# Effects of Cooking Time on the Nutritive Values of African Yam Bean (*Sphenostylis Stenocarpa*)

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## Abstract

*The experiment was conducted to determine the effects of cooking time on nutritive values of African yam bean (AYB) (Sphenostylis stenocarpa). Five diets were formulated. Diet 1 contained raw AYB (RAYBM-unsoaked) while diets 2,3, 4 and 5contained presoaked AYB for 24 hours, cooked for 30,60, 90 and 120 minutes respectively corresponding to ($CAYBM_1$, $CAYBM_2$, $CAYBM_3$ and $CAYBM_4$). These diets were respectively randomly assigned to five groups of 12 rats each in a complete randomized design (CRD). Results of proximate analysis indicated that only ash and moisture content were significantly ($P<.05$) affected with increased cooking time. Performance indices indicated that daily weight gain, feed intake and feed gain ratio and protein quality of AYB seeds as reflected in the apparent digestibility (AD), biological value (BV), net protein utilization (NPU) and protein efficiency ratio (PER) values were significantly higher as cooking time increased. Therefore to improve the nutritive values of AYB seed the optimum cooking time and temperature of 90 – 120minutes at $100^oc$ is recommended.*

*The Coconut*

## Introduction

African Yam bean (AYB) (*Sphenostylis stenocarpa*) is a climbing legume widely grown in West Africa. In Nigeria, it is widely cultivated in Southern part of the country for its nutritious seeds, as well as edible tubers. Although, there has been declined in cultivation in Nigeria especially in Southern Nigeria, we have three major varieties: namely; black, white and brown. The ripe pods vary between 120 and 300mm in length and contain from 10-30 seeds, with crude protein levels varying from 21 to 26% (Evans and Boulter, 1974). African yam bean represents a less expensive source of dietary protein than Soya bean among Nigerians of low economic status and very little is known about its nutritional potentials (Apata and Ologhobo, 1990) and when compared to available information with other types of beans.

Grain legumes contain significant amount of phosphorus and substantial amount of essential minerals and vitamins specifically the B-complex vitamins needed for proper growth and development of the body. Generally legumes are low in fat content ranging from 1-5% with the exception of oil seeds such as soya bean, wing bean, and ground nut with lipid content of 18% and 43% respectively. But the adverse effect of coronary heart disease will be of great interest to patients which will find adequate quality of legume seeds highly desirable in diets because they lower blood lipids and increase dietary fibre content (Elegbede, 1998).

In Nigeria, it is known as sumunu-Iseyin (Yoruba), Girigiri (Hausa), Akidi-Oshishi (Igbo). In Edo state, it is commonly called Iyie (Etsako) and Ikhie-khie in Benin and its surrounding environs. While, in Ewato it is a forbidden crop. But in Ogwa in Esan-West local Govt. of Edo state, it is used in a special festival and is preferred over other grain legumes. A protein content of between 20 - 29% has been reported. This is lower than that of Soyabean – 38% but the lysine proportion in the protein is reported to be equal or higher than soyabean. However, there are at least two major constraints hindering more extensive use of African yam bean. Firstly, is the presence of anti-nutritional factors such as tannin, lectin, canavanine, proteinase inhibitors, saponins, cyanogenic glucosides, phytic acid and oxalic acid (D'Mello 1995). There is little literature about the anti-nutritional factors in African yam bean (Edem, Amugo and Eka, 1990; Apata and Ologhobo, 1997).

African yam bean (*Sphenostylis stenocarpa)* seeds can be consumed in different form either in an immature green state or matured form. But at maturity, African yam bean seeds coats are very hard resulting in long cooking time and high energy requirement before any specific preparation can be carried out. Diets formulated using boiled African yam bean meal (AYBM) from the rat experiment indicated that biological value (BV) was highest in boiled AYBM. Boiling as a food processing techniques has been highlighted as possible means of reducing or totally eliminating the anti-nutrients and improving the nutritive values at levels that can be tolerated by

man and his animals particularly in monogastric nutrition hence, this study was designed to investigate the effect of cooking time on the nutritive values of African yam bean.

**Materials and Method**

**Processing of African yam Bean Seeds:** Some African yam bean seeds were purchased from the central market at Ekpoma in Edo State, Nigeria. The seeds were divided into five parts of 2kg each. Four (4) parts were pre-soaked for 12 hours to facilitate bean hydration before boiling. The pre-soaked samples were respectively boiled for 30, 60, 90 and 120minutes at $100^0$c using aluminum pot. The boiling water was not changed. At the end of the boiling period, the residual boiling water was drained off and the sample oven-dried over-night at $75^0$c and later sun-dried. All the processed samples and the raw sample were finally milled using a laboratory hammer mill to form the African yam bean meal (AYBM).

