Plant Archives Volume 20 No. 2, 2020 pp. 4135-4138 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

THE EFFECT OF SOAKING FOR DIFFERENT PERIODS AND COOKING ON THE LEVEL OF PHYTIC ACID AND INORGANIC PHOSPHORUS IN COWPEA SEEDS

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Abstract

An experiment was conducted in the laboratories of the Food Science Department at the University of Kufa to estimate the content of cowpea seeds of black eye variety of essential nutrients and assess the effect of seed soaking for different periods (8, 12, 16 hours) and cooking on the relative seed content of phytic acid and inorganic phosphorus. The experiment was completely randomized with four coefficients and five replications.

The results of the analysis of the basic nutrients showed that cowpea seeds contain protein, fat, ash, moisture, dietary fiber and carbohydrates by 21.92%, 5.33%, 3.40%, 8.66%, 14.33% and 46.16%, respectively. As for the content of cowpea seeds from phytic acid and inorganic phosphorus in the direct analysis of dry seeds were 6.63% for phytic acid and 0.13% for inorganic phosphorus. The percentage of phytic acid after cooking without soaking decreased to 5.95%, while the inorganic phosphorus increased to 0.19%. Similarly, cooking after soaking for 16, 12 and 8 hours led to an increase in acid content to 5.07%, 4.94% and 4.62%, which was accompanied by an increase in the percentage of inorganic phosphorus to 0.23%, 0.30% and 0.37%, respectively.

Key words: cowpea seeds ; phytic acid ; plants

Introduction

Cowpeas (*Vigna unguiculata* L. Walp) is one of the most important legume crops grown in the tropics with varying environmental conditions ranging from dry to humid, withstands high temperatures and drought, and does not require highly fertile soil (Dugje *et al.,* 2009). Cowpea occupies an important position in agriculture in terms of the value of its protein and starch content and the ability of its plants to repair nitrogen in the atmosphere (Fernandez *et al.,* 2002). Cowpea seeds are included in the supplementation of traditional starchy meals because they contain a relatively high percentage of protein ranging from 20.42 to 32.60% with increasing reliance on cowpea seeds as an alternative to animal proteins (Al-Shibli, 2018). In many developing countries, cowpea is the main source of dietary protein because it contains lysine, which is the most essential amino acid in legumes as a good dietary supplement (Steele, 1985).

Beans are important in meeting food needs, especially for resource-poor households. It is a source of high quality protein for human and animal nutrition based on dry weight. Cowpea seeds contain 23.4% protein, 1.8% fat and 60.3% carbohydrates and thus provide a high-quality vegetable protein that can be used to replace or add meat protein in the diet of low-income families. It also contributes to alleviating the problem of protein malnutrition in children under five in carbohydrate-based diet communities. (Mbwaga *et al.,* 2010).

It is noted that cowpea is a good source of minerals such as phosphorus, potassium, calcium, sulfur and iron and the calcium content ranges from 120 to 260 mg / 100 g. Numerous methods, such as soaking, cooking, germination and fermentation, have been used to improve the nutritional quality of legumes. The biological value of cowpea seeds is adversely affected by the presence of anti-nutritional factors, including trypsin inhibitors and phytic acid (Al-Shibli, (2018; Lambot, 2002). As cowpea is a rich source of vitamins and minerals, it is an important nutritional enhancer when its high lysine content is combined with the high content of methionine and cysteine in legumes. However, the presence of high phytic acid in food reduces the bioavailability of minerals due to the

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formation of intestinal insoluble and insoluble complexes (Didar *et al.,* 2010).

The stability of phytate complexes with metallic elements depends on the number of phosphate groups associated with the inositol molecule. This stability decreases with decreasing phosphate aggregates and thus increasing their solubility (Nielsen *et al.,* 2007). The concern in this nutritional state is the presence of phytates in the dry cowpea, since phytates reduce the bioavailability of the basic minerals and may interfere with the efficiency of the metabolism of proteins due to complexes of phytate proteins and metalloproteins. (Urbano *et al.,* 2000). The objective of this study, therefore, was to estimate the content of cowpea seeds of essential nutrients and assess the effect of seed soaking for different periods and cooking on seed content of relative phytic acid and inorganic phosphorus.

