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PERFORMANCE AND NUTRIENT DIGESTIBILITY OF GROWING RABBITS OFFERED CORN COB-BASED DIETS SUPPLEMENTED WITH FEED ADDITIVES

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Abstract

A ten-week feeding trial was conducted to investigate the effects of corn cob-based diet supplemented with feed additives on growth and nutrient digestibility in growing rabbits. Forty-eight growing rabbit bucks of mixed breeds (New Zealand White x Chinchilla), weighing 642.01±4.99g were randomly allocated to four dietary treatments at three replicates of four rabbits each in a completely randomized design. Diet 1 (Basal, corn cob-based diet with no additive), diet 2 [Basal diet + Probiotic (Bactofort® at 500g/ton)], diet 3 {Basal diet + Exogenous Enzyme (Cellulase at 500g/ton)} and diet 4 {Basal diet + Symbiotic (Bactofort® at 500g/ton + Cellulase at 500g/ton)}. The daily body weight gain was found similar among the treatments fed supplemented diets with a range of 18.40±0.19–18.72±0.36 g/day, but higher (P<0.05) than control (14.81±0.27 g/day). The values obtained for feed conversion ratio for all the groups fed supplemented diets were similar (P<0.05) and ranged from 3.17±0.19–3.32±0.13, but lower than 4.45±0.41 in control. The ether extract (84.78±0.83) and hemicelluloses digestibility (72.32±1.05) were highest in the group fed probiotic-supplemented diet and lowest in control. It is therefore concluded that supplementing corn cob-based diet with probiotic (Bactofort®) alone may be enough to enhance nutrient digestibility in growing rabbits.

Keywords: Growth performance, nutrient digestibility, corn cob, feed additives

Introduction

Animal protein consumption by Nigerians is reported to be abysmally low compared to advanced countries of the world (Boland *et al*., 2013). Although proteins can as well be sourced from plants, the place of animal protein remains significant, owing to its balanced amino acid profile (Ogunsipe *et al*., 2014). Animal protein is rich in essential amino-acids, which results to a greater body tissues synthesis, and brings about replenishment of nitrogen lost in urine, injured skin, faeces, saliva, nails and hairs very quickly (Iwena, 2002). Poultry sector has always been developed to cater for meat demand from Nigerians not only because of its short breeding period, but also high growth rate. Nevertheless, the daily increase in the cost and competition with man for some feed ingredients (e.g. maize), have been documented to be the factors militating against the realisation (Taiwo *et al*., 2005). To therefore bridge the gap created by lack of adequate animal protein consumption in Nigerians' diets, there should be a paradigm shift to the production of animal like rabbit which is well known to be easily managed.

However, production of rabbit for consumption in large scale is not without challenges. Paramount among them is scarcity of fibre sources most especially during drying season. During this period, the conventional fibre sources in rabbit diet, for example, maize and wheat offals are always very expensive making the rabbit production unsustainable. Meanwhile, crop residue like corn cob is always produced in large quantity as a by-product of maize and available all-year round. Different reports have come from different researchers vis-à-vis the utilization of this crop residue in different farm animals. While some observed that it could be used in replacing the conventional fibre sources without adverse effects on growth and digestibility, among other parameters in livestock study, some reported that it cannot be used most especially in non-ruminants without supplementing the diet with feed

additives. It is against this background that this study was carried out to evaluate the effects of supplementing corn cob-based diet with different feed additives on growth and nutrient digestibility in growing rabbits.

Materials and Methods

Experimental Site

The experiment was conducted at the Rabbitry Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. It is situated in the humid forest zone of South-West, Nigeria on latitude 7o7'N and longitude 3o5' to 3o36'E with mean annual temperature of 25oC - 30oC, relative humidity of 65% - 84%, average annual rainfall of about 1250mm and altitude between 200m and 300m.

Compositions of the Experimental Diets

A total of four treatments were used for this experiment. The control diet had 20% corn cob as the main source of fibre as shown in table 1, while treatments 2, 3 and 4 were the same diet as control but supplemented with probiotics, cellulase, and probiotics + cellulase, respectively. The experimental design was completely randomised design. The probiotic used was commercial Bactofort®, containing: *Lactobacillus acidophilus* (77 x 109 cfu/kg), *Enterococcus faecium* (44 x 109 cfu/kg), *Saccharomyces cerevisiae* (5,000 x 109 cells/kg) and *Bacillus subtilis* (2.2 x 109cfu/kg). It is manufactured by Biofeed Technology Inc., Brossand, QC, Canada, and mixed at the rate of 0.5g/kg according to manufacturer's recommendation. Cellulase is manufactured by Co-Suppliers Ltd, China. Cellulase system according to the manufacturer consists of three major components: endoglucanases (endo-1,4-β-D-glucanases), cellobiohydrolases (exo-1,4-β-D-glucanases), and β-glucosidases (1,4-β-D-glucosidase). It was as well mixed at the rate of 0.5g/kg according to manufacturer's recommendation.

