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Productive performance of broiler birds fed *Tetrapleura tetraptera* fruit meal containing diets

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Abstract. *A forty-two day feeding trial was conducted to evaluate the effect of diets containing Tetrapleura tetraptera fruit meal on the productive performance of broilers on feed intake, body weight, carcass and organ characteristics. Tetrapleura tetraptera fruit was processed and incorporated in the diets at 0%, 1.0%, 1.5% and 2.0% dietary levels, represented as T1, T2, T3 and T4, respectively, for both starter (7-28 days of age) and finisher phase (28-49 days of age). One hundred and twenty unsexed abor acre broiler birds were brooded for seven days and thereafter 30 birds were randomly allotted to four treatments in a completely randomized design (CRD) and each treatment was replicated three times with 10 birds per replicate. The data collected showed significant ($p<0.05$) differences for feed intake, body weight changes and feed conversion ratio for both starter and finisher broilers. Live weight, dressed weight and dressing percentage were significantly better for T1 across the treatments ($p<0.05$). Wing, drumstick breast muscle and thigh cuts were significantly improved at the treatment groups ($p<0.05$). The gizzard, heart, and spleen were significantly ($p<0.05$) higher at T1. Liver also differed significantly ($p<0.05$) with T4 having the highest weight over other treatments. It could therefore be concluded that T2 produced the best body weight and should be recommended for enhanced broiler production.*

Keywords: spices, unconventional feed stuff, broilers, feed intake, dressing percentage

Introduction

Poultry industry is one of the most dynamic of world agribusiness trade. Research on meat production globally identified broiler as one of the fastest growing sector especially in developing countries (Jiwuba et al., 2018). Poultry production is the most popular enterprise adopted by small and medium scale farmers partly due to efficient feed conversion to animal protein, short generation interval and ease of management. As a matter of urgency, Nigerian poultry industry appears optimistic because the demand for poultry products is expected to increase along with population increase.

The average Nigerian does not consume enough animal protein that is needed for nourishing of the body, tissue development, repairs and healthy living. This is because animal production in Nigeria has not been able to meet animal protein need of the increasing Nigeria's population (Jiya et al., 2016). This resulted in malnutrition experienced among vulnerable groups (children and low income earners) who constitute a majority in the society at large (Uko and Kamal, 2008). The current trend in the cost of feed as well as irregular supply of feed poses a threat to the future of the poultry industry. The Food and Agricultural Organization (FAO, 2007) and Ukpabi et al. (2017) reported that feed prices have jumped to a high record and may further increase due to diminishing supply and increasing demand. The cost of feeding alone represents approximately 75% of the cost of poultry production. It therefore becomes very imperative to intensify the search for cheaper, abundant and locally available alternatives that have no dietary value to man for sustainable production (Odunsi et al., 2007). Exploring cheap feed resources like *Tetrapleura tetraptera* fruit meal for animal production would lower the market price and therefore increase intake of animal protein by the general populace in under-developed countries such as Nigeria. This would in turn ameliorate the havoc caused by malnutrition and undernutrition in such societies, of which the brunt is borne by women and children (Jiya et al., 2016). Therefore, this experiment was carried out to investigate the effects of graded levels of *Tetrapleura tetraptera* fruit meal on the productive performance of broiler birds.

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Material and methods

Location of the experiment

The research work was carried out at the Poultry Unit of the Research and Teaching Farm of Abia State University, Umuahia Campus located at latitude 5°29'N of the Equator and longitude 7°33'E of the Greenwich Meridian and at height of 122 m above sea level. Air relative humidity in wet season is about 80% and 72% in dry season. The normal ambient temperature is between 17°C and 30°C (Adiele et al., 2005).

Tetrapleura tetraptera fruit meal

Fruit of *T. tetraptera* was bought from Eke market, Ishiagu in Ivo Local Government Area of Ebonyi State. The fruit was sliced, sun dried and milled into powdered form before it was taken to laboratory for proximate analysis and incorporation into the experimental diets.

