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Research Article
Effect of Potash on the Tenderness and Phytochemical Constituents of *Cajanus cajan*

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Abstract

Background and Objective: The seed of *Cajanus cajan* enclosed in a hard, tough and thick skin with a semi-permeable membrane, restricting the movement of water through the mesocarp. This study aimed to assess the effect of potash on the tenderness and phytochemical constituents of pigeon pea. **Materials and Methods:** Pigeon pea was cooked with 2, 3, 4 and 5 g of potash after which the texture of the cooked whole grains was determined using the thumb and index finger and thereafter; the degree of tenderness of each sample in comparison with the control sample was rated. Proximate analysis was carried out on each of the samples. **Results:** The study showed that potash increased the level of tenderness of *Cajanus cajan* when compared to the control. The higher the concentration of potash, the higher the level of tenderness. Also, potash decreased the phytochemical constituents of *Cajanus cajan.* The higher the concentration of potash, the lower the phytochemical constituents. **Conclusion:** So, it was concluded that the potash increased the tenderness of *Cajanus cajan* but decreased its phytochemical constituents.

Key words: Potash, tenderness, phytochemical, *Cajanus cajan*

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Potash also known as Kaun (Yoruba), Akanwa (Igbo) or Kanwa (Hausa) is a lake salt (sodium bicarbonate) that is very dry and hydrated in nature. It may be found in white (complex potash), mixture of grey/reddish brown (lite potash) with wide range of particle size. Its grey/reddish brown colour depends upon the presence of trace amount of other elements such as; iron. It is found in salt deposit forms and shoots out from soil during rainy season as sea water/ocean evaporate, but tends to fall off, solidifies and get dried during dry season into bed of potash ore[1,2]. Studies revealed that potash is the second most popularly used salt in Nigeria[1,2]. However, it has high sodium content and very little potassium[3,4]. It is used in Nigeria as tenderizing agent, local dishes preparation, tooth ache relief, preservatives due to its antifungal properties, fire extinguisher, fertilizer production, medicinal purposes (herbal concoction), cough treatment, constipation relief, stomach ache, tobacco snuff preparation and lactation purposes[5].

Cajanus cajan (L.) Mill sp. (Leguminosae) pigeon pea in English[6], is native to India which is the world's largest producer. It is also grown in Africa and the Americas and has been suggested to be one of Africa's drought-tolerant crops referred to as 'orphan crop' because it falls into the group of least researched crops world-wide[7]. It served both as a food and forage crop[8].

Despite of its importance for nutrients and as vegetable, pulses and its food value in other countries, Nigerians are yet to utilize the pigeon-peas in their menu. In Nigeria, pigeon pea is less popular and cheaper than other legumes such as; cowpea, Bambara groundnuts, soya bean, etc[9].

Since pigeon pea is well adapted to tropical regimes and insufficient protein of good quality is a limiting factor in developing countries with ever increasing population, appropriate processing to improve the utilization of this legume is of high importance. Attempts have been made to improve its utilization in human diet due to increasing need for cheaper and available plant proteins to meet the increasing demand of the Nigerian populace. Reduce cooking time and acceptability have been achieved for pigeon pea through dehulling process. Fermentation process had also been utilized to increase the protein and textural qualities of the seeds[10]. Pigeon pea seeds apart from being hard to cook are hard to dehull thus the drudgery process of dehulling the seed is also limiting the utilization of pigeon pea into other form of products apart from cooking the seeds[11].

Energy efficiency is a fundamental requirement for sustainable food and energy development. Energy efficiency, environmental protections and food processing waste management have attracted increasing attention in the food industry[12]. Effective energy utilization and energy source management in food processing facilities are desirable for reducing processing costs, conserving non-renewable energy resources and reducing environmental impact. Cooking energy accounts for approximately 90% of all household energy consumption in developing countries[13].

Processing of pigeon pea involved de-podding, cleaning, cooking, drying and milling. The seed of the pigeon pea is enclosed in a hard, tough and relatively thick skin that has a semi-permeable membrane. Movement of water through the mesocarp is restricted because the adhesive force that binds the mesocarp to the seed is relatively high[14].

