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EFFECTS OF VARYING LEVELS OF SOAKED FALSE YAM (*ICACINA OLIVIFORMIS*) TUBER MEAL ON GROWTH PERFORMANCE AND SUBSEQUENT EGG-LAYING

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Abstract
False yam (*lcacina oliviformis*) is a perennial shrub with large tuberous root, which is common in the arid and semi-arid areas of West and Central Africa. The tuber is rich in carbohydrates but contains some anti-nutritional factors like gum resins that can be partially removed by soaking in water. A feeding trial involving layer chicken was conducted to evaluate the effects of varying levels of sun-dried soaked false yam tuber meal on their performance during the grower phase and subsequent egg production phase. Harvested false yam tubers were peeled, chopped, soaked for 12 days in water, sun-dried for 6 days and milled into gritty flour and labeled Soaked False Yam Tuber Meal (SFYTM). The SFYTM was included in the diets of growing hens (pullets) at 0% (control), 5%, 7.5% and 10% as a substitute for maize on a weight-by-weight basis at the grower phase (9-19 weeks of age); after which all hens were fed a standard layer diet at the layer phase (20-29 weeks of age). A total of 120 Lohmann chicks brooded for 8 weeks with an average live weight of 525g per bird were randomly assigned to the 4 dietary treatments and each treatment was replicated thrice (n=10). Feed and water were given *ad libitum*. Data were analyzed by one-way ANOVA using GenStat. Only hens fed the 5% SFYTM diet at the grower phase had comparable performance to their control counterparts in terms of feed intake, live weight gain, feed conversion efficiency, egg weight and egg production. It is concluded that sun-dried soaked false yam tuber meal can be included at 5% in the grower diet of layer chicken with no adverse effects on growth and egg-laying performance.

Keywords: False Yam, Growth Performance, Egg Production, Layer Chicken

Introduction

The development of the poultry industry is key to fighting poverty, improving food security and providing livelihoods (Atuahene *et al*., 2010). High cost and occasional shortage of feed ingredients such as maize is a major constraint facing the layer enterprise. Bell and Weaver (2002) reported that about 85% of the world's chicken dietary energy is derived from maize, also known as corn (*Zea mays*). This results in competition between animals and humans for maize, making its supply limited and expensive. Therefore, the use of cheap and locally available non-conventional feed ingredients including wild plant resources like false yam has been advocated to reduce the high cost or occasional shortage of conventional feed ingredients (e.g. maize).

The false yam (*lcacina oliviformis)* is a perennial shrub (Fig. 1) which belongs to the family *lcacinaceae* and is native to the arid and semi-arid areas of West and Central Africa (Fay, 1987).

Fig. 1. False Yam Plant Showing the Dug-out Tuber

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It is drought-resistant and grows all year round even in the absence of rainfall producing a fleshy tuberous root which is rich in nutrients. Sunday *et al.* (2016) reported that the tuber contains low protein content (5.25%), but very high carbohydrate content (91.93%). Judging from its nutrient composition, particularly carbohydrate content, the false yam tuber could serve as a good source of feed for livestock, especially monogastric animals (e.g. poultry).

However, the utilization of false yam tuber as animal feed is limited by the presence of some anti-nutrient factors or bitter principles in the plant, which include gum resins, hydrogen cyanide, tannin, phytate, oxalate, alkaloids and flavonoids in the false yam (Vanhaelen *et al.,* 1986; NRI., 1987; Dei *et al*., 2011; Okoronkwo *et al.,* 2014). These anti-nutritional factors reduce the intake and palatability of the feed when given to animals.

It has been shown that feed processing methods such as soaking the false yam tuber in water for several days can reduce the concentrations of some anti-nutritional factors such as gum resins thereby improving its nutritive value for broiler chickens (Dei *et al*., 2013). Therefore, this study was undertaken to evaluate the effects of varying dietary levels of sun-dried soaked false yam tuber meal on the growth of layer chickens and their subsequent egg-laying performance.

