PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 10 (2): 155-158, 2011
ISSN 1680-5194

Fortification of the Nutritive Value of Mushroom (*Termitomyces microcarpus*) with Paw-Paw Leaf Meal for Broiler Chicks Diet

C.I. Ebenebe[1], O. Itefue[1], T.C. Ebere-Ohameje[2] and J.C. Okonkwo[3]
[1]Department of Zoology, Nnamdi Azikiwe University Awka, Anambra State, Nigeria
[2]Department of Fisheries, Ministry of Agriculture and Natural Resources, Owerri, Imo State, Nigeria
[3]Department of Agricultural and Bioresource Engineering,
Nnamdi Azikiwe University Awka, Anambra State, Nigeria

Abstract: The effect of fortifying the nutritive value of mushroom with paw-paw leaf meal in the diet of broilers was studied using one hundred and eight day old chicks. Three diets were formulated, the first which served as control had no mushroom (Diet A) and the second diet had 2% mushrooms (Diet B) while the third had 2% mushroom and 2% paw-paw leaves (Diet C). Thirty-six broiler chicks were randomly assigned to each of the three dietary at the rate of twelve chicks per replicate and three replicates per experimental unit in a Completely Randomized Design (CRD). Beside feed trail period, the experiment lasted for five weeks. During this period, the birds were subjected to similar husbandry and sanitation practices; daily records of food intake and weekly record of weight gain were taken. Data obtained were subjected to ANOVA appropriate for Completely Randomized Design and the differences between means were separated using Least Significant Differences (LSD). The result showed that birds fed with control diet had the highest feed intake of compared to those fed Diet B and Diet C. Broiler chicks on Diet C however had the highest records in all the productive indices (weight gain, specific growth rate and food conversion ratio) investigated. The study therefore recommends inclusion of at least 2% paw-paw leaf meal in broiler chicks' diet that contains mushroom.

Key words: Mushroom, paw-paw leaf meal, diet and nutritive value

INTRODUCTION

Poultry production, especially broiler chicks has remained one of the viable ways of achieving sustainable and rapid production of high quality animal protein to meet the demands of Nigerian teeming population (Apata and Ojo, 2000). However, the major constraint of poultry production is the high cost of energy and protein concentrates. Animal scientists, nutritionists and poultry farmers are therefore challenged to provide alternative low cost feed ingredients that will improve yield and the profitability of the business so as to attract more investors into the industry.

Mushroom, a macro-fungi with distinctive fruit bodies (Fasidi, 2006) may be a useful ingredient for livestock feed if the nutrients locked in the cell wall can be successfully harnessed. Edible mushroom has been reported to contain all essential amino acids, linoleic acid (An unsaturated fatty acid considered desirable for good health), vitamins such as thiamine (B1), riboflavin (B2), niacin, biotin, ascorbic acid (C) and low fat content (Oei, 2003). Oei (2003) also reported that mushroom contain between 19-35% protein on wet basis and is also rich in lysine which is a limiting amino acid in most cereal grains (Kadiri, 2006) as well as some important minerals (Vetter, 2007). The chemical composition of these mushrooms however, show other constituents which can affect the digestibility or have negative effects. The main components of the fungal cell wall are the polysaccharides (80-90% of the dry matter). The N-containing chitin is one of the skeletal fungal polysaccharides responsible for the rigidity and shape of the cell wall and so lowers its digestibility (Vetter, 2007). Inclusion of mushroom in livestock feed has been attempted (Tangol, 1976; Onyimonyi and Onu, 2009) and in rats (Nadubuya *et al*., 2010).

