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Research Article

DETERMINATION OF PHYTIC ACID FROM CEREAL AND LEGUME SAMPLES

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ABSTRACT

Various anti-nutritional factors are present in food obtained from plants. One of the major anti-nutrient is phytic acid. The phosphate present in the seeds are primarily stored in the form of phytic acid. Phytic acid is present in cereals, legumes, nuts and seeds. It is known as anti-nutrient because it can form complex with minerals and micronutrient using its chelating ability and as a result those nutrient are not available for intestinal assimilation. In this study, the phytic acid content of cereals and legumes was determined using TCA (Tri-chloroacetic acid) method.

INTRODUCTION

Anti-nutritional factors are those element found in many food substances that are toxic to humans or in certain ways reduce the nutrient availability to the body (Inuwa*et.al.*, 2011). Various such factors are proteinase inhibitors, lectin, raffinose oligosaccharides, saponins, polyphenols and phytate are present in legumes. Among these, phytic acid (*myo*-inositol 1, 2, 3, 4, 5, 6-hexa*kis*-phosphate) characterize a chief anti-nutrient in food(Vojtiškova*et.al.*, 2010). It is a innately happening plant acid and is present in huge extent (1-5%) in edible plant seeds (Rasheed *et.al.*, 2017).Generally, phosphate and inositol are primarily stored in the form of phytic acid in seeds (Hidvégi *et.al.*, 2003).Phytic acid is mainly distributed in seeds of plants such as cereal grains, legumes, nuts, oilseeds, and so on, acting as a main source of phosphorus (Hong *et.al.*, 2017). Phytic acid restricts the intestinal assimilation of certain minerals, mainly zinc and thus causes nutritional deficiencies (Lolas *et.al.*, 1976).

However, it is stated that the phytic acid has an anticancer, antioxidant, hypoglycemic and hypolipidemic functions(Rasheed *et.al.*, 2017). Along with this, various benefits of phytic acid on human health have also been discovered for soft tissue, colon, prostate, metastatic and mammary cancers. Renal stone development can also be inhibited using phytic acid (Saad*et.al.*, 2011). It shows protective action in Parkinson's disease and it also reduces blood glucose levels (Hong *et.al.*, 2017).

Mature soya bean grain confines a number of anti-nutritional elements with several biological activity. Phytate is one of the most important anti-nutrients present in soya bean grain. It is not absorbed by monogastric animals, it does not present sufficient phosphorus and minerals to monogastric animals (Dragičević*et.al.*, 2010).Peanut meal is a noble resource of active ingredients, which comprise about 47-55% protein, 20-30% carbohydrates, 8-10% crude fibre, 2-3% fat and 1.0-1.2% phytic acid (Hong *et.al.*, 2017).

In wheat, the phytate is widely scattered among those tissues that go into the by-products of flour milling and huge quantity is present in the high-protein flour (wheat protein concentrates) made for human intake by remilling selected by-product fractions. The phytate is isolated using trichloroacetic acid and precipitated as the ferric salt. The iron content of the precipitate is decided colorimetrically and the phytate phosphorus amount is calculated from this value assuming a constant 4 Fe: 6 P molecular ratio in the precipitate (Wheeler and Ferrel*et.al.*, 1971).

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MATERIAL AND METHODS

Collection and Processing of Sample

The samples; wheat, oats, soybeans and peanut were collected from the local grocery stores of Bhiwandi, Thane; Maharashtra, India. After collection, each sample was finely ground using mixer grinder.

Determination of Phytic Acid (Wheeler And Ferrel et.al., 1971)

Finely ground sample was weighed and extracted by adding 50ml of 3% TCA followed by mechanical shaking for 30-45 mins. And the suspension thus obtained was centrifuged and 10ml of supernatant was transferred into conical centrifuge tube.

4ml of $FeCl_3$wasrapidly added and the contents were heated in boiling water bath for 45 mins or till the supernatant becomes clear. If the supernatant still remained turbid 1-2 drops of $NaSO_4$ prepared in 3% TCA was added and the heating was continued.

The suspension was again centrifuged for 15 mins and supernatant was decanted. The precipitate was washed in 20ml of 3% TCA and the heating procedure was repeated for 5-10 mins. The solution was centrifuged and the precipitate was dispensed in few ml of water and 3ml of 1.5N NaOH was added. The volume was brought to 30ml with the addition of water and again heated in BWB for 30 mins. The precipitate was filtered through Whatman No. 2 and the filtrate was discarded.

The precipitate from the paper was dissolved in 40ml of hot 3.2N HNO_3 in a 100ml flask. The solution thus obtained was cooled and diluted if required. And 5ml of aliquot was transferred to 100ml volumetric flaskand diluted to approx. 70ml and then 20ml of 1.5M KSCN was added, diluted to 100ml volume and the colour was immediately read within 1 min at 480nm.

