Asian Journal of
Poultry Science

ISSN 1819-3609

Academic Journals Inc.

www.academicjournals.com

Asian Journal of Poultry Science 7 (2): 55-64, 2013
ISSN 1819-3609 / DOI: 10.3923/ajpsaj.2013.55.64

Effect of Dietary Maize Substitution with Sweet Potato Meal on Performance of Growers (10-22 weeks) and Subsequent Egg Production (23-35 weeks)

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ABSTRACT

A study was conducted to compare maize and Sweet Potato Meal (SPM) as sources of energy in grower chickens' diets while another was conducted to determine the effect of SPM on the performance of the birds used in the grower study. A total of 210 pullets aged 10 weeks of Shika Brown breed were used for the grower study, while a total of 180 chickens aged 23 weeks acquired from the proceeds of the first study were used for the layer study. Five treatments comprising of diets containing 0, 10, 20, 30 and 40% levels of SPM were applied in both experiments in a completely randomized manner and performance of birds were monitored at both phases. Each of the experiments lasted 12 weeks. Result of grower study showed that the control, 10 and 20% SPM diets produced similar weight gain, final weight, feed efficiency and feed cost kg^{-1} weight gain and were superior ($p<0.05$) to 30 and 40% SPM diets. Result of the layer experiment showed that the control, 10 and 20% SPM diets produced similar final body weight, weight gain, feed intake, hen-day egg production and cumulative egg production/bird which were significantly better ($p<0.05$) than those produced by the 30 and 40% SPM diets. Ages at 1st egg and at 5% production were least ($p<0.05$) for the control birds while the age at 50% production was least for the 10% SPM diets. From the result, it is inferred that grower chicken or young layers should not be fed with diets containing more than 20% SPM.

Key words: Sweet potato meal, growers, layers, diets, feed efficiency, egg quality

INTRODUCTION

The gross inadequacy of animal protein in the diets of most Nigerians is clearly recognized by nutritionists. Lawrie (1979) reported 70 g day^{-1} as protein requirement of adult if protein deficiency condition is to be avoided while in Nigeria, children below the age of 5 years require body-building protein in sufficient quantities and should consume about 2 g da kg^{-1} b.wt. for good health maintenance. About 80% of these children suffer varying degrees of protein malnutrition.

The bulk of proteins consumed in most developing countries like Nigeria are of plant origin (Dafwang, 2006). While these sources lack certain essential amino acids, proteins of animal origin are more balanced and complete in amino acids (Fasuyi, 2005). The need for animal protein sources therefore cannot be over-emphasized. Future meat production from cattle, sheep and goat is unlikely to meet the expected demand for animal protein in developing countries like Nigeria (Olubanjo, 1976). These species of animals, according to Kroeski (1984) have strong biological constraints for a rapid growth in population as increasing their population takes a very long time.

Besides, the traditional animal husbandry system characterized by low output cannot cope with the increasing demand for animal protein. A scientific approach at meeting this need has been directed to the expansion in the production of animals, such as poultry with the advantages of short generation intervals, faster rate of growth and other attributes of economic importance (Job, 1992). However, feed problems have been the major hindrance to the growth of poultry industry in Nigeria.

Prices of poultry products, especially the eggs keep on rising as a result of the rise in the costs feed, which constitute between 60-80% of the total production costs (Nuhu *et al.*, 2008). The conventional energy feed sources constitute between 40-65% of formulated poultry diets and have high price tags as a result of their numerous alternative uses (Afolayan, 2010). Among these sources, maize is the most widely employed for poultry feed formulation (Afolayan *et al.*, 2012; Vantsawa, 2001). In order to step down the problem of high and unstable price situation and save the collapse of the poultry industry, there is need to broaden the energy source base by assessing unconventional feedstuffs (Afolayan *et al.*, 2012). It is for this purpose that sweet potato meal is being evaluated as a source of energy for growers and young layers in this study.

