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CHEMICAL AND FUNCTIONAL PROPERTIES OF GARDEN CRESS (*Lepidium sativum* L.) SEEDS POWDER

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ABSTRACT: Garden cress (*Lepidium sativum*) is a rapidly increasing yearly herb that grow in Egypt and West Asia countries, although now grown around the globe. The herp is often known as garden cress (GC). Their seeds have a wealth of protein, fiber, omega-3 acids, iron and other vital nutrients. The chemical composition, minerals contents, phenolic compounds, flavonoids, antioxidant activity and functional properties of GC seeds powder were investigated. The results revealed that GC seeds powder contained 7.05% moisture, 19.73% crude protein, 14.18% crude fat, 35.45% carbohydrate, 18.79% crude fibers and 4.8% ash. In addition, potassium (2955.50 mg/100g) was the most abundant element in GC seeds followed by phosphorus (947.32 mg/100g) and magnesium (322.00 mg/100g). The extract of GC seeds had a 157.24 mg/g of total phenols and 75.01 mg/g of total flavonoids. Gallic acid and hisperidin were the most abundant phenolic and flavonoid compounds in GC seed extract being 3001.75 and 4934.99 µg/100g, respectively. After 120 min of DPPH tests, the antioxidant activity of GC extract achieved 89.75%. The ability of GC seeds to water holding capacity (WHC) was 4.51 ml/g, 2.79 ml/g for oil holding capacity (OHC) with 44.54% of emulsifying activity (EA). It could be conducted that GC seeds are recommended in order to enhance nutritional quality and functional properties as food supplementation.

Key words: *Lepidium sativum*, chemical composition, phenolics, flavonoids, functional properties, garden cress.

INTRODUCTION

Garden cress (GC), scientific name: *Lepidium sativum* L., is an annual herb, belonging to family Brassicaceae **(Sharma and Agarwal, 2011)**. It is a fast-growing, edible plant botanically related to watercress and mustard and sharing their peppery, tangy flavour and aroma **(Balasubramanian, 2009). Bigoniya *et al.* (2011)** reported that, GC seeds are small, oval-shaped, pointed and triangular at one end, smooth, about 3-4 mm long, 1-2 mm wide, reddish brown in colour. Seeds, leaves and roots are economically important, however, the crop is mainly cultivated for seeds. In some regions garden cress is known as garden pepper cress, pepper grass or garden pepper cress, pepper grass or chandrasur in India and it is an important chandrasur in India and it is an important medicinal crop in India **(Doke and Guha, 2014)**. The main character of GC is that it can grow in any type of climate and soil condition with few requirements **(Balasubramanian, 2009)**. It is also known as important medicinal crop in India. GC is indigenous to Egypt and south west Asia and was referred to over many centuries ago in Western Europe **(Sharma and Agarwal, 2011; Doke and Guha, 2014)**. Garden cress is a annual plant, and an important green vegetable consumed by human beings, most typically as a garnish or as a leaf vegetable. **(Tiwari and Kulmi, 2004)**. A furrow present on both surfaces extending up to two thirds downward, a slight wing like extension present on both the edges of seed. On soaking in water seed coat swells and gets covered with

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transparent, colorless, mucilage with mucilaginous taste.

GC seed is a special seed used in special food preparations given to girls at menarche and after delivery in traditional Indian foods. It is rich in iron (100 mg/100g) and also contains several nutraceutical components. The seeds possess fair levels of protein (21-25%), fat (23-27%), carbohydrate (30-34%), dietary fiber (30%), phosphorus (723 mg/100 g), magnesium (430 mg/100 g), calcium (296-377mg/100 g), iron (76-100 mg/100 g), zinc (5 mg/100 g) and thus an important nutraceutical seed for nutrient enrichment **(Sood and Sharada, 2002; Gokavi *et al.*, 2004; Gopalan *et al*., 2011; Sharma and Agarwal, 2011; Zia-Ul-Haq *et al.*, 2012; Mohite *et al.*, 2012; Mohammed, 2012; Shail *et al*., 2016; Doke and Guha, 2017).** The most abundant amino acid in GC protein is glutamic acid (19.3%) and among the essential amino acid, leucine, is the highest (8.21%) and methionine, is the lowest (0.97%) (**Sharma and Agarwal, 2011)**.

