Original Research Article

EFFECTS OF DIFFERENT PROCESSING METHODS OF FALSE YAM (*Icacina oliviformis*) SEEDS ON GROWTH PERFORMANCE OF ALBINO RATS

ABSTRACT

Aims: The experiment was conducted to determine the response of albino rats to diets containing three differently processed false yam seed meals.

Study design: Completely Randomized Design (CRD) was used for the study.

Place and Duration of Study: Department of Agricultural Engineering, Bolgatanga Polytechnic, Bolgatanga. The experiment lasted for four weeks.

Methodology: Sixteen individually-housed, albino rats (8 males and 8 females) were allotted to four dietary treatments labelled, Control (Maize-based diet), Boiled False Yam Seed Meal (BFSM), Roasted False Yam Seed Meal (RFSM) and Soaked False Yam Seed Meal (SFSM). Each treatment was replicated four times, with a rat representing a replicate. Feed and water were offered *ad-libitum* and growth performance was monitored for four weeks. The data were analyzed using the General Analysis of Variance with Duncan Multiple Range Test used to separate treatment means.

Results: The average total feed intake values were significant (P =.05). The values obtained were 340.00, 240.00, 242.00 and 341.00 g for Control, BFSM, RFSM and SFSM diets respectively. The rats fed the Control and SFSM diets significantly performed better than their counterparts fed the other diets (BFSM and RSFM) in terms of average daily feed intake and average daily weight gain. The final weight values were 141.30 g (Control), 105.00 g (BFSM), 89.30 g (RSFM) and 139.00 g (SFSM). The mean weights of the full stomach (Control=2.30, BFSM=2.69, RSFM=2.58 and SFSM=3.33 g), empty stomach (Control=0.95, BFSM=0.92, RSFM=1.12 and SFSM=1.17 g), full GIT (Control=16.00, BFSM=13.30, RSFM=11.40 and SFSM=15.20 g) empty GIT (Control=6.67, BFSM=4.94, RSFM=4.33 and SFSM=5.21 g), heart (Control=0.58, BFSM=0.44, RSFM=0.38 and SFSM=0.59 g), spleen (Control=0.61, BFSM=0.50, RSFM=0.44 and SFSM=0.61 g) and viscera (Control=24.50, BFSM=19.70, RSFM=15.50 and SFSM=20.90 g) were not significantly influenced by the dietary treatments. However, the weights of kidney and the liver were statistically different (P=.05) as rats on Control recorded the heaviest kidney (1.25 g) and liver (5.38 g), while rats on RFSM recorded the lightest kidney (0.83 g) and liver (3.31 g).

Conclusion: It was concluded that soaking is an effective method of processing false yam seeds and that, farmers could use false yam seeds as an alternative and cheaper feedstuff in diets of monogastric animals.

Keywords: Processing methods, growth performance, Albino rats, false yam

1. INTRODUCTION

In Africa, subsistence farmers contribute significantly to food security by raising pigs and poultry for domestic consumption and for sale on local markets [1]. Their production is adversely affected by ever-increasing cost and inadequate supply of feed, particularly the conventional type [2]. Conventional feed ingredients such as maize, wheat, fish meal and soya bean meal used in the formulation of monogastric diets are predicted to be in short supply in a few years to come due to high demand [3]. The cost of feeding accounts for 60 - 80 % of the total cost of production for intensively reared livestock especially poultry and pigs [4,5].

In Ghana, maize is a major cereal grain in the diets of monogastric animals and forms about 50 - 60 % of such diets [6, 5]. Also, it is estimated that 90% of all maize grown in Ghana goes into human consumption while only 10% goes into animal feed [7].This brings about a competition between animals and humans for the staple, making its supply limited and expensive when available [8]. Consequently, the cost of monogastrics and monogastric products escalates and often becomes unaffordable to the average Ghanaian household leading to malnutrition in children.

In order to combat the problem of high feed costs and make poultry and poultry products affordable to the average consumer, animal nutritionists are exploring the potentials of non-conventional feed resources which are cheaper than grains and legumes, but have potentials for use as animal feed. One of such materials is false yam (*Icacina oliviformis*). *I. oliviformis* is a small, drought-resistant shrub forming dense stands in the West African and Central African savannas [9]. It yields three different types of food: a snack, a staple, and a famine food [10] and these products are depended on by many people when the need arises.

I. oliviformis has a variety of uses ranging from the leaves used as medicine [11] to the fruits, seeds, and tubers used as food for humans [9, 10] as well as feed for animals [12].

