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Growth Performance and Blood Profile of Pre-pubertal Boars Fed Aidan (*Tetrapleura tetraptera*) Pod Meal

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Abstract
Growth performance, hematology and serum chemistry values were studied in 18 weaned boars of Large White X Duroc cross fed Aidan pod meal (APM). The boars weighing 9.47kg on average, were divided into three equal groups. The treatments were 0.0%, 2.5% and 5.0% APM per kg of feed, respectively. The experiment was completely randomized. Daily weight gain and feed conversion ratio were significantly higher (P<0.05) in boars fed 5.0% APM than in those fed control diet. There were significantly (P<.0.5) lower red blood cell counts and packed cell volumes in boars fed 0.0% APM than those fed APM. Hemoglobin had the least (P<0.05) concentration in boars fed without APM. White blood cell counts were lowered (P<0.05) in boars treated with 2.5% APM but increased at 5.0% APM. Platelets were highest at 5.0% APM. MCV and MCH were lower (P<0.05) in the APM-treated groups than those fed control diet. MCHC was lower (P<0.05) in boars fed 2.5% APM. There was a significant reduction in serum glucose with the addition of 5.0% APM. Addition of APM caused progressive (P<0.05) increase in serum protein. Aspartate aminotransferase (51.69, 45.33, 30.68) u/l and alanine aminotransferase (31.62, 29.33, 22.17) u/l were both significantly reduced progressively with an increase in APM. Changes in urea were irregular, increasing significantly at 2.5% and decreasing at 5.0% APM. Creatinine was progressively (P<0.05) reduced with addition of APM. Triacylglycerol and total cholesterol were reduced (P<0.05) with increase in the test ingredient. It is concluded that addition of APM improved formation of red blood cells, hemoglobin concentration, packed cell volume, white blood cells and serum protein while triacylglycerol, total cholesterol, AST, ALT and creatinine were reduced.

Keywords: Growth performance, blood profile, pre-pubertal boars, Aidan

Introduction

Application of herbs may be a sustainable alternative to use of pharmaceutically manufactured antimicrobial growth promoters (Ezea et al., 2021). Harmful residues and cross-resistance by pathogens to antibiotics tend to limit application of antibiotic growth promoters (Hunters et al., 2010). As a result, they have been banned for use in many developed nations. Increasing researches on herbal feed additives is also linked to consumer awareness and pressure to exclude all non-plant xenobiotic agents from the feed of food animals (Kumar et al., 2014). According to Frankic et al. (2009), herbal extracts stimulate appetite and enhance digestion of feed/food. They are also sources of anti-oxidants and are useful in prevention and treatment of certain pathological conditions and modulation of physiological functions.

Aidan pod is a seasoning and nutritive spice, used in West African folk medicine (Kuate et al., 2015). In South-eastern Nigeria, a decoction of the dry pod is prepared alongside other spices and herbs as a *post-partum* treatment for women (Uyo et al., 2013a). It is rich in polyphenols (tannins, flavonoids), saponins, phytate, triterpenoid, coumarin (scopoletin), phenols (caffeic and cinnamic acids) and triterpene glycoside (aridanin) (Jezska-Skowroma et al., 2014). The presence of these substances tends to support the reported biological and pharmacological activities of the plant such as anti-inflammatory, hypoglycaemic, hypolipidaemic, hypotensive, anti-microbial, anti-parasitic, etc. (Kuate et al., 2015).

Flavonoids, saponins, fibres and phytate (all contents of the pod) are credited with at least one of antidiabetic, anti-inflammatory, antioxidant, and anti-obesity properties (Chen et al., 2013).

Reduction in plasma cholesterol *in vivo* by naringenin, an isolation of the pod, was reported by Wilcox et al. (2001). Kuate et al. (2015) submitted the hypolipidaemic property and ability of Aidan pod extract to reduce tissue steatosis. Aidan pod meal was reported to have depressed haematological indices, compromised the stability of red blood cells, reduced serum proteins, alanine aminotransferase but increased serum lipids in weaner boars (Ezea et al., 2021). Blood cells and metabolites are dynamic, reflecting the quality of whole feeds and feed additives. They therefore provide useful information on the chemical and nutritional health status of animals in feeding trials (Maxwell et al., 1990). This work investigated the growth and changes in blood constituents of pre-pubertal boars in response to Aidan pod meal.

