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Organoleptic Quality, Pork Characterization and Hematological Indices of Growing Pigs Fed Supplemental Diets Containing Bitter Leaf and Hospital Too Far

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Abstract

Effect of bitter leaf (Vernonia amygdalina) and hospital too far (*Jathropha tanjorensis*) *leaf meals on organoleptic characteristics of pork and haematological indices of growing pigs was investigated. A total of 32 grower pigs were completely randomized into 4 dietary treatments. Eight young pigs were placed on each treatment with four replicates of 2 pigs each. Four diets were formulated: T_1 (basal feed only), T_2 (basal feed + 4% bitter leaf meal), T_3 (basal feed + 4% hospital too far leaf meal) and T_4 (basal feed + 2% bitter leaf meal + 2% hospital too far leaf meal). Haematological indices measured include: haemoglobin, packed cell volume, red blood cells, and white blood cells from 16 pigs (4 per treatment). The pigs were thereafter slaughtered for carcass evaluation and organoleptic quality assessment. Results indicated significant ($P<0.05$) increase in terms of carcass yield and primal cuts (loin, chump chop, breast and rib chop) for T3 followed by T2 and T4. Pigs in T_3 group recorded the best dressing percentage and increase in the primal cuts. The test diets had no negative effects on the organoleptic quality of pork. However, T1 was significantly better in terms of tenderness followed by T2 and T4 indicated significant difference ($P<0.05$) among treatment groups with the highest score recorded in T1. Red and white blood cells were significantly higher in the T_3 group compared to other treatments. Haemoglobin and packed cell volume were significantly higher in the T4 group while the control (T_1) had the least. MCH and MCHC were significantly higher in all treatments except in the control. It is concluded that the test diets improved the carcass characteristics, organoleptic quality and haematological indices of the pigs. Based on the results, hospital too far leaf meal (HTFLM) is recommended.*

Key words*:* Pig, Carcass, V*ernonia amygdalina*, *Jathropha tanjorensis*, organoleptic quality

1.0 Introduction

The competing demand for cereal grains between the increasing human population and livestock has necessitated the need to diversify into the use of alternative feedstuff which are cheap and readily available for both ruminants and non-ruminants, especially pigs and poultry (Phiny *et al*., 2008; Etuk *et al.,*2013). As a way of contributing to the nation's economic gains, the raising of pigs have shown great potential because they have a short gestation period, high fecundity and farrow between 6-15 piglets depending on the breed (Lekule and kyysgaard, 2003).

Bitter leaf (*Vernonia amygdalina*), is a perennial shrub belonging to the family Astereacea, and is found to grow throughout tropical Africa. It is widely consumed as a vegetable and also used for medicinal purposes (Danladi *et al*., 2018). Investigation into its bioactive properties reveal that the plant has potent antidiabetic, anthelminthic, antiplasmodial, antimicrobial, antioxidant and antianemic activities (Atangwho *et al*., 2010; Omolola *et al*., 2013). The plant also contains certain phytochemicals which is of medicinal and pharmacological benefits (Ademola and Eloff, 2011; Adesanoye and Farombi, 2014).

Hospital too far (*Jathropha tanjorensis*) is another perennial shrub belonging to the family Euphorbiaceae. The plant is widely used in Nigeria, in traditional medicine and as a vegetable for many recipes in Nigerian homes (Chibuogwu *et al.,* 2021). Its usage in the southern parts of Nigeria, especially Akwa Ibom State, as a vegetable in soups has been reported by Ansari *et al*. (2020) and Olayiwola *et al*. (2004) and also for the treatment of diabetes, malaria and anaemia. The potential of the plant for the treatment of cardiovascular diseases as well as its antianemic and antibacterial properties have been widely reported (Ansari *et al*., 2020; Iwalewa *et al.,* 2005). However, less is known about bitter leaf and hospital too far as additives in pigs feed. Ekpo and Okon (2022) in a study with pigs fed *Vernonia amygdalina* and *Jathropha tanjorensis* reported an improvement in the performance and lipid profile of the animals. Igbinaduwa *et al*. (2011) reported that the leaf of Jathropha fed on wistar rats had a relatively positive effect on some hematological indices and carcass characteristics. This study aimed to determine the impact of bitter leaf and hospital too far leaves as supplemental diet on the organoleptic quality, carcass characteristics and hematological indices of grower pigs.

