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Research Article

Growth Performance and Carcass Characteristics of Growing Pigs Fed Diets Containing Urea-Molasses Treated Rice Husk as a Replacement for Wheat Offal

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Abstract

The use of non-conventional fibrous feed stuff in pig nutrition to reduce cost requires strategies to increase its utilisation due to its low nutrient content and poor digestibility. This study investigated the effect of graded levels of urea-molasses treated rice husk (UMTRH) as replacement for wheat offal in diet of growing pigs. A total of 60 pigs of about 8 - 10 kg weight were used to investigate the growth performance and carcass characteristics. Pigs were allotted on weight equalisation basis into five dietary treatments. The pigs were randomly allotted into 15 pens and each treatment contained 12 pigs consisting of 3 replicates of 4 pigs each. The diets formulated consists of a standard basal diet Control; (wheat offal based without treated rice husk) and treated rice husk was used to replace wheat offal at 25, 50, 75, and 100% replacement levels in a standardized grower pigs diet. Performance data was collected at the end of 8th and 16th week of the study while carcass measurement was done at the end of 16th week. Cut parts and organs were expressed as % of live weight (% LW). Data obtained were subjected to analysis of variance in a completely randomized design. At 8 weeks, total weight gain (TWG) was higher ($P < 0.05$) for pigs fed control diet (22.25 kg) and those fed diets containing 25% (22.17 kg) and 50% (21.42 kg) UMTRH than those fed diet with 100% (19.42 kg) UMTRH. 25% inclusion of UMTRH in the diet of pigs resulted in better ($P < 0.05$) feed conversion ratio (FCR). At 16 weeks, the inclusion 25% UMTRH resulted in improved ($P < 0.05$) weight gain comparable to the control while pigs fed diet with 100% UMTRH had reduced ($P < 0.05$) weight gain (21.00 kg). Pigs fed diet with 100% UMTRH had reduced ($P < 0.05$) dressing percentage (67.59%) compared to that of the control. It was concluded that inclusion of 75% UMTRH supports weight gain of pigs like that of the control diet with comparable dressing percentage.

Keywords: Pigs; Rice Husks; Urea-Molasses; Growth Performance; Carcass

Introduction

The consumption of animal protein is a major constraint in most African countries which is caused by the low per capital income, monthly income and monthly food expenditure of the household head prevalent in these region [1,2]. In Nigeria, an average person consumes 45.4g [3] as against 53.8g that the World Health Organization (WHO) [4] recommended. The implication of the poor intake of protein of animal origin is predicated by the cost price of such product [5]. The determining factor of the prices is the average cost of production which about 70 - 75% of it is expended on feeding and the incessant increase in the price of livestock feed is premised on the forces of demand and supply of the ingredients making up of the feed resources. Most conventional livestock feed ingredients are also consumed by humans thus creating competition between man and animals [6]. Based on this, research should be geared towards the production of the classes of animals that can yield more animal protein within a short period of time and can also easily utilize feedstuffs regarded as waste to human but edible to livestock.

Pig is one of the most efficient converter of waste (kitchen, agricultural and agro-industrial) to edible meat. Its high level of prolificacy earned it another unequalled attribute amongst the domestic animals [7]. Pigs have about 15,000 taste buds that permits it to be able to utilize a number of agro-industrial waste as feed including forages. Pig reach maturity age between 6 - 8 months with an average meat yield of about 68 kg. Pork meat is rich in vitamins and mineral that are important to humans. A major constraint to pork consumption apart from religious discrimination is the high meat-fat deposition however, lean meat can be obtained with the feeding of fibrous diet. Herr., *et al*. [8] reported that feeding high fibre diet to pigs have a suppressive effect on its meat-fat deposition.

Wheat offal is a globally recognized fibre source to all classes of livestock feed [9]. However, its increased demand had led to a geometric hike in its prevailing price. This sporadic and incessant increase in the price of wheat offal have further jerk up the price of most livestock products [10]. The solution to stem this high cost of production is to incorporate a cheaper less demanding and readily available agricultural waste as alternative to the conventional feedstuff [11]. Rice husk is the waste generated from rice production and it constitutes about 20% of the product during rice production which is about 482 million metric tons annually [12] and if not utilized, it can become a menace to the environment and hazardous to the populace. Rice husk is known to be high in fibre (67.53%) with low protein (2.9 - 3.6%) [13]. The fibre is lignified and this may hinder its digestibility except it is subjected to chemical or biological treatments. High dietary fibre is implicated in decreased nutrients utilization and low net energy value [14]. Therefore, processing strategies should be engaged to increase the utilisation of the fibrous feed products.