Sarkar *et al.* (2014) reported that garden cress seed is categorized under nuts and oil seeds. GC oil is considered to be fairly stable oil, since its component natural antioxidants (tocopherol, phytosterol, and carotenoids) protect the oil from rancidity **(Diwakar *et al*., 2010)**. The primary fatty acids in GC seed oil were oleic (22-30.6%) and linolenic acids (29-34%) and was found to contain high concentrations of tocopherols. It contains good amount of lignans and antioxidants, which can stabilize the n-3 polyunsaturated fatty acids in its seed oil. The primary phytosterols in *Lepidium sativum* were sitosterol and campesterol, with avenasterol (**Diwakar *et al.*, 2008; Bryan *et al*., 2009; Sharma and Agarwal (2011)**). GC seed oil is a rich source of omega-3-fatty acids (30%) and natural antioxidant tocopherol (139 mg/100 g) and carotenoid (1.0 µg/100 g oil) **(Gokavi *et al.*, 2004; Diwakar *et al*., 2010)**. GC seed also contains sufficient amount of vitamins, mainly thiamine (0.59mg), riboflavin (0.61mg) and niacin (14.3 mg). These vitamins work as a co-factor and help in body metabolism (**Gopalan *et al*., 2011)**.

Alkaloids, flavonoids, cardiotonic glycosides, glucosinolates, sterols, tannins, and triterpenes are important phytochemical constituents, which impart pharmacological characteristics to GC seed **(Ghante *et al.*, 2011**). Total polyphenol and total flavonoid content of ethanolic extract of *Lepidium sativum* L. seeds were 4.46-8.651 mg gallic acid equivalent (GAE)/g and 3.57-4.023 mg quercetin equivalent (QE)/g, respectively **(Yadav *et al*., 2011; Indumathy and Aruna, 2013).** The antioxidant properties depend on the phenolic compounds present in garden cress seeds (**Ait-Yahia *et al* (2018)**.

Tocopherols are the major phenolic compounds in GC extracts. Tocopherols are biological radical scavengers that prevent oxidation of oil. In addition to having a major human nutritional function as a vitamin E source, tocopherols also prevent illnesses **(Brigelius *et al*., 2002; Jeong *et al.*, 2004; Dandge *et al*., 2012; Jain and Grover, 2017)**.

Sharma and Agarwal (2011) reported that garden cress seed's bran has a high water holding capacity due to high dietary fiber content (74.3%). GC seeds protein isolate contains 86.90% protein and has high water absorption capacity of 229 ml H_2O/100 g and oil absorption capacity of 3.5 ml oil/g, that makes it a potential ingredient in meat, bread and cakes industries and can be used as a nutrient substitution or supplementation and also act as a functional agent in food systems **(Ali, 2013)**. **Tuncay *et al.* (2011) and Gaafar *et al.* (2013)** reported that *L. sativum* seeds with high nutritional value can be exploited as a functional food ingredient. The seeds are consumed either raw or processed (soaked, boiled and roasted) forms. The different processing improves shelf life as well as acceptability of food. Processing techniques affect the nutritive value of oil seed **(Arinola and Adesina, 2014)**.

The objective of this research consisted of assessing the GC seeds as food supplements in relation to: its chemical composition, phenolic compounds, flavonoids, antioxidant activity and functionality.

MATERIALS AND METHODS

Materials

Garden cress seeds were purchased from local market, Zagazig city, Sharkia Governorate, Egypt. The seeds were cleaned and rendered free of dust, dirt, foreign materials and broken

seeds. All chemicals and reagents were of the analytical grade and purchased from Elgomhurya Company, Zagazig Branch, Egypt.

Methods

Preparation of garden cress seeds extract

Garden cress seed powder was prepared by grinding the seeds (Moulinex A59, France). Sieving process with 40 mesh sizes used to sieve the end product. The seed powder was extracted with ethanol (70%), at a ratio of 1:10 (*W/V),* in closed vessels by magnitic stirring (250 rpm) at room temperature (25±2°C) for 4 hr., followed by filtration through Whatman No 1 filter paper. The residues were re-extracted again under the same conditions. All vessels were wrapped with aluminum foil to prevent light degradation during extraction (**Yu *et al*., 2005)**.

