EFFECT OF INCORPORATION OF COWPEA AND SOYBEAN PODS IN DIETS ON FEED INTAKE, DIGESTIBILITY AND WEIGHT GAIN PERFORMANCES OF RABBIT

Running title: Performances of rabbits fed with diets containing legumes pods

**Koura B.I., Houndonougbo F. and Houinato M*

ABSTRACT

We carried out an experiment to compared performances (feed intake, feed digestibility and weight gain) of rabbit fed ration containing cowpea and soybean pod shells. Sixty rabbits of 06 weeks old were used for the trial in a completely randomized block with 3 treatments and 5 replications, with 4 rabbits per replication. The treatments consisted of a rabbit feed ordinary used in farms (as control) and two other feeds, CP_{10} and SB_{10}, where cowpea and soybean pods has been incorporated at 10%, respectively. Feed intake was significantly higher ($p<0.001$) in CP_{10} (70g/d) and lower in SB_{10} (59g/d). The intakes of DM and N was higher in CP_{10} (respectively 62g/d and 12g/d) than that in SB_{10}. Also, cellulose intake in CP_{10} (8.6g/d) was higher than in the two others diets. Dry matter, Nitrogen and cellulose digestibility was higher in the diet with 10% of cowpea pods and low in that with 10% of soybean pods. The higher live weigh gain were fund in CP_{10} (22.10g/d) and the lowest in SB_{10} (12.13g/d). However, performance in the control diet was not significantly different from the two treatments CP_{10} and SB_{10}. The feed conversion ratio, the feed cost as well as economic feed efficiency were not different ($p>0.05$) between the treatments. However, profit can be increased through reduction of production cost by using crop residues in rabbit feed. This is a good issue for smallholders in urban and peri-urban areas in Africa.

Keywords: Animal nutrition, Cellulose, Crop residues, Non-conventional resources, Benin

RESUME

Effet de l'incorporation des enveloppes de gousses de niébé et de soja dans l'aliment sur l'ingestion alimentaire, la digestibilité et les performances de croissance des lapins

Une expérimentation a été conduite pour comparer les performances (ingestion alimentaire, digestibilité et croissance) des lapins nourris avec des rations contenant des enveloppes de gousses de niébé et de soja. Soixante lapins de 06 semaines d'âge ont été utilisés pour l'essai dans un block complètement aléatoire de 03 traitements et 5 répétitions, avec 04 lapins par répétition. Les traitements sont : une ration ordinaire de lapin (témoin) et deux autres rations, CP_{10} et SB_{10} où les enveloppes de gousses de niébé et de soja ont été incorporées à 10%, respectivement. L'ingestion alimentaire était significativement plus grande dans CP_{10} (70g/jr) et faible dans le traitement SB_{10}. L'ingestion de la matière sèche et de l'azote étaient plus grande ($p<0.001$) dans CP_{10} (respectivement 62g/jr et 12g/jr) que dans SB_{10}. Aussi, l'ingestion de la cellulose était significativement plus grande (8.6g/jr) dans le traitement CP_{10}. De même l'aliment contenant les enveloppes de gousses de niébé était plus digeste et permettait de meilleurs gains de poids, 22.10g/jr contre 12.13g/jr avec le traitement SB_{10}. Les performances avec la ration ordinaire n'étaient pas significativement différentes des deux autres traitements. Le taux de conversion alimentaire, le coût alimentaire et l'indice d'efficience alimentaire n'étaient pas statistiquement différent entre les traitements. Toutefois, les profits peuvent être augmentés à travers la réduction des coûts de production en utilisant les résidus agricoles dans l'aliment des lapins. Cela constitue une bonne alternative pour les petits éleveurs dans les zones urbaines et périurbaines en Afrique.

Mots-clés: Nutrition animal, Cellulose, Ressources non conventionnelles, Résidus de récolte, Benin.

Department of Animal Sciences, Faculty of Agricultural Sciences, University of Abomey-Calavi, 01 BP 526 Cotonou, Bénin.

