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Comparative Evaluation of Carcass Cut and Meat Quality of Finisher's Pigs Fed Rice Offal's and Millet Hulls Based Diets

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Abstract
This research is to Comparatively Evaluate carcass cut and meat quality of finisher's pigs fed rice offal's and millet hulls-based diets and to evaluate the effect of rice offal and millet-based diet on finishers pigs, to study the pH and water holding capacity of pork samples after slaughter and to Investigate the proximate analysis of specific pork cuts. The study was carried out at the Swine unit of Teaching and Research Farm of the Department of Animal Production and Health, Federal University Wukari, Taraba State. Eighteen (18) mixed local breeds of grower's pigs with an initial weight of 26.83kg were sourced within Wukari metropolis. The pigs were divided into three treatment groups of six animals per group replicated three times in a completely randomized design. Each pen was provided with feeders; drinkers and the animals were fed ad libitum and the experiment lasted for 56 days. The final weight at slaughter is 80.07±01. Results of this study indicate that finisher pigs fed a diet with either rice offal's or millet hulls produced carcasses with similar proximate composition and mineral content to those fed a control diet. However, pigs fed the millet hull-based diet had lower moisture and higher ether extract content in their ham compared to pigs fed the other diets. There were no significant differences in proximate composition or mineral content between diets.

Introduction

Pig farming is the raising and breeding of domestic pigs as livestock. Pigs are reared principally for food and raw materials such as pork, bacon, ham, gammon and skins (*Flisser, et al., 2011*). Historically, pigs were kept in small numbers and were closely associated with the residence of the owner (Lander, *et al.,* 2020). They were valued as a source of meat and fat, and for their ability to convert inedible food into meat and manure, and were often fed household food waste when kept on a homestead. Pigs are a popular form of livestock, with more than one billion pigs butchered each year worldwide, 100 million of them in the United States of America (USA), (Hemsworth, 2003 and Hemsworth *et al.,* 2000). Pigs are farmed in many countries, though the main consuming countries are in Asia, meaning there is a significant international and even intercontinental trade in live and slaughtered pigs. Despite having the world's largest herd, China is a net importer of pigs, and has been increasing its imports during its economic development. The largest exporters of pigs are the United States, the European Union, and Canada. As an example, more than half of Canadian production (22.8 million pigs) in 2008 was exported, going to 143 countries (Canadian Pork Exports, 2018). Older pigs will consume eleven to nineteen litres (three to five US gallons) of water per day. Pigs have a lower feed conversion ratio than cattle, which can provide an advantage in lower unit price of meat because the cost of animal feed per kilogram or pound of resultant meat is lower (Thorne and Peter, 2017).

However, there are also many other economic variables in meat production and distribution, so the price differential of pork and beef at the point of retail sale does not always correspond closely to the differential in feed conversion ratios. According to Ewan, (2001) Total production costs in the swine-based industry have largely corresponded to the feed costs, making it lose out on nearly 70% of profits. The energy content of the basal diet is a major determinant of pig performance and is the most expensive part of the diet's cost. Corn–soybean meal (SBM)-based diets are both common energy and protein sources for swine diets in South Korea. The non-starch polysaccharides (NSP) in corn–SBM-based diets can negatively affect the performance, which in turn can have serious consequences for the profitability of the pork industry (Omogbenigun *et al.,* 2004 and Van Kempen *et al.,* 2006). Corn contains 0.9% soluble and 6% insoluble NSP, while soybean contains 6% soluble and 18% to 21% insoluble NSP (Bach *et al.,* 1991 and Summers, (2001). Therefore, an increasing consideration is paid on enzyme utilization in livestock nutrition. Exogenous enzyme supplementation is used to target NSP and protein, consequently improving digestion, weight gain in monogastric animals fed corn–SBM diets (Kim *et al,.* 2006 and Fang *et al.,* 2007) and absorption of nutrients such as energy and protein, while reducing feed costs. Increasing dietary energy from added enzyme has been consistently shown to be able to improve growth performance and feed efficiency from the middle to nursery period (Jo *et al.,* 2012).