Chemical composition of garden cress seeds

The major chemical constituents, moisture, crude protein, crude fat, crude fiber and ash in GC seeds were determined in triplicate according to **AOAC (2005**). Carbohydrate content was calculated by differences follows: 100 - (% ash + protein + fat + moisture). These assays were conducting in Central Laboratory, Faculty of Agriculture, Zagazig University, Egypt.

Determination of minerals contents

Minerals contents in GC seeds Potassium (K), Phosphorus (P), Magnesium (Mg), Sodium (Na), Calcium (Ca), Iron (Fe), Zinc (Zn), Manganese (Mn), Copper (Cu), Lead (Pb), Chromium (Cr), Cobalt (Co), Bromine (Br), Selenium (Se), Cadmium (Cd) and Nickel (Ni) were determined according to the method of **AOAC (2005)** using atomic absorption spectrophotometer (ICAP 6500 Duo, England Multi-element certified standard solution 100 mg/l Merk, Germany) at the Central Laboratory, Faculty of Agriculture, Zagazig University, Egypt.

Determination of total phenolic compounds (TPC)

The concentration of TPC in GC seed extract was measured using UV spectrophotometer (Jenway-UV-VIS Spectrophotometer), based on a colorimetric oxidation/reduction reaction, as described by **Škerget *et al.* (2005)** using Folin-Ciocalteu reagent. Specifically, 0.5 ml of diluted extract (10 mg in 10 ml solvent) was mixed with 2.5 ml of Folin–Ciocalteu reagent (diluted 10 times with distilled water) and 2 ml of Na_2CO_3 (75 g/l). The sample was incubated for 5 min at 50˚C then cooled. For a control sample, 0.5 ml of distilled water was used. The absorbance was measured at 760 nm. Total phenolic content expressed as gallic acid equivalent (GAE) was calculated, and the results were expressed as an mg GAE/g extract. Total phenolic content expressed as gallic acid equivalent (GAE) was calculated using the following linear equation based on the calibration curve:

$$Y= 0.015x + 0.0533; R^2 = 0.9966$$

Where:

Y is the absorbance and x is the concentration (mg GAE /g extract).

R^2 = correlation coefficient. This assay was conducting in Agricultural Res. center laboratory, Cairo, Egypt.

Determination of total flavonoid compounds (TFC)

The content of flavonoids in the examined GC seed extract was determined using spectrophotometric method (**Quettier *et al*., 2000**). The sample contained 1 ml of methanol solution of the extract in the concentration of 1 mg/ml and 1 ml of 2% $AlCl_3$ solution dissolved in methanol. The samples were incubated for an hour at room temperature. The absorbance was determined using spectrophotometer at λmax = 415 nm. The samples were prepared in triplicate for each analysis and the mean value of absorbance was obtained. The same procedure was repeated for the standard solution of rutin and a dilution series of rutin of concentrations 0.01, 0.02, 0.03, 0.04 and 0.05 mg/ml was prepared and the calibration line was construed. Based on the measured absorbance, the concentration of flavonoids was read (mg/ml) on the calibration line; then, the content of flavonoids in the extracts was expressed in terms of rutin equivalent (mg of RU/g of extract).

Fractionation of Phenolic and flavonoid compounds

The phenolic and flavonoid compounds of GC extract were determined in Central Laboratory

of Food Technol. Res. Inst., Agric. Res. Center, Giza, Egypt. An HP1100 HPLC system equipped with an alpha bond C 18 125A column (4.6.250 mm, particle size 5 µm) and coupled with agilent 1100 series Chem. Station software was used for quantifying the individual phenolic acids. The mobile phases consisted of 2.0% acetic acid in distilled water (A) and acetonitrile (B). The column was eluted at 1 ml/min under a linear gradient from 5% mobile phase B to 75% over 20 min, to 100% over 5 min. Sample injection volumes were 20 µl. Compounds were detected at 280 nm and 330 nm for phenolic and flavonoid compounds with an HP1100 series ultraviolet (UV) diode array detector. Standards obtained from Sigma Co. were dissolved in a mobile phase and injected into HPLC. Retention time and peak area were used to calculation of phenolic and flavonoid compounds concentration by the data analysis of HEWLLET packared software, according to **Goupy *et al.* (1999).**