The following proximate composition has been reported [13] for the false yam seeds and tuber; the seeds contained 12.3% water, 8% protein, 0.1% fat, 72-73% carbohydrate and 0.5% ash. The tuber contained 11.7 % water, 10.3 % protein, 0.7% fat, 74.5% carbohydrates, 2.8% ash. It has also been reported [11] that nutritional analyses of both the seed and tuberous roots of *I. 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%, and that of fresh root is 59%" [14]

However, *I. oliviformis*, like any other non-conventional feed resources contains anti-nutritional factors. It contains toxic complexes called cyanogenic glycosides [9] and this renders it dangerous for direct human consumption. However, if well processed, false yam can be helpful in minimizing hunger in the lean season for majority of people in poor rural settings.

This study therefore seeks to investigate the effect of different processing methods on the nutrient content of false yam seeds, and the growth performance and carcass characteristics of albino rats.

2.1 Study area and duration of the experiment

The study was conducted at the Department of Agricultural Engineering, Bolgatanga Polytechnic, Bolgatanga, Ghana. Bolgatanga, the capital of the Upper East Region of Ghana lies on latitude 10˚47’8N and longitude 0˚51’ 5W of the equator and 180 m above Mean Sea Level (MSL) [15]. The average rainfall in the area is about 921 mm with temperature ranging between 15˚C (December-February) and 45˚C (March-April) while relative humidity is 30% and 80% in the dry and wet seasons respectively [16]. The experiment lasted for four weeks. It started on 7th May and ended on 4th June, 2014.

2.2 Collection and processing of false yam seeds

The false yam fruits were collected from the field in the East Mamprusi District of the Northern Region of Ghana. The fallen matured fruits were picked and sun-dried for seven days. The fruits were then pounded to remove the seeds. The pounded material was winnowed and the seeds were obtained.

Three processing methods employed were boiling, soaking and roasting to remove the bitter substances in the seeds.

2.2.1 Boiling

Three kilograms of false yam seeds were totally immersed in boiling water and boiled for four hours (9 am- 1 pm). The water was changed every one hour to ensure adequate removal of the bitter substance. The water was then drained using perforated plastic basket. The seeds were sun-dried for three days before milling to form boiled false yam meal (BFSM).

2.2.2 Soaking

The same quantity of false yam seeds as in (a) were also totally submerged in water for seven days. The water was regularly changed every two days. On the seventh day, the water was totally drained off and seeds sun-dried for three days before milling to form soaked false yam seed meal (SFSM).

2.2.3 Roasting

The same quantity of false yam seeds as in (a) were roasted for 1 hour in a heated metal pot using coal as a source of heat. The seeds were then cooled and milled to form roasted false yam seed meal (RFSM).

2.3 Experimental rats and design of the experiment

Sixteen albino rats (8 males and 8 females) of an average age of 6 weeks were obtained from the SAS Farms Ltd in Nalerigu for the experiment. The rats were randomly allotted to the four dietary treatments namely; control (maize diet), Boiled false yam seed meal (BFSM), Roasted false yam seed meal (RFSM) and Soaked false yam seed meal (SFSM) on the basis of sex and weight in a Completely Randomized Design with 4 replicates per treatment.

2.4 Housing

Transparent plastic containers measuring 30×19×16 cm served as cages for the rats. Uniform empty tomato paste cans were fitted to the corners of the cages to serve as feed troughs and drinkers. There were welded wire mesh covers at the top of the cages to ensure proper ventilation. The plastic cages had perforations at the bottom to allow for the flow of urine and faeces out of the cages onto shelves which were regularly cleaned. The cages were randomly arranged on wooden shelves.

2.5 Feeding

The diets shown in Table 1 were offered to the rats during the experimental period. The feed was weighed using an electronic scale into plastic jars with a weekly allocation of 150 g/rat. The plastic jars with tight lids were labeled according to the treatments. Feed and water were provided ad libitum. Any droppings (faecal matter) in the feed troughs were removed each morning and additional feed was provided where necessary. Fresh clean water was also given each morning.

2.6 Medication and Sanitation

Four days to the commencement of the experiment, the rats were dewormed to destroy any endo-parasites. One day to the start of the experiment, the cages, feed troughs and water troughs were washed with a mild detergent (omo) and the wooden shelves were cleaned with a wet rag soaked in the detergent. The experimental room was also swept regularly to ensure good hygiene. Any faecal droppings in the cages were removed every day and there was total cleaning of the cages on the weighing days (Wednesdays).

2.7 Parameters measured

In the course of the experiment, weekly feed intake and weekly weight gains were recorded and corresponding average daily feed intake and average daily weight gain were calculated. At the end of the 4 weeks, the rats were humanely slaughtered, dissected and the viscera removed and weighed with an electronic scale. The liver, spleen, kidneys, stomach and full gastro-intestinal tract (GIT) were also individually weighed after separation. The empty GIT and the empty stomach were cleaned and also weighed accordingly.

