Effect of meals of sweat potato and cassava varieties formulated with soya meal or cottonseed meal on broiler production.

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Abstract

Sundried sweet potato tuber and cassava root meal with peels were incorporated at 40% levels of the ration and fed from zero to eight weeks to broilers. Diets had soya bean meal or cottonseed meal as principal protein source. Growing and finishing chickens consumed more of the soyabean- supplemented diets than diets containing cottonseed meal as base protein. Chicks found root crop based diets less palatable than maize based diet but older birds adapted well to diets.

At eight weeks of age, chickens ate and grew similarly on the cassava white meal (3985, 1987 g/bird) and maize (4312,2080 g/bird), but these traits were significantly ($P<0.05$) superior to those of birds fed sweet potato variety 1112 (4009, 1801 g/bird), Cassava red meal (4033, 1797 g/bird) and sweet potato variety TIBI (4009, 157 g g/bird). The efficiency of food utilization values showed that birds fed CWM were most efficient followed by those fed maize, SP1112 and CRM based diets. The most inefficient diet was that based on SPTIBI suggesting that there were varietal differences among potato and cassava meals.

Introduction

Cereal free diets for chickens are a vital necessity in Cameroon, as for most African countries, given the inability of these countries to produce adequate quantities of cereals to meet human and animal needs. In developing countries, recent increases in cereal prices have resulted in the search for alternative energy sources (Calpe, 1993). This competition for resources is not limited to cereals alone but can be extended to the availability of land, fuel wood, labour, time and finances - to name a few. Cassava and sweet potatoes which can and are inter-cropped with maize, harvested, chipped and sundried, show great potential in terms of reducing the need for additional land, fuel wood, time, labour and subsequently feed costs.

Sweet potatoes yield 3-20 tons dry matter per hectare, cassava yield 3-7 tons dry matter per hectare while maize yield 2-4 tons/ha dry matter in Cameroon (IRA, 1988). Purcell *et al.* (1976) and Hahn (1992), stated that environment, varietal, agronomic and processing factors affect product quantity and quality of roots and tubers. However if export standards of moisture level below 13%, starch levels of 60-70% and 4% level of impurities including crude fibre and ash (EEC, 1974, EEC 1979) are maintained, reformulation of diets at feed mills become unnecessary.

With efficient supplementation for protein, fats and minerals, these energy sources can adequately replace maize in chicken diets. Chou and Muller (1972), Christiensen et al (1977) and Khajaren (1993) have shown that cassava tuber meal can be successfully incorporated at the 40-60% levels in both phases of broiler production. On the other hand, Turner et al., (1976) and Gerpacio et al. (1978) noted that the best results are obtained when 50% or at most 75% of maize was replaced by sweet potato root meal. Or, Sweet potato meal should make up 30-40% of the diet. In Cameroon several varieties have been developed in collaborative studies between the International potato

Table 1. Chemical composition of energy sources used in test diets(% except specified otherwise

Energy Source	Dry matter			Crude protein	Ether Extract	Crude Fibre	Ash	Calcium	Phosphorus	Lysine	Methionine & cystine	NaCl	Price
	M	DM	AME MJ/kg										CFA/kg
Sweet Potato													
TIBI	28.34	96.67	12.15	3.98	1.07	2.63	3.06	0.11	0.12	0.20	0.17	0.01	110
TIB2	26.53	93.86	12.08	5.06	0.78	2.58	3.28	0.01	0.11	0.26	0.26	0.01	106
1112	25.45	93.13	12.31	4.54	0.39	2.55	2.95	0.07	0.08	0.22	0.25	0.02	106
Cassava+													
White skin	34.69	93.65	12.65	2.58	0.38	2.79	2.46	0.08	0.07	0.10	0.16	0.02	60
Red skin	35.28	94.27	12.47	3.28	0.81	3.09	2.04	0.08	0.07	0.12	0.23	0.01	65
Maize	36.52 (85.0)*	93.65	13.98	7.64	4.35	1.75	1.19	0.01	2.25	0.31	0.66	0.01	157
Soya bean meal	-	90.00	10.30	49.00	1.56	7.80	7.20	0.30	0.68	3.09	1.43	0.14	450
Cotton++ Seed meal	-	91.41	9.31	56.12	7.44	8.20	7.77	0.34	1.39	1.93	1.20	0.09	150

*FM dry matter determined from fresh matter.
** Field dry matter of maize
*** one UD Dollar = 500 CFA
+ Hydrogen cyanide content 45mg/kg for red skin and 50mg/kg for white skin.
++ Free gossypol 125 mg/kg