Literature abounds on the processing and nutritional components of *Cajanus cajan* using different methods; however, there is little or no information on the effect of potash on the phytochemical constituents of *Cajanus cajan.* This study therefore, was designed to determine the effect of potash on the tenderness and phytochemical constituents of *Cajanus cajan*.

MATERIALS AND METHODS

Study area: The study was conducted in September 2018 at the Biological Sciences Department Laboratory, Kogi State University Anyigba, Nigeria. The site was located on 7°151N-7°291N and 7°111E-7°321E. The site was known with a suitable atmospheric condition having an annual mean rainfall and temperature of 1250 mm and 25°C, respectively. The vegetation was typical of derived Savanna with a sandy soil[15].

Collection of materials: The food items; pigeon pea, onions, fresh pepper and palm oil were purchased from the market in Anyigba (Unity square). These items and other cooking materials such as kerosene, stoves and water were moved to Biological Sciences Laboratory, Kogi State University, Anyigba.

Sample preparation: The methodology used in this study was similar to that of Sheneni *et al.*[16] and Adebanke *et al.*[17]. Here pigeon peas were poured into a bowl where the bad ones, dirt, sand and stones were removed. About 500 g of pigeon peas (2 cups) were measured into five different plastic containers and different grams of potash 2-5 g were weighed measured using electric weighing balance and transferred into beakers which were appropriately labelled. Fresh pepper was also washed and blended with a manual blender. The pigeon peas were washed with water and drained in sieves. The five

stoves were arranged on the workbench and lit. Five pots containing about 1 L of water in each were covered and arranged on the stoves and heated until the water boiled after which the drained beans were introduced into each of the boiling water for all the five stoves. About 2-5 g of potash were introduced into the second, third, fourth and fifth pots respectively with no potash in the first stove (Control). Each cooking set-up was carefully labelled; control (0 g), 2, 3, 4 and 5 g, respectively with a masking tape using ink marker. Forty minutes later, 4 g of fresh pepper, 4 g of seasoning cube, 6 g of salt and 10 g of palm oil were introduced into each of the five setups. Thereafter, the set-ups were covered and allowed to cook for 3 h after which all the stoves were put off.

Tenderizing effect of samples: The cooked pigeon pea from different cooking methods were coded and the texture of each food samples was tested with hands (thumb and index), each in comparison with the control sample (0 g). The degree of tenderness of each samples were rated by sampling in comparison with the control sample to know whether the level of tenderness was low, high, higher and highest or no tenderness.

Phytochemical analysis of samples: After cooling, samples were gotten from each of the five pots and put into plastic air-tight containers and further allowed to cool before refrigerating for about 7 h. Phytochemical analysis was carried out in biochemistry laboratory of Kogi State university, Anyigba, Nigeria using the methods described in Associ chemist[18].

Data analysis: Statistical analysis of the data obtained from the respondents for tenderness test and the result from phytochemical analysis of samples was performed using the Statistical Package for Social Sciences (SPSS) version 20. Pearson's Chi-square test was performed where appropriate to identify any effect of potash on *Cajanus cajan*. The level of significance of each test was set at p-value less than 0.05 ($p<0.05$).

RESULTS

Tenderizing effect of potash on *Cajanus cajan*: Data in Table 1 shows the result of *Cajanus cajan* cooked using different concentrations of potash (2, 3, 4 and 5 g) at a constant time (3 h). The level of tenderness for 2 g of potash was low, 3 g was high, 4 g was higher, 5 g recorded the highest level of tenderness while the control was not tendered.

The result of the quantitative phytochemical analysis of *Cajanus cajan* carried out after cooking are given in Table 2. Apart from tannin constituent, all other phytochemical constituents differ significantly. Control recorded the highest flavonoid (16.53 ± 0.03^{a}) while 5 g recorded the lowest flavonoid (8.42 ± 0.02^{e}). The highest saponins was recorded at control (5.92 ± 0.05^{a}) while 5 g recorded the lowest saponins (0.22 ± 0.05^{e}). Control recorded the highest phenol (175.6 ± 0.01^{a}) while 5 g recorded the lowest phenol (51.06 ± 0.10^{e}). Control recorded the highest alkaloid (0.100 ± 0.00^{a}) while 5 g recorded the lowest phenol (0.020 ± 0.00^{d}).