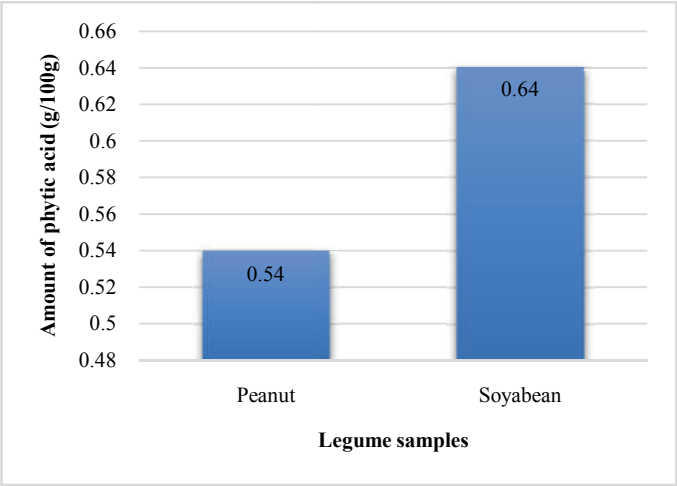
The reagent blank and standard tube were ran simultaneously. The iron content from a $Fe(NO_3)_3$ standard ran at the same time or read from a previously prepared standard curve was calculated. And the phytate phosphorus from the iron results assuming a 4:6 iron:phosphorus molecular ratio was calculated.

Standard preparation: Accurately 433mg $Fe(NO_3)_3$was weighed in 100ml of distilled water then 2.5 ml of this stock standard was diluted and made upto 250 ml in a volumetric flask. And 2.5, 5, 10, 15 and 20 ml of this working standard was pipetted out into a series of 100 ml volumetric flask and diluted upto 70 ml. Then 20 ml of 1.5M KSCN was added, diluted to volume and the colour was read at 480 nm.

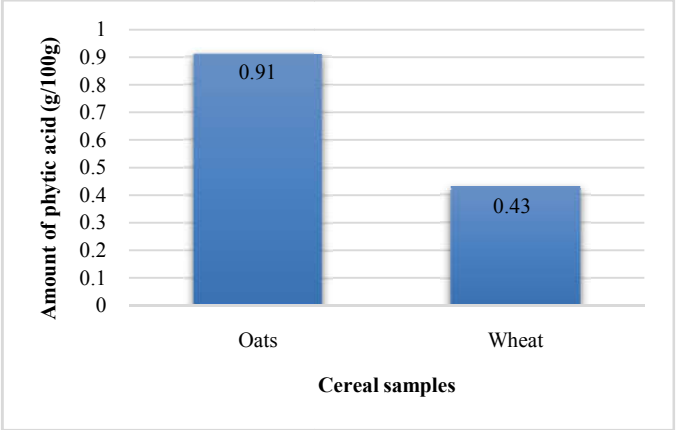
RESULTS AND DISCUSSION

Collection and Processing of Sample

The cereal and legume samples (wheat, oats, soyabean, peanut) were collected from local grocery store and their expiry dates were checked before use. Processing of samples was done using grinder into fine powder and were packed into air tight container for future use.



Graph 1 The amount of phytic acid (g/100g) in legume samples.



Graph 2 The amount of phytic acid (g/100g) in Cereal samples.

Determination of Phytic Acid

The phytic acid content in each of the samples was determined using TCA method.

The quantity of phytic acid (g/100g) in legumes and cereals are represented in Graph 1 and Graph 2 respectively.
The phytic acid content in oats was found to be the highest with 0.91 g/100g of phytic acid and the lowest phytic acid was found in wheat with 0.43 g/100g of phytate.In wheat, the amount of phytic acid was close to the value which was found by M. Hidvégi*et.al.*in2003.The phytic acid content in soyabean was calculated to be 0.64 g/100g and in oats was found to be 0.91g/100g which was similar to the phytate found byM. Hidvégi*et.al.*in2003.

CONCLUSION

Phytic acid is an anti-nutrient which is present in legumes, cereals, nuts and seeds. It was extracted using TCA and precipitated as ferric salt. The iron content in the precipitate was determined calorimetrically and the quantity of phytic acid was then determined using the ratio 4Fe:6P.

Two cereals (wheat and oats) and two legumes (peanuts and soybeans) were checked for their phytic acid content and it was found thatamong cereals, oats had more amount of phytic acid than wheat and in legumes, peanuts had more amount of phytic acid when compared with soybean. This is point of concern because usually, in day-to-day life many people consume oats

and peanuts and hence measures should be taken to reduce the phytic acid content in such foods and thus make them more accessible for consumption. Along with several household technique like milling, germination, roasting and soaking, other techniques at industrial level should be carried out and processed to reduce the phytic acid content. Even though phytic acid is an anti-nutrient, it has various other properties of preservation, anti-oxidation, and treating health ailments which should be taken into consideration while processing and consumption of foods with phytic acid content.

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