Table 4. Composition of sweet potato and cassava in broiler finisher diets

Foodstuff	Maize control	Potato TIB1	Potato 1112	Cassava white	Cassava red	CSMFe potato TIB1	CSMFe white	CSM potato TIB1
Fishmeal	7.23	9.99	10.00	9.76	10.00	0.77	2.51	0.41
Oyster sea shells	0	0.10	0	0	0.06	0.12	0.03	0.11
Bone meal	0.63	0	0.07	0.64	0.50	1.45	1.19	1.52
Blood meal	2.45	2.45	0.85	0	0.11	0.60	2.45	0.86
Soya bean meal	10.96	12.09	17.75	23.56	21.52	0	0	0
Salt	0.26	0.20	0.21	0.22	0.22	0.32	0.29	0.32
Methionine	0.14	0.07	0.11	0.03	0.05	0.09	0.21	0.10
Palm oil	1.50	7.00	6.95	6.20	7.00	7.15	7.11	7.15
Palm kernel meal	8.66	0	0.42	2.52	8.08	0	0	0
Rice bran	0.71	12.16	10.93	0	0	0	0	0
Vit-min premix	1.00	1.00	1.00	1.00	1.00	1.001	1.00	1.00
Cottonseed meal	0	0	0	0	025.00	25.00	25.00	
Lysine	0.20	0	0	0	0.31	0.16	0.31	
Maize	66.26	14.94	11.71	16.07	11.46	23.43	19.99	23.22
Sweet potatoTIB1	0	40.00	0	0	0	40.00	0	40.00
Sweet potato 1112	0	0	40.00	0	0	0	0	0
Cassava white	0	0	0	40.00	0	0	40.00	0
Cassava red	0	0	0	0	40.00	0	0	0
Ferrous sulphate	0	0	0	0	0	0.06	0.06	0
Total	100	100	100	100	100	100	100	100
Cost (FCFA/kg)*	213	221	235	231	229	168	162	165

Note: Figures are in % unless otherwise stated

* one US dollar = 500 FCFA

Table 5. Chemical composition of test diets fed broiler finisher chickens

Chemical characteristic	Maize control	Potato TIB1	Potato 1112	Cassava white	Cassava red	CSMFe-TIB1	CSMFe-white	CSM-potato TIB1
Crude protein	18.67	18.05	19.17	19.81	20.14	17.30	19.32	17.29
Energy AME (MJ/kg)	12.70	12.78	12.66	12.94	12.81	12.78	12.95	12.78
Calcium	0.58	0.58	0.56	0.73	0.74	0.64	0.61	0.61
Phosphorus	0.61	0.61	0.61	0.60	0.60	0.63	0.63	0.63
Lysine	1.10	1.18	1.21	1.23	1.23	0.68	0.84	0.08
Methionine + cystine	1.14	0.96	1.06	1.01	1.03	0.63	0.83	0.63
Salt	0.44	0.46	0.45	0.45	0.46	0.36	0.38	0.36

Note: Figures are in % unless otherwise stated

Table 6. Performance of broiler chickens fed root and tuber meal-based diets for eight weeks

Characteristics	Maize	Potato	Potato	Cassava	Cassava	CSMFe potato	CSMFe cassava	CSM-potato	SEM
	control	TIB1	1112	white	red	TIB1	white	TIB1	
Weight gain 0-4 weeks (g)	835^{a}	642^{b}	639^{b}	776^{a}	753^{c}	299^{c}	339^{c}	274^{c}	35.2*
Weight gain 4-8 weeks (g)	1245^{a}	933^{d}	1162^{abc}	1211^{ab}	1044^{cd}	643^{e}	1094^{bc}	518^{e}	47.7*
Total weight gain (g)	2080^{a}	1575^{c}	1801^{b}	1987^{a}	1797^{b}	942^{e}	1433^{c}	813^{e}	51.7*
Food intake 48 weeks (g)	3067^{a}	3076^{a}	2859^{a}	2774^{a}	2989^{a}	2143^{bc}	2009^{c}	2355^{b}	107.9*
Total food intake (g)	4312^{a}	4009^{b}	4021^{b}	3985^{b}	4033^{ab}	2787^{d}	3103^{c}	2873^{cd}	100.8*
EFU-0-4 weeks	0.61^{a}	0.53^{b}	0.54^{b}	0.66^{a}	0.59^{ab}	0.42^{c}	0.42^{c}	0.42^{c}	0.031*
EFU 4-8 weeks	0.41^{bc}	0.31^{d}	0.41^{bc}	0.44^{b}	0.35^{cd}	0.30^{d}	0.55^{a}	0.22e	0.026*
Overall EFU	0.44^{ab}	0.37^{d}	0.41^{bc}	0.45^{a}	0.41^{bc}	0.29e	0.40^{c}	0.26^{f}	0.011*
Weight gain/FCFA(cost)									
0-4 weeks	2.51	2.21	2.20	2.52	2.25	2.23	2.26	2.28	
0-8 weeks	1.92	1.470	1.74	1.90	1.53	1.79	3.40	1.33	
Overall mean	2.22	1.80	1.97	2.21	1.89	2.01	2.83	1.81	

