Effects of Feeding Noodle (Indomie) Waste on the Nutrient Digestibility and Cecal Parameters of Growing Rabbits

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Abstract— *In an 8-week feeding trial, the nutrient digestibility and cecal parameters of mixed breeds of rabbits fed with noodle waste in replacement of maize were evaluated. The rabbits were randomly assigned to four dietary treatments (T1, T2, T3, and T4) in a Completely Randomized Design (CRD). The indomie waste was incorporated in a conventional feed at an inclusion levels of 0%, 6%, 12%, and 18% respectively. At the end of the experiment, Nutrient digestibility and cecal parameters were assessed. The result from the study stipulated that the crude protein, dry matter, crude fat, ash, crude fibre and nitrogen free extract were significantly different (P < 0.05) among treatments. Increase in the inclusion levels of indomie waste led to increased digestibility in Dry matter, ash, and nitrogen free extract with rabbits in treatment 4 showing superior values in relative to other treatment groups. Also, rabbits fed diet 2 showed a significant increase in nutrient digestibility values (P < 0.05) in crude protein, crude fibre, and crude fat compared to those fed diets 1, 2 and 4 while crude fibre was better digested among rabbits in the control groups when compared to others. Furthermore, the cecal pH and NH_3 were significantly (P<0.05) influenced by the test diet with the highest value of cecal pH recorded among rabbits in Treatment 4 and decreased values of NH_3 when compared to other treatment groups. Rabbits fed 6% indomie waste shown better digestibility of nutrients when compared to other inclusion levels, this level of inclusion is therefore recommended to rabbit owner*.

Keywords— Cecal parameters, Indomie waste, Maize, Nutrient digestibility, Rabbit.

I. INTRODUCTION

The need for animal products will rise consistently in response to increasing world population which in turn is posing so much pressure on the livestock industry (Assan, 2018). To meet the growing demand for animal protein, mini livestock production has been identified as alternative animal production strategy that could bridge the gap. However, rabbit is the most common and accessible among other mini livestock class in Nigeria.

Increased rabbit production is a fast means of meeting the animal protein requirements of the Nigerian populace (Iyeghe-Erakpotobor *et al.,* 2002). This is because of its high fecundity, high genetic potential, rapid growth rate and relatively low cost of production. Rabbit (*Oryctolagus cuniculus*) has short generation interval, high prolificacy, good mothering ability and easy management requirements, with ability to utilize waste and other non-conventional feed sources. The unique digestive physiology of rabbit has made it possible to use what other single stomach animals cannot utilize. For instance, rabbits can feed on a wide variety of grasses, herbs, leafy weeds, vegetables and household wastes or garbage. Besides, rabbit meat is high in protein content (about 22 %), low in fat (about 4 %) and cholesterol (about 5 %) which can contribute positively towards improving the good health of the populace (Aduku and Olukosi, 1990).

Sadly, the increase in rabbit production in Nigeria is challenged with series of problems ranging from high cost of feed, poor nutrient digestibility, diseases, poor management system and host of others (Asar *et al*., 2010). Therefore, conscious efforts need to be made to address such menace with the view of keeping pace between supply and demand of quality animal protein from rabbits (Makinde *et al*., 2014).

II. MATERIALS AND METHODS

2.1 Experimental site and Duration

The experiment was conducted at the rabbitry unit of the Faculty of Agriculture Research and Demonstration Farm of the University of Port Harcourt, Choba Rivers State, Nigeria. It is located on the 4°45'N, 6°50'E,(4.750°N, 6.833°E),having an annual temperature of 26°C (78.8°F) (Chima and Ofodile, 2015).The experiment lasted for eight weeks (8)

2.2 Experimental Rabbits and Management

Twenty (24) dutch rabbits of both sex of about 8 weeks old with mean weight of 745 ± 2.5 g were used in this study. The rabbits were purchased from Micheal Okpara University of Agriculture, Animal Breeding unit, Umudike, Abia state. Prior to commencement of the experiment, the hutches were well cleaned and disinfected with saponated creso (Izal) and allowed to dry for seven (7) days before the rabbits were introduced therein. The rabbits were conditioned for seven days (7) to facilitate their adaptation of the rabbits to the new environment before commencement of the experiment. During the adaptation period, they were fed commercial ration (grower's mash) and water given ad-libitum. The rabbits were treated against external and internal parasites using *ivomectin* ® at 0.2ml per rabbit prior to commencement of the experiment. A broad spectrum antibiotic (water soluble powder) and protective, absorbent anti-diarrhoea (dry suspension) were used in drinking water against bacterial infection.

