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Food Restriction Based on Cassava Flour and Compensatory Growth of Broilers

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Abstract : The effect of dietary restriction based on cassava flour and maize bran was studied on compensatory growth of 75 chick's broiler. Aged four weeks chicks were randomly divided into three groups of 25 birds. Group 1 (control) received a diet without cassava flour and maize bran. Groups 2 and 3 received during three weeks diets containing respectively 10 and 30% of cassava flour but also 25 and 20 of maize bran. Diets 2 and 3 contained respectively 85 and 70% of the protein and energy density of the control diet. At the end of the period of food restriction, all birds were fed during four weeks at the same level appropriate to their physiological needs. After one week of food restriction, broilers of group 3 consumed with 83 g 0/head/day significantly ($p<0.05$) less food than those of groups 1 and 2 with 95 and 92 g, respectively. The food consumption was 123 g 116 and 107 g, respectively by broilers of groups 1, 2 and 3 at the end of the restriction period. At this time the chickens showed an average live weight of 1191, 1150 and 895 g respectively for groups 1, 2 and 3 with a highly significant difference ($p<0.0001$) between groups 1 and 2 on one side and the group 3 on the other. After four weeks of refeeding, chickens consumed an average of 120 g, 122 g and 108 g/head/day and weighed 2380, 2200 and 1763 g, respectively for groups 1, 2 and 3 which the growth late could not be fully compensated.

Key words: Food restriction, broiler, compensatory growth, cassava flour, bran

INTRODUCTION

Animal husbandry represents an activity practiced by most households both in rural and suburban areas in Africa. The farming of short cycle animals, such as poultry, has been mainly developed in order to provide highly nutritious and cheaply animal products to the population. Despite the proof of its socio-economic importance (Boko *et al*., 2012), the traditional poultry farming and especially chicken suffers from a deficit of zoo-technical performances. This does not effectively meet the populations' growing needs of meat products. According to FAO, the amount of animal protein necessary for each person is 42 kg/individual/year. But, the meat sector provides only 34 kg/individual/year in Benin, including the consumption of game's meat whereas poultry's contribution is just 2.4 kg/ individual/year. Chicken meat is the cheapest protein animal at the local market (Mankor, 2009). To improve local chicken's growth performance and laying, many traditional farmers quicken to introduce efficient genetically foreign chickens in their farming. But these chickens' diet and sanitary requirements are often above their limited incomes. However, the major constraint of chicken farming is their feeding which constitute the most important expenditure items. Poultry feed occupies 65-70% of the total cost of production (Dayon and Arbelot, 1997). This constraint is also strengthened as bird farming diet from cereals competes with human food. For the broiler's diet preparation, farmers use maize or sorghum as an energy source (55-65% of volume and 35-40% of the food cost) soybean cake as protein source, industrial concentrated "pre-mix", concentrated mineral vitamin. It is important to reduce the cost of broilers' diet resulting to the improvement of food consumption index. For this reason, chickens have to be bred in an economic logic which seeks inputs optimization with genetic performance to improve breeds. The use of cassava in livestock feed in general and poultry in particular are the subject of various studies (Sonaiya and Swan, 2004). Any effective strategy that can increase broiler's productivity and participate to reduce poverty and improve food safety should be sought. The first emerged question from this problem statement is as follows: can the broilers submitted to a restrictive diet made up of cassava flour and maize bran for a certain period be able to compensate their growth deficit when their food condition is optimal?

MATERIALS AND METHODS

Framework: The test was conducted in the Faculty of agronomy application and research farm to the University of Parakou. The township of Parakou is located in the

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Table 1: Experimental device of the study

	Trial periods						
		Phase 2			Phase 3		
	Phase 1	Control	Restriction		Control	Refeeding	
Criteria forn study	Start-up	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Duration (weeks)	4	3	3	3	4	4	4
Total animals	75	25	25	25	25	2	25
Cassava flour in the ration (%)	0	0	10	30	0	0	0
Energy and protein density f the ration (%)	100	100	85	70	100	100	100

Table 2: Percentage composition of food rations chicks and broilers

	Startup-regime	Finishing-growth regime		
Ingredients	Regime I	Regime II (control)	Regime III	Regime IV
Corn (%)	65	70	30	20
Cottonseed cake (%)	7	0	4	6
Soybean meal (%)	8	10	5	3
Fishmeal (%)	6	4	4	2
Cassava flour (%)	0	0	10	30
Malt brewery (%)	0	0	6,5	6,5
Corn bran (%)	0	0	25	20
Wheat bran (%)	8	12	12	9
Oyster shell (%)	1,2	1,2	1,2	1,2
Table Salt (%)	0,25	0,25	0,25	0,25
Iron sulphate (%)	0,05	0,05	0,05	0,05
CMV (%)	4,5	2,5	2	2
Total	100	100	100	100
ME (Kcal kg^{-1})	3000,00	3100,00	2650,00	2170,00
CP (%)	20,00	18,76	16,40	13,10