Sweet potato is one of the crops that have not been widely evaluated for poultry. Fetuga and Oluyemi (1976) determined the metabolizable energy of sweet potato and some roots and tubers using two week-old chicks and reported that dehydrated sweet potato roots and cassava meals are superior to cocoyam, yam and plantain meals in terms of energy content and the potential of cassava as a source of dietary energy is being limited by the presence of residual anti-nutritional factor in the meals. Presently in Nigeria, sweet potato is cheap and has less alternative uses compared with maize. Its potential for high yield and high adaptation to tropical climate is well recognized. Presently, the price of top quality eggs in Nigeria is high (N700.00/crate), the profit margin to producers will undoubtedly increase with cheaper feed formulation and the per capita consumption of egg protein will increase if sweet potato is found suitable.

The objectives of this study were to determine whether SPM as a source of energy can be a good substitute for maize in the diets of growers and young layers and know the adequacy and economics of using SPM as a source of energy in these feeds.

MATERIALS AND METHODS

Grower phase (10-22 weeks): Two hundred and ten, nine-week old Shika Brown pullet chickens were used in this experiment. The birds were fed a common grower diet for one-week adjustment period after which they were weighed and distributed in equal groups of fourteen into pens of dimension 3.05 by 1.22 m^2 each, in a deep litter house. Sanitary measures were taken throughout the period of the experiment. The group weights were adjusted to 716.67 g/bird approximately before the distribution. Five treatments were allotted to birds, such that each treatment had three replicates. The treatments consisted of diets containing 0, 10, 20, 30 and 40% levels of SPM. The diet containing no SPM was used as the control diet. The ingredients composition as well as the calculated proximate composition of the diets is shown in Table 1. Feed and water were given to the birds *ad-libitum*. At the end of each week, birds were weighed in groups to determine the weight gain. Left over feeds were also cleaned of all dirt and weighed to determine the feed consumption. Mortality records were kept for each treatment group. The experimental diets were fed for a period of 12 weeks. The data collected were summarized for each period and then subjected to Analysis of Variance (ANOVA) and where statistical significances were observed, the means were compared using the DMRT according to SAS (1995).

Table 1: Composition of experimental growers diets (10-22 weeks)

	Levels of dietary SPM (%)				
Item	0	10	20	30	40
Ingredients (%)					
Maize	41.15	30.20	19.25	8.35	0.00
Sweet potato meal	0.00	10.00	20.00	30.00	40.00
Groundnut cake	13.05	14.00	14.95	15.85	16.92
Maize offals	20.00	20.00	20.00	20.00	17.28
Palm kernel cake	10.00	10.00	10.00	10.00	10.00
Wheat offal	12.00	12.00	12.00	12.00	12.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15
Vit-min premix	0.15	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
ME (kcal kg^{-1})	2699.00	2653.00	2608.00	2562.00	2541.00
CP (%)	16.01	16.01	16.01	16.01	16.01
Ca (%)	1.18	1.20	1.22	1.24	1.27
P (%)	0.81	0.81	0.81	0.81	0.82
Lysine (%)	0.68	0.69	0.70	0.72	0.73
Meth.+Cyst (%)	0.56	0.56	0.55	0.56	0.55
Feed cost (N kg^{-1})	28.71	28.44	28.17	27.89	27.96

Growers' vitamin premix supplies the following per kg diet: Vit. A 10,000 IU, Vit.D3 2,000 IU,Vit.E 51 IU, Vit, K 2.34 mg, Riboflavin 5.5 mg, Vit.B1210 mg, Calcium pantothenate 10 mg, Niacin 25 mg, Choline chloride 250 mg, Folic acid 1 mg, Manganese 56 mg, Zinc 50 mg, Copper 10 mg, Iron 20 mg, Cobalt 1.25 mg, Amprolium 125 mg and Tetracycline 100 mg