**Corresponding author: Tel: (+229) 97019780/64321378;*
Email: kouraivan@gmail.com (Koura BI.)

Introduction

World food productions are consistently lower than needs for ensuring food security to the growing population. To address the problem of shortage of animal protein in the developing countries, strategies that have been suggested include the production of short generation time animals such as rabbit, poultry and pigs. The rabbit *Oryctolagus curriculus*is a pseudo-ruminant with high reproduction rate (age at maturity 4-12 months, gestation period 31-32 days, litter-size ranges from 3-12 young) which is potentially more reflective than other livestock at converting forage into meat, with high protein, low fat energy and cholesterol content (Kpodekon *et al.*, 2009; Etchu *et al.,* 2013). Thus, rabbit production is a good issue for empowerment of small farmers in the peri-urban and urban since it provide high quality protein to a growing urban consumers (Houndonougbo *et al.*, 2012). Raw materials particularly agricultural by-products like brans and meals, used in rabbits' diets are less availability and expensive (Aboh *et al.*, 2002; Aboh *et al.*, 2013; Mohammed and Jamala, 2013) in some period. Feeding cost are therefore heavy in farms while the price of the meat don't change as well. Thus, the use of new feedstuffs locally available need to be explored for their incorporation in rabbit diets (Dahouda *et al.*, 2013; Mohammed and Jamala, 2013).

Fibers are one of the main components of rabbits' diets (Garcia *et al.*, 1999); because they play a key role in rabbit feeding by contributing to caecum activity for efficient digestion (Gidenne, 1992). Fibrous crop by-products or farm wastes are characterized by extensive lignification of the cellulose and the hemicellulose, and by low levels of protein, soluble carbohydrates and minerals (van Hao and Ledin, 2001). Crop residues, particularly legumes pod shells, are available and the great part is burn after harvest. However, legume pod shells can constitute a good and cheaper source of fiber in rabbit diets (Mohammed and Jamala, 2013). Cowpea is one of the major legumes in West Africa and their residues constitute a major source of livestock feed (Singh *et al.*, 2003). Soybean production is increasing in Benin and constitute a potential rent crop. The use of residues from these crops could therefore allow to suggest cheaper rabbits' rations for smallholders in the peri-urban areas. This work aimed to compare the effect on feed intake, feed digestibility and weight gain performances of growing rabbits' in diets including 10% of cowpea and soybean pods.

Materials and methods

Study area

A fattening experiment has been carried in a farm at Sékou and the digestibility experiment at the faculty of agricultural sciences of the University of Abomey-Calavi. The two sites are localized in the same district of Atlantic in republic of Benin. The experimental farm is located at Sékou in the commune of Allada at 6°37'0" North and 2°13'0" East. The University is located in Abomey-Calavi commune between 6°21'-6°42' North latitude and 2°13'-2°25' East longitude. The area has a sub-equatorial climate with two rain seasons alternated with two dry seasons of unequal duration. The rainfall amounts recorded by the Agency for Aerial Navigation Safety in Africa and Madagascar (ASECNA) from 1981 to 2012 are between 739.6 mm and 2203.3 mm with an average of 1305.95 mm. The soil is sandy and ferrallitic types (Volkoff, 1976). The vegetation consists of shrubs, grassland swamps, swamp forest and mangrove on the coastal belt and of semi-deciduous dense forests on bar land area (Akoègninou *et al.*, 2006).

Residues collection

Pod shells from soybean (*Glycine max*) and cowpea (*Vigna inguculata*) were collected during the dry season in a farm randomly chosen in the study area. Samples of each residues were collected for chemical composition analysis (Table I).

Table I. Chemical composition of cowpea and soybean pod shells

Chemical composition	Pod shells from	
	Cowpea	Soybean
DM *(%)*	92.12	91.11
Ash *(% DM)*	6.505	7.09
CP *(% DM)*	9.02	7.36
EE *(% DM)*	0.695	4.35
NDF *(% DM)*	67.095	64.47
Cellulose *(% DM)*	35.08	39.31

Animals

Sixty rabbits (*Oryctolagus cuniculus*) of 06 weeks age, and average weight of 616.25g were used for the experiment. During the trial, they were treated against internal and external parasites and against coccidiose. In addition, they were offered vitamins.

