Review Article

International Journal of Translational Science & Research

Phytic Acid and its Overall Effects on Health

Mohammad Kamil*

Director General, Lotus Holistic Institute, Abu Dhabi, UAE.

***Correspondence:**

Professor Dr. Mohammad Kamil, Director General, Lotus Holistic Institute, Abu Dhabi, UAE.

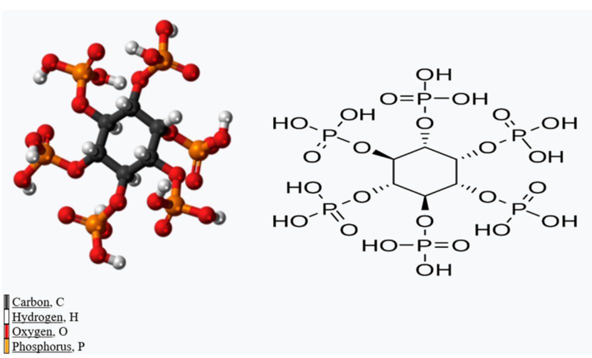
Received: 10 Jul 2025; **Accepted:** 18 Aug 2025; **Published:** 27 Aug 2025

Citation: Mohammad Kamil. Phytic Acid and its Overall Effects on Health. Int J Transl Sci Res. 2025; 1(1): 1-4.

Keywords

Phytic Acid, Mineral absorption, Well-balanced diet.

Phytic acid is a unique natural substance found in plant seeds. to more clarify Phytic acid is found only in foods that come from plants. All edible seeds, grains, legumes, and nuts contain phytic acid in varying quantities. Small amounts are also found in roots and tubers.



Phytic acid can affect how the body absorbs some minerals, including iron. It may contribute to mineral deficiencies over time, but this is rarely a concern for people who eat well-balanced diets. It has received considerable attention due to its effects on mineral absorption. Phytic acid prevents the absorption of iron, zinc, and calcium and may promote mineral deficiencies. That's why it is often referred to as an anti-nutrient. It's not that simple, though — phytic acid also has a number of health benefits. It serves as the main form of storage for phosphorus in the seeds. Then, when seeds sprout, phytate is broken down and the phosphorus is released. The phosphorus will be used by the young plant.

Phytic acid which is found in many plant-based foods, is also called inositol hexaphosphate and IP6. This acid is the primary way phosphorus is stored in many plants, including beans, seeds, and nuts. When phytic acid is consumed, it binds to other minerals to create phytates.

Phytic Acid

Phytic acid is a six-fold dihydrogenphosphate ester of inositol (specifically, of the myo isomer), also called inositol hexaphosphate, inositol hexakisphosphate (IP6) or inositol polyphosphate. At physiological pH, the phosphates are partially ionized, resulting in the phytate anion.

The (myo) phytate anion is a colorless species that has a significant nutritional role as the principal storage form of phosphorus in many plant tissues, especially bran and seeds. It is also present in many legumes, cereals, and grains. Phytic acid and phytate have a strong binding affinity to the dietary minerals calcium, iron, and zinc, inhibiting their absorption in the small intestine [1].

Phytic acid was discovered in 1903 [2]. Phytases were first identified by Suzuki et al., who found an enzyme present in rice bran. Moreover, phytases are widespread in nature and can be produced from various host sources, including plants, animals, and microorganisms.

Generally, phosphorus and inositol in phytate form are not bioavailable to non-ruminant animals because these animals lack the enzyme phytase required to hydrolyze the inositol-phosphate linkages. Ruminants are able to digest phytate because of the phytase produced by rumen microorganisms [3].

In most commercial agriculture, non-ruminant livestock, such as swine, fowl, and fish [4], are fed mainly grains, such as maize, legumes, and soybeans [5]. Because phytate from these grains and beans is unavailable for absorption, the unabsorbed phytate passes through the gastrointestinal tract, elevating the amount of phosphorus in the manure [3]. Excess phosphorus excretion can lead to environmental problems, such as eutrophication [6]. The use of sprouted grains may reduce the quantity of phytic acids in feed, with no significant reduction of nutritional value [7].

Also, viable low-phytic acid mutant lines have been developed in several crop species in which the seeds have drastically reduced levels of phytic acid and concomitant increases in inorganic phosphorus [8]. However, germination problems have reportedly hindered the use of these cultivars thus far. This may be due to phytic acid's critical role in both phosphorus and metal ion storage [9]. Phytate variants also have the potential to be used in soil remediation to immobilize uranium, nickel, and other inorganic contaminants [10].

Biological Effects

Plants

Although indigestible for many animals as they occur in seeds and grains, phytic acid and its metabolites have several important roles for the seedling plant.