Young layers phase (23-35 weeks): A total of one hundred and eighty 22 week old Shika Brown grower chickens acquired from the proceeds of the grower experiment were used in this experiment. The birds were fed a common layer diet for one-week adjustment period after which they were weighed and distributed in equal groups of twelve into pens of dimension 3.05 by 1.22 m^2 each, in a deep litter house. Proper sanitary measures were taken throughout the period of the experiment. The groups' weights were adjusted to 1811.33 g $bird^{-1}$ approximately before the distribution. Five treatments were allotted to birds, such that each treatment had three replicates. The treatments consisted of diets containing 0, 10, 20, 30 and 40% levels of sweet potato meal. The diet containing no sweet potato meal was used as the control diet. The ingredient composition, as well as the calculated proximate chemical composition of the diets is shown in Table 2. Feed and water were given to the birds *ad-libitum*. Collection of eggs was done twice daily (11.00 a.m. and 6.00 p.m.). Age at which the first egg was dropped as well as the age at which chickens attained 5 and 50% egg production levels were taken. Egg weights were also taken at various levels of production. Egg collections were pooled together to determine the hen-day egg production.

At the end of each week, feeds were cleaned of 3 all dirt and weighed to determine the feed consumption. Two freshly collected eggs of average weight for each group were broken to determine the shell thickness, yolk index and Haugh unit as measures of egg quality. The yolk index measurement was obtained by determining the yolk height and diameter and using the expression given by Card and Nesheim (1976) to calculate the value. Measurement of

Table 2: Composition of experimental young layers diets (23-35 weeks)

	Levels of dietary SPM (%)				
Item	0	10	20	30	40
Ingredients (%)					
Maize	41.52	29.52	18.62	7.72	0.000
Sweet potato meal	0.00	10.00	20.00	30.00	40.000
Groundnut cake	15.00	17.00	17.90	18.80	20.000
Maize offals	20.00	20.00	20.00	20.00	16.520
Wheat offals	5.00	5.00	5.00	5.00	5.000
Palm kernel cake	9.00	9.00	9.00	9.00	9.000
Bone meal	4.58	4.58	4.58	4.58	4.580
Common salt	4.00	4.00	4.00	4.00	4.000
Methionine	0.25	0.25	0.25	0.25	0.250
Lysine	0.15	0.15	0.15	0.15	0.150
Vit-min premix	0.25	0.25	0.25	0.25	0.250
Calculated analysis					
ME (kcal kg^{-1})	2610.00	2556.00	2511.00	2466.00	2451.000
CP (%)	16.01	16.02	16.01	16.00	16.030
Ca (%)	3.15	3.18	3.20	3.22	3.250
P (%)	1.00	1.00	1.00	1.00	1.000
Lysine (%)	0.85	0.89	0.91	0.93	0.940
Meth. +Cyst (%)	0.75	0.77	0.78	0.79	0.810
Feed cost (N kg^{-1})	30.01	29.71	29.44	29.17	29.320

Layers' vitamin premix supplies the following per kg diet: Vit. A 10,000 IU, Vit.D3 2,000 IU,Vit.E 51 IU, Vit, K 2.34 mg, Riboflavin 5.5 mg, Vit.B1210 mg, Calcium pantothenate 10 mg, Niacin 25 mg, Choline chloride 250 mg, Folic acid 1 mg, Manganese 56 mg, Zinc 50 mg, Copper 10 mg, Iron 20 mg, Cobalt 1.25 mg, Amprolium 125 mg and Tetracycline 100 mg

shell thickness was carried out by using micrometer screw gauge while those of the diameter and height of yolk as well as the height of albumen were carried out by using vernier calipers.

Statistical analysis: The data collected were summarized for each period and then subjected to Analysis of Variance (ANOVA) and where statistical significances were observed, the level of significances were determined and the means were compared using the DMRT according to SAS (1995).