CMV = Concentrated Mineral Vitamin; ME = Metabolisable Energy; CP = Crude Protein

center of Benin between 19°21' North latitude and 36°2' East longitude. With an average attitude of 350 m, it covers an area of 44 km^2 of which 30 Km^2 is urbanized. The climate is Sudano-Guinean type with an annual average rain falls which varies between 1000 and 1500 m and two seasons that alternate as follow: a rainy season from mid-April to mid-October and a dry season from mid-October to mid-April. In this part of Benin, the temperature oscillates between 28 and 35°C.

Diets composition : A starting diet and three experimental diets were prepared. The three experimental diets were randomly assigned to different groups of broilers in an experimental completely randomized block (Table 1). The diet 1 (starting diet) was given to all chicks up to the age of 4 weeks. The diet 2 (growth-finishing off diet) is served to the chickens in group 1 (control) during the growth-finishing phase which lasts seven weeks. The diet 3 was served to chickens in group 2 during dietary restriction period and during the same period the diet 4 was intended for the chickens in group 2. Water and diet were distributed *ad libitum* throughout the test period. All diets (Table 2) have been locally made up of the following raw materials: maize grain, wheat bran soybean wheat, cottonseed meal, fish meal, cassava flour, maize, brain, salt, iron sulfate, malt for brewing, oyster Shelly, Concentrated Mineral and Vitamin (CMV) commonly available and accessible at the local markets.

Animal materials : The study was conducted with 75 one day old chicks of Hubbard strain. At the purchase, the chicks are subject to various usual sanitary treatments (vaccination against Newcastle, antibiotic treatment vitamins, vaccine against Gumboro disease, anti-coccidian treatment) up to four weeks when the test started. The chicks were reared under confined conditions in a preheated by wood made litter at density of 20 chicks m^{-2}. The diet was served twice daily at fixed hours (8:30 am and 5:30 pm) in wooden linear feeders. Drinking water was always available in siphoid plastic troughs. All the chicks were individually identified by a numbered plastic ring secured to their leg.

Data collection and processing: The average diet consumption of the chicks and broilers are daily determined on the amount of diet served the day before and the rejected diet the next day based on the Dry Material (DM). The body weight of chicks and broilers were individually recorded every week at the same time between 7 and 8am with a SALTER, an electronic weigh scale of 3 kg capacity with an accuracy of 1 g. Data entry and processing were carried out with Dbase 5 and Excel.

Data analysis : Statistical analysis of the collected data was performed with SAS (Statistical Analysis System) 9.2 software. The daily food consumption and body weigh average of the chicks and broilers were the dependent variables taking into account. These two variables were previously submitted to a normal distribution test, so as to ensure their compliance with variance analysis which was performed with GLM (General Linear Model) procedure. The statistical model used for the Analysis Of Variance (ANOVA) was as follow:

$$Y_{ijk} = \mu+a_i+b_j+e_{ijk}$$

Where:

- Y_{ijk} = An observed value of the dependent variable of interest Y
- μ = The average of the dependent variable of interest Y
- a_i = The fixed effect of dietary level (i = 1, 2, 3)
- b_j = The fixed effectof the live weight of the chicks at the end of the initial period (continuous variable)
- e_{ijk} = Variance residue

RESULTS AND DISCUSSION

Diet consumption of chicks and broilers : The average of daily diet consumption (g dry matter) of birds during the starting phase was 14.62 g, 27.63 g, 59.17 g and 70.9 g respectively for the 1st, 2nd, 3rd and 4th week of testing (Fig. 1). After the first week of dietary restriction, broilers consumed an average, respectively 95.51 g, 92.17 g and 83.11 g diet in control group, group 2 and 3 (Fig. 1). This consumption remained correspondingly to the energy and protein density of the diet. At the end of restriction phase, the average of diet consumption was respectively 122.63, 115.54 and 107.44 g in control group, group 2 and 3 (Fig. 1). The beginning of refeeding phase was marked by a significant decline in diet consumption of all broilers regardless to the diet stage. Broilers, on average, consumed 25 g less food than at the end of previous phase (Fig. 1).