Most notably, phytic acid functions as a phosphorus store, as an energy store, as a source of cations and as a source of myo-inositol (a cell wall precursor). Phytic acid is the principal storage form of phosphorus in plant seeds [11]. Phytic acid impairs (prevents) the absorption of zinc, iron, calcium, and other minerals by your body (1Trusted Source, 3Trusted Source).

This applies to a single meal, not overall nutrient absorption throughout the day. In other words, phytic acid primarily reduces your mineral absorption during the meal but doesn't have major effects on subsequent meals.

Animals

In animal cells, myo-inositol polyphosphates are ubiquitous, and phytic acid (myo-inositol hexakisphosphate) is the most abundant, with its concentration ranging from 10 to 100 µM in mammalian cells, depending on cell type and developmental stage. Being not directly absorbed in the gut, phytic acid is not obtained from the animal diet, but must be synthesized inside the cell from phosphate and inositol (which in turn is produced from glucose, usually in the kidneys) [12,13].

In vitro

The interaction of intracellular phytic acid with specific intracellular proteins has been investigated *in vitro*, and these interactions have been found to result in the inhibition or potentiation of the activities of those proteins [14,15].

Inositol hexaphosphate facilitates the formation of the six-helix bundle and assembly of the immature HIV-1 Gag lattice. IP6 makes ionic contacts with two rings of lysine residues at the centre of the Gag hexamer. Proteolytic cleavage then unmasks an alternative binding site, where IP6 interaction promotes the assembly of the mature capsid lattice. These studies identify IP6 as a naturally occurring small molecule that promotes both assembly and maturation of HIV-1 [16].

Dentistry

IP6 has potential use in endodontics, adhesive, preventive, and regenerative dentistry, and in improving the characteristics and performance of dental materials [17-19].

Food Science

Phytic acid, mostly as phytate in the form of phytin (i.e. the calcium/magnesium salts of phytate), is found within the hulls and kernels of seeds [20], including nuts, grains, and pulses [1].

In-home food preparation techniques may break down the phytic acid in all of these foods. Simply cooking the food will reduce the phytic acid to some degree. More effective methods are soaking in an acid medium, sprouting, and lactic acid fermentation , such as in sourdoug and pickling [21].

No detectable phytate (less than 0.02% of wet weight) was observed in vegetables such as scallions and cabbage leaves or in fruits such as apples, oranges, bananas, or pears [22].

Dry food sources of phytic acid [22,26-32]		
Food	Proportion by weight (g/100 g)	
	Min.	Max.
Hulled Hemp Seed [20]	4.5	4.5
Pumpkin seed	4.3	4.3
Linseed	2.15	2.78
Sesame seeds flour	5.36	5.36
Chia seeds	0.96	1.16
Almonds	1.35	3.22
Brazil nuts	1.97	6.34
Coconut	0.36	0.36
Hazelnut	0.65	0.65
Peanut	0.95	1.76
Walnut	0.98	0.98
Maize (corn)	0.75	2.22
Oat	0.42	1.16
Oat meal	0.89	2.40
Brown rice	0.84	0.99
Polished rice	0.14	0.60
Wheat	0.39	1.35
Wheat flour	0.25	1.37
Wheat germ	0.08	1.14
Whole wheat bread	0.43	1.05
Beans, pinto	2.38	2.38
Buckwheat	1.00	1.00
Chickpeas	0.56	0.56
Lentils	0.44	0.50
Soybeans	1.00	2.22
Tofu	1.46	2.90
Soy beverage	1.24	1.24
Soy protein concentrate	1.24	2.17
New potato	0.18	0.34
Spinach	0.22	NR
Avocado fruit	0.51	0.51
Chestnuts [33]	0.47	
Sunflower seeds	1.60	

Fresh food sources of phytic acid [28]		
Food	Proportion by weight (%)	
	Min.	Max.
Taro	0.143	0.195
Cassava	0.114	0.152

Dietary Mineral Absorption

Phytic acid has a strong affinity for dietary trace elements, calcium, iron, and zinc, inhibiting their absorption from the small intestine [1,34]. Phytochemicals such as polyphenols and tannins also influence the binding [35]. When iron and zinc bind to phytic acid, they form insoluble precipitates and are far less absorbable in the intestines [36,37]. Likewise, absorption of calcium is impaired, with the result that diets high in phytates but low in calcium can result in rickets [38].

Soaking: Cereals and legumes are often soaked in water overnight to reduce their phytate content [39,40]. Because phytic acid can also affect the absorption of iron, "dephytinization should be considered as a major strategy to improve iron nutrition during the weaning period" [41]. Dephytinization by exogenous phytase to phytate-containing food is an approach being investigated to improve nutritional health in populations that are vulnerable to mineral deficiency due to their reliance on phytate-laden food staples. Crop breeding to increase mineral density (biofortification) or reducing phytate content is under preliminary research [42].

