International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 4, Issue 5, May – 2020, Pages: 116-119

Comparative Determination of Phytate from Matured Soya (Glycine max), Brown [Phaseolus vulgaris (Pinto group)] and White/Navy (Phaseolus vulgaris) beans via Acidic Precipitation as Ferric Phytate.

Olabimtan Olabode.H*[1], Samuel Florence. A[2], Kanus James. H[3], Rahul Bhattacharjee[4] & Agboni Mercy.O[5]

[1]National Research Institute for Chemical Technology, Department of Industrial and Environmental Pollution, Zaria Kaduna State, Nigeria.
[2]National Research Institute for Chemical Technology,Department of Scientific and Industrial Research, Zaria Kaduna State, Nigeria.
[3]Nigeria Army University, Department of Chemistry Biu Borno State, Nigeria.
[4]Kalinga Institute of Industrial Technology Patia Bhubaneswar, India.
[5]Ogel chemicals and services Zaria Kaduna State, Nigeria.
Corresponding author's email: Olabode4angel@gmail.com

Abstract: *Phytate or phytic acid ($Fe_4P_6C_6H_6O_{24}$), an anti-nutritional factor impairing mineral absorption and protein digestion even when present in small amounts has been a subject of investigation from nutritional and chemical viewpoints. As an essential source of phosphorus, phytic acid, which is the inositol combined with six phosphates group, is also a common component in most plants. Simplified methods for its determination is needed. In the light of these, three matured species of beans(50g each), soya (Glycine max), Brown [Phaseolus vulgaris (Pinto group)] and White/navy (Phaseolus vulgaris) beans were analyzed for phytate by direct precipitation of ferric phytate complex with 0.01M/L hydrochloric acid and centrifuged at 4000rpm for 10 minutes. The derived order of phytate is; soya bean (0.9605 ± 0.0035) mg > white/navy beans (0.9513± 0.0021) mg > (0.9495± 0.0063) mg with the triplicate determinations. This should trigger a practical approach for the reduction of phytate in beans especially.*

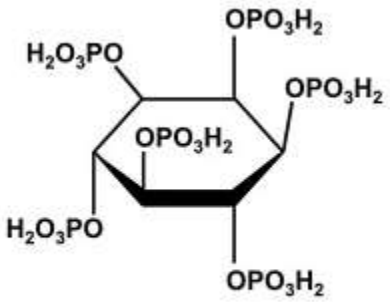
Keywords: phytate, antinutrtional, beans, ferric phytate complex & acidic precipitation.

1.0 INTRODUCTION

Typically, plant sources of protein retain an important position in human diets. For instance, commonly eaten soybean meals have always been a growing interest in western nations in the form of isolates, concentrates, and thickener products [1]. Most of those phytate soybeans can be extracted through adequate direct heating paired with raw or reduced factors [1]. Low bioavailability of nutrients is not enhanced through heating because multiple researchers have claimed that phytic acid could have been responsible for the low availability of metals especially zinc [2]. To reliably examine the correlation between phytic acid and nutrient distribution in soybeans, a range of commodities other than soybeans should be allowed to accurately quantify the phytic acid content. Phytic acid is an essential origin of stored phosphate and inositol in plant materials with approximately 70 percent of its total phosphorus [3] with 80 percent in legumes [4]. Furthermore, phytates are released naturally with the process of maturation on the grains and seeds, while most plant-based foods as well accumulate a variety of bioactive compounds as their phytochemicals [3]. A maximum amount of phytate exists in portion of ground grain and protein products. Dicotyledonous plants with seeds such as nuts, oilseeds, and legumes appear to be directly linked with proteins and often separated with the protein content of those products that are medium for phosphate and natural nutrients essential for plant nutrients [3]. Phytate is also a polydentate ligand that can chelate metallic ions at specific pH with effective reduction and bioavailability of important nutrients [3] [5]. Phytic acid is biochemically metabolized by phytases, or spontaneously to decrease phosphates of inositol as inositol tetra phosphate (IP4), inositol pentaphosphate (IP5) inositol triphosphate (IP3) under germination, preservation, fermentation, food preparation and absorption with the human gastrointestinal tract. Both IP5 and IP6 retain negative influence on nutrient bioavailability [3]. Phytates are identified for displaying pharmacological activities as iron chelate retarding iron-mediated reactions with oxidation and preventing specific site DNA termination and blocking tumor formation through controlling of chemically reactive OH• radical[3]. Phytate analysis is based on indirect characterization, as no precise substrate is accessible for phytate evaluation. Phytate determination depends on the quantitative estimation of phosphate or Inositol as an indirect detection tool or as an easy-to-measure stoichiometric approach [3]. Descriptive techniques rely on inositol phosphate esters isolation and detection, with electrophoresis, thin layer, paper, and Ion exchange chromatography. Basically phytic acid experiments actually use ferric chloride to precipitate ferric phytate, and then sodium hydroxide to turn the precipitate into sodium phytate and ferric hydroxide [6]. Upon