Materials and Methods

The experiment used the seeds of cowpea (*Vigna unguiculata*) obtained from the local market of the city of Karbala. The seeds were sifted and then cleaned well to be free from foreign matter, impurities and dust. A random sample of clean seeds was milled using the Sokany household coffee grinder and then the ground sample was developed to estimate its nutritional contents including protein, carbohydrate, ash, fiber, fat. The remaining seeds were divided into three groups with five treatments for the purpose of estimating the seed contents of phytic acid and organophosphorus and comparing their proportions between different treatments. The first group included treatment control Ta1 dry ground sample. The second group treated Ta2 and the seeds were cooked in boiling distilled water for 30 minutes. (Luo and Xie, 2013) and then dried in a 50°C air oven for 24 hours and grinded. The third group included Ta4, Ta3 and Ta5, which were soaked seeds for eight, twelve and sixteen hours respectively and then cooking drying and grinding as previously mentioned (Paredes-Lopez and Harry, 1989; Ibrahim, 2002).

Nutritional contents in cowpea seed sample

The contents of cowpea seed sample of moisture, ash, protein, fat and fiber were estimated using standard methods according to AOAC (2008). While, seed content of total carbohydrates was calculated by subtracting the sum of the estimated contents from the total content value (AOA AC)., 2008)

Determination of Phytic acid in cowpea seeds

Phytic acid content was determined in 5g seed sample following the method by Wheleer and Ferrel (1971) by

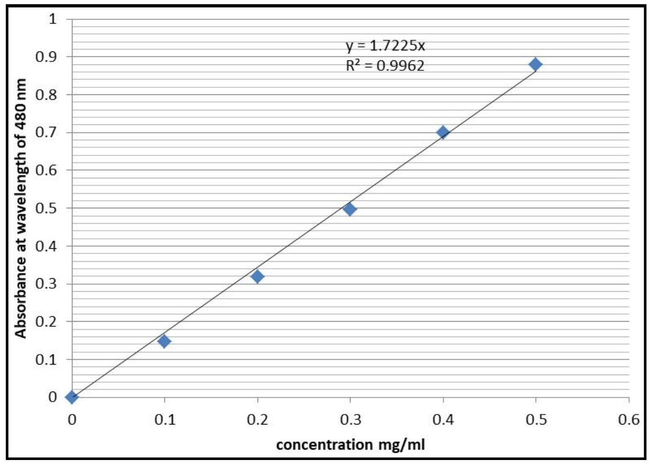

Fig. 1: Standard curve for ferric nitrate (Fe $(NO_3)_3 \cdot 9H_2O$) solution at mg/ml at 480 nm wavelength.

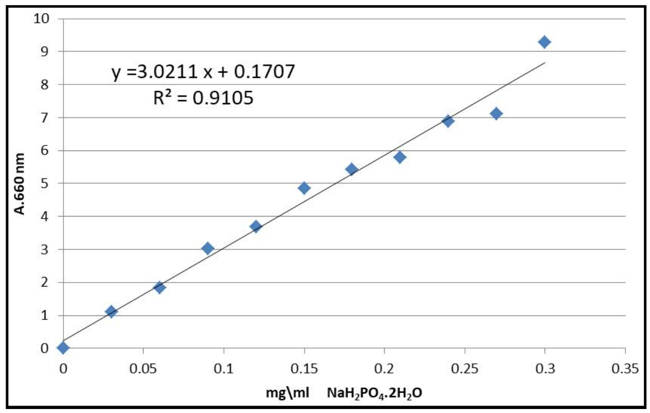

Fig. 2: Standard curve for sodium phosphate solution prepared at 0.15-1.5 mg/ml measured at wavelength 660 nm for inorganic phosphorus content in cowpea seeds.

the aid of a spectrophotometer where absorbance was read within one minute with a maximum wavelength of 480 nm.

