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High Untreated Phytic-Acid In The Diet, May Lead To Mineral Deficiencies, Specifically, During Pregnancy

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***Abstract*—Wheat bread, rice and unfermented soy, are the main part of the many industrialized country's people diet. Due to improper preparation and fermentation, Phytic-acid, The compound which bounds with calcium, magnesium and zinc and reduce the absorption of these important minerals, is one important cause of mineral deficiencies in men and women. Improper sourdough fermentation and not enough time to fermentation process, will not reduce the amounts of phytic-acid in bread and legumes. The certain mineral deficiency during pregnancy is one of the main health issues that is important to be considered by physicians. Magnesium, iron, zinc and calcium are three of the main mineral for the healthy mother and child which could be depleted by consuming high-phytate diets.**

Keywords—Phytic-acid, mineral deficiency, pregnancy, sourdough fermentation

INTRODUCTION

Phytic-acid or inositol hexa-kisphosphate (IP6), inositol polyphosphate, or phytate when in salt form, discovered in 1903, a saturated cyclic acid, is the principal storage form of phosphorus in many plant tissues, especially bran and seeds.[33] It can be found in cereals and grains. Catabolites of phytic-acid are called lower inositol polyphosphates.

It contains the mineral phosphorus which is tightly bounded in a molecule in the shape of snowflake. Humans and animals have one stomach, which results in the phosphorus to be not readily bioavailable. In addition to blocking phosphorus availability and absorption, the arms of the phytic-acid molecule readily bind with the minerals, such as calcium, magnesium, iron and zinc, which results in making them unavailable as well. In this form, the produced compound is called "phytate".

Phytic-acid not only chelates important minerals in human body, but also inhibits enzymes that we need to digest our food, including pepsin[1], which is needed for the breakdown of proteins in the stomach, and amylase, needed for the breakdown of starch into sugar. Trypsin, needed for protein digestion in the small intestine, is also inhibited by phytates.[3]

The presence of phytic acid in so many enjoyable foods we regularly consume, makes it imperative that we know how to prepare and make these foods to neutralize phytic acid compound as much as possible, and also to consume them in the form of a diet containing factors that mitigate the harmful effects of phytic-acid.

Phytic-acid is present in beans, seeds, nuts, grains, specifically in the bran or outer hull. phytates are also found in tubers, and trace amounts occur in certain fruits and vegetables like berries and green beans. Almost 80 percent of the phosphorus, a vital mineral for bones and health, present in grains is locked into an unusable form as phytate.[4] When a diet including more than small amounts of phytates is consumed, the body will bind calcium to phytic acid and form insoluble phytate complexes. The result is you lose calcium, and don't absorb phosphorus. Further, research suggests that we will absorb approximately 20 percent more zinc and 60 percent magnesium from our food when phytate is absent.[5]

The amount of phytates in grains, nuts, legumes and seeds is highly variable. the levels that researchers find when they analyze a specific food probably depends on growing conditions, harvesting techniques, processing methods, testing methods and even the age of the food being tested. Phytic acid will be much higher in foods grown using modern high-phosphate fertilizers than those grown in natural compost.[6]

Diets high in phytates, results in mineral deficiencies. In populations where cereal grains provide a major source of calories, rickets and osteoporosis are common.[7]

The human body has some ability adapting to the effects of phytates in the diet. Several documented studies show that subjects which are given high levels of whole wheat at first, excrete more calcium than they take in, but after several weeks on this diet, they reach a balance and do not excrete excess calcium.[8] But, no studies of this important phenomenon have been carried out over a long period, nor have researchers looked at whether human beings can adjust to the phytate-reducing effects of other important minerals including iron, magnesium and zinc.

The zinc and iron-blocking effects of phytic-acid can be just as serious as the calcium-blocking effects. For example, a wheat roll containing 2 mg phytic acid inhibited zinc absorption by 18 percent, 25 mg phytic-acid in the roll inhibited zinc absorption by 64 percent, and 250 mg inhibited zinc absorption by 82 percent.[9] Nuts have a marked inhibitory action on the absorption of iron due to their phytic-acid content.[10]

Over the long run, when the diet low or lacks minerals, contains high levels of phytates or both, the metabolism goes down, and the body goes into mineral starvation stage. The body then sets itself up to use as little of these minerals as possible. Adults may get by for years on a high phytate diet, but teens and growing children face severe problems. In a phytate-rich diet, their bodies will suffer from the lack of calcium and phosphorus with poor bone growth, short stature, rickets, narrow jaws and tooth decay, and for the lack of zinc and iron with anemia and mental retardation.

Material & Methods

By reviewing the results from several studies and deeply categorizing their conclusions, we can simply organize our data based on in vivo experiments:

(A) Phytase

Phytase is the enzyme which neutralizes phytic-acid and liberates the phosphorus. This enzyme exists in plant foods that contain phytic acid.

