ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Chemical And Mineral Composition Of Wheat Germ Of East Kazakhstan Region.

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ABSTRACT

This paper presents the results of determination chemical and mineral composition of wheat germ collected from East Kazakhstan region. The protein content of wheat germ is 23.15g/100g. Another part of wheat germ composition is the carbohydrates (38.6 g/100g), food fibre (13.2 g/100g), fat (9.72%) and ash (4.21 g/100g). Major mineral elements represented in high concentration by potassium (892.0 mg/100g), phosphorus (842.0 mg/100g) and magnesium (239.0 mg/100g). Calcium and sodium concentration were 39.0 mg/100g and 12.0 mg/100g, respectively. Among the trace elements analyzed, manganeseand zinc concentrations were 13.3 mg/100g and 12.29 mg/100g.

Keywords: wheat, germ, mineral elements, protein, fat, ICP

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ISSN: 0975-8585

INTRODUCTION

At present time people pay more attention to healthy nutrition. For providing the human body with vitamins, microelement and other vital nutrients many food experts suggest to include the wheat germ to the daily diet [1]. Wheat grain and its products hold a most unique position among the grains of other plant crops. Wheat protein is one of the vital components in human nutrition, holding third part of all protein intakes in human. Wheat grain consists of bran, endosperm and germ[2].

Wheat germ is rich in nutrients. It contains almost all amino acids (18 from 20 amino acids), along with this 50% of total mass of germ is protein components and 25% of nutrients are presented mainly with sucrose, the majority of fat (about 15%) in wheat germ is polyunsaturated fat. Wheat germ is also source of vitamins, minerals and fiber. Among the high protein content, it contains about 8–14% oil. Wheat germ oil contains more than 70% of polyunsaturated fatty acids with ω_6 to ω_3 ratio of around 3:1, which is optimal to lipid metabolism in human body [3]. Wheat germ oil also contains myristic, oleic, erucidic and about 10 nucleic acids. Also, it is a rich source of water-soluble vitamins (B_1, B_2, B_6, D, PP, panthothenic and folic acids) and fat-soluble vitamins (vitamin E and A). Wheat germ is considered the richest plant source of vitamin E (300–740 mg/kg dry matter) [4].

Regular intake of wheat germ oil has a revitalizing and tonic effect, increases the physical efficiency and the body's resistance to various infectious diseases. The wheat germ oil normalizes the function of endocrine glands, metabolism, improves digestion [5].

The goal of this paper is to study the chemical and mineral composition of wheat germ sampled from East-Kazakhstan region.

MATERIALS AND METHODS

Sampling

Totally 100 kg of wheat grain is kindly provided by East Kazakhstan Flour Mill Company (Semey city, Republic of Kazakhstan). The production of wheat germ is performed at experimental processing equipments of Shakarim State University of Semey.

Process flow chart of wheat germ production

Drying

Drying process conditions:

- Air temperature +20°C, air humidity 50%, drying temperature +85 °C (for decreasing the moisture content from 19% to 14%) without cooling, pressure 0.1 MPa.
- Air temperature +10°C, air humidity 50%, drying temperature +90 °C (for decreasing the moisture content from 36% to 14%) without cooling, pressure 0.1 MPa.
-

First pressing (cold pressing)

Wheat germ oil output – around 30% of total mass. The pressure in the pressing cage of press equipment is 10-30 MPa. Screw shaft speed varied from 12 to 25 rounds per minute.

Second pressing

Steam moisturization of oil seed until the moisture content reaches 10-12% of total mass, preliminary pressing (10 MPa).

Remained oil mass is dried at 115-120 °C up to the humidity 5%. Then it is pressed at 30 MPa. Oil germ cake contains 5-7%of fat.

Oil filtration

Wheat germ oil is filtered on filtering press at 20 °C.