RESULTS

Response of grower chickens: The result of this experiment is summarized in Table 3. There were positive responses in the weight gain and final weight of birds up to 20% level of SPM inclusion. Although, there were no significant differences between the 0 and 10% SPM diets, differences exist between the 10 and 30% SPM diets. The 10% SPM diet gave a significantly ($p<0.05$) better weight gain or final weight than the 30% SPM diet. The 30% SPM diet and the 40% SPM diets were not statistically different as far as these two parameters were concerned, though the 40% SPM diet gave lower values.

There were no significant differences in the consumption of the experimental diets. Differences were observed in the efficiency with which the feeds were converted into flesh. The 10% SPM diet though, proved a little bit more efficient than the control, it was not statistically better ($p>0.05$) than the control or 20% SPM diet. The 40% SPM diet proved the least efficient, though similar to the 30% SPM diet. There was no mortality during the entire period of the experiment (Table 3).

Table 3: Response of chickens to graded levels of sweet potato meal in grower diets (10 -22 weeks)

	Levels of dietary SPM (%)						
Parameters	0	10	20	30	40	SEM	Sig.
Initial wt. g bird^{-1}	716.67	716.67	716.67	716.67	716.67	0.00	ns
Final wt. g bird^{-1}	1758.33^{ab}	1850.81^{a}	1772.22^{ab}	1627.78^{b}	1650.61^{bc}	47.87	*
Cum. wt. gain g bird^{-1}	1041.66^{ab}	1134.14^{a}	1055.55^{ab}	911.11^{b}	833.94^{bc}	47.87	*
Cum. feed intake g bird^{-1}	7375.46	7883.72	7979.33	7929.16	7945.68	194.53	ns
Feed efficiency	7.09^{a}	7.02^{a}	7.60^{a}	8.70^{b}	9.56^{b}	0.37	*
Daily feed intake (g/bird/day)	87.80	93.85	94.99	94.39	94.59	2.32	ns
Daily wt. gain (g/bird/day)	12.40^{ab}	13.50^{a}	12.57^{ab}	10.85^{b}	9.93^{b}	0.57	*
Age at 1st egg (days)	130.00^{a}	133.00^{b}	133.00^{b}	135.00^{b}	139.00^{c}	1.48	*
Age at 5% prodn (days)	132.00^{a}	136.00^{b}	136.00^{b}	139.00^{c}	146.00^{d}	2.33	*
Egg wt. at 5% prodn (g)	42.00^{c}	44.00^{b}	44.00^{b}	45.00^{b}	47.00^{a}	0.81	*
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00	ns
Feed cost kg^{-1} wt. gain (N)	203.28^{a}	197.69^{a}	212.95^{a}	242.71^{b}	266.40^{b}	11.64	*

Means within the sane row with different superscripts are significantly different (p<0.05), SEM: Standard error of the means, NS: Non-significant, *Significant

Table 4: Response of young layers to graded levels of sweet potato meal in layer diets (23-35 weeks)

	Levels of dietary SPM (%)						
Parameters	0	10	20	30	40	SEM	Sig.
Initial body wt. g bird^{-1}	1780.50	1780.50	1780.50	1780.50	1780.50	-	-
Final body wt. g bird^{-1}	2041.11^{a}	2025.33^{a}	2003.66^{a}	1961.11^{b}	1955.33^{b}	15.25	*
Cum. wt. gain g bird^{-1}	260.61^{a}	244.83^{a}	223.16^{a}	180.61^{b}	174.83^{b}	12.25	*
Daily feed intake (g/bird/day)	137.08^{b}	140.33^{ab}	141.04^{ab}	142.48^{a}	144.18^{a}	1.76	*
Feed intake/egg (g)	245.10^{b}	240.38^{b}	257.73^{b}	314.47^{a}	310.56^{a}	28.95	*
Feed conversion ratio (FI/egg wt.)	4.63^{b}	4.49^{b}	5.09^{b}	7.25^{a}	7.67^{b}	0.68	*
Cum. egg prodn/bird	47.00^{ab}	49.00^{a}	46.00^{ab}	38.00^{b}	39.00^{b}	2.33	*
Hen-day egg prodn (%)	53.54^{a}	58.04^{a}	54.86^{a}	47.32^{b}	46.63^{b}	2.83	*
No. of eggs kg^{-1} feed	4.08	4.16	3.88	3.18	3.22	0.21	ns
Feed cost/egg (N)	7.78^{a}	7.46^{a}	8.54^{a}	11.84^{b}	12.59^{b}	0.96	*
Age at 50% prodn. (days)	164.00^{b}	155.00^{c}	164.00^{b}	166.00^{b}	175.00^{a}	3.18	*
Egg wt at 50% prodn. (g)	54.00	54.00	53.00	53.00	53.00	0.25	
NSAverage egg weight (g)	56.00	56.00	57.00	56.00	56.00	0.18	ns
Haugh unit	80.44	79.75	78.97	78.31	77.03	0.81	ns
Yolk index	0.42	0.42	0.41	0.41	0.41	0.00	ns
Shell thickness (mm)	0.36	0.36	0.36	0.36	0.37	0.00	ns
Mortality (%)	0.00	0.00	2.78	0.00	0.00	1.19	ns