The edible mushroom *Termitomyces microcarpus* belong to a group of organisms known as eukaryotes, subdivision Basidiomycetes, tribe Termitomyeteae and species microcarpus. They grow basically in the wild usually in the rainy season in places where termite mounds are found (Nadubuya *et al*., 2010; Oei, 2003). Oei (2003) noted that the nutritional value of *Termitomyces* is better than that of cultivated White button mushroom and that they contain more protein than *Agaricus*. Fibre rich feed ingredients result in poor performance of poultry birds. Use of synthetic enzyme to improve utilization of fibre rich ingredients is common in literature but there is paucity of information on the use of natural enzymes like papain (found in the latex of paw-paw leaves) and bromelain (found in pineapple). Papain

Corresponding Author: J.C. Okonkwo, Department of Agricultural and Bioresource Engineering, Nnamdi Azikiwe University Awka, Anambra State, Nigeria

is a cysteine protease capable of improving protein digestion and utilization. Apart from papain, Mohamed *et al*. (1997) reported the presence of Class II chitinase enzyme in the latex of tropical species of paw-paw (*Carica papaya*) which is of dietary importance. This study therefore intends to assess the effect of the use of paw-paw leaves in improving the nutritive value of mushroom for broilers chicks.

MATERIALS AND METHODS

Experimental site: The study was carried out in the Animal section of the Department of Zoology Research and Teaching Laboratory, Nnamdi Azikiwe University, Awka, Anambra state, Nigeria. Anambra State falls within the humid tropics. One hundred and eight day old broiler chicks were purchased from a reputable poultry farm. The chicks were allowed to acclimatize with the environment for seven days before the onset of the experiment.

Experimental design: The experiment was carried out in a Completely Randomized Design (CRD). Treatment (Diet) was handled in three levels with three replicates. The model therefore is:

$$Y_{ij} = \mu + t_i + €_{ij}$$

Where:

Y_{ij} = Observed effect of the treatment on the performance of the birds

μ = Population mean

t_i = Treatment effect

$€_{ij}$ = Error term associated with the observations

Assumptions: The error terms are randomly, independently and normally distributed with a mean, zero and a common variance. The main effects are additive.

Experimental animals: The chicks were vaccinated against New Castle and Gumboro before the onset of the experiment. Within the one week period when the birds were left to acclimatize with the environment, they were fed with commercial feed, thereafter the chicks were randomly grouped into three and each group subjected to different dietary treatment.

Preparation of paw-paw leaf meal: Fresh paw-paw leaves were harvested from the paw-paw plants behind the Zoology laboratory. The leaves were spread on bare floor inside the laboratory to dry under shade for two weeks so as to retain its greenish colouration. The dried leaves were fragmented by rubbing between palms and spread close to a window to let in air and sunlight for two days to make the leaves crispy to facilitate milling. Thereafter, the leaves were milled before incorporation into the experimental diet. Part of the milled leaves was analyzed for proximate composition in accordance with the official methods of the Association of Official and Analytical Chemists (AOAC, 1990).

Preparation of mushroom: The mushrooms were procured from mushroom collectors in a forest at Envwreni, Ughelli North Local Government Area of Delta State within the Forest ecological region of southern Nigeria. They were sun-dried for three days to a stable moisture content of about 10%. The soils attached to the “roots” were removed and the mushrooms were later oven-dried at 60-70^{0}C for 48 h (Nadubuya *et al*., 2010) to ease grinding. They were later milled before being incorporated into the experimental diets. Part of the milled mushroom was analyzed for proximate composition in accordance with the official methods of the Association of Official and Analytical Chemists (AOAC, 1990).

Experimental diet: Three diets were formulated and designated Diet A, Diet B and Diet C. Diet A had no mushroom, Diet B had 2% mushroom while Diet C had 2% Mushroom and 2% paw-paw leaves. The experimental diets were equi-protein and caloric levels as shown in Table 1. All rations were mixed thoroughly with mixer after grinding to similar mesh size and bagged before use.