International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 4, Issue 5, May – 2020, Pages: 116-119

accepting the ferric hydroxide with the acid it is easy to measure the iron as phytate. The condition in which phytate is present in various materials differs however. Both the protein and the mineral environments decide precisely the natural state of the phytate in the seed [7]. Phytate contained in a particular ecosystem of minerals and proteins does not inherently function in exactly the same way for a given assay. Meanwhile, soybeans, brown beans, and white beans with the applicability of wet ashing with acidic phytate precipitate using iron chloride as a precursor were developed for simplicity, accuracy, and reliability of phytic acid value.



Phytic acid

2.0 EXPERIMENTAL

2.1 Materials

50g of samples(soya, brown and white beans), 80% absolute ethanol, blender, water bath, volumetric flask, measuring cylinder, desiccator, standard ferric chloride solution, 0.01M HCl, what man filter paper, analytical balance, centrifuge, deionized water.

2.2 Methods

2.2.1 Maceration

The beans sample (50g each) was washed with distilled water and homogenized with few quantity of hot 80% ethanol in a blender, which was further made up to mark (250ml) and further heated at 35^{o}C with water bath for about 2minutes. The slurry mixture was filtered [3].

2.2.2 Solubilization and extraction of phytic acid

Phytic acid was precipitated by adding excess standard ferric acid (1mg $Fecl_2$/0.01M HCl) [11] to the filtrate achieved in step above. The precipitated mixture was centrifuged at 4000rpm for 10 minutes and was carefully decanted and dried in a desiccator to amass the ferric phytate precipate [3].

3.0 RESULTS AND DISCUSSION

Table 1 .Nutritional information of soya, brown and white beans.

Parameter/100g	Soya bean (*Glycine max*)	REF	Brown bean *Phaseolus vulgaris (Pinto group)*	REF	White/navy bean *Phaseolus vulgaris*	REF
Energy(KJ)	1866	[8]	598	[9]	1468	[10]
Carbohydrate(g)	30.16	[8]	26.22	[9]	60.75	[10]
Dietary fiber(g)	9.30	[8]	9.0	[9]	15.3	[10]
Fat(g)	19.94	[8]	0.65	[9]	1.50	[10]
Protein(g)	36.49	[8]	9.01	[9]	22.33	[10]
Vitamin A(ug)	1.000	[8]	0	[9]	0	[10]
Vitamin B1(mg)	0.874	[8]	0.193	[9]	0.775	[10]
Vitamin B2(mg)	0.870	[8]	0.062	[9]	0.164	[10]
VitaminB3(mg)	1.623	[8]	0.318	[9]	2.188	[10]
Vitamin B5(mg)	0.793	[8]	-	[9]	0.744	[10]
VitaminB6(mg)	0.377	[8]	0.229	[9]	0.100	[10]
Vitamin B9(ug)	375	[8]	172	[9]	364	[10]
Vitamin C(mg)	6.00	[8]	0.8	[9]	0.90	[10]
Vitamin E(mg)	0.85	[8]	0.94	[9]	3.40	[10]
Vitamin K (ug)	47.00	[8]	3.5	[9]	0.70	[10]
Calcium(mg)	277	[8]	46	[9]	147	[10]
Copper(mg)	1.658	[8]	0.370	[9]	0.834	[10]
Zinc(mg)	4.89	[8]	0.98	[9]	3.65	[10]
Potassium(mg)	1797	[8]	436	[9]	1185	[10]
Magnesium(mg)	280	[8]	50	[9]	175	[10]
Phosphorus(mg)	704	[8]	147	[9]	0.407	[10]
Manganese(mg)	2.517	[8]	-	[9]	1.418	[10]
Iron(mg)	15.7	[8]	2.09	[9]	5.49	[10]
Sodium(mg)	2	[8]	238	[9]	5	[10]
Moisture(g)	8.54	[8]	62.95	[9]	4.20	[10]

Table 2. Ferric phytate precipitates

Run (mg)	Soya bean	Brown bean	White bean
1st	0.9650	0.9470	0.9520
2nd	0.9630	0.9540	0.9490
3rd	0.9580	0.9450	0.9530
Actual mean value(mg)	0.9605 ± 0.0035	0.9495 ± 0.0063	0.9513 ± 0.0021

