Phytoferritin: A Potential Iron Supplement Derived from Manitoba Pulses and Soybeans

Phytoferritin derived from legumes is a readily available and quickly digestible source of iron. From this research, an extraction and isolation protocol compatible with industrial, large-scale production was developed.

IRON DEFICIENCY AFFECTS approximately 3.5 billion people worldwide. Iron deficiency can result in anemia, which is a reduction in the number of red blood cells and hemoglobin in the blood, leading to an insufficient oxygen supply to muscles and vital organs.

Iron-containing supplements are used to boost the availability of dietary iron. Most current supplements have been associated with negative symptoms, resulting in lower supplement consumption. Alternatively, certain plant sources of iron can help improve consumption. Plant-based iron boosts plasma iron levels in the blood, preventing iron deficiency anemia and other negative symptoms.

Phytoferritin is a well-known organic form of iron that can be isolated from plants, especially pulse and soybean seeds, for use as an ingredient in nutraceutical supplements. Phytoferritin is essentially a storage molecule that holds up to 4500 iron atoms within its core, while other sources average around 2500 iron atoms.

Based on previous research, the low dose of ~2.4 mg phytoferritin/day could be used to improve iron deficiency symptoms. Thus far, clinical trials have shown that phytoferritin does not produce the same intense negative symptoms as traditional iron supplements. Nor does it suffer from low bioavailability.

In general, pulse and soybean seeds have higher levels of iron and phytoferritin than cereal grains, attributed in part to the large iron requirement during nitrogen fixation by nodules. Phytoferritin is recycled to the seed during nodule breakdown. Concentrations can vary between 8–80 micrograms of phytoferritin per gram of seed, with the highest concentrations in peas, soybeans and mung beans.

This research aimed to establish Manitoba-grown pulse and soybean crops as important sources of phytoferritin. To date, it has provided information on extractability, as well as structural and functional components, adding value to our Manitoba pulse and soybean crops.

The first objective of this research was to determine the yield and purity of phytoferritin concentrates isolated from soybeans, yellow peas, red and white dry beans, lentils, mung beans and chickpeas. As a result, an extraction and isolation protocol compatible with industrial-scale production was developed to produce phytoferritins from Manitoba legume seeds. Phytoferritin yield ranged from 7% to 19% (seed weight basis) with an iron content of up to 45 mg/100 g weight.

The second objective was to determine the susceptibility of phytoferritin to breakdown by gastrointestinal enzymes through simulated stomach and intestinal digestion treatments. Phytoferritins first subjected to pepsin, a main digestive enzyme to simulate stomach breakdown, followed by another enzyme pancreatin to simulate intestinal breakdown, were successfully digested.

Phytoferritin digestion led to the complete release of iron, indicating that the product is compatible with the human digestive tract. During digestion, iron release occurred very quickly and was completed within 45 minutes. Therefore, it is very likely that the phytoferritin iron load will empty very quickly within the upper tract of the digestive system, which is excellent for absorption into the blood circulatory system.

This research has successfully demonstrated that phytoferritins derived from pulse and soybean seeds are digestible. It has also resulted in protocols that are compatible with industrial production to produce plant-based iron supplements, benefitting the pulse and soybean value chain.

PRINCIPAL INVESTIGATOR Rotimi Aluko, University of Manitoba
MPSG INVESTMENT $5,000
CO-FUNDER Agri-Food Research and Development Initiative (ARDI)
DURATION 2 years