Tropentag 2011
University of Bonn, October 5 - 7, 2011
Conference on International Research on Food Security, Natural Resource Management and Rural Development

Evaluating replacement of maize and wheat bran with sweet potato tubers and vines on performance, digestibility and blood chemistry of pullet chicks

Ladokun Olusola A.[a] and Aderemi Foluke A.[b*]
[a]Department of biochemistry Lead City University Ibadan,Nigeria
[b*]Department of Animal Science and Fisheries management Bowen University Iwo, Nigeria
[*]faaderemi@yahoo.co.uk

Introduction

In recent years the use of agro industrial by products in animal nutrition has been successfully adopted as a strategy to reduce feeding costs and also to cope with the need to recyle waste material which is costly to dispose of. In several studies cassava peels, root sieviate (Aderemi *et al*., 2004), sweet potato (Abu, 1997) have been successfully used as supplements in monogastric diets. However restricted inclusion of non-conventional feeding ingredients in monogastric diets has been recommended by most authors because of their fibrousness (Chesson, 1987). Sweet potato tuber has frequently been compared with maize in terms of its value in poultry diets. There were conflicting results on the extent to which this substitution can take place without losses in production, Job *et al*. (1979) reported that sweet potato could replace only10-20% of maize in chick diets Abu (1997) reported a 60% replacement 344g/kg and Tewe (1994) reported a 30% replacement of maize180g/kg diet as optimum. The leaves and vines (tops) are rarely used for poultry. This feeding trial was designed to investigate the effects of the mixed feeding of dehydrated sweet potato top meal and sweet potato tuber meal on the performance, nutrient digestibility and blood constituents of pullet chicks.

Materials and Methods

The Experimental Diets

The sweet potato farm was paid for and the tubers and the vines harvested at a farm in oyan Nigeria. The tubers were washed and chipped for sun drying which were later placed in the oven at 40 ^{o}C for 72 hours. To standardize, 30cm of the vines including the leaves were the part harvested for this study. The sweet potato tops were washed sun dried until a constant weight was achieved the tubers and the vines were now separately grinded with hammer mill and tagged SPM and SPT respectively. Five diets were formulated diet I served as control with100% maize and wheat bran, 0% sweet potato meal (SPM) and sweet potato tops (SPT) Diets II –III had maize and wheat bran replaced partially with SPM and SPT, while in diets IV-V there was complete replacement.

One hundred and fifty yafa pullet chicks were purchased from a reputable farm in Nigeria. The chicks were fed with commercial diet for seven days for stability. They were divided into fifteen of ten pullets each and randomly assigned to the diets, each dietary treatment had three replicates. The birds were housed in electrically heated floor pens; feed and water were given ad libitum. Standard routine management and vaccination were carried out which include removal of dead bird in the morning if there was any, draining of remaining water, washing of the watering trough and supply of fresh clean cool water. Removal of poultry dropping from the

remaining feeds in the feeders and addition of fresh feed on daily basis. Records of feed intake, weight gain and feed efficiency were determined weekly on all replicates which lasted for ten weeks.

Metabolic Trial

Two 56 day old pullet chicks of similar weights from each dietary treatment were separately housed in metabolic cages. Equal quantity of 75 g feed was served at 8.00 am daily to each bird. The birds were routinely managed dropping were collected and weighed daily separated from feed and other extraneous materials then oven dried at 85 ^{o}C for 48 hours. Weights of wet and oven dried droppings were recorded to calculate the dry matter. The dried samples were kept for chemical analysis.

Blood Analysis

At four weeks of age, two birds per replicate were randomly selected and bled by puncturing the jugular vein blood was collected in carefully labeled specimen bottles for estimation of serum metabolites. The blood was allowed to clot and the serum decanted after centrifugation. Serum total proteins (albumin and globulins) were determined according to the method of Doumas(1975). The glucose fraction was determined using the method of Bonder and Mead (1974, total cholesterol according to Allain *et al*. (1974). Urea was estimated by the diacetylmonoxine method described by Fawett and Scott (1960) and modified by Kaplan and Szabo (1979). Aspartste amino transferase (SAST) and Alanine amino transferase (SALT) were analysed using a method described by Auckers (1970).

Chemical analysis

The proximate composition of the experimental diets and droppings were estimated by the methods of AOAC (2000) while the gross energy values of the diets were determined using the bomb calorimeter.

Statistical Analysis

All the data generated in this study were analyzed according to the procedure of the Statistical Analysis System (SAS 2001).

Results and Discussion

There were five diets each with three replicates of ten chicks. Diet I served as control with100% maize and wheat bran, 0% sweet potato meal (SPM) and sweet potato tops (SPT) Diets II –III had maize and wheat bran replaced partially with SPM and SPT, while in diets IV-V there was complete replacement Table 1.

