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ORIGINAL RESEARCH ARTICLE

Evaluation of chemical composition and anti-nutritional factors in raw and toasted African yam bean (*Sphenostylis sternocarpa*) seeds as feedstufff for monogastrics

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ABSTRACT

Chemical composition and anti-nutritional factors of raw and toast African yam bean seeds (AYBS) were evaluated. A known weight of clean seeds was toasted using frying pan of length 74.50cm and breath of 38.00cm for 3-5 minutes. The oven dried samples were analysed for crude protein, crude fibre, ether extract, ash, energy, calcium and phosphorus, phytate, tannin, oxalate, trypsin inhibitor using standard procedures. The results showed that raw African yam bean had 25.90% crude protein, 4.00% crude fibre, 4.00% ash, 3460.93Kcal/kg metabolisable energy, 0.29% calcium and 0.38% phosphorus while toasted seeds had 26.60% crude protein, 4.00% crude fibre, 5.00% ash, 3324Kcal/kg metabolisable energy, 0.31% calcium and 0.42% phosphorus. Raw AYBS contained 0.57% phytate, 0.25% oxalate, 0.09% tannin, 31.26% trypsin inhibitor while toasted had 0.24% phytate, 0.17% oxalate, 0.08% tannin, 28.64% trypsin inhibitor. Toasted AYBS indicated that heat inactivated anti-nutritional factors. Therefore, toasted African yam bean seeds can be used as feedstuff for monogastrics.

Keywords: African yam bean seeds, anti-nutritional factors and chemical composition

INTRODUCTION

Cowpea seeds have good nutritional profile and have been used successfully in poultry feeds (Robinson, 2001). They are rich in protein and energy while the amino acids contents are high (Wethli, 1995). The occurrence and distribution of various anti–nutritive factors (ANF) such as protease inhibitors, tannins, phytic acid, alkaloids and indigestible carbohydrates in these feedstuffs affect nutrient utilization. Heat treatment is commonly used to inactivate proteolytic ANFs (Van der Poel, 1989). The success of heat treatment depends on the capability to balance between the inactivation of ANF and the loss of heat sensitive amino acids (Van der Poel 1989). African yam bean (AYB), an under-exploited grain legume, is a potential source of plant protein and energy that could be used to replace soyabean in monogastric animal diets. However, this legume contains various biologically active compounds also know as anti-nutritional factors which when consumed by animals and human conferred impaired nutrient digestion and utilization. These ANFs in AYB negatively affect the nutritive value of bean through direct and indirect reactions, they inhibit protein and carbohydrate digestibility, induce pathological changes in intestine and liver tissues thus affecting metabolism, inhibit a number of enzymes and bind nutrients.

Underutilized feedstuff such as AYBS is usually ignored by livestock farmers probably because their economic value is not apparent (Stifel, 1990) and `hence are excluded from research and development agenda. The level of research focus on acceptability and consumption are among the measures of the rate of underutilization of crop species. The decreasing agro biodiversity (Hadgu *et al.*, 2009) of these species in many parts dependent on the poor awareness of the potential of the neglected crop species. According to Adewale *et al. (*2009), AYBS is peculiarly regarded as underutilized crop due to lack of detailed information on its nutrient profile. It is leguminous crop grown in West Africa mostly in Cameroon, Cote d' Ivoire, Ghana, Nigeria and Togo as a minor crop in mixed cropping with yam and cassava (Nnam, 1997). It grows widely in the forest region of Nigeria but has not been fully exploited. The crude protein content of African yam bean seeds ranged from 21-29% while the amino acid profile is similar to that of soyabean (Kine *et al*., 1991). Similarly NRC (2007) reported that lysine and methionine levels in AYBS are higher than those in other legumes including soyabean.

The presence of potent anti-nutritional substances (protease inhibitors, haemagglutinins, lectins, tannins,

saponins, and alkaloids) in the seed is a significant factor. These limit the use of raw AYBS in livestock feed although processing techniques tend to reduce the anti-nutritional factors content of the seed. Several studies (Van der poel, 1989; Agunbiade *et al.*, 1996; Soetan and Oyewole 2009.and Nwodo and Nwinyi 2012) indicated that heat treatment, germination processing as well as enzyme supplementation. It was reported that moist and dry heating (toasting) increased the digestible nutrients in AYB which resulted in improved growth when fed to broiler chicks. The objective of this study, therefore, was to evaluate the effects of chemical composition and some anti-nutritional factors in raw and toasted African yam bean (*Sphenostylis sternocarpa*) seeds as feedstuff for monogastric animals.

MATERIALS AND METHODS

Location of the experiment

The experiment was carried out at the Oyo State College of Agriculture and Technology, Igboora, Oyo State, Nigeria.

Procurement of African yam bean seeds

African yam bean seeds were procured at Bodija market in Ibadan North Local Government, Ibadan, Oyo State, Nigeria.

Sorting and processing of African yam bean seeds

The beans were sorted to remove extraneous materials and other spices apart from brown variety of African yam bean seeds. Toasting were carried out by spreading beans thinly in frying pan of 74.50cm by 38.00cm and placed on firewood between 3-5 minutes. It was stirred continuously to maintain uniform heating. Toasting was considered adequate when the beans changed from brownish to crispy to touch.