Experimental diets and management of the broilers

Dried and milled *T. tetraptera* fruit meal used for the formulation of the experimental diets which were isocaloric and isonitrogenous. 0%, 1.0%, 1.50% and 2.00% *Tetrapleura tetraptera* were added to diets T_1, T_2, T_3 and T_4, respectively. During the brooding, the broilers were given feed and water *ad-libitum*. All the routine vaccinations were strictly followed and administered during the experiment period. After allocation of birds on the 7th day into replicates and treatments, weighed quantities of feed were given daily while water was supplied *ad-libitum*. Feed consumption was measured daily while the weights of the birds were taken weekly in groups.

The experiment lasted for 42 days after the first 7 days of brooding and stabilization of the birds in deep litter pens. One hundred and twenty (120) unsexed abor acre broilers were brooded for seven days and thereafter 30 birds were randomly allotted to four treatments for a completely randomized design (CRD) and each treatment was replicated three times with 10 birds per replicate. Non-conventional formulated broiler feed was used in the experiment. The composition of the experimental starter (7-28 days of age) and finisher (28-49 days of age) diets are presented in Tables 1 and 2, respectively. The chemical composition of *Tetrapleura tetraptera* fruit meal is presented in Table 3.

Table 1. Composition of the experimental starter diets (7-28 days of age)

Ingredients	Treatments			
	T_1 (0.0%)	T_2 (1.0%)	T_3 (1.5%)	T_4 (2.0%)
Maize	50.0	49.0	48.5	48.0
Groundnut cake	9.00	9.00	9.00	9.00
Soya bean meal	18.0	18.0	18.0	18.0
Wheat offal	8.00	8.00	8.00	8.00
Palm kernel cake	6.00	6.00	6.00	6.00
Fish meal	4.00	4.00	4.00	4.00
Blood meal	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00
Tetrapleura tetraptera	0.00	1.00	1.50	2.00
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25
Total	100.0	100.0	100.0	100.0

Table 2. Composition of the experimental broiler finisher diet (28-49 days of age)

Ingredients	Treatments			
	T_1 (0.0%)	T_2 (1.0%)	T_3 (1.5%)	T_4 (2.0%)
Maize	52.0	51.0	50.5	50.0
Groundnut cake	7.00	7.00	7.00	7.00
Soyabean meal	14.0	14.0	14.00	14.0
Wheat offal	10.0	10.0	10.0	10.0
Palm kernel cake	8.00	8.00	8.00	8.00
Fish meal	4.00	4.00	4.00	4.00
Bone meal	4.00	4.00	4.00	4.00
Tetrapleura tetraptera	0.00	1.00	1.50	2.00
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25
Total	100.0	100.0	100.00	100.0

Table 3. Chemical composition of *Tetrapleura tetraptera* fruit meal

Ingredients	Content, %
Dry matter	81.90
Crude protein	7.55
Ether extract	14.50
Crude fibre	18.70
Ash	3.80
Nitrogen free extract	37.35

Initial live weights of the animals were taken at the beginning of the feeding trial and weekly thereafter. Final live weight was obtained by weighing the birds at the end of the experiment. Daily weight gain, daily feed intake, and feed conversion ratio were calculated.

Carcass and organ weight studies

At the end of the experiments, three birds per replicate were randomly selected, starved of feed for 12 hours and slaughtered for the determination of carcass and organ weights. Carcass weight (without neck) was calculated by removing the head, lower shank bones, and internal organs from the defeathered weight. Dressing percentage was calculated as the percentage of the carcass weight to the final live weight. The internal organ weight (gizzard, liver, heart, spleen, kidneys, proventriculus and lungs) and weight of the cut parts (wings, thighs, drumsticks and breast muscles) were expressed as percentage of carcass weight.

Statistical analyses

All the data obtained were subjected to one way analysis of variance for completely randomized design (Steel and Torrie, 1980) significant means were separated by applying New Duncan multiple range test as outlined by (Duncan, 1955).

