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

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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 (galactomannnos) 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., 2007 and 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)
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°C for 60 min.) The powder was 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°C 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° for 30 min. the extract clarified with lead acetate and finally dealeded 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:
  \[
  \text{Total sugar (\%)} = \frac{(\text{O.D.} \times \text{Dilution factor} \times 100)}{K \times 10^6}
  \]
  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:
  \[
  \text{Non –reducing sugar (\%)} = \text{Total sugar (\%)} – \text{reducing sugar (\%)} \text{ at dry weight basis}
  \]
Minerals Contents:

Elements concentration (K, P, Mg, Ca, Na, Fe, Cu, Zn, and Mn) were determined using an Atomic Absorption Spectrophotometer (Perkin Elmer 2380, 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, Jena 32-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 H₂SO₄ (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, 16 hr. 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).
Carob powder                  Grinding                   Defattening  
                    (1:6 w/v, 16hr)         air dried   
 Stored-20°C  
                18 hr  
                20g  
                Blend  
                a sand core funnel                     ( 1.2 L ethanol- water50 - 100% v/v )24 hr  
                Filter  
                (1M HCL to pH 6)  
                Concentrated  
                (40 °C -rotary evaporated at 90 rpm).  
                acidification  
                Cooling15 °C  
                Filteration  
                2000 rpm for 10 min  
                Centrifugation  
                Weighting  

Acquired ratio of lignans = \( \frac{\text{Weight of freeze–dried lignans}}{\text{Weight of defatted carob powder}} \times 100 \)

**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 °C 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 H2O 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 °C until analyzed by Amino Acid Analyzer LC3000 Eppendorf 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°C, 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°C for 5 min; 750 ml of Na₂CO₃ (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 Na₂CO₃ 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 England Model 4050).

Samples were prepared by transferring 5g of the sample to a 500 - ml volumetric flask, diluted to mark with H₂O 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

<table>
<thead>
<tr>
<th>Parameters</th>
<th>NC P</th>
<th>R CP</th>
<th>CS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>10.11± 0.13</td>
<td>9.04± 0.03</td>
<td>8.42± 0.45</td>
</tr>
<tr>
<td>Crude protein</td>
<td>6.83± 0.12</td>
<td>7.80±0.12</td>
<td>10.40± 0.20</td>
</tr>
<tr>
<td>Crude fat</td>
<td>0.24± 0.04</td>
<td>0.74± 0.02</td>
<td>1.67 ± 0.05</td>
</tr>
<tr>
<td>Total fiber</td>
<td>11.52± 1.51</td>
<td>11.46±0.04</td>
<td>66.92± 0.04</td>
</tr>
<tr>
<td>Ash</td>
<td>2.76±0.22</td>
<td>2.48± 0.01</td>
<td>5.82± 0.03</td>
</tr>
<tr>
<td>carbohydrate*</td>
<td>68.54± 0.31</td>
<td>68.48± 0.01</td>
<td>6.76± 0.05</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Sugar</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sugars</td>
<td>50</td>
</tr>
<tr>
<td>Reducing Sugars</td>
<td>15.6</td>
</tr>
<tr>
<td>Non - Reducing Sugars</td>
<td>34.4</td>
</tr>
</tbody>
</table>

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)*

<table>
<thead>
<tr>
<th>Micro Elements</th>
<th>mg / 100g.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mn</td>
<td>10.28</td>
</tr>
<tr>
<td>Zn</td>
<td>24.71</td>
</tr>
<tr>
<td>Fe</td>
<td>381.80</td>
</tr>
<tr>
<td>Cu</td>
<td>4.84</td>
</tr>
<tr>
<td>Se</td>
<td>9.79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Macro Elements</th>
<th>mg / 100g.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>2123.00</td>
</tr>
<tr>
<td>K</td>
<td>505.97</td>
</tr>
<tr>
<td>S</td>
<td>8637.64</td>
</tr>
<tr>
<td>Ca</td>
<td>2255.21</td>
</tr>
<tr>
<td>P</td>
<td>17577.80</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>pulp powder</th>
<th>Seed powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Total phenols</td>
<td>19.5 mg/g</td>
<td>40.5 mg/g</td>
</tr>
<tr>
<td>*Tannins</td>
<td>2.75 mg/g</td>
<td>16.2 mg/g</td>
</tr>
<tr>
<td>**lignan</td>
<td>-</td>
<td>20.1 %</td>
</tr>
</tbody>
</table>