Fire Retarding Agent

Recently, phytic acid, in combination with other chemicals like silicates or others, has been increasingly used to enhance the fire retardancy of various composite materials [43,44].

Health Benefits of Phytic acid

Phytic acid is a good example of a nutrient that is both good and bad, depending on the circumstances. For most people, it's a healthy plant compound that serves as an antioxidant and may protect against insulin resistance [45]. Scientists have even suggested that phytic acid may be part of the reason why whole grains have been associated with a reduced risk of colon cancer [46]. In fact, phytic acid is a very powerful antioxidant found in nuts, seeds, and the fiber around rice, grains, and beans, along with some vegetables. It's there to protect the seed from growing. It's true that when we consume too much phytic acid it can block our zinc, iron, and other minerals [47,48].

References

1. Schlemmer U, Frølich W, Prieto RM, et al. Phytate in foods and significance for humans: Food sources, intake, processing, bioavailability, protective role and analysis. Mol Nutr Food Res. 2009; 53: S330-375.
2. Mullaney EJ, Ullah Abul HJ. Phytases: attributes, catalytic mechanisms, and applications. United States Department of Agriculture-Agricultural Research Service. 2012; 99-110.
3. Klopfenstein TJ, Angel R, Cromwell G, et al. Animal Diet Modification to Decrease the Potential for Nitrogen and Phosphorus Pollution. Council for Agricultural Science and Technology. 2002; 21.
4. Romarheim OH, Zhang C, Penn M, et al. Growth and intestinal morphology in cobia (Rachycentron canadum) fed extruded diets with two types of soybean meal partly replacing fish meal. Aquaculture Nutrition. 2008; 14: 174-180.
5. Jezierny D, Mosenthin R, Weiss E. The use of grain legumes as a protein source in pig nutrition: A review. Animal Feed Science and Technology. 2010; 157: 111-128.
6. Mallin MA. Industrialized Animal Production-A Major Source of Nutrient and Microbial Pollution to Aquatic Ecosystems. Population and Environment. 2003; 24: 369-385.
7. Malleshi NG, Desikachar HSR. Nutritive value of malted millet flours. Plant Foods for Human Nutrition. 1986; 36: 191-196.
8. Guttieri MJ, Peterson KM, Souza EJ. Milling and Baking Quality of Low Phytic Acid Wheat. Crop Science. 2006; 46: 2403-2408.
9. Shitan, Nobukazu Yazaki, Kazufumi, et al. Chapter Nine - New Insights into the Transport Mechanisms in Plant Vacuoles. Int Rev Cell Mol Biol. 2013; 305: 383-433.
10. Seaman JC, Hutchison JM, Jackson BP, et al. In situ treatment of metals in contaminated soils with phytate. J Environ Qual. 2003; 32: 153-161.
11. Reddy NR, Sathe SK, Salunkhe DK. Phytates in legumes and cereals. Adv Food Res. 1982; 28: 1-92.
12. Szwergold BS, Graham RA, Brown TR. Observation of inositol pentakis and hexakis-phosphates in mammalian tissues by 31P NMR. Biochem Biophys Res Commun. 1987; 149: 874-881.
13. Sasakawa N, Sharif M, Hanley MR. Metabolism and biological activities of inositol pentakisphosphate and inositol hexakisphosphate. Biochem Pharmacol. 1985; 50: 137-146.
14. Hanakahi LA, Bartlet-Jones M, Chappell C, et al. Binding of inositol phosphate to DNA-PK and stimulation of double-strand break repair. Cell. 2000; 102: 721-729.
15. Norris FA, Ungewickell E, Majerus PW. Inositol hexakisphosphate binds to clathrin assembly protein 3 (AP-3/AP180) and inhibits clathrin cage assembly in vitro. J Biol Chem. 1995; 270: 214-217.
16. Dick RA, Zadrozny KK, Xu C, et al. Inositol phosphates are assembly co-factors for HIV-1. Nature. 2018; 560: 509-512.
17. Mohannad Nassar, Rania Maki, Husain Al-Yagoob, et al. Phytic Acid: Properties and Potential Applications in Dentistry. Frontiers in Materials. 2021; 8: 29.
18. Nassar M, Maki H, Al-Yagoob A, et al. Phytic Acid: Properties and Potential Applications in Dentistry. Frontiers in Materials. 2021; 8: 29.
19. Rania Nassar, Mohannad Vianna, Morgana E, et al. Antimicrobial Activity of Phytic Acid: An Emerging Agent in Endodontics. Front Cell Infect Microbiol. 2021; 11: 753649.

