Institute of Medicine
Food and Nutrition Board
Committee on Food Chemicals Codex

New Monograph - Sugar Beet Fiber

Please send comments to the Committee on Food Chemicals Codex, National Academy of Sciences, FO 3042, 2101 Constitution Avenue, N.W., Washington, DC 20418 or email them to fcc@nas.edu. All comments must be received by December 15, 1996, for consideration for the First Supplement.

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Sugar Beet Fiber

Beet Fiber; Dietary Fiber from Beets; Sugar Beet Pulp

DESCRIPTION

Sugar Beet Fiber is the natural, light-brown colored fiber of sugar beets remaining after water extraction of the sugar from the mechanically sliced sugar beets. It exists in various grades, from coarse fibrous flakes to fine, free-flowing powders.

Functional Use in Foods Anticaking agent; binding agent; bulking agent; dietary supplement; dispersing agent; nutrient; stabilizing agent; texturizing agent; thickening agent.

REQUIREMENTS

Identification

A. Boil 10 g of the sample with 90 mL of water for 5 min, filter while hot through No. 616 filter paper, and add 5 drops of iodine TS to the filtrate. No change in color from the yellow-red to red-yellow is produced, indicating the absence of starch.

B. Add 95 mL of water to 5 g of the sample, and mix (coarse grades should be ground so a major portion will pass through a 60-mesh screen). Heat to boiling, and filter while hot. Add 1 mL of 1 N sodium hydroxide to 5 mL of cooled filtrate, mix, and allow to stand at room temperature for 15 min. The formation of a thick, yellowish gel indicates the presence of soluble fiber, which dissolves upon addition of a few drops of 6 N hydrochloric acid.

C. Mix 12.5 g of α-naphthol with 250 mL of methanol; add a few drops of this solution to 5 mL of cooled filtrate from identification test B, and mix. Carefully layer sulfuric acid down the side of the test tube. A purple color change occurs at the interface, indicating the presence of residual sucrose.

Assay Not less than 70.0% total fiber, and not less than 20.0% soluble fiber, calculated on the dried basis.

Ash (Total) Not more than 6.0%.

Heavy Metals (as Pb) Not more than 10 mg/kg.

Lead Not more than 1 mg/kg.

Loss on Drying Not more than 10.0%.

Microbial Limits:

Aerobic Plate Count Not more than 10,000 CFU per g.

Salmonella Negative in 25 g.

Yeasts and Molds Not more than 200 CFU per g.

pH of a 10% Dispersion Between 4.0 and 5.0.

TESTS

Assay (Based on AOAC method 991.43).

Mixed 8.2 Buffer Solution Mix equal volumes of 0.1 M 2-(N-morpholino)ethanesulfonic acid (MES) and 0.1 M tris(hydroxymethyl)aminomethane (TRIS), and carefully adjust the pH to 8.2 at 24°, using 6 N sodium hydroxide as necessary. If the buffer temperature differs from 24°, adjust the pH by interpolation from a high of 8.3 at 20° to a low of 8.1 at 28°.

Protease Solution Use a freshly prepared solution containing 50 mg of protease (Sigma Chemical Co. catalog number P 3910, or equivalent) per mL of Mixed 8.2 Buffer Solution.

> Note: Verify that all enzymes used in this procedure exhibit not less than 95% of their declared potencies using the tests given in Enzyme Assays, Appendix V.

Filtering Crucible Prepare 60-mL filtering crucibles, each with a coarse fritted disk (Corning No. 36060-606 Pyrex Büchner funnel, 40- to 60-μm pore size, or equivalent) as follows: Ignite overnight at 525° in a muffle furnace. Allow the temperature to fall below 130° before removing the crucibles from the furnace. Soak the crucible for 1 h at room temperature in a 2% cleaning solution containing a liquid surfactant-type laboratory cleaner. At the end of the hour, rinse the crucible with water, de-ionized water, and 15 mL of acetone. Allow to air dry. Add about 1 g of diatomaceous earth (Celite 545 AW, or equivalent), packing it down firmly. Dry at 130° to constant weight. Cool the crucible for about 1 h in a desiccator, then accurately record its weight.

Sample Preparation Transfer 1 g of the sample, accurately weighed, to a 400-mL beaker, and add 40 mL of Mixed 8.2 Buffer Solution. Prepare four samples (two sets of duplicates). The two sets are used for the Determination of Total Fiber and Determination of Soluble Fiber, each with its respective blank.

Procedure Run the Procedure on two duplicate samples, and with a blank for each sample. Stir the Sample Preparation magnetically until the sample is totally dispersed. To each beaker add 50 μL of heat-stable α-amylase solution (Sigma Chemical Co. catalog number A 3306, or equivalent). Cover the beaker with aluminum foil, place it on a water bath, and with stirring, incubate at 95° to 100° for 15 min. Start the timing when the temperature

reaches 95°. Remove the beaker from the bath, and cool to 60°. Uncover the beaker. With a spatula, scrape any ring on the inside wall of the beaker, and disperse any gels formed at the bottom of the beaker. Rinse the beaker walls and spatula with 10 mL of water.

