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Incorporation of African Yam Bean tubers starch (*Sphenostylis stenocarpa* Hochst ex A. Rich) Harms in the feeding of COBB 500 strain broiler

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ABSTRACT

Description of the subject. One of the major constraints in the urban and rural strain broiler livestock is feeding. Small breeders cannot afford the Midema ration to feed strain broiler because of its expensive costs, whereas it is the man source of supply. The African Yam Bean, a local and traditional plant can solve the strain broiler-feeding problem due to its higher tuber yield, its nutritional value it is available, accessible, well adapted, easy and cheap to produce.
Objective. To assess the effects of the tubers of African Yam Bean (AYB), in the Broiler feeding.
Methods. The COBB 500, race of chicken used during the research, were nourished by three types of rations: The control ration: Midema, the ration with 30% of soya bean and the ration with 15 % of AYB tubers flour and with 15% of soya bean.
Results. After four weeks of feeding of the chickens, the weight of chickens fed by AYB was as high as Midema ration, respectively (1977.50±13.00 g and 2035.00±123.00 g) whereas the indice of consumption was lower for the chicken fed with AYB (2306.97±120c) than the Midema ration (2477.26±111.00). The ration with 30% of soya bean, besides being expensive, indicated the lowest weight of the chickens (1834.00±121.00 g) with the highest consumption of food (2421.60±131.00). The price of production per kilogram of chicken fed with AYB tubers was the lowest ($ 1.51±0.02 et $ 1.57±0.01).
Conclusion. Feeding chickens with AYB is more economic and more beneficial, cheaper and accessible to the poor people. Farmers, who are growing the AYB plant, can feed their chickens freely using AYB tubers from their fields.

Keywords. AYB, ration, broiler chicken, starch, tubers.

RESUME

Description du sujet. L'alimentation est l'une des principales contraintes du cheptel de poulets de chair en milieu urbain et rural. Les petits éleveurs ne peuvent pas se permettre la ration Midema pour nourrir les poulets de chair de souche en raison de ses coûts élevés, alors que c'est la source d'approvisionnement en nourriture. Le haricot-igname africain, une plante locale et traditionnelle peut résoudre le problème d'alimentation des poulets de chair grâce à son rendement plus élevé en tubercules, sa valeur nutritionnelle, est disponible, accessible, bien adaptée, facile et bon marché à produire.
Objectif. Évaluer les effets des tubercules de l'igname africaine (AYB) dans l'alimentation des poulets de chair.
Méthodes. Les COBB 500, race de poulet utilisée lors de la recherche, étaient nourris par trois types de rations: La ration témoin (Midema), la ration avec 30 % de soja et la ration avec 15 % de farine de tubercules AYB et 15 % de soja.
Résultats. Après quatre semaines d'alimentation des poulets, le poids des poulets nourris par AYB était aussi élevé que la ration Midema, respectivement (1977,50 ± 13,00 g et 2035,00 ± 123,00 g) alors que l'indice de consommation était plus faible pour le poulet nourri avec AYB (2306,97 ± 120c) que la ration Midema (2477,26 ± 111,00). La ration avec 30 % de soja, en plus d'être chère, indiquait le poids le plus bas des poulets (1834,00 ± 121,00 g) avec la plus grande consommation de nourriture (2421,60 ± 131,00). Le prix de production par kilogramme de poulet nourri avec des tubercules AYB était le plus bas (1,51 $ ± 0,02 et 1,57 $ ± 0,01).
Conclusion. Nourrir les poulets avec AYB est plus économique et plus avantageux, moins cher et accessible aux pauvres. Les agriculteurs qui cultivent la plante AYB peuvent nourrir librement leurs poulets en utilisant les tubercules AYB de leurs champs.

Mots-clés : HIA, ration, poulet de chair, farine, tubercules.

1. INTRODUCTION

Since some decades, there is an increasing interest and attention on the local and neglected crops. African Yam Bean (*Sphenostylis stenocarpa* Hochst. Ex A. Rich) is a tropical legume with duo food (tubers and beans), both of them rich in protein, carbohydrates and minerals (Adewale and Dumet, 2009; Adewale and Odoh, 2013; Omowaye *et al.,* 2015).

Nutritional potentialities of this underexploited African legume urge Scientifics to plead for the extension of that neglected and disappearing crop (Amoatey *et al.,* 2000; Klu *et al*., 2001; Adewale *et al.,* 2010). Interesting on one hand by the nutritional qualities of the products, such as the protein content (10 – 19% in the tubers and 21 – 29% in the beans) and on the other hand by the great tuber yields (Bungu *et al*., 2016), the crop can extensively be used in various rations for human and livestock.