* significant at $P<0.05$
SEM standard error of the mean
abc superscript within rows which are different are significant at $P<0.05$

Results

Foodstuff Composition

Table 1 showed that the energy values of sweet potato and cassava varieties were slightly lower than that for maize. Also the quality of root and tuber meals in terms of fat, sulphur amino acids and macro minerals were very much lower than that for maize. However the fibre and ash values for the sweet potato and cassava meals were much higher than that of maize.

Weight gain

Growth rates (**Table 6**) showed that chicks were significantly ($P<0.05$) heavier when fed maize (836 g/bird), Cassava White Meal, CWM (776g/bird) and Cassava Red Meal, CRM (753 g/bird) than when fed SPTIBI (642g/bird) and SP1112 (639 g/bird). The weights of the latter were in turn significantly ($P<0.05$) higher than those of birds fed sweet potato and cassava and cotton seed meal as the base protein. Finisher chickens 4-8 weeks had similar rates of weight gain when fed maize (1245g/bird), CWM (1211g/bird) and SP1112 (1162g/bird). The values for birds fed SP112 were similar to those of chickens fed CSMFe-CWM (1094g/bird). Weight gain of birds fed SPTIBI based diets supplemented with either cotton seed meal or soya bean meal were significantly ($P<0.05$) the lightest birds compared to all the others. At eight weeks of age the heaviest chicken were those fed maize (2080g/bird), CWM (1987g/bird) and these chickens were significantly ($p<0.05$) heavier than those fed SP1112 (1801g/bird) and CRM (1798g/bird) based diets. The latter birds were significantly heavier than those fed SPTIBI (1575g/bird) and CSMFe-CWM (1433g/bird). The lowest weights were registered by chickens fed CSM-SPTIBI (942g/bird) based diets.

Food Intake

Food intake of birds at the starter phase (**Table 6**) showed that the most palatable diets were the maize (1359 g/bird) and the cassava red (1276g/bird) based diets. These values were significantly higher ($p<0.05$) than those of birds fed diets made from meals of all the varieties of sweet potato (SPTIBI, SP1112) and cassava white (CWM) diets. The lowest food intake values were observed for chicks fed sweet potato (CSMFe-SPTRIBI, XSM-SPTIBI) and cassava (CSMFe-CWM) meals with cotton seed meal (with and without ferrous sulphate) as base protein. During the finisher phase, chickens adapted well to the diets and food intake values were similar for all energy sources with soya bean meal as the principal protein source. These values were significantly better ($p<0.05$) than values of birds fed CSM-TIB1 and CSMFe-TIB1. The least palatable diet was that based on CSM-CWM. At eight weeks of age the food intake values reflected the pattern observed for chicks at the starter phase except that birds this round, significantly ($p<0.05$) consumed more (3103g/bird) feed when fed CSM-CWM (3013g/bird) than when fed CSMRe-SPTIB1 (2873g/bird) based diets.

Efficiency of food utilization

Weigh gain/food intake ratio values at the starter phase showed that birds fed maize (0.61), CWM (0.06) and CRM (0.59) were similar but significantly ($p<0.05$) superior to values of birds fed all the other energy sources with cotton seed meal as principal protein source. The values for birds fed SPTIB1 (0.03) and SP1112 (0.54) were similar to those of chicks fed maize and cassava red meal based diets. At the finisher phase, efficiency of food utilization were best for birds fed CSMFe-CWM and this value was significantly ($p<0.05$) better than the values for chickens fed maize, SP1112 and CWM. The values for birds fed CRM were similar to those of birds fed maize, SPTIB1, and CSMFe-TIB1. The latter values were significantly higher ($p<0.05$) than the values of birds fed CSMTIB1. At eight weeks of age the most efficient diets were those of birds fed CWM (0.45) and maize (0.45) based diets. The values of birds fed SP1112 (0.41) and CRM (0.41) were similar to values of chickens fed maize and CSMFe-CWM (0.40) diets. Significantly ($p<0.05$), the least efficient diet were those of birds fed with SPTIB1 based diets.