Add 100 µL of Protease Solution to each beaker, cover with aluminum foil, and with continuous stirring, incubate the mixture at 60° for 30 min. Start the timing when the temperature of the solution reaches 60°. Uncover the beaker, and with continued stirring, immediately add 5 mL of 0.5 N hydrochloric acid. While maintaining the temperature at 60°, adjust the pH to between 4.0 and 4.7 using either 1 N hydrochloric acid or sodium hydroxide.

> Note: It is important to check and adjust the pH when the solutions are at 60° because the pH is temperature dependent.

Next, while stirring, add 300 µL of amyloglucosidase solution (Sigma Chemical Co. catalog number AMG A 9913, or equivalent). Cover and incubate the mixture at 60° for 30 min with constant agitation. Start the timing when the mixture reaches 60°.

Determination of Total Fiber To duplicate samples and blanks, still maintained at 60°, add 225 mL of 78% ethanol. Remove from the bath, cover, and allow to stand at room temperature for 1 h for complete precipitation. Wet and redistribute the Celite bed in a previously prepared and tared Filtering Crucible, using 15 mL of 78% ethanol to wash the sides of the crucible. Apply suction to draw the Celite onto the fritted disk as an even mat. Filter the alcohol-treated sample though the crucible, quantitatively transferring all particles to the crucible with the help of a spatula and a wash bottle containing 78% ethanol. If a gum is formed, break the film with the spatula.

Wash the residue in the Filtering Crucible successively with two 15-mL portions of 78% ethanol, 95% ethanol, and acetone, applying a vacuum after each wash. Dry the crucible and its contents at 105° to constant weight. Use the residue from one sample to determine the Nitrogen content as directed under Appendix IIIC. The weight of nitrogen determined, multiplied by 6.25, gives the weight of protein. Use the second sample of residue for the Ash determination. The weight of the residue, corrected for the blank, protein, and Ash, is equal to the weight of the total fiber (see Calculations, below).

Determination of Soluble Fiber Using about 3 mL of water, wet and redistribute the Celite bed in a Filtering Crucible. Apply suction to draw the Celite into an even mat. Treat the second set of duplicate samples and blanks in the following manner: filter through the Filtering Crucible, collecting the filtrate and subsequent washings. Using water maintained at 70°, rinse the beaker, and wash the residue with two 10-mL portions of the hot water. Discard the residue and transfer the combined filtrate and all washings to a tared 600-mL beaker. Weigh the beaker to obtain an estimate of the volume of the contents. Add four volumes of 95% ethanol maintained at 60°, and allow to stand at room temperature for 1 h for complete precipitation.

Proceed as described above under Determination of Total Fiber, beginning with "Wet and redistribute the Celite bed…." The weight of this second residue, corrected for the blank, protein, and Ash, is equal to the weight of soluble fiber (see Calculations, below).

Calculations Determine the blank, B, in mg, using the following equation:

$$B = [(BR_1 + BR_2)/2] - P_B - A_B,$$

in which BR_1 and BR_2 are the residue weights, in mg, of the duplicate blank determinations; and P_B and A_B are the weights, in mg, of protein and ash, respectively, determined in the first and second blank residues.

Determine the percent Fiber (F), which applies to both Total Fiber and Soluble Fiber, with the following equation:

$$F = 100\{[(R_1 + R_2)/2] - P - A - B\}/[(M_1 + M_2)/2],$$

in which R_1 and R_2 are the residue weights, in mg, for duplicate samples; P and A are the weights, in mg, of protein and ash, respectively, determined on first and second residues; B is the blank weight, in mg; and M_1 and M_2 are the weights, in mg, of the samples, corrected for Loss on Drying.

Ash (Total) Determine as directed in Appendix IIC using the residue obtained from one of the digested samples obtained under Determination of Total Fiber in the Assay.

Heavy Metals Prepare and test a 2-g sample as directed in Method II under the Heavy Metals Test, Appendix IIIB, using 20 µg of lead ion (Pb) in the control (Solution A).

Lead Determine as directed for Flame Atomic Absorption Spectrophotometric Method under the Lead Limit Test, Appendix IIIB, using a 10-g sample.

Loss on Drying, Appendix IIC Dry at 105° for 5 h.

Microbial Limits:

Aerobic Plate Count Proceed as directed in chapter 3 of the FDA Bacteriological Analytical Manual, Eighth Edition, 1995.

Salmonella Proceed as directed in chapter 5 of the FDA Bacteriological Analytical Manual, Eighth Edition, 1995.

Yeasts and Molds Proceed as directed in chapter 18 of the FDA Bacteriological Analytical Manual, Eighth Edition, 1995.

pH of a 10% Dispersion Determine by the Potentiometric Method, Appendix IIB, using a dispersion prepared by mixing 10 g of sample with 90 mL of water and allowing to stand at room temperature for 2 h.

Packaging and Storage Store in well-closed containers.