Table 1: Gross composition of experimental diets

Ingredients	I	II	III	IV	V
Maize:SPM	100:0	50:50	50:50	0:100	0:100
Wheatbran:SPT	100:0	50:50	0:100	50:50	0:100
Maize	50.0	25.0	25.0	-	-
SPM	-	25.0	25.0	50.0	50.0
Wheat bran	18.40	9.2	-	9.2	-
SPT	-	0.2	18.4	9.2	18.4
Groundnut cake	6.0	6.0	6.0	6.0	6.0
Soybean meal	19.0	19.0	19.0	19.0	19.0
Fish meal	3.0	3.0	3.0	3.0	3.0
Bone meal	2.0	2.0	2.0	2.0	2.0
Oyster meal	1.0	1.0	1.0	1.0	1.0
Premix*	.25	.25	.25	.25	.25
Salt	.25	.25	.25	.25	.25
Methionine	.10	.10	.10	.10	.10
Calculated analysis(%)					
Crude protein	20.76	20.13	20.32	19.84	19.98
Crude fibre	4.13	5.88	7.12	6.04	6.98
ME kcal/kg	2818.28	3045.94	3137.25	3175.43	3244.47

*To provide the following per kg diet vitamin A 10,000iu vit D_3 1500iu vit E 715mg,vit K2mg riboflavin 3mg pantothenic acid 6mg, niacin 15mg choline 5mg,vit B12 0.08mg, folic acid 4mg,Mn 8mg Zn0.5mg 11.0mg Co12mg;Cu10mg Fe 20mg.

Results show that daily feed intake ranged from 28.02g (100%SPM, 50%SPT) to 42.65g for chicks on the control Table 2.

Table 2: Performance characteristics of pullet chicks fed partial and completely replaced maize and wheat bran diets

Diets	**I**	**II**	**III**	**IV**	**V**	**SEM**
Maize:SPM	**100:0**	**50:50**	**50:50**	**0:100**	**0:100**	
Wheatbran:SPT	**100:0**	**50:50**	**0:100**	**50:50**	**0:100**	
Parameters						
Initial body weight(g)	55.52	55.45	55.53	55.56	55.47	0.04
Final body wt(g)	492.10^{a}	426.30^{b}	369.6^{c}	362.6^{c}	319.06^{d}	0.87
weightgain (g/bird/day)	7.03^{a}	6.09^{b}	5.28^{c}	5.18^{c}	5.38^{c}	0.07
feedintake (g/day)	42.65^{a}	34.88^{b}	30.78^{c}	30.56^{c}	28.02^{d}	0.56
Feed:gain ratio	11.54^{c}	12.22^{b}	12.01^{b}	11.87^{c}	13.44^{a}	0.14
Mortality(%)	0^{b}	0^{b}	10^{a}	10^{a}	10^{a}	0.67

abc Means with the same superscript along a row are not significantly different (P>0.05)

Feed conversion efficiency shows that those on control diets had the best value. This suggest improper utilization of the test ingredients this agrees with Olugbemi et al(2010).Digestibility measures the ratio of the nutrient retained to intake expressed in percentage. The digestibility of dry matter values of chicks on the control appeared better than the sweet potato diets Table3.

Table 3: Apparent nutrient digestibility of pullet chicks fed partial and completely replaced maize and wheat bran diets

Diets	**I**	**II**	**III**	**IV**	**V**	**SEM**
Maize:SPM	**100:0**	**50:50**	**50:50**	**0:100**	**0:100**	
Wheatbran:SPT	**100:0**	**50:50**	**50:50**	**50:50**	**0:100**	
Parameters						
Dry matter	71.00^{a}	70.09^{b}	70.44^{b}	65.50^{d}	61.35^{c}	0.93
Crude protein	72.50^{a}	73.03^{a}	73.58^{a}	69.92^{b}	71.46^{b}	0.37
Ether extract	80.34^{a}	78.78^{b}	78.41^{b}	78.02^{b}	77.95^{c}	0.28
NDF	54.40^{c}	69.89^{a}	70.02^{a}	60.15^{b}	69.92^{a}	0.17
ADF	20.87	21.62	23,10	22.05	22.68	0.22

abc Means with the same superscript along a row are not significantly different (P>0.05)

The decrease in dry matter digestibility of the sweet potato based diet is consistent with the findings of Abdel-Samie et al (1983). Perhaps the different chemical composition of maize/SPM on one hand and wheat bran/SPT on the other hand was responsible for this and this is similar to the findings of Therdchai and Mikled (2001).The haematological parameters observed the plasma protein (PP) mean cell volume (MCV) and MCHC were significantly affected (P<0.05) Table 4.