Chicks and broilers weight gain : At the end of starting phase which lasts four weeks and also corresponding to the beginning of dietary restriction phase, the broilers showed a body weight average of 516.13 ±111.14 g. After a week in the dietary restriction phase, the broilers weight respectively passed to 764.24 g, 758.96 g and 665.7g for broilers in control group, group 2 and 3. Group 3 broilers fed with a diet containing 30% cassava flour and 20% maize bran and also 30% less energy and protein than control group broilers showed a significant growth gap ($p<0.0001$) of 99.07 and 93.79 g respectively compared to broilers in control group and group 2 (Fig. 2). The group 2 broilers diet containing 10% cassava flour and 25% maize bran and also 15% less energy and protein than control group has delayed 5.28 g but not significantly ($p>0.05$) to their weight gain (Fig. 2). This trend was broadly maintained throughout the dietary restriction phase with a gradual weight increase between broilers in control group and group 2 on one side and group 3 on the other. At the end of dietary restriction, the average body weight was respectively 1191.25 g, 1149.84 and 895.73 for broilers in control group, group 2 and 3. So, the group 3 broilers have a considerable growth delay.

Weight growth curves speed (Fig. 2) remained relatively regular during the re feeding phase. The control group and group 2 broilers with respectively 2380.73 g and 2200.83 g showed a body weight almost similar ($p>0.05$) at the end of the experimentation whereas group 3 broilers have a body weight average of 1763.85 g

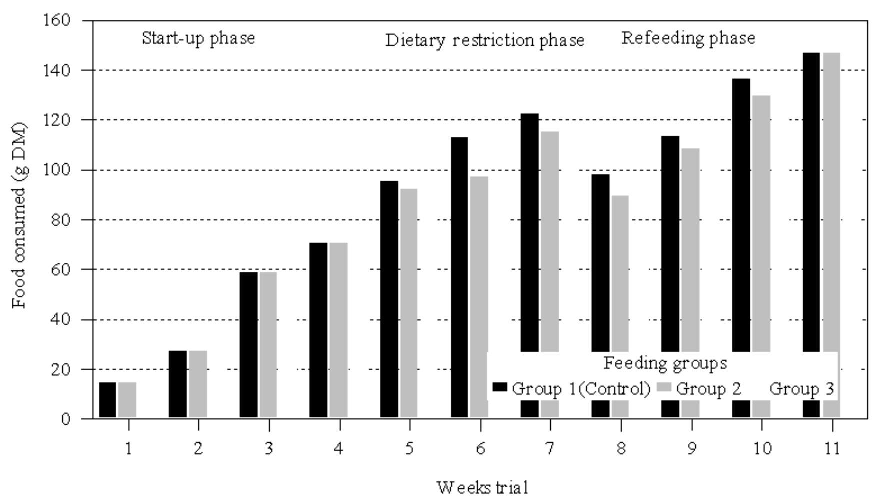

Fig. 1: Food consumption of chicks and broilers during the period of 11 weeks experiment

