Online Journal of Animal and Feed Research

Volume 4, Issue 4: 91- 96 (2014) *ISSN 2228-7701*

SYNERGISTIC EFFECTS OF HATCHERY BY-PRODUCTS AND CASSAVA PEEL MEAL MIXTURES ON THE PERFORMANCE OF CROSSBRED GROWING RABBITS

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ABSTRACT: In an attempt to broaden the scope in the use of non-conventional feed resource for rabbit production, the synergistic effects of combined hatchery waste and cassava peel meal (HWCPM) (3:2) on the performance characteristics of growing rabbits were investigated using twenty eight (28) crossbred growing rabbits of between 6 to 8 weeks of age. The hatchery wastes (candled out egg and dead in embryo) were cooked for one hour at 100^{0}C, sun dried and combined with sun dried cassava peels in ratio 3:2. Four experimental diets were formulated with the control having no HWCPM. Other three diets had HWCPM included in them at 5, 10, and 15%. Four groups of seven rabbits were randomly assigned to the four diets in a completely randomized design with each rabbit serving as a replicate. Results shows that rabbits on the control diet had lower ($P<0.05$) final weight (1207.5 ± 104.66g) than those fed 5% (1452.25 ± 57.42g), 10% (1596.25 ± 46.21g) and 15% (1350.25 ± 107.21g) HWCPM containing diets. Feed intake increased linearly ($P<0.05$) with increasing levels of HWCPM in the diets while feed cost per kg as well as feed cost per kg weight gain decreased linearly ($P<0.05$). Production costs were lower in the diets fed HWCPM diets than in the control reaching the lowest at 10% inclusion level. Digestibility of nutrients was not affected by dietary treatments. Results indicated that the relative organ weights were not ($P>0.05$) affected by dietary treatments. It was concluded that HWCPM can be included in growing rabbits diets up to 15% however the highest return in terms of lower production cost is in favour of 10% inclusion.

Keywords: Non-Conventional Feed, Hatchery Waste, Cassava Peel, Performance Characteristics, Feed Cost

ORIGINAL ARTICLE
Received 12 Jul. 2014
Accepted 01 Aug. 2014

INTRODUCTION

Feeding the world's poor is one of the most pressing challenges of the present day as human population grows and put increasing strain on natural resources (FAO 2011). Livestock have an important part to play as they provide high quality protein to consumers and regular income to producers. To realise the full potential of livestock, sustainably, they need to be well managed. Nutrition is critical to the realisation of full expression of livestock potential hence the urgent need to use available resources more efficiently and recycle waste in order to create a positive balance sheet in livestock contribution to global food supplies (FAO 2011), Rabbit production especially in developing countries could be a more veritable means of alleviating the prevailing problem of low animal protein consumption due to its obvious advantages over other livestock. However feeding rabbit especially on concentrate in order to obtain optimum growth and good reproductive performance is a major problem because of the high demand for cereal and legume grains by man for consumption and industrial uses. Historically, the use of grains to feed animals has primarily been a practice of developed countries. According to the report released by FAO, (2012) 40% of cereals are used for livestock feed in the United States, while only 14% are used for feed in Africa. The feed industry in most developing countries is faced with a number of challenges not only with regards to availability of ingredients but also the ability to produce high quality products in a cost effective manner (Chauynarong et al., 2009). Sourcing for alternative ingredients to conventional ingredients therefore becomes imperative. Two of such ingredients are the hatchery by-products and cassava peels. Hatchery by products (candled out eggs, egg shell and dead in embryo) has high protein content and can be processed into useful energy and protein feed stuff (Gohl 1970; Reddy, 1988; and Boushy, 2007). According to Cox et al. (1999) it is a useful and economical source of nutrients, especially during feed stuff shortages which will also reduce pollution and its attendant consequences on the climate. According to Tadtyanants et al. (1993), hatchery waste can be processed into useful feed ingredients by dehydration, boiling, toasting, drying, autoclaving, grinding and irradiation. Doufloth et al. (1987) reported that hatchery waste meal has been found to be a good source of protein, energy and minerals especially phosphorus and calcium. Its calcium-phosphorus ratio is 2:1 which favours the bio-availability of the minerals (Arigbede et al. 2007). The authors observed that ration containing hatchery waste meal elicited a better performance in terms of weight gain and feed efficiency in broilers fed 12 % HWM than those fed similar amount of fish meal.