2.3 Experimental Design

24 Dutch rabbits were randomly assigned to four dietary treatments using a Completely Randomized Design (CRD), and were individually weighed having 6 rabbits each,

2.4 Experimental diet

The noodle waste for the feeding trail was purchased from Mordern Agro Enterprise, Port Harcourt, Rivers State. The noddle waste was formulated with conventional feed stated as follow, T1 contained 0% of noddle waste, T2 contained 6% of noddle waste, T3 contained 12% of noddle waste, and T4 contained 18% of noddle waste as shown in Table 1 below:

TABLE 1
PERCENTAGE INGREDIENTS AND CALCULATED NUTRIENT COMPOSITION OF THE DIETARY TREATMENTS

Ingredients	T1	T2	T3	T4
Yellow maize	48.00	42.09	36.09	30.09
Indomie waste	0.00	6.00	12.00	18.00
Wheat bran	10.75	10.75	10.75	10.75
PKC	12.42	12.42	12.42	12.42
Soybean Meal	12.0	12.0	12.0	12.0
GNC	8.48	8.48	8.48	8.48
Bone meal	4.5	4.5	4.5	4.5
Salt	0.13	0.13	0.13	0.13
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Vit/min premix	3.13	3.13	3.13	3.13
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**

TABLE 2
PROXIMATE COMPOSITION OF THE EXPERIMENTAL DIETS

Parameters	T_1	T_2	T_3	T_4	SEM
Crude protein	14.90^{d}	11.84^{c}	22.34^{b}	25.41^{a}	0.01
Dry matter	83.53^{d}	88.53^{a}	87.40^{c}	88.21^{b}	0.02
Crude fat	4.63^{a}	1.83^{c}	3.93^{b}	3.93^{b}	0.02
Ash	8.23^{a}	5.33^{b}	5.13^{c}	4.63^{d}	0.02
Crude fibre	7.10^{a}	2.14^{c}	7.00^{a}	4.65^{b}	0.02
NFE	48.68^{d}	67.41^{a}	54.02^{b}	49.61^{c}	0.07

^{a,b,}***Means within each rows showing different superscript differ significantly (P<0.05)***

2.5 Data Collection

2.5.1 Nutrient Digestibility

Digestibility study was conducted using four rabbits per treatment at the end of feeding trial. The faeces were weighed and oven-dried at 80^{o}C for twenty four hours (24 hrs). The oven-dried faeces per replicate were also weighed at the end of the digestibility study. The faeces from each replicate were bulked, thoroughly mixed together and ground. Samples of ground faeces were stored in airtight sample bottles for proximate analysis. The faecal samples was analyzed for dry matter (DM), crude protein (CP), crude fibre (CF) , ether extract (EE) and total ash (TA) at the Laboratory. Nitrogen-free extract (NFE) was also calculated as described by Association of Official Analytical Chemists (AOAC, 2006) as shown below:

%NFE = 100 – (%CP + %CF + %EE + %Ash)

Digestibility coefficients was calculated using the following equation:

Percentage digestibility = X100

2.5.2 Cecal parameters

Samples of cecal contents were collected from each rabbit (n = 16) into nylon bags after the animals were euthanized. Consistent with the procedures outlined by Belenguer *et al*. (2005), the cecal contents were immediately measured for pH with a glass electrode pH-meter. From these samples, two 1 g aliquots of cecal contents were acidified with 0.2 mol/L HCl and 0.15 mol/L H_3PO_4 into 50 mL disposable centrifuge vials and stored at −20 °C pending determination of ammonia and short chain fatty acids (SCFA), respectively. Samples for NH_3 analysis were mixed 1:1 with a 25% solution of meta-phosphoric acid and frozen, then separated into supernatant and analyzed according to the procedures of Mullins *et al.* (2007).

2.6 Statistical Analysis

Data collected from the study were analyzed with statistical analysis of variance (ANOVA) using Statistical Package for Social Science (SPSS). Treatment means were compared using Duncan multiple range test of the same software.