Determination of the mineral elements

One to two grams of the sample was placed in a high-pressure Teflon container. Each sample was combusted at 400°C for 4 h and then to 600°C for 2 h using a muffle furnace. A representative 1 g (dry weight) of ashes was digested by adding 3 cm^3 HNO_3 and 2 cm^3 of HF. This was placed in a microwave at 200 ˚C for 20 min (Bergh of Speed Wave microwave system, Germany). After microwave digestion, the samples were diluted with 1% HNO_3 in a 10 cm^3 vessel.

The content of elements in muscle samples was determined with an inductively coupled plasma–mass spectrometric method (ICP-MS, Varian-820 MS, Varian Company, Australia). Calibration standards Var-TS-MS, IV-ICPMS-71A (Inorganic Ventures Company, USA) were used for calibrating the mass-spectrometer. The sensitivity of the mass-spectrometer was tuned up using a diluted calibration solution Var-TS-MS with concentration of Ba, Be, Ce, Co, B, Pb, Mg, Tl, Th of 10 µg/L. Three calibration solutions were used for the detector calibration. They were IV-ICPMS-71A of Cd, Pb, Cu, Zn elements diluted to 10, 50 and 100 µg/L. Discrepancies between the certified values and concentrations quantified were below 10 %. The operating parameters of the inductively coupled plasma mass spectrometer Varian ICP 820 –MS were as follows: plasma flow 17.5 L/min; auxiliary flow 1.7 L/min; sheath gas 0.2 L/min; nebulizer flow 1.0 L/min; sampling depth 6.5 mm; RF power 1.4 kW; pump rate 5.0 rpm; stabilization delay 10.0 s.[6].

All analyses were performed in triplicates, and the results, given in mg/kg wet weight, are expressed as mean ± (SE).

RESULTS AND DISCUSSION

The protein is an essential and most deficient component of food. Its role is to provide the human body with essential and non-essential amino acids. The protein content of wheat germ collected from East Kazakhstan region is 23.15g/100g.Wheat germ is a source of structural and enzyme proteins, which are close to the properties of animal protein. The protein consists of albumen, globulin and nucleoprotein. Along with protein, germ contains from 10.0% to 15.3% of non-protein nitrogen compounds. These compounds are represented by asparagine, allantoin, betaine, choline, lecithine and glutathione [7].

By its nutritive, biological and chemical composition the protein of wheat germ is comparable to the animal protein, for example, the protein of dry milk, egg, casein, dried beef. Up to 70% of protein in germ is a mixture of water- and salt soluble protein. Another part of wheat germ composition is the carbohydrates (around 40% of total mass), which includes sugars (16.5%), raffinose (4%), and small quantity of mannose and maltose [8].

The seed and bran covering are mixed with wheat germ, during the separation of wheat germ from whole wheat. This has resulted in concentration of food fibre in the wheat germ (13.2%). Next major organic component of wheat germ is fat content, which account for 9.72g/100g. The fat participates in the complex biochemical reactions in germ. The content of carbohydrate and ash are 38.6 g/100g and 4.21 g/100g, respectively (fig.1).