2.0 Materials and Methods

The study was carried out at the Piggery unit of the department of Animal science, Akwa Ibom State University, Obio Akpa Campus, Nigeria. Obio Akpa is located on latitude 5^{o}17'N and 5^{o}27'N and longitude 7^{o}21'E and 7^{o}58'E with a monthly temperature range between 24 to 26^{o}C depending on the season, while the relative humidity varies between 60 to 90 % and the annual rainfall from 3500 to 5000 mm (AKSU-MET 2021).

2.1 Sourcing, Processing and Proximate Analysis of Test Materials

Leaves of hospital too far (*Jathropha tanjorensis*) and bitter leaf (*Vernonia amygdalina*) were sourced from the adjourning farms of Oruk Anam Local Government Area of Akwa Ibom State, Nigeria. They were later air-dried for 24 hours, chopped into sizeable portions and incorporated into the diets of the experimental animals as supplements. The chopped leaves were included as

supplement at 4 % of the animal's live weight. Samples of bitter leaf and hospital too far leaf meals collected were analysed (AOAC, 2003) in the laboratory of the Department of Animal Science, Akwa Ibom State University.

2.2 Animal Management and Experimental Diet

Thirty-two crossbreed (Large white x Landrace) growing pigs were acquired from a reputable private pig farm in Abak, Akwa Ibom State, Nigeria for the experiment. Before the experiment began, the pigs were dewormed accordingly, while feeds with clean water were also served *ad-libitum* for two weeks. The animals were thereafter allotted to different treatment groups of four diets, comprising of Treatment 1 (CTL) with no test material, Treatments 2 and 3 containing 4 % of bitter leaf meal (BLM) and hospital too far leaf meal (HTFLM) respectively, and Treatment 4 containing 2 % each of BLM and HTFLM. The animals were fed twice daily (8:00am and 4:00 pm), with the two test ingredients added as supplements of the formulated experimental diet, according to the method described by NRC (1998) as shown in Table 2.1.

2.3 Blood Collection and Carcass Evaluation

2ml of blood samples were collected from the marginal vein of the pig's ear into sterilized bottles containing ethylene diamine tetra-acetate (EDTA) as anticoagulant for hematological analysis using the method described by Schalm *et al*. (1975). On the 56^{th} day of the feeding trial, 16 pigs (4 per treatment) were starved of feed and not water for 12 hours. They were thereafter slaughtered by severing the jugular vein immediately after stunning. This was followed by evisceration and removal of guts, separation of organs before dividing the carcass into primal cuts (shank and trotter, belly, breast, thick rib chop, rib chop, loin, chump chop, leg fillet end as well as leg shank end). This was according to the method described by Ekpo *et al.* (2020). Leg shank end and leg fillet end of the fabricated carcass were thereafter dissected into muscles and bones. The muscle and bones were weighed separately to obtain the muscle/bone ratio.

2.4 Organoleptic Quality Evaluation

Samples of meat (200g) from the loin of the pig were taken from all the treatment groups for organoleptic quality assessment. The meat samples were put in 100ml of boiled (100^{o}C) water and cooked for 15 minutes using a pressure pot on a kitchen gas cooker. Afterwards, the cooked meat samples were sliced into uniform sizes and presented to the panelists. Twelve consumer panelists within the range of 25-30 years representing the pork consumers were engaged in tasting the meat. Parameters evaluated were colour, flavour, juiciness, tenderness and overall acceptability using a 9-point hedonic scale as described by Umeh *et al* (2006). Each scorer was provided with a bottle of table water and pieces of bread to serve as flavour neutralizers between samples as described by Ekpo *et al.* (2022a).

2.5 Experimental Design and Statistical Analysis

The experiment was laid in a completely randomized design of 4 treatment groups. Each treatment comprised of 8 animals which were further replicated into 4 groups with 2 pigs making a replicate. All the data collected were subjected to a one way Analysis of Variance (ANOVA). Statistical computations were done using the procedure of the Statistical Package for Social Sciences (SPSS, 2007) while the significant differences between means were separated using Duncan's Multiple Range Test (Duncan, 1955).