Means within the sane row with different superscripts are significantly different (p<0.05), EM: Standard error of the means, NS: Non-significant, *Significant

The feed cost kg^{-1} weight gain were significantly (p<0.05) different. The 10% SPM diet gave the least value of feed cost kg^{-1} weight gain which was of course similar to the values given by the 0% and 20% SPM diets, while the 30 and 40% SPM diets were more expensive (p<0.05) compared to these (Table 3).

Response of young layers: The result of this experiment is summarized in Table 4. The result showed that the final body weight, cumulative weight gain, hen-day egg production and cumulative egg production/bird decreased (p<0.05) as the sweet potato level of diets increased while the daily feed intake/bird, age at 1st egg drop, age at 50% egg production, egg weight at 5% production level, egg weight at 50% production level and feed cost/egg increased ($p<0.05$) as the dietary levels of sweet potato meal increased. However, there were no differences ($p>0.05$) across the treatments in the Haugh Unit, yolk index, shell thickness, number of eggs/kg feed, egg weight at 50% production, average egg weight and mortality.

DISCUSSION

Grower study

Weight gain: The weight gain observed in this study was at variance with the report of Maiyekogbon (1981) who recorded similar weight gain in the pullets fed control or 40% SPM diets. Paucity of information exists on the grower chickens' response to dietary SPM inclusion. However, the response in this experiment showed that SPM should not be included in grower chicken diet at a level higher than 20%. The birds' weight at 22 weeks of age also followed a trend similar to that of weight gain where the 10% SPM diet proved better than the control diet, even though not statistically and the 40% SPM diet proved to be the poorest.

Feed consumption: The pattern of feed consumption in this experiment did not follow the inverse relationship with increase in dietary sweet potato reported for broilers by Tewe (1994), Banser *et al.* (2000), Maphosa *et al.* (2003) and Ayuk (2004). The fact that there were no significant differences across the treatments showed that there were no hindrances to the intake of sweet potato meal. Also, there is likelihood that the sweetness of the potato meals has played a positive role in the consumption of diets containing SPM, considering the fact that the diet without SPM inclusion was the least consumed.

Feed: gain ratio: A positive relationship was established between the FGR and the level of dietary SPM. The 10% SPM diet appeared to be the most efficiently utilized but it was not significantly better than the 0 or 20% SPM diet. The 40% SPM diets was the most poorly utilized, though not different from the 30% SPM diet but both were significantly different from the rest of the diets. Similar trends of efficiency of feed utilization had been reported by Gerpacio *et al.* (1978), Job *et al.* (1979), Dominguez (1992) and Tewe (1994) for poultry. The presence of unidentified inhibitors in sweet potato and the possibility of microbial growth on the sweet potato chops during sun-drying before milling were among the reasons attributed to the trend observed in the feed efficiency.