Cost effectiveness

Evaluating weight gains in terms of unit feed cost showed very slight differences among test diets at the starter phase. But there were distinct differences, as birds grew older. The most cost -effective diet was CSMFe-CWM, followed by the maize; CWM and SP1112 based diets. The least cost effective diets were those based on SPTIB1 and CSM-TIB1.

Discussion

The chemical composition of root and tuber meal (**Table 1**) showed these to be deficient in fats, protein , lysine and sulphur amino acids. This confirms work by purcell et al (1972) and Willie and Kinabo (1980) who observed similar results but went on to state that adequate supplementation did render these energy sources comparable to maize. The high crude fibre and ash levels in these meals must be the result of peels being processed along with the pulp. However Fomuyam and Tebong (1985) showed that broiler chicks could tolerate 5-8% fibre in their diets without affecting growth.

Khajarern and Khajarern (1993) stated that the type and level supplementation greatly influenced the performance of chickens. Thus the differences in food intake, growth and efficiency of food utilization of birds fed cottonseed meal as the principal protein source suggested that the quality of cotton seed meal is not comparable to that of soya bean meal. Although, Ngoupayou and Njoya (1983) observed that up to 30% level of cotton seed meal can be fed to broiler chickens without any detrimental effect on growth, free gossypol could not have been a factor for concern, as the presence of iron sulphate did not improve feed intake or weight gains. Fombad (1998) in an extensive study on cottonseed meal in animal feed showed that free gossypol content of Cameroon cottonseed meal varied from 100-150 mg/kg. Waldroup (1981) showed that free gossypol levels above 180mg/kg did affect broiler growth. It is suggested that the high fat levels in the meal in the warm tropical climate of Cameroon might have encouraged the growth of undesirable micro-organisms that rendered diet disagreeable to chicken.

Although chicks consumed less feed and grew at slower rate than those fed maize or CWM, these chicks did efficiently utilize their diets. This was because chicks effectively digested sweet potato based diets. Yosida and Morimoto (1959) confirmed that sweet potato was 90% digestible by chicks. Fetuga and Oluyemi (1976) showed that the rate and efficiency of gain by chicks were best when sweet potato replaced 25 or 40% of the glucose of the basal diet. The comparability of cassava root meal to maize in sustaining food intake and weight gain suggests that cassava starch was as efficient as maize starch. Several researchers have shown that cassava 50-60% levels of the diet for chickens can promote growth (Chou and Muller, 1972; Christensen et al, 1997; Longe and Oluyemi, 1977). Apparently hydrocyanic acid, a toxic substance associated with the poor utilization of cassava based diets, was not a factor in these diets. Even the presence of peels known to contain more prussic acid did not affect feed intake or growth. Palm oil in the diet reduce reduced the dustiness of the diets. Thus the poor food intake observed for chicks might be due to palatability of diets caused by differences in the varieties of the root and tubers.

As the bird grew older they adapted well to the diets resulting in comparable food intake values. With older birds, more energy was needed for muscling and metabolic activities so much so that result desegregated energy sources in terms of quality as result of varietal effects. That is, cassava white was more comparable to maize than cassava red or sweet potato meals, and sweet potato variety 1112 appeared to be more effective than sweet potato variety TIBI. The difference between cassava and sweet potato might be due to the rate of digestibility. Szylit et al (1977) stated that the starch structure of sweet potato, maize and cassava was the same but the size of starch molecule for sweet potato was larger (25um)compared to that of maize and cassava (12um) and accounted for the slow digestion of sweet potato based diets. Mohamed et al. (1974) and Gerpacio et al (1978) also noted that the presence of non-identified factors inhibited digestive and metabolic processes when sweet potato was used as energy source for older chickens. However the fact that certain varieties were more efficiently utilized than others suggested that these unidentified factors which inhibit digestion might be more in some varieties than in others. It could also be that the differences in the sugar content affected the supply of energy by the energy sources, given that sucrose is less efficient than starch in the supply of energy, and thus accounted for the differences in performance when the different energy sources were used.

The efficiency of weight gain with respect of feed costs reflected the balance between feed costs and quality. This explains why the locally produced cottonseed meal and cassava, an efficient and cheaper energy source than maize, were most cost effective. Thus data on varietal effectiveness of foodstuff in terms of sustaining adequate performance or chickens will be useful in the process of reducing feed costs.

Conclusion

Cassava root meal of the white skin variety at 40% levels of the ration was comparable to maize in terms of rate and efficiency of gain. Sweet potato variety 1112 was best in sustaining broiler chicken growth. Energy sources with soya bean meal as principal protein source apart from cotton seed meal, were more effective in promoting food intake and growth of birds but were less cost effective.

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