Table 1. Chemical composition of raw and toasted African yam bean seeds

Composition	Raw	Toasted
Dry matter (%)	90.05	95.00
Ether extract (%)	11.00	5.00
Crude protein (%)	25.90	26.60
Crude fiber (%)	4.00	4.00
Ash (%)	4.00	5.00
Nitrogen free extract (%)	45.15	54.40
Metabolizable energy (Kcal/kg)	3460.93	3324.40
Calcium (%)	0.29	0.31
Phosphorus (%)	0.38	0.42

Chemical composition of African yam bean seeds.

African yam bean seeds were ground to powder and made to pass through the 2mm sieve. Samples were obtained for crude protein (CP), crude fibre (CF), ether extract (EE), ash, and dry matter (DM) according to AOAC (2010) while metabolisable energy (ME) was calculated as reported by Pauzenga (1985) using the following equation: ME(Kcal/kg) = (37 x CP) + (81.8 x EE) + (35.5 x NFE) while NFE was calculated as (100 – CP –CF – EE –Ash-MC). The mineral content (Calcium) was determined using atomic absorption spectrophotometer and Phosphorus was determined by Vonadomolybdate calorimetry method A.O.A.C (2010).

Anti-nutritional factors

Concentrations of haemagglutinin and trypsin inhibitors were determined. The haemaglutinin assay was carried out according to Valdebouze *et al.* (1980) and Van Oort *et al.(*1989). Tannin and phytate contents were determined by the methods described by Hoff and Singleton (1977) and Apata (1990). Oxalate was determined by a gravimetric method described by Apata (1989).

RESULTS AND DISCUSSION

The result of chemicals and minerals compositions of raw and toasted African yam bean seeds is shown on Table 1. Raw African yam bean seeds had 90.50% dry matter, 11.00% ether extract, 4.00% crude fibre, 4.00% ash, 45.15% nitrogen free extract, 3469.93Kcal/kg metabolizable energy, 0.29% calcium and 0.38% phosphorus while toasted African yam bean seeds showed 95.00% dry matter, 5.00% ether extract , 26.60% crude protein , 4.00% crude fibre, 5.00% ash , 54.40% nitrogen free extract% (3324.40% metabolizable energy, 0.31% calcium and 0.42% phosphorus .

The crude protein content of raw (25.90%) and toasted (26.60%) seeds used in this study fell within the report of Kine *et al.* (1991) who established that crude protein of raw African yam bean seeds ranged between 21-29%. This range qualifies both raw and toasted African yam bean seeds as a protein source. Toasting enhanced crude protein content of the seeds of African yam bean seeds (TAYBS), this increased (26.60%) crude protein content of TAYBS in this study is in line with report of Agunbiade *et al.* (1996) who asserted that processed seeds were of significant nutritional superiority over unprocessed. It also in accordance with the report of Soetan and Oyewole. (2009) who reported that thermal treatment was most effective in improving protein when compared with dehulling, soaking and germination. The

11.00% ether extract analyzed in the raw seeds in the present study is higher than 9.49% reported by Nwodw and Nwinyi (2012). The NFE in the raw (45.15%) and toasted (54.40%) seeds in this study is higher than the 44.40% reported by Nwodo and Obinna (2012). Salunkhe *et al.* (2001) stated that a wide variability exists in the composition of pigeon (under-utilized) seeds depending on the geographical location cultivar and growth conditions. The increased in the NFE of toasted African yam bean over raw seeds in this study agrees with reports of Adeparasi (1994) and Onu and Okongwu (2006). The increase in NFE with toasting implies higher total digestible nutrient.

Table 2. Result of some anti-nutritional factors of raw and toasted African yam bean seeds

Parameters	Raw	Toasted
Phytate (%)	0.57	0.24
Tannin (%)	0.09	0.08
Oxalate (%)	0.25	0.17
Trypsin inhibitor (TIU/mg)	31.26	28.64

Results of some anti-nutritional factors of both raw and toasted African yam bean seeds are shown in Table 2. Raw African yam bean seeds had 0.57% phytate, 0.09% tannin, 0.25% oxalate and 31.26 TIU/mg trypsin inhibitor while toasted African yam bean seeds had 0.24% phytate, 0.08 % tannin, 0.17 % oxalate and 28.64 TIU/mg trypsin inhibitor. This finding confirmed the report of Apata *et al.* (1997) who established that African yam bean seeds contain these ANFs. It is also in accordance with the report of Bressani *et al.* (1988) who revealed that heat processing inactivating thermo-labile anti nutritional factors of legume grains. Toasting resulted in reduction of phytate, tannin, oxalate, trypsin inhibitor analysed. This study in agreement with Farris and Singh (1990) and Balogun *et al.* (2001), who reported that most ANFs in legume seeds can be reduced by proper application of heat. This may be due to higher ability of toasting to inhibit the ANFs when heat is applied.

CONCLUSION

The study showed that raw and toasted African yam bean seeds were high in dry matter, crude protein, ether extract, crude fibre and ash. The seeds possessed a variety of anti-nutritional factors that can cause adverse effects on monogastric animals. Toasting had significant reduction effect on the anti-nutritional factors of the seeds and toasting of African yam bean seeds will be beneficial and should be encouraged in feeding monogastric animals.

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