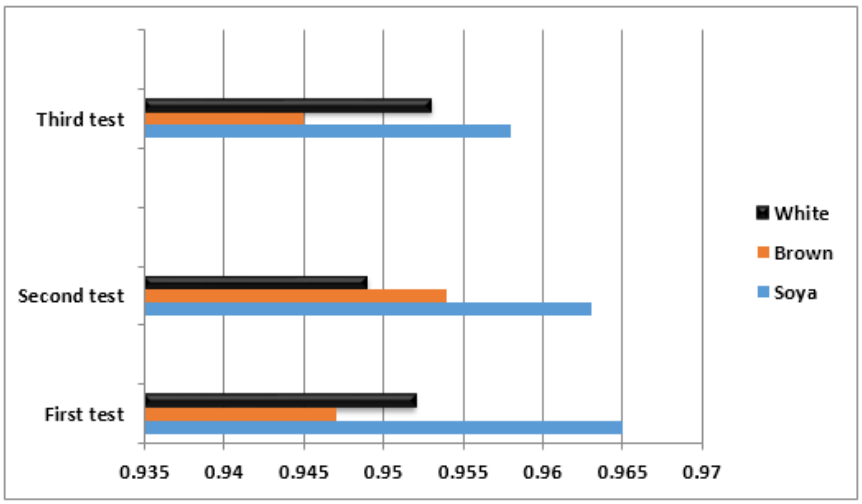


Figure 1. The level of phytates with acidic (0.25M, HCl) precipitation from the beans samples.

Phytic acids were successfully estimated by active acidic precipitation of residual ferric phytate complex from the standard ferric salt with the recalls of some of their nutritional and proximate information (Table 1). The levels of phytates were concisely reported and represented in table 2 and figure 1.

4.0 CONCLUSION

For several instances, phytate is regarded as an unacceptable characteristic because of its chelating ion effects, which are necessary. And with the marked evidence of the significance of phytates in the reduction of colorectal cancer and tumor formation. As it is highly essential to determine the quantity of phytate in the diet we consume so as to decide the measures that will reduce or limit the activity of phytate acid.

5.0 REFERENCE

1. Thompson, d. b., & Erdman, j. w. (1982). Phytic Acid Determination in Soybeans. Journal of Food Science, 47(2), 513–517. doi:10.1111/j.1365-2621.1982.tb10114.x
2. Buentello, J. A.et al (2009). Dietary Zinc Requirement of Hybrid Striped Bass, Morone chrysops×Morone saxatilis, and Bioavailability of Two Chemically Different Zinc Compounds. Journal of the World Aquaculture Society, 40(5), 687–694. doi:10.1111/j.1749-7345.2009.00288.x
3. Keerthana Sivakumaran and Suitha Kothalawala (2017). An overview of the analytical methods for food phytates. International Journal of chemical sciences. https://www.researchgate.net/publication/323414648_An_overview_of_the_analytical_methods_for_food_phytates.
4. Skoglund, E.et al (2009). Phytate. Healthgrain Methods, 129–139. doi:10.1016/b978-1-891127-70-0.50014-5
5. Ursula Konietzny et al (2006). Phytate - an undesirable constituent of plant-based foods? Journal für Ernährungsmedizin 2006; 8 (3), 18-28.
6. Vesna D. Dragiĉević et al (2011). Validation study of a rapid colorimetric method for the determination of phytic acid and inorganic phosphorus from seeds. http://www.doiserbia.nb.rs/img/doi/1450-7188/2011/1450-71881142011D.pdf.
7. Lisbeth Bohn et al (2008). Phytate: Impact on environment and human nutrition. A challenge for molecular breeding. J Zhejiang Univ Sci B. 2008 Mar; 9(3): 165–191.doi: 10.1631/jzus.B0710640.
8. Corke, Walker and Wrigley (2004). Encyclopedia of Grain Science. Academic Press. ISBN 978-0-12-765490-4.
9. Bhagwat et al (September 2008). USDA Database for the Isoflavone Content of Selected Foods (PDF) (Release 2.0 ed.). Beltsville, Maryland: U.S. Department of Agriculture. Retrieved 10 March 2015.
10. USDA National Nutrient data base (2019) https://fdc.nal.usda.gov/.
11. Hong, R.et al (2017). Optimization of extraction condition for phytic acid from peanut meal by response surface methodology.http://creativecommons.org/licenses/by-nc-nd/4.0/