Experimental diets layout:

Diet 1: Basal diet
Diet 2: Basal diet + Bactofort®
Diet 3: Basal diet + Cellulase
Diet 4: Basal diet + Bactofort® + Cellulase

Management of Animals and Experimental Procedures

Forty-eight growing rabbit bucks of mixed breeds (New Zealand White x Chinchilla), weighing 642.01±4.99g were used for the experiment. The rabbits were procured from a reputable farm in Abeokuta, Ogun State. On arrival, the animals were dewormed with Banmith. They were acclimatized for the first two weeks in the experimental site. During this period, control diet was slowly introduced to the rabbits to take the place of the diet the animals were being fed before. This was to ensure that there was no stomach upset in the rabbits that could lead to enteritis and some other related problems. After the acclimatization period, the rabbits were allotted to four dietary treatments. Twelve rabbits were in each treatment, and there were three replications in a treatment at four rabbits per replicate arranged in a completely randomized design. Clean water was supplied *ad libitum*.

Growth Study

The weight of rabbits in each treatment was balanced before the commencement of the experiment. Each rabbit was weighed on weekly basis so as to get weekly weight gain. At the end of the ten weeks measurement, the total weight added by each rabbit was divided by the number of days to arrive at average daily gain. In order to measure feed intake, the rabbits were served a known quantity of experimental diets daily with the feed intake arrived at by measuring the weight of the leftover feed and subtracting it from the weight of the served

quantity. Feed conversion ratio was obtained through the division of the total feed consumption by the total body weight gain per rabbit.

Digestibility Trial

This trial took place on the tenth week of the study. A total number of twenty-four rabbits (six per treatment) were chosen for this trial. The animals were fed the same way they were in the first nine weeks using the same experimental diets. Observation of daily feed consumption as well as faecal output for each animal was recorded for seven days. The faeces were collected by using wire gauze placed underneath the cage of each treatment to prevent it from being soaked by urine.

Table 1: Gross Composition of Experimental Diets

Ingredients	Basal Diet
Maize	20
Maize offal	10
Corn cob	20
Soybean meal	20
Palm kernel cake	21.5
Others*	8.5
Total	100
Calculated Nutrient Composition:	
Dry matter	85.62
Crude protein	16.34
Crude fibre	12.11
Ether Extract	3.70
Ash	3.60
Nitrogen Free Extract**	49.87
Neutral Detergent Fibre	36.77
Acid Detergent Fibre	17.63
Acid Detergent Lignin	5.67
Hemicellulose***	19.14
ME (kcal/g)****	2.65

***Others: Cassava Flour = 5%, DCP = 2%, Oyster Shell = 1%, Table Salt = 0.25%, Premix = 0.25% **Calculated as 100 – (% moisture + % CP + % CF + % EE + % Ash) ***Calculated as %NDF - %ADF, ****Calculated using Pauzenga Formula, ME = Metabolizable Energy**

The faecal matter in every hutch was also collected and added to the one packed on the wire gauze for that particular hutch separately at 8:00am every morning when cleaning the pen. After each period of faecal collection, samples from each rabbit were pooled together, and at last all the faecal samples were dried in oven at 105^{o}C for 24 hours for DM determination and chemical analysis according to AOAC (2000) and Van Soest *et al*. (1991).

Statistical Analysis

Data collected were analysed using analysis of variance with the procedure of SAS (2003). Observed statistically significant means were compared using Duncan Multiple Range test of the same package at 5% level of probability.

