NOTE

Dietary Fiber Content of Different Cereal Products in Norway

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Cereal products are important sources of dietary fiber, and an easy way to increase the content of dietary fiber in the diet is to increase the consumption of unrefined cereal products. These products are also important sources of minerals and vitamins.

Information about the content of dietary fiber in foodstuffs is of interest to consumers. In most food tables, fiber values are lacking or inaccurate because of use of the crude fiber method. However, this method has generally been abandoned (Southgate 1976, Van Soest and Robertson 1976). The latest edition of the British food tables, however, includes dietary fiber values according to Southgate's method (Paul and Southgate 1978).

The definition and terminology of dietary fiber are still under discussion, but authors seem to agree that all nonstarch polysaccharides and lignin should be included. Some authors (Saunders and Betschart 1980) prefer to include undigestible protein as well. Other substances associated with dietary fiber, such as phytic acid and tannins, are generally quantitatively small.

Routine purposes require the use of a rapid and accurate method for determining dietary fiber. Fractionation methods with colorimetric or gas chromatrographic assays of monomer constituents give important detailed information but are too laborious for routine purposes. The neutral detergent fiber method gives satisfactory measurements of insoluble components but does not measure soluble components, which in a mixed diet could account for up to 40% (Asp and Johansson 1981).

This article gives information on the fiber content in various cereal products analyzed by an enzymatic, gravimetric procedure (Asp et al 1982). The method measures the residue after enzymatic removal of protein and starch, corrected for undigestible protein and ash associated with the fiber.

The contents of the most commonly used cereals, wheat and rye, were reported previously (Frølich and Asp 1981), but means are included in the present paper for comparison.

MATERIALS AND METHODS

Cereal products were bought in local markets in Norway, except for the flours that were obtained directly from the mills. The products were then divided into four main groups: flours obtained throughout the year by The Norwegian Grain Cooperation from each of Norway's nine mills; ready-to-eat cereals, both Norwegian and foreign types; crackers, flatbread, and crispbread; and rices and pastas.

Sample Preparation

Samples containing more than 10% fat were defatted with hexane or with chloroform-methanol (2:1, v/v) in a Soxhlet apparatus before use (Schweizer and Würsch 1979). The samples were ground in a Cyclotec sample mill (Tecator) to a particle size of less than 0.45 mm.

General Methods

Ash was determined by ignition at 550–600°C to constant weight (6 hr). The dry weights were determined by oven-drying at 105°C to constant weight (18 hr).

Dietary Fiber Method

The method used to determine the fiber content was based on Hellendoorn's gravimetric, enzymatic method (Hellendoorn et al 1975) with the following modifications, described by Asp et al 1982. To remove starch completely, an extremely heat-stable α-amylase (Termamyl 60 L, Novo, Copenhagen, Denmark) was used in an initial gelatinization step at 100°C for 15 min. Enzyme digestions were performed with pepsin at pH 1.5 for 1 hr and with pancreatin at pH 6.8 for 1 hr, both at 40°C, thus simulating the conditions in the human gastrointestinal tract. Soluble dietary fiber components were precipitated with ethanol, recovered together with the originally insoluble components by filtration. Separate values of insoluble and soluble fiber can be obtained by filtration in two steps: initial filtration recovering the insoluble components, and another filtration after alcohol precipitation of the soluble components. These two procedures give the same values of total dietary fiber (Asp et al 1982). The filtrations were performed with Tecator's Fibertec system (Tecator AB, Höganäs, Sweden), using 0.5 g of Celite as a filter aid. The fiber filtrates recovered were dried overnight at 105°C before weighing. They were then analyzed for ash and residual nitrogen by the Kjeldahl method (conversion factor to protein = 6.25). Dietary fiber values given are corrected for residual protein and ash.

The dietary fiber values reported in the tables are the means of duplicate gravimetric analyses. The standard deviation of total dietary fiber calculated from duplicate samples was previously determined to 0.32 g/100 g in samples with low to moderate dietary fiber content (Asp et al 1982). All values are given in percent, both on a moisture-free basis and on a wet-weight basis, and represent means of duplicate analysis.

RESULTS AND DISCUSSION

The contents of dietary fiber for the different cereals on the market in Norway are shown in Tables I–IV.

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TABLE I
Dietary Fiber Content of Flours and Other Milling Products

	Dietary Fiber (wet weight, %)	Moisture (%)	Dietary Fiber (dry weight, %)
White wheat flour (78–80% extraction)[a]	3.2	11.2	3.6
Whole grain flour, wheat[a]	12.6	11.4	14.4
Barley flour (50% extraction)	10.8	10.7	12.1
Barley flour (70% extraction)	13.6	10.4	15.2
Barley, whole grain	23.2	8.5	25.3
Whole grain flour, rye[a]	14.7	11.4	16.8
Rye flour (mixed with 15% white wheat flour)	7.2	10.9	8.1
Oat flakes	10.7	8.6	11.7
Bran of wheat[a]	52.8	11.4	59.3
Bran-germ of wheat	22.1	8.1	24.0
Germ of wheat	19.7	9.1	21.7
Semolina	2.3	11.7	2.6
Triticale	13.9	7.4	15.0

[a]From Frølich and Asp 1981.