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 concentration 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)

<table>
<thead>
<tr>
<th>Essential amino acids</th>
<th>FAO provisional * pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucine</td>
<td>9.30</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>3.80</td>
</tr>
<tr>
<td>Methionine</td>
<td>1.40</td>
</tr>
<tr>
<td>Threonine</td>
<td>5.10</td>
</tr>
<tr>
<td>Lysine</td>
<td>4.20</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>3.10</td>
</tr>
<tr>
<td>Valine</td>
<td>9.05</td>
</tr>
<tr>
<td>* FAO / WHO / UNU (1985)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-essential amino acid</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alanine</td>
<td>10.55</td>
</tr>
<tr>
<td>Aspartic</td>
<td>18.25</td>
</tr>
<tr>
<td>Glutamic</td>
<td>9.65</td>
</tr>
<tr>
<td>Glycine</td>
<td>3.55</td>
</tr>
<tr>
<td>Histidine</td>
<td>2.80</td>
</tr>
<tr>
<td>Cysteine</td>
<td>0.80</td>
</tr>
<tr>
<td>Serine</td>
<td>0.86</td>
</tr>
</tbody>
</table>

* 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

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Colour</th>
<th>Flavor</th>
<th>Texture</th>
<th>Over acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>8.60± 0.49a</td>
<td>7.60± 0.45ab</td>
<td>7.60± 0.58a</td>
<td>7.60± 0.45ab</td>
</tr>
<tr>
<td>C25</td>
<td>7.80± 0.24a</td>
<td>6.80± 0.24b</td>
<td>7.00± 0.21a</td>
<td>7.20± 0.13a</td>
</tr>
<tr>
<td>C50</td>
<td>7.80± 0.38a</td>
<td>7.60± 0.26ab</td>
<td>7.40± 0.16a</td>
<td>8.20± 0.24a</td>
</tr>
<tr>
<td>C75</td>
<td>8.20± 0.38a</td>
<td>7.80± 0.24a</td>
<td>7.20± 0.13a</td>
<td>8.00± 0.21ab</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Colour</th>
<th>Flavor</th>
<th>Texture</th>
<th>Over acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>7.40± 0.33b</td>
<td>7.60± 0.16b</td>
<td>8.40± 0.54b</td>
<td>7.40± 0.16c</td>
</tr>
<tr>
<td>C25</td>
<td>7.40± 0.16b</td>
<td>8.00± 0.21ab</td>
<td>8.80± 0.38a</td>
<td>8.20± 0.24ab</td>
</tr>
<tr>
<td>C50</td>
<td>8.00± 0.21b</td>
<td>8.20± 0.13ab</td>
<td>7.60± 0.16b</td>
<td>7.80± 0.13bc</td>
</tr>
<tr>
<td>C75</td>
<td>9.00± 0.36a</td>
<td>8.60± 0.45a</td>
<td>7.80± 0.13ab</td>
<td>8.60± 0.16a</td>
</tr>
</tbody>
</table>

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 biscuits with 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, ice cream, and candies, and it is made by kibbling, roasting, and grinding of carob pods. It is known as a likely sweetener with appearance and flavour alike to cocoa; thus, it is broadly used as a cocoa 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. (Siastala et al., 2014, Rozylo et al., 2017).

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

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

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

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Colour</th>
<th>Flavor</th>
<th>Texture</th>
<th>Overall acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>7.60 ±0.33a</td>
<td>8.60 ±0.16a</td>
<td>6.80 ±0.24b</td>
<td>8.20 ±0.24a</td>
</tr>
<tr>
<td>C25</td>
<td>8.40 ±0.33a</td>
<td>7.20± 0.38b</td>
<td>7.00 ±0.21ab</td>
<td>7.20± 0.24b</td>
</tr>
<tr>
<td>C50</td>
<td>8.00 ±0.29a</td>
<td>7.00± 0.21b</td>
<td>7.40± 0.16ab</td>
<td>7.40 ±0.33ab</td>
</tr>
<tr>
<td>C75</td>
<td>8.00± 0.36a</td>
<td>8.40 ±0.26a</td>
<td>7.60± 0.26a</td>
<td>8.00 ±0.21ab</td>
</tr>
</tbody>
</table>

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


Technol. 17 351–354.