Results

Growth Performance and Nutrients Digestibility of Growing Rabbits Offered Corn Cob-Based Diets Supplemented With Feed Additives

Table 2 shows the results obtained on growth performance and nutrient digestibility of growing rabbits administered diets fortified with feed additives. Average final weight was greater ($P<0.05$) in probiotic fortified group by 14.50% and 2.70% than control and enzyme supplemented groups respectively, but statistically similar to probiotic + enzyme supplemented group. In addition, the treatment administered diet treated with enzyme got higher ($P<0.05$) average final weight by 12.13% than control. Average daily gain was statistically similar ($P<0.05$) among the treatments fed treated diets, with their values higher ($P<0.05$) than the control. Feed conversion ratio was equally found similar ($P<0.05$) among the treatments fed fortified diets, but significantly improved than in the control. Dry matter digestibility was better ($P<0.05$) in probiotic group (80.02±0.13) with reference to control (74.44±1.53) and enzyme groups by 6.97% and 3.91% respectively, but statistically similar to probiotic + enzyme group. Crude protein digestibility was almost same ($P>0.05$) within the supplemented groups, but significantly higher ($P<0.05$) than the control group (73.26±1.87). Crude fibre digestibility followed the same pattern observed in CP digestibility. Crude fibre digestibility was greater ($P<0.05$) in probiotic, enzyme, and probiotic + enzyme groups with reference to control by 23.82%, 18.42% and 23.60% respectively. Ether extract digestibility was higher in probiotic group compared to other treatments, with the group higher by 11.93%, 3.29% and 5.38% than control, enzyme, and probiotic + enzyme groups respectively.

Digestibility of ash was statistically similar among probiotic, enzyme, and probiotic + enzyme groups. The values obtained for probiotic, and enzyme groups were however higher ($P<0.05$) by 4.70% and 6.61%, respectively than what was observed for control (76.39±1.86). Nitrogen free extract and ADF digestibility were observed to have similar pattern, with their digestibility better ($P<0.05$) in the fortified groups than what was observed in control. Neutral detergent fibre digestibility in probiotic group was found similar ($P>0.05$) to probiotic + enzyme group, but greater by 27.10% and 9.41% than control and enzyme groups respectively. Hemicellulose digestibility was statistically similar between probiotic and probiotic + enzyme groups, with their values found greater ($P<0.05$) than the values for control and enzyme groups.

Table 2: Effects of Diets Supplemented With Probiotic, Enzyme, and Addition of Probiotic and Enzyme on Growth Performance and Nutrients Digestibility in Growing Rabbits

Performance	Control	Probiotic	Enzyme	Probiotic + Enzyme	SEM
Av. Initial Wt.	640.08	644.00	641.75	642.17	1.44
Av. Final Wt.	1698.67^{c}	1986.75^{a}	1933.10^{b}	1968.22^{ab}	21.01
ADG (g/day)	14.81^{b}	18.72^{a}	18.40^{a}	18.55^{a}	0.18
FCR	4.45^{a}	3.24^{b}	3.32^{b}	3.17^{b}	0.16
Digestibility (%)					
Dry Matter	74.44^{c}	80.02^{a}	76.89^{bc}	79.24^{ab}	0.74
Crude Protein	73.26^{b}	83.28^{a}	81.24^{a}	84.32^{a}	1.38
Crude Fibre	40.17^{b}	52.73^{a}	49.24^{a}	52.58^{a}	1.89
Ether Extract	74.67^{d}	84.78^{a}	81.99^{b}	80.22^{c}	1.14
Ash	76.39^{b}	80.16^{a}	81.80^{a}	79.32^{ab}	0.71
NFE	70.15^{b}	79.90^{a}	76.51^{a}	77.59^{a}	1.19
ADF	23.60^{b}	32.15^{a}	30.49^{a}	30.53^{a}	1.06
NDF	33.38^{c}	45.79^{a}	41.48^{b}	42.43^{ab}	2.10
Hemicellulose	55.85^{c}	72.32^{a}	69.03^{b}	71.12^{a}	2.00

a, b, c, d, means in the same row with different superscript differ significantly (P<0.05). Av=Average, Wt.=Weight, DMI=Dry Matter Intake, FI=Feed Intake, ADG=Average Daily Gain, FCR=Feed Conversion Ratio, NFE=Nitrogen Free Extract, ADF=Acid Detergent Fibre, NDF=Neutral Detergent Fibre, SEM = Standard Error of Means.

