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Phytic Acid: An Optimal Barrier to Iron Absorption

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ABSTRACT

As an enzyme inhibitory agent, phytotic acid binds to certain macronutrients and micronutrients to aid in digestion and limit the body's ability to absorb them. Every time iron enters the body, phytotic acid acts as an enzyme to limit its absorption, resulting in deficiencies such as anemia, folic acid shortage, and many others. As an enzyme inhibitor, phytotic acid binds to certain macronutrients and micronutrients to aid in digestion and limit the body's ability to absorb them. Phytic acid functions as an enzyme that limits the body's ability to absorb iron. When iron enters the body along with phytotic acid, it can cause shortages such as anemia and folic acid insufficiency, among other things. Phytate, another name for phytic acid, acts as a barrier to the absorption of iron. Many grains and cereals are high in phytic acid, which prevents our bodies from absorbing iron when eaten. Since most individuals are unaware of the reason for poor iron absorption, it is crucial to raise public knowledge about phytic acid in order to encourage them to alter their eating habits. Deficits in minerals, such as zinc, iron, calcium, and magnesium, are the result. Numerous studies on phytic acid and its impact on iron absorption have revealed that staple foods are high in phytic acid, and numerous innovative methods have been developed to reduce the amount of phytic acid in staple foods.

Keywords: Phytic Acid; Bioavailability; Heme Iron; Non-Heme Iron; Phytate; Phytase; Dephytinization

Introduction

A naturally occurring chemical that inhibits the absorption of minerals such as iron, zinc, and calcium. It acts as a barrier to stop the absorption of nutrients. It prevents minerals and nutrients from being absorbed by binding them. Phytic acid is found in considerable amounts in a variety of plant-based foods, including cereals, legumes, corn, wheat, rice, and soybeans.

What is phytic Acid Used For?

Phytotic acid does not cause disease, but it can induce shortages in iron and zinc, which can result in several other health problems [1]. Iron and zinc are important micronutrients that are necessary for many human physiological processes. These components, which are abundant in a variety of plant-based meals like cereals and legumes, face barriers to absorption because of substances like phytic acid and polyphenols present in the food matrix. As a result, areas that depend significantly on plant-based diets frequently have deficits. By creating soluble chelates with iron and zinc from plant-based sources, some organic acids, such as citric acid and ascorbic acid, have been shown to be essential in improving absorption of these elements [2]. A strong chelating agent, phytotic acid can bind to vital micronutrients such calcium, manganese, magnesium, iron, and zinc [3]. As a result, insoluble plant salt complexes are created, which drastically lower the bioavailability of bound minerals and prevent the gastrointestinal tract from absorbing them [4]. and possibly resulting in deficits, especially in areas where phytic acid-rich foods are the main source of their diet [5].

Phytate

Iron absorption in plant-based diets is mostly inhibited by myo-inositol hexakisphosphate, also known as phytate. Phytate has been shown to have a dose-dependent negative effect on iron absorption, starting at incredibly low concentrations of 2–10 mg/meal. The molar ratio of phytate to iron can be used to evaluate the effect on absorption. In plain cereal or legume-based meals without any iron absorption enhancers, the ratio should be less than 1:1, or ideally less than 0.4:1, or less than 6:1 in composite meals that include meat and some vegetables that contain ascorbic acid as enhancers. Milling, heat treatment, soaking, germination, and fermentation are some of the food processing and preparation techniques that can be employed to eliminate or break down phytate to varying degrees. Iron absorption can be significantly improved by using exogenous phytotase, activating it during food preparation, or adding it to a meal just before consumption [1]. Iron bioavailability in common beans is negatively impacted by phytic acid (PA) and polyphenols (PPs). Novel low-PA (lpa) beans with 90% less PA and different PPs may improve iron bioavailability [6].

Young Women's Low Iron Bioavailability from Common Beans is Influenced by Polyphenols and Phytotic Acid

Iron absorption decreased by 14% ($P < 0.05$) with 50 mg PP and by 45% ($P < 0.001$) with 200 mg PP. The average iron absorption from whole bean porridge was 2.5%. While eliminating PP from dephytinized oatmeal increased absorption 2.6 times ($P < 0.001$), removing PP and PA doubled absorption ($P < 0.001$). Between-study comparisons showed that dephytinization did not improve iron absorption in the presence of PP; however, absorption increased 3.4 times in their absence ($P < 0.001$) [7].

Disorders Resulting from Iron Malabsorption

These phytate complexes result in anemia, skeletal abnormalities, osteoporosis, malabsorption, and Kwashiorkor syndrome because of deficits in Fe, Mn, Ca, Zn, and proteins. Additionally, they are not accessible to people. A successful phytic acid reduction method should lead to improved micronutrient bioavailability [8].