Ruminant animals such as cows, sheep and goats, have no trouble with phytic-acid because phytase is produced by rumen micro-organisms. Mono-gastric animals also produce phytase, Mice produce thirty times more phytase than humans[11], therefore they do not face problems eating a raw whole grain.

In general, humans do not produce enough the phytase enzyme to safely consume large quantities of high phytate foods on a regular basis. But, probiotic lactobacilli, and other species of the endogenous digestive micro-flora can produce phytase[12]. Therefore, humans who have good intestinal flora will have an easier time with foods containing phytic-acid. Increased production of phytase by the gut microflora explains why some men and women can adjust to a high-phytate diet. Sprouting technique, activates phytase and reducing phytic-acid[13]. The consumption of sprouted grains will reduce the quantity of phytic acids in animal feed, with no significant reduction of nutritional value.[14]

Soaking grains and flour in an acid medium at very warm temperatures, as in the sourdough process, also activates phytase and reduces or even eliminates phytic acid.

Before the advent of industrial agriculture, farmers typically soaked crushed grain in hot water before feeding it to poultry and hogs. Today, feed manufacturers add phytase to grain mixes to get better growth in animals. Commercial phytases are typically produced using recombinant DNA technology. For instance, a bacterial phytase gene has recently been inserted into yeast for commercial production.

Not all grains contain enough phytase to eliminate the phytate, even when properly prepared. For example, corn, millet, oats and brown rice do not contain sufficient phytase to eliminate all the phytic acid they contain. On the other hand, wheat and rye contain high levels of phytase—wheat contains fourteen times more phytase than rice and rye contains over twice as much phytase as wheat.[15] Soaking or souring these grains, when freshly ground, in a warm environment will destroy all phytic acid. The high levels of phytase in rye explain why this grain is preferred as a starter for sourdough breads.

Phytase is destroyed by steam heat at about 176 degrees Fahrenheit in ten minutes or less. In a wet solution, phytase is destroyed at 131-149 degrees Fahrenheit.[16] Thus heat processing, as in extrusion, will completely destroy phytase—think of extruded all-bran cereal, very high in phytic acid and all of its phytase destroyed by processing. Extruded cereals made of bran and whole grains are a recipe for digestive problems and mineral deficiencies!

Phytase is present in small amounts in oats, but heat treating to produce commercial oatmeal renders it inactive. Even grinding a grain too quickly or at too high a temperature will destroy phytase, as will freezing and long storage times. Fresh flour has a higher content of phytase than does flour that has been stored.[17] Traditional cultures generally grind their grain fresh before preparation. Weston Price found that mice fed whole grain flours that were not freshly ground did not grow properly.[18]

Cooking is not enough to reduce phytic acid—acid soaking before cooking is needed to activate phytase and let it do its work. For example, the elimination of phytic acid in quinoa requires fermenting or germinating plus cooking. In general, a combination of acidic soaking for considerable time and then cooking

will reduce a significant portion of phytate in grains and legumes.

(B) The Phytate Threshold

It seems that once the phytate amount has been reduced, such that there is more available phosphorus than phytate in the grain, we have passed a critical point and the food becomes more beneficial. Phosphorus retention decreases when phytates in the diet is 30-40 percent or more of the total phosphorus.[19]

For best health, phytates should be lowered as much as possible, ideally to 25 milligrams or less per 100 grams or to about 0.03 percent of the phytate-containing food eaten. At this level, micronutrient losses are minimized. White rice and white bread are low-phytate foods due to their bran and germ have been removed. Of-course, they are also empty of vitamins and minerals.

(C) Phytates And roasting Process

Heating and Roasting wheat, barley or green grains decreases phytic-acid content by around 40%.[20] If one, soaks roasted grains, he/she should do so with a culture that supplies additional phytase, since phytase enzyme will be destroyed by the roasting process.

(D) Phytates And Soaking Method

For grains and legumes that are low in phytase, soaking them does not usually and sufficiently reduce or even eliminate phytic-acid. Soaking of soya bean, maize, sorghum, and mung bean at 92 degrees F for 24 hours decreased the amount of phytic-acid by 4–51 percent.[21] With these same grains and beans, soaking at room temperature for 24 hours reduced phytic-acid levels by 16 to 21 percent.[22] However, soaking the pounded maize for 60 minutes at room temperature, already led to a reduction of phytic-acid by 51 percent.[23]