Discussion

All the three groups of rabbits fed supplemented diets were observed with significantly improved average final weight compared to those given control diet. This probably could be an indication that supplementation with the feed additives had enhanced growth in the rabbits. Kritas *et al*. (2008) had previously concluded that supplementing rabbit diets with probiotics did lead to enhanced growth in the animals. The significant increase in the final live weight of rabbits administered probiotic supplemented diet in this work compared to the control corroborated the observations of Bhatt *et al*. (2017), who gave diets supplemented with *lactobacillus acidophilus* and *Lactococcus lactic* to weaner rabbits and reported significant improvement in final body weight of the rabbits fed *lactobacillus acidophilus* compared to control. Also, in the work of Abdel-Aziz *et al*. (2015) supplementing rabbit diets with *L. acidophilus*, ZAD® enzyme and combination of the two additives led to higher growth in rabbits placed on the treated treatments compared to control. Aliakbarpour *et al*. (2012) also gave a report of similar results in broiler chicks when they fed commercial monostrain and multistrain probiotics to the chicks and got significant improvement in final body weight in treatment served diet supplemented with probiotic in comparison to control. A significant improvement observed in average daily gain of rabbits given diets treated with feed additives in this study was in agreement with the observation of Sherif (2018) who supplemented rabbits' diets with enzymes, organic acids and probiotics with the reports that supplementation gave rise to significantly improved daily weight gain and FCR in rabbits. The results were also in tandem with the observation of El-Badawi *et al*. (2017), who

administered diets fortified with *Bacillus subtilis*, *Saccharomyces cerevisiae* and their mixtures to rabbits and obtained significant increase in average daily gain and better FCR in rabbits offered diets supplemented with feed additives in comparison to control.

A higher growth rate in addition to a better FCR observed in rabbits served fortified diets might be as a result of higher digestibility of CP, CF, EE, NFE and fibre fractions (ADF, NDF and hemicellulose) obtained in them compared to control. In this study, the group fed probiotic-supplemented diet was observed with the highest digestibility values for all the nutrients except crude protein. The value obtained for the treatment fed diet supplemented with probiotic alone was at the same time similar to the other diets supplemented with other feed additives. All these seemingly suggested a more effective utilisation of the supplemented diets. The significant improvement in digestibility achieved by enzyme supplementation over the non-supplemented diet may have resulted from partial degradation and solubilization of non-starch polysaccharides which allow for greater utilisation of nutrients and hence improved performance of the rabbits. Results close to this are indicated in the observation of Bhatt *et al*. (2017), that there was improved digestibility of DM, OM, CP, NDF and hemicellulose in rabbits offered probiotic (*Lactobacillus acidophilus*) supplemented diet. Increase in nutrients digestibility due to supplemental dietary probiotics and yucca extracts resulting to reduction in surface tension of cell membranes, which aided better absorption of nutrients across the cell membranes, was equally observed by Amber *et al*. (2004). Ewuola *et al*. (2011) likewise reported significant improvement in digestibility of DM, CF, Ash and EE in rabbits served probiotic treated diets with reference to control. Also corroborating the outcome obtained in this trial was the observation of Abaza and Omara (2011), with the report that supplementing corn cob–based diets with enzymes (Kemzyme), led to significant improvement in digestibility coefficients of diets supplemented with enzymes compared to control.

The derived values for dry matter digestibility in this work were very similar to 74.1-78.9% reported by Abdel-Aziz *et al*. (2014) who fed sugarcane bagasse based-diets supplemented with either *Lactobacillus acidophilus*, exogenous enzymes ZAD or their mixtures to growing New Zealand White rabbits. Crude protein digestibility (CPD) obtained was similar to the ranges of 81.31-83.90% and 82.6-82.7% observed by Abdul-Aziz *et al*. (2014), and Bhatt *et al.* (2017), who administered diets treated with *Lactobacillus acidophilus* and *Lactococcus lactis* to weaner Chinchilla rabbits. Crude protein digestibility in this work was however greater than 69.91-75.93% observed by Ewuola *et al*. (2011), who gave diets treated with prebiotics, probiotics and the combination of both to weaner rabbits. Crude fibre digestibility values got in this trial were below the ranges (53.51-66.97%) and (81.20-87.04%) reported by Rabie *et al*. (2011) and Onu and Oboke (2010), when growing New Zealand White rabbits were fed Avian Plus probiotics-supplemented diets, and crossbred weaner rabbits were served maize processing waste-based diets with the supplementation of enzyme and probiotic, respectively.

Conclusion

The average daily gain and feed conversion ratio of the growing rabbits were significantly improved by supplementing corn cob-based diet with probiotics, enzyme, and probiotics + enzyme. Also, nutrient digestibility was significantly better in the treatments fed supplemented diets with the best results observed in the group fed probiotic-supplemented diet.

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