Materials and methods

Study location

The experiment was carried out at the Piggery Unit of the Livestock Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike. Umudike is on Latitude 05^0 29' N and Longitude 07^0 33' E, altitude of 122m above sea level and records average annual rainfall of 1700 to 2100 mm. Minimum and maximum temperature vary from 18-23^0 C and 26-36^0 C, respectively. Relative humidity ranges from 57-91% (NRCRI, 2022).

Sourcing and preparation of Aidan pod/pod meal

The pods were bought from a market in Aba, Abia State. Fleshy portions of dry pods were extracted with a sharp knife, milled, and added to the pigs' diets at 0.0% (control), 2.50% and 5.0%, respectively.

Sourcing and management of experimental animals

The piglets (all male) which were of the Large White x Duroc crossbreeds, were sourced from a reputable farm in Imo State. They were about 6 weeks of age and weighing approximately 9.47kg on average.

They were quarantined for two weeks. Ivermectin, an injectable anthelmintic solution (1%) was administered via the subcutaneous route at the dose of 0.25ml/12.5 kg body weight. The boars were fed two times daily and water supplied *ad libitum*. They were raised in pens with hard and mildly rough concrete floor. The pens were cleaned daily to prevent multiplication of pathogens.

The ingredient compositions of the experimental diet are presented in Table 1

Table 1: *Diet composition for the experimental pre-pubertal boars*

	Treatment		
Ingredients	**0.0% APM**	**2.5% APM**	**5.0% APM**
Maize	50.30	50.30	50.30
Groundnut cake	16.00	16.00	16.00
Wheat offal	31.10	31.10	31.10
Bone meal	1.25	1.25	1.25
Oyster shell	0.50	0.50	0.50
Vitamin/mineral premix*	0.20	0.20	0.20
Methionine	0.05	0.05	0.05
Lysine	0.15	0.15	0.15
Salt	0.45	0.45	0.45
Total	**100**	**100**	**100**
Aidan pod pulp meal (%)	0.00	2.50	5.00
Crude protein (%)	16.98	16.98	16.98
Digestible energy (Kcal/kg)	3154.37	3154.37	3154.37

* To provide per kg of diet: vitamin A (10 000 IU), vitamin D (20 000 IU), vitamin E (5 IU), vitamin K (2.5 mg), choline (350 mg), folic acid (1 mg), Manganese (56 mg), iodine (1 mg), iron (20 mg), copper (10 mg), zinc (50 mg),

Cobalt (1.25 mg).

Experimental design

Eighteen weaned male piglets were randomly allotted into three equal treatment groups. The treatments were replicated three times. Two pigs constituted a replicate. The experiment was a completely randomized design.

Data collection

Data were collected on growth performance indices such as daily feed intake, daily weight gain, feed conversion ratio and mortality as well as on haematological and blood chemistry indices.

Growth performance:

Weight Gain: The boars were weighed at the commencement of the experiment to get the initial live weight. Subsequently, they were weighed at weekly intervals to gain weight, with a hanging scale. At the end of the experiment (56 days), mean daily weight gain was computed as follows:

Total weight gain = Final live weight – Initial live weight
Mean weight gain = Total weight gain / Number of boars
Mean daily weight gain = Mean weight gain / 56
Feed Intake: Feed was weighed with a top-loading scale before feeding the boars.

Mean daily feed intake was computed as follows:
Mean daily feed intake = Total feed intake / Number of boars

56

Feed conversion ratio (FCR): FCR = Feed intake / Weight gain

Mortality: This is the number of animals that died during the experiment

Sampling and analyses of blood

Blood (2ml) was sampled from the cephalic vein of the boars into each of two separate bottles for the evaluation of haematological and serum chemistry indices, respectively. Samples for haematology were collected in bottles treated with ethylene diamine tetra-acetic acid (EDTA). while those for serum chemistry were collected in EDTA-free bottles to allow coagulation. Haematological indices were evaluated according to Jain (1986), while the serum parameters were determined using Randox kits

Data analysis

Data were subjected to one-way analysis of variance according to Steele and Torrie (1980) while mean separation was done using Fischer's least significant difference (F-LSD) with SPSS version 22.

