BAP -02

Effect of Soaking Duration on Nutritional Content of Kidney Bean (*Phaseolus vulgaris*)

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Abstract
A study was carried out to investigate the effects of soaking duration on nutritional contents of kidney bean (*Phaseolus vulgaris*). Five hundred grams of the whole seeds were soaked in distilled water at room temperature in a 1:30 (bean: water) ratio for 12, 24, 36, 48, 60 and 72 hours and labelled as T1, T2, T3, T4, T5 and T6, respectively. The soaked seeds were drained, rinsed and dried at 105^{o}C for about 18 hours until constant weight is achieved. The dried seeds were milled in attrition mill, packaged in polyethylene bags for further analysis.At the end of the processing, each treatment was replicated twice and samples were taken for analysis. Soaking generally increased the content of Na (0.153 - 0.178 mg/100g), K (0.467 - 0.643 mg/100g), Ca (0.2 - 0.237 mg/100g), P (0.251- 0.345 mg/100g) and Mg (0.221 - 0.254 mg/100g) as compared to the values obtained in the raw however, soaking for 60hrs gave the best results of 581.35 and 32.15 mg/100g for vitamins A and C while that of 72 hours produced the best result for vitamin B (3.16 mg/100g). The result of the effect of soaking duration on amino acids contents of KB shows a progressive increase in the values of the acids as the time of soaking increased. Soaking of KB seeds for at least 60 hours produces the best result suitable for feeding of monogastric animals including fish therefore, monogastric animal farmers can adopt the 60 hours soaking of KB bean seeds before feeding them to animals.

Keywords: Soaking duration, nutritional value, kidney beans, processing method

Introduction

Kidney beans occupy an important place in human nutrition, especially among the low-income groups of people in developing countries (Graham *et al.,* 2003). They are a good source of protein; significantly higher than that of cereal, dietary fiber, starch, minerals and vitamins (Balochand Zubair, 2010). They are a staple food and low-cost source of protein in developing countries where protein-energy malnutrition (PEM) is prevalent. The world production of kidney beans was 23.2 million metric tons in 2010, which represented an increase of almost 70% and compared to that in 1980. From 1980 to 2000, dry production increased by 3.9 million MT (FAOSTAT 2011). However, a significantly higher increase (5.6 million MT) was reported in only the 10 – year period from 2000 to 2014 (Pugalenthi *et al.,* 2005). The characteristic that makes beans good food values includes health, wellness and environmental sustainability.

The inclusion of kidney beans and other legumes in the daily diet has much beneficial effect in controlling and preventing various metabolic diseases such as diabetes mellitus, coronary heart disease and colon cancer (Cardador-Martinez *et al*., 2002). In African diet, legumes are the major contributors of protein and calories for economic and cultural reasons. However, their role appears to be limited because of several factors including low protein and starch digestibility, poor mineral bioavailability and high anti-nutritional factors (Hoover and Zhou, 2003). Traditional treatment such as cooking, soaking, germinating and fermenting have been used to improve the nutritional quality of the legumes, the kidney beans. Soaking is an integral part of bean processing (Kikuchi *et al*., 2006). There is a relationship between bean structure and water absorption during the soaking process. Beans volume increases with soaking time due to seed coat softening and cotyledonary swelling (Harris *et al.,* 2006). Water uptake and volume of bean increases directly with soak time and accelerate at higher soak temperature (Kader and Jutzi, 2002). Soaking can reduce the level of total sugars, minerals, phytic acid and proteolytic enzyme inhibitors, which can be partly or totally solubilized and eliminated with the discarded soaking solution.

The human body needs about twenty different minerals in order to function properly. This element can be classified into macro and micro minerals. Macro minerals are needed in amounts higher than 100mg/day and include calcium, phosphorus, magnesium, sulphur, sodium, chloride, and potassium. Micro minerals (needed in amounts lower than 100mg/day) include elements such as iron, zinc, iodine, selenium, manganese, chromium, copper, molybdenum, Fluorine, boron, cobalt, silicon, aluminum, arsenic, tin, lithium, and nickel (Whelton *et al*., 2002). The competition between man and non-ruminants for certain cereal grains and legumes has led to the

scarcity of these feed ingredients, hence, the need to seek for alternative ways of reducing the cost of production of monogastric animals which are the major sources of protein to man.

The objective of this study is therefore, to investigate the effect of soaking duration on minerals, vitamins and amino acid profile of kidney bean.

Materials and Methods

The experiment was carried out in the Biochemistry Laboratory of the Department of Animal Science of the Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia Campus.

Kidney beans were purchased from Shabu market within Lafia Local government of Nasarawa State. Five hundred grams of whole seeds were soaked in distilled water at room temperature in a 1:30 (bean: water) ratio for 12, 24, 36, 48, 60 and 72 hours and labelled as T1, T2, T3, T4, T5 and T6, respectively. The soaked seeds were drained, rinsed and dried at 105^{o}Cfor about 18 hours until constant weight is achieved. The dried seeds were milled in an attrition mill, packaged in polyethylene bags for further analysis.

