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Nutritional Composition of the Seed of *Icacina Senegalensis/oliviformis* (False Yam)

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Abstract: This paper seeks to determine the nutritional composition of the seed of *Icacina senegalensis* (false yam), a plant found in the Yunyoo community in the northern region of Ghana. The seed in both its unprocessed and processed forms were analyzed for their proximate and mineral compositions. This was done to determine the nutrient content and the effect of processing on the nutrient composition. The results showed a general decline in the mineral concentration from the unprocessed to the processed forms of the seed. However, for the proximate composition, there was an increment in the concentration of moisture, fibre and carbohydrate while the rest of the compositions (crude protein, fat, ash as well energy) decreased in the processed seeds. There was significant difference between the nutrient content of the unprocessed and processed seeds (P<0.05) and hence, it was concluded that the mode of processing had the effect of reducing the nutritional value of *Icacina senegalensis* seed.

Key words: *Icacina segalensis, Icacina oliviformis*, proximate, composition, spectrophotometry

INTRODUCTION

Food is any edible, non-toxic, liquid or solid substance which when ingested either raw or cooked provides the body with energy and nutrients to perform one or more physiological functions. There are six food nutrients and every food contains one or more of these nutrients in different proportions. Among many of these food types is the *Icacina senegalensis* (*I. senegalensis*) plant. It is a wild plant of the icacinacaea family, found growing in savanna areas in some countries hence indigenous to West and Central Africa (National Research Council, 2008). In Ghana, it is conspicuous in the Northern, Upper East and Upper West regions and in some forest areas just as reported by Timothty *et al.* (2011).

False yam (*I. senegalensis*) is a shrubby recurrent or perennial plant with underground fleshy tuber producing a bright-red fruit containing a single sphere-shaped seed (Irvine, 1930; Dalziel, 1984; National Research Council, 2008). It has various names indigenous to where it is located, such as "bankanas" and "kouraban" in Senegal (Tournier, 1951), "manankaso" in Gambia as well as "pane" in Sudan (Dalziel, 1984), while in Ghana, it is known as "tàŋkòrò" (Irvine, 1961). The Bimobas and the Mamprusi in the East Mamprusi and Bunkpurugu-Yunyoo Districts of the Northern Region of Ghana call it "kpalbila" and "kwaliya" respectively. *Icacina senegalensis* metamorphosed in terms of classification to be known as *Icacina oliviformis* and now known as Icacina in English (Fay, 1987; Dei *et al.*, 2011).

Icacina senegalensis has a variety of uses ranging from the leaves being used as medicine (Valentine and Sulemana, 2012) to the seeds, fruits and tubers used as food for humans (Fay, 1987; National Research Council, 2008; Ezeigbo, 2010; Udeh *et al.*, 2011) as well as feed for animals. According to Woot-Tsuen *et al.* (1968), flour produced from the tubers has the following compositions; water (11.7%), protein (10.3), fat (0.7%), carbohydrates (74.5%), ash (2.8%), calcium (150mg/100g), iron (7mg/100g) and flour from the seeds has the following compositions; water (12-3%), protein (8%), fat (0.1%), carbohydrate (72-73%) and ash (0.5%). Meanwhile, Fay (1991) cited in Valentine and Sulemana (2012) stated that "Nutritional analyses of both the seeds and tuberous roots of *Icacina oliviformis* (Icacinaceae) from the Central African Republic had revealed that the seeds contain 80.7% Nitrogen-free Extract (NFE), 14.0% crude protein and 0.5% crude fat (dry weight) and the roots contain 84.5% NFE, 4.4% crude protein and 1.6% crude fat (dry weight). The average moisture content of live seeds is 18.3%, the moisture content of the fresh root is 59%" (Fay, 1991).

Unfortunately, fleshy roots or tubers and seeds of *I. senegalensis* contain some toxic complexes-cyanogenic glycosides (Irvine, 1930; Dalziel, 1984) and this renders it dangerous for human consumption. It therefore has to undergo thorough processing (soaking in water for several days and drying) before it is made safe for human consumption. It was alleged in 2005 that, three (3) children from a household in the Yunyoo community in the Bunkpurugu-Yunyoo Districts of the Northern Region of Ghana died after consuming a meal prepared from flour obtained from seeds not-well-processed.