Sourdough fermentation method of grains which contains high amounts of phytase enzyme, such as wheat and rye berries, is the process that works best for the reduction of phytates. Sourdough fermentation technique of whole wheat flour for just 4 hours at 92 degrees Fahrenheit, led to a 60 percent reduction in phytic-acid. Phytic-acid amount of the bran samples was reduced to 44.9 percent after 8 hours at 92 degrees fahrenheit.[24] The addition of malted grains and bakers yeast increased this reduction to 92-98 percent. One well-documented study showed almost complete reduction or even elimination of phytic-acid in whole wheat bread after 8 hours of sourdough fermentation method.[25]

By reviewing a study of phytates in recipes, used typically by home bread bakers, found that leavening with commercial yeast was much less effective at removing phytates. Yeasted whole wheat breads lost only 22-58 percent of their phytic acid content from the start of the bread making process to the complete loaf.[26]

(E) Rice And Brown Rice

Brown rice is high in phytates. One reference puts phytate content at 1.6 percent of dry weight, another at 1250 mg per 100 grams dry weight (probably about 400 mg per 100 grams cooked rice). Soaking brown rice will not effectively eliminate phytates because brown rice lacks the enzyme phytase; it thus requires a starter.[30] Nevertheless, even an eight-hour soak will eliminate some of the phytic-acid, reducing the amount in a serving to something like 300 mg or less.[28]

The ideal preparation of rice would start with home-milling, to remove a portion of the bran, and then would involve souring at a very warm temperature (90 degrees fahrenheit) at least sixteen hours, preferably twenty-four hours.[28] Using a starter would be ideal. For those with less time, purchase brown rice in air-tight packages. Soak rice for at least eight hours in hot water plus a little fresh whey, lemon juice or vinegar. If you soak in a tightly closed mason jar, the rice will stay warm as it generates heat. Drain, rinse and cook in broth and butter.

(F) Bread

Bread, is the main part of human's food. If it will not have careful preparations, therefore bread can be the highway to an early grave. Firstly, the flour of the grains used in any kinds of bread should be stone ground. Wheat and rye contain high levels of phytase, but this enzyme is destroyed and eliminated by the heat of industrial grinding, and also becomes less over the period of time. Fresh grinding of wheat or rye berries before use will ensure that the main amount of phytase remains in the flour.[31, 32]

Rye berries do contain highest amount of phytase in comparison with phytates of any grain, so rye berries are maybe the perfect grain to use as a sourdough starter. Phytates in wheat grains are mostly reduced during sourdough preparation method, because wheat is also high in phytase. Yeast rising bread may not completely reduce phytic-acid levels.[27] Phytate breakdown is apparently higher in sourdough bread than in yeasted bread preparation method.[29]

Yet even with the highly fermentable rye, a traditional ancient recipe from the French calls for removal of 25 percent of the bran and coarse substances. As an example of this practice, one small bakery in Canada sifts the coarse bran out of the flour before making it into bread.[31, 32]

Mineral Deficiency During pregnancy

Certain mineral deficiency during pregnancy will cause certain health issues for mother and fetus. Zinc deficiency may lead to auto immune disorders.[34] Magnesium is an important mineral needed for regulation of body temperature, DNA and protein synthesis and in maintaining nerve and muscle cell electrical potentials.[36]Iron and calcium deficiency outcome is well established during pregnancy that may link to certain types of disorders in mother and fetus.[36]

Discussions

Phytates and phytic-acid is only one of many anti-nutrients in grains, nuts, seeds and beans. These include oxalates, tannins, trypsin inhibitors, enzyme inhibitors, lectins (hemagglutinins), protease inhibitors, gluten, alpha-amylase inhibitors and alkylresorcinols .

Anti-nutrients exist in these plant foods because they are part of the process of life. The natural world requires them in order to perform many important tasks, including protection against insects, maintaining freshness of seeds for germination, and protection against mold, bacterias, viruses and fungus. In order to eat these foods regularly, we must remove phytates and other anti-nutrients through processing in harmonious ways. Many professionals in the field of healthcare assure us that if something is from nature, then it will not need processing. Phytates act as the seed's system of preservatives, like the impossible-to-open plastic packaging of many consumer goods. To get to the item we need, for instance phosphorus, we need to un-wrap the phytate-phosphorus package.[29]

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Conclusion

Grains need careful preparation since they contain a number of anti-nutrients that can cause serious health issues. Phytic-acid, is an organic acid compound, in which phosphorus is bound. It is mostly found in the bran or outer hull of seeds. Untreated phytic-acid can combine with calcium, magnesium, copper, iron and especially zinc in the intestinal tract and block their absorption. This is the main reason a diet high in improperly prepared whole grains may lead to serious mineral deficiencies. The modern misguided practice of consuming large amounts of unprocessed bran often improves colon transit time at first but may lead to irritable bowel syndrome(IBS) and, in the long run, many other adverse effects. In a well-balanced diets, this is rarely a concern, but may be a significant problem during periods of malnutrition, and in developing countries where the main food source is grains or legumes.

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