

EFFECT OF AQUEOUS *Tetrapleura tetraptera* (AFRICAN PORRIDGE FRUIT) ON PERFORMANCE AND GUT MORPHOLOGY OF BROILER CHICKENS

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ABSTRACT

A study was conducted for 8 weeks to determine the effect of administering varying levels of aqueous *Tetrapleura tetraptera* (African porridge fruit) on performance and gut morphology of broilers. A total of 150 day old broiler chicks (Abor acre) were randomly selected and allotted to 5 treatments and 6 replicates per treatment. The experimental ingredient was extracted and served to the birds in the 5 different treatments as follows; Control (water with no additive), Positive control (antibiotics), 3, 6 and 9 mls respectively. Total weight gain, feed intake and feed conversion efficiency were not ($P > 0.05$) significantly different across the varying levels of *Tetrapleura tetraptera* administered. There were also no differences in feed conversion ratio of birds administered with *Tetrapleura tetraptera* compared with those on antibiotics. Broiler's gut parameters measured indicated that there were no significant differences ($P > 0.05$) across the varying levels of the *Tetrapleura tetraptera* extract administered on the broilers. The study demonstrated that administration of *Tetrapleura tetraptera* extract in water for broilers compared favorably with birds on antibiotics though no significant differences were recorded

Keywords: *Tetrapleura tetraptera*, Performance, Gut morphology, Broiler chickens

INTRODUCTION

In Africa and other less developed nations, the low level of supply of animal protein is due to the poor performance of livestock, which has been attributed to factors such as inadequate nutrition, high price and poor quality of feeds and inefficiency in production and distribution in the feed industry (Tewe, 1997). It is noteworthy that several attempts have been made in this region to reduce feed cost while improving productivity of high-meat yielding exotic poultry like broiler chickens. These include the use of agro-industrial by-product, leafy vegetable protein concentrates (Agbede and Aletor, 2003), and maggot meal (Awoniyi *et al.*, 2004). In pursuit of improved chicken healthiness and in order to fulfill consumer expectations in relation to food quality, poultry producers commonly apply natural feeding supplements, mainly herbs (Gardzielewska *et al.*, 2003).

Antibiotics have been added to poultry diets to maintain health and production efficiency in the last few decades (Rosen, 1995). Recently, there has been an increase in the indiscriminate use of antibiotics as feed supplement. The use of antibiotics has been discovered to have side effect that can sometimes prove to be difficult to manage than the ailment they are meant to cure. They destroy friendly bacteria along with disease causing organisms and because of this, resistance by pathogenic bacteria has developed which can impact on public health. Therefore, antibiotics are being taken out of poultry and pig diets around the world (Dibner and Richards, 2005). The search for alternatives to replace the use of antibiotics has gained increasing interest in animal nutrition in recent years.

Medicinal plants includes plants or plant parts, which in one or more of its organ contains substances that can be used for growth promotion, therapeutic or curative purposes, and which also are precursors for

the synthesis of useful drugs (WHO, 1975). Spices which include plant materials of medicinal importance have been used for the treatment of human ailments as far back as prehistoric times (Cowan, 1999).

Tetrapleura tetraptera commonly known as "aridan" (Yoruba name) fruit in south western Nigeria is a medicinal plant of the *mimosaceae* family. It is specie of flowering plants in the pea family native to the western parts of Africa. The fruit consist of a fleshy pulp with small brownish black seeds, and possesses a fragrant characteristic pungent aromatic odor (Aladesanmi, 2007). Its sweet fragrance is highly valued, thus making it a popular seasoning spice in southern and eastern Nigeria (Okwu 2003 *et al.*). It is also used for the treatment and management of convulsion, leprosy, inflammation, rheumatism (Ojewole and Adewumi 2004). The fruit can also be used traditionally for the treatment and control of adult onset type 2 *Diabetes mellitus*. It is also discovered to be used as an insect repellent because of its characteristically pungent aromatic odor. The aqueous fruit extract has also been shown to have hypoglycaemic properties.

OBJECTIVES OF THE STUDY

- To determine the effect of aqueous extract of *Tetrapleura tetraptera* on performance and gut morphology of broiler chickens.
- To determine if aqueous extract of *Tetrapleura tetraptera* can conveniently replace antibiotics.