The use of urea [15] and urea molasses [16] in treating fibrous products have yielded positive results. Urea treatment helps to improve the quality of fibrous feed resources by increasing their nitrogen content and the solubility of its fibre fractions [17]. Molasses is high in soluble carbohydrate and its sucrose sweetness is employed to placate the bitter taste of urea to make it readily acceptable to livestock [18] and it also increases the palatability of diets [19]. Therefore, this research work investigates the effect of urea-molasses treated rice husk as replacement for wheat offal on performance and carcass characteristics of growing pigs.

Materials and Methods

Experimental site and test materials

The experiment was carried out at the Teaching and Research Farm of Yaba College of Technology, Epe campus (latitude 6.58°N, Longitude 3.98°E.) which lies on Km 11 Epe-Ijebu Ode road, Epe Lagos [20]. Rice husk was procured from Lagos State rice processing factory at Itoikin and was properly sundried and milled using 2 mm sieve and stored in airtight bags until when needed. Similarly, fertilizer grade of urea and liquid molasses were purchased from the Lagos State Agricultural Input Supply Services Epe and stored until usage time.

Experimental animals and management

Sixty male cross breed (Landrace × Large white) weaner pigs of about 8 - 10 kg body weight (60 - 75 days old) were purchased from Joan Exclusive Treasures Farm, Mojoda in Epe local government area of Lagos state and brought into the Teaching and Research Farm of Yaba College of Technology, Epe, Lagos. Fifteen pens were washed and disinfected before the arrival of the pigs to prevent infections. After arrival, recommended routine medication (deworming and delousing) programs was strictly adhered to. They were allowed to stabilize for seven days and were fed diets formulated to meet their nutrient requirements [21] before the commencement of feeding trial.

Preparation of urea-molasses treated rice husk (UMTRH)

Urea-molasses was prepared by mixing 2% of fertilizer grade urea thoroughly with 10% liquid molasses in 25 w/v litres of water. 100 kg of milled rice husk was added into the mixture of urea, molasses and water and stirred thoroughly in a big plastic bowl to obtain Urea-molasses treated rice husk (UMTRH). The product was allowed to soak for 5 minutes [22] before being spread on polythene nylon on concrete floor and air-dried for 2 days and then oven dried at 65°C for 30 minutes and then bagged for usage.

Chemical analysis of test ingredients

Samples of test ingredients (untreated rice husk (URH) and treated rice husk (TRH)) were analysed. Analysis per sample was done in triplicates. Ground samples was analysed for its proximate constituents and fibre fractions by AOAC [23] and Van Soest [24] respectively. The total polyphenol [25], flavonoid [26], extractable tannin [27] and saponin content [28] of samples were determined according to the standard procedures.

Dietary treatments and experimental animals

The pigs were randomly allotted on weight equalization basis into five (5) dietary treatments in a completely randomized design. The pigs were randomly allotted into 15 pens and each treatment contained 12 pigs consisting of 3 replicates of 4 pigs each. Five experimental diets were formulated for growing pigs (Table 1). A standard basal diet Control (wheat offal based without treated rice husk) and treated rice husk was used to replace wheat offal at 25, 50, 75 and 100% replacement levels in a standardized grower pigs diet [21]. Pigs in each group were assigned to their respective experimental diets and the experiment trial was conducted for 16 weeks. During the experimental period, feed and water were supplied *ad-libitum.*

	Control	UMTRH			
Feed Ingredients (%)	**(0%)**	**(25%)**	**(50%)**	**(75%)**	**(100%)**
Maize	30.00	30.00	30.00	30.00	30.00
Soybean meal	12.00	14.00	15.50	17.50	20.00
Palm kernel cake	15.00	13.00	11.50	7.50	10.00
Wheat offal	39.00	29.25	19.50	9.75	-
TRH	-	9.75	19.50	29.25	39.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.40	1.40	1.40	1.40	1.40
*Vitamin/Mineral Premix	0.10	0.10	0.10	0.10	0.10
Sodium Chloride	0.30	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Analysed nutrients (%)					
Crude protein	17.67	17.51	17.20	17.05	17.60
Crude fibre	14.43	13.68	12.95	12.19	11.75
Ether extract	4.77	4.55	4.36	4.15	4.14
Ash	3.22	5.35	6.50	7.76	8.97

Table 1: Gross composition of experimental diet for growing pigs (g/100g DM).

