

Phytate Effect and Nutrient Levels in Whole Grain Flours

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ABSTRACT SUMMARY

Iron and several B vitamins have been added to refined wheat flour in North America and the United Kingdom since the 1940s to improve public health (2). Now more than 70 countries fortify wheat flour with at least iron or folic acid (11).

Folic acid, a form of vitamin B9, has been added to flour since 1996. This has resulted in a 30–70% decline of neural tube defects (12).

These birth defects such as spina bifida are permanently disabling or fatal, but they can be mostly prevented if women consume 400 micrograms of folic acid daily at least a month before conception and in the first few weeks of pregnancy.

Many countries which fortify wheat flour do not require fortification of whole grain flour. In some places, whole grain flours are not fortified to give consumers a choice between fortified and unfortified grain products. In other countries, whole grain flours are not fortified because whole grain flour retains more of the wheat's original vitamins and minerals and is thereby considered adequately nutritious without fortification. However, whole grain flours have a high phytate content which inhibits absorption of iron, zinc, and calcium (4). Also, wheat's naturally occurring vitamins may not be enough to have a desired public health impact.

As consumers are encouraged to eat more whole grains, it may be necessary to consider fortification of these flours.

Introduction

Wheat berries are natural sources of iron, zinc, and vitamins B1 (thiamine), B2 (riboflavin), B6 (pyridoxine), and E. Smaller amounts of essential vitamins such as B9 (folate) also naturally occur in wheat (3).

These nutrients are in the outer layers of the wheat grain, and highly refined wheat flour may lose as much as 80% of the wheat's natural vitamin content in the milling process (4). Whole grain flours are less refined and consequently retain more of wheat's natural nutrition.

In the United States, consumers are encouraged to increase their consumption of whole grains. Beginning in 2011, the U.S. Department of Agriculture has suggested that half of a person's daily grain consumption should be from whole grains (10).

While following this advice will increase fiber intake, choosing more whole grains could inhibit consumers' mineral absorption due to the grains' higher phytate content.

Also, the United States is one of several countries where the prevalence of neural tube defects declined significantly after flour was fortified with folic acid (12). Whole grain flour is typically not fortified in many countries, including the United States. If consumers replace refined, fortified grain products with whole grain, unfortified grain products, the unintended consequence could be an increase in the incidence of neural tube defects.

Phytates

When the wheat plant draws iron, calcium, and zinc from the soil, these minerals are chemically bound with the phytates in the wheat berry. The nutrients and the phytates are in the outer layers of wheat, and both are removed to a large degree in highly milled refined flours. In contrast, whole grain flours retain more of wheat's natural nutrients and phytates.

Phytates are considered potent inhibitors of iron, zinc, and calcium absorption (4). One study of a rural population in Iran found iron-deficiency anemia even though the people's diets included high iron intakes. This was attributed, in part, to the "substantial intakes of phytate present in the unleavened wholemeal wheat bread that is the main dietary staple of the villagers" (5). Because whole wheat flour inhibits iron, zinc, and calcium absorption (9), consumers who choose more whole grains may be inadvertently limiting their ability to absorb essential minerals.

Completely removing phytates from complementary foods has been shown to increase the percentage of iron absorbed from those foods by as much as 12-fold (6). Yet it is not practical to completely remove phytates during flour milling. Instead, World Health Organization (WHO) recommendations for flour fortification call for using sodium iron with ethylenediaminetetraacetic acid (EDTA) in whole grain flours (8). The EDTA in this iron compound serves as a chelating agent to make the iron used in flour more bioavailable. The WHO recommendations also call for higher levels of zinc to be used in whole grain fortification (8). Flour can be fortified with calcium, but global guidelines are not available to help determine the amount of calcium that would need to be added to flour for nutritional purposes.

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Nutrient Amount

Even though whole grains retain more of the wheat's natural nutrients, these levels of vitamin and minerals may not be enough to address public health concerns. One example is folic acid. In the early 1990s, some countries added folic acid to flour at a level to replace the nutrient lost in the milling process. These amounts were not high enough to significantly impact the prevalence of neural tube defects, however (1).

Women who may become pregnant are encouraged to take 400 micrograms of folic acid every day to help prevent neural tube defects. The naturally occurring form of vitamin B9, known as folate, is less bioavailable than folic acid. It is very difficult to consume the dietary equivalent of 400 micrograms of folic acid a day from unfortified foods (7).

Beginning in 1996, several countries began adding folic acid to flour at a rate of 1.4 or 1.5 parts per million. The 10 countries that have studied the change in neural tube defect prevalence since fortifying flour with folic acid at these levels have reported declines of 30 to 70 percent (12). The WHO recommendations for flour fortification now call for one to five parts per million of folic acid, depending on the population's average per capita consumption of wheat flour (8).

Conclusion

The list of foods made with refined flour is almost endless. Sandwich buns and rolls, pizza crust, crackers, tortillas, instant noodles, pretzels, and spaghetti are only a few examples. Whether consumers follow the advice to choose these products made with whole grains instead of more refined flour is yet to be determined.

If whole grain consumption increases consistently, countries which fortify flour as a public health intervention may want to consider revising their standards to include fortification of whole grain flours. Adding more zinc and an iron compound that counters the effect of phytates would enhance the health benefits of whole grain products.

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Sarah Zimmerman is communications coordinator for the Flour Fortification Initiative, a network of partners in the public, private, and civic sectors working together to make flour fortification standard milling practice worldwide.

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