Fattening experimental design

The experimental design is a completely randomized block with 3 treatments and 5 replications, with 4 rabbits per replication. The treatments consisted of a rabbit diet ordinary used in farms (as control) and two other rations CP_{10} and SB_{10} where cowpea and soybean pod shells has been incorporated at 10% respectively (Table II).

Table II. Ingredients included in the three feeds tested

Ingredients (g/kg)	Feeds		
	Control	CP_{10}	SB_{10}
Cowpea pod shell	0	100	0
Soybean pod shell	0	0	100
Maize	220	310	310
Wheat bran	280	100	100
Soybean meal	90	140	140
Cotton meal	70	70	70
Palm meal	300	250	250
Oyster shell	30	17	17
Lysine	1	1	1
Methionine	1	1	1
Phosphate bicalcium	10	10	10
Salt	3	3	3
Concentrate flesh	2	0	0
Iron sulfate	1	0.2	0.2

Measurements

The voluntary feed intake study lasted on 60 d of which 04 d of transition to the new diet and 56 d for data collection, while the digestibility study lasted on 8 d with 3 d for adaptation to rations and 5 d for data collection. Each replication cage was provided with a feeding pen and all animals had free access to water.

In the weight gain performance study, feed was weighed and offered each morning at 07.00 AM. Refusals were collected and weighed each morning before fresh feed were offered. Samples of the feed refusals was collected each day and stored in plastic bags. At the end of the study, composite samples were thoroughly mixed and a representative sample for each treatment was collected for laboratory analyses.

During digestibility study, faeces were in addition collected daily and weighed before the animals were fed. For each rabbit, subsamples of faeces were collected and stored at 25–30 °C. Composite faecal samples were collected at the end of the digestibility study from each rabbit for laboratory analysis.

Representative samples of feed offered, 100 g were collected at the beginning, middle and the end of the study. At the end of the study, these samples were thoroughly mixed and one composite sample (100g) was preserved for laboratory analyses.

Each rabbit was weighed once a week at 07:00AM.

Chemical composition

All samples were oven-dried for 48–72 h at 60°C for dry matter (DM), ground to pass a 1 mm screen and analyzed for residual dry matter, crude protein (CP), ether extract (EE) and ash as suggested by AOAC (2000) procedures (ID number: 2001.12, 978.04, 920.39 and 930.05 for DM, CP, EE and ash, respectively). The method of Weende was used for cellulose determination. For mineral analyses, samples was burned at 450°C and the ash was dissolved in 1 M HCl. The mineral contents were determined using a Varian 720 Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES, Frankfurt, Germany).

Data processing

The live weight (LW) gain was calculated as the change in LW between two successive measurements divided by the number of days between measurements. The feed conversion ratio (FCR) was estimated as gain (or loss) in weight (in g) divided by the amount of feed consumed (in g). The economic feed efficiency (EFE) was estimate as the income generate by LWG divided by the cost of the feed consumed (Houndonougbo *et al.*, 2012). The apparent digestibility were calculated as the difference between the amount of feed ingested and faeces as a proportion of the ingested feed, and expressed as a proportion.

Data analysis

Data was analyzed using the GLM option of the SPSS Inc. (2010) to determine least square means and the significance of differences among treatments. The model was: $y_{ij} = \mu + R_i + \varepsilon_{ij}$; where, y is the single data, μ is the mean, R is the ration effect (i = 03 rations) and ε the error term.

Results

Chemical composition of feeds and refusals

Table III shows the chemical composition of experimental feeds. CP_{10} and SB_{10} feeds showed higher cellulose content than the Control. However the crude protein content and digestive energy were as well as the same. The control were richer in lipid, Ca and P while SB_{10} was rich in lysine and low in P.