DISCUSSION

The result of the study showed that the set up with the highest concentration of potash (5 g) was the most tendered of all the treatments while that of the control was the least tendered. The higher the concentration of potash, the higher the level of tenderness and the lower the phytochemical constituents. The results of this study is similar to that of Uzogara *et al.*[19] who reported the use of potash as food tenderizer for dry beans and other tough foods. Cowpea

Table 1: Effect of potash on the tenderness of cooked *Cajanus cajan*

Treatment time taken (3 h)	Tenderness
Control	Not tendered
2 g	Low
3 g	High
4 g	Higher
5 g	Highest

Table 2: Quantitative phytochemical analysis of *cajanus cajan* cooked with different potash treatments

Treatments	Flavonoid (mg g^{-1})	Tannin (mg g^{-1})	Saponin (mg g^{-1})	Phenol (mg g^{-1})	Alkaloid (mg g^{-1})
Control	16.53 ± 0.03^{a}	2.62 ± 0.02	5.92 ± 0.05^{a}	175.6 ± 0.01^{a}	0.100 ± 0.00^{a}
2 g	12.74 ± 0.04^{b}	2.57 ± 0.02	2.25 ± 0.05^{b}	144.9 ± 0.01^{b}	0.45 ± 0.05^{b}
3 g	10.53 ± 0.03^{c}	2.24 ± 0.02	1.56 ± 0.05^{c}	117.3 ± 0.10^{c}	0.040 ± 0.00^{b}
4 g	9.42 ± 0.02^{d}	1.97 ± 9.03	0.94 ± 0.05^{d}	90.86 ± 0.01^{d}	0.030 ± 0.00^{c}
5 g	8.42 ± 0.02^{e}	1.41 ± 0.02	0.22 ± 0.05^{e}	51.06 ± 0.10^{e}	0.020 ± 0.00^{d}
Total	11.93 ± 0.95	3.98 ± 1.80	2.18 ± 0.662	115.94 ± 14.3	0.047 ± 0.093
p-value	0.000*	0.494^{ns}	0.000*	0.000*	0.000*

Means with the same superscript are not significant at $p>0.05$. *$p<0.05$, ns: Non significant

which is noted for its prolonged cooking time of 40-65 min was reduced to 10-15 min when cooked with high concentration of potash than the control samples without potash. The results in this study coincides with the work of Adebanke *et al*.[17] where the application of potash and wood ash were used as softening agents for the seeds of *Prosopis africana*. The results of this study were similar to the work of Yewande and Thomas[20] where the addition of potash led to significant reduction in the anti-nutrient constituents of *Vigna unguiculata* and *Vigna angustifoliata*. These observations confirmed the previous reports that potash has an adverse effect on chemical constituents of foods[21]. The high phytochemical constituents in this study is in line with the result of Zu *et al*.[22] and Wu *et al*.[23], who documented that *Cajanus cajan* is rich in phenol, saponins, conspicuous amount of tannins and moderate quantities of alkaloids and flavonoids. Consumption of potash especially in large quantity can lead to reduced birth weight as increase in sodium administration leads to increase in calcium excretion[2], it can also prevent conception and also induce abortion during early pregnancy[1,3,24] and also affects the kidney[4]. A study by Madode *et al*.[4] showed an insignificant loss of amino acids in 0.5% kanwa cooked cowpeas and an insignificant change in available lysine content.

Developed time-saving cooking technologies for pigeon pea will reduce nutrient losses and fuel consumption and provide product diversification. Essentially, factors that contribute to legume hardening and their interactions with processing treatments need further investigation.

CONCLUSION

Potash increased the level of tenderness of *Cajanus cajan* at different concentrations. The higher the concentration of potash, the higher the level of tenderness. Potash also decreased the phytochemical constituents of *Cajanus cajan*. The higher the concentration of potash, the lower the phytochemical constituents.

SIGNIFICANCE STATEMENT

This study discovered the effect of potash on growth and phytochemical constituents of *Cajanus cajan*. This study will help the researchers to uncover the critical areas of food production and security that many researchers were not able to explore. Thus a new theory on food production, management and security may be arrived at.

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