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EFFECT OF FOOD WASTE ON THE PERFORMANCE AND HAEMATOLOGICAL PROFILE OF WEANED PIGS

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ABSTRACT

This study evaluated the performance, haematological and serum biochemical parameters of weaned pigs fed rice wastes. Twenty seven weaned pigs (8.83kg±0.5) were randomly assigned into three treatments (n=9) as control (T1: 25% basal + 75% concentrate), T2 (25% basal + 37.5% concentrate +37.5% rice waste) and T3 (25% basal + 75% rice waste) in an experiment that lasted for 7 weeks. Significant variations were observed in weight changes and feed conversion ratio of pigs fed T1 (12.70kg and 0.93) and T2 (10.07kg and 1.12) respectively. Pigs fed T2 recorded significant values of 12.83($x10^3$/µl) in WBC and 44.00% in lymphocyte compared to pigs fed other diets. Furthermore, the addition of rice waste improved significantly ($P<0.05$) the glucose (77.35mg/dl) and cholesterol (179.80mg/dl) content of the serum of pigs in T3 compared to 60.15mg/dl and 112.23mg/dl that was observed in pigs fed T1. No significant variation was also observed in the Alanine amino transferase (ALT) content of pigs fed T1 (35.45 I.U/l) and T2 (40.80 I.U/l). It can be concluded that combination (25% basal + 37.5% concentrate + 37.5% rice waste) of rice waste and concentrate can serve as a feed for weaned pigs for maximal growth.

Keywords: Rice wastes, Weaned pigs, Performance, Haematology

INTRODUCTION

Food waste can be defined as any edible material or byproduct that is generated in the production, processing, transportation, distribution, or consumption of food (Westendorf and Myer, 2012). The primary waste products fed to swine are plate and kitchen waste, bakery waste, and food products from grocery stores. The primary sources of plate waste are restaurants, institutions, schools, and to a small degree, households. For the purpose of this work, the term food waste will be used to refer to all food wastes, including plate waste, kitchen or table scraps, garbage, or swill, and all food residuals discarded after serving.

Feeds and feeding constitutes the greatest cost (about 70%) in raising pigs (Kumar *et al.,* 2014). Feed manufacturers and livestock producers are facing the problems of high prices of grains and oil cakes. Feeding of food waste to swine and other livestock is a common practice throughout the world and is often more common around metropolitan centers where it is available in bulk (Westerndorf *et al.*, 1999) as it helps to reduce environmental pollution. Also, food wastes are nutrient rich surplus materials with high crude protein and energy value and can be used as regular feeds for pigs after boiling (Westerndorf *et al.*, 1999).

The aim of this study was to evaluate the performance, haematological and serum biochemical parameters of weaned pigs fed rice wastes.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the piggery unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. The farm is situated in Southern Nigeria at $7^{0}20^{1}$N, $3^{0}50^{1}$E at an altitude of 200-300 m above sea level.

Source of waste food sample

The food waste was mainly rice; it was obtained from restaurants within the University of Ibadan. The food wastes were collected twice a day. Samples of the food waste were analyzed for proximate analysis.

Experimental diets and animal management

Twenty seven weaned pigs of average weight of 8.83±0.5kg were used. The pigs were obtained from the piggery unit of the Teaching and Research Farm, University of Ibadan piggery unit. The animals were kept and monitored for one week in order to acclimatize them before the commencement of the experiment. The experiment lasted for seven weeks. Concentrate diet (Table 1) was compounded to meet the nutrient requirement of weaned pigs according to NRC, 2012. The pigs were fed 8% of their body weight daily. The basal diet which forms 25 % of the total feed contains cassava peels, palm kernel cake and brewer's dry grain.

Experimental design

The pigs were arranged into three treatments with each treatment having three replicates. The treatments were as follows;

T_1 (25% basal + 75% concentrate)

T_2 (25% basal + 37.5% concentrate +37.5% rice waste)

T_3 (25% basal + 75% rice waste)

The experimental design used was completely randomized design.

Data collection

Data collection on the following parameters started immediately after the pigs were placed in treatments.

Growth performance

Data was collected on the growth parameters of the weaned pigs for seven weeks. Feed intake was obtained by subtracting the leftover feed from the total quantity of feed served weekly and thereafter, the summation of all the values obtained weekly for the duration of the experiment. This was done using a table top weighing scale. Weight gain of the pigs was determined by subtracting the initial live weight from the final live weight. Feed conversion ratio is defined as the quantity of feed (kg) consumed to gain a unit of live weight (kg) and this was obtained by dividing the total feed consumed by total weight gain for each pig (Wondifraw and Tamir, 2014).

Haematological parameters

On the last day of the experiment, five pigs were chosen at random from each treatment for blood sampling. Blood sample for haematological analysis was collected into sample bottles containing Ethylene-dimethyl-tetraacetic acid (EDTA) to prevent the blood from cloting. The haematological parameters determined include; packed cell volume (PCV), haemoglobin, red blood cell (RBC), white blood cell (WBC), lymphocytes, monocytes, eosinophils and neutrophils. The haematological parameters were determined according to the methods described by Sastri, 1985.