2.8 Chemical and Statistical Analyses

The proximate compositions of the false yam seeds and diets were determined using procedures outlined by the Association of Official Analytical Chemists [17]. All data collected during the experiment were analyzed using the General Analysis of Variance of GenStat (Discovery edition 4). All the statistical tests were done at a significance level of 5% while the Duncan Multiple Range Test was used to separate treatment means.

Table 1 Percentage composition of the experimental diets

Ingredient	**Dietary treatments**			
	Control	BFSM	RFSM	SFSM
Maize	60	45	45	45
False yam meal	-	15	15	15

Fishmeal	20	20	20	20
Soyabean meal	6	6	6	6
Wheat bran	12	12	12	12
Egg shell	1.00	1.00	1.00	1.00
Common salt	0.50	0.50	0.50	0.50
Vitamin-traced mineral premix	0.50	0.50	0.50	0.50
Total	100	100	100	100
Analyzed composition				
Crude protein	18.33	20.13	18.93	17.30
Ether extract	3.00	2.00	0.83	2.00
Crude fibre	4.40	5.55	4.24	4.34
Moisture	9.50	9.66	11.16	9.50
Ash Content	17.00	16.16	14.16	15.50
Dry Matter	90.50	90.34	88.84	90.50

Vitamin Trace Mineral Premix: Inclusion rate is 2.5g/kg to supply Vit. A = 8000 IU, Vit. D = 500 IU, Vit. E = 2.5 mg, Vit. K3 = 1mg, Vit. B2 = 2 mg, Vit. B12 = 0.005 mg, Folic Acid = 0.5 mg, Nicotinic Acid = 8 mg, Calcium Panthothenate = 2 mg, Choline Chloride = 50 mg, Manganese = 50 mg, Zinc = 4 mg, Copper = 4.5 mg, Cobalt = 0.1 mg, Iodine = 1 mg, Selenium = 0.1 mg.

3. RESULTS AND DISCUSSION

3.1 Proximate composition of false yam seeds with different processing methods

The proximate composition of the false yam seeds processed with three different methods is shown in Table 2.

The crude protein content was significantly highest in the roasted followed by soaked and boiled. This experiment reported higher crude protein than the 8% crude protein reported by one studies [13] but lower than the 14% crude protein reported by another study [18]. The results are also higher than the 10.07± 0.09 % crude protein for unprocessed seeds [19] and 8.54± 0.83% crude protein for processed seeds. It has been reported that when the seed is unprocessed the anti-nutritional factors increase the bulk percentage of the crude protein [18] and this assertion is being confirmed by the current study.

The values in Table 2 suggest that boiling and soaking increase ether extract content of the seeds though not significant. These results compared favourably with the findings of another study [18]. There were no significant (*P=.05*) differences between the processing methods in terms of crude fibre but unprocessed and roasted recorded significant higher values of 2.00 and 2.67 % for ash respectively. These results are in line with the findings of another study [18].

There were significant (*P=.05*) differences among treatments of the various processing methods for moisture. The values of moisture contents in the present study were lower than those of [13]. Again, the moisture content in the unprocessed (7.17%) and soaked (9.33%) were higher than those reported by [19] for unprocessed (SYSM) of (6.63±1270). However, in this experiment, the moisture content value of 5.83 % for each of the boiled and roasted were lower than those reported by [19].

Table 2 Proximate composition (%) of the false yam seeds with three different methods used in the experiment (as-fed basis)

Parameter	**Processing method**				
	Unprocessed	**Boiled**	**Soaked**	**Roasted**	**Sign.**
Crude protein	13.10^{b}	11.33^{d}	12.17^{c}	13.37^{a}	*
Ether extract	0.83	1.00	1.00	0.83	NS
Crude fibre	1.10	1.13	1.09	1.10	NS
Ash	2.00^{b}	1.50^{c}	1.17^{c}	2.67^{a}	*
Moisture	7.17^{b}	5.83^{c}	9.33^{a}	5.83^{c}	*
Dry matter	92.83^{b}	94.17^{a}	90.67^{c}	94.17^{a}	*

Sign= Level of significance, NS= Not significant, *= Significant, ^{a,b,c} values in the same row with different letters are significantly different ($P < 0.05$)

3.2 Growth performance of the albino rats on the treatment diets

The growth performance of albino rats on the treatment diets is shown in Table 3. There were no significance differences among the Control, BFSM, RFSM and SFSM with respect to initial weight of the albino rats. This was achieved through careful allotment of the rats based on sex and weight.

The results showed that feed consumption, Average Daily Feed Intake (ADFI) and Average Daily Gain (ADG) were significantly (*P*=.*05*) different between treatments. The SFSM recorded the highest feed consumption while BFSM and RFSM recorded the lowest (Table 3).These differences could be because boiling and roasting could not remove greater portion of anti-nutritional factors which decrease the feed intake, growth rate and weight gain. This is in line with the findings [20] that due to the presence of these anti-nutritional factors, feed intake, growth rate and weight gain decrease in monogastric species.