The proximate, mineral and vitamin compositions of each of the treatment samples from the six soaked seeds were determined according to AOAC (1990) methods. Amino acid determination was carried out using the method of Speckman *et al.* (1958). The samples were emptied into Petri dishes and oven dried to constant weight, defatted, hydrolysed, evaporated in a rotary evaporator and loaded into the Technicon Sequential Multi-Sample Amino Acid Analyser (TSM)

The experimental design used for this trial was the Completely Randomized Design (CRD). Each sample served as a treatment and was replicated thrice.

Data obtained for each parameter were subjected to Analysis of Variance (ANOVA) and where significant differences occurred, the means were separated using Duncan's Multiple Range Test (DMRT) as outlined by Steel and Torrie (1980).

Results and Discussion

The result of the effect of soaking duration on proximate composition of KB is presented in Figure I. Soaking generally increased the content of Na (0.153 - 0.178 mg/100g), K (0.467 - 0.643 mg/100g), Ca (0.2 - 0.237 mg/100g), P (0.251- 0.345 mg/100g) and Mg (0.221 - 0.254 mg/100g) as compared to the values obtained in the raw. This observation is similar to the earlier findings of Kpanja *et al.* (2016) who investigated the effect of soaking and fermentation on the proximate composition, levels of anti-nutritional factors, oil quality and mineral elements composition of Castor and noted an increase in most of the proximate components due to soaking.

The result of the effect of soaking duration on vitamins A, B and C contents of KB are presented in Figures II, III and IV. Soaking KB for 60hrs gave the best results of 581.35 and 32.15 mg/100g for vitamins A and C while that of 72 hrs produced the best result for vitamin B (3.16 mg/100g). The processing of leaching and bleaching starts with solubilization in the soaking processing, thus the values of the vitamins, particularly those of water-soluble tend to increase as the duration of soaking increases. The observations made in this study are similar to those earlier reported by Alu (2016).

The result of the effect of soaking duration on amino acids contents of KB (Figure V) shows a progressive increase in the values of the acids as the time of soaking increased. The present result agrees with the earlier assertion of Zacharie and Ronald (1995) who reported a decrease in ash, most minerals, vitamins, and some essential amino acids in soaked, cooked and soaked-cooked beans.