Nasar-Abbas, S. M., Huma, Z., Thi-Huong V., Khan, M., K., Esbenshade, H.and

method for carboxymethylation of galactomnan. Carbohydrate Polymer,
62: 137–141.


Hill .publishing Company limited, New Dehlhi. P108.

Physical and antioxidant properties of gluten-free bread enriched with

powder in milk chocolate manufacturing. Australian Journal of Basic and
Applied Sciences, 6(3): 572-578.

fructose from carob pod extract and cheese whey by (Leuconostoc
mesenteroides) NRRL B 512(f). Biochemical Engineering Journal, 25:
1 -6.

textural properties of wheat bread crumb (in Polish). Zeszyty
Problemowe Postępów Nauk Rolniczych, 578, 111 -119.

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 quince (cydonia oblonga Miller) fruit

Shan,Z. Dong Li, Li- Jun Wang, Necati Ozkanc, Xiao Dong Chena, Zhi-huaui
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

total phenolics in selected fruits, vegetables and grain products Journal of
Agricultural and Food Chemistry, 46: 4113-4117.

Corporation, Des Noines, ZZIowa. P.126.


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الملخص العربي

المكونات الغذائية لبودرة الخروب وتطبيقاتها في المنتجات الغذائية المصنعة

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أيمن أبوالزيد

قسم علوم الغذاء - كلية زراعة سابا باشا- جامعة الإسكندرية

الخروب من الأغذية الغنية بالمركبات النشطة حيوية التي تستخدم في الوقاية من كثير الأمراض. الخروب غني بالسكر والفيتامينات والألياف والمعدن الهامة من أجل الصحة. أظهرت النتائج أن الخروب مصدر غنى بالمغذيات حيث أنه يحتوي نسب عالية من الكالسيوم والفسفر والصوديوم والحمض. كما توجد هذه العناصر بالتركيزات الأثبات 505.97. 

الخروب تحتوي على كمية كبيرة من البروتينات والألياف والدهن والكالسيوم بينما الخروب منزوع البذور يحتوي على كمية كبيرة من الكربوهيدرات. كما أظهرت النتائج أن الخروب يحتوي على 15 حمض أميني منهم 8 حمض أمينة أساسية وأكثر الأمحماض الأمينية تواجداً هو الحمض الأميني (استيراتك). وكذلك تحتوي بذور الخروب على المكونات الغذائية والتنيات واللجناء، كما أن الخروب لا يحتوي على مواد ضارة تؤثر على صحة الإنسان كالكافيين والثيوريدين وكذلك لا يثيرنا انتصاب الكالسيوم كما في حالة الكاكاو. وعلى الرغبة في تقييم استبدال الكاكاو ببودرة الخروب بعد إزالة البذور من الخروب، يمكن أن يحتوي على الخصائص الغذائية والصحية وكذلك استبدال القهوة بدءًا من خميس الخروب ببودرة الفروق بنسبة مختلفة (35% - 50%).

وقد أظهرت النتائج أن الشروط التي أظهرت التقييم الجسمي أن البذور الكاكاو والكيانو يحتوي على مسحوق الخروب المحمص على درجة حرارة 150 درجة مئوية لمدة 70 دقيقة قد لاقى قبولًا بدرجة عالية وخصائص البرونيز والتي أعطت أعلى الدرجات مقارنة بالعينات الأخرى والعينة الضابطة عند استخدام مسحوق الخروب المحمص كدليل لمسحوق الكاكاو. في الجملة لدعم التحليل الحسي المتحصل عليه لعينات القهوة التي تم معاملتها بالمعالجة C75 كانت أفضل النسب من حيث القبول العام.