Determination of antioxidant activity of GC extracts

Radical scavenging activity (RSA) of GC seed extracts was measured by bleaching of the purple coloured solution of DPPH according to the method of **Hanato *et al.* (1988).** One hundred µl of each extracts (10mg extract/10 ml solvent) was added to 3 ml of 0.1 mM DPPH dissolved in ethyl acetate and ethanol according to the solvent used for extraction. After 30, 60 and 120 min incubation period at room temperature, the absorbance was estimated against a control at 517 nm **(Gulcin *et al.*, 2004)**. Percentage of antioxidant activity of free radical DPPH was calculated as follows:

DPPH scavenging activity (%) = $[(A_0 - A_1)/A_0]\times 100$, where, A_0 is the absorbance of the control reaction and A_1 is the absorbance in the extract. Samples were analyzed in triplicate.

Determination of water-holding capacity (WHC)

WHC was measured after centrifugation of the water insoluble residues according to **Chau and Huang (2003)** with slight modifications. Samples (1g) were hydrated in excess 20 ml distilled water at room temperature for 1 hr., prior to centrifugation at 1200 × g for 30 min (Model D-3750, SIGMA, Germany). Excess supernatant was decanted. WHC was calculated as the amount of water retained by the sample (ml water/g dry weight).

Determination of oil-holding capacity (OHC)

OHC was measured according to **Garau *et al.* (2007)** with some modification. Powder samples (1g) were mixed with olive oil (20 ml), centrifuged at 1200×g for 30 min and the excess supernatant was decanted. OHC was expressed as ml oil/g dry weight.

Emulsifying capacity and stability

Emulsifying capacity and stability were determined using the method of **Neto *et al.* (2001)**. Five milliliters of garden cress seeds powder suspension (2% *W/V*) were homogenized with 5 ml corn oil. The emulsions were centrifuged at 1100 ×g for 5 min. The height of emulsified layer and that of total contents in the tube was measured.

The emulsifying capacity (EC) was calculated as:

$$EC(\%)=\frac{\text{Height of emulsified layer in the tube}}{\text{Height of the total content in tube}}\times 100$$

Emulsion stability was determined by heating the emulsion at 80°C for 30 min before centrifuging at 2200 rpm for 5 min.

$$ES(\%)=\frac{\text{Height of emulsified layer after heating}}{\text{Height of emulsified layer before heating}}\times 100$$

Determination of foaming capacity and stability

Foaming capacity and stability of the samples were studied at different pH values (4, 5, 6 and 7) according to the method of **Sathe and Salunkhe (1981)**. One gram of the sample was whipped with 100 ml of citrate phosphate buffer at pH 4, 5, 6 and 7 for 5 min using Universal Laboratory aid Mixer (Type 309, Poland) at speed setting 150 and was pound into a 250 ml cylinder. The total volume recorded at time intervals of 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0 hrs as foam stability. Volume increase (%) was calculated according to the following equation: volume increase (%) = (a – b) / b×100, where: a= volume after whipping, b = volume before whipping.

Standard deviation determination

Tests were conducted in triplicate and the means were recorded. The standard deviation of obtained results was calculated as described by a

statistical for social science package "SPSS" version 20 for Microsoft windows according to **Dominick and Derrick (2001)**.

RESULTS AND DISCUSSION

Chemical Composition

The chemical composition of GC seeds is presented in Table 1. GC seeds powder contained 7.05% moisture, 19.73% crude protein, 14.18% crude fat, 35.45% carbohydrate, 18.79% crude fiber and 4.8% ash. These results show that the macronutrients are considerably high and suitable for human nutrition. In addition, the above findings are almost in accordance with the outcomes reported by **Zia-Ul-Haq *et al*. (2012), Mohammed (2012)** and **Doke and Guha (2017). Mohammed (2012),** reported that the garden cress seeds contain 25% of protein, 14-24% of lipids, 33-54% of carbohydrates and 8% of crude fiber. **Zia-Ul-Haq *et al.* (2012)** observed the proximate chemical compositions the moisture 2.9%, crude protein 24.2%, crude fat 23.2%, carbohydrate 30.7%, crude fiber 11.9%, ash 7.1%.