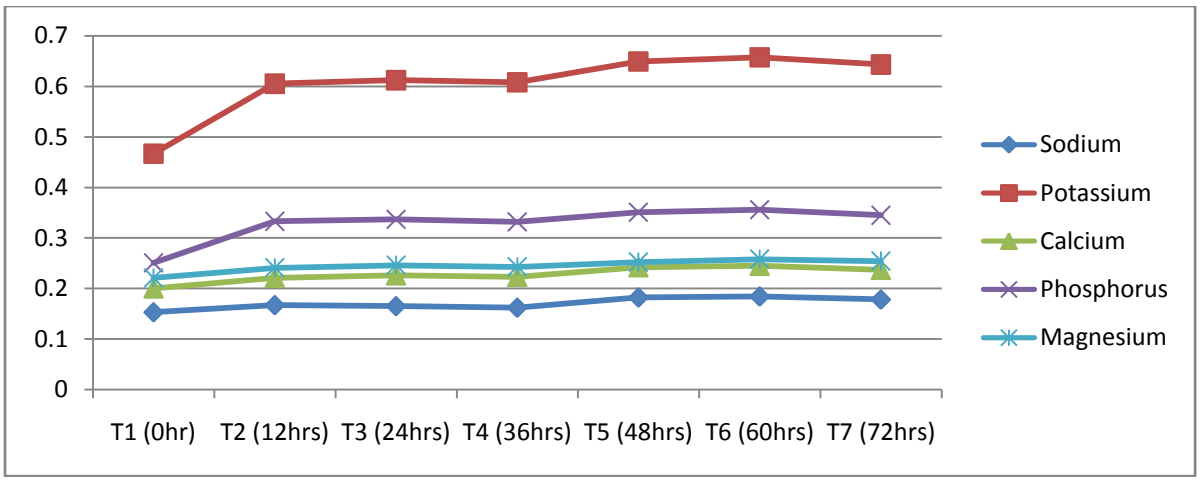


Fig.I: Effect of soaking duration on mineral composition of kidney bean

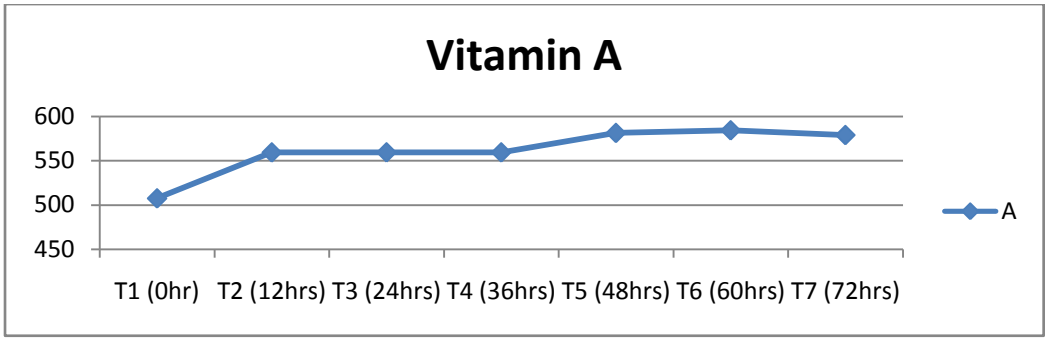


Fig.II: Effect of soaking duration on vitamin A composition of kidney bean

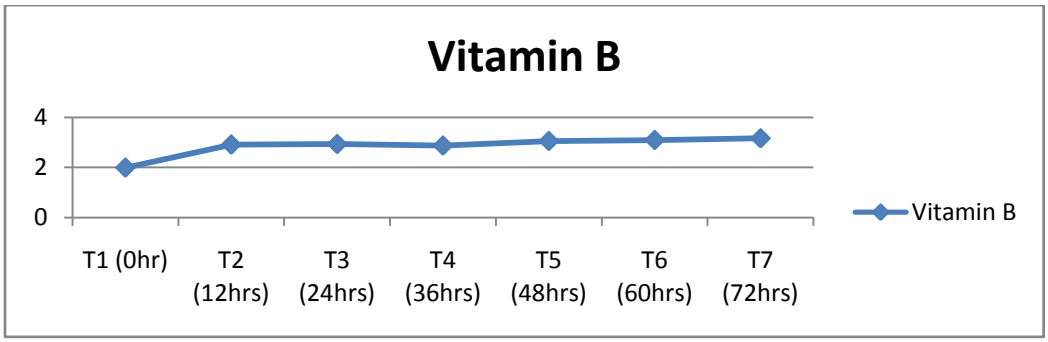


Fig. III: Effect of soaking duration on vitamin Bcomposition of kidney bean

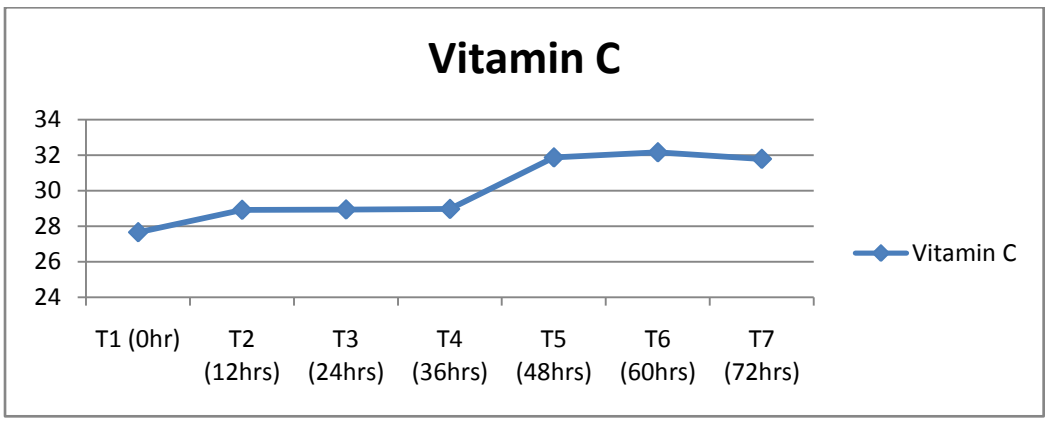


Fig. IV: Effect of soaking duration on vitamin C composition of kidney bean

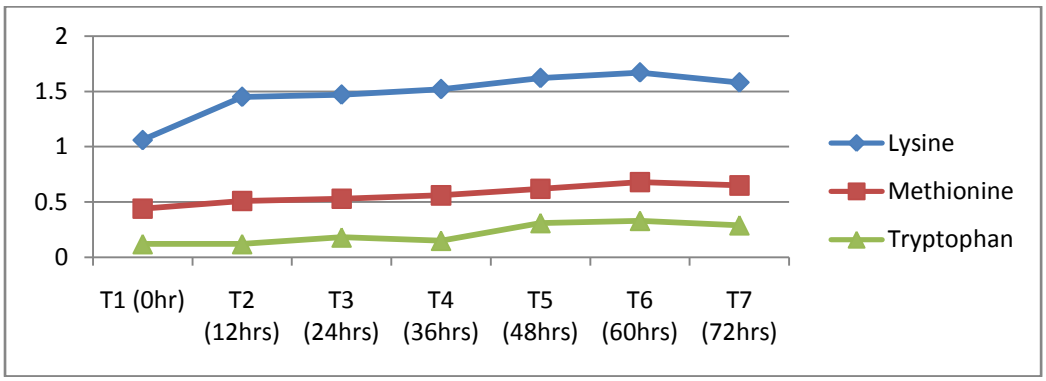


Fig. V: Effect of soaking duration on amino acid composition of kidney bean

Conclusion and Recommendation

Soaking of KB seeds for at least 60 hours produces the best result suitable for feeding of monogastric animals including fish.

Therefore, monogastric animal farmers can adopt the 60 hour soaking of KB bean seeds before feeding them to animals.

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