Results and discussion

The effect of *Tetrapleura tetraptera* fruit meal on growth performance of starter broilers is presented in Table 4. The results revealed significance ($p<0.05$) for all the parameters evaluated except final body weight. Average daily weight gain was significantly ($p<0.05$) higher in T_3 and T_1 in comparison with T_2 and T_4. This indicated that 1.5% inclusion of *T. tetraptera* fruit meal numerically produced the highest body weight gain at the starter phase. The result is higher than the range of 24.01-29.65 g/d reported by Nworgu et al. (2015) - for broiler starter chickens fed water leaf (*Talinum triangulare*) meal supplement but lower that 39.65-42.96 g/d reported by Abdulrashid et al. (2013). However, average daily feed intake showed lower ($p<0.05$) value for T_2 in comparison to T_1, T_3 and T_4. The significantly ($p<0.05$) improved feed intake observed in 2% inclusion of *T. tetraptera* fruit meal may be attributed to high biological properties of the test ingredient which may have improved the appetite of the birds. Feed conversion ratio (FCR) showed significantly ($p<0.05$) lower values for T_2 and T_3 in comparison with T_1 and T_4. The significantly ($p<0.05$) better conversion reported in T_3 is evidenced by higher weight gain reported for the treatment.

Table 4. Effect of *Tetrapleura tetraptera* fruit meal on growth performance of starter broilers

Parameters	T_1 (0.0%)	T_2 (1.0%)	T_3 (1.5%)	T_4 (2.0%)	SEM
Initial weight (g)	80.00	80.00	78.33	80.00	0.34
Final weight (g)	513.66	370.00	410.00	390.00	5.81
Average daily weight gain (g/d/b)	30.56^{ab}	29.00^{b}	31.85^{a}	29.50^{b}	4.49
Average daily feed intake (g/d/b)	37.63^{a}	33.78^{b}	36.52^{a}	37.00^{a}	0.50
Feed Conversion Ratio	1.23^{a}	1.16^{b}	1.15^{b}	1.25^{a}	0.01

$^{a-b}$ means in the same row with different superscript differed significantly ($p<0.05$)

The effect of *Tetrapleura tetraptera* fruit meal on growth performance of finisher broilers is presented in Table 5. Final body weight (FBW) differed ($p<0.05$) across the treatments. The high ($p<0.05$) final body weight observed in T_1 birds may be attributed to high initial weight of the treatment group. Average daily weight gain (ADWG) was similar ($p>0.05$) for T_1, T_2 and T_4, but differed significantly ($p<0.05$) from T_3. The ADWG of 35.20-39.65 g/day obtained in this study is lower than 47.87-59.48 g/day for broiler finisher fed composite cassava meal as reported by Ironkwe and Ukanwoko (2012) - and higher than 19.48-31.34 g/day for broiler finisher fed raw and processed pigeon pea seeds as found by Ogbu et al. (2015), but comparable to 25.94-35.71 g/day for broiler finisher birds fed different levels of sweet potato root reported by Jiwuba et al. (2016). The total feed intake of the birds fed the different dietary treatments differed ($p<0.05$) with T_4 having the highest and T_1 having the lowest value over the period of the experiment. This could be attributed to the acceptability of the diets since birds are known to eat more when diets are acceptable and coarse. The better intake reported for the treatment groups may be an indication of absence or tolerable level of antinutritional factors. It followed a definite trend which is an indication that *T. tetraptera* does not suppress feed intake. This could be a result of the positive aromatic effect of the additive. Oke et al. (2012) reported that combinations of two or more additives produce a greater positive effect in poultry production. The feed conversion ratio (FCR) in the different treatments indicated that T_1 is the best. This indicates efficient utilization of the control diet by the finisher broilers in the group. This could be seen in the significant effect on the final weight gain, and average daily weight gain.