Minerals Content

Minerals contents of GC seeds are shown in Table 2. The most abundant element in GC seeds was potassium **(**2955.50 mg/100g) followed by phosphorus (947.32 mg/100g) and magnesium (322.00 mg/100g). In addition, it contained remarkable levels of sodium and calcium. GC seeds are free from bromine, selenium, cadmium and nickel. **Shail *et al*. (2016) and Doke and Ghua (2017)** reported that GC seeds are a good source of minerals such as potassium, phosphorus and magnesium.

Total Phenolic and Total Flavonoid Compounds

The yield of garden cress seeds extract was 11.24 g/100g. These results are in harmony with those reported by **Abo El-Maati *et al.* (2016) and Malar *et al.* (2014)**. Variation in the yields of extracts is attributed to differences in polarity of compounds present in plants and assist methods, such differences have been reported **(Jayaprakasha *et al.,* 2001)**. To obtain acceptable yields with minimal changes of functional properties of the extract required, the extraction technique is one of the most important stage (**Zhu *et al.*, 2011**).

Phytochemicals from plants are being used for prevention from various diseases mainly caused by free radicals. The higher polyphenol content would then exhibit stronger inhibition and also higher antioxidant activity (**Prakasha *et al.,* 2001**). The results presented showed that ethanolic extract of GC seeds had 1572.4 µg/g total phenols. These results agree with that reported by **Zia-Ul-Haq *et al*. (2012) and Ait-Yahia *et al*. (2018**). The technique of phenolic isolation from a plant material, including the methods and type of extracting solvent, depends generally on the type of phenolic compound and the solvents **(Goli *et al*., 2005**). On the other hand, ethanolic GC seeds extract had 750.1 µg/g of total flavonoids. These results are in agreement with that reported by **Zia-Ul-Haq *et al*. (2012) and Ait-Yahia *et al*. (2018**).

Phenolic compounds are very important plant constituents because of their scavenging ability due to their hydroxyl groups **(Oktay *et al.,* 2003)**. HPLC results displayed in Table 3 indicate that 21 phenolic compounds have been quantified in GC seed extract. Gallic acid and Protocatechuic acid are phytochemicals that are considered a potential source of functional food ingredients for their high antioxidant capacity **(Sethiya *et al.,* 2014).** Gallic acid (3001.75 µg/ 100g) was the main phenolic compound followed by ellagic (1460.80 µg/100g) and protocatechuic (582.23 µg/100g). In addition, pyrogallol was found at the lowest level of 6.29 µg/100g as given in Table3. The obtained results are similar to those reported by **Zia-Ul-Haq *et al.* (2012) and Panwar and Guha (2014)**.

The current research has found that nineteen flavonoid compounds were quantitatively identified in GC seeds extract as shown in Table 4. The Hisperidin was the major component and it showed 4934.99 µg/100g. Quercetin, another phytochemical in the seed, is a flavonoid that has attracted great interest because it is a potent antioxidant with proven anticancer effects. Its structure contains a double bond in the C ring and a 4-oxo group, which enhance its antioxidant activity (**Moskaug *et al*., 2004**).

Table 1. Chemical composition of garden cress seeds powder

Moisture (%)	Crude protein (%)	Crude fat (%)	Carbohydrate (%)	Crude fiber (%)	Ash (%)
7.05±0.45	19.73±1.03	14.18±0.94	35.45±1.65	18.79±0.79	4.8±0.88

* The results are means of triplicate determination ± standard deviation.

