Some physical treatments on wheat bran for producing dietary fiber*


Introduction

During the last years more attention has been given to dietary fiber than any single component of the diet has ever received. Dietary fiber acts as a bulking agent that increase intestinal motality and moisture content of feces. It was postulated that those effects are important in preventing diseases of the colon, other studies showed evidence that plant fiber can lower serum cholesterol level and improve oral glucose tolerance in human. Fiber contains cellulose, hemicellulose, lignin and probably residues of protein, starch and pectic substances. From a dietary stand point, fiber can defined as the material that resists the digestion secretion of gastrointestinal tract.

Consumption of highly cereals, processed foods and frozen foods has increased in considerably in recent years. Decrease in the intake of fibers in the diet may therefore cause fiber deficiency diseases.

Wheat bran is a major source of dietary fiber (9—10%) crude fiber, but also is a rich source of phytate (3.5—4.0%), that can also binds some minerals when fed to mono-gastric animals in large amounts. Concerns were reported that phytate reduced the availability of dietary calcium, zinc, iron, copper, magnesium, and manganese. Thus the quality of dietary fiber becomes a nutritional factor particularly concerning phytate content.

The purpose of this study was to develop a new method for decreasing the amount of phytate wheat bran by phytase enzyme which can be produced spontaneously, and investigated the effect of dephytinization process on some physical, chemical and nutritional properties of low-phytate wheat bran.

Materials and methods

Commercial samples of wheat bran (Hard red spring), were obtained locally from the market. The samples were gently shaking to withdraw foreign materials.

Preparation low-phytate wheat bran:

The procedure for preparation low-phytate wheat bran from wheat bran is shown schematically in Fig (I). The bran was soaked in distilled water for 30 minutes, after soakint period the soaked bran was dropped in a buffer solution. 0.1 M of sodium acetate in the presence of 0.002M MgSO₄ (pH value was range 5.0—5.2),

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PROCEDURE FOR PREPARATION LOW-PHYTATE WHEAT BRAN:

phytase activity = \( \text{WHEAT BRAN (WB)} \) Phytate content (3.5%) db

\( \text{Km} = 0.22 \times 10^{-3} \text{ M} \)

Michaelis-Mentan Constant

Shaking to remove foreign materials

Soaking in distilled water for (60 minutes)

\((0.1 \text{ M sodium acetate} + 0.002 \text{M Mg SO}_4)\).

Suspended in buffer-solution at 40 – 45° c for 6 hr pH(5.0 – 5.2)

Filteration through nylon seive

Washed twice with water

Washing residuale

LPWD

Low phytate wheat bran

Centrifuged for 10 min.

LPWB dried in hot air at 70 – 80 °C

(moisture content 10 – 12%).

which was stored in a container and incubated at 40 – 45 °C for 6 hours. At the end of incubation period the suspension was filtered through a nylon sieve and the bran washed with water. Then the product centrifuged for 10 minutes to reduce the moisture content. The final product was dried in hot air at 70 – 80 °C to remove the moisture to a level 10%.

Analytical procedures:

1. Phytic acid content was determined in wheat bran before and after dephytilization process by the method described by Wheeler and Ferrel (1).
2. Phytase activity was measured by method by Hassan and Singh (1980).
3. Moisture, crude fiber were determined by AOAC procedure (1973).
4. Neutral detergent fiber (NDF) was measured by the method of Van Soest and Wine (2), modified to include an -amylase starch digestion step. Cellulose and lignin determined by the acid detergent fiber (ADF) method of Van Soest (3) as modified by Holst (4).

5. Particle size: A sample of 25 gm was placed on the largest of a descending seives of 20, 30, 40, 50 and 70 mesh stainless steel US standard seives that were fitted with a par and a cover. The nested seive were shaken for 10 minutes disassembled and contents were stirred lightly, then shaken for an additional 5 minutes. The residue of each seive was carefully removed with the aid of a brush weighed each residue was expressed as percent by weight of the original sample.

6. Water-holding capacity: Water-holding capacity was measured by the procedure of Mc-Connel et al. (5).

7. Density determinations: For density determination a calibrated graduate cylinder was filled with slight shaking with bran. The contents of the cylinder were weighed and the average of triplicate determinations was expressed as g/ml.

8. Hydrated density: A calibrated 10mL graduated cylinder was filled with a known amount of distilled deionized water, and a known weight of wheat bran was added carefully to avoid adhesion of particles to cylinder walls. Results expressed grams of sample bran per mL of water displaced.

9. Bulk density: Bulk density was measured with a calibrated graduate syring (open end packed with cotton). The syring was filled with a known amount of sample, which varied somewhat depending on particle size and density. Pressure was applied manually until additional pressure would not further reduce the volume.