Determination of inorganic phosphorus in cowpea sample

Inorganic phosphorus was estimated according to the method reported by Chen *et al.,* 1956 and referred to by Dole and Reddy, 2015) with a slight adjustment which included raising the quantities by 10 times. The intensity of violet color was measured using Japanese-made Optima SP-300 Spectrophotometer at 660 nm. The amount of inorganic phosphorus after reading fixation was calculated in a linear curve equation resulting based on standard sodium phosphate curve Fig. 2.

Results and Discussion

Nutritional contents in cowpea seed sample

Results table1 showed that the percentages of nutritional components in cowpea seeds were within the acceptable range and within the values of previous studies.

Table 1: Nutritional value of cowpea seeds in dry sample.

Mois-ture%	Ash %	Prot-ein%	Fat %	Fib-ers%	Total carbo-hydrates%
8.66	3.60	21.92	5.33	14.33	46.16

The values of moisture content, ash, protein, fat, dietary fiber and total carbohydrate were 8.66%, 3.60%, 21.92%, 14.33%, 5.33% and 46.16%, respectively. The results showed that the percentages of some components were in agreement with the previous researchers, while the percentages of other components differed with the results of some studies. The moisture content of cowpea seeds was close to what it found (Al-Shibli, 2018) but lower than that obtained (Punia, 2000). 13.20%, 10.95%. This is logically acceptable since the moisture content of seeds is the limiting factor phytic acid in the cowpea compared to treatment without cooking and soaking. Although there were no significant differences between the three soaking treatments, it is clear that the longer the soaking time, the lower the percentage of phytic acid.

In general, the percentage of phytic acid in untreated dry cowpea seeds was relatively higher than in previous studies (Ibrahim *et al.,* 2002; Trinidad *et al.,* 2010; Yassin, 2013). Low phytic acid was found after cooking regardless of soaking or non-soaking of the seeds. The reduction in phytic acid after cooking may be due to the formation of insoluble tanning protein compounds or non-extractable phytate proteins from cooked seeds. This result was similar to what found by Ibrahim *et al*., (2002), but was not in agreement with Longe (1983). The results showed that the increase in seed soaking period before cooking led to significant decrease in phytic acid levels. This can be attributed to the activation of endogenous phytase within 16 hours of soaking (Ogun *et al.,* 1989). This is consistent with similar results in legume seeds (Mahgoub *et al.,* 1998).

Cowpea seed content of phytic acid affected by different treatments

The percentage of inorganic phosphorus in cowpea seeds was also affected by different treatments of soaking and cooking. Unlike phytic acid, the highest inorganic phosphorus was recorded in Ta5 (soaking for 16h+cooking) with a value of 0.37%, while the lowest was 0.13% in Ta1 treatment (untreated control). The results table1 showed that the percentage of inorganic phosphorus in cowpea seeds increased significantly in cooked sample by 46% over the uncooked control seeds, and these results differed completely from the results of Ologhobo and Fetuga (1984). Findings also showed that pre-cooking soaking treatments significantly increased inorganic phosphorus in cowpea seeds compared to cooking without soaking treatment and the control treatment. As shown in the same table 1, the increase in the soaking period for 8, 12 or 16 hours was accompanied by an increase of inorganic phosphorus by 76% and 138% and 184% over the untreated control, respectively.

The reason for this increase is due to the appropriate conditions of moisturizing period and temperature, which leads to the availability of a suitable medium for the enzyme phytase activity. Soaking in water is part of these processes, which usually ends with cooking. In addition to softening the seeds, the soaking process can be considered useful in reducing a large amount of phytate and increasing inorganic phosphorus in cowpea seeds.

Table 2: Effect of different treatments on cowpea seeds content of phytic acid and inorganic phosphorus.

% content of	Treatments				
	Uncooked dry seeds (Ta1)	Cooked non-soaked (Ta2)	Cooked soaked seeds for		
			8h (Ta3)	12h (Ta4)	16h (Ta5)
Phytic acid	6.63 %c	5.95 %b	5.07 %a	4.94 %a	4.62%a
Inorganic phosphorus	0.13%a	0.19%b	0.23%c	0.31%D	0.37%e

Weans with similar that have same letters are not significantly different at $P \leq 0.05$

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