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Research Paper

A New Analytical Data on Dietary Fiber Content in Grain and Flour from Einkorn and Wheat

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Abstract: *The dietary fibers content in cereals (einkorn and wheat); flours (from einkorn) and wholemeal wheat flour from different batches, with different geographical origin was studied. The average fiber values (16%) in einkorn grain origin Bulgaria and Spain are almost identical, but significantly different from the average values obtained for einkorn grain origin Italy (26%). The indicated average fiber content is approximately 2 times lower than that determined in wheat (35%; 30%). The results of this initial study showed higher fiber content in wholemeal wheat flour from the USA (22%) compared to flour origin Bulgaria, and the difference is slightly more than 2 times.*
The familiarity of the type and variety of grown cereals, for example wheat (winter, spring, soft, hard), as well as the characteristic features of geographical areas, are factors that can explain the quantitative differences in dietary fibers content.
The above presented factual material was obtained on the basis of own analyses and provides a basis for comparative assessment of fiber content in studied cereals.
A part of data is suitable for inclusion in Bulgarian tables for food chemical composition, another part needs to be confirmed and expanded. Overall, the results provide a basis for a more informed attitude towards cereals and raw materials; and other foods as dietary fiber sources in the modern population dietetic nutrition.
Keywords: *dietary fiber, flour, einkorn, wheat*

I. Introduction

In the European Union, Regulation 1169/2011 [1] on the provision of food information to consumers, defines the fiber as 'carbohydrate polymers with three or more monomeric units, which are neither digested nor absorbed in the human small intestine and belong to the following categories:
- edible carbohydrate polymers naturally occurring in the food as consumed;
- edible carbohydrate polymers which have been obtained from food raw material by physical, enzymatic, or chemical means and which have a beneficial physiological effect demonstrated by generally accepted scientific evidence;
- edible synthetic carbohydrate polymers which have a beneficial physiological effect demonstrated by generally accepted scientific evidence [2].

Single-grain einkorn (Triticum monococcum) has a wild and cultivated forms and subspecies. Two - grain einkorn (Triticum dicoccum), also called emmer, is a type of wild wheat. During Mesolithic-Neolithic era, the two-grain einkorn was widely used as a plant food, and later was replaced by cultivated wheat [3].
It has been found that consumption of grains and whole grains rich in dietary fiber (DF) has a preventive effect against cardiovascular disease in adults. Today, einkorn is considered as a healthy food because it contains a higher percentage of protein than wheat, respectively: (from 11,8% ÷ 13,9% in einkorn); (from 10,8% ÷ 12,4% for wheat), as well as a large amount of fiber, fat, phosphorus, minerals and B vitamins [4].

Whole wheat and other whole-grain cereals may promote gut health and reduce your risk of colon cancer [5]. Observational studies link the consumption of whole grains — including whole wheat — to a reduced risk of colon cancer [6] and [7] and [8].

One observational study estimated that people on low-fiber diets could cut their risk of colon cancer by 40% by eating more fiber [6].

II. Health Benefits Of Einkorn Flour

Einkorn is an ancient wheat that has not been hybridized. Thus it has higher nutritional content and lower gluten than modern wheat. Recently, this ancient grain has been rediscovered by consumers looking for better health [9]. Einkorn is easily digestible wheat due to its lower gluten. Some people who are gluten-

intolerant can handle products made from einkorn wheat. It contains less gluten, and it is different than the gluten in modern wheat.

2.1 Einkorn Flour Can Help Lose Weight

Conventional wheat bread can make people gain weight because it is low in nutritional value and supplies empty calories. Einkorn bread and baked goods have more nutrition and leave you feeling more full. Because you feel full, you eat less and lose weight.

2.2 Einkorn Wheat May Prevent Diabetes

A study at the Aarhus University Hospital in Denmark showed that people who eat products made from ancient wheat, including einkorn, had lower levels of high-density lipoprotein (HDL) cholesterol than those who ate products made from conventional wheat. Furthermore, eating einkorn and other ancient wheat varieties decreased glucose and fat metabolism cell production, delaying or even preventing the onset of Type 2 diabetes.

Whole wheat is high in fiber, but refined wheat contains almost none. The fiber content of wholegrain wheat is 12–15% of the dry weight [5]. As they are concentrated in the bran, fibers are removed during the milling process and largely absent from refined flour.