Serum biochemical parameters

Blood sample for serum biochemical analysis was collected into sample bottles and allowed to clot at room temperature. The clotted samples were spun in the centrifuge to separate the blood cells from the serum. The serum was then used to analyse for the following parameters; Serum total protein, serum glucose, serum total cholesterol, urea, albumin, creatinine, Aspartate Amino Transferase (AST) and Alanine Amino Transferase (ALT). Serum total protein was determined using the SP400UV/VIS spectrophotometer (Lowry *et al.,* 1951), serum glucose and serum total cholesterol concentration were determined using the colorimetric procedure as described by Lindner and Mann, 1960. Albumin was analysed using bromocresol green method as described by Doumas *et al.,* 1971 while aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activities were determined using the method of Reitman and Frankel, 1957.

Statistical analysis

Data were subjected to analysis of variance (ANOVA) of SAS, 2010 at $\alpha_{0.05}$ and significance means were separated using Duncan's Multiple Range Test.

RESULTS

Table 1: The gross composition of concentrate ration fed to weaned pigs

Ingredient	Percentage
Maize	46.75
Wheat offal	30.00
Groundnut cake	10.00
Full fat soya	10.00
Bone mean	1.50
Oyster shell	1.00
Premix	0.25
Salt	0.5
Total	100
CALCULATED ANALYSIS	
Crude Protein (%)	18.28
Energy (kca/kg ME)	2720.5
Calcium (%)	0.99
Phosphorus (%)	0.68
Lysine (%)	0.74
Methionine (%)	0.27
Fibre (%)	4.53

Performance characteristics of pigs fed diet supplemented with food waste

The results from Table 2 for the feed intake was not significantly different (P>0.05). However, there was a significant (P<0.05) difference in the weight gain of the experimental animals where Treatment 1 (12.70kg) was significantly (P<0.05) different from Treatment 3 (7.00kg). The feed conversion ratio also showed significant (P<0.05) increase as the percentage of food waste was increased in the feed where Treatment 3 (1.63) was significantly (P<0.05) different from Treatment 1 (0.93).

Table 2: Performance characteristics of pigs fed diet supplemented with rice waste

Parameters/Treatment	T1	T2	T3	SEM
Initial weight(kg)	8.83	9.13	8.77	0.20
Final weight(kg)	21.53^{a}	19.20^{ab}	15.77^{b}	0.68
Weight changes(kg)	12.70^{a}	10.07^{ab}	7.00^{b}	0.51
Feed intake(kg)	11.54	11.09	11.08	0.65
Feed conversion ratio (FCR)	`0.93^{b}	1.12^{ab}	1.63^{a}	0.11
Cost of concentrate per pig	562.58	270.32		
Cost of conc. per weight changes	7144.77	2722.12	_	
Cost benefit	523.20	302.75	_	

a,b,c: Means along the same row with different superscript are significantly different (P<0.05)

T_1 (25% basal + 75% concentrate)

T_2 (25% basal + 37.5% concentrate +37.5% rice waste)

T_3 (25% basal + 75% rice waste)

Hematological parameters of pigs fed experimental diets

Table 3 shows the effect of the experimental diets on the haematological parameters of the pigs. There were no significant (P>0.05) differences in the PCV (%), red blood cells (RBC), Eosinophil (%) and hemoglobin of the pigs across the treatments. Significant differences were observed on the lymphocytes of the pigs fed the experimental diets, where Treatment 1 (50.00%) was significantly higher than Treatment 2 (44.00%) and Treatment 3 (41.33%). The result of white blood cell shows there were significant (P<0.05) difference among the treatments where the pigs on Treatment 2 had the highest mean value of 12.83 x 10^3 µL while pigs on Treatment 3 had 9.05 ×10^3µL and Treatment 1 had the least value of 6.95 x 10^3µL.

Significant (P<0.05) difference were observed in the result of platelet count across the treatments, with Treatment 2 having the highest mean of 271.50 x 10^3µL and the pigs on Treatment 1 had the least mean value of 125.00 x 10^3 µL.

Table 3: Haematological parameters of pigs fed experimental diets

Parameters/Treatment	Ref values	T1	T2	T3	SEM
PCV (%)	26.00-35.00	33.67	35.00	33.33	0.94
Haemoglobin (gm/dL)	9.00-13.00	8.73	9.70	8.77	0.34
Red Blood Cell ($x10^6$/uL)	5.00-7.00	6.86	7.30	7.81	0.45
Lymphocytes (%)	35.00-75.00	50.00^a	44.00^b	41.33^b	3.02
Monocytes (%)	0.00-10.00	4.00^{ab}	4.33^a	2.00^b	0.35
Eosinophils (%)	0.00-15.00	2.00	3.00	2.67	0.44
White Blood Cell ($x10^3$/uL)	11.00-22.00	6.95^b	12.83^a	9.05^b	0.39
Platelet ($x10^3$/uL)	200.00-500.00	125.00^c	271.50^a	154.00^b	5.02
Neutrophils (%)	20.00-70.00	44.33^b	48.67^b	60.50^a	1.41

a,b,c: Means along the same row with different superscript are significantly different (P<0.05)
Reference haematological values of pigs (Mitruka and Rawnsely, 1977)
T_1 (25