To cite this paper: Ojebiyi O.O, Oladunjoye I.O., Rafiu T.A., Shittu M.D. Ajayi O. 2014. Synergistic effects of hatchery by-products and cassava peel meal mixtures on the performance of crossbred growing rabbits. *Online J. Anim. Feed Res.*, 4(4): 91-96.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Processed cassava peel meal has been used extensively as a cheaper substitute for maize as a source of energy in non-ruminant (Esonu and Udedibie, 1993). The major limitation in the use of cassava and its by-products for feeding livestock is its low protein content and high level of cyanide. Consequently cassava peels usage in animal feeding requires protein supplementation and or processing to reduce the cyanide content (Okpako et al., 2008). This assertion was collaborated by Larsen and Amaning-Kwarteng, 1976, Otchere et al., l977, and Oboh 2009 who reported that protein enhancement of cassava and cassava by-products through less expensive means is desirable for optimal utilization as livestock feed. Similarly, Ojebiyi (2009) used low protein cassava peels with blood meal in feeding rabbits while a combination of low protein cassava sievates with soybean milk residue was used in feeding snail by Ojebiyi et al. (2011). Ojebiyi et al. (2013) evaluated the synergetic effect of cassava sievate/soybean milk residue mixtures as replacement for maize in growing rabbits. The present study is aimed at evaluating the nutritional potential of processed hatchery by-product-cassava peel meal mixture in the diet of growing rabbit.

MATERIAL AND METHODS

Location of the study

The experiment was carried out at the Rabbit unit of the Teaching and Research Farm, Ladoke Akintola University of Technology. Ogbomoso, Nigeria. The study site lies between latitudes 8^{0}07'N and 8^{0}12'N and longitudes 4^{0}04'E and 4^{0}15'E. The climate condition of Ogbomoso area is between humid and fairly hot sub-humid tropical with marked wet and dry seasons. There is a short period of harmattan in between the two seasons (wet and dry). The mean annual rainfall is 1,400mm with a weekly developed bimodal pattern of distribution, reaching peak around July and September. The air temperature ranges between 25.8°C in August and 30.5°C in March with the mean annual temperature of 27°C. The average relative humidity is 77% with 92.98% and 61.44% in morning and afternoon respectively.

Preparation of test ingredients and formulation of experimental diets

Hatchery-by-product was collected from a reputable hatchery within the study area. Fresh cassava peels was collected from the local gari processing plant in the University. The hatchery waste used were candled out without shell. Hatchery by-products were prepared according to the method of Agunbiade et al. (2011). After cooking shell were removed before sun drying, while the fresh peels from matured cassava (up to twelve months of age) variety TMS 30572, were rinsed in ordinary water, allowed to drain before spreading to sundry with regular turnings at intervals to prevent spoilage.

The dried hatchery by- products and cassava were milled separately, bagged, and preserved from dampeners and vermin. Both the hatchery wastes and cassava peel were combined at ratio 3:2, thoroughly mixed and used to formulate the experimental diets. Four experimental diets were formulated with the control having no HWCPM. The other three diets had HWCPM included at 5, 10, and 15% (Table 1).

Table 1 – Gross composition of experimental diets

Ingredients (%)	Diet 1	Diet 2	Diet 3	Diet 4
HWCPM	-	5	10	15
Groundnut cake	10	6	4	2
Brewers dry grain	24	22.5	21	19.5
Palm kernel cake	15	15.5	14	12.5
Maize	24	24	24	24
Fixed ingredients [1]	27.00	27.00	27.00	27.00
Crude protein (%)	16.67	16.90	16.76	17.26
Metabolizable Energy (kcal/kg)	2504.66	2535.38	2556.31	2577.21
Cost/kg feed (₦)	50.32	45.51	42.46	39.40

[1] Fixed ingredients (%): corn bran 8.25, rice bran 14, fish meal 1, bone meal 2.5, salt 0.5, premix 0.25, lysine 0.25 and methionine 0.25. Diet 1 = 0% HWCPM, diet 2 = 5% HWCPM, diet 3 =10% HWCPM, diet 4 = 15% HWCPM, ₦ = Nigerian Naira, HWCPM= hatchery waste and cassava peel meal

Experimental Animals and Management

Twenty eight 6-8 weeks old crossbred rabbit progenies from mating between (New Zealand×Chinchilla breeds) were used for the study. The rabbits which were between 450-459g average initial weights were individually housed and maintained in cages measuring 44×34×44 cm in open sided house. The rabbits were randomly divided into four treatment groups consisting of seven rabbits each. These were assigned into the experimental diets in a completely randomized design. The rabbits were prophylactically treated to take care of likely infections. They were also treated against ecto and endo parasites.

