Processed Wheat Bran as a Food that Decreases Food Intake
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Research Questions

Control of eating is clearly a very complex phenomenon. However, a number of hormones have been identified that play important roles in both the desire to begin eating and the signal to stop eating. These are referred to as satiety-related hormones.

Wheat bran is a rich source of phenolic compounds that, if absorbed, are thought to have highly beneficial health effects. Unfortunately, these phenolic compounds are normally bound in such a way that they remain almost entirely unavailable for absorption. As part of a recently completed USDA grant, we have conducted a study in obese, diabetic rats (Zucker Diabetic Fatty rats) in which we fed wheat bran that was chemically treated and subjected to high pressure homogenization to release the phenolic compounds, thereby making the phenolic compounds present in the wheat bran available for intestinal absorption. Rats consuming the processed wheat bran tended to weigh less and tended to consume less diet that rats consuming normal wheat bran. Most importantly, the rats consuming the processed wheat bran diet clearly had less body fat, indicating that the processed wheat bran was in some way reducing the accumulation of body fat.

We hypothesized that consumption of the processed wheat bran may have changed the concentration of these satiety-related hormones in such a way as to decrease food intake in our animals compared to rats eating normal, unprocessed wheat bran.

Results

The Zucker Diabetic Fatty (ZDF) rat is a model for the human condition referred to as metabolic disease. Metabolic disease is a risk factor for diabetes and cardiovascular disease. Rats fed processed wheat bran had reductions in the factors that define metabolic disease, such as high cholesterol, high fasting glucose, insulin resistance, and excess body fat. These rats also ate less diet. Although the hormone results were complex and the interpretation challenging, overall, the changes in the satiety-related hormones were in the direction that would suggest that the processed wheat bran increased satiety and therefore may explain, in part, the decrease in food intake.

Application/Use

Wheat bran processed in such a way as to release bound phenolics, which are predominantly ferulic acid, could be used as a food ingredient for cereal-based foods such as bread, pastries, ready-to-eat cereals, and pasta. Doing so may well impart a significant health benefit by increasing satiety, as well as other health benefits identified in the USDA study (improved glucose control, cholesterol lowering).

Materials and Methods

Plasma obtained from rats fed the diets contain unprocessed and processed wheat bran were analyzed for satiety-related hormones by radioimmunoassay (RIA) or ELISA.

Economic Benefit to a Typical 500 Acre Wheat Enterprise

Wheat bran is currently a byproduct of wheat milling with low economic value. Processing the wheat bran to release bound phenolics would create a product with potentially much higher economic value. Creation of such a product may increase the value of wheat overall, thus providing economic benefit to the wheat growers.

Related Research

Studies are currently underway examining the health benefits of whole wheat flour and its various fractions (refined wheat flour, wheat bran, and wheat germ) in Zucker Diabetic Fatty rats. Parameters being examined include large intestinal fermentation, liver cholesterol, fatty liver, glucose control, bile acid excretion, and plasma adipokine profiles. These studies are intended to attempt to define which fraction(s) of wheat are most important in providing health benefits. An abstract of our results to date has been submitted for the Experimental Biology 2013 meetings in April.

Recommended Future Research

Further work exploring more commercially feasible methods of processing wheat bran in such a way as to release phenolics is clearly warranted. Additionally, studies on the mechanism of action of the released phenolics in producing the health benefits defined so far (e.g. cholesterol lowering, improved glucose control, reduced body fat) would be use-
ful in gaining acceptance of such a product. Finally, studies on the benefits of the processed wheat bran in other animal models, such as a model of insulin resistance, or even humans would be most beneficial for promoting wheat bran processed to liberate phenolics as a commercial product.

**Other Sources of Funding for this Project**

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**Appendix**

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**Plasma Ghrelin**

Bars represent the means ± SEM, n=12. Bars within a feeding state (fasted vs. fed) with different letters are significantly different (p<0.05).

Greater plasma concentrations of ghrelin are associated with great hunger. Thus, lower ghrelin concentrations suggest great satiety.

**Publications**

High plasma concentrations of amylin are thought to increase satiety and decrease food intake. However, recent evidence suggests that amylin concentrations may also reflect the total amount of body fat.

**Plasma PYY**

*PYY* is produced in the lower part of the small intestine and the colon, and high concentrations in the plasma have been found to lower food intake. That is, high PYY concentrations are thought to increase satiety.