MATERIALS AND METHODS

Location and duration of experiment

The experiment was carried out for 8 weeks at the pullet unit of the Teaching and Research Farm, Faculty of Agriculture and Forestry of University of Ibadan.

Experimental birds and design

One hundred and fifty day old Arbor-Acre broiler chicks were randomly selected, weighed and put into their respective pens. Birds were randomly allotted to five treatments and five replicates with six birds per replicate making a total of 30 birds per treatment. The design of the experiment was completely randomized design.

Experimental diets and aqueous *tetrapleura tetraptera* inclusion

Diets were formulated to meet the broilers' nutrient requirement e.g. energy, protein, fats, minerals and vitamins. 20g oven dried and milled *Tetrapleura tetraptera* was dispensed in 200ml of water (ratio 1:20) with subsequent stirring for 30 minutes and allowed to stand for 2 hours before filtering it using muslin cloth. The filtrate was then allowed to pass through filter paper. The filtrate was dispensed in water at varying concentrations e.g. 3mls/litre, 6mls/litre and 9mls/litre respectively. The same diet was given to the birds with varying concentration of *Tetrapleura tetraptera* aqueous extract served as negative and positive controls respectively i.e. Treatment 1 contained neither *Tetrapleura tetraptera* nor antibiotics, Treatment 2 contained only antibiotics and Treatments 3, 4 and 5 contained 3, 6 and 9mls/litre of *Tetrapleura tetraptera* in water respectively.

Parameters measured

Performance characteristics were measured as follows:

- Feed consumed = initial feed supply – final feed remaining
 - i. The weight of the birds per week
 - ii. The weight gained by the bird per week. The weight gained was used in calculating feed conversion ratio as thus;
 - iii. Water intake was measured per week as thus; Water intake = initial water supplied – final water remaining
- Weighing of the birds was done weekly. This was done per replicate for a period of eight weeks. Average age per treatment was calculated by

dividing the total weight of the birds by the number of bird in the treatment. The weight gain was obtained by subtracting the live weight of birds at the beginning of every week from the final weight of the birds at the end of the week this was done per replicate.

Gut morphology of the small intestine

Intestinal tissues were obtained immediately after slaughter. Segments were removed from the duodenum and ileum as follows:

- 1) Intestine from the gizzard to pancreatic and bile ducts was referred to as the duodenum
- 2) The ileum was defined as the region from Meckel's diverticulum to a point 40 mm proximal to the ileo-cecal junction.

Tissue samples (3cm) were taken at the midpoint of each section and immersed in a phosphate-buffered formalin solution. Two portions per sample were cut perpendicular to the longitudinal axis of the intestine. Transverse sections were cut (3µm), stained by hematoxyline-eosin, and analyzed under a light microscope to determine morphometric indices using image-analysis software. The morphometric variables included villus height, crypt depth, muscular wall length. The ten longest and straightest villi and associated crypts were measured from each segment. Measurements for the villi height were taken from the tip of the villus to the villus-crypt junction. The crypt depth was defined as the depth of the invagination between adjacent villi and the villus width was measured at the top and bottom of villi internal muscular layer and tunica muscularis measurement was performed from under part of submucosa until outer part of external muscularis layer. The mean from 10 measurements per sample was used as the average value for further analysis.

Statistical analysis

The data obtained were subjected to statistical analysis using analysis of variance (ANOVA) of SAS (1999) and significant means were separated using the Duncan Multiple Range Test.

Table 1: Gross composition of experimental starter diets fed to broiler chickens treatments

Ingredients	1 (-ve control)	2 (+ve control)	3	4	5
Maize	55.50	55.50	55.50	55.50	55.50
Soybean meal	26.50	26.50	26.50	26.50	26.50
GNC	15.00	15.00	15.00	15.00	15.00
Fish meal (72%)	0.35	0.35	0.35	0.35	0.35
DCP	1.00	1.00	1.00	1.00	1.00
Oyster shell	2.00	2.00	2.00	2.00	2.00
Methionine	0.15	0.15	0.15	0.15	0.15
Broiler premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Antibiotics	-	0.5ml/litre	-	-	-
<i>Tetrapleura tetraptera</i>	-	-	3ml/litre	6ml/litre	9ml/litre

- 1- Control
- 2- Antibiotics (Enrofloxacin)
- 3- 3mls of aqueous extract
- 4- 6mls of aqueous extract
- 5- 9mls of aqueous extract
- GNC- Groundnut Cake
- DCP- Di-Calcium Phosphate

Table 2: Gross composition of experimental finisher diets fed to broiler chickens

Ingredient	Inclusion (%)
Maize	56.00
Soybean meal	14.50
Groundnut cake	13.00
Wheat ofal	12.50
Fish meal	0.35
Oyster shell	1.00
DCP	1.00
Broiler premix	0.25
Methionine	0.15
Salt	0.25

RESULTS

Performance characteristics

Performance characteristics of broilers administered aqueous *Tetrapleura tetraptera* is presented in appropriate table showing significant differences for feed consumed (intake), average weight gained and feed conversion ratio.