TABLE II
Dietary Fiber Content of Ready-To-Eat Breakfast Cereals

Cereal	Dietary Fiber (wet weight, %)	Moisture (%)	Dietary Fiber (dry weight, %)
Kellogg's Corn Flakes	6.2	5.6	6.6
Kellogg's Müssli	12.8	8.3	14.0
Kellogg's Rye Flakes	11.2	11.7	12.7
Kellogg's Oat Mix	10.1	10.4	11.3
Kellogg's Bran Buds	29.5	7.5	31.9
Kellogg's Fiber Rich	33.8	7.5	36.6
OTA, Sun-Breakfast	7.6	8.4	8.3
Collett's Everyday (Norwegian)	9.8	6.1	10.2
Bjølsen 4 grain (Norwegian)	10.0	8.0	10.9

TABLE III
Dietary Fiber Content of Crackers, Flatbread, and Crispbread

Product	Dietary Fiber (wet weight, %)	Moisture (%)	Dietary Fiber (dry weight, %)
Crackers			
Bran cracker, type I (G. Gundersen)	45.8	4.4	47.9
A/S Säetre, type II	34.9	2.9	35.9
Bran cracker type III (Hoba A/S)	42.0	3.5	43.5
Bran cracker, health shop	36.6	4.9	38.5
Flatbreads and crispbread			
Korni Flatbread	17.9	3.4	18.5
Korni Export Flatbread	17.9	3.4	18.5
Korni Breakfast Flatbread	18.6	3.0	19.2
Korni Flatbread with bran	22.0	4.2	23.0
Ideal Flatbrød	7.6	3.0	7.8
Ideal Homemade	10.7	3.2	11.1
Ideal Fiber flatbread	15.7	3.7	16.2
Korni, Thin Crispbread	21.9	4.8	23.0

Table I shows the dietary fiber content of different flours and other milling products, most of which have a fiber content of 11.7–59.3% (dry basis). The content of soluble fiber components in oat is considerably higher (50%) (unpublished data[2]) than in other cereals (7–20%) (Frølich and Asp 1981).

Table II shows the dietary fiber content of ready-to-eat cereals. The products can be divided into two groups with respect to dietary fiber content, one based on bran and the other on whole grain flour. Some of these products are extremely rich in fat and sugar and should not be regarded as healthful, high-fiber products.

Flatbread, a Norwegian specialty, is produced primarily from whole grain flour and has a dietary fiber content of approximately 22% (Table III).

TABLE IV
Dietary Fiber Content of Pasta and Rices

Product	Dietary Fiber (wet weight, %)	Moisture (%)	Dietary Fiber (dry weight, %)
Sopps, spaghetti	4.1	9.6	4.5
Sopps, macaroni	4.5	8.9	5.0
Sopps, whole wheat flour spaghetti	9.7	8.7	10.7
Sopps, whole wheat macaroni	10.8	8.1	11.8
Galla, porridge rice	3.0	10.0	3.3
Galla, precooked porridge rice	2.3	11.2	2.6
Galla, precooked rice	3.5	8.6	3.9
Galla, party rice	4.6	10.2	5.1
Galla, dinner rice	3.7	10.6	4.1
Ming, precooked rice	3.3	8.9	3.6
Ming, American rice	3.0	9.8	3.4
Ming, porridge rice	2.1	11.4	2.3
Geisha, parboiled rice	3.1	7.8	3.4
Geisha, porridge rice	2.1	9.2	2.3
Geisha, dinner rice	3.2	11.2	3.6
Geisha, nature rice	4.6	10.7	5.1
Unpolished, round grain rice (health shop)	3.4	6.8	3.7
Unpolished, long grain rice (health shop)	4.2	11.6	4.7
Nature rice, biodynamic-grown (health shop)	4.5	10.2	5.0
Uncle Ben, parboiled rice	2.9	7.9	3.1
Uncle Ben, brown rice, type I	9.1	10.2	10.1
Uncle Ben, brown rice, type II	8.7	10.3	9.7

Bran crackers have become increasingly popular in Norway and are a more acceptable way of eating bran for the consumer.

Pasta products in Norway are based either on wheat flour (78% extraction rate) or on whole wheat flour. The whole flour products have a fiber content about twice as high as that of the other pasta products (Table IV).

The content of dietary fiber in rice is rather low (Table IV), in most cases lower than that of Norwegian white wheat flour (78% extraction rate). Even rice bought in health shops and advertised as unpolished has a rather low fiber content, not much higher than typical rice on the market. Only two types of rice have a higher dietary fiber content than others, indicating more unrefined products.

The values given led us to conclude that products with a relatively high content of dietary fiber are on the market. This information is important to consumers who require increased dietary fiber content.

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