20. Ellison, Campbell Moreno, Teresa Catchpole, et al. Extraction of hemp seed using near-critical CO2, propane and dimethyl ether. The Journal of Supercritical Fluids. 2021; 173: 105218.
21. Phytates in cereals and legumes. CRC Press. 1989.
22. Phillippy BQ, Wyatt CJ. Degradation of phytate in foods by phytases in fruit and vegetable extracts. Journal of Food Science. 2021; 66: 535-539.
23. Functional Food - Improve Health through Adequate Food. 86.
24. Wise Eating, Made Easy. Archived from the original.
25. Bloot, Ana Paula Marinho Kalschne, Daneysa Lahis Amaral, et al. A Review of Phytic Acid Sources, Obtention, and Applications. Food Reviews International. 2023; 39: 73-92.
26. Yara Koréissi-Dembélé, Nadia Fanou-Fogny, Diego Moretti, et al. Dephytinisation with Intrinsic Wheat Phytase and Iron Fortification Significantly Increase Iron Absorption from Fonio (Digitaria exilis) Meals in West African Women. PLoS One. 2013; 8: e70613.
27. Reddy NR, Sathe SK. Food Phytates. Boca Raton. CRC.
28. Phillippy BQ, Bland JM, Evens TJ. Ion chromatography of phytate in roots and tubers. J Agric Food Chem. 2003; 51: 350-353.
29. Macfarlane BJ, Bezwoda WR, Bothwell TH, et al. Inhibitory effect of nuts on iron absorption. Am J Clin Nutr. 1988; 47: 270-274.
30. Gordon DT, Chao LS. Relationship of components in wheat bran and spinach to iron bioavailability in the anemic rat. J Nutr. 1984; 114: 526-535.
31. Arendt EK, Zannini E. Cereal grains for the food and beverage industries. Wood head Publishing. 2013; 388.
32. Pereira Da Silva B. Concentration of nutrients and bioactive compounds in chia (Salvia Hispanica L), protein quality and iron bioavailability in wistar rats. Federal University of Viçosa. 2016.
33. Scuhlz M. Paleo Diet Guide: With Recipes in 30 Minutes or Less: Diabetes Heart Disease: Paleo Diet Friendly: Dairy Gluten Nut Soy Free Cookbook. PWPH Publications.
34. Gupta RK, Gangoliya SS, Singh NK. Reduction of phytic acid and enhancement of bioavailable micronutrients in food grains. J Food Sci Technol. 2013; 52: 676-684.
35. Prom-u-thai C, Huang L, Glahn RP, et al. Iron (Fe) bioavailability and the distribution of anti-Fe nutrition biochemicals in the unpolished, polished grain and bran fraction of five rice genotypes. Journal of the Science of Food and Agriculture. 2006; 86: 1209-1215.
36. Hurrell RF. Influence of vegetable protein sources on trace element and mineral bioavailability. J Nutr. 2003; 133: 2973S-2977S.
37. Toxicants Occurring Naturally in Foods. National Academy of Sciences. 1973; 363-371.
38. Pettifor John M. Nutritional rickets: deficiency of vitamin D, calcium, or both? Am J Clin Nutr. 2004; 80: 1725S-1729S.
39. Weston Petroski, Deanna M Minich. Is There Such a Thing as Anti-Nutrients? A Narrative Review of Perceived Problematic Plant Compounds. Nutrients. 2020; 12: 2929.
40. Gustafsonn EL, SANDBERG AS. Jour Food Science.
41. Hurrell RF, Reddy MB, Juillerat MA, et al. Degradation of phytic acid in cereal porridges improves iron absorption by human subjects. Am J Clin Nutr. 2003; 77: 1213-1219.
42. Raboy Victor. Low phytic acid crops: Observations based on four decades of research. Plants. 2020; 9: 140.
43. Lin Chia-Feng Zhang, Peter Rantuch, Chi Karlsson, et al. Phytic Acid-Silica System for Imparting Fire Retardancy in Wood Composites. Forests. 2023; 14: 1021.
44. Zhang Mengfei, Wang Yang, Huang Jing, et al. Phytic acid–based flame retardant and its application to poly(lactic acid) composites. New Journal of Chemistry. 2023; 47: 19494-19503.
45. Ruican Wang, Shuntang Guo. Phytic acid and its interactions: Contributions to protein functionality, food processing, and safety. Compr Rev Food Sci Food Saf. 2021; 20(2): 2081-2105.
46. Dagfinn Aune, Doris S M Chan, Rosa Lau, et al. whole grains, and risk of colorectal cancer: systematic review and dose-response meta-analysis of prospective studies. BMJ. 2011; 10: 343-d6617.
47. Ruican Wang, Shuntang Guo. Phytic acid and its interactions: Contributions to protein functionality, food processing, and safety. Compr Rev Food Sci Food Saf. 2021; 20: 2081-2105.
48. Lydia Pramitha J, Sumi Rana, Pooja Rani Aggarwal, et al. Diverse role of phytic acid in plants and approaches to develop low-phytate grains to enhance bioavailability of micronutrients. Adv Genet. 2021; 107: 89-120.