Table 4: Serum metabolites of pullet chicks fed partial and completely replaced maize and wheat bran diets

Diets	**I**	**II**	**III**	**IV**	**V**	**SEM**
Maize:SPM	**100:0**	**50:50**	**50:50**	**0:100**	**0:100**	**-**
Wheat bran:SPT	**100:0**	**50:50**	**0:100**	**50:50**	**0:100**	**-**
Total protein(g/dl)	6.70^{a}	6.67^{a}	6.44^{b}	6.27^{d}	6.39^{c}	0.05
Albumin(g/dl)	3.24	3.30	3.08	3.09	3.11	0.04
Globulin(g/dl)	3.46^{a}	3.37^{b}	3.36^{b}	3.18^{c}	3.21^{c}	0.03
Creatinine(mg/dl)	1.43^{c}	1.53^{b}	1.60^{a}	1.57^{a}	1.42^{c}	0.02
Glucose(mg/dl)	180.57^{e}	190.18^{d}	191.38^{b}	191.18^{c}	194.84^{a}	1.28
Urea(mg/dl)	7.28^{a}	7.08^{b}	6.86^{d}	7.05^{b}	6.67^{c}	0.04
Cholesterol(mg/dl)	108.21^{a}	105.71^{c}	106.92^{b}	106.65^{c}	105.76^{d}	0.25
SAST(IU/L)	43.83^{a}	40.54^{b}	39.98^{d}	40.36^{c}	38.90^{e}	0.26
SALT (IU/L)	21.33^{e}	22.65^{d}	22.82^{c}	23.33^{b}	24.35^{a}	0.44

abc Means with the same superscript along a row are not significantly different (P>0.05)

The chicks fed control and partially replaced diets had similar haematological values and these were higher compared to other diets. The total protein, albumin, cholesterol, urea, serum alanine transaminase values of all the chicks were within standard range when compared with reports of Mitruska and Rawnsley (1977).This implied no impairment to the liver of the fed chickens. The glucose value increased as the level of inclusion of SPM and SPT increased this perhaps suggest

the unavailability of this for the animal use and possibly inhibition to glycolysis by the diets. The mortality recorded during the feeding trial however cut across the diets and could not be linked to dietary treatment.

Conclusions and Outlook

Conclusively partial replacement of maize and wheat bran with SPM and SPT supported growth without abnormality in blood profile of the experimental birds. Thus partial replacement of maize with SPM and Wheat bran with SPT would be a valuable feeding strategy.

References

Abdel-Samie, R.E., Ranweera K.N.P. and Nano W.E. (1983). The influence of fibre content and physical texture of the diet on the performance of broilers in the tropics. British poultry Science Journal 24:283-290.

Abu O.A. (1997) Biochemical characterization and utilization of processed sweet potato (Ipomea batatas) for rabbit feeding. Ph.D. thesis Department of Animal Science.University of Ibadan, Ibadan Nigeria.

Aderemi, F.A. Ladokun O.A. Tewe O.O. (2004**).** Study on haematology and serum biochemistryof layers fed biodegraded cassava root sieviate. Bowen Journal of Agric. 1 pp. 78 – 83.

Allain C.A. Poon L.S., Chang C.S.G., Richmond W. and Fu P.C. (1974) Enzymatic determination of total serum cholesterol.Clinical chemistry 20:470-475.

A.O.A.C. (2000) Officail methods of analysis Association of official analytical chemists Wasghinton D.C.

Auckers G.K. (1970) Analytical gel chromatography of proteins Advance protein chemistry of Agricultural Food chemistry 32: (3) 469-473.

Bonder R.J. L. and Mead D.C. (1974) Evaluation of Glucose -6 phosphate dehydrogenase from lecuonostoc mesteteroides in the hexokinase method for determining glucose in serum. Clinical Chemistry, 20:586-590.

Chesson A. (1987) Supplementary enzymes to improve utilization of pigs and poultry diets. Recent Advances in Animal Nutrition. Butterworth London 71-89.

Doumas B.T. (1975) Standards for total protein assay a collaborative study. Clinical Chemistry, 21: 1159-1166.

Fawett J.K. and Scott J.E. (1960) A rapid and precise method for determination of urea Journal Clinical pathology 13: 156-159.

Job T.A., Oluyemi J.A. and Emtonu S. (1979) Replacing maize with sweet potato in diets for chicks. British Poultry Journal 20: 515-519.

Kaplan A. and Szabo L.L. (1979) Clinical chemistry :interpretation and technique. Henry Kampton pubishers, London pp 109-110.

Mitruska B.M. and Rawnsley H.M. (1977) In: Clinical biochemical and haematological reference value in normal experimental animals Masson publishing USA, Inc.

Olugbemi T.S., Mutayoba S.K. and Lekule F.P. (2010) Evaluation of moringa oleifera leaf meal inclusion in cassava chip based diets fed to laying birds. Livestock Research for Rural Development 22 (6): 1-7.

SAS Institute (2001) SAS/STAT guide for personal computers, version and edition (Cary North Carolina SAS Institute).

Tewe O.O. (1994) Biochemistry and Utilization of Sweet potato (Ipomea batata) for Animal feed. Implications for food security for Africa in :Product development for Root and Tuber Crops, Vol III –Africa (Lima, Peru/ Ibadan.Nigeria.International Potato centre /International Institute of Tropical Agriculture.

Therdchai V. and Mikled C. (2001) Site and extent of cassava starch digestion in Ruminants. International Workshop on current Research and Development on Use of Cassava as Animal Feed. Khon Kaen University, Thailand, July 23-24 2001. Retrieved 15th April 2008 from http:www.mekarn.org/procKK/choc.htm