Few is known about the flocks and the herds livestock diets from AYB products, excepted two researches conducted by Emiola (2011) on the poultry and by Agubiande and Longe (1996) in the rabbit. In Democratic Republic of the Congo, most of breeders cannot afford Midema feed because it is expensive and not accessible in great quantity. That ration made in Kinshasa down town does not reach the villages where population requires protein.
This research was initiated with aim to estimate the effects of the AYB tubers flour on the broiler weigh growth, race COBB 500. The present study is motivated by the results obtained by Bungu (2016) ranging 17745 kg.ha^{-1}, yields searched to solve the flocks and the herd's livestock quantity and quality problems. The livestock breeding requires sufficient feed with low costs and easily accessible.

Besides the low breeding costs, AYB is a plant a longtime cultivated traditionally by the women farmers, tubers and seeds can locally be used to feed broiler, goats, sheep, pigs and cows.

2. MATERIAL AND METHODS

Fifty four broiler clicks race COBB 500 two weeks old and weighing each 500 g were bought in a priest Monastery named « Prieuré Notre Dame de l'Assomption » located in a bush closed to the University of Kinshasa.

Three diets were used to feed strain broiler: AYB tuber flour, soya flour and Midema diet, used by the breeders.
To make diets, varied ingredients were used: corn, wheat bran, fish meal, sugar molasses, limestone powder, Oligovitamines and cooking salt.

The chicks were vaccinated against bird flu. Two weeks later, they were vaccinated against Gumboro disease.
The experment was setup in a complete randomized design with three treatments repeated six times. The rations were : (i) R0 : Midema Ration, considered as the reference ration, due to its large use by most of the breeders; (ii) R1 : Ration consisted by 30 % of soya beans; (iii) R2 : Ration formulated by mixing 15 % of soya bean and 15 % of african tuber flour.

Each bloc ranged nine chicks distributed in three groups of rations with three chicks per treatment placed in a 50 cm x 50 cm x 35 cm metal cage. The chiks were fed twice per day, in the morning around 9 am and in the evening around 5 pm.

To reduce food waste on the ground, the feeders were cylindrical and made in plastic. The water was distributed in cyindrical drinkings through three times per day. The Chicks were fed during a total of four weeks that equals a total of six weeks old, in addition of two weeks old on the purchase.

Parameters mesured were : (i) The live weight (g) : noted at the end of each week using the Sartorius electronic balance. The average was determined for the all chicks ; (ii) The weekly food consumption (g): obtained by the sum of daily food consumed. The daily food consumed was obtained the morning by subtracting the total food given and the rest collected; (iii) The price per kg of live weight ($): obtained by dividing the total cost of food consumed by the broiler weight. The composition of the experimented feed is shown in table 1.

Table 1. Feed ingredient composition

The table one gives the ingredients to make diets

Ingredients	Soya beans	AYB tuber flour	Corn	Wheat	Fish	Molasses
Protein (%)	35.00	10,8	9,00	15,6	64,6	3.20
Fat (%)	18.00	0,79	3,70	4,4	9,20	0.40
Energy (Kcal/kg)	4720,	3660	4490	1460	3180,00	1962.00
Carbohydrates (%)	33.55	86,3	2,40	5,40	-	-
Calcium (%)	0.28	0,07	0,03	0.15	5,4	0.89
Phosphorus (%)	0.55	0,22	0,27	0.93	2,5	0.08
Sodium (%)	0,01	0,02	0,01	0.10	-	1.30
Potassium (%)	1,83	0,56	0,38	1.38	-	5.20
Magnesium (%)	0.31	0,08	0,13	0.46	-	0.32
Ash (%)	3.88	2,05	1,45	6.67	-	11.6
Fibers (%)	17.7	34,12	2,2	10,1	0	0.40

Legend: AYB = African Yam bean

The table 1 indicates the proportions of ingredients used to formulate Ration R2 composed with 30 % of soya beans and R3 formulated by mixing 15 %

of soya bean and 15% of african tuber flour. To save his formula, the proportion of Midema diet is unkonwn. The food was bought at the firm.