Results and discussion

Table 2: Growth performance parameters of pre-pubertal boars fed APM

Parameter	0.0% APM	2.5% APM	5.0% APM	SEM
Initial weight (kg)	21.00	21.50	21.50	0.17
Final weight (kg)	33.69^{c}	35.50^{b}	37.16^{a}	0.54
Daily weight gain (kg)	0.23^{b}	0.25^{ab}	0.28^{a}	0.01
Daily feed intake (kg)	0.90	0.90	0.90	0.00
Feed conversion ratio	3.98^{b}	3.60^{ab}	3.26^{a}	0.12
Mortality	0.00	0.00	0.00	0.00

^{a,b} Means on the same row with different superscripts are significantly (P<0.05) different. SEM= standard error of the mean, APM = Aidan pod pulp meal

Daily weight gain and feed conversion ratio (FCR) were respectively higher and smaller (P<0.05) in boars fed 5.0% Aidan pod pulp meal (APM) than in those fed the control diet. Weight gain and FCR were positively impacted by 5.0% addition of APM. Available research data are void of information on the specific effect of feeding APM on growth performance of boars. Information could however, be gleaned from reports on some other phytogenic resources. For instance, significant improvements in average daily gain and feed conversion ratio in grower pigs fed a herb mixture (great nettle, garlic and wheat grass) were demonstrated by Grela et al. (1998). Moreover, growing/finishing pigs fed diets treated with garlic had higher average daily gain, average daily feed intake and feed conversion ratio, compared with those fed control (Janz et al., 2007). At 5.0% level of addition, APM could probably have beneficially impacted the gastro-intestinal tract by possibly reducing microbial toxins; as a result, reducing stress and improving nutrient absorption for better growth (Windisch et al., 2008). It goes to say therefore that APM might have acted as a source of antibiotic, enhanced intestinal morphology and improved nutrient digestibility. This seems to confirm the reported antimicrobial activity of essential oils against some pig gut microorganisms (Michiels et al., 2010) in corroboration of Stein and Kil (2006), who informed that *Escherichia coli* and *Salmonella spp* in pig gut were inactivated by essential oils; even as the non-pathogenic *Lactobacillus spp* proliferated. The *in vitro* antioxidant activities of mature pods were underscored by Irondi et al. (2013).

Table 3: Haematological indices of pre-pubertal boars fed APM

Parameter	0.0%APM	2.5%APM	5.0%APM	SEM
Red blood cells (x 10^{12}/l)	6.56^{c}	7.33^{a}	7.51^{b}	0.14
Packed cell volume (%)	41.56^{c}	43.33^{a}	42.55^{b}	0.26
Haemoglobin (g/l)	10.88^{c}	10.98^{b}	11.32^{a}	0.07
White blood cells (x 10^{9}/l)	15.71^{a}	13.88^{b}	15.99^{a}	0.33
Platelets (x 10^{9}/l)	194.33^{b}	200.33^{b}	232.10^{a}	10.44
Mean cell volume (fl)	63.70^{a}	58.13^{b}	56.94^{c}	1.04
Mean cell haemoglobin (pg)	16.63^{a}	14.97^{b}	15.15^{b}	0.26
Mean cell haemoglobin concentration (g/l)	26.23^{b}	25.36^{c}	26.58^{a}	0.18

$^{a-c}$ Means on the same row are statistically (P<0.05) different, SEM=Standard error of mean