Table 2. Mineral contents of garden cress seeds powder

Element	(mg/100g)	(%)
Potassium (K)	2955.50	63
Phosphorus (P)	947.32	20
Magnesium (Mg)	322.00	6.9
Sodium (Na)	229.35	4.9
Calcium (Ca)	203.23	4.3
Iron (Fe)	6.50	0.13
Zinc (Zn)	2.95	0.06
Manganese(Mn)	1.94	0.04
Copper (Cu)	0.77	0
Lead (pb)	0.61	0
Chromium (Cr)	0.36	0
Cobalt (Co)	0.01	0

Table 3. Phenolic compounds in garden cress seeds extract

Phenolic compound	(µg/100g)	(%)
Gallic	3001.75	34.3
Pyrogallol	6.29.00	0.07
4-Aminobenzoic	127.85	1.45
Protocatechuic	582.23	6.65
Catechein	107.61	1.22
Chlorogenic	552.75	6.30
Catechol	173.74	1.97
Caffiene	212.55	2.42
P.oH. benzoic	27.85	0.30
Caffeic	245.30	2.80
Vanillic	422.79	4.82
p-Coumaric	113.86	1.29
Ferulic	78.40	0.89
Iso- ferulic	540.34	6.17
Ellagic	1460.80	16.6
Benzoic	275.76	3.14
α- Coumaric	36.77	0.41
3,4,5.Methoxy Cinnamic	82.03	0.93
Coumarin	517.52	5.91
Salicylic	72.20	0.82
Cinnamic	111.9567	1.28
Total	1572.40	8750.34

Table 4. Flavonoid compounds in garden cress seeds extract

Flavonoid	(µg/100g)	(%)
Apig.6-arbinose 8-glactose	629.98	4.68
Apig.6-rhamnose 8-glucose	684.40	5.09
Narengin	963.79	7.17
Rutin	1216.72	9.05
Hisperdin	4934.99	36.7
Quercitrin-3-o-glucose	269.71	2.00
Rosmarinic	516.27	3.84
Apig.7-o-neohespiroside	282.19	2.09
Quercitrin	1520.33	11.3
APigenin-7-glucose	288.43	2.14
Kaemp.3-(2-pcomaroyl)glucose	1286.89	9.57
Quercitrin	97.39	0.72
Acacetin 7neo hesperside	66.15	0.49
Narengin	142.98	1.05
Hispertin	142.74	1.05
Acacetin neo.rutinoside	184.95	1.37
Rhamentin	129.77	0.96
Apegnin	14.62	0.10
Kampferol	58.05	0.43
Total	750.10	13429.3

The scavenging activity of GC seeds extracts against DPPH at 0, 30, 60, 90 and 120 min of incubation is represented in Table 5. The antioxidant activity of GC seed extract at the beginning of the incubation was 79.18% and this value reached 89.75% after 120 min. The results are found to be in agreement with those reported by **Abo El-Maati *et al*. (2016)**. In general, the extracts that contained the high amount of total phenolic compounds showed relatively high antioxidant activity and it has been proven that the antioxidant activity of extracts is mainly ascribable to the concentration of phenolic compounds in the plant **(Heim *et al.*, 2002)**.

Functional Properties

The WHC is commonly related to the amount of water in the fiber equilibrated in an environment of known water potential and absorbed by a capillary suction mechanism (**Namir *et al.*, 2015**). Table 6 shows the WHC, OHC, emulsifying capacity and stability. Results showed that GC seed extract absorbed 4.51 ml/g water and 2.79 ml/g oil. Furthermore, emulsifying activity and stability of GC seeds were 44.54 and 40.65, respectively. **Ali (2013)** reported that GC seeds protein isolate contains 86.90% protein and has water absorption capacity of 229 ml H_2O/100 g and oil absorption capacity of 3.5 ml oil/g, that makes it a potential ingredient in meat, bread and cakes industries and can be used as a nutrient substitution or supplementation and also act as a functional agent in food systems.

Foaming capacity and stability of GC seeds were illustrated in Figs. 1 and 2, respectively. The activity of foaming increased 25% by increasing pH value to pH 7. On the other hand, foaming stability was decreased during time intervals reached 2.5, 5 and 10% after 2 hr., at pH 4, 5 or 6 and 7, respectively.

Conclusion

It could be concluded that GC seeds have significant content of microelements, phenolic and flavonoids, along with excellent functional characteristics, which can be used as a food supplement and functional agent.