**Experimental Diets**

Boiling was the processing method used for the African yam bean seeds as indicated above. The processed African yam bean meals were used in formulating the diets for rats. Five (5) diets were formulated in all with each diet incorporated in the nitrogen free corn starch basal diets comprising 75.5, 10,5,5,1,2.50.0.5 and 0.25% of corn starch, groundnut oil, glucose, non-nutritive cellulose, mineral/vitamin premix, bone meal oyster shell and common salt respectively (Oke, Tewe and Ologhobo, 1999) In diets 2, 3, 4, and 5 were constituted by substituting RAYBM in diet 1 with AYB cooked for 30,60,90 and 120 minutes ( $CAYB_1$, $CAYB_2$, $CAYB_3$ and $CAYB_4$) respectively. Protein sources to be evaluated were added at the expense of maize starch to give 10% crude protein on dry matter basis, while diet1 was formulated to contain raw African yam bean meal (RAYBM)

**Experimental Animals and Design**

In the feeding trial, sixty weanling albino rats (30males and 30 females) of about four (4) weeks of age were used. The rats were randomly sorted into five groups of twelve (6male +6female) each in a completely randomized design, on the basis of initial weight and litter origin. The group of rats which were in three replicates of four rats (2male + 2female) each were housed in perforated cages (metabolic) with facilities for separation of fecal and urinary deposits. Each group of rats was assigned five treatment diets (1, 2, 3, 4 and 5). Experimental diets and clean water were supplied to them *ad libitum*

**Performance Study**

During the feeding trial, weekly feed consumption and weight changes were measured, while weight gain, feed gain ratio and protein efficiency ratio were estimated.

**Protein Quality Study.** Feaces and urine were collected from the rats for five consecutive days from the 16th day of the feeding trial. At the end of the collection period, nitrogen in test diets, dry feaces and urine were determined by the method of A.O.A.C. (2000). The nitrogen in dried feaces, test diets and urine were used to compute the apparent digestibility (AD), biological value (BV), net protein utilization (NPU), net protein ratio (NPR) and protein efficiency ratio (PER) as outlined for rats by NAS (1963).

**Results and Discussion**

The chemical composition of the African yam bean as affected by cooking time is showed in table 1. Results indicated that crude protein, fat, fibre, carbohydrate and gross energy were not significantly (P>.05) affected by cooking time with the exception of ash and moisture content which were significantly (P<.05) affected. The ash and moisture content decreased as the cooking time increased. Values obtained indicated that ash and moisture content were highest in the raw African yam bean (RAYBM) and least in African yam bean cooked for 120minutes ($CAYBM_4$). However, ash content values of African yam bean cooked for 30 minutes were statistically similar to that in the raw state, while African yam bean cooked for 60 and 90 minutes ($CAYBM_2$ and $CAYBM_3$) was statistically similar. The African yam bean cooked for 120minutes ($CAYBM_4$) were significantly different from all other cooked samples and the raw AYB. The moisture content in the raw African yam bean was comparable to that in $CAYBM_1$, while $CAYBM_1$and $CAYB_2$, $CAYBM_3$ and $CAYBM_4$ were also similar. The result in this study collaborates with that of Osho, Ogundipe and Dshiell (1995) and Omoikhoje 2008 who worked on bambara groundnut using the same processing methods as in this study.

Table1. Proximate composition of raw and cooked African yam bean (% Dry matter basis).

| | 0 | 30 | 60 | 90 | 120 |
|---|---|---|---|---|---|
| Constituents | | Cooking time minutes. | | | |
| | RAYBM | CAYBM | CAYBM | CAYBM | CAYBM SEM± |
| Ash | 3.93[a] | 3.51[a] | 2.90[b] | 2.84[b] | 2.00[c] 0.37 |
| Moisture | 7.16[a] | 6.4[ab] | 6.34[b] | 6.26[b] | 5.59[b] 0.11 |
| Crude protein | 21.92 | 21.54 | 21.44 | 21.38 | 20.08 0.26 |
| Fat | 5.13 | 5.10 | 5.21 | 5.28 | 5.49 0.14 |
| Fibre | 5.55 | 5.52 | 5.50 | 5.47 | 5.25 0.11 |
| Carbohydrate | 56.31 | 56.55 | 57.01 | 58.78 | 58.79 1.11 |
| Gross energy | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| (Kcal/kg) | 307.50 | 307.91 | 317.11 | 317.72 | 318.01 |
| | 6.49 | | | | |

a-d: Means in the same row with varying superscripts differ significantly (P<.05).
**SEM**: Standard error of means.