Table 2. Ration made from Soya bean (R1)

The ingredients used to make the ration from the soya bean are indicated in the table **2.**

Ingredients	Quantity (kg)	CP (%)	ME (kcal/kg)	Ca (%)	P (%)	Price ($)
Maize	45.00	4.05	1537.20	0.01	0.12	35.00
Wheat bran	10.30	1.60	118.03	0.01	0.09	5.72
Melasse	2.00	0.06	39.24	0.01	0.00	1.11
Soya bean	30.00	10.80	1155.00	0.075	0.16	36.67
Fishmeal	10.00	6.46	318.00	0.63	0.25	5.56
$CaCO_3$	0.44	-	-	0.05	0.04	0.21
Phosphate	0.25	-	-	-	-	0.04
NaCl	1.48	-	-	-	-	0.02
Total	100.00	22.98	3167.75	0.97	0.67	84.32

Legend : CP = Crude Protein, ME = Metabolizable Energy, Ca = Calcium, P = Phosphorus

Table 3. Ration with 15% of soya bean and 15 % of AYB tuber meal

The table 3, gives the ingredients to make the ration from soya and AYB tuber in the table 3.

Ingredients	Quantity (kg)	CP (%)	ME (kcal/kg)	Ca (%)	P (%)	Price ($)
Maize	45.00	4.05	1537.20	0.01	0.12	35.00
Wheat bran	5.00	0.78	59.01	0.07	0.04	5.72
Melasse	2.00	0.06	39.24	0.01	0.00	1.11
Soya bean	15.00	5.40	577.50	0.05	0.08	18.33
AYB	15.00	1.62	549.00	0.00	0.03	10.00
Fishmeal	16.00	10.33	508.80	0.86	0.40	8.89
Oligovit	0.02	-	-	-	-	1.33
NaCl	1.98	-	-	-	-	2.20
Total	100.00	-	-	1,0145	0.68	82.59

3. RESULTS

3.1 Live weight evolution

The results on the live weight evolution on the strain broiler fed with the three types of rations are indicated on the table 4.

Table 4. Weekly strain broiler live weight evolution (g)

Rations	Weight (g)					
	0(2)	1(3)	2(4)	3(5)	4(6)	Mean
Midema	500	798.60±40.00a	1351.00±96.00a	1588.30±91.00a	2035.00±123.00a	1254.00±71.00a
30% Soya	500	606.30±37.00b	1238.00±81.00b	1383.00±91.00b	1834.00±121.00b	1112.00±70.00b
15% soya + 15%AYB	500	764.00±45.00a	1309.00±75.00ab	1484.60±94.00ab	1977.50±131.00ab	1207.02±66.00ab

There is no significant difference on the strain broiler according to the type of diet. The strain broiler fed with ration made from AYB tuber flour indicate statistically the same weight with those fed with ration made from Midema diet, respectively 1207.02±66.00 and 1254.00±71.00.

The AYB can replace the Midema diet and 50% of soya beans diet. Using AYB in the livestock diet will reduce the competition with soybeans which are expensive to produce and largely recommended to the population to fighting against the malnutrition. Furthermore, the diet with soybeans ranges the latest weight on the strain broiler. These results discourage breeders to feed their strain broiler with soybeans which yields less to the field, 800 kg. ha^{-1} whereas AYB tubers yields 15 tons. ha^{-1}.

The results obtained with the three different rations do not join those reported by Fournier (2005), 2626 g of weight six weeks old to the race COBB 22. Certainly, ecological conditions and rations need to be improved. That can require an additional ingredient to the diet.

However, the AYB ration can be considered as a significant alternative in the livestock feed supply with advantage to be grown and consumed by the poor rural communities who cannot afford feeding the strain broiler with the Midema diet (Potter, 1992; Aremu et Ibirinde, 2012; Otsoseng *et al.*, 2012; Ogah, 2013).

Quantity of food consumed (g)

The table 5 presents the quantity of feed consumed by the strain broiler during the four weeks.

Table 5. Quantity of food consumed (g)

Rations	Quantity of food					
	1 (3)	2 (4)	3 (5)	4 (6)	Total	Mean
Midema	446.11±11.00^a	596.55±43.00^a	701.55±47.00^b	733.05±44.00^a	2477.26±111.00^a	619.32±33.00^a
30% Soya	388.72±23.00^c	591.44±61.00^b	713.33±28.00^a	728.11±35.00^b	2421.60±131.00^b	605.40±24.00^b
15% soya + 15% AYB	416.88±27.00^b	605.55±59.00^a	549.88±36.00^c	734.66±25.00^a	2306.97±120.00^c	576.74±30.00^c

With the same live weight, it appears clearly through the results above, the lowest quantity of AYB food consumed during four weeks, 2306,97±120^c against the Midema food, 2477,26±111^a, the weekly average range respectively 576,74±30^c and 619,32±33^a. Moreover, the quantity of AYB food used to the sixth month (734,66±125^c) is fewer than that indicated by Leclercq *et al.* (1989), 1065 g.