Mortality: No mortality' result recorded across the treatments has further confirmed the earlier discoveries that even though sweet potato may contain unidentified growth inhibitor, the level in sweet potato definitely posed no danger of death to birds. Many researchers (Tewe, 1994; Ravindran and Sivakanesan, 1996) have attested to the claim that sweet potato in broiler chickens diets has no effect on mortality. Maphosa *et al.* (2003) however differed and attributed the high mortality recorded in their experiment to sweet potato inclusion. The difference in this result and that of Maphosa *et al.* (2003) may be due to the difference in the type of sweet potato cultivars used.

Feed cost per kg weight gain: Feed cost kg^{-1} weight gain increased as the level of sweet potato in the diets increased. Although, the 10% SPM diet appeared to be better in cost than the control diet and 20% SPM diets, the differences were not significant ($p>0.05$); they indeed cost less ($p<0.05$) than the 30 or 40% SPM diets.

Young layers study

Weight gain: The results in this study though showed a trend similar to those observed in the growers study. However, comparison of the rate of weight gain in this study with the rate in the previous experiments showed that the rate of gain in weight decreased as bird approached ages of physical and sexual maturity. It should be understood that the bulk of the nutrients consumed at this stage is diverted to the formation of eggs. Sobamiwa (1988) attested to the trend of weight gain observed in this experiment in which maize was replaced with sweet potato meal at 0, 5, 10 15 and 20% levels in layers diets and no significant difference was recorded in the weight gains or final weights when fed to 26 to 35 week-old layers. At 35 weeks of age, the control diet did not show significant differences ($p>0.05$) in weights when compared with 10 or 20% SPM diets, even though the control diet appeared to be the best of the three. The final weights produced by the 30 and 40% SPM diets were similar and significantly lower ($p<0.05$) than the weights produced by the rest of the diets. However, it is believed that the chickens, particularly those on high levels of sweet potato meal have not attained their terminal growth. The fact that the birds were already in lay only showed that sexual maturity is attained ahead of the physical maturity.

Cumulative egg production: This result is also in agreement with Sobamiwa (1988), who did not record any significant difference in the cumulative egg production when sweet potato was incorporated up to 20% in layers diets.

Hen-day egg production: The 10% SPM diet proved superior to the rest of the feeds in hen-day egg production, even though the difference was not significant when compared with the control or 20% SPM diets. Birds on these three diets however had significantly higher ($p<0.05$) hen-day egg production than the birds on 30 or 40% SPM diets, thus suggesting that SPM should not be included beyond 20% level in young layers' diets. The result obtained by Agwunubi (1995) was not too different when sweet potato peel meals was fed to layers, as depression in egg production only set in when the inclusion went beyond 23.1% level.

Egg weight: At 5% in lay, the 40% SPM diet gave the heaviest egg weight (47 g). The egg weight (45 g) produced by 30% SPM diet was similar to those produced by the 40% SPM diet but significantly ($p<0.05$) heavier than those produced by the rest of the diets. The differences observed could be attributed to the differences in the ages at which the chickens attained the 5% laying level. On the other hand, the differences in egg weights observed at 50% egg production level were found to be insignificant ($p>0.05$). Thus, the result showed that the older the chicken, the heavier the egg produced until physical maturity is attained. It is observed that preference is given to the formation and production of eggs rather than physical development in terms of nutrient diversion once a hen gets to the age of egg-laying. The trend of egg weights at 50% production level indicated that all the birds involved were sexually and physically matured by the time they were 50% in lay. The average egg weights over the entire period of the experiment showed no significant differences ($p>0.05$) across the diets. This result is in agreement with the report of Shoremi and Job (2000) who found no difference in similar birds used for sweet potato trial. Sweet potato meals, however, produced a different result as egg weight became depressed at 80% maize substitution level in the study conducted by Agwunubi (1995).

Feed consumption: Feed intakes were statistically similar except for the birds on control diet which consumed significantly ($p<0.05$) less feed compared with birds on the 30 and 40% SPM diets.