Table 2.1. Percentage composition of the experiment diets

Ingredient	**T_1**	**T_2**	**T_3**	**T_4**
Maize	45.00	45.00	45.00	45.00
Soybeans	16.00	16.00	16.00	16.00
Palm Kernel Cake	16.60	16.60	16.60	16.60
Wheat Offal	19.40	18.90	18.90	18.90
Bone meal	2.25	2.25	2.25	2.25
Vitamin Premix	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
Calculated Composition				
Crude Protein (%)	21.48	21.48	21.48	21.48
Crude Fiber (%)	1.01	1.01	1.01	1.01
Crude Fat (%)	5.34	5.34	5.34	5.34
Ash (%)	4.70	4.70	4.70	4.70
Gross Energy (Kcal/Kg)	2901	2901	2901	2901

Composition per 2.5kg: Vit.A 10,000,000 IU; Vit.D_3 2,000,000 IU; Vit. E 20,000 IU; Vit. K 2250.5mg; Thiamine B_1 1750mg; Riboflavin B_2 5,000mg; Pyridoxine B_6 4 mg; Niacin 40 mg; Vit. B_{12} 0.0 mg; Pantothenic acid 7500 mg; folic acid 7500mg; Biotin 50mg; Choline chloride 400g, Antioxidant 125g; cobalt 200mg; Zinc 50g.

3.0 Results and Discussion

Table 3.1 presents the result of proximate composition of the experimental diets. No differences ($P>0.05$) were observed in the assessed parameters across treatments. However, numerical differences were recorded. As indicated in the result, T_4 had the highest crude protein value followed by T_3, while T_1 had the least. The crude fibre was highest in the T_2 group while T_1 group had the least value. T4 recorded the highest ether extract value while T_2 had the least value. The ash content indicated a higher amount of ash in T_2 and the least value obtained in T_1. Ether extracts, nitrogen free extracts and metabolizable energy values obtained in this study for BLM were within the range reported by Ejoh *et al*. (2007). Generally, the calculated values as presented in table 2.1 were higher than values in table 3.1. Nevertheless, the slight differences obtained in the proximate composition of the experimental diets between treatments may be attributed to differences in variety, geographical location, soil type and method of propagation of the plants. Report by Ekpo *et al.* (2020) indicated that the fundamental causes of differences in nutrient composition of plants are variety, geographical location, soil type and method of propagation.

Table 3.1. Proximate and gross energy composition of experimental diets

Sample (%)	T_1	T_2	T_3	T_4
Dry matter	87.69	87.16	86.98	83.13
Crude protein	14.37	14.69	14.88	15.07
Crude fiber	3.87	4.13	4.05	3.93
Ether extract	2.59	2.78	2.89	2.95
Ash	3.48	3.69	3.57	3.52
Nitrogen free extract	63.38	61.87	61.59	61.48
Gross energy (kcal/kg)	2,829	2,862	2,873	2,885

Results of carcass characteristics of the pigs fed bitter leaf and hospital too far leaf meals are presented in Table 3.2. Improvements ($P<0.05$) were recorded for live weights with the highest statistical value (28.68 kg) obtained from pigs fed diet containing hospital too far meal (T_3). This was followed by those in T_2 and T_1. Pigs in T_4 recorded the least live weight values (21.24 kg). The trend was observed to be similar for eviscerated weight and dressing percentage. Results obtained for head, belly, thick rib chop, leg fillet end, leg shank end, shank and trotter indicated no significant ($P>0.05$) differences across dietary treatments. However, the loin, chump chop, breast and rib chop values showed significant ($P<0.05$) differences across treatments. The difference in loin values obtained was not definitively attributed to dietary effect. The other primal cuts (rib, chump chop and rib chop) recorded the highest values for pigs in T_3 group while those in the control (T_1) had the least values. The disparity in value may be attributed to the effect of diet as well as the increase in slaughter weight. The result of this study is in line with the findings of Ekpo *et al* (2008) and Latorre *et al.* (2008). These authors reported that the weight of primal cuts increased with weight at slaughter. The result however disagrees with findings of Virgili *et al.* (2003) who proposed that the proportion of primal cut decreases with an increase in body weight and the growth rate of the whole body. Abdominal fat recorded significant ($P<0.05$) differences of the test ingredient across treatments. Animals in the control group recorded the highest value. This is indicative of the anti-lipidemic properties of the bitter leaf and hospital too far. This corroborates the earlier findings of Ekpo and Okon (2022) on grower pigs with bitter leaf and hospital too far as supplements. Result on muscle/bone ratio also indicates an improvement ($P<0.05$) on pigs fed the test diets. This might not be unconnected with the improved nutrient composition of hospital too far and bitter leaf, especially protein and minerals (Ekpo *et al*. 2022b). With respect to the internal organs, values obtained for kidney and liver showed no significant ($P>0.05$) treatment effects. However, significant ($P<0.05$) effect was recorded for the lungs, with those in T4 recording the least value. This suggest that the inclusion of the supplements in the diets did not cause any deleterious effect to internal organs. This agrees with the findings of Ekpo *et al.* (2016) and Olajide *et al.* (2019) who reported reduction in the weight of internal organs (lungs) of rabbits fed pumpkin stem and pigs fed beniseed hulls respectively.

Table 3.2. Effect of bitter leaf and hospital too far on the carcass characteristics of growing pigs

Parameters (kg)	T_1	T_2	T_3	T_4	SEM
Live weight	24.60^{c}	27.60^{ab}	28.68^{a}	21.24^{d}	2.33
Eviscerated weight	18.00^{c}	21.00^{ab}	23.00^{a}	15.00^{d}	2.35
Dressing %	73.17^{c}	76.09^{b}	80.19^{a}	70.62^{d}	2.50
Prime cuts & organs expressed as % of live weight					
Head	11.78	11.66	11.85	10.82	1.41
Loin	2.64^{a}	2.25^{b}	2.70^{a}	2.45^{a}	0.40
Chump chop	3.25^{c}	3.51^{ab}	4.02^{a}	3.29^{cd}	0.65
Leg shank end	4.55	4.24	4.36	4.24	1.11
Leg fillet end	3.45	3.80	4.08	4.09	1.04
Breast	2.76c	3.26^{ab}	4.25^{a}	3.86^{ab}	1.14
Belly	2.32	2.72	2.61	2.98	1.02
Shank & trotter	2.03	2.25	2.33	1.98	1.04
Rib chop	3.86^{c}	4.89^{ab}	5.12^{a}	3.53^{cd}	1.00
Thick rib chop	5.36	5.14	5.58	4.00	1.20
Heart	0.43	0.45	0.44	0.49	0.13
Spleen	0.24	0.18	0.19	0.18	0.10
Kidney	0.21	0.23	0.25	0.39	0.90
Lungs	1.41^{ab}	1.56^{a}	1.44^{ab}	1.30^{c}	0.24
Liver	2.33	2.41	2.50	2.91	0.88
Fat (g)	0.54^{a}	0.14^{b}	0.10^{b}	0.11^{b}	0.11
Meat/bone ratio	0.12^{b}	0.23^{a}	0.21^{a}	0.25^{a}	0.06

^{abc}means across the treatment bearing different superscript are significantly different ($P<0.05$)

Table 3.3. Effect of bitter leaf and hospital too far on organoleptic profile of pigs

Parameters	T_1	T_2	T_3	T_4	SEM
Colour	7.10	7.30	6.90	7.10	0.31
Flavor	6.70	6.90	7.10	6.95	0.28
Juiciness	7.13	7.00	6.90	6.82	0.22
Tenderness	7.50^a	6.85^b	6.55^c	6.80^b	0.18
Overall acceptability	7.80	7.65	7.69	7.58	0.15

^{abc}means across the treatment bearing different superscripts are significantly different ($P<0.05$)

The result of organoleptic evaluation of the pork is presented in Table 3.3. No significant ($P>0.05$) effect was observed in colour, flavor, juiciness and overall acceptability indicating that the test diets had no negative effects on the organoleptic quality of pork. However, tenderness significantly ($P<0.05$) reduced in T_2, T_3 and T_4 compared to T_1. The lower scores obtained in T_3 followed by T_2 and T_4 can be connected to reduced fat content of the pork meat from the groups fed the supplements as a result of their anti-lipidemic properties. Also, the increased fiber levels for the T_2, 3 and 4 groups may be responsible for the reduced tenderness. This corroborates the report of Dawkins *et al.* (2001) who reported reduced tenderness on chevon and beef obtained from goats and cattle fed higher levels of fiber from wheat and oat bran.

Table 3.4 shows the results of haematological indices of pigs fed diets containing bitter leaf and hospital too far supplements. The mean corpuscular volume, neutrophils, lymphocytes, monocytes, eosinophils and basophils of the pigs across the treatments were not positively ($P>0.05$) affected. However, positive ($P<0.05$) effect were recorded for red blood cell, packed cell volume, haemoglobin, white blood cell and mean corpuscular haemoglobin.

Red and white blood cells were significantly higher in the T_3 group compared to other treatments. Haemoglobin and packed cell volume were significantly higher in the T_4 group while the control (T_1) had the least. MCH and MCHC were significantly higher in all treatments except in the control. The level of PCV and WBC in the test diets suggest the presence of anti-nutritional factors. This is because PCV and WBC is an index of toxicity (Oyawoye and Ogunkunle, 2004). Muhammad and Oloyede, (2009) had reported that inadequate intake of energy and protein in monogastrics such as broiler birds decreases packed cell volume (PCV). Haemoglobin level increased in T_4 followed by T_3 indicating a high nutrient assimilation of the diets. Inadequate intake of energy and protein has been reported to decrease haemoglobin (Hb) concentration leading to anemia (Muhammad and Oloyede, 2009). T_3 recorded a significantly ($P<0.05$) higher value of MCH than T_2 and T_1 but similar to T_4. T_1 recorded the least MCH

Table 3.4. Effect of bitter leaf and hospital too far on haematology of pigs

Parameters	T_1	T_2	T_3	T_4	SEM	Range (Cooper *et al.*,2014)
Red Blood Cell ($x10^6/mm^3$)	5.15^b	5.31^{ab}	5.68^a	5.40^{ab}	0.38	5.52 - 9.11
Packed Cell Volume(%)	39.00^a	36.67^c	37.33^b	38.67^a	0.45	36.00 - 49.00
Haemoglobin (g/dl)	12.23^d	12.67^c	12.80^b	13.00^a	0.11	9.18 - 15.70
White Blood Cell ($x10^3/mm^3$)	9.10^b	9.30^b	10.57^a	9.73^{ab}	0.20	6.00- 21.70
MCV(fl)	68.77	69.04	72.47	71.70	0.68	53.00-79.00
MCH(pg)	21.57^b	23.85^a	24.86^a	24.11^a	0.40	13.00-27.00
MCHC (g/dl)	31.37^b	34.56^a	34.32^a	33.63^a	0.43	33.11-34.68
Neutrophils (%)	55.00	55.00	54.00	58.00	0.73	8.10-100.00
Lymphocyte (%)	34.67	34.67	34.67	31.67	0.84	32.88- 41.82
Monocyte (%)	6.00	6.67	7.00	6.33	0.19	3.00-7.30
Eosinophils (%)	3.33	3.00	3.67	3.33	0.14	3.00-4.81
Basophils (%)	1.00	0.67	0.67	0.67	0.13	0.14-1.46

^{ab} means across the treatment bearing different superscript are significantly different ($P<0.05$)
MCV = Mean Corpuscular Volume; MCH = Mean Corpuscular Haemoglobin; MCHC = Mean Corpuscular Haemoglobin Concentration, EOS = Eosinophils

value. The values in this research were higher than the values for MCH of 11.1-18.4% reported by Cooper *et al*.(2014). There were significant ($P<0.05$) effects among the treatments. T_2, T_3 and T_4 values in this research were higher than the values for T_1. In summary, the significant increase obtained in packed cell volume, haemoglobin, red blood cell, and white blood cell of pigs fed the supplements suggests that the feed were effectively utilized as well as absorped into the blood stream of the pigs. This agrees with the report of Onu (2010) in broiler birds fed bitter leaf meal. The result shows that the supplements positively influenced the haematological indices of the pig. This agrees with Tokofai *et al.* (2020) in broiler chickens fed bitter leaf meal.

4.0 Conclusion

This study revealed that inclusion of hospital too far leaf meal (HTFLM) at 4% in the pig diet did not adversely affect the carcass characteristics, organoleptic quality and haematological indices of the pigs. Therefore, to obtain improved carcass yield, organoleptic quality and haematological profile in pig, hospital too far leaf meal is recommended for inclusion.

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