*Vitamin/Mineral Premix: Vit. A. 5,500,000 (iu), Vit D3. 1500,000 (iu), Vit E. 10,000 (mg), Vit. k3 1,500 (mg), Vit. B1, 1,600 (mg), Vit. B2 24,000 (mg), niacin 20,000 mg, pantothenic acid 5,000 mg vit B6 1,500 mg, Vit. B12 10 mg, folic acid 500 mg, Biotin H2 750 mg, chlorine chloride 175,500 mg, cobalt 200 mg, copper 300 mg, iodine 1,000 mg, iron 20,000 mg, manganese 40,000 (mg), selenium 200 mg, zinc 30,000 mg, antioxidant 1,250 mg.

UMTRH: Urea-Molasses Treated Rice Husk.

The dietary treatments are Diet 1 (Control; 0% UMTRH replacement level), Diet 2 (25% UMTRH replacement for wheat offal), Diet 3 (50% UMTRH replacement for wheat offal), Diet 4 (75% UMTRH replacement for wheat offal) and Diet 5 (100% UMTRH replacement for wheat offal).

Performance measurement

The performance characteristics of the pigs were monitored and determined by measuring the weight gain, feed intake and feed conversion ratio (FCR).

Body weight gain was calculated from the differences between the body weight gain for the given week and the previous week (Formula 1). Final weights was taken and recorded at the end of each periods of the experiment:

(1) Body weight gain (kg) = Final body weight (kg) - Initial body weight (kg).

Feed intake was calculated by the difference between quantity of feed supplied and leftover divided by the number of pigs (Formula 2):

$$\text{Feed intake} = \frac{\text{Feed supplied - Leftover feed}}{\text{Number of pigs}}$$

The feed conversion ratio of each of the group of pigs was determined by calculating the ratio of feed intake to weight gain (Formula 3):

$$\text{FCR} = \frac{\text{Total feed intake (Kg)}}{\text{Total body weight gain (kg)}}$$

Carcass characteristics

At the end of the 16th week of the experiment, fifteen pigs (i.e. three pigs per treatment representing the average weight) were selected randomly for carcass measurements. The pigs were starved of feed for 12 hours, weighed and manually slaughtered by cutting the jugular vein to allow proper bleeding. The slaughtered pigs were defurred and eviscerated to evaluate their carcasses, Carcass weight measurements (the main body, head, kidneys, liver, heart and other edible parts) were determined according to procedures described by Jensen [29]. The carcasses were weighed while weights of the cut parts and organs were recorded and expressed in percentage of live weight (%LW). Dressing percentage was determined by dividing the dressed weight by the live weight and multiplied by one hundred (Formula 4):

$$\text{Dressing percentage} = \frac{\text{Carcass weight}}{\text{Live weight}} \times 100$$

Statistical analysis

The data collected were subjected to one-way analysis of variance (ANOVA) in a completely randomize design (CRD). The significance means were separated and compared using Duncan Multiple Range Test [30] of SAS [31] at 5% level of probability.

Results

The proximate, fibre fractions and antinutritional composition of untreated rice husk and urea-molasses treated rice husk is presented in Teable 2.

Parameters (%)	URH	UMTRH
Proximate composition		
Crude Protein	3.91	4.65
Crude Fibre	34.28	34.20
Ether Extract	3.65	3.11
Ash	19.44	18.64
NFE	26.17	26.38
Fibre fractions		
Cellulose	41.42	36.83
Hemicellulose	27.24	25.37
Lignin	18.62	15.61
Acid detergent fibre	19.43	22.33
Neutral Detergent fibre	49.57	45.93
Acid detergent lignin	12.53	11.96
Antinutritional constituent		
Saponin	3.7	4.2
Tannin	42.24	38.39
Flavonoids	3.85	5.27
Terpenoids	13.55	16.6

Table 2: Proximate, fibre fractions and antinutritional composition of untreated rice husk and urea-molasses treated rice husk.

URH: Untreated Rice Husk; UMRH: Urea Molasses Treated Rice Husk; NFE: Nitrogen Free Extract.

Performance of weaner pigs (8 weeks)

The performance of pigs fed diet containing UMTRH at 8 weeks is shown in Table 3. The result shows that final weight (FW), total weight gain (TWG) and feed conversion ratio (FCR) were significantly (P < 0.05) affected by UMTRH inclusion. Pigs fed control diet, those fed diet containing 25% UMTRH and those fed diet containing 50% UMTRH had higher (P < 0.05) FW than those fed diet containing 100% UMTRH. A similar trend was observed for TWG. Pigs fed diet containing UMTRH at 25% inclusion level had the best FCR however, similar to other inclusion levels except that of 100%.