Average weight gain

Values obtained showed that there were no significant differences ($P>0.05$) in total weight gain. It was observed that birds on the Treatment 2 (antibiotics) had the highest numerical value (1248.4g), while birds in treatment 5 (9mls) had the lowest weight gain (1065g).

Feed intake

There were no significant differences ($P>0.05$) in the total feed intake among treatments, though numerically, values ranged from 3382.8g (Treatment 1 – no additive) to 3044.6g (Treatment 5 – 9mls/litre)

Feed conversion ratio

The values for feed efficiency obtained showed that there were no significant differences observed ($P>0.05$) among treatments. The treatments 2 and 4 are the same numerically and have the lowest value (2.67) while Treatment 3 (3mls/liter) had the highest value.

Table 3: Performance characteristics of broilers administered varying levels of aqueous *Tetrapleura tetraptera*

Parameters	Treatments					SEM
	1	2	3	4	5	
Feed consumed(g)	3382.8	3316.6	3379.4	3073.7	3044.6	172.1
Average weight (g)	1216.7	1248.4	1203.3	1184.7	1065	84.8
FCR	2.77	2.67	2.80	2.67	2.86	0.2

SEM – standard error of mean

1- Control

2- Antibiotics (Enrofloxacin)

3-3mls of aqueous extract

4 -6mls of aqueous extract

5 -9mls of aqueous extract

FCR- Feed conversion ratio

Gut morphology

The results of the gut morphology analysis of broiler administered varying levels of aqueous *Tetrapleura tetraptera* in water is presented in the Table 4.

Ileum

It was observed that there were no significant differences across the varying level of the extract administered on ileal morphology of the broilers ($p>0.05$). It was observed that Treatment 2 (antibiotic) had the highest numerical value of crypt depth (249.10um), while the lowest crypt value (210.76um) was on Treatment 5 (9ml). In evaluating the villus height, the results indicated that Treatment 3 (3ml) had the highest numerical value (1188.20um) and Treatment 5 (9ml) had the lowest value (210.76um). Ileal muscular wall thickness was highest on

Treatment 2 (antibiotic – 422.80um), while the control (Treatment 1) had the lowest value (277.00um).

Duodenum

Duodenal morphological analysis showed that *Tetrapleura tetraptera* extracts did not have any significant effect ($p>0.05$) on the parameters measured. Crypt depth measurements revealed that treatment 1 (control) had the highest numerical value (271.09um) and treatment 3 (3ml) the lowest (182.11um). In evaluating for the villus height, the result indicated that treatment 1 (control) also had the highest numerical value (1213.10um) and treatment 3 (3ml) the lowest (1010.10um).

The results obtained showed that treatment 5 (9ml) had the highest muscular wall thickness (403.70um), while treatment 4 (6ml) gave the lowest value (212.70um).

Table 4: Gut morphology of broilers administered varying levels of *tetrapleura tetraptera* extract

Parameters	1	2	3	4	5	SEM
Ileum						
Crypt depth	218.05	249.1	216.41	215.91	210.76	44.92
Villus height	901.6	1178.3	1188.2	1122.3	210.76	154.86
M.Wall length	277.0	422.8	334.1	333.1	348.4	72.08
Duodenum						
Crypt depth	271.09	215.82	182.11	228.68	247.23	34.92
Villus height	1213.1	1082.6	1010.1	1140.1	1038.3	109.96
M.Wall length	330.3	308.7	332.0	212.1	403.7	88.48

M. Wall length; muscular wall thickness

SEM – standard error of mean

1- Control

2- Antibiotics (Enrofloxacin)