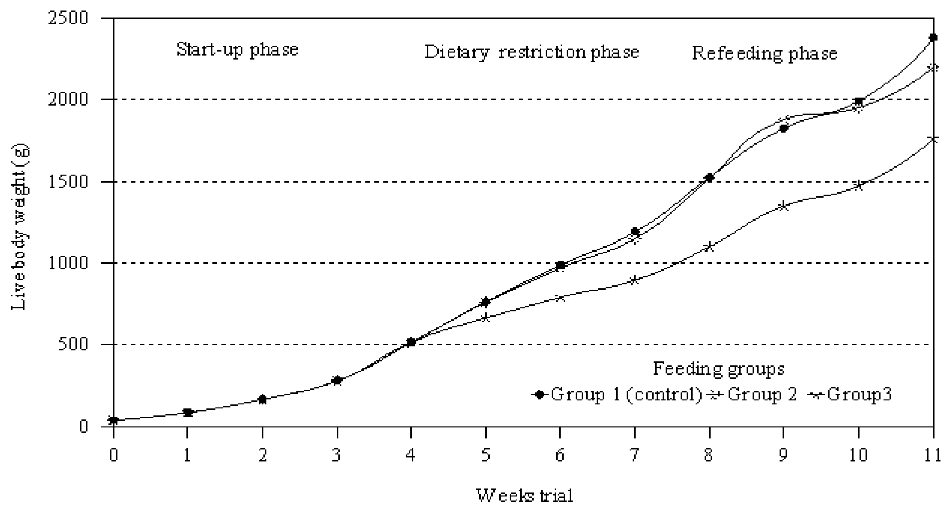

Fig. 2: Weight gain of chicks and broilers from 0-11 weeks

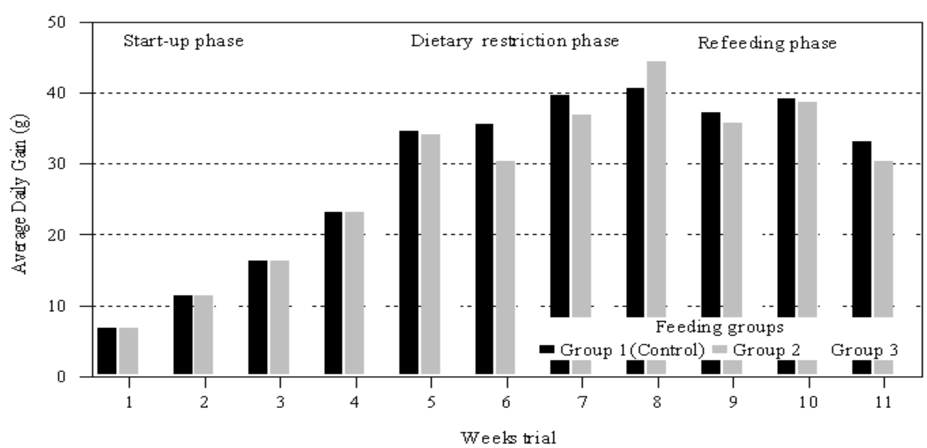

Fig. 3: Average daily gain of chicks and broilers during the 11 week experiment

with a significant growth delay ($p<0.0001$) of 617 g than the control group broilers and 437 g than those of group 2.

The broilers showed average daily gain (ADG) of 6.85 g during the first week of the starting phase (fig .3). This value weekly increased with a daily average of 5 g during the starting phase. After the first week of dietary restriction, the ADG value was respectively 34.77 g, 34.29 g and 16.87 g for control group, group 2 and 3. Broilers growth pace has relatively remained regular to the end of dietary restriction phase where the ADG values were respectively 39.77 g, 37.10 g and 16.33 g for control group, group 2 and 3 (Fig. 3).

After the first week of refeeding, ADG values were respectively 40.7, 44.52 and 31.29 g in control group, group 2 and 3. The second week of refeeding was firstly marked by an ADG slight decline of the three groups broilers (Fig. 3). Then, the growth pace has progressed in peaks and troughs to the end of refeeding phase where the ADG were respectively 33.17, 30.53 and 20.24 g for control group, group 2 and 3 (Fig. 3). Then, the pace of growth has progressed in saw tooth until the end of the period of replenishment where ADG were 33.17, 30.53, 20.24 g respectively in chickens of control group, group 2 and 3 (Fig. 3).

The mixing of cassava flour in the diet, associate with a reduction in energy and protein density during the growth phase has significantly ($p<0.05$) affected the level of diet consumption, particularly between the broilers of control group and those of group 2 on one side and those of group 3 on the other. The broiler's diet consumption seems to correspond to the energy and protein density of the diet. A similar trend was observed by Sakande in broilers fed with varying crude protein rate. The author noted a lower diet consumption of broilers fed with diet made up of 14% crude protein compared to those fed with diet made up of 20% crude protein. The consumption outcomes in the study conducted by Vilarino showed that broiler tends to over-consume diet containing protein and under-consume diet containing energy. Sonaiya and Swan (2004) found that the total substitution of maize grain by cassava flour induced lower food consumption by laying hen and has led to not only a reduction egg weight but also a change in the yolk's colour. The decline of diet consumption at the beginning of refeeding phase in this study was seemingly caused by the renewal food stock to which the broilers have firstly sought to get used to. From the second week of refeeding phase, diet consumption raised again in all groups. The rising of diet consumption in group 3 broiler's, previously submitted to an intensive dietary restriction, converges respectively to control group and group 2's diet consumption average throughout the refeeding phase. Nevertheless, this diet ingestion did not induce a compensatory weigh gain because the control group broiler's body weight is 179.9 g superior to those of group 2.