Table 5. Effect of dietary *Tetrapleura tetraptera* fruit meal on the performance of finishing broilers

Parameters	T_1 (0.0%)	T_2 (1.0%)	T_3 (1.5%)	T_4 (2.0%)	SEM
Initial weight (g)	513.67	370.00	410.00	390.00	5.81
Final body weight (g)	2066.7[a]	1900.0[c]	1816.7[d]	1950.0[b]	27.3
Average daily weight gain (g/d/b)	39.65[a]	38.65[a]	35.20[b]	39.29[a]	0.57
Average daily feed intake (g/d/b)	51.55[d]	52.60[c]	53.75[b]	55.05[a]	1.17
Feed conversion ratio	1.30[d]	1.36[c]	1.53[a]	1.40[b]	00.3

[a-d] means with the same superscripts along the same row are significantly ($p<0.05$)

The carcass characteristics of broilers fed *Tetrapleura tetraptera* fruit meal was presented in Table 6. There was significant ($p<0.05$) difference for live weight with the control diet showing significantly ($p<0.05$) higher live weight. The live weights were statistically different ($p<0.05$) in the study. The control diet had the higher ($p<0.05$) value recorded T_1, which could be attributed to better feed utilization as evidenced by better FCR recorded for the same treatment. Iyayi et al. (2003) noted that high fibre diets decrease nutrient utilization and precipitate metabolic dysfunction with weight reduction. Dressed weights were significantly different ($p<0.05$) with control (T_1) having the highest value of 1769.01 g. The values did not follow a definite trend which could be due to the bird randomly selected for the carcass study. Dressing percentages were statistically ($p<0.05$) different for T_1 and T_3 but similar for T_2 and T_4. The control had the highest value of 85.59% followed by T_3, T_2 and T_4 with 81.48, 74.94 and 73.27%, respectively. This result is not in agreement with the findings of Omojola and Adesehinwa (2007) who found superior ($p<0.05$) dressing percentage for birds fed enzyme supplemented diets in comparison with the control. The values were higher than 65-70% reported by Oluyemi and Roberts (2007). Wings were significantly affected ($p<0.05$) with T_1 being similar ($p>0.05$) to T_4 but however differed ($p<0.05$) significantly from T_2 and T_3. Thigh weights were significantly ($p<0.05$) influenced with a definite pattern. The study showed increased values as the level of inclusion of *Tetrapleura tetraptera* fruit meal increased in the diet. Drumstick and breast muscle showed significant ($p<0.05$) variations. Oluyemi and Roberts (2007) reported 88.21% wing weight, 17.40% breast weight, 12.95% thigh weight and 11.68% drumstick weight. The high cut parts reported in this study may be attributed to better nutrient digestion and utilization which resulted in enhanced weight of the cut parts. In earlier studies (Windisch et al., 2008), the importance of spices in nutrient utilization with resultant better performance for broilers have been discussed. This may be as a result of the high biological value of these phytogenic materials. The report by Onunkwo and George (2015) that the proportion of drumstick and breast muscle had the highest value at 0.0% *Moringa oleifera* leaf meal agrees with the present study. In contrast, Ndelekwute et al. (2016) found that drumstick and wings were significantly ($p<0.05$) altered by ground black pepper. In earlier reports (Windisch et al., 2008), the importance of spices in nutrient utilization with maybe resulttant better performance for broilers have been discussed.

Table 6. The Effect of *Tetrapleura tetraptera* fruit meal on carcass characteristics of broilers

Parameters	T_1 (0.0%)	T_2 (1.0%)	T_3 (1.5%)	T_4 (2.0%)	SEM
Live weight (g)	2066.70[a]	1900.00[c]	1816.70[d]	1950.00[b]	27.30
Dressed weight (g)	1769.01[a]	1423.97[d]	1480.29[b]	1428.84[c]	42.90
Dressing percentage (%)	85.59[a]	74.94[c]	81.48[b]	73.27[c]	1.51
Cut-up parts (% dressed weight)					
Wing	12.17[a]	12.00[b]	11.58[c]	12.16[a]	0.07
Thigh	13.48[d]	15.13[c]	15.69[b]	15.84[a]	0.28
Drumstick	15.49[c]	16.92[a]	15.27[d]	16.43[b]	0.20
Breast muscle	22.45[d]	23.80[b]	25.73[a]	23.34[c]	0.36

