

QUALITY AND SAFETY ATTRIBUTES OF ACCLIMATED SPECIES *FAGOPYRUM ESCULENTUM* MOENCH

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Abstract

The aim of this study was the characterization of the buckwheat seeds (*Fagopyrum esculentum* Moench.) powder derived from a Ukrainian species acclimated in Southern Romania, in terms of physicochemical and microbiological characterization and also the nutritional attributes, in order to develop finished products as dietary supplements with this naturally active ingredient. The results obtained from the physicochemical and microbiological analysis of the samples of *Fagopyrum esculentum* Moench. demonstrated that they are within the limits of admissibility stipulated by the 9th European Pharmacopoeia and the literature. To highlight the attributes of the nutritional profile and quality in the view of ensuring a high level of consumer health protection, the energy value of Buckwheat seeds powder - *Fagopyrum esculentum* Moench. was determined in accordance with EU Regulation 1169/2011.

Rezumat

Obiectivul acestui studiu a fost caracterizarea pulberii din semințe de hrișcă (*Fagopyrum esculentum* Moench.) obținută din materialul al plantei acclimatizate în sudul României, rezultată din semințe provenind din Ucraina. Studiul a inclus determinări fizico-chimice și microbiologice precum și atributele nutriționale cu intenția de a dezvolta suplimente alimentare conținând acest produs vegetal. Rezultatele obținute în urma analizelor fizico-chimice și microbiologice a pulberii din semințe de *Fagopyrum esculentum* Moench. au demonstrat faptul că acestea se încadrează în limitele de admisibilitate prevăzute de Farmacopeea Europeană ediția a 9-a și literatura de specialitate. Pentru a evidenția atributele valorii și calității nutriționale în vederea asigurării unui nivel ridicat de protecție a sănătății consumatorilor, valoarea energetică a pulberii din semințe de hrișcă - *Fagopyrum esculentum* Moench. a fost stabilită în conformitate cu reglementarea UE 1169/2011.

Keywords: *Fagopyrum esculentum*, buckwheat, physicochemical characterisation, microbial contamination, dietary supplements

Introduction

Buckwheat (*Fagopyrum esculentum* Moench., *Polygonaceae*) is grown throughout a large area of Asia and Southeast Asia as a crop and is very popular in Slovenia, Poland, Ukraine, the Republic of Moldova and Russia [17]. Common buckwheat (*Fagopyrum esculentum* Moench.) is a crop of secondary importance in many countries. The plant is not a cereal, but the seeds are usually classified among the cereal grains because of their similar usage. The proteins of buckwheat are rich in the essential amino acid lysine, unlike common cereals. Common buckwheat contains high nutritive substances (63% carbohydrate, 11.7% protein, 2.4% fat, 9.9% fibre, 11% water and 2% minerals), being a gluten free, nectariferous and pharmaceutical plant, with a high content of flavonoids, namely rutin and quercetin [7, 15, 17]. Health benefits attributed to buckwheat include plasma cholesterol level reduction, neuroprotection, anticancer, antiinflammatory, hypoglycaemic effects, and improvement of hyper-tensive conditions. In

addition, buckwheat has been reported to possess prebiotic and antioxidant activities. *In vitro* and animal studies suggest that buckwheat's bioactive compounds, such as D-chiro-inositol, the proteins and flavonoids may be partially responsible for the observed effects [4, 5, 12, 18].

Rutin [16], quercetin and other polyphenols are well known as strong anticancer agents against colon cancer [8] and the phenolic compounds are cited as lowering blood glucose and lipids. Buckwheat has a very low content of prolamines and, based on chemical and immunological studies, can be a valuable source of dietary proteins for gluten-sensitive individuals [6].

Materials and Methods

Physicochemical characterization of the buckwheat seed powder. Three samples of buckwheat seed powder S1, S2, S3, samples from indigenous culture in Southern Romania, harvested during the same period, from different plot lots were used. The

physicochemical tests were performed according to the European Pharmacopoeia 9th Ed. and the Romanian Pharmacopoeia 10th Ed. [10, 19]. The parameters evaluated were: macroscopic characters; loss on drying, %; total ashes% [2]; content in total polyphenols expressed as chlorogenic acid% [8, 20]; content in total flavonoids expressed as rutin% [3]; content in total protein% [5]; content in fatty oil% [14] and mineral content [ppm]/100g of product [17, 18].

Reagents. The following reagents were used: sodium phosphowolframate solution, caffeic acid, ethanol, methanol, rutin (reference standard) 0.01% solution in methanol, selenium, glucose, hydrochloric acid and nitric acid. All reagents were purchased from Sigma Aldrich and were of analytical purity.

Equipment. a Jasco V-650 UV-Vis spectrophotometer was used to determine the total polyphenol content expressed as chlorogenic acid and the total flavonoid expressed as rutin; distillation and mineralization installation for total protein content; Soxhlet extraction apparatus for fatty oil content; a Shimadzu AA-6300 atomic absorption spectrophotometer equipped with cathode ray lamps as a source of radiation, deuterium lamp used as a background corrector, acetylene-air flame/nitrous-acetylene nitrous flame for determining the content of minerals, trace elements and heavy metals.

The microbiological characterization of the three samples of the buckwheat seeds powder product from the point of view of microbial contamination was carried out in accordance with the regulations of the European Pharmacopoeia 9th Ed. [1, 10, 20]. Reagents used, culture mediums and solutions for determining the total number of aerobic microorganisms (TAMCs) were: casein soya bean digest agar, buffered sodium chloride broth pH = 7.0; for the

determination of the total number of yeasts and filamentous fungi (TYMC): Sabouraud agar with dextrose, buffered sodium chloride broth pH = 7.0; for the isolation and identification of gram-negative bacteria-tolerant bile salts: *Enterobacteria* enrichment broth (Mossel), violet red bile glucose agar, casein soya bean digest broth. For the control of specific microorganisms, namely *Escherichia coli* and *Salmonella sp.* there were used: MacConkey broth, MacConkey agar, casein soya bean digest broth, triple sugar iron agar (TSI), Rappaport Vassiliadis *Salmonella* enrichment broth, xylose, lysine, deoxycholate agar.