Materials and Methods

Location, Sources and Processing of the False Yam Tuber

The study was carried out at the Poultry Unit of the Department of Animal Science, University for Development Studies, Tamale. Tubers of wild-growing false yam were obtained by harvesting them manually around the environs of Nyankpala. The tubers were peeled and chopped into small pieces using a kitchen knife. The sliced pieces were soaked in water for 12 d in the ratio of 1:2, that is, one part of false yam tuber to two parts of water while changing the water every 3 days. After 12 d of soaking, they were sun-dried for 6 d and then milled into gritty flour using a grinding mill and labelled Soaked False Yam Tuber Meal (SFYTM).

Management of Experimental Birds

One thousand (1000) day-old commercial layer chicks (Lohmann) were obtained from a hatchery in Kumasi and fed starter mash for eight weeks *ad libitum*. At the end of the 8th week, one hundred and twenty birds of uniform weight (525g/bird) were randomly put into 12 groups (n=10) for the feeding trial. The birds were housed in raised wire-mesh floor pens of the dimension of 0.9m x 1.8m with a floor space of 0.16m^2 per bird. The birds were given feed and water *ad-libitum* and light was provided for 24h.

Experimental diets and design

Four experimental diets were formulated with inclusion levels of SFYTM at 0, 5, 7.5, and 10%. The SFYTM was used to replace maize on a weight-by-weight basis. The control diet contained no SFYTM. Table 1 shows the composition of the experimental diets and a standard layer diet fed to the birds during the growth phase (9-19 weeks of age) and egg-laying phase (20-29 weeks of age), respectively.

The 12 groups of birds were randomly assigned to each experimental diet and each treatment (n=10) was replicated thrice using a completely randomized design.

Data Collection

Feed Intake

Feed intake of birds was measured weekly using an electronic weighing scale (Jadever, JPS-l050). Feed intake was obtained by subtracting the left-over feed at the end of the week from the total feed provided for the week for each replicate. The weekly mean feed intake of birds

Table 1: Composition of Standard and Experimental Diets

Ingredients	0% SFYTM	5% SFYTM	7.5% SFYTM	10% SFYTM	Layer diet
Maize (*Zea mays*)	58	53	50.5	48	60
Fishmeal	8	9	9.8	10	10
SFYTM	0	5	7.5	10	-
Wheat Bran	15.5	15.6	6.5	6.5	5.8
Soya Meal	15.2	13.8	16.1	15.9	15.4
Vit/min premix*	0.3	0.3	0.3	0.3	0.3
Dicalcium	-	-	-	-	0.3
Oyster Shell	3	3	3	3	8
Palm Oil	0	0	6	6	-
Salt	0.3	0.3	0.3	0.3	0.2
Total	100	100	100	100	100
Calculated Nutrient Analysis					
Crude Protein (%)	19.0	19.0	19.0	19.0	20
Metabolizable Energy (MJ/kg)	11.7	11.5	11.0	11.2	11.9

SFYTM-Soaked false yam tuber meal.

**Composition of layer premix per kg: Vitamin A 8,000,00 IU; Vitamin D3 15,000,000 IU; Vitamin E 2,500 mg; Vitamin K3 1,000 mg; Vitamin B2 2,000 mg; Vitamin B12 5 mg; Folic acid 500 mg; Nicotinic acid 8,000 mg; Calcium panthotenate 2,000 mg; Choline cloruro 50,000 mg; Magnesium (mono-hydrate sulphate magnesium) 50,000 mg; Copper (as penta-hydrate sulphate copper) 4,500 mg Cobalt; (as hepta-hydrate sulphate cobalt) 100 mg;Zinc (as zinc oxide) 4,000 mg; Iodine (as potassium iodide) 1,000 mg and Selenium (as sodium selenium) 100 mg.*

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in each pen was divided by the total number of birds in a replicate and further by the number of days in a week and then multiplied by a thousand (1000) to obtain the mean feed intake per bird per day in grammes.

Live Weight Gain

The live weight gain was calculated by subtracting the initial mean live weight per bird from the mean live weight per bird at the end of the week and the weight divided by the number of days in the week and multiplied by 1000 to obtain the weekly mean live weight gain per bird per day in grammes.

Feed Conversion Efficiency

The feed conversion efficiency was calculated as live weight gain per unit of feed consumed. That is, weight gained/feed consumed. For the laying phase, the feed conversion efficiency was calculated as the feed/egg ratio. Mean feed conversion was obtained by dividing the feed consumed by the egg weight during the same period.