Feed intakes in this study were generally higher than the values (108.77-127.97 g/bird/day) reported for the young layers in a study conducted by Ladokun and Tewe (2003), probably as a result of breed differences and coarseness of the sweet potato chips grinding. A linear increase in feed intake was noticed as sweet potato level of diets increased across the treatments. This is expected as the energy density of the diets decreased with increase in dietary sweet potato level. Layers, like other animals tend to eat to satisfy their energy requirements and then quit feeding. Many broiler chicken experiments Tewe (1994), Banser *et al.* (2000) and Ayuk (2004) reported similar trend in feed intake. However, the feed intake observed in the layer experiments conducted by Agwunubi (1995) and Sobamiwa (1988) were not affected.

Feed conversion: The feed conversion in this study was calculated for the layers as the amount of feed taken per weight of egg produced. The poorer results observed at the higher levels of SPM inclusion could be related to the extra amount of nutrients required to meet up with the body growth, as birds on these diets attained physical maturity later. The feed conversion ratio values in this study were generally high (4.49-7.67). This was because substantial amounts of feeds were diverted to growth purposes in the young layers before attaining physical maturity. In the same manner, depression in feed efficiency was observed by Agwunubi (1995) when sweet potato peel meals was included beyond 23.1% level or 40% maize substitution in layers diet.

Number of eggs per kg feed: Although, egg number per kg feed appeared to decrease as dietary level of SPM increased, the differences in the means of this parameter were not significant. This result indicated that laying chickens could equally perform well on dietary energy content as low as 2451 kcal ME kg^{-1} or as high as 2610 kcal ME kg^{-1} used in the feed formulation.

Feed cost per egg: Feed cost per egg increased as sweet potato of diets increased. Although, the maize-based diet which was the control cost higher than the 10% SPM diet, it was not significantly different. The highest cost was recorded for the 40% SPM diet. While, the costs of 30 and 40% SPM diets were similar, they were significantly higher than the cost of other diets. The lower efficiency of the sweet potato diets must have resulted into the trend observed in this experiment.

Haugh units: The Haugh units across the treatments did not differ significantly. This is in agreement with the report given by Williams (1992) that albumen quality is not influenced by nutrition. The values recorded for eggs produced from 0, 10, 20, 30 and 40% SPM diets were 80.44, 79.75, 78.97, 78.31 and 77.03, respectively. These values present all the eggs resulting from sweet potato diets as of high quality.

Yolk index: Similar values of yolk index were recorded for all the eggs produced in this experiment. The yolk index of 0.42, 0.42, 0.41, 0.41 and 0.41 were recorded for eggs produced by the birds on 0, 10, 20, 30 and 40% SPM diets, respectively. This indicates that sweet potato has no negative effect on the internal egg quality.

Shell thickness: The mean values for the shell thickness observed across the treatments in this study were similar. The mean shell thickness of eggs produced by birds on the 0, 10, 20, 30 and 40% SPM diets were 0.36, 0.36, 0.36, 0.36 and 0.37 mm, respectively. The similarity in these values showed that sweet potato has no adverse effect on the metabolism of either calcium or phosphorous of the diets. Values observed in this study also agreed with the report (0.33-0.36 mm) given by Sakunthala and Reddy (2004) for white leghorn eggs.

Mortality: There was no mortality throughout the period of the experiment except a case of death of one of the birds placed on 20% SPM diet which amounted to 2.78% mortality. It was a case that cannot be linked to dietary treatment.

CONCLUSION

In view of the fact that incorporation of sweet potato meal at levels beyond 20% resulted in reduced feed efficiency, increased feed/kg weight gain and reduced final weight in growers and the fact that inclusion of sweet potato meal in the diets of young layers at levels beyond 20% resulted in feed intake, increased feed conversion ratio, reduced hen-day egg production and increased cost/egg, it is conclude that sweet potato should not be incorporated into the diets of either the grower chickens or young layers at more than 20% level.

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