Table III. Chemical composition of feed as formulated

Chemical composition	Feeds		
	Control	CP_{10}	SB_{10}
DM	89.1	88.7	88.8
Cellulose	9.25	12.3	11.27
CP	17.57	17.57	17.08
EE	7.46	6.55	6.80
DE	2.64	2.57	2.57
Lysine	0.82	0.85	1.59
Methionine	0.38	0.38	0.38
Sulfur amino acid	0.71	0.69	0.69
Ca	1.51	0.98	0.72
P	0.93	0.72	0.14
Na	0.16	0.14	1.36

DM = dry matter (%), CP = crude protein (% DM), EE = ether extract (% DM), DE = Digestive energy (MJ/g DM), Ca = Calcium (%), P = Phosphore (%), Na = Sodium (%).

Intake and weight gain performance of rabbits

In table IV intake, weight gain and economic performance of rabbit in the different treatments are showed. Feed intake was higher (p<0.001) in CP_{10} (70g/d) and lower in SB_{10} (59g/d). The intakes of DM and N was significantly higher in CP_{10} (respectively 62g/d and 12g/d) and low in SB_{10} while cellulose intake in CP_{10} (8.6g/d) was significantly higher than in the two others diets. Regarding LWG, higher values were fund in CP_{10} (22.10g/d) and the lowest in SB_{10} (12.13g/d). However, the FCR value was similar among the treatments. Also, analysis of economic performances showed that feed cost as well as economic efficiency of the feed were similar. Although the feed cost was better in SB_{10} (570 vs. 1001 F FCA/kg LWG in the Control) and the EFE was higher in CP_{10} (2.6) than in the other treatments. Low mortality rate (5%) was recorded in Control and CP_{10} during the experiment while in SB_{10} it was about 25%.

Table IV. Effect of cowpea (CP10) and soybean (SB10) pod shells on feed intake, nutrient intake, 166 rabbit weight gain performances and economic efficiency of diets

Parameters	Treatments			SEM
	Control	CP_{10}	SB_{10}	
Feed Intake (g/d)				
Feed intake	59.15^{B}	69.99^{A}	43.95^{C}	2.814
Nutrient intake (g/d)				
DM intake	52.70^{B}	62.08^{A}	39.02^{C}	2.500
N intake	10.39^{B}	12.30^{A}	7.51^{C}	0.487
Cellulose intake	5.471^{B}	8.609^{A}	4.953^{B}	0.309
Weight gain performances				
ILW (g)	640.0	627.4	611.0	31.68
FLW (g)	1596^{AB}	1865^{A}	1290^{B}	130.1
LWG (g/d)	17.09^{AB}	22.10^{A}	12.13^{B}	2.650
FCR (g/g)	3.05	3.23	3.05	0.059
Economic performances				
Feed Cost (fCFA feed/kg LWG)	1001	840.0	570.0	327.1
Economic Feed Efficiency	2.422	2.607	2.462	0.475

DM = dry matter, N = Nitrogen, NDF = neutral detergent fiber, ILW = Initial Live Weight (g), FLW = Final live Weight (g), LWG = live weight gain (g), FCR = feed conversion ratio.
CP_{10}: 10g of cowpea pod shells; SB_{10}: 10g of soybean pod shells. SEM: Significant differences between means on the same line (A,B,C: P<0.01).

Digestibility of the feeds

Table V presents digestibility of the experimental diets. Dry matter digestibility was significantly higher (P<0.001) in the Control (49%) and the diet with 10% cowpea pod shells (56%) than in the diet with 10% soybean pod shells (35%). The digestibility of the crude protein was higher in the CP_{10} (39%) than in the SB10 (32%) while the control showed moderate value (36%). Regarding digestibility of cellulose, higher value (P<0.05) was found in CP_{10} (67%) whereas the conventional rabbit diet (59.5%) and the ration with soybean pod shells (60%) showed the lowest values.

Table V. Effect of cowpea and soybean pod shells on intake (g/d) and digestibility (%) of dry 179 matter (DM), N, neutral detergent fiber (NDF) and cellulose.

