Basic Science

Utilization of Cassava, Sweet Potato, and Cocoyam Meals as Dietary Sources for Poultry

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ABSTRACT [ENGLISH/ANGLAIS]

Tuber crops are staple food in many parts of the tropics, being the source of daily carbohydrate intake for large population of man and livestock. Due to high cost of conventional energy sources in animal feed, efforts are being made towards developing alternative sources of energy in the area of utilization of tuber meal. The tubers examined were cassava (*Mannihot esculentum*), sweet potato (*Ipomoea batata*) and cocoyam (*Colocasia esculetum*). It was found that cassava root meal replaced up to 30% of maize without detrimental effect on the performance on poultry. Also cassava sievate meals are included up to 20% in the starter cockerel diet. Sweet potato meals are included up to 38.73%. For more efficient utilization of the tuber meals, effort should be geared towards sourcing the best processing technique like decomposing directing by heating them above a temperature of 150^{0}C. Crushing the tubers to allow greater interaction and microbial detoxification that will ensure reduction in the levels of anti- nutritional factor such as hydro cyanide (HCN) in cassava and calcium oxalate in cocoyam and pelletizing the tuber meals to reduce dustiness.

Keywords: Cassava, sweet potato, cocoyam meals, diet

RÉSUMÉ [FRANÇAIS/FRENCH]

Tubercules sont des aliments de base dans de nombreuses régions des tropiques, êtrela source de l'apport glucidique quotidienne pour la population grande de l'homme et du bétail. En raison du coût élevé des sources d'énergie conventionnelles dans l'alimentation animale, des efforts sont réalisés en vue de développer des sourcesd'énergie alternatives dans le domaine de l'utilisation de la farine de tubercule. Lestubercules de manioc ont été examinés (Mannihot esculentum), la patate douce(Ipomoea batata) et le taro (Colocasia esculetum). Il a été constaté que la farine demanioc a remplacé jusqu'à 30% de maïs, sans effet néfaste sur la performance de la volaille. Aussi manioc repas sont inclus sievate jusqu'à 20% dans le régime alimentairecoq démarreur. Repas de patates douces sont inclus à 38,73%. Pour une utilisation plus efficace des repas tubercules, les efforts doivent être orientés versl'approvisionnement de la meilleure technique de traitement comme la décompositionen scène en les chauffant au-dessus de la température de 1500C. Broyage destubercules afin de permettre une plus grande interaction et de désintoxicationmicrobienne qui assureront la réduction des niveaux d'anticorps anti-facteur nutritionneltels que l'oxalate hydro cyanhydrique (HCN) dans le manioc et le calcium dans le taro et de polluer les repas tubercules afin de réduire la formation de poussières.

Mots-clés: Le manioc, la patate douce, taro repas, l'alimentation

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INTRODUCTION

Energy feed sources (maize and sorghum) are expensive feedstuff, constituting about 50-55% of the formulated poultry diets, Maize as a major component of feed is expensive, the productivity is low which means it does not meet its demand. Agbede et al. [1], Hamzat et al. [2], and Okereke et al. [3]. The livestock producer appears most hit in terms of serious scarcity and high cost of feed [4]. With the present trend of rising prices of animal feed stuff all over the world, greater attention is being paid to the search for safe and cheap local feed stuff (including unexplored feed-stuff, by –products of agriculture and industry. especially in the developing countries that cannot afford the expensive diets for livestock.

Nigeria, like most other developing countries suffer greatly from a constant shortage of livestock feeds, especially those supplying protein and energy.

Limitation imposed by scarcity of maize and completion with human consumption have forced many farmers into employing alternative sources of energy for poultry feed formulation, Such alternatives include feeding of farm by products (maize straw, cocoa husk, maize-cob) and

effort had also been geared towards the utilization of relatively cheaper and available roots and tubers in recent years.
The paper is therefore aimed at evaluating the progress made so far in the use of root and tuber crops and to articulate the various problems being faced and the way out, primarily for the advancement of poultry industry

CASSAVA (*Manihot esculenta crantz*)