Table 5. DPPH radical scavenging (%) of garden cress seeds extract during incubation time (min)

	Incubation time (min)				
	Zero	**30**	**60**	**90**	**120**
DPPH inhibition (%)	79.18±1.05	87.32±0.97	88.37±1.43	88.59±1.74	89.75±0.99

* The results are means of triplicate determination ± standard deviation.

Table 6. Water, oil holding capacity, emulsifying activity and stability of GC seeds powder

Functional property	Value
Water holding capacity (ml/g)	4.51±0.83
Oil holding capacity (ml/g)	2.79±0.32
Emulsifying activity (%)	44.54±1.35
Emulsifying stability (%)	40.65±1.02

* The results are means of triplicate determination ± standard deviation.

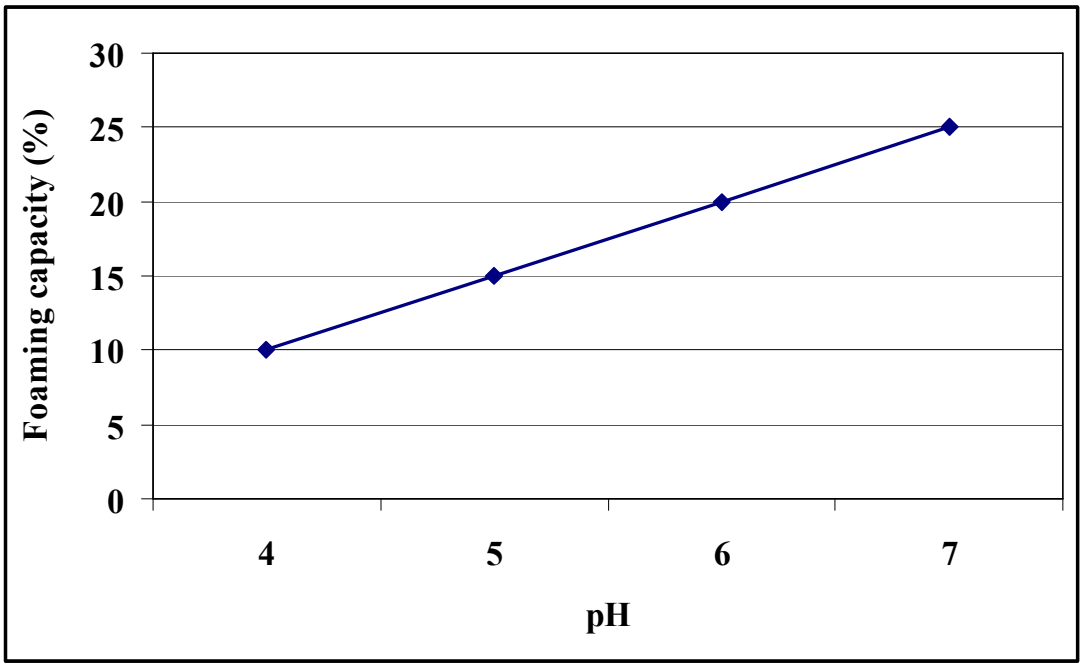

Fig. 1. Foaming capacity (%) of GC seeds powder as a function of pH

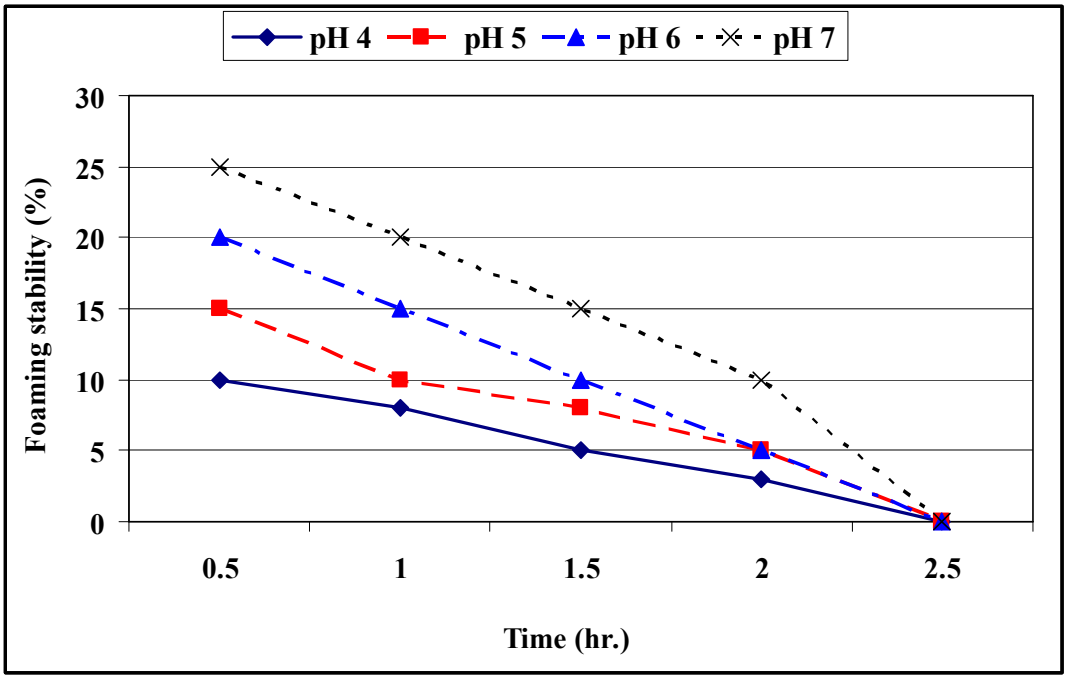

Fig. 2. Foaming stability (%) of GC seeds powder as a function of pH

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الخواص الكيميائية والوظيفية لبـــذور حب الرشـــاد (*Lepidium sativum* L., GC)

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نبات حب الرشاد هو عشب حولي سريع النمو، بالرغم من أن نبات حب الرشاد ينمو في جميع أنحاء العالم إلا أنه ينمو بصورة كبيرة في مصر ودول غرب آسيا، هذه البذور