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Despite this, the seed has been helpful in minimizing hunger in the lean season since majority of the people have survived after consuming it. There has not been much research about this plant and especially its seed which could be a life-saver for the people in northern Ghana. This paper therefore looked at the nutrient composition of the seed before and after processing and to determine the effect of processing on the nutrient value of the seeds.

MATERIALS AND METHODS

Sample source and preparation: Icacina senegalensis seeds used were collected from the study area, Yunyoo. The community was sectioned into four quarters and the samples (seeds) were collected as follows. The matured fruits were picked from the wild, dried for about 5 to 6 days and then cracked to obtain the seeds. A portion was taken and grounded, kept in an air tight container and labeled unprocessed sample. The rest of the seeds were further processed (Fig. 1) by soaking in water for about two (2) weeks (that is 14 days) to remove the toxic principle which was evident by the formation of foam on the water in which the seeds were soaked. The seeds were removed, washed and then re-soaked and rewashed for extra three days after which the seeds changed colour from dark brown to light brown. Finally, seeds were dried for three days. The seeds were then grounded kept in an air tight container as well and labeled as processed sample to avoid any mix-up.

Laboratory analysis: Laboratory determination of the various parameters was carried out using standard prescribed methods of the Association of Analytical Chemists (AOAC, 1990). All analysis were done in

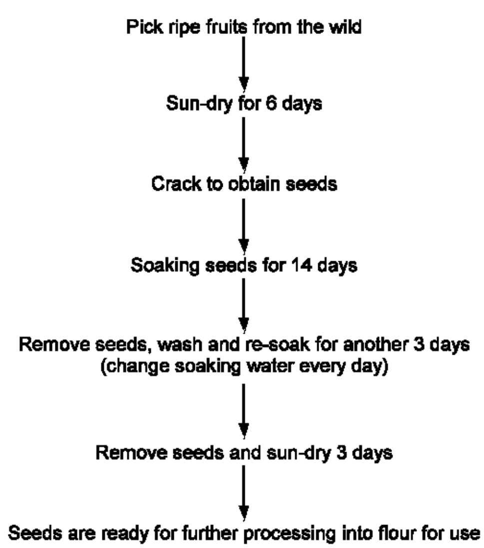

Fig. 1: Flow chart for processing (detoxifying) *Icacina senegalensis* seeds

duplicates. Moisture, protein, fat, ash, fibre were determined proximately. Carbohydrate content was calculated by differences while energy value in kilojoules (kJ) of sample was calculated using the percentage components of fat, protein and carbohydrate and each multiplied by 9, 4 and 4, respectively (appropriate factors). These were all added together to give the energy content in calories. The calories were then converted into kilojoules by multiplying by a factor of 4.185. Mineral analysis was done using flame atomic absorption spectrophotometry (Fe, Cu, Mg, Zn, Ca, K) and UV-spectrophotometry for phosphorus.

Data analysis: The data collected from the laboratory assessment of the samples were organized by entering the data into Microsoft Excel. A one way ANOVA (Analysis of Variance) was performed using Minitab (version 16) to compare means and see how they differ significantly.

RESULTS AND DISCUSSION

Proximate analysis: Moisture content in the process seed (10.30%) was more than that present in the unprocessed seeds having 6.63%, probably due to the intensive soaking that characterized the processing procedure. The 10.30% is relatively lower compared to 12% reported by Woot-Tsuen *et al.* (1968) and not comparable to the 18.3% moisture content of the live seed from Central African Republic (Fay, 1991).

The fat content reduced from 4.27% to 0.98% after it had been processed but relatively comparable to the fat content of cowpea (1.3-1.5%). There could have been oil-in-water emulsion formed during the soaking process and the throwing away of the soaking water could account for the steep reduction. This value (0.98%) is however comparable to 0.7% reported on flour from the tubers of *I. senegalensis* but far higher than value reported for flour from the seeds by Woot-Tsuen *et al.* (1968) and almost double the 0.5% crude fat reported on the seed from Central African Republic by Fay (1991). These differences may be as a result of geographical disparities.

Protein content ranged between 10.07% and 8.54% for unprocessed and processed seeds, respectively. This reduction may be due to dissolution of parts of the seed during the processing of the seed. Though the protein concentration of the seed was generally low compared to other staples such as cowpea (22-24g/100g) and soybean (43.20g/100g), it nevertheless provided about 15-16% of the adult male RDA of 56g.

