How can Phytase Improve Public Health Nutrition?

III World Congress on Public Health Nutrition

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At a symposium on November 11, 2014, held during the III World Congress of Public Health Nutrition in Las Palmas de Gran Canaria, Spain, experts discussed the role phytase could potentially play in public health nutrition. Richard Hurrell from ETH Zurich, who chaired the meeting with the author of this contribution, opened the session by explaining that the speakers would address how this enzyme could help improve mineral status of infants and children, thereby potentially improving growth.

What is the potential role of phytase?

Saskia de Pee of the UN World Food Programme (WFP) emphasized the significance of iron and zinc deficiency for the burden of disease, particularly in developing countries, where diets contain few or no animal-source products. In those regions, staple foods as well as complementary foods are typically plant-based and contain high levels of absorption inhibitors such as phytate. She referred to a review of the topic by Gibson et al,[1] concluding that dephytinization of plant-based foods combined with animal-source foods and/or fortification was necessary to ensure sufficient supply of iron, zinc and calcium for infants. For the WFP, ensuring adequate amounts of bioavailable iron from such diets while at the same time limiting the amount of added iron is a clear priority – given the supposed negative effects on child morbidity of unabsorbed iron in particular. The addition of phytase could be one potential solution to this problem, but according to Saskia de Pee, further studies should address the feasibility and cost of phytase in food processing as well as in foods ready for consumption. Moreover, additional information about the potential role of phytase with regard to linear growth in younger children is needed.

From left to right: Olayiwola Adeola, Parul Christian, Barbara Troesch, Damiet Koenders, Saskia dePee and Richard Hurrell.

> "Ensuring adequate bioavailable iron while limiting the amount of added iron is a clear priority for the World Food Programme"

Consuming active phytase: what evidence is there?

This question was addressed by Richard Hurrell, who explained that the inhibitory effect of phytate on mineral absorption could be countered by the removal of the phytate, by its enzymatic degradation, or by adding compounds such as EDTA that prevent phytate-mineral binding. Traditionally, enzymatic phytate degradation was ensured by activation of endogenous enzymes through soaking, germination and fermentation or else by adding an exogenous phytase during food processing. However, with a phytase from *Aspergillus niger* (Tolerase™ G) that remains active at the low pH in the stomach, phytate can also be degraded during stomach transit time. It has been shown that iron absorption from a high-phytate maize porridge can be significantly increased when the enzyme is added just before consumption.[2] Similarly, Tolerase™ G can also enhance zinc absorption from a millet-based porridge, making the addition of phytase to complementary foods a simple but potentially efficient strategy to enhance mineral bioavailability.[3]

Plaza Las Canteras, Gran Canaria, with the Alfredo Kraus Auditorium – the venue for the III World Congress on Public Health Nutrition.

What are the potential applications for phytase?

Damiet Koenders from the DSM Biotechnology Center presented various applications that hold promise for the use of phytase either during processing or just before consumption. Based on the available evidence, she concluded that the use of phytase as a food ingredient in products such as micronutrient powders, lipid-based nutrient supplements and condiments such as fish or soy sauce can be recommended. Phytase can also be used for flour fortification – in which case the degradation could take place during the processes of bread-making. She also explained that the Joint FAO/WHO Expert Committee on Food Additives assigned an "Acceptable Daily Intake – not specified" to phytase (Tolerase™), which indicates its safety for use. Moreover, phytase was listed in the Codex Alimentarius Guidelines on Formulated Complementary Foods for Older Infants and Young Children as a recommended strategy to reduce phytate content and thereby increase mineral bioavailability. Damiet Koenders concluded that the endorsement of these two bodies enabled intergovernmental organizations to use phytase in high-phytate foods, even for infants. For its use in specific countries the national situation needs to be assessed, but according to her, in many countries the use of phytase is already approved or no legal barriers exist.

> "In many countries, the use of phytase is already approved"

What can we learn from animals?

Exogenous phytase has been used to improve physical performance in non-ruminant animals by releasing otherwise unavailable phosphorus as well as various minerals. Consequently, a vast range of evidence on its effect on growth is available, particularly from pigs and poultry. Olayiwola Adeola from Purdue University reviewed this evidence to draw conclusions about the role phytase could play in reducing stunting in infants. In his opinion, the degradation of phytate can be expected to improve phosphorus retention, protein solubility and consequently retention, and also mineral bioavailability. Moreover, the generation of inositol, thought to mimic insulin in the body, could potentially have a beneficial effect on cellular glucose uptake, protein deposition efficacy and therefore overall growth. However, extrapolation from studies in animals to humans has its limitations, and the role of phytase on growth in infants and

young children can only be resolved with evidence from this target population. Still, given the importance of zinc, calcium, phosphorus and possibly iron on growth; the role phytase plays in their bioavailability from plant-based foods; and the high prevalence of stunting in many regions of the world, it would be a missed opportunity not to pursue this further.

What is known in humans?

Last but not least, Parul Christian from the Johns Hopkins Bloomberg School of Public Health reviewed the limited evidence available on the effect of phytase on linear growth in humans. Even though it has been postulated that zinc deficiency plays an important role in the development of stunting early in life, the effect of interventions with zinc supplements has so far been ambiguous. This might be partly due to the poor absorption of zinc, but also due in part to the multifactorial causes of stunting. Therefore fortification with multiple nutrients, such as micronutrient powders or other ready-to-use fortified foods, might be more promising. However, this will only be the case if the bioavailability of the added micronutrients can be optimized using enhancers such as ascorbic acid for iron or phytase for iron, zinc and other minerals. Parul Christian concluded that further research is required to show the impact of adding phytase to lipid-based fortified foods, as well as other ready-to-use or fortified blended foods, on linear growth and the prevention of stunting.

> "Further research is required to show the impact of adding phytase to fortified foods on linear growth"

Conclusion

Even though more studies could always shed further light on any research topic, the data available from animals and humans already gives an indication of the important role phytase could play in growth in areas where plant-based foods predominate in the diets of infants and young children. Moreover, the role of phosphorus has so far not been studied, as it is abundantly present in Western-type diets. However, in the plant-based foods consumed by infants and young children in low- and middle-income countries, a large part of phosphorous is phytate-bound and therefore poorly available. Given the importance of phosphorus in bone formation and consequently growth, the addition of phytase can be expected to provide an additional benefit.

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