When the whole grain is ground to wholegrain flour, we achieve a product that has all substances from the composition of wheat, corn or rye preserved [10].

Wholegrain flours and their products contain the three parts of the grain – bran, germ, endosperm. Wholegrain cereal products are very diverse – various types of wheat, rye and combined bread, pasta, wholegrain cereals, croup, oatmeal, brown rice, extruded products, variegated combined grain mixtures. The dietetic practice implements also the grain fragments rich in fibers and bioactive substances – wheat bran, germs etc. [11].

The aim of the current study is to present in a comparative plan the quantity of dietary fiber content in cereals: einkorn and wheat; in flour from einkorn and whole wheat flour from countries with different geographical origins.

III. Material And Methods

Samples of individual lots, of various geographical origins: einkorn (grain); wheat (grain) and products from its processing were delivered in 2023 to the Laboratory for analysis of dietary fibers content.

The analyses were made with the implementation of the enzymatic-gravimetric method AOAC 985.29, respectively:

- Einkorn, grain (four samples, origin Bulgaria);
- Einkorn, grain (five samples, origin Spain);
- Einkorn, grain (one sample origin Italy);
- Wheat, grain (two samples, origin Bulgaria);
- Wheat, grain (one sample, origin United States of America (USA));
- Einkorn, flour (two samples, origin Bulgaria);
- Wheat flour, whole grain (two samples, origin Bulgaria);
- Wheat flour, whole grain (two samples, origin USA).

From each batch, laboratory sample was prepared and analyzed in two parallel determinations. An average value was obtained from analyzes of laboratory samples for each individual batch. The dietary fiber content was determined by a verified enzyme - gravimetric method AOAC 985.29 [12].

Principle of the method: duplicate samples of dried foods, fat extracted if containing > 10 % fat, are gelatinized with Termamyl (heat-stable α-amylase), and then enzymatically digested with protease and amyloglucosidase to remove protein and starch. Four volumes of ethyl alcohol are added to precipitate soluble dietary fiber. The total residue is filtered, washed with 78 % ethyl alcohol, 95 % ethyl alcohol, and acetone. After drying, the residue is weighed. One duplicate is analyzed for protein, and the other is incinerated at 525 ^{O}C and ash is determined.

IV. Results And Discussion

The differences in values for total fiber content are shown in Table 1 and discussed below [13].

Product	DF,g/100g ± SU
wheat, grain, (n=2), origin Bulgaria	34,53 ± 0,39
wheat soft, grain, origin USA	29,46 ± 0,33
einkorn, grain (n=4), origin Bulgaria	16,17± 0,18
einkorn, grain (n=5), origin Spain	16,64 ± 0,19
einkorn, grain, origin Italy	25,60 ± 0,29
einkorn, flour (n=2), origin Bulgaria	14,17± 0,16

wheat flour, whole grain (n=2), origin Bulgaria	10,04 ± 0,28
wheat flour, whole grain (n=2), origin USA	21,94 ± 0,25

*SU-standard uncertainty

Table 1: Dietary fiber content in cereal products

The obtained results concerning wheat flours show a relatively high content of total fibers but too large differences between various lots declared as wholegrain. The imported USA lots of wholegrain wheat flour have high fiber content.

According to international literature sources [14] lower content of total dietary fibers is detected in analogous products analyzed by the same enzymatic-gravimetric method 985.29, respectively:

- For wholegrain wheat flour the values vary in the interval 9,9 – 13,8% (Danish Food Composition Databank, 2009).
- The average values of dietary fiber (16%) in einkorn, grain origins Bulgaria and Spain are almost identical, but significantly different from the average values obtained for einkorn, grain origin Italy (26%).

The reported average fiber content is approximately 2 times lower than those determined in wheat (35%; 30%), which is probably due to the elimination of bran from the grain mass. The results of this initial study showed higher fiber content in the wheat flour, whole grain from the USA (22%) compared to the flour origin Bulgaria, the difference being slightly more than 2 times and also in all probability a result of the milling technology in the USA, which does not exclude the bran from the cereal mass.

V. Conclusion

The above factual material was obtained on the basis of own analyzes and provides a basis for a comparative assessment of the fiber content in the examined cereals. Part of the data is suitable for inclusion in the Bulgarian food composition tables, another part needs to be confirmed and expanded again. Overall, the results provide a basis for a more informed attitude towards cereals and raw materials; and other foods as sources of dietary fiber in the modern dietary nutrition of the population.

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