The carbohydrate concentration (Table 1) of the processed edible form was 77.94, 3.15% higher than toxic unprocessed seed but not significantly different ($P<0.05$). This compares favourably with the carbohydrate content of flour produced from the tubers of the plant (74.5%) and from the seeds (72-73%) as reported by Woot-Tsuen *et al.* (1968). This value was

Table 1: Proximate composition of *I. senegalensis* seeds

Sample	Parameters [Means (% or kJ)±Standard Deviations]						
	Moisture (%)	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	Carbohydrate (%)	Energy (kJ)
IU	6.63±0.1270^a	10.07±0.0990^a	4.27±0.1414^a	1.42±0.0566^a	2.61±0.2121^a	74.79±0.1270^a	1585.0±4.2400^a
IP	10.30±0.0710^b	8.54±0.0283^b	0.98±0.0141^b	1.99±0.1273^b	0.28±0.0141^b	77.94±1.3440^a	1484.2±1.7000^b
	P = 0.001	P = 0.002	P = 0.001	P = 0.029	P = 0.004	P = 0.081	P = 0.001

IU means: *Icacina* unprocessed; IP means: *Icacina* processed. Means that do not share the same letter (superscript) are significantly different (P<0.05). Those that share the same letter (superscript) do not differ significantly (P>0.05)

Table 2: Mineral composition of *I. senegalensis* seeds

Sample	Parameters [Means (mg/100g)±Standard Deviations]						
	Fe	Cu	Mg	Zn	Ca	K	P
IU	3.89 ± 0.1273^a	0.30 ± 0.1131^a	21.90±1.2730^a	0.83±0.0424^a	56.30±0.0710^a	37.23±0.0420^a	126.67±17700^a
IP	0.28 ± 0.0141^b	'ND'	10.11±0.1410^b	0.26±0.0141^b	52.12±0.0141^b	7.54±0.7070^b	126.45±0.7500^a
	P = 0.017	'ND'	P = 0.006	P = 0.003	P = 0.001	P = 0.000	P = 0.886

IU means: Icacina unprocessed; IP means: Icacina processed. Means that do not share the same letter (superscript) are significantly different (P<0.05). Those that share the same letter (superscript) do not differ significantly (P>0.05). 'ND' means not determined due to equipment error

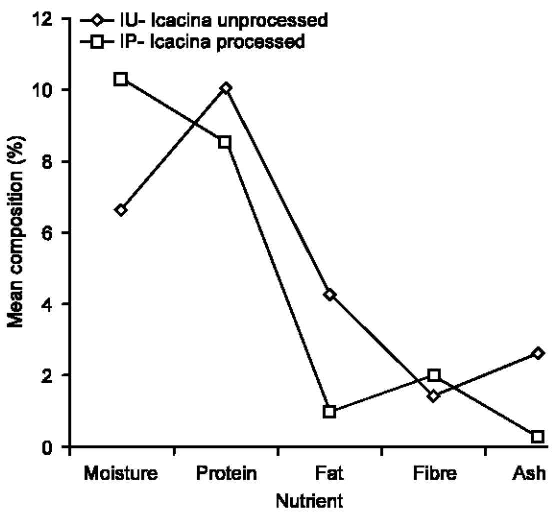

Fig. 2: Proximate composition of *I. senegalensis* seeds

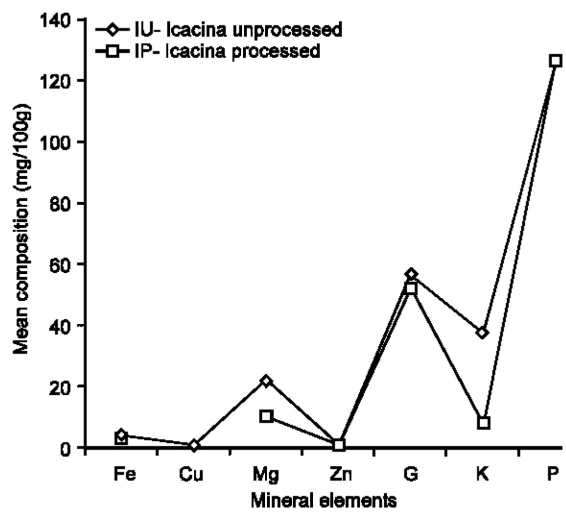

Fig. 3: Mineral composition of *I. senegalensis* seeds

quite high compared to cowpea (56-66g/100g) and soybean (20.9g/100g) making *I. senegalensis* a good source of carbohydrate.

