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Wheat Bran

DEFINITION

Wheat Bran is the outer fraction of the cereal grain, comprising the pericarp, seed coat (testa), nucellar tissue, and aleurone layer, and is derived from *Triticum aestivum* L., *T. compactum* Host, *T. durum* Desf., and other common einkorn and emmer wheat cultivars. It is obtained by the milling and processing of the whole wheat grain meeting U.S. Standards for Number 1 wheat (7 CFR 810.2201). It contains NLT 36.0% of dietary fiber.

IDENTIFICATION

• **A. Botanic Characteristics**

Microscopic: Fragments of aleurone and nucellar layers (about 60% of the components) and fragments of seed coat and pericarp (about 40%); aleurone and nucellar tissues composed of a usually single layer of thick-walled, isodiametric, translucent cells having conspicuous protoplasm and a single, inconspicuous layer of thick-walled, nearly transparent cells; inconspicuous seed coat, consisting of two layers of thin-walled cells crossing at roughly right angles to each other; pericarp composed of an inconspicuous endocarp layer of elongated, thick-walled tube cells, a cross layer with cells longer than wide, arranged side-by-side in rows, having thick, highly pitted side and end walls, and epicarp and hypoderm layers with cells longer than wide, arranged alternately in rows and having thick, highly pitted side and end walls; epicarp and hypoderm cells larger than and crossing at right angles to the cells of the cross layer; and a few trichomes also present, with lumens narrower than the thickness of their cell walls and originating from isodiametric-polygonal epicarp cells. If micronized, the original structures are mostly destroyed.

COMPOSITION

• **Content of Total Dietary Fiber**

Buffer: pH 6.0 phosphate buffer (see *Reagents, Indicators, and Solutions—Buffer Solutions*)

Protease solution: Dissolve 5 mg of protease in 0.1 mL of *Buffer*.

Samples: Prepare two samples in parallel previously dried in a vacuum oven at 100° for 5 h. Mill the dried Wheat Bran to a coarse powder, and store in a desiccator until use.

Analysis: To correct for any contribution from reagents, perform examinations of reagent blanks, which are treated similarly to the *Samples*. Transfer 1.0 g of each *Sample* into separate 400-mL, tall-form beakers. Add 50 mL of *Buffer*, and adjust the pH, if necessary, to 6.0 ± 0.1. Add 0.2 mL of heat-stable α-amylase solution. Cover the beaker with aluminum foil, place in a boiling water bath for 15 min at 100°, shaking gently every 5 min, and cool to room temperature. Adjust with about 10 mL of 0.275 N sodium hydroxide solution to a pH of 7.5 ± 0.1. Add freshly prepared *Protease solution*, cover the beaker with aluminum foil, and incubate for 30 min at 60° with continuous agitation. Cool, and adjust with 10 mL of 0.325 N hydrochloric acid to a pH of 4.5 ± 0.2. Add 0.3 mL of amyloglucosidase, cover with aluminum foil, and incubate for 20 min at 60°, with continuous agitation. Heat 280 mL of alcohol to 60°, add to the digest, and allow the precipitate to form at room temperature for 60 min. Place 0.5 g of chromatographic siliceous earth in a crucible with fritted disk, dry at 130° to constant weight, and weigh. Wet the chromatographic siliceous earth in the crucible using a stream of 78% alcohol from a washing bottle, and apply suction to evenly distribute the chromatographic siliceous earth over the fritted disk. Maintain suction, and quantitatively transfer the enzyme digest precipitate to the crucible. Wash the residue successively with three 20-mL portions of 78% alcohol, two 10-mL portions of alcohol, and two 10-mL portions of acetone. In some cases, gums may form during filtration, trapping liquid in residue. If so, break the surface film with a spatula to improve filtration. Dry the crucible containing the residue at 105° in an air oven for 16 h, cool in a desiccator, and determine the weight of the residue. Determine the percentage of protein in the first *Sample* as directed in the test for *Limit of Protein*. Incinerate the residue from the second *Sample* as directed in *Articles of Botanical Origin ⟨561⟩, Total Ash*.