There were significantly lower numbers of red blood cells and packed cell volumes in boars fed 0.0% APM than those fed APM. Haemoglobin had the least (P<0.05) concentration also in boars fed without APM. Number of white blood cells per litre of blood was lowered (P<0.05) in boars treated with 2.5% APM but increased at 5.0% APM-fed boars. Platelets were highest at 5.0% APM. Average volume of red blood cells (MCV) in the whole blood was lower (P<0.05) in the APM-treated groups than those fed without the test ingredient. The mean cell haemoglobin (MCH) followed the same trend as in MCV. The percentage of red blood cell mass attributable to haemoglobin (MCHC) was lower (P<0.05) in pre-pubertal boars fed 2.5% APM.
The haematological indices of pre-pubertal boars in this study fell within the reference ranges reported by RAR (2009), in the blood of feeder pigs. They were also in line with normal haematology reference values submitted by Klem et al. (2010) among Norwegian crossbred grower pigs. The RBC, MCH and MCHC obtained in this work were however, lower than those (9.12 x 10^{6} μl, 33.89pg and 39.21g/dl) recorded by Eze et al. (2010) among boars reared in the south-eastern Nigeria. The MCV on the other hand, was quite superior to that reported by the same authors. Despite being within reported normal ranges, the significant reduction in MCV and MCH in the APM-treated boars could be a pointer to microcytic anaemia, which can occur even in the face of normal RBC and PCV. The significantly increased platelets counts in pre-pubertal boars fed the test meal could be linked to presence of inflammatory mediators. Inflammatory mediators are known to increase platelet production and activation, diminish endogenous anticoagulant activity; initiating and contributing to propagation of the coagulation cascade (Esmon, 2005).
Table 4 shows the serum chemistry parameters of the experimental pre-pubertal boar

Table 4: Serum chemistry indices of pre-pubertal boars fed APM

Parameter	0.0%APM	2.5%APM	5.0%APM	SEM
Glucose (mg/dl)	74.30^{a}	74.64^{a}	67.93^{b}	0.92
Albumin (mg/dl)	3.49^{c}	3.68^{b}	4.23^{a}	0.11
Globulin (mg/dl)	2.97^{c}	3.23^{b}	3.32^{a}	0.05
Total protein (mg/dl)	6.44^{c}	6.91^{b}	7.56^{a}	0.16
Aspartate aminotransferase (u/l)	51.69^{a}	45.33^{b}	30.68^{c}	3.12

Alanine aminotransferase (u/l)	31.62[a]	29.33[b]	22.17[c]	1.15
Urea(mg/dl)	14.96[b]	21.20[a]	15.7[b]	0.98
Creatinine(mg/dl)	1.23[a]	0.92[b]	0.70[c]	0.08
Total cholesterol	103.12[a]	111.63[b]	100.68[c]	1.66
Triacylglycerol	153.44[a]	142.73[b]	139.06[c]	2.16

[a-c] Means on the same row are statistically ($P<0.05$) different, SEM=Standard error of mean

There was a significant reduction in serum glucose with addition of 5.0% APM. There was progressive ($P<0.05$) increase in serum protein. Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were both significantly reduced progressively with an increase in APM. Changes in urea were irregular, increasing significantly at 2.5% and decreasing at 5.0% APM. Creatinine was progressively ($P<0.05$) reduced with addition of the test ingredient.
Serum chemistry indices obtained in this work are within the ranges of values reported in feeder pigs by Friendship et al. (1984) and in Norwegian cross-bred grower pigs reported by Klem et al. (2010).
Triacylglycerol and total cholesterol were reduced ($P<0.05$) with increase in the test ingredient. The negative association between the quantity of APM and serum triglycerides in the animals seems to agree with Kuate et al. (2015), who attributed hypolipidaemic property to a hydro-ethanolic extract of Aidan pod. The implication of this is a tendency to depletion of the fat stores in the growing pigs. Aidan pod pulp treatment might have negatively influenced anabolic processes that favour lipogenesis, placing the animals in a net lipolytic state, with lipolysis having upper hand in the entire lipid metabolic process. This agrees with Harris et al. (1993), who explained that under stress (e.g. nutritional), the adipose tissue is broken down (lipolysis) to provide energy for peripheral tissues.

Conclusions

It is concluded that addition of APM improved formation of red blood cells, haemoglobin concentration, packed cell volume, white blood cells and serum protein while triacylglycerol, total cholesterol, AST, ALT and creatinine were reduced.

Aidan pod pulp meal can be applied up to 5.0% per kg in the ration of pre-pubertal/growing-finishing pigs for enhanced general wellbeing of the animals and production of lean pork for man.

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