غنية بالبروتين والألياف وأحماض أوميجا ٣ والحديد بالإضافة إلى المكونات الغذائية الضرورية، تم تقدير كل من التركيب الكيميائي والمحتوي من الأملاح المعدنية والمركبات الفينولية والفلافونويدية والنشاط المضاد للأكسدة والخواص الوظيفية لبذور حب الرشاد (*Lepidium sativum* L.)، وأكدت النتائج أن مسحوق بذور حب الرشاد يحتوي علي ٧,٠٥% رطوبة و ١٩,٧٣% بروتين خام و١٤,١٨% دهن خام و٣٥,٤٥% كربوهيدرات و١٨,٧٩% ألياف خام و٤,٨% أملاح معدنية، وبالإضافة إلى ذلك وجد أن أكثر العناصر المعدنية وفرة هو البوتاسيوم (٢٩٥٥,٥٠مجم/١٠٠ جم) متبوعا بالفوسفور (٩٤٧,٣٢مجم/١٠٠جم) ثم الماغنسيوم (٣٢٢,٠٠ مجم/١٠٠ جم) وأيضًا يحتوي المستخلص الإيثانولي لبذور حب الرشاد علي (١٥٧,٢٤مجم/جم) فينولات كلية و٧٥,٠١مجم/جم فلافونويد وأن حامض Gallic و Hisperidin هما من أكثر المركبات الفينولية والفلافونويدية تواجدا في مستخلص بذور حب الرشاد مسجلة٣٠٠١,٧٥ و٤٩٣٤,٩٩ ميكروجم/١٠٠جم علي التوالي، وفي بداية فترة التحضين أثناء إجراء اختبار DPPH كان النشاط المضاد للأكسدة هو ٧٩,١٨% وقد وصلت هذه النسبة إلى ٨٩,٧٥% بعد ١٢٠ دقيقة، كما أظهرت بذور حب الرشاد قدرة عالية علي مسك الماء والزيت ونشاط الإستحلاب والرغوة وثباتهما وأخيرا يوصى هذا البحث باستخدام بذور حب الرشاد في تدعيم الأغذية لتحسين قيمتها الغذائية وخواصها الوظيفية.

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