Calculate the corrected weight, *W*, of the sample residue:

$$W = W_U \times (1 - P_U/100 - A_U/100) - W_B \times (1 - P_B/100 - A_B/100)$$

W_U = average weight of the *Sample* residues

P_U = percentage of protein present in the *Sample*

A_U = percentage of ash found in the *Sample*

W_B = average weight of the blank residues

P_B = percentage of protein found in the test for *Limit of Protein* for the blank

A_B = percentage of ash found in the blank

Calculate the percentage of the total dietary fiber in the portion of Wheat Bran taken:

$$\text{Result} = (W/W_I) \times 100$$

W_I = weight of the *Sample* taken

Correct the final percentage of the total dietary fiber for fat and for water.

Acceptance criteria: NLT 36.0%

CONTAMINANTS

- **Articles of Botanical Origin, *Limits of Elemental Impurities* ⟨561⟩:** Meet the requirements
- **Limit of Insect Infestation**

  Sample: 50 g of Wheat Bran

  Analysis: Prepare a smooth slurry by transferring the *Sample* to a 1-L beaker and adding 500 mL of 1.5 N hydrochloric acid. Add 50 mL of light mineral oil, and carefully heat to boiling on a hot plate. Boil for 10 min to digest, stirring occasionally to prevent scorching. Remove from the hot plate, and stir for 5 min with a magnetic stirrer, increasing the stirring speed until a vortex is formed without visible splashing. Quantitatively transfer the contents of the beaker to a separatory funnel with the aid of hot water. Allow to stand for 30 min, stirring gently with a glass rod several times during the first 10 min. Drain the lower layer to about 2.5 cm from the layer interface. Wash the funnel with hot water, and allow 5 min for the layers to separate. Drain the lower layer, and wash with cold water several times until the lower phase is clear. Filter the contents of the funnel through ruled filter paper with the aid of a Büchner funnel and suction. Thoroughly rinse the separatory funnel with water and a detergent solution, filtering each rinse through the same paper. Examine the ruled filter paper under a microscope at 30× magnification.

  Acceptance criteria: NMT 25 insect fragments are seen.

- **Microbial Enumeration Tests ⟨61⟩** and **Tests for Specified Microorganisms ⟨62⟩:** The total aerobic microbial count does not exceed 10^4 cfu/g, and it meets the requirements of the tests for absence of *Salmonella* species and *Escherichia coli*.

SPECIFIC TESTS

- **Limit of Protein**

  Sample: 1 g of Wheat Bran

  Analysis: Place the *Sample* in a 500-mL Kjeldahl flask, and proceed as directed in *Nitrogen Determination ⟨461⟩, Method I*. Multiply the percentage of nitrogen found by 6.31.

  Acceptance criteria: NMT 18.5%

- **Limit of Fat**

  Sample: 2 g of Wheat Bran, previously dried in a vacuum oven at 100° for 5 h

  Analysis: Transfer the *Sample* to an extraction thimble, and mix with an equivalent quantity of dry, clean sand. Place a fat-free cotton or glass wool plug on top of the thimble. Place the thimble in a continuous-extraction apparatus provided with a tared collection flask. Pour 75 mL of solvent hexane through the sample into the collection flask. Extract at a condensation rate of 5–6 drops/s for 4 h, then at a rate of 2–3 drops/s for the next 16 h. Detach the collection flask, carefully evaporate the solvent, and dry the collection flask and its contents in a drying oven at 100° for 30 min to constant weight. Calculate the percentage of the extract (crude fat) in the portion of Wheat Bran taken.

  Acceptance criteria: NMT 6%

- **Absence of Peroxidase Activity**

  Sample: 1 g of Wheat Bran

  Analysis: Transfer the *Sample* to a test tube, and add 50 mL of water. Add, in the order specified, 2 mL of 5.68 mM erythorbic acid, 3 mL of 0.69 mM dichloroindophenol, and 0.1 mL of 1.2% hydrogen peroxide, each freshly prepared. Stopper the test tube tightly, and shake until the *Sample* is dissolved. Place into a water bath at 38° for 5 min.

  Acceptance criteria: No color change is observed, indicating the absence of peroxidase activity.

- **Water Determination, *Method III, Procedure for Articles of Botanical Origin* ⟨921⟩:** NMT 12%
- **Articles of Botanical Origin, *Total Ash* ⟨561⟩:** NMT 8%

ADDITIONAL REQUIREMENTS

- **Packaging and Storage:** Preserve in well-closed containers, secured against insect attack.

Auxiliary Information - Please check for your question in the FAQs before contacting USP.

Topic/Question	Contact	Expert Committee
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