	Replacement levels of UMTRH						
Parameters	**0**	**25**	**50**	**75**	**100**	**P-value**	**SEM**
Initial weight (Kg)	10.00	9.58	9.92	9.58	9.67	0.799	0.31
Final weight (Kg)	32.25^{a}	31.75^{ab}	31.33^{ab}	30.17^{bc}	29.08^{c}	0.001	0.47
Total weight gain (Kg	22.25^{a}	22.17^{a}	21.42^{a}	20.58^{ab}	19.42^{b}	0.001	0.47
Total feed intake (kg)	45.83	41.33	46.42	44.35	44.08	0.089	1.29
Feed conversion ratio	2.06^{ab}	1.87^{b}	2.17^{ab}	2.16^{ab}	2.28^{a}	0.007	0.15

Table 3: Performance of growing pigs fed UMTRH as replacement for wheat offal (8 weeks).

^{ab}Means on the same row with different superscript are significantly different (P < 0.05)

UMTRH: Urea Molasses Treated Rice Husk; SEM: Pooled Standard Error of Mean.

Performance of growing pigs (16 weeks)

Table 4 shows the effect of UMTRH inclusion on performance of pigs at 16 weeks. The result shows significant (P < 0.05) effect of UMTRH on all performance parameters measured except FCR. Pigs fed diet without UMTRH had higher (P < 0.05) FW compared to those fed diet with 50, 75 and 100% inclusion level of UMTRH but similar to those fed diet with inclusion of UMTRH at 25%. Pigs fed diet containing 100% UMTRH had reduced (P < 0.05) TWG than those fed control diet. Inclusion of UMTRH at 0% in the diet of pigs resulted in increased (P < 0.05) TFI compared to those fed diets containing 50 and 100% UMTRH.

Carcass characteristics of growing pigs (16 weeks)

Table 5 presents the effect of UMTRH on carcass characteristics and organ weight of growing pigs at 16 weeks. The result shows that inclusion of UMTRH significantly affected (P < 0.05) all carcass parameters measured. Inclusion of UMTRH at 0% resulted in higher (P < 0.05) live weight (LW), dressed weight (DW), and dressing percentage than those fed diet containing 100% UMTRH while those fed diet containing 25, 50 and 75% UMTRH had similar dressing percentage with that of the control group. Inclusion of UMTRH at 0, 25 and 75% resulted in the highest (P < 0.05) head

	Replacement levels of UMTRH						
Parameters	**0**	**25**	**50**	**75**	**100**	**P-value**	**SEM**
Initial weight (Kg)	42.25^{a}	41.75^{a}	41.33^{a}	40.17^{ab}	39.08^{ab}	0.001	0.47
Final weight (Kg)	63.25^{a}	64.83^{ab}	65.35^{b}	63.58^{b}	66.10^{b}	0.001	1.98
Total weight gain (Kg)	27.02^{a}	23.08^{ab}	24.02^{ab}	23.42^{ab}	21.00^{b}	0.002	1.72
Total feed intake (kg)	66.43^{a}	63.08^{ab}	61.33^{b}	63.58^{ab}	61.00^{b}	0.022	1.13
Feed conversion ratio	3.19	2.79	2.61	2.77	2.31	0.361	0.34

Table 4: Performance of growing pigs (16 weeks).

^{ab}Means on the same row with different superscript are significantly different (P < 0.05)

UMTRH: Urea Molasses Treated Rice Husk; SSFRH: Solid State Fermented Rice Husk; SEM: Pooled Standard Error of Mean.