[a-d] means within a row with different superscript differ significantly ($p<0.05$)

The organ characteristic of broiler finisher birds fed *Tetrapleura tetraptera* fruit meal is presented in Table 7. Gizzard, liver, heart, spleen, proventriculus and lungs were significantly ($p<0.05$) influenced by the treatment diets. The lungs increased with increase of *T. tetraptera* inclusion. The results showed significant differences ($p<0.05$) across the treatments. Olajide and Akinsoyinu (2011) established variations in kidney, heart, proventriculus and gizzard. In contrast, Omojola and Adesehinwa (2007) reported no significant ($p>0.05$) effect on organs. Egbeyale et al. (2010) reported no significant ($p>0.058$) difference on organs except for spleen. Kehinde et al. (2013) found that heart and liver showed no significant difference ($p>0.05$). The results of Lee et al. (2004) and Ndelekwute et al. (2016) showed no significant differences ($p>0.05$) on kidney. In contrast, Onunkwo and George (2015) reported significant ($p<0.05$) difference on kidney of broilers fed 10.00% inclusion of *Moringa olefera*. Onyeyile et al. (1998) identified kidney and liver as the primary organs of biotransformation and linked the changes in these organs to their role in elimination of metabolic waste and toxins from the animals' body.

Table 7. Organ histology of broiler finisher birds fed *Tetrapleura tetraptera* fruit meal

Internal organs (% DW)	Treatment				SEM
	T_1 (0.0%)	T_2 (1.0%)	T_3 (1.5%)	T_4 (2.0%)	
Gizzard	6.18[a]	5.70[b]	4.61[d]	5.39[c]	0.17
Liver	3.15[b]	2.80[d]	2.96[c]	3.20[a]	0.05
Heart	0.87[a]	0.70[d]	0.78[c]	0.83[b]	0.02
Kidneys	0.07	0.06	0.06	0.08	0.03
Spleen	0.13[a]	0.09[b]	0.13[a]	0.10[b]	0.01
Proventriculus	0.52[d]	0.85[a]	0.70[b]	0.61[c]	0.04
Lungs	0.96[d]	1.05[c]	1.10[b]	1.27[a]	0.03

[a-d] means with the same superscripts along the same row are significantly different ($p<0.05$)
DW= Dressed weight

The significant increase in liver observed in birds placed on T_4 (*T. tetraptera*) could be due to increase in metabolic activities of the organ, which could be traceable to high fibre content of the diet. This agrees with the observation by Nwoche et al. (2010) who reported significant increase in liver for birds placed on T_4 (rice milling waste) and Ukachukwu (2000) observed that increase in the metabolic activities of liver being the major detoxification organ may lead to enlargement and increase in weight. Olajide and Akinsoyinu (2011) established an increase in gizzard and proventriculus weights of birds and attributed them to the extra muscular or secretory work required to process these diets which were relatively higher in fibre compared with the control. Asaniyan et al. (2008) attributed such an increase to the excessive picking of coarse sand. Atteh (2004) reported that the weight of organs in broilers was a reflection of the anatomical response of birds to the type of diet consumed, especially high fibre particles. Gizzard is affected by nutrition and physical activity. The organ weight observed in the broiler could have been a result of feed and nutrient utilization.

Conclusion

The result of this study indicates that the increasing levels of *Tetrapleura tetraptera* fruit meal up to 2.0% did not affect adversely the ability of the broiler birds to utilize the feed, hence no adverse effect on the performance of the birds. However, higher level of inclusion of *T. tetraptera* fruit meal could be investigated further.

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