Feed Cost

The amount of ingredients used to formulate 100 kg feed was multiplied by the unit cost of each ingredient to obtain the cost of 100 kg feed. This was then divided by 100 to get the unit cost of each diet. Feed cost per bird was obtained by multiplying the unit cost of feed by the total feed consumed per bird. The SFYTM incurred only harvesting and processing cost which was determined by the minimum working hours per day and minimum daily wage per person per day. The minimum daily wage was multiplied by the number of workers used. The actual cost of SFYTM in kilogramme was multiplied by the amount of SFYTM used in the diet.

Hen-day Egg Production and Egg Weight Measurements

Hen-day egg production was calculated as the number of eggs laid in a day as a percentage of the number of birds in the pen and mean weekly hen-day production per replicate was recorded.

Egg weight was taken daily by using an electronic scale (master chef).

Data Analysis

Data collected were subjected to the analysis of variance (ANOVA) using GenStat software (12th edition) and figures and graphs were prepared using GraphPad Prism 6.

Results

Feed Intake

At the growth phase (9-19 weeks of age), there was no significant difference (p>0.05) between the feed intake of birds fed with the control diet and those fed with the 5% SFYTM diet (Table 2) but differed significantly (p<0.05) from those fed with 7.5% and 10% SFYTM. Also, there was a significant difference between birds fed with a 5% SFYTM diet and those fed with 7.5% and 10% SFYTM diets but no significant difference (p>0.05) was observed between birds fed with 7.5% SFYTM and 10% SFYTM diets in terms of feed intake. There was no significant difference (p>0.05) among the treatments in feed intake at the laying phase (20-29 weeks of age) (Table 3). However, feed intake by birds fed the control diet tended to be slightly higher than their counterparts fed diets based on the SFYTM.

Growth Performance

At the end of the growth phase, there was no significant difference (p>0.05) in live weight gain and final live weight between birds fed with the control and those fed with a 5% SFYTM diet; but the control birds differed significantly (p<0.05) from those fed with 7.5% and 10% SFYTM (Table 2). However, there was no significant difference (p>0.05) between birds fed with the SFYTM-based diets.

Feed Conversion Efficiency and Feed Cost

Feed utilization during the growth phase was not significantly different (p>0.05) between the test diets and the control diet even though the birds on the control diet tended to record a better gain-to-feed ratio (Table 2).

Also, no significant difference (p>0.05) in total feed cost per bird between the control diet and the test diets was observed (Table 2).

Egg Laying Performance

The egg production variables are shown in Table 3.

Hen Day Egg Production

There was no significant (p<0.05) difference in the hen day egg production between the birds on the control diet and those fed a 5% SFYTM diet; but differed significantly from those fed a 7.5% and 10% SFYTM diet (Table 3). However, the hen-day egg production values among the groups fed the test diets were not significant (p>0.05).

Mean Egg Weight

The mean egg weights of the hens among the treatments were similar (p>0.05). However, eggs laid by the 7.5% SFYTM group tended to weigh higher than those laid by the control, 5% and 10% SFYTM groups (Table 3).

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Table 2: Effects of SFYTM on Growth Performance and Feed Cost Analysis of Feeding Pullets (9-19 Weeks) with SFYTM

Parameters	0% SFYTM	5% SFYTM	7.5% SFYTM	10% SFYTM	*±SED*	*p- value*
Feed intake (g/bird/day)	72.4[a]	75.7[a]	64.0[b]	62.5[b]	*2.013*	*<0.001*
Weight gain (g/bird/day)	13.3[a]	11.7[ab]	11.1[b]	10.2[b]	*0.671*	*0.011*
Final weight (kg/bird)	1.54[a]	1.42[ab]	1.38[b]	1.31[b]	*0.052*	*0.011*
Gain /Feed Ratio	0.18	0.15	0.17	0.16	*0.012*	*0.143*
Feed cost/kg (GHS)	0.98	0.96	1.10	1.12	-	-
Total feed cost (GHS/bird)	5.46	5.60	5.43	5.40	*0.174*	*0.682*

SED: Standard Error of Difference, p: probability, means with the same superscripts are not significantly different (p> 0.05).