Equipment. Venticell 111 owen, Incucell Incubator 404, Friocell Incubator 404, microbiological box-laminar air flow Telstar AV 100 and BSC-EN I-IV.

The energy value of the unique common sample was determined according to Food Energy- methods of analysis and conversion factors/ FAO Food and Nutrition [2, 11, 13], and the EU Regulation 1169/2011 [9]. The energy value was calculated for each of the categories of proteins, carbohydrates, lipids, by multiplying the quantity obtained with the conversion factor expressed in KJ and Kcal. The buckwheat seeds powder sample has been tested by the National Institute for Research and Development for Food Bioresources - IBA Bucharest, Romania.

Results and Discussion

The results of the physicochemical analysis of the buckwheat seed powder (*Fagopyrum esculentum* Moench.) demonstrate a conjugate behaviour of the three analysed samples, and the results are within the limits of admissibility imposed by the Eur. Ph. 9th Ed. (Table I).

Table I

The results of the physico-chemical analysis of the product of buckwheat seed powder (*Fagopyrum esculentum* Moench.)

Crt. No.	Characteristics	Limits of admissibility	Results for sample S1	Results for sample S2	Results for sample S3
1	Macroscopic characters	The product is an achene with three edges, with a gray or blackish coating	met	met	met
2	Drying loss, %, max.	15.0	8.68	8.71	8.66
3	Total ash, %, max.	5.00	3.23	3.22	3.25
4	Content in total polyphenols expressed as chlorogenic acid, %, min.	0.40	0.50	0.52	0.50
5	Content in total flavonoids expressed in rutin, %, min.	0.10	0.12	0.13	0.12
6	Content in total protein, %, min.	8.00	8.63	8.66	8.64
7	Content in fatty oil, %, min.	1.00	1.36	1.40	1.38

In addition, there is a very good content in mineral salts of calcium, magnesium, sodium and potassium and of

trace elements: manganese, iron, zinc. Also, the samples did not show heavy metals, lead and cadmium (Table II).

Table IIThe mineral content of buckwheat seed powder (*Fagopyrum esculentum* Moench.)

Sample: powder from buckwheat seeds (<i>Fagopyrum esculentum</i> Moench.)	Mineral content [ppm]/100g										
	Ca	Mg	Na	K	Mn	Fe	Zn	Cu	Cr	Pb	Cd
S1	125	365	1800	3300	12	16	16	ND	ND	ND	ND
S2	128	360	1810	3310	10	15	14	ND	ND	ND	ND
S3	127	362	1815	3308	13	16	14	ND	ND	ND	ND

ND - not detectable

The results obtained on the powder samples of buckwheat seed from the point of view of the microbial

contamination are presented in Table III.

Table III

The results obtained on the powder samples from buckwheat seeds from the point of view of microbial contamination

Characteristics	Limits of admissibility	Results for sample S1	Results for sample S2	Results for sample S3
Microbial contamination: Total aerobic microorganisms (TAMC), CFU/g, max.	1×10^5	2.6×10^2	2.0×10^2	2.3×10^2
Total combined yeast and filamentous fungi (TYMC), CFU/g, max.	1×10^4	1.3×10	1.0×10	1.1×10
Gram-negative bacteria-tolerant bile salts, CFU/g, max.	1×10^4	< 10	< 10	< 10
- <i>Escherichia coli</i> /g	absent	absent	absent	absent
- <i>Salmonella sp.</i> /25 g	absent	absent	absent	absent

The results obtained in the analysis of the microbial contamination of the seed powder of *Fagopyrum esculentum* Moench. taken into consideration demonstrated that they are of high quality, subject to the admissibility limits stipulated by the European Pharmacopoeia 9th Ed. It is noteworthy that the unprocessed natural product had microbial contamination values related to the total number of aerobic microorganisms (TAMC), the combined

total number of yeasts and filamentous fungi (TYMC) and gram-negative bacteria tolerant to bile salts lower with a logarithmic rate of 10^3 against the admissibility limits imposed, as well as the absence of gram negative pathogenic microorganisms *Escherichia coli* and *Salmonella spp.*

Determination of the energy value. The nutritional profile of the analysed powder is presented in Table IV and compared with data from literature.

Table IV

Determination of energy value of buckwheat seed powder

Features	U.M - Units of Measurement	Methods of Analysis	Results acclimated species	Data from literature
Energy value	Kcal/100g	UE Regulations 1169/2011	364	343
Energy value	KJ/100g	UE Regulations 1169/2011	1543	1435
Protein	%	The Kejdhal method	11.92	11.7
Lipids	%	Soxhlet extraction	3.51	2.4
Glucides of which:	%	Reg. UE 1169/2011	71.19	63
sugars	%	Modified Mohr method	< 0.08	1.1
Moisture	%	FR 10 th Ed.	11.7	11
Ash	%	FR 10 th Ed.	1.68	1.61

Conclusions

Our research results demonstrated that acclimated *Fagopyrum esculentum* Moench. conforms with the international standards in terms of: microbial contamination, total protein content, energy value, lipids and carbohydrates. The results were comparable to those in the literature regarding the parameters: humidity, ash, content in total polyphenols, expressed

as chlorogenic acid, content in total flavonoids, expressed as rutin.

Buckwheat seed powder obtained from the acclimated plant can be used as a quality and safe active ingredient for the development of dietary supplements.

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