There was a 0.57% increase in crude fibre content of the seed from the unprocessed (1.42%) to the processed form (1.99%). Fibres are the structural parts of plants and thus are found in all plant-derived foods. The low fibre concentration has the possibility of low interference with absorption of minerals such as iron, zinc, magnesium and calcium. High fibre in food is said to interfere with the absorption of the above stated minerals (Wardlaw, 2003).

The seed provides an appreciable level of energy with significantly higher concentration in the unprocessed (1585kJ) than in the toxic unprocessed seed (1484.25kJ). It could therefore be said to be less energy-giving than soybean that presents 1807kJ of energy.

Mineral composition: Minerals paly vital roles in several physiological functions in the human body including critical involvement in nervous system functioning, cellular reactions, water balance in the body and in structural systems such as the skeletal. Mineral concentrations in the processed seeds were generally lower than the unprocessed seeds (Fig. 3). Most minerals can be lost when they dissolve in water that is then discarded. This could account for the reduction in the concentrations of all the minerals analyzed. These values however make *I. senegalensis* better source of minerals than maize (a common staple source of flour) 26 and 2.7mg/100g for calcium and iron, respectively.

Magnesium concentration in the processed seed was 10.11%, about 11.79% lower than the level in the unprocessed seeds. The presence of Magnesium is of nutritional importance because Magnesium is very essential in a number of body functions such as improving bone strength, aiding in enzyme, nerve and heart function. It also plays an important role in the normal functioning of the human immune system (Jensen, 2000).

Fig. 4: Unprocessed *Icacina senegalensis* seeds

The processed seeds had a calcium content of 52.12mg/100g. This is about 2.6-5.2% of the RDA of 1000-2000mg for adults (Wardlaw, 2003). This is however lower compared to 76-104 and 240mg/100g of cowpea and soybean, respectively. Magnesium and calcium are essential minerals in the contraction and relaxation of muscles.

Phosphorus was the highest occurring mineral in the study material, 126.45% in the processed seeds and 126.67% in the unprocessed seeds. This difference in the concentration is however not significant (P<0.05). It is an important element in the production of energy and storage of energy in the body of mammals (Jensen, 2000).

Zinc is very necessary for a strong, healthy immune system. The seed contains 0.26mg/100g in the processed form and 0.83mg/100g in the unprocessed form. The seed has a considerably low level of iron in relation to the daily Recommended Dietary Allowance (RDA) of 18mg/day for women ages 19-50 years (Wardlaw, 2003). The seed in the processed form presents just 13.5% of this recommendation. Cowpea seeds have a better iron content of 5mg than the *I. senegalensis* seed of 2.88-3.89mg. Iron, taken at the same time as zinc, will reduce zinc assimilation as a result of mineral-mineral interactions.

I. senegalensis seed contained significantly lower potassium concentration (7.54mg/100g) in the processed seeds than the unprocessed seeds (37.23mg/100g). The 7.54mg/100g represents 10% of the RDA of the nutrient for the average adult requirement of 2 to 3mg per day (Wardlaw, 2003).

Conclusion: The seed of *Icacina senegalensis* (false yam) is of great nutritional importance. It contains a number of nutrients in varying quantities in the unprocessed and processed states. Moisture, carbohydrate and fibre concentrations were higher in the processed than the unprocessed seeds whilst protein, fat and ash concentrations were lower in the processed seeds. For the minerals, the concentrations were higher in the unprocessed than in the processed seeds. The unprocessed seeds present more energy (1585kJ) than the processed ones (1484.2kJ). The concentration of nutrients in the unprocessed seeds were significantly different (P<0.05) from the processed seeds with the exception of carbohydrate and phosphorous which were not significantly different (P>0.05) in both the unprocessed and processed seeds (refer to Table 1 and 2). Generally, the mode of processing resulted in reducing the nutritional value of *Icacina senegalensis* seeds.

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