The Statistical Model is stated as:

Yij = U + Ti + Eij

Where; Yij = Single Observation

U = Population mean

Ti = Effect where ith treatment where i = 1, 2…4

Eij = Random error.

III. RESULTS

3.1 Nutrient digestibility of rabbit fed indomie waste as partial replacement for maize

The nutrient digestibility of rabbits fed indomie waste meal partially replaced for maize is presented in Table 3. The crude protein, dry matter, crude fat, ash, crude fibre and nitrogen free extract were significantly different (P < 0.05) among treatments. Increase in the inclusion levels of indomie waste led to increased digestibility in Dry matter, ash, and nitrogen free extract with

rabbits in Treatment 4 showing superior values with respect to other treated groups. Rabbits fed diet 2 showed a significant (P<0.05) increase in nutrient digestibility values in crude protein, crude fibre, and crude fat than those fed diets 1, 3, and 4. Thus, crude fibre was better digested among rabbits in the control groups when compared to others.

TABLE 3
NUTRIENT DIGESTIBILITY OF RABBIT FED INDOMIE WASTE AS PARTIAL REPLACEMENT FOR MAIZE

Parameters	T_1	T_2	T_3	T_4	SEM
Crude protein	72.33^b	112.70^a	27.19^d	30.76^c	0.77
Dry matter	25.52^b	24.79^c	17.71^d	28.02^a	0.04
Crude fat	12.43^d	223.55^a	194.01^b	53.35^c	8.6
Ash	35.59^c	86.86^b	88.24^b	261.15^a	4.23
Crude fibre	55.77^b	65.77^a	27.92^c	5.98^d	2.01
NFE	21.32^b	11.86^b	12.31^b	66.35^a	3.25

^{a,b,}Means within each rows showing different superscript differ significantly (P<0.05)

3.2 Cecal parameters of rabbit fed indomie waste as partial replacement for maize

The cecal parameters of rabbit fed indomie waste as partial replacement for maize was shown in Table 4 Result from the study showed that cecal pH and NH_3 differs significantly (P<0.05) among the treated groups. Thus, values for cecal pH were statistically highest among rabbits fed Treatment 4 with decreased levels of NH_3 with respect to other dietary treatments.

TABLE 4
CECAL PARAMETERS OF RABBIT FED INDOMIE WASTE AS PARTIAL REPLACEMENT FOR MAIZE

Parameters	T1	T2	T3	T4	SEM
Cecal pH	6.45^b	6.41^b	6.33^c	7.01^a	0.02
Cecal NH_3	4.80^a	4.70^a	4.5^b	3.4^c	0.01

^{a,b,} means within each rows showing different superscript differ significantly (P<0.05)

IV. DISCUSSION

The result from the present study was consistent with the works of Lala *et al*. (2011) who stated that the dry matter, crude protein, and crude fibre digestibility showed significant (P>0 05) difference with an inclusion of instant noddle waste in rabbits as compared to those in the control.Generally, dry matter content indicates the presence of and quantity of nutrients in a feed sample. Thus, the notable elevation in dry matter digestibility among rabbits fed diets 4 when compared to those in the control is in consonance with the findings of Ieuzo *et al*., (2013) and Fadiyimu *et al*. (2010) who recorded higher dry matter digestibility of growers rabbits fed corn based diet partially replaced with macaroni waste meal. This shows that indomie waste possess the nutrient requirements necessary for the wellbeing of the growers rabbits as corroborated by the works of Ortiz-Chura *et al*. (2018). The higher digestibility coefficient of crude protein obtained in diet 2 indicated that the dietary protein was better utilized by the rabbits fed the test diet. This perhaps supports the assertion that the inclusion of indomie waste meal partially replaced for maize may have influenced the digestibility, since dietary protein have been shown to enhance digestibility (Ahamefule, 2005). Similar results were also observed by (Cheek *et al*. (2014); Okolo *et al*. (2012) who reported that protein digestibility decreased with decreasing levels of dietary protein.