Cassava is used in West African as a cheap source of carbohydrate food for man and livestock [5]. The metabolizable energy value of cassava unpeeled cassava root meal (3870kcal/kg) is higher than that of maize 3430kcal/kg Tion and Adeka [6] previous studies have shown that peeled cassava root meal could be used effectively for broilers and layers [7], Ademosum and Eshiett [8], Tewe [9], and Egbunike and Egbunike [10].
However, the low protein content [11] and the dustiness of the feed [12] are among the limiting factors in cassava utilization. It is essential therefore that a good quality protein has to be included in diets containing cassava along with methionine because cassava root contains so little protein that its amino acid balance is of little direct interest. The success of using it as a substitute for maize therefore depends largely on the availability of an excellent source of protein (with sufficient methionine to meet both the body requirement and cyanide detoxification) Okereke et al. [13].
Erubetine and Oguntona [14] showed that unpeeled cassava root meal (URCM) could be included at levels up to 30% in diets for layers throughout the laying period (40 weeks) without any detrimental effects. Consequent upon the continued search for alternative source of cheap feed ingredient in poultry production, (CPM) could successfully be used in starter diets and finishers diets at 30% and 60%, respectively.
Tion and Adeka [6] also demonstrated the beneficial effect of using cassava root meal to replace up to 30% maize in a broiler diet while attempts are made to reduce the dustiness through the addition of oil and supplementation with adequate levels of methionine and lysine.
Idowu et al. [15], observed that could be replacement of up to 10% wheat offal by cassava root sievate-based diets, it is therefore recommended to effectively reduce 20%, 10% and 17% content of the plasma, egg yolk and whole egg respectively at performance level that are comparable with that of the control group. Akinola and Oruwari [16] found that cassava root meal is capable of totally replacing maize in diet for laying hen, Edache *et al* [17], reported that 35% cassava meal based diet is recommended for growing Japanase quail. Nwokoro et al [18] (see Table 3), from his study showed that cockerel starter birds could tolerate only about 28% level of cassava sievate in their diet. Onwujiariri et al. [19] revealed that wet maize milling waste and cassava root sievate could effectively replace maize up to 35% without adverse effect on growth and feed utilization on finisher broilers.

SWEET POTATO (*Ipomoea Batata)*

The fresh tuber of sweet potato consists of about 60-70% water, 15-25% starch. The tuber can be fed to livestock either in the fresh form or in the form of chips Onwueme et al. [20] of the tuber, the sweet potatoe (*Ipomoae batata)* as an energy source for poultry is perhaps the most studied Yoshida et al. [21] stated that recommended level of inclusion of oven dried potato flour in livestock rations are 10% for layers, 12% for starter broiler, 18% for finisher broiler and 17% for weaner and grower pigs. Shoremin and Job [22] revealed that sweet potato at a substitution of 45% can safely replace maize in pullet mash. Okereke, et al. [23] observed that orange-fleshed sweetpotato tuber meal can be included up to 25% in diet of laying hens without any negative effect on egg quality. Onyekwere et al. [24] studied that sweet potato root meal, improved its value to the extent that 20% dietary inclusion of the meal produce no adverse effect on broiler starter. In a related study, Maphosa et al. [25] carried out a study on the use of raw sweet potato tuber meal as an ingredient in broiler diets and concluded that, it should not be added to broiler starter diets but could be added to 50% inclusion levels in finisher's diet without affecting the performance of the birds. Edache et al. [37] (see Table 2) revealed that 38.73% dietary sweet potato will support acceptable growth performance for Japanese quail.
The carbohydrate of sweet potato is highly digestible and soluble. It is low in fibre and consists predominantly of starch between 4-7% which occurs as sugar. Also, high reducing sugar in sweet potato tuber and flour causes diarrhea at high levels. Thus limiting inclusion rate in livestock rations. The use of no-sweet clone is therefore recommended [26]. The tube is rich is diatose.

COCOYAM

In many part of Africa, the term cocoyam is used to refer collectively to members of the genus *Colocasia* and the genus *Xanthosoma* which are used for food and feed, when referred to separately, *Colocasia* species are called taro while *Xanthosoma* species are called tannine.

Wild cocoyam (*Caladium bicolor)* is a neglected high moisture tuberous root stock; it is not directly consumed by man and equally of no industrial use as at now. Available literature on the feeding of wild cocoyam to finisher broilers suggests that it is a satisfactory energy ingredient at up to 20% of the whole ration Onu et al. [27]. Abdulrashid and Agwunobi [28] (see Table 1) revealed that cocoyam meal with proper processing will effectively replace maize at 50% level of inclusion as a major source of energy in finishing diet of broiler birds for maximum profit. However, its use in the feeding of monogastric animal could be encumbered by the presence of some anti-nutritional factors (calcium oxalate, tannins and trysin inhibitions) which adversely affect protein and energy utilization in broilers Onu et al. [29].

ANTI-NUTRITIONAL FACTORS PRESENT IN ROOT AND TUBER CROPS

Phytate

Phytic acid interferes with the utilization of mineral element. It forms compounds which are not readily broken down, thus reducing the absorption of the metal [30].

Hydrocyanic Acid

When a high level of hydrogen cyanic acid is injected by man and animals, it will react rapidly with metal ions such as Fe^{++}, Cu^{++} and Zn^{++} in the blood. The hydrocyanic acid then combines with the iron in the heamoglobin of red blood cells to form a complex called cynahaemoglobin. This complex causes the haemoglobin to loose its oxygen carrying capacity in the animal body. Hydrocyanic acid can also combine with copper of the cytochrome oxidase and thereby inhibit its oxygen carrying capacity [31].

Tannins

Tannins are poly phenols non-nitrogenous plant toxins. They are important group secondary metabolites found in higher plants Robert et al. [32]. Vohra et al. [33] reported that 1% of tannin brought growth retardation in chicks due to difficulty in breaking down protein-tannin complexes and they pass out in the faeces.