Phytic Acid levels in Pregnant Pakistanis' Diets and Iron Insufficiency in Norway

To test the hypothesis that pregnant Pakistani women in Oslo are more likely than pregnant Norwegian women to experience iron deficiency, and to determine whether dietary differences can explain some of the variances in stored iron. During the 18th week of pregnancy, a cross-sectional study was conducted. 38 Norwegian and 38 Pakistani women who were referred to the Aker and U llevål Hospitals in Oslo for routine ultrasound exams took part. Phytate (inositol hexaphosphate) and the breakdown products were examined in bread and chapattis. Iron deficiency appears to be far more common in pregnant Pakistanis in Norway than in expecting Norwegians. We speculate that the main reasons for this are the higher phytate content in the Pakistani group's diet, lower prevalence of iron supplementation during pregnancy, and higher parity [9].

Examining Phytate-Element Interactions

Impacts for the Bioavailability of Calcium, Zinc, and Iron with a Focus on Legumes

Since its role in element bioavailability has already been investigated, we restate in this review the importance of phytate breakdown as a method to enhance the mineral bioavailability of mineral-fortified legume crops. When paired with other bioavailability enhancers (such NaCl), two food processing methods—development and fermentation—have been shown to be successful in lowering phytate and raising mineral bioavailability [10].

Elements that Impact Iron Absorption and How Fortification Raises Iron Levels

Certain food elements can either enhance or limit the body's ability to absorb iron from the diet. Animal proteins and organic acids improve iron absorption, while phytate, calcium, and polyphenols reduce it [11].

Iron Bioavailability in Indian Women is Considerably Increased by a Natural Low Phytic Acid Finger Millet Accession

Compared to the high phytic acid accession, iron absorption was significantly higher in the low phytic acid accession (3.7 vs. 1.3%, $p < 0.05$). Iron insufficiency may be avoided in regions where finger millet eating is widespread due to its low phytic acid content [12].

Pregnancy Supplements Raise the Chance of Neonatal Anemia in Infants

High untreated phytic acid intake can lead to mineral deficiencies, especially during pregnancy [13].

Pycnogenol's Stability as a Component in Fruit Juices that Undergo Simulated Gastrointestinal Digestion

Anti-nutrients such as phytic acid in food affect nutrient absorption and bioavailability. Anti-nutrients are substances, either natural or synthetic, that prevent nutrients from being absorbed and becoming bioavailable. Phytotic acid (PA) is one anti-nutrient that can interfere with the absorption of nutrients. It affects the bioavailability and intestinal absorption of some vital minerals, including calcium, magnesium, iron, and zinc, which are required for the basic chemistry of life [14].

Cereal Grains' Phytic Acid Content: Composition, Safe or Unsafe Methods of Lowering it, and the Impact on Nutritional Value

Variability in PA composition is influenced by a number of factors, including growing conditions, harvesting and processing techniques, and the age of the food grains collected [15].

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Analysis of the Molar Ratios of Calcium, Iron, Zinc, and Phytate in Regularly Consumed Raw and Cooked Foods in Malaysia

It may be very risky and create a conflict of interest for plant growth and development to try to generate plants low in PA through bio-fortification, which reduces the amount of PA in edible plants for nutritional purposes. Nonetheless, some plant-based foods—especially those that are high in PA and low in micronutrients—need to be genetically altered. Rice, a basic grain that is commonly consumed, especially in developing countries, has significant amounts of PA, according to study by Norhaizan and Norfaizadatu [16].

Minerals, Tannins, and Phytic Acid in 18 Brazilian Desert Fruits. Journal of Food Sciences & Nutrition International

The molar ratio of PA minerals establishes whether PA results in mineral deficiency. One can estimate the mineral bioavailability by using the molar ratio of PA to Zn, Ca, and Fe [17].

Pathological Calcifications, Phytate, and Plant Phosphates in Chronic Renal Disease.

Nefrología There are certain health benefits even if PA's negative effects on calcium may not be ideal for your diet. It prevents kidney stone disease (urolithiasis) by preventing kidney stones from developing [18].

For Ghanaian Kids from Rural Areas, Micronutrient-Fortified Rice can be a Substantial Source of Dietary Bioavailable Iron

Fe weakness "A very serious nutritional challenge globally," anemia may be made worse by PA-induced alterations in Fe bioavailability. A deficit in hemoglobin production is what sets it apart. Almost two billion people worldwide suffer from anemia [19-21].

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