The response of broilers to a variation of the diet energy level is common. Any restriction of diet energy level is associated with the decline of the broilers' pace of growth (Simon, 1972; Allain *et al*., 1982; Simon and Leclercq, 1983; Sakande, 1993; Tesseraud, 1995). Ngandjou observed growth parameters in broiler chickens fed diets containing 40.5% cassava flour during the starting phase and 46.5% cassava flour during the growing-finishing phase, in substitution of 75% corn, comparable to the control group chickens fed the diet containing only corn, so without cassava flour. The same authors have registered in broiler chickens fed the diet in which 50% of corns were substituted for cassava flour, higher growth parameters than those recorded in chickens in the control group fed the diet containing only maize, therefore without cassava flour. According to YO, the mixing of 10-30% cassava flour in the broilers diet did not affected their final body weight and weight gain. However, a cassava rate exceeding 10% in the diet served to the chicken resulted in an increase of their consumption index, therefore a decrease in the nutrient efficiency of the food.

The average body weight at the end of dietary restriction in this study is widely below those recorded by Ngandjou on the broiler's aged 7 weeks fed with diet containing 0-100% cassava flour replacing maize. In fact, at 75% mixing level, the author remarked a significant decline in the broiler's body weight. A similar observation was made by Kana *et al.* (2014) on broiler's fed with a diet made of cassava residue.

The diet made up of 30% cassava flour and 20% maize bran has significantly affected the ADG of broilers, but was not the case with the broilers fed with diet containing 10% cassava flour. Indeed, the ADG of chickens in the control group was only 0.48 g higher than those in group 2. The broiler's refeeding phase was marked by an accelerated growth pace, especially in broilers previously submitted to intensive dietary restriction. During this phase, the broiler's which previously received diet of lower protein and energy rate, have a better growth pace progression. After a restriction phase, Group 3 broilers have doubled the compensatory growth pace and it passed from 16.33-31.29 g. However, this growth performance was a result of better efficient diet and it remained insufficient to fully compensate the delay observed during the preceded dietary restriction phase.

CONCLUSION

Result of the investigation show that 10 to 30% cassava flour associated with 20 to 35% maize bran can replace a part of 70% maize in broilers diet. Mixing cassava flour and maize bran in the diet with a reduction protein and energy density extremely affected the broilers diet consumption level. This level relatively remained corresponding the diet protein and energy density. The broilers previously submitted to a dietary restriction, the substitution of 50% maize by 30% cassava flour and 20% maize bran associated with 30% protein and energy density, were not able to consume more diet than control broilers during the refeeding phase. Therefore, their body weight extremely declined during the first week of the test. This decline could not be fully compensated during the four weeks of refeeding phase. So, farmers must feed the broilers of their livestock with a diet made up of 30% maize grain, 10% cassava flour and 25% maize bran to guarantee acceptable growth of their broiler's.

REFERENCES

Allain, X., J. Simon, B. Chevalier and M. Derouet, 1982. Inefficacite d'une suralimentation imposee des la naissance pour modifier le comportement alimentaire, la croissance et la composition corporelle ulterieurs du poulet. Reprod. Nutr. Dev., 22: 27-40.

Boko, K.C., T.M. Kpodekon, M. Dahouda, D. Marlier and J.G. Mainil, 2012. Contraintes techniques et sanitaires de la production traditionnelle de pintade en Afrique subsaharienne. Ann. Med. Vet, 156: 25-36.

Dayon, J.F. and B. Arbelot, 1997. Guide D'elevage des Volailles au Senegal. CIRAD-EMVT, Montpellier, France, Pages: 169.

Kana, J.R., R.N. Tadjong, H.M. Kuietche, Y. Tefack and H. Zambou *et al*., 2014. Valorisation des residus de manioc en substitution du mais dans la ration alimentaire du poulet de chair. Livestock Res. Rural Dev., 26: 48-48.

Mankor, A., 2009. Evolution du secteur de l'elevage Ouest africain, Consommation urbaine de viande en Afrique de l'Ouest: l'exemple de Dakar. Grain Sel, 46: 16-17.

Simon, J. and B. Leclercq, 1983. Relation entre insulinemie et adiposite dans deux lignees de poulets rendus maigres ou gras par selection. Reprod. Nutr. Dev., 23: 443-451.

Simon, J.D., 1972. Etude de differentes techniques d'alimentation en vue de la production d'un poulet de chair de qualite. Ann. Zootechnie INRA/EDP. Sci., 21: 233-243.

Sonaiya, E.B. and S.E.J. Swan, 2004. Production en Aviculture Familiale-Un Manuel Technique. FAO, Rome, Italy, Pages: 134.

Tesseraud, S., 1995. Metabolisme proteique chez le poulet en croissance: Effet des proteines alimentaires. INRA. Prod. Anim, 8: 197-212.