Oxalate

It forms a complex with the minerals resulting to an insoluble complex compound, eg. calcium oxalate which causes irritation of the body and gut in raw cocoyam thereby resulting in low feed intake. It can also result in deficiency of calcium, leading to poor bone formation and energy metabolism particularly regulation of pyruvate dehydrogenase complex enzymes in the conversion of pyruvate to acetyl-coA Robert et al. [34]. The presence of toxins, inhibitors and anti-nutritional factors in food and feeding-stuff is a problem that limits their maximum utilization.

PROCESSING TECHNIQUE FOR CASSAVA AND COCOYAM

Root and tubers are traditionally processed by a wide range of methods which reduce their toxicity, improve palatability and convert the perishable fresh root and tubers into stable products. These processing methods consists of different combinations of one or more of the following:

Peeling

In this you remove the outer part of the tuber.

Chipping

The tubers are cut into smaller size to increase the surface area.

Grafting →Soaking→ drying→ boiling→ fermenting are detoxification methods.

Table 1: This table shows performance of broiler finisher on varying levels of boiled tannin cocoyam meals

	Dietary	Treatments	Levels	
Parameter	0%	20%	50%	100%
Avg. initial live weight (g)	508.00	550.00	558.00	575.00
Avg. final live weight (g)	2830.00	2550.00	2690.00	2000.00
Avg daily feed intake/bird (g)	167.86	17.2.14	155.24	151.19
Avg daily weight gain/bird (g)	55.00	57.38	50.95	31.67
Feed conversion ratio	4.4	3.86	7.71	13.57
Mortality	0	1	0	1
cost of production				
Avg cost of feedN/kg	51.13[a]	48.97[a]	46.81[a]	42.49[b]
Avg cost of daily feed inta	8.58	8.43	7.27	6.42

Source: Abdulrashid and Agwunobi [28]

Table 2: This table shows effect of different sweet potato meal level on mean feed consumption, weight gain and feed/weight gain ration of quail chicks at 6 weeks of age

Parameters	A0%	B13.73%	C23.73%	D 38.73%	SEM
Initial weight g/bird)	9.03	8.78	9.03	8.93	$\pm$0.112
Final weight(g/bird)	131.03	139.28	130.40	131.08	$\pm$ 6.52
Feed consump(g)	702.10^{a}	818.62^{b}	688.59^{a}	689.96^{a}	$\pm$7.20
Weight gain (g)	122.00	130.50	121.37	122.15	$\pm$4.42
Feed cost (N/kg)	6.67	7.61	6.12	6.26	$\pm$1.43
Cost/Kg gain (N)	97.87^{a}	94.23^{a}	104.94^{a}	134.81^{b}	$\pm$24.47

Source: Edache et al. [37]

Table 3: This table shows performance characteristics of cockerel starters feed the experimental diets

Cassava Sievates Meal Between 0 and 8 Weeks					
	Diets (percent inclusion)				
Parameters	0	20	40	80	100
Ini live weight (g/bird)	31.64	31.69	31.92	32.19	31.15
Fin live weight (g/bird)	753.16	666.75	618.00	461.60	406.25
Weight gain (g/bird/day)	12.85^{a}	11.25^{a}	10.48^{ab}	8.23^{abc}	6.70^{c}
Feed intake (g/bird/day)	33.18^{a}	38.46^{a}	36.07^{b}	29.59^{c}	34.35^{-ab}
FCR	2.58^{a}	2.97^{a}	3.44^{a}	3.60^{ab}	5.13^{b}
Nitrogen retention (%)	68.24^{a}	69.05^{c}	72.18^{b}	72.11^{b}	73.12^{b}

Results of the performance of the cockerels showed that the starter birds could tolerate only about 20% level of cassava sievate in their diet
Source: Nwokoro et al. [18]

Three Methods of Detoxification

- Decomposing directly by heating them above a temperature of 150^{0}c
- Crushing the tubers to allow greater interaction
- Microbial detoxification, sometimes a combination of (1) and (iii) methods above can be used in order to be assured of the safety of the root and tuber products [31].

While all these processing methods for cassava is geared toward reducing the cyanide level and for cocoyam reducing the oxalate effect. For cassava sun-drying of cassava chips has been shown to reduce the cyanide concentration to lower than 10mg/100g Mahungu et al. [35] and 100ppm Tewe et al. [36]

CONCLUSION

Cassava, sweetpotato, cocoyam should be palletized in other to eliminate irritation of the respiratory organs and eye infection and ensure an optimum feed intake. Cassava, sweetpotato and cocoyam crops diet must be formulated with more care than cereal based diets. Great attention must also be paid to the balancing of limiting amino acids, essential fatty acids lineoleic acid, especially for laying hens. Basic minerals and micro elements (such as zinc and iron) and vitamins also need be considered. Finally, tuber crops yield in terms of dry matter per acre is high when compared to maize. If properly handled, it will successfully replace maize in animal diet.

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CONFLICT OF INTEREST

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