Table 3: Effect of Soaked False Yam Tuber Meal (SFYTM) on Egg-laying Performance (20-32 Weeks of Age)

Parameters	0% SFYTM	5% SFYTM	7.5% SFYTM	10% SFYTM	*±SED*	*p- value*
Feed intake (g/bird/day)	90.5	88.5	86.4	87.6	*2.79*	*0.538*
Hen-day egg production (%)	68.9[a]	60.9[ab]	52.1[b]	47.6[bc]	*6.28*	*0.038*
Mean egg weight (g)	49.2	48.9	49.9	49.4	*0.88*	*0.709*
Egg mass output (g)	34.1	30.3	26.0	23.6	*3.49*	*0.066*
Egg mass-to-feed ratio	0.54	0.55	0.58	0.57	*0.019*	*0.355*

SED=Standard error of difference, P-probability, and means of the same superscripts are not significantly different.

Egg Mass Output

There was no significant (p>0.05) difference in egg mass output ratio (Table 3). Egg mass output for control birds tended to be higher than their counterparts fed 5%, 10% and 7.5% SFYTM. This variable was slightly decreased as the SFYTM level in the diets increased.

Egg Mass-to-Feed Ratio

There was no significant difference (p>0.05) in egg mass-to-feed ratios recorded for all hens. However, the feed conversion efficiencies of hens fed the SFYTM-based diets tended to be better (Table 3).

Mortality

There was one death recorded in the group fed 5% SFYTM during the grower phase; whereas in the laying phase, one hen each died in the groups fed the 5% and 10% SFYTM diets.

Discussion

In fact, feeding poultry using locally available non-conventional feed ingredients is the surest way of reducing dependency on conventional feed ingredients, which at times are imported or scarce. In poultry production, feed alone accounts for a huge part (70-80%) of the cost of total production as a result of the high cost of conventional feed ingredients like maize (Ademola and Farinu, 2006) and occasional shortages of cereal grains (maize) due to droughty conditions or hike in prices.

In this study, the use of dried soaked false yam tuber meal as a substitute for maize in the diet of growing layer chickens is beneficial when fed at 5% dietary inclusion level in terms of growth and subsequent egg production. Its use beyond 5% in the diets significantly depressed feed intake in the grower phase (Table 2) with consequent depression in egg production (Table 3).

This suggests that the sexual development of the pullets was impaired during the growth phase as a result of anti-nutritional factors in the processed tuber when high dietary level (7.5 and 10%) of the soaked tuber was fed to them. This could be attributed to the residual concentrations of anti-nutritional factors in the tuber after the soaking. Soaking the false yam tuber in water is inadequate in eliminating the adverse effects of the anti-nutritional factors in this material (Dei *et al*., 2013; David-Oku *et al*., 2018).

The presence of bitter components (e.g. gum resins) in the false yam tuber as reported by Vanhaelen *et al.* (1986) limits the palatability and hence low intake as the inclusion level in the grower diets increased beyond 5% in the diets. This study has shown that soaking may be a preferable method of processing the false yam tuber for feeding layer chickens compared to boiling; because a study by Dei *et al.* (2012) showed that boiled false yam tuber could be substituted for maize at 2.5% in the diets of pullets (layer chicken) with no adverse effect on their growth performance.

This suggests that soaking may be more effective than wet heating (boiling) in leaching out the bitter compounds (terpenes) contained in the tuber.

Although the soaked false yam tuber currently has no market value, the cost of harvesting and processing by hand has made it to have no beneficial effect on the cost of feeding birds. In a previous study, Dei *et al.* (2012),states that feeding pullets with boiled false yam tuber meal in their diets had no beneficial effect on the feeding cost of the pullets.

Conclusion

The study revealed that sun-dried soaked false yam tuber meal can be fed at a 5% dietary inclusion level as a substitute for maize in the grower diet of layer chickens without any adverse effects on their growth performance and subsequent egg production. The use of this material as a feed ingredient in the diet of growing layer chickens had no beneficial effect on the feeding cost.

Competing interest

The authors declare no potential conflicts of interest with respect to the authorship and/or publication of this article.

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