The high intake of the SFSM indicates high acceptability of this meal as a result of the soaking which eliminates greater portion of anti-nutritional components in the seed. The similarities in performance of SFSM and control diets imply that soaking was effective in eliminating most or all anti-nutritional factors in the false yam. This is in line with the findings [21] that soaking enables the movement of soluble cyanide into solution in cassava roots.

The low values of BFSM and RFSM could be attributed to the inability of the roasting and boiling to eliminate the bitter taste of seeds hence not enhancing eating qualities and palatability as compared to soaking. This is in line with findings [22, 23] that anti-nutritional factors are responsible for reduction in dry matter digestibility. But the results disagree with findings [24, 25] that boiling has been effective in eliminating some anti-nutritive factors in false yam seed meals as well as terpenes in leaves.

Table 3 Growth performance of albino rats fed the four treatment diets

Parameter	Control	BFSM	RFSM	SFSM	SIGN
Mean initial weight, g	95.00	94.70	95.70	95.70	NS
Mean final weight, g	144.30	105.0	89.30	139.00	NS
Mean Weight gain, g	46.30^{a}	10.3^{b}	-6.30^{b}	43.30^{a}	*
Mean ADG, g	1.65^{a}	0.37^{b}	-0.23^{b}	1.55^{a}	*
Mean Feed consumption, g	340.00^{a}	240.00^{b}	242.00^{b}	341.00^{a}	*
Mean ADFI, g	12.14^{a}	8.58^{b}	8.64^{b}	12.17^{a}	*

BFSM= Boiled false yam seed meal, RFSM= Roasted false yam seed meal, SFSM= Soaked false yam seed meal, SIGN= Level of significance, NS= Not significant, *= Significant, ^{a,b,} values in the same row with different letters are significantly different (P < 0.05)

3.3 Carcass and internal organs characteristics of rats fed the four dietary treatments

There were no significant differences among treatment means of the internal organs including the full stomach, empty stomach, full GIT, empty GIT, the heart and the spleen but the kidney and liver showed significant differences (*P =.05*) among the four treatment means (Table 4). It was observed that the means of most parameters (full stomach, empty stomach, empty GIT, heart and spleen) were higher in SFSM. As reported by another study [26] soaking removes greater portion of anti-nutritional factors, inhibitors and other glycosides that reduce the quality of the carcass. This means that, most of the anti-nutritional factors in the SFSM were eliminated, resulting in higher feed intake with positive effect on weights of the internal organs.

It has been reported [27] that the presence of anti-nutritional factors is associated with enlargement of organs like liver and pancreas but another report [28] remarked that factors like age, diet and body weight affect organ weights. However, it has been reported that dressed weight and internal organ weight characteristics are indicators of the level of reduction or otherwise of anti-nutritional factors [29].

There was no enlargement or atrophy of internal organs beyond normal thus indicating that the albino rats were able to tolerate the test ingredients.

Table 4: Carcass and internal organs characteristics of rats on the four treatment diets

Parameters	Control	BFSM	RFSM	SFSM	SIGN
Mean Full Stomach, g	2.30	2.69	2.58	3.33	NS
Mean Empty Stomach, g	0.95	0.92	1.12	1.17	NS
Mean Full GIT, g	16.00	13.30	11.40	15.20	NS
Mean Empty GIT, g	6.67	4.94	4.33	5.21	NS
Mean Heart, g	0.58	0.44	0.38	0.59	NS
Mean Kidney, g	1.25^{a}	0.97^{ab}	0.83^{b}	1.06^{ab}	*
Mean Liver, g	5.38^{a}	4.69^{ab}	3.31^{b}	4.88^{ab}	*
Mean Viscera, g	24.50	19.70	15.50	20.90	NS
Mean Spleen, g	0.61	0.50	0.44	0.61	NS

BFSM= Boiled false yam seed meal, RFSM= Roasted false yam seed meal, SFSM= Soaked false yam seed meal, SIGN= Level of significance, NS= Not significant, *= Significant, ^{a,b,} values in the same row with different letters are significantly different ($P < 0.05$).

4. CONCLUSION

The results from the study suggest that, there were differences between treatments in the elimination of toxic substances by the processing methods. The use of soaking resulted in similar feed intake and growth rate with the control. Some carcass parameters were similar for all the treatments but Control and SFSM diets gave the best results in all parameters measured. It can therefore, be concluded that soaking is an effective method of processing false yam seeds and that, farmers could use false yam seeds as an alternative and cheaper feedstuff in diets of monogastric animals.

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