%). وقد أظهرت نتائج التقييم الحسي أن المشروب والكيك والبرونيز المصنع من مسحوق الخروب المحمص علي درجة حرارة ١٥٠ درجة مئوية لمدة ٣٠أو ٤٠ دقيقة قد لاقي قبولا بدرجة عالية وخاصة البرونيز والتي أعطت أعلي الدرجات مقارنة بالعينات الأخرى والعينة الضابطة عند استخدام مسحوق الخروب المحمص كبديل لمسحوق الكاكاو وان قيم التحكيم الحسي المتحصل عليه لعينات القهوة التى تم معاملتها بالمعاملة C_{75}كانت أفضل النسب من حيث القبول العام