	Rations [A]			
	Control	CP_{10}	SB_{10}	SEM
DM intake (g/d)	70.40^{ab}	73.81^{a}	51.88^{b}	9.239
DMD (%)	49.4^{B}	56.4^{A}	35.4^{C}	2.289
N intake (g/d)	13.88^{ab}	14.62^{a}	9.979^{b}	1.579
ND (%)	35.8^{AB}	38.8^{A}	31.7^{B}	1.869
Cellulose intake (g/d)	7.309^{B}	10.24^{A}	6.584^{C}	1.043
Cellulose D (%)	59.5^{a}	67.0^{b}	60.4^{ab}	2.972

DM = dry matter, N = Nitrogen, NDF = neutral detergent fiber. [A] CP_{10}: 10g of cowpea pod shells; SB_{10}: 10g of soybean pod shells. SEM: Significant differences between means on the same line (A,B,C: P<0.01; a,b: P<0.05).

Discussion

Rabbit weight gain performances

Intakes of dry matter and nutrients were significantly higher in CP_{10}. Although, rabbit fed to the Control diet showed better intakes than in SB_{10} treatment. The less intake in SB_{10} treatment is quiet strange while this ration has good nutrient content, it may be due to presence of some anti-nutritional factors like tannins and phenols in this residue. However, the experimental diets had cellulose content of about 9-12%, which fit the range level of dietary fiber for growth and maintenance of rabbits (Mohammed and Jamala, 2013).

In general, weight gain performances of the animal were in accordance to chemical composition, intakes and digestibility values of the diets. LWG was better on CP_{10} than in SB_{10}. LWG in CP_{10} was close to data reported in literature (19.7 to 23.1 g/d) by Houndonougbo *et al.* (2012) using palm-press fibers in ration and Kpodekon *et al.* (2009) using a conventional rabbit diet, but was higher than results of Dahouda *et al.* (2013) using *Moringa oleifera* leaves in the rabbit diet. Results in CP_{10} was also better than data reported by Oluonku (2005) and Mohammed and Jamala (2013) stating LWG of 10.38g/d and 16.61g/d respectively with 25% and 40% of cowpea pods shells in the diet of rabbit.

Regarding the ration with soybean pod shells, less information existed on this residue and this diet allowed quiet low performances compared to results reported in literature for rabbit diet in general. The low quality of the diet SB_{10} was reflected in the high mortality found in this group (about 25%). Low mortality was obtained in the other diets experimented, however some authors (Houndonougbo *et al.*, 2012; Aboh *et al.*, 2013; Mohammed and Jamala, 2013) reported no mortality in their study on rabbits. The use of quiet new feedstuff that are crop residues may have influence on the rabbit health status. Particularly soybean pods may have some anti-nutritional factors, as reported by Vasconcelos *et al.* (1997) in soybean grain. In addition, this might be due to environment condition of the trial house. Indeed, this trial had been undertook in a farm while the latest authors implemented their study in experimental house where the environment conditions are controlled.

The feed conversion ratio of diet with legumes pods (3 to 3.23 g feed/g LWG) is low compared to data reported by Houndonougbo *et al.* (2012) with ration containing fed palm-press fiber, Kpodekon *et al.* (2009) with a conventional diet, Adeyemi *et al.* (2010) using diet with pineapple peel, Oluokun (2005) and Mohammed and Jamala (2013) with diet including cowpea pod shells at 25% and 40%, respectively. Thus, higher proportion of pod shells in the diet decrease the valuation of the diet by the animal. Although the treatment of legumes pods with urea can increase its nutritional value (Oluokun, 2001), indeed urea is efficiently use by rabbits (Raharjo *et al.*, 1986; Singh *et al.*, 1988).

The high feeding cost was the main factor that limited profitability of rabbit farms and most of those farms died after few (2-3) years of existence (Dahouda *et al.*, 2013). The cost of feed with legumes pod shells experimented was lower than that of the conventional diet. Diets with palm-press fibers (Houndonougbo *et al.*, 2012) and that with *Moringa oleifera* leaves experimented by Dahouda *et al.* (2013) had lower feed cost, however the economic feed efficiency was greater in this study with cowpea and soybean pods. Thus, including legumes pods in rabbit diet is a good issue for empowerment of rabbit farms.