Table 1: Proximate composition of the experimental diets

Ingredients	Diet 1	Diet 2	Diet 3
Maize	57.50	57.50	57.50
Soyabean	27.00	25.00	23.00
Fishmeal	4.00	4.00	4.00
DBG	5.00	5.00	5.00
Mushroom	-	2.00	2.00
Paw-paw leaf	-	-	2.00
Palm oil	2.00	2.00	2.00
Bone meal	2.50	2.50	2.50
Oyster shell	0.50	0.50	0.50
Premix/vitamins	0.50	0.50	0.50
DL methome	0.30	0.30	0.30
Lysne-HCl	0.20	0.20	0.20
Salt	0.50	0.50	0.50
Proximate composition of the experimental diets (%)			
Crude protein	20.65	20.36	20.06
Crude fibre	3.95	4.24	4.46
Ether extract	4.43	4.45	4.45
Ash	5.49	6.22	6.68

Housing/management of experimental chicks: One hundred and eight chicks were randomized into three treatments of three replicates each. Thus, twelve birds comprised a replicate group and were housed separately in a metabolic cage. Feed and water were served *ad libtum* using clean feed and watering trough. Within the five weeks period of the experiment, the birds were subjected to similar management and sanitation practices.

Data collection: The birds were weighed at the beginning of the experiment and thereafter at weekly intervals. Daily feed intake was determined using a weighing scale calibrated in grammes, weight of leftover and spilled food subtracted from weight of feed served gives the weight of feed intake on daily basis. Subtraction of initial weight of birds from weekly weight gives the weight increase per week. These weights were later divided by seven to give daily record of weight increase. Metabolic weight gain and feed efficiency were calculated using the following formula:

Feed efficiency = Total weight gain (g)/Total feed intake (g)

Statistical analysis: Data collected were summarized and subjected to analysis of variance appropriate for Completely Randomized Design and the differences between treatment means were separated using Least Significant Difference (LSD).

RESULTS

Table 1 presents the proximate composition of the experimental Diets, while the nutrient profiles of paw-paw leaf meal and mushroom meal are presented in Table 2. Then, the result of performance of broiler birds on the three dietary treatments is shown in Table 3. Broiler birds on Diet C which contained 2% of paw-paw leaf meal and 2% mushroom together with other ingredients performed significantly better ($p<0.05$) better than those on commercial feed (Diet A) and those on diet B containing 2% mushroom in terms of final weight and daily weight gain. The final weights were 1878.24±2.71, 1488.6±3.23 and 1985.6±2.33, respectively for birds on Diet A, B and C. Daily weight gain of birds also followed the same trend with the birds on Diet C (containing mushroom and paw-paw leaves) having the highest record of 44.93±2.97 g/day, while birds on Diet B (containing mushroom) had the least record 40.34±2.71 g/day. The feed intake was however more ($p<0.05$) in birds on commercial feed (Control/Diet A) and least in birds on Diet B. The actual figures were 77.3±2.30 g/day, 67.6±3.40 g/day and 71.6±2.87 g/day, respectively for birds on Diet A, Diet B and Diet C. The Feed conversion ratio expectedly was highest for birds on Diet B and least for birds on Diet C.

Table 2: Proximate composition of paw-paw leaf meal (*Carica papaya*) and mushroom meal in % DM basis

	Paw-paw meal	Mushroom meal
Crude protein	28.20	24.56
Crude fibre	11.30	12.32
Ether extract	0.38	2.23
Ash	8.82	22.00
NFE	37.80	29.00