Results and discussions

Proximate composition of wheat bran, crude fiber, acid detergent fiber, neutral detergent fiber, dietary fiber and phytic acid for AACC certificated wheat bran and wheat bran before and after dephytinization process was summarized in table (1). The disappearance of phytic acid after dephytinization process from 3.46% to 0.4% during the 6 hours at 40 °C of incubation period was caused by enzyme degradation as confirmed by phytase when involving at pH 5 — 5.2 adjustments. From results shown in Fig (1) it can be seen that a number of different factors influenced the hydrolysis of phytic acid during incubation period.

Holding the mixture of wheat bran under conditions allow the enzyme to affect changes in the mixture bran phytate, it was observed that wheat phytase does not hydrolysis all six phosphate from phytate, but only five phosphate to give inositol-monophosphate, phosphatase which produced by wheat enzyme split minosit monophosphate to inorganic phosphorus and inositolé. It would seem, therefore that phytase requires a soluble substrate for its action and that the increased destruction which takes place with the lowering of pH is due partially to the increased solubility of natural phytates.

Major sources of confusion are the term dietary fiber and crude fiber. Crude fiber is what remains of cell-wall constituents after treatment with acid, alkal and alcohol. Wheat bran contains about 22% cellulose and lignin. 25% hemicellullos and 6% total sugar. Microorganisms in the colon can, however digest the component of dietary fiber. The process of dephytinization process did bot alter the level of crude fiber. ADF, NDF and dietary fiber significantly, slightly changes were occured may be due to the solubility of some starch, pectin or hemicellulose content of wheat bran.
Table II. summarized and compared with known values of wheat bran AACC. Higher percentage of material were retained on the 30-40 mesh before and after dephytinization process. Some investigators linked diversity in particle size of fiber to increase in rate of water absorption in human colon. When bread with different amount of the same fiber (20-40 peashulls) were tested for the relationship of consumed cellulose to fecal volume, the correlation coefficient increased to \( r = 0.686 \). This claim that increase the mesh (P. S) improve human nutrition. Bread made with different concentration of 20-40 mesh peas hulls show an excellent correlation \( (r = 0.980) \) between fecal volume and dry matter digestability. Research suggest that the extent of milling also affect of physical characteristic of fiber containing foods. They indicated that mean particle size (MPS) increased the water-holding capacity, also rises. The bile salt binding was also correlate with log (MPS).

Effect of dephytinization process on densities and waterholding capacity:
Types of dry density measurements as well as measures of hydrated density are shown in table III. The AACC wheat bran compared with wheat bran before and after dephytinization process. It was observed that densities did not change significantly after dephytinization. The densities of wheat bran are capable of retaining water to some degree, and the water displacement or hydrated density value reflect the extent of hydration. It was noted in some cases the denser fiber soon exhibited the largest hydrated density values. The AACC bran considered of higher recorded densities among the food fiber source.

Water-holding capacity: In this study several measures were carried to estimate water-holding capacity of wheat bran. Table III. showed that water-holding capacity was decrease from 7.10 to 6.80 ml/g. The causes of this changes may be due to hydration and drying process which can effect on cell-wall and change in holding capacity of water, the test was carried out at pH 7.3. Some data reflect that there was considred variations in response to pH variations. The nutritional
significance of water holding-capacity for wheat bran as density fiber. In general
change in fecal output reflect the digestability of the foods and their water-holding
capacity and/or their breakdown into osmatically or physiologically active compo-
nents. Wheat bran had a greater water-holding capacity than oat bran or that
wheat bran feeding increased motility sufficiently so that water holding effectively
recovered from the intestinal contents.

Several publications had linked particle size with water absorption. It have
shown that for certain dietary fiber a reduction in particle size results in a signi-
ficance decline in estimated hemicellulose content a constituents largely responsible
for hydrophilic characteristics and consequently water-holding capacity. The same
component was also shown to be partially solubilized in particular fibers when
exposed to acid or alkali treatment. When AACC certificated wheat bran was
exposed to pH 2,69 and 5,20 the water-holding capacity was 5,99 and 5,70 respec-
rively, means that the variation of pH in the acid side had insignificant effect the water-holding capacity of wheat bran. Hold wheat bran at 40—45 °C du... capacity. Some investigators showed that rise temperature to 100 °C resulte... enlarged, elongated particle and structure damage will occurred.

The most significant finding in this study was the reduction of phytic by this simple process by phytase activity of wheat bran and improve its nutritional value as a good source for dietary fiber for supplementary foods.

Further studies are needed to establish the nutritional evaluation of dephosphatization wheat bran.

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