The rabbits were weighed at the commencement of the study and subsequently at weekly intervals. Feeding was done daily between 7:00-8:00hrs in the morning and between 15:00-16:00hrs in the evening. The feeds were offered at the rate of 100g per rabbit per day. Leftover feeds were measured daily at each feeding time so as to determine the total feed intake. Water was provided *ad- libitum*. Feed and water were served in flat bottom earthen pots that were reinforced with concrete to prevent tipping off. Weight gain, feed costs and feed cost/ kg gain were

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computed. Feed intake was computed as feed offered minus feed left over plus wastage. Cost of feeds was computed from costs of ingredients used in feed preparation. Cost per kg weight gained was computed using Feed: gain ratio multiplied by feed cost per kg.

Digestibility trial

At the 7th week of the study, faecal samples were collected daily from the rabbit for five days. The fresh and dried weights were recorded for each animal per day. After the collection period, the faecal samples per rabbit were bulked and subsamples taking for proximate analysis.

Carcass analysis

At the end of the feeding trial, four animal per treatment were randomly selected, starved of feed for 12hrs, weighed and then slaughter, the organs were neatly dissected out, weighed and the value obtained were used to determine the dressing percentage.

Laboratory Analysis

The test ingredients, experimental diets, as well as faecal samples were analysed for proximate composition by the procedure of AOAC (2005).

Statistical Analysis

Data collected were subjected to analysis of variance using the GLM of SAS
(2000). Means were separated using Duncan Multiple Range Test of the same statistical package.

RESULTS AND DISCUSSION

The proximate composition of the test ingredients are shown in Table 2. The proximate composition of the hatchery by products indicated a crude protein value of 34.93%, either extract of 9.87 and ash 11.45% which were lower than the values of 36.85%, 15.2% and 26.85% reported by Agunbiade et al. (2011). The differences in value be due to the type of hatchery waste use. The one used in this study was candled out without shell.

Table 2 - Chemical composition of test ingredients (DM basis)

Parameters (%)	Cassava peel	Hatchery Waste	Hatchery Waste/ Cassava peel CPM
Dry Matter	89.25	89.76	89.81
Crude protein	5.86	34.93	26.32
Crude Fibre	13.63	2.31	11.31
Ether extract	3.45	9.87	3.58
Ash	6.37	11.45	6.16
Nitrogen Free Extract	58.85	33.58	42.44
Cyanide content (mg/kg)[1]	19.69	ND	9.31
Gross energy (kcal/g)[2]	2.046	4.106	2.555

ND=not determined, [1]mg/kg, [2]kcal/g

The proximate composition of the cassava peel falls within the range reported by Asaolu, 1988; Amaefule et al., 2005 and Ojebiyi, 2009). The proximate composition of the diets shows that they are adequate for growing rabbits as recommended by Lebas et al., 1986).

Table 3 shows the effects of dietary inclusion of hatchery/Cassava peel meal mixture on the performance of weaner rabbits. Dietary inclusion of hatchery/cassava peel meal mixture had significant ($P<0.05$) effect on the mean final weight. The values obtained for rabbits fed HCWPM based diets were higher ($P<0.05$) than the value (1207.50g) recorded for the control.

Table 3 - Performance Characteristics of Weaner Rabbits Fed HW/CPM

Parameter	Diets1	Diets2	Diets3	Diets4
Initial weight (g)	457.6±83.67	457.1±72.63	459.6±64.4	451.8±95.94
Final weight (g)	1207.5±104.67^{c}	1452.25±57.42^{b}	1596.35±7.2^{a}	1350.25±107.21^{b}
Daily weight gain (g)	11.90±2.37^{c}	15.80±1.91^{b}	18.04±1.03^{a}	14.26±1.53^{b}
Daily feed intake (g)	47.4±7.8^{c}	57.1±0.7^{b}	63.2±3.9^{a}	63.9±1.1^{a}
Feed : gain ratio	3.98±1.23^{b}	3.61±0.51^{c}	3.50±0.33^{c}	4.48±0.38^{a}
Feed cost/kg (₦)	50.23	45.51	42.46	39.40
Feed cost/ weight gain (₦)	199.91±64.10^{a}	164.29±23.32^{b}	148.61±14.03^{c}	176.51±15.13^{c}

^{abc}Means along these row with similar superscripts are not significantly different($p>0.05$)., Diet 1 = 0% HWCPM, diet 2 = 5% HWCPM, diet 3 =10% HWCPM, diet 4 = 15% HWCPM, ₦ = Nigerian Naira

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Average daily weight gain followed a similar trend as the final weights. The results agree with the report of Agunbiade et al. (2011). In this study the average daily weight gain of rabbit fed HWCPM based diet falls within the range (14 -17g/day) reported by Ijaiya et al. (2002) but lower than 42.76-45.36g/day reported by Dairo et al. (2002). Many factors among which are the age of the experimental animal, breeds, sex and nutrient level and/or availability of the feed and feed component could have been responsible for this variation.