The results of crude fibre digestibility in this study showed that crude protein content of diets was positively correlated with crude fibre digestibility. Crude protein and crude fibre are components of dry matter and therefore any factor that affects the dry matter of a feed would similarly affect the crude protein and crude fibre component of the same feed (Ahamefule, 2005). This may explain why the digestibility coefficient of crude protein and crude fibre was elevated in T2. Furthermore, the higher crude fibre digestibility coefficient of T2 may suggest an increase in the activities of fibrolytic bacteria in the cecal content probably as a result of the availability of essential nutrients especially protein, energy, vitamins and minerals which are evident in indomie waste meal to enhance microbial growth and multiplication in grower rabbit.

With the exception of diet 1, the similarities in ash digestibility between the diets (T2, and T3) agrees with previous observations that diets with adequate mineral supplementation hardly vary in their total mineral digestibility Onifade and Tewe, (2013). Thus, the significant elevation in digestibility of fat in treatment 2 is in agreement with the observation of Cheek,

(2006) and Onifade and Tewe, (2013). This attested to the good ability of rabbits to utilize dietary fat in indomie waste meal partially replaced for maize as corroborated by the findings of Beyen, (2008).

However, the statistical similarities for nitrogen free extract in the control group, diet 2, and diet 3 during the study indicated that indomie waste possesses considerable extraction of energy to meet the energetic requirements of grower rabbits, and this is in line with the findings of Cheeke *et al*. (2011); Onifade and Tewe, (2013) that high values of digestibility in nitrogen free extract improves performance.

The significant ($P<0.05$) difference cecal PH observed in the present study are in accordance with those obtained by Taie *et al*. (2006) who found that incorporation of industrial waste in rabbit diets led to significant ($P<0.05$) differences in cecum parameters. This was contrary to the report by Helal *et al*. (2021) who stated absence of notable differences among rabbits fed graded levels of kitchen food waste and instant noddle waste. The noted confliction in the obtained results regard to the current result and those reported by the previous author may be related to breed of rabbit, method of determination, constituent of the feed and its utilization as supported by (Onifade and Tewe, (2013).However, (Abo-Egla *et al.* (2013) reported that caecum pH value is one of the most important factors which affect bacterial fermentation in the caecum. Thus, the significant increase of Caecum pH among rabbits fed 18% inclusion level of noddle waste was consistent with the works of Ramadan *et al*., (2009) who reported that the highest acidity was recorded for rabbits fed diets containing 16% crude fiber. So, such superior values of Caecum pH in the current study may be attributed to an increase in dietary fibre from the noddle waste due to increasing levels of the test diet from the study as opined by the works of (Bellier and Gidenne, (1996). This also shows that the high fibre content in noddle waste wasn't just indigestible, but fermentable carbohydrate which can escape degradation in the small intestine and reach the large intestine, to stimulate microbial growth and multiplication that could improve digestion of feeds (Dwivedi, 1991).

Concerning NH_3-N concentration, noddle waste supplementations influenced its activities with reference to control. According to Macfarlane and Gibson (1995) a series of factors could influence NH_3-N concentrations within the cecum, including H_2 pressure, chyme reaction, and carbohydrates availability. In comparison with ruminants, proteolytic activity in the rabbit cecum is relatively higher and ammonia levels fluctuate between 1.86–23.9 mmol·l-1 as shown by Gidenne, (1997) and Garcia *et al*. (2002). Thus, the reduced level of NH_3-N concentrations observed among rabbits fed partial replacement of maize with noddle waste at 18% inclusion levels could be attributed to the great ability of noddle waste to absorb ammonia. Ivan *et al* (1992) speculated that, industrial waste could also absorb some proportions of proteolytic enzymes, which would then be unable to act on the dietary proteins or it could absorb free dietary amino acids that also would not be accessible to bacterial fermentation. These results are in agreement with those reported in ruminants by (Saleh (1994) who found that, addition of industrial waste led to a decrease in ruminal NH_3-N concentration.

V. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Results from this study suggest that partial replacement of maize with noddle waste could lead to improvement in nutrient profiles of the rabbit diet and favorable modifications in cecal environment presumably, acidification of cecal contents and stabilization of ammonia nitrogen concentrations. These alterations should be considered as an advantage, as they improve the impact of the supplemented noddle waste on cecal fermentation pattern and rabbit metabolism.

5.2 Recommendation

Rabbits fed partially replaced noddle waste at 6% inclusion showed better digestibility of nutrients when compared to other inclusion levels and should be adopted by rabbitry owners, as well as nutritionist. However, subsequent investigations is recommended to complement the result from the present study.

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