The results above on the quantity of the AYB food consumed are more economical that of the Midema food. Hence, with the yield of 15 tons.ha^{-1} as reported by Bungu *et al.* (2016), AYB is able to feed countless broilers at fewer quantities than Midema and 30 % of soybean food.

3.3. Price of strain broiler ($/kg)

The table 6 gives the prime cost of one kg of broiler.

Table 6. Prime Cost one kg strain broiler ($)

Rations	Food consumed per broiler (kg)	Price of 1kg of food ($)	Price of whole food consumed per broiler ($)	Strain broiler weight 4 weeks old (kg)	Prime cost per kg of broiler ($)
Midema	2.47±0.20^{a}	0.94±0.02^{a}	2.33±0,3^{a}	1.55±0.06^{a}	1.51±0.02^{a}
30% Soya	2.42±0.1^{a}	0.90±0.03^{a}	2.18±0.02^{b}	1.39±0.02^{c}	1.57±0.01^{a}
15% soya + 15 % AYB	2.30±0.10^{b}	0.80±0.01^{b}	1.83±0,01^{c}	1.49±0.04^{b}	1.23±0.03^{b}

There is a significant prime cost ($p< 0.05$) to the AYB ration compared to the Midema and the soybean diets. The cost to produce one kilogramme of broiler feed with the AYB is lower than that of Midema, ranging respectively on 1.23 ± 0.03^{a} and 1.51 ± 0.02^{a}.

The Midema feed are is expensive so that peasants cannot afford it. Big quantities require to be consumed to produce one kilogramme of broiler weight, that means the strain broiler does not really take advantage of the food which does not favor proportionally the gain of body weight. Hence, these results in a lower cost price per kg of broiler fed with AYB ration than with Midema feed. It means that, the smaller quantity of AYB tubers consumed gave statistically the same broiler weight than the higher quantity of Midema food consumed. Broiler chickens are more profitable when fed with AYB.

Thus, broilers will be produced at a lower cost by feeding them with AYB tubers and they can be considered as an uneglectable food security source. AYB will provide protein to the consumers of tubers and facilitate access to the broiler meat for the low income population. Indeed, the low cost of producing broiler chicken will inevitably result in a low selling price compared to broiler chickens fed with Midema. It supposes to recommend diets with more rate of AYB

4. DISCUSSION

Chicken is the most consumed food in whole the Democratic Republic of Congo and in all of its villages. The high demand of the chicken has led to the development of broiler farms in peri – urban areas.

The main problem faced by the breeders remains the feed due to the high price which limits the production of strain broiler. In the villages, hens are left to their own devices – feeding on a rambling diet. The reason remains the lack of food that they cannot access, particularly the Midema food.

HIA tubers have demonstrated their ability to feed humans and livestock (Akinmutimi *et al.*, 2006). This research has indicated that the AYB can play a determining role in the feeding of human and the broiler livestock.

Consumed for the first time, broiler have taken advantage of AYB flour by indicating statistically equal live weight gain compared to the Midema ration, commonly consumed and even higher than the soybean ration.

Although the live weight of broiler was comparable, it is important to indicate that AYB flour is profitable, the quantity consumed is smaller than in Midema ration.

Indeed, at the same quantities of AYB and Midema diets, the live weight of strain broiler fed with AYB flour is higher than that of Midema and soya diets (Adewale and Dumet 2009).

The lower consumption of AYB will effectively result from a lower prime cost and thus in a lower selling price for a broiler chicken. The highest yield provided by the AYB is a healthy alternative for large, medium and small broiler farms.

In the villages, farmers can take advantage of the yield of AYB tubers to feed their few number of broilers with no food competition and increase the broiler stock.

5. CONCLUSION

This research aimed to assess the effects of AYB ration on the live weight gain in COBB 500 broiler chicken race. Results obtained indicated positive effects on live weight gain with a low consumption index.
The lower consumption index presents the advantage of selling broiler chicken at a lower price than broiler chicken fed with Midema

Indeed, except its dietary qualities, AYB can be an important source of vegetable protein and income for both of farmers and breeders. For this reason, AYB is a raw material for poultry feed agroindustry. As the broiler chicken cheapest source of feed, AYB can ensure the permanent supply of chicken meat to poor and rural populations and indirectly contribute to food security by supplying animal protein.

There is, however, a need to continue this research to find much more economical formulas with the smallest quantity of soybeans leading to the higher live weight of broiler chicken. Research may also be directed towards testing HIA tubers in the diet of other broiler breeds and even of the local breed found in village environments.

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