	Replacement levels of UMTRH						
Parameters	**0**	**25**	**50**	**75**	**100**	**P-value**	**SEM**
Live weight (kg)	64.85^{a}	62.33^{c}	62.00^{c}	63.58^{ab}	64.10^{b}	< 0.001	0.72
Dressed weight (kg)	46.47^{a}	44.72^{b}	44.37^{b}	42.32^{bc}	41.93^{b}	< 0.001	0.90
Dressing (%)	72.47^{a}	67.70^{ab}	69.75^{ab}	68.89^{ab}	67.59^{b}	0.031	1.23
Cut parts (% LW)							
Head	5.70^{a}	5.45^{a}	4.30^{c}	5.51^{a}	4.63^{b}	0.021	0.05
Belly	2.45^{a}	1.70^{d}	2.16^{b}	1.99^{c}	1.64^{d}	0.002	0.02
Back	9.33^{b}	7.66^{d}	7.70^{cd}	9.98^{a}	7.95^{c}	0.005	0.07
Fore limb	8.51^{a}	6.46^{bc}	5.61^{c}	7.11^{b}	5.96^{bc}	0.013	0.13
Hind limb	8.57^{a}	6.38^{c}	6.40^{c}	7.73^{b}	6.56^{c}	0.042	0.11
Loin	7.61^{a}	6.05^{b}	4.48^{d}	5.28^{c}	4.91^{c}	0.034	0.06
Weight of organs (% LW)							
Kidney	0.19^{bc}	0.20^{ab}	0.18^{c}	0.21^{ab}	0.22^{a}	< 0.001	2.95
Liver	1.08^{a}	0.95^{d}	0.90^{e}	1.05^{b}	0.96^{c}	0.025	2.18
Spleen	0.08^{c}	0.09^{c}	0.11^{b}	0.12^{b}	0.13^{a}	0.036	1.44
Whole GIT	7.27^{b}	5.37^{e}	6.63^{c}	6.03^{d}	7.49^{a}	0.030	0.05

Table 5: Carcass characteristics of growing pigs (16 weeks).

^{abcde}Means on the same row with different superscript are significantly different (P < 0.05)

UMTRH: Urea Molasses Treated Rice Husk; SEM: Pooled Standard Error of Mean; %LW: Percentage Live Weight.

weight. Pigs fed control diet had the highest (P < 0.05) belly, fore limb, hind limb, loin and liver weight compared to other treatments. Inclusion of 100% TRH in the diet of pigs increased (P < 0.05) kidney, lungs, spleen, stomach and intestine weight.

Discussion

The inclusion of UMTRH at 25 and 50% level in the diet of pigs at the end of week 8 resulted in TWG comparable to that of the control. This may be due to tolerable level of dietary fibre with adequate nutrient availability and utilization by the pigs. However, a decrease in TWG was observed with 100% inclusion level of UMTRH. This decline might be due to the increase in fibre content of the diet which increased gut fill due to increased water holding capacity with resultant suppressed feed intake [32]. Pigs fed diet containing 25% UMTRH had the best FCR compared to other inclusion levels. This connotes the nutrient adequacy of the diet resulting in improved weight gain with lower feed intake. This is in consonance with the report of Thi Thu Hong., *et al*. [33] who reported improved FCR for pigs fed diet containing fermented rice bran and fermented cassava waste.

At the end of 16 weeks, improved FW was observed for pigs fed diet containing UMTRH at 0 and 25% inclusion level compared to those fed diets with 50, 75 and 100% inclusion level of UMTRH. The TWG of pigs fed diet containing 100% UMTRH was also reduced. The reduction observed at these inclusion level of UMTRH is associated with the level of fibre in the diet which altered nutrient utilisation resulting in reduced weight gain. Gonzalez-Alvarado., *et al*. [34] reported that inclusion of fibre in the diet had depressing effect on body weight gain of broilers. A similar trend was observed for total feed intake. The most reduced feed intake was observed for pigs fed diet containing 100% UMTRH. This decline in feed intake can be associated with the depressing effect of fibre on feed intake. Pigs tends to halt their continuous feed intake to avoid gut compaction when their stomach is filled up.

The carcass measurements shows that pigs fed control diet had increased LW, DW and dressing percentage. The response of pigs fed this diet indicates the pigs had access to adequate quantity of energy and protein. It has been reported that constituents of diets fed to pigs has great effect to influence its response in terms of carcass yield [35]. Increase in belly, loin, forelimb and hind limb weight observed for pigs fed diet containing 0% UMTRH correlates with the high LW and DW obtained for the pigs. This corroborates the report of Njoku., *et al*. [36] who reported that pigs with larger body weights had higher ham, feet and shoulder weights. The increased weight of stomach and whole GIT observed for pigs with inclusion of UMTRH at 100% could be due to increased pressure on the gastrointestinal tract in order to handle the high fibre content [37].

Conclusion

UMTRH can be replaced for wheat offal at 75% in the diet of pigs for increased weight gain comparable to that of the control and a better FCR can be achieved with the inclusion of UMTRH as a replacement for wheat offal at 25% in the diet of pigs. The replacement of UMTRH for wheat offal at 75% was able to give good dressing percentage comparable to that of the control.

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