Feed digestibility

The digestibility of the different diets followed the trend of the intakes. CP_{10} showed high digestibility of the dry matter, N and Cellulose. As reported by Gidenne and Bellier (2000) the digestibility of diets fed to rabbit increase with the fiber content. In particular, results with legumes pods showed higher DM degradability than data reported by Aboh *et al.* (2013) and Etchu *et al.* (2013) on rabbits fed rations with respectively pineapple peel and groundnut haulms. However, higher digestibility value had been found using diet with *Leucaena leucocephala* (Adedeji *et al.*, 2013), due to the high palatability and high protein content of this forage. While with higher proportion of cowpea pods (40%) in the diet, dry matter digestibility obtained by Oluokun (2005) was about the same as in this study, results of this author revealed higher value of Nitrogen digestibility (52%). Ration with soybean pod shells was less digested, confirming the thesis of presence of some anti-nutritional factors or phenol components in this residues like found in grain by Vasconcelos *et al.* (1997). Regarding digestibility of cellulose, the same trend was observed as for digestibility of DM and N. However, cellulose digestibility was higher in ration with cowpea pod shells compared to the soybean one. In particular, the digestibility in CP_{10} was higher than that reported for NDF and ADF by Oluokun (2005).

Conclusion

Our investigation in fattening of growing rabbit revealed that good performances can be obtained with rations containing 10% of legumes pod shells. Ration with cowpea pod shells showed good performances of rabbits regarding intakes (DM and nutrients), digestibility (DM and nutrients), weight gain and economic characteristics. Thus, smallholders can supply for the fibers needs of their animal by using cowpea pod shells. Cowpea pod shell can be stored for using in period when conventional raw material are less available or expensive. This is a good issue for empowerment of smallholders in the peri-urban areas. Further studies can invested the effect of incorporation of legumes pods in reproduction performances of the rabbits.

Acknowledgement

The authors are grateful to the University of Abomey-Calavi (Benin) for funding the trial on animals through the project entitled Productivity of integrated crop-livestock systems in Benin (PROSAIE/PFCR$_2$/UAC), and to the NGO Bourge for housing the experimentation.

References

Aboh A.B., Olaafa M., Dossou-Gbété G.S.O., Dossa A.D., Djagoun N., 2002. Ingestion volontaire et digestibilité apparente d'une ration à base de la farine de graines de *Mucuna pruriens* var. utilis complétée de fourrages chez les lapins. *Tropicultura*, 20: 165-169.

Aboh A.B., Zoffoun G.A., Djenontin A.J.P., Babatoundé S. and Mensah G.A., 2013. Effect of graded levels of dry pineapple peel on digestibility and growth performance of rabbit. *Journal of Applied Biosciences*, 67: 5271-5276.

Adedeji O.S., Amao S.R., Ameen S.A., Adedeji T.A. and

Ayandiran T.A., 2013. Effects of Varying Levels of *Leucaena leucocephala* Leaf Meal Diet on the Growth Performance of Weaner Rabbit. *Journal of Environmental Issues and Agriculture in Developing Countries*, 5: 5-9.

Adeyemi O.A., Ajado A.O., Okubanjo A.O. and Eniolorunda O.O., 2010. Response of growing rabbits to graded levels of fermented and unfermented pineapple peel. *Electronic Journal of Environmental, Agricultural and Food Chemistry*, 20: 898-909.

Akoegninou A., van der Burg W.J., van der Maesen L.J.G., Adjakidje V., Essou J.P., Sinsin B. and Yedomonhan H., 2006. Analytical Flora of Benin (1st edn). Backhuys Publishers: Cotonou (Benin) & Wageningen.

AOAC, 2000. Official Methods of Analysis. 18th ed., Association of Official Analytical Chemists, Arlington, VA, USA.