The performance data as influenced by cooking time is depicted in table 2. Results indicated that daily feed intake, weight gain and feed gain ratio of rats were significantly (P<.05) affected by cooking time. Highest weight gain was recorded on rats fed $CAYBM_4$ but statistically similar to those placed on $CAYBM_2$ and $CAYBM_3$ based diet, while the least was recorded in RAYBM. Feed intake among the rats fed differently cooked African yam bean were not significantly (P>.05) different from each other, but were significantly (P<.05) different from the raw African yam bean based diet which recorded the least value. Feed gain ratio was better in rats fed $CAYBM_4$ and $CAYBM_3$ with same value, followed by $CAYBM_2$ and RAYBM

**Table 2.Effect of Cooking Time on the (In Minutes) Performance of Rats**

| | | 0 | 30 | 60 | 90 | 120 | |
|---|---|---|---|---|---|---|---|
| Parameters | RAYBM | $CAYBM_1$ | $CAYBM_2$ | | CAYBM | $CAYBM_4$ | SEM± |
| Av.Initial weight, (g) | 40.49 | 39.50 | | 40.30 | | 40.05 | 40.00 |
| - | | | | | | | |
| Daily weight gain,(g) | 2.75[c] | 4.92[b] | | 5.39[a] | | 5.44[a] | 5.52[a] |
| 0.02 | | | | | | | |
| Feed intake,(g) | 11.54[b] | 17.00[a] | | 17.01[a] | | 17.03[a] | 17.29[a] |
| 0.02 | | | | | | | |
| Feed gain ratio | | 4.1[d] | | 3.46[c] | | 3.16[b] | 3.13[a] |
| 3.13[a] | | | 0.03 | | | | |
| Mortality (%) | 0.00 | 0.00 | | 0.00 | | 0.00 | 0.00 |
| - | | | | | | | |

a-d: Means in the same row with varying superscripts differ significantly (P<.05).
**SEM**: Standard error of means.

Table3. Effect of cooking time (in minutes) on the protein quality of African yam bean

| | | 0 | 30 | 60 | 90 | 120 |
|---|---|---|---|---|---|---|
| Parameters | RAYBM | $AYBM_1$ | $CAYBM_2$ | $CAYBM_3$ | $CAYBM_4$ | SEM± |
| App. digestibility (AD) | 11.05[c] | 45.50[b] | 45.98[b] | 47.56[a] | 47.59[a] | 0.56 |
| Biological value (BV) | 28.61[c] | 49.31[b] | 57.66[a] | 67.56[a] | 67.60[a] | 0.54 |
| Net protein ratio (NPR) | 1.74[e] | 3.30[d] | 3.48[bc] | 4.41[ab] | 4.45[a] | 0.22 |
| Net protein utilization (NPU) | 19.69[d] | 48.31[c] | 56.66[ab] | 57.32[a] | 57.65[a] | 0.26 |
| Protein efficiency ratio (PER) | 1.52[c] | 2.62[b] | 2.70[a] | 2.72[a] | 2.73[a] | 0.01 |

a-d: Means in the same row with varying superscripts differ significantly (P<.05).
**SEM**: Standard error of means

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The performance indices showed that the longer the cooking time the better the performance of rats with respect to growth rate and feed utilization. Similar values were obtained in African yam bean cooked for 30minutes ($CAYBM_1$) and 60minutes ($CAYB_2$) in apparent digestibility and 90minutes and 120 minutes ( $CAYBM_3$ and $CAYBM_4$) could be attributed to the possible reduction or complete elimination of some of the anti-nutrients in the African yam bean seeds by processing methods. The result in these findings agrees with the earlier work of Geevani and Theophilus (1980) who opined that the nutritive value of feeding stuff does not depend on the nutrient composition in the raw form, but also on the degree of nutrient loss or retained during processing.

Results on the protein quality of African yam bean revealed that apparent digestibility, (AD), biological value (BV), net protein utilization (NPU), net protein ratio (NPR) and protein efficiency ratio (PER) of rats fed African yam bean of varied cooking time were significantly ($P<.05$) affected. Better improvements of protein quality were observed with increased cooking time.

**Conclusion**

The nutritive values of African yam bean seeds were significantly improved with increased cooking time; hence an optimum cooking time from 90-120 minutes at $100^{o}$c can be considered ideal.

**Recommendation**

The optimum cooking time and temperature of 120minutes at $100^{o}$c suggest better result. The poor protein quality of raw African yam bean meal based diets must have been accounted for by the presence of anti-nutritional substances in them.

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