3-3mls of aqueous extract

4 -6mls of aqueous extract

5 -9mls of aqueous extract

DISCUSSION

Growth-promoting effects of certain medicinal plants were reported to be comparable to antibiotic treatments (Mountzouris *et al.*, 2009). The result indicated that 6mls of *Tetrapleura tetraptera* compared favourably with antibiotics, there were low feed conversion efficiency in the treatment with *Tetrapleura tetraptera* and antibiotics used. This correlated with the findings on African porridge fruit (*Tetrapleura tetraptera*) which has been reported to enhance the performance of livestock animals. The growth-promoting effects are dependent on the specific additive, the application level, the age of birds as well as the delivery method (water or feed). Some of the important bioactive constituents found in these spices are alkaloids, tannins, flavonoids, saponins and phenolic compounds Muhammad *et al.* (2009). Nweze *et al.* (2011) however observed no significant differences in final weights of broilers fed *Tetrapleura tetrapleura* extracts in their diets; they recorded that *Tetrapleura tetraptera* extracts led to a reduction in feed consumption. Odoemelam *et al.* (2012) also found no differences in final body weights and weight gain of broilers fed varying levels of *Ocimum gratissimum* in their diets. The efficiency with which broilers convert nutrients from feed into body tissue is arguably the most important determinant of profitability in broilers production. Bassett (2000) reported that adding herbal essential oils to the feed or water improved feed conversion and weight of broiler chickens. Studies involved in probiotics across Brazil between 1995 and 2005 seems to indicate that probiotics are a technically viable alternative to feed additive in broiler feeding (Faria Filho *et al.*, 2006). Guo *et al.* (2004) demonstrated that plants and their extracts could improve the growth performance, reduce the populations of coliforms and enhance both cellular and humoral immune responses of chickens.

This finding corroborate partially with results reported by Loddi (2003), in which there were no differences in the villus depth in the jejunum and duodenum of the broiler chickens fed with probiotics and prebiotics. Gut microflora is known to have significant effects on host nutrition, health, and growth performance (Barrow, 1992) by interacting with nutrient utilization and the development of gut system of the host. This interaction is very complex and, depending on the composition and activity of the gut microflora, it can have either positive or negative effects on the health and growth of birds. When pathogens attach to the mucosa, gut integrity and function are severely affected (Droleskey *et al.*, 1994) and immune system threatened (Neish, 2002).

Furthermore, it is generally agreed that gut microflora is a nutritional "burden" in fast growing broiler chickens (Dibner and Richards, 2005), since

an active microflora component may have an increased energy requirement for maintenance and a reduced efficiency of nutrient utilization. Some herbal extracts have also been shown to possess a coccidiostatic activity (Youn and Noh, 2001; Christakia *et al.*, 2004). The combination of these effects can enhance the morphology of the intestine. It was observed in this study that morphological parameters assessed did not differ, with *Tetrapleura tetraptera* extract which compared favorably with antibiotics administration to broiler chickens. However, effects on gut morphology are obviously numerous. Sometimes, phytochemicals irritate intestinal tissues leading to shortage of intestinal surface and on the other side change the microbial population to a more favorable composition. Furthermore, they result in an enhanced secretion of digestive enzymes resulting in an improved gut functioning (Windisch *et al.*, 2009).

Platel and Srinivasan (2004) reported that stimulation of digestive secretions e.g. saliva, bile and mucus and enhanced enzyme activity are their core mode of nutritional action. Similarly, essential oils used as feed additives for broilers were shown to enhance the activities of trypsin and amylase (Lee *et al.*, 2004; Jang *et al.*, 2004). They were also reported to stimulate intestinal secretion of mucus in broilers an effect that was assumed to impair adhesion of pathogens and thus stabilizing the microbial eubiosis in the gut of the animals (Jamroz *et al.*, 2006). On the other hand Kreydiyyeh *et al.*, (2000) observed that cinnamaldehyde and eugenol, a main component of clove essential oils, when fed at high concentrations significantly impaired the absorption of alanine by rat jejunum. Also Odoemelam, *et al.* (2012) stated that the favorable attributes of spices could be masked when they are used in large proportions where the effects of inherent anti-nutritional factors like tannin and saponin become pronounced. These anti-nutritional factors have been reported to affect utilization of nutrients and depress growth.

CONCLUSION

Tetrapleura tetraptera is therefore suggested as an effective natural growth promoter which is readily available, economical and effective in aiding feed conversion to the desired output.

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