ISSN: 0975-8585

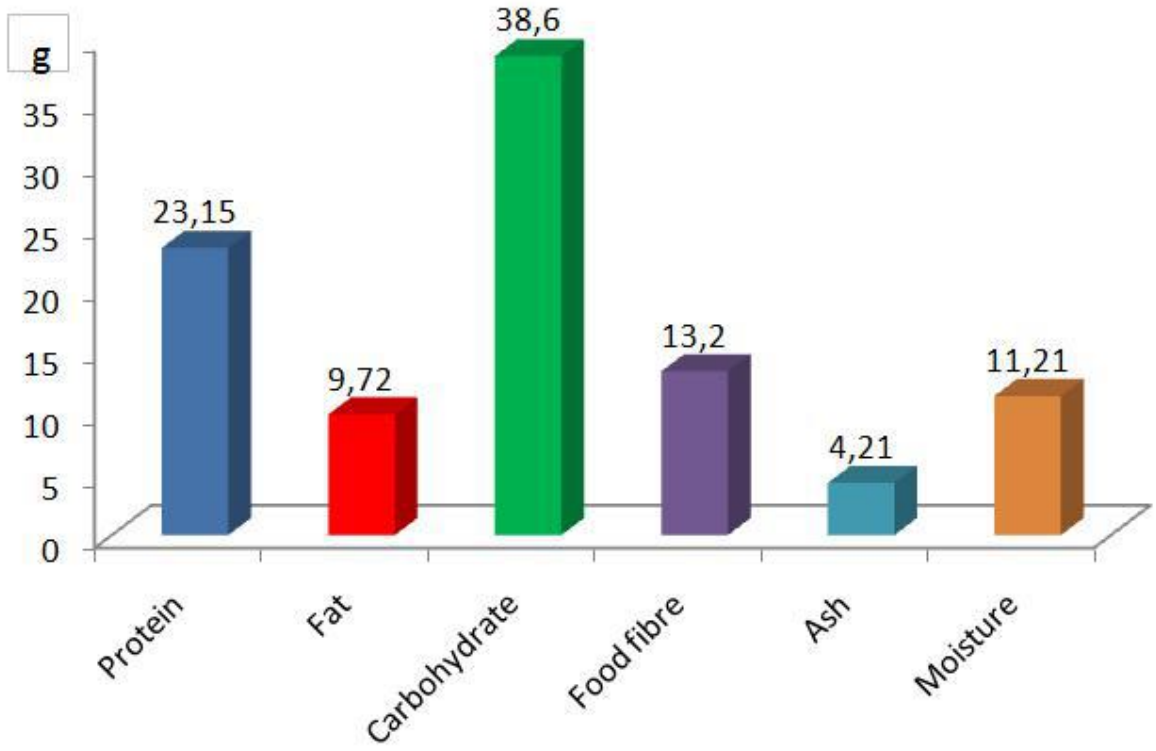

Fig 1: Chemical composition of wheat germ

Higher protein content (26.75%) was observed in coarse wheat germ by Levent and Bilgicli, while the moisture (4.04%) and fat (8.72%) content were lower and similar ash content (4.21%) [9]. Seleet et.al. (2016) reported the wheat germ composition as follows: protein (27.12 g/100g), lipid (7.22 g/100g), ash (3.59 g/100g) and fibre (12.74 g/100g)[10].Kara (2016) reported the protein content of wheat germ sampled from different type of wheat to be in the range of 23.99-27.70%, oil (9.68-11.67%), moisture 11.58-12.96% and ash (4.58-5.03%)[11]. In the study of Mahmoud et. al. the raw wheat germ contained 12.63g/100g moisture, 27.69 g/100g crude protein, 3.08 g/100g ash, 1.54 g/100g crude fiber, 46.07 g/100g carbohydrates and 9 g/100g of total lipids [12].

On the next stage the mineral composition of wheat germ was determined (Table 1). Major mineral elements represented in high concentration by potassium (892.0 mg/100g), phosphorus (842.0 mg/100g) and magnesium (239.0 mg/100g). These results were higher than those obtained by Levent (2013) [9]. Calcium and sodium concentration were 39.0 mg/100g and 12.0 mg/100g, respectively. Among the trace elements, the high concentration were analyzed in manganese 13.3 mg/100g, zinc 12.29 mg/100g. Significantly higher content of manganese of 18.47% and similar zinc 12.63% were determined by Levent (2013) [9].

Table 1: Mineral composition of wheat germ, mg/100g

Element	mg/100g
Macro element	
Calcium	39
Magnesium	239
Sodium	12
Potassium	892
Phosphorus	842
Micro element	
Iron	6,26

Zinc	12,29
Copper	0,796
Manganese	13,30

CONCLUSION

Wheat germ is an essential protein and vitamin concentrate. This study revealed that the wheat germ is a rich source of protein and mineral elements. Future studies will be carried out to develop the food additives from wheat germ for production of functional food products.

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