Dahouda M., Adjolohoun S., Senou M., Toleba S.S., Abou M., Vidjannagni D.S., Kpodekon M. and Youssao A.K.I., 2013. Effets des aliments contenant les folioles de *Moringa oleifera* Lam. et des aliments commerciaux sur les performances de croissance des lapins (*Oryctolagus cuniculus*) et la qualité de la viande. *International Journal of Biological and Chemical Sciences*, 7(5): 1838-1852.

Etchu K. A., Ngu G.T., Yongabi K.A. and Woogeng I.N., 2013. Effect of varying level of groundnut (*Arachis Hypogea*) haulms on the growth Performance of weaners rabbits (*Oryctalagus cuniculus*). *International journal of livestock production*, (5):81-87.

Garcia J., Carabano R. and De Blas J.C., 1999. Effect of fiber source on cell wall digestibility and rate of passage in rabbits. *Journal of Animal Science*, 77 (4): 898-905.

Gidenne T., 1992. Effect of fibre level, particle size and adaptation period on digestibility and rate of passage as measured at the ileum and in the faeces in the adult rabbit. *British Journal of Nutrition*, 67: 133-146.

Gidenne T. and Bellier R., 2000. Use of digestible fibre in replacement to available carbohydrates - Effect on digestion, rate of passage and caecal fermentation pattern during the growth of the rabbit. *Livestock Production Science*, 63: 141-152.

Houndonougbo M.F., Chrysostome C.A.A.M., Attakpa S.E., Sezan A. and Dehou H.B., 2012. Growth Performance of Rabbits Fed Palm-Press Fibres-Based Diets. *International Scholarly Research Network (ISRN), Veterinary Science*, DOI:10.5402/2012/915729.

Kpodekon M., Youssao A.K.I., Koutinhouin G.K., Baba L., Dessou J.M. and Djago Y., 2009. Effet de la granulation sur les performances de croissance, l'efficacité alimentaire et la viabilité des lapereaux en condition d'élevage tropical. *Revue d'Élevage et Médecine Vétérinaire des Pays Tropicaux*, 62 (1): 75-80.

Mohammed M. and Jamala G.Y., 2013. Performance and Nutrient Digestibility of Rabbit Fed Urea Treated Cowpea Husk. *Journal of Agriculture and Veterinary Science*, 5 (2): 34-37.

Oluokun J.A., 2001. Performance of growing rabbits fed a low protein diet supplemented with urea or roasted soybean meal. *Journal of Animal Production and Research*, 17 (1&2): 89-99.

Oluokun J.A., 2005. Intake, digestion and nitrogen balance of diets blended with urea treated and untreated cowpea husk by growing rabbit. *African Journal of Biotechnology*, 4 (10): 1203-1208.

Raharjo V.C., Cheeke P.R., Patton N.M., 1986. Growth and reproductive performance of rabbits on a moderately low crude protein diet with or without methionine or urea supplementation. *Journal of Animal Science*, 63: 795-803.

Singh B.B., Makkar H.P.S., Lal Krishna, 1988. Utilization by growing rabbits of a low crude protein diet with or without urea and groundnut cake supplementation. *Journal of Applied Rabbit Research*, 2 (1): 25-29.

Singh B.B., Ajeigbe H.A., Tarawali S.A., Fernandez-Rivera S., Abubaka M., 2003. Improving the production and utilization of cowpea as food and fodder. *Field Crops Research*, 84: 169-177.

SPSS Inc, 2010. PASW (Predictive Analytics Software) 17.0. SPSS Inc., Chicago, IL, USA.

Van Hao N. and Ledin I., 2001. Performance of growing goats fed *Gliricidia maculate*. *Small Ruminant Research*, 39: 113-119.

Vasconcelos I.M., Siebra E.A., Maia A.A.B., Moreira R.A., Neto A.F., Campelo G.J.A. and Oliveira J.T.A., 1997. Composition, toxic and antinutritional factors of newly developed cultivars of Brazilian soybean (*Glycine max*). *Journal of the Science of Food and Agriculture*, 75(4): 419-426.

Volkoff B., 1976. Carte pédologique de reconnaissance à 1:200 000 de la République Populaire du Bénin. ORSTOM. Paris.