The daily feed intake (DFI) increased as inclusion level increased. The least ($p<0.05$) DFI value (47.4g/day) recorded in the control diet may be an indication that it was less accepted by the animals compared to HWCPM based diets. This could have been as a result of increase in palatability of the diet caused by the test ingredient. Although the feed to gain ratio favours animals placed on 5 and 10% HWCPM based diets, the rabbits fed 10% had the least the feed cost per kg body weight gain indicating that diet 3 was more utilized by the animal than any other diets. Although the relative organ weights except lungs showed no significant ($p>0.05$) differences (Table 4),

Table 4 - Effect of HWCPM based diet on relative organ weights of weaner rabbit

Parameter (% body wt)	Diet1	Diet2	Diet3	Diet4
Liver	3.60±0.01	3.60±0.16	3.65±0.29	3.66±0.39
Heart	0.25±0.03	0.23±0.03	0.20±0.00	0.23±0.25
Kidney	0.60±0.10	0.60±0.40	0.65±0.03	0.63±0.10
Spleen	0.35±0.01	0.35±0.01	0.35±0.00	0.36±0.00
Lungs	0.55 ± 0.06^{ab}	0.60 ± 0.10^{ab}	0.55 ± 0.03^{b}	0.70 ± 0.14^{a}

^{abc} Means along the same row with similar superscripts are not significantly different ($p>0.05$); Diet 1 = 0% HWCPM, diet 2 = 5% HWCPM, diet 3 =10% HWCPM, diet 4 = 15% HWCPM

The values obtained falls within the range reported by Sankhyyan et al. (1991) and Dairo et al. (2002). Weights of the lung of the rabbits that received diets that contained HWCPM were comparable to that of the control which indicates that the variation in the values could not be due to the use of the test ingredient. No clinical signs of ill health observed in the rabbits during the experiment to warrant histological studies.

Nutrient digestibility of the rabbits (Table 5) was not affected by the use of test ingredient (HWCPM) except the crude fibre digestibility.

Table 5 - Effects of feeding HWCPM based diet on nutrient digestibility of weaner rabbits

Parameter (%)	Diet1	Diet2	Diet3	Diet4
DM	65.31±0.49	63.35±0.49	67.08±0.52	67.32±0.47
CP	62.08±0.44	60.80±0.66	61.39±0.58	62.02±0.63
CF	43.30 ± 5.2^{ab}	48.19 ± 5.1^{a}	33.43 ± 1.29^{b}	44.60 ± 5.50^{ab}
EE	85.29±0.16	84.72±0.25	84.29±0.15	83.75±0.08

^{abc} Means along these row with similar superscripts are not significantly different ($p>0.05$). Diet 1 = 0% HWCPM, diet 2 = 5% HWCPM, diet 3 =10% HWCPM, diet 4 = 15% HWCPM, DM=dry matter digestibility, CP=crude protein, CF= crude fibre, EE=ether extract.

The values obtained for dry matter digestibility in this study however fall within the range reported by Adejinmi et al. (2003) who fed growing rabbit with fermented cocoa pod husk. Digestibility of crude fibre and ether extract falls within the range reported by Omole et al. (2003), Adams and Haruna (2002) and Ranjhan (2001). Apart from crude fibre digestibility the coefficient of digestibility for other nutrients are well above average values. The poor digestibility of crude fibre is a confirmation of the earlier report of Oduguwa (2006). Rabbits according to Slade and Hinzt (1989) and Adegbola and Okonkwo (2002) are less efficient at digestibility of fibre than sheep and goat. The lower digestibility could be due to the type of fibre in the diet, since fibre from different sources could vary in their digestibility depending on the proportions of cellulose, hemicellulose and lignin.

CONCLUSION

It could be inferred from this study that inclusion of hatchery waste/cassava peel mixture in weaner rabbit diet up to 15% level had no adverse effect on growth performance and organ characteristics of the growing rabbit. However, inclusion of 10% HWCPM resulted in lowest production cost. Since these products are of no direct value in human nutrition, their usage will reduce the cost of production thereby making cheaper animal protein more available for Nigerians. Their usage will also reduce environment pollution and its attendant risks.

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