DISCUSSION

Poor performance of birds on Diet B containing 2% mushroom may be due to the fact that mushroom has some constituents that limit digestibility (Oei, 2003; Vetter, 2007). According to Vetter (2007), the main components of the fungal (Zygo-, Asco- and Basidiomyces) cell wall are N-containing chitin which decrease digestibility. The lower feed intake of birds on Diet B which contributed to poor performance of the birds may be the result of their higher fibre content. High dietary fibre has been reported to delay release of chyme from stomach into the intestine. This effect creates a feeling of satiety as well as slowing down of the digestion process resulting in low intake of feed (Nadubuya *et al*., 2010). Excellent performance of the chicks on Diet C containing both mushroom and paw-paw leaf meals may be explained in two ways. Firstly, it could be that the enzyme chitinase preponderance in paw-paw leaf meal acted on or breakdown the chitin domicile in mushroom meal, thereby, releasing the nutrients locked up in the cell walls of mushroom. This is possible because, Mohamed *et al*. (1997) reported that the latex of tropical paw paw plants is a rich source of Class II chitinase and Onyimonyi and Onu (2009) also observed better performance and organoleptic properties of finisher broilers fed Diets containing paw-paw leaf meal. Secondly, papain, an enzyme found in paw-paw leaf meal is also a protease (proteolytic) enzyme capable of aiding/enhancing protein digestion.

The study therefore recommends the fortification of mushroom based poultry diets with at least 2% paw-paw leaf meal and further studies on isolation and characterization these two important enzymes (chitinase and papain) in order to produce them synthetically from paw-paw.

Table 3: Performance of chicks under each dietary treatment

	Control	DWM	DWMP
Initial wt. (g)	445.8±2.23	446.8±2.40	445.5±2.46
Final wt. (g)	1878.2±2.71^{b}	1488.6±3.23^{c}	1985.6±2.33^{a}
Daily feed intake (g/day)	77.3±2.30^{a}	67.6±3.40^{c}	71.6±2.87^{b}
Daily wt gain (g/day)	40.34±2.71^{b}	29.77±3.33^{c}	44.93±2.97^{a}
Feed/wt. gain	1.88^{b}	1.93^{a}	1.62^{c}

*Means bearing different superscripts in the same row are significantly different ($p<0.05$). Where DWM: Diet with Mushroom and DWMP: Diet with Mushroom and paw-paw leaves

REFERENCES

Apata, D.F. and V. Ojo, 2000. Efficiency of the *Trichoderma viride* Enzyme Complex in Broiler Starter Fed Cowpea Testa Based Diets. Book of Proceedings of the 25th Annual Conference of Nigerian Society of Animal Production, pp: 132-133.

AOAC, 1990. Association of Official Analytical Chemists. Official Method of Analysis, 13th Edn., Washington D.C.

Fasidi, J.O., 2006. Substrate Source and Preparation for Mushroom Cultivation. A Paper Presented at the Workshop on Cultivation of Edible Mushroom, Department of Botany, University of Ibadan, Nigeria. 20th-22nd November 2006.

Kadiri, M., 2006. History of Mushroom Cultivation. A Paper Presented at the Workshop on Cultivation of Edible Mushroom, Department of Botany, University of Ibadan, Nigeria. 20th-22nd November 2006.

Mohamed, A., A. Amrani, M. Nije, A. Vandermeers, S. Zerhouni, N. Smolders and Y. Looze, 1997. *Carica papaya* latex is a rich source of a class II chitinase. Photochemistry, 46: 1319-1325.

Nadubuya, A., J.H. Muyonga and J.D. Kabasa, 2010. Nutritional and hypocholesterolimic properties of *Termitomyces microcarpus* mushroom. Afr. J. Food, Agric., Nutr. Dev., 10 (3). www.ncbi.nlm.nih.gov/pubmail/20.

Oei, P., 2003. Mushroom Cultivation: Appropriate Technology For Mushroom Growers. Backhuys Publishers, Leiden, The Netherlands, pp: 429.

Onyimonyi, A.E. and E. Onu, 2009. An assessment of paw-paw leaf meal as protein ingredient for finishing broiler. www.pjbs.org/ijps/fin1533pdf. Assessed 30th September 2010.

Tangol, R., 1976. Diccionario etimologico Chiloe, Chiloe, Chile.

Vetter, J., 2007. Chitin Content of Cultivated Mushrooms *Agaricus bisporu, Pleurotus ostreatus* and *Lentinula edodes*. Food Chem., 102: 6-9. www.elsevier.com/locate/foodchem.