The effect of the use of fermented sweet orange peel on carcass quality of broilers was investigated by Oluremi *et al.*, (2010). These authors reported a significant effect on the birds dressing percentage and concluded that 30% replacement of maize with naturally fermented sweet orange peel meal is practicable in broiler production enterprise. Fermented cassava products have also been used severally as alternative feed sources for many livestock species with cost-reducing benefits (Udedibie *et al.,* 2004; Ekpo *et al.,* 2009). There is however little information on the effects of the use of rice offal and Millet hulls wastes on meat quality and carcass characteristics of farm animals and especially of pigs.

Materials and methods

Location of the study

The study was carried out at the Swine unit of Teaching and Research Farm of the Department of Animal Production and Health, Federal University Wukari, Taraba State. Wukari is located at longitude 9°47'0" E and latitude 7°51' 0" N longitude 9°47'0" E. The vegetation of the area is predominantly characteristics of savannah zone and with major climatic seasons of wet or rainy seasons, which starts in March or April, and ends in October and the dry season which starts in November and ends in March or April (Taraba State Dairy, 2008).

Experimental Diets

Three dietary treatments were compounded using rice offals and millet hulls. Diet 1 will serve as control containing 100% maize offals while diets 2 were contain 100% rice offals, and diet 3 were contain 100% millet hulls inclusion levels respectively. The diets were supplemented with 0.2kg /100kg of Quadraxyme® (Table 1).

Experimental Design and Animal Management

Eighteen (18) mixed local breeds of growers' pigs with an initial weight of 26.83kg were sourced within Wukari metropolis. The pigs were divided into three treatment groups of six animals per group replicated three times in a completely randomized design. Each pen were provided with feeders, drinkers and wallow. Animals were dewormed before the commencement of the experiment. The animals were fed *ad libitum* and the experiment lasted for 56 days. And the final weight as slaughter is 80.07±01.

Table 1 Ingredient Composition of Experimental Diets

	Dietary treatments		
Ingredients	T1	T2	T3
Maize	48.00	48.00	48.00
Soyabean meal	25.00	25.00	25.00
Maize offal	25.00	0.00	0.00
Rice offal	0.00	25.00	0.00
Millet hulls	0.00	0.00	25.00
Bone meal	1.00	1.00	1.00
Methionine	0.30	0.30	0.30
Lysine	0.20	0.20	0.20
*Premix	0.20	0.20	0.20
Salt	0.30	0.30	0.30
**Enzyme	0.00	0.20	0.20

*premix composition (per kg of diet): vitamin A, 12500 IU; vitamin D_3, 2500 IU; vitamin E, 50.00 mg; vitamin K_3, 2.50 mg; vitamin B_1, 3.00 mg; vitamin B2, 6.00 mg; vitamin B_6, 6.00 mg; niacin, 40 mg; calcium pantothenic, 10 mg; biotin, 0.08 mg; vitamin B^{12}, 0.25 mg; folic acid, 1.00 mg; chlorine chloride, 300 mg; manganese, 100 mg; iron, 50 mg; zinc, 45 mg; copper, 2.00 mg; iodine, 1.55 mg; cobalt, 0.25 mg; selenium, 0.10 mg; and antioxidant, 200 mg

** Enzyme composition per kg diet: amylase 110,000units, cellulose 500,000.00units, xylanase 1,000,000units, lipase 10,000units, pactinase 30,000.0units and 4,000 units.

Data Collection

Statistical analysis

Data collected were subjected to Analysis of Variance using JMP SAS (2014) version13. Significant level of difference among treatment means were separated using the same statistical tool.

Carcass Sampling of Pigs

Slaughter is the process of killing of animals intended for human consumption, it also refer to killing of animal by bleeding. Slaughter involves three distinct stages

1. Preslaughter handling: include the arrival of the animal, unloading from the truck, handling and moving of the pigs.
2. Stunning: include restraining of the animal and categories into Three mechanical, electric and gas stunning.
3. Slaughter.

Procedure for Slaughtering Pig

1. Stunning: the act of rendering the animal or pig unconscious in preparation for slaughter.
2. Bleeding: this involves hanging of the stunned pig and cutting of the neck.

3. Scalding: this is the immersion of the slaughter pig into hot water and using of knife or razor blade to scramp the hair.
4. Evisceration: this is the removal of guy by a long cut below the belly to remove the internal Organs.
5. Pig slaughter method influences the quality of pig product and also serves as a critical point for the control of zoonosis and other food borne infections. The study aims at assessing the animal welfare concern and public health.

Water Holding Capacity Determination

Drip loss method

This water holding capacity can be determined by using the suspension method of Honikel. Each muscle was sliced to 2.0-cm in thickness, and processed into a disk with a diameter of 4 cm. Samples will be put into netting and suspended in a plastic bag. Samples will be stored at 4°C for 24 h. The weight of each slice was recorded before and after. Drip loss was express as a percentage of weight loss after suspension relative to the initial weight of the slice. Drip loss was measured in 3 replicate samples from each carcass, with the average value recorded as the drip loss for each sample.

Filter paper press method

The external force used to drive out the water was the filter paper press method. A Chromatography paper was kept for 24 h in a dissociated 38% sulfuric acid in advance that it complies with 60% humidity and it helped to diffuse out the water freely through the paper. Five grams of 24h aged meat will be homogenized on a metal plate. Out of this, 300 mg meat were measured right after preparation and put on the paper and then was placed between two slides on which a 100 g weight were placed on the top slide for 5 min so as to exert downward force and to release water from the meat as per the method described by Abraham and Kumar (2000). The water released from the meat which were eventually wet the paper and the boundary of that wetted area were demarcated using sharp pencil and was measured and reported in percentage of the ratio of the diameter of the meat to the diameter of the wetted paper as per Mendiratta *et al*., (2008).

pH Determination

A pH-meter with a glass electrode standardized for pH 4.6 and 7.0. will be used in determining the ph. The pH-meter will be automatically corrected for pH values, taking into account the muscle temperature of the different meat samples. An incision was made with the tip of a knife and the pH meter inserted in the meat samples to take readings.

Proximate Composition of the Meat Samples

Moisture content:

This was carried out according to method of Der-Jiumet al. (2012). A clean crucible was dried to constant weight in a hot air oven at 105oC and it was cooled in desiccators and was weighed (W1). Two grams (2g) of the meat sample was weighed into the previously labeled crucible and reweighed (W2). The container was dried in hot air oven at 105oC to constant weight (W3). The percentage moisture content was calculated as: % moisture content = W3-W1×100 /W2-W1.

Determination of Crude Protein

The method of Babalola and Akinsoyinu, (2011) was adopted. Briefly, 1.5g of defatted sample in an ashless filter paper was dropped into 300ml Kjeldahl flask. Twenty-five milliliters (25ml) of H_2SO_4 and 3g of digesting mix catalyst (which was weighed separately into an ashless filter paper) was dropped into Kjeldahl flask. The flask was then transferred to Kjeldahl digestion apparatus. The sample was digested until a clear green colour was obtained. The digest was cooled and diluted to 100 ml with distilled water. Distillation of the digest: Twenty milliliters (20ml) of the diluted digest was measured into a 500ml Kjeldahl flask containing anti bumping chips and 40ml of 40% NaOH was slowly added by the side of the flask. A 250ml conical flask containing a mixture of 50ml of 2% of Boric acid and 4 drops of mixed indicator was used to trap the ammonia liberated. The conical flask and the Kjeldahl flask were then placed in the Kjeldahl distillation apparatus, with the tubes inserted into the conical flask and the Kjeldahl flask. The flask was then heated to distill out the ammonia. The distillate was collected into boric acid solution. From the point when the boric acid turned green, 10 minutes was allowed for complete distillation of the ammonia present in the digest. The distillate was titrated with 0.1M HCl. Calculation: % N = 14 x M14 x Vt x Tv x 100 Weight of Sample (mg) x Vs % crude protein = % Nitrogen (N_2) x 6.25 Where M = Actual molarity of acid, Tv = titre volume of acid used, Vt = Total volume diluted digest, Vs = Aliquot volume distilled.

Crude lipid content:

A clean, dry 500ml round bottom flask, containing few anti bumping granules were weighed (W1) and 300ml of petroleum ether (40 - 60oC) for extraction was poured into the flask fit with soxhlet extraction unit (AOAC, 2010). The extractor thimble containing twenty grams (20g) of the sample will be fixed into the soxhlet extraction unit. Extraction was carried out for six hours (6 h). The solvent was recovered and the oil was dried in the oven at 70oC for one hour (1h) (AOAC, 2010). The round bottom flask containing the oil was cooled in the desiccators and then weighed (W2). The lipid content was calculated thus: Percentage crude Lipid Content = % ash content = W2 - W2 x 100 Weight of sample

Ash content:

The ash was determined according to the method reported by Association of Official Analytical Chemists (AOAC, 2010). A porcelain crucible was dried and was cooled in a desiccator and weighed (W1). Two grams (2g) of the meat was placed into the weighed crucible and was reweighed (W2). The sample was first ignited and transferred into a furnace, which was set at 550°C. The sample was heated in the furnace for eight hours to ensure proper ashing. The crucible containing the ash was removed and cooled in desiccators and weighed (W3). The percentage ash content was calculated as: % ash content = W3-W1×100 /W2 – W1

Carbohydrate content (by difference):

The total carbohydrate content was determined by difference. The sum of the percentage moisture, ash, crude lipid, crude protein and crude fiber will be subtracted from 100.
Calculation: % Total Carbohydrate = 100 - (%Moisture + %Ash + %Fat + %Protein + % Fibre).

Results and discussion

Table 2 Proximate composition of hind limb

Parameters	T_1	T_2	T_3	SEM	P-value
Moisture	27.600a	27.550^{a}	25.330^{b}	0.4368	0.0164
DM	72.400	72.450	74.670	0.7495	0.1255
ASH	1.5600	1.2300	1.2300	0.1783	0.3800
E.E	5.8300^{a}	3.5400^{c}	4.2600^{b}	0.1812	0.0003
C.P	23.760	24.870	24.760	1.3104	0.8104

Mean bearing different superscript on the same row differ significantly at ($p< 0.05$).
SEM Standard error mean.DM= Dry Matter; EE = Ether Extract; CP= Crude protein T1 = Control Diet T2 = Millet hulls T3 = Rice offals

Proximate composition of hind limb

Table 2 presents the proximate composition of HAM from finisher pigs fed different diets. The results showed that moisture content differed significantly ($p<0.05$) among the diets, with T3 (25.33%) having a significantly lower moisture content than T1 (27.60%) and T2 (27.55%). The dry matter content was significantly higher ($p<0.05$) in T3 (74.67%) compared to T1 (72.40%) and T2 (72.45%). The ether extract (EE) content was significantly higher ($p<0.05$) in T1 (5.83%) than T2 (4.26%) and T3 (3.54%). The crude protein (CP) content did not differ significantly ($p>0.05$) among the diets. These results suggest that the rice offal-based diet supplemented with enzymes led to a decrease in moisture content and an increase in dry matter content and a reduction in ether extract content compared to the control and millet hulls-based diets.

The results of this study are consistent with previous studies that have shown a reduction in moisture content (27.2 – 25.0%) with the use of rice byproducts in animal diets (Nwagu *et al.,* 2019; Suksombat *et al.,* 2019). Similarly, several studies have reported a reduction in ether extract content (4.982 – 4.235%) with the use of rice byproducts in animal diets (Adejumo *et al.,* 2018; Ha *et al*., 2019). The increase in dry matter content observed in this study with the rice offal-based diet is consistent with previous studies that have reported an increase in dry matter with the use of rice byproducts in animal diets ranging from 73.56 to 74) (Nwagu *et al*., 2019; Suksombat *et al*., 2019).

Table 3 pH and Minerals Composition of hind limb

Parameters	T_1	T_2	T_3	SEM	P-value
Ph	5.3400	5.3400	5.0200	0.1061	0.1232
Potassium	210.89^{ab}	209.45^{b}	212.76^{a}	0.8579	0.0881
Calcium	10.540^{b}	11.450^{a}	11.110^{b}	0.4445	0.4004
Iron	0.6100	0.700	0.7200	0.0191	0.0143
Phosphorus	250.78	250.67	260.67	16.431	0.8872
Cooking loss	22.870	22.560	23.670	0.6395	0.4912
WHC	28.650^{a}	23.670^{b}	24.670^{b}	0.6008	0.0025

T1 = Control Diet T2 = Millet hullsT3 = Rice offals pH = potential hydrogen WHC = Water holding capacity

Minerals of hind limb

Table 3 shows the mineral composition of hind limb, including potassium, calcium, iron, phosphorus, cooking loss, and water holding capacity (WHC). The results showed that the WHC of the hindlimb was significantly higher in T1 (28.650%) compared to T2 (23.670%) and T3 (24.670%). The potassium and iron content of the HAM did not vary significantly among the treatments, while the calcium and phosphorus content were significantly higher in T2 (11.450 mg/kg and 250.67 mg/kg, respectively) compared to T1 and T3. These results suggest that feeding pigs with millet hills-based diet supplemented with enzymes (quadraxymesR) could lead to a higher calcium and phosphorus content of hindlimb compared to feeding them with rice offals.
The results of this study suggest that the use of millet hulls and rice offals in pig diets did not significantly affect the mineral composition of the hindlimb. The higher calcium content observed in T2 is consistent with previous studies that have reported an increase in calcium content with the use of millet in animal diets (Luo *et al*., 2015). Similarly, the higher iron content observed in T3 is consistent with previous studies that have reported an increase in iron content with the use of rice byproducts in animal diets (Adejumo *et al*., 2018; Ha *et al*., 2019). The higher WHC observed in T1 is in agreement with previous studies that have reported a reduction in WHC (25 – 24.3) with the use of rice byproducts in animal diets (Nwagu *et al.,* 2019; Suksombat *et al.,* 2019).

Table 4 Proximate composition of blade shoulder

Parameters	T_1	T_2	T_3	SEM	P-value
Moisture	26.770a	23.440b	21.550b	0.6459	0.0035
DM	73.230	76.560	78.450	1.9342	0.2342
ASH	1.4500	1.3400	1.5600	0.1741	0.6875
E.E	5.5100a	3.6700b	4.1300b	0.2720	0.0074
C.P	22.110	23.560	23.560	1.2979	0.6773

Mean bearing different superscript on the same row differ significantly at ($p < 0.05$).
SEM Standard error mean.DM= Dry Matter; EE = Ether Extract; CP= Crude protein T1 = Control Diet T2 = Millet hulls T3 = Rice offals

Proximate composition of Blade Shoulder

Table 4 presents the proximate composition of shoulder meat samples from finisher pigs fed with three different diets: control diet (T1), millet hulls-based diet (T2), and rice offals-based diet (T3). The results show that moisture content significantly differed ($p<0.05$) among the three diets, with T1 having the highest moisture content (26.770%) and T3 having the least value (21.550%). Ether extract (EE) content ranged from 3.670% to 5.510%. The crude protein (CP), pH, dry matter (DM), and ash content did not significantly differ among the three diets.
The reduction in moisture content in the meat samples of pigs fed with diets T2 and T3 might be due to the fiber content of millet hulls and rice offals, respectively, which can bind water (Jha *et al*., 2015). The lower EE content in T2 and T3 diets might be due to the higher fiber content in these diets, which can limit the absorption of lipids in the digestive system of pigs (Li *et al*., 2021).

Table 5 pH and Minerals Composition of Blade shoulder

Parameters	T_1	T_2	T_3	SEM	P-value
Ph	5.0100	5.1100	5.0100	0.0350	0.1437
Potassium	209.78	211.56	211.45	0.9754	0.4078
Calcium	20.560	10.450	11.450	0.4957	0.3583
Iron	0.5600b	0.7100a	0.7100a	0.0287	0.0152
Phosphorus	236.56	251.56	259.34	7.0333	0.1450
Cooking loss	21.670a	23.110ab	24.890b	0.8142	0.0813
WHC	27.450	24.670	24.210	1.7940	0.4365

T1 = Control Diet T2 = Millet hullsT3 = Rice offals pH = potential hydrogen WHC = Water holding capacity.

Minerals of Blade shoulder

In Table 5, the mineral composition of shoulder meat samples from finisher pigs fed with the three diets is presented. The results reveal that iron content significantly differed ($p<0.05$) among the three diets, with T1 having the least value (0.5600 mg/kg) and T2 and T3 having the highest (0.7100 mg/kg) iron content. The cooking loss and water holding capacity (WHC) and the other minerals (potassium, calcium, and phosphorus) did not significantly differ among the three diets.

The higher iron content in meat samples from pigs fed with T2 and T3 diets might be attributed to the higher iron content in millet hulls and rice offals, respectively as reported by Lestari *et al*., 2018. The non-significant difference in potassium, calcium, and phosphorus content among the three diets might be due to the similar mineral content in the ingredients of the three diets.

Table 6 Proximate composition of Pork belly

Parameters	T_1	T_2	T_3	SEM	P-value
Moisture	21.550	20.550	23.550	1.6716	0.4787
DM	78.450	79.450	76.450	1.6716	0.4787
ASH	1.4500	1.3200	1.3400	0.1126	0.6954
E.E	5.5600^{a}	3.6700^{b}	4.2600^{b}	0.2717	0.0070
C.P	23.450	23.230	23.560	0.7670	0.9535

Mean bearing different superscript on the same row differ significantly at ($p< 0.05$).
SEM Standard error mean.DM= Dry Matter; EE = Ether Extract; CP= Crude protein T1 = Control Diet T2 = Millet hulls T3 = Rice offals

Proximate Composition of Pork belly

The table 6 shows the proximate composition of bacon samples from finisher pigs fed with the three diets. The results indicate that the moisture and ether extract (EE) content significantly differed ($p<0.05$) among the three diets, ranging from 23.550% to 20.550%, while T1 had the highest EE content (5.560%) and T2 had the lowest (3.670%). The pH, dry matter (DM), ash content, and crude protein (CP) did not significantly differ among the three diets.

The higher moisture content in T3 pork belly's samples might be due to the higher moisture content in rice offals-based diet. The lower EE content in T2 bacon samples might be due to the higher fiber content in millet hulls-based diet.

Table 7 pH and Minerals Composition of Pork belly

Parameters	T_1	T_2	T_3	SEM	P-value
Ph	5.1100	5.4600	5.2100	0.1643	0.3633
Potassium	210.35	210.45	208.56	1.6037	0.6634
Calcium	10.560	11.560	10.56	0.5843	0.4294
Iron	0.5000b	0.7200a	0.6900ab	0.0553	0.0601
Phosphorus	251.10	252.12	248.78	12.303	0.9809
Cooking loss	22.780	24.670	23.560	0.79110	0.3082
WHC	22.560b	25.670a	27.450a	0.7866	0.0126

T1 = Control Diet T2 = Millet hullsT3 = Rice offals pH = potential hydrogen WHC = Water holding capacity

Minerals of Pork belly

Table 7 presents the mineral composition of bacon from pigs fed different diets supplemented with QuadraxymesR. The data shows the concentration of potassium, calcium, iron, and phosphorus in the bacon, as well as the cooking loss and water-holding capacity (WHC) of the samples.

The results show that there were no significant differences ($p > 0.05$) among the three treatments (T1, T2, and T3) in terms of potassium concentration, with values ranging from 208.56 to 210.45 mg/100 g. These values are within the normal range reported for pork, which is 220-360 mg/100 g (Li et al., 2017). Calcium concentration ranged from 10.56 to 11.56 mg/100 g, with no significant differences among the treatments. These values are also within the normal range reported for pork, which is 5-20 mg/100 g (Li *et al*., 2017). Iron concentration ranged from 0.50 to 0.72 mg/100 g, with T2 having the highest concentration of iron. Although there was no significant difference among the treatments, the values obtained are within the normal range reported for pork, which is 0.3-1.0 mg/100 g (Li *et al*., 2017). Phosphorus concentration ranged from 248.78 to 252.12 mg/100 g, with no significant differences among the treatments. These values are also within the normal range reported for pork, which is 150-250 mg/100 g (Li *et al.,* 2017). The cooking loss ranged from 22.78% to 24.67%, with no significant differences among the treatments. The cooking loss is an important quality parameter for meat, as it indicates the amount of weight loss during cooking and can affect the texture and juiciness of the meat. The results obtained are within the range reported for pork, which is 20-30% (Li *et al*., 2017).

The WHC ranged from 22.56% to 27.45%, with T3 having the highest value. The WHC is an important quality parameter for meat, as it indicates the ability of the meat to retain water during cooking and can affect the tenderness and juiciness of the meat. The results obtained suggest that the pigs fed T3 had meat with better water-holding capacity, which may be due to the higher moisture content observed in Table 5. This is supported by previous studies that have shown that diets high in fiber and water can improve the water-holding capacity of pork (Li *et al*., 2017).

Conclusion

The results of this study indicate that finisher pigs fed a diet supplemented with Quadraxymes® and either rice offals or millet hulls produced carcasses with similar proximate composition and mineral content to those fed a control diet. However, pigs fed the millet hull-based diet had lower moisture and higher ether extract content in their ham compared to pigs fed the other diets. In terms of shoulder composition, pigs fed the millet hull-based diet had lower moisture and ether extract content and a lower water holding capacity compared to the other diets. The mineral content of shoulder meat did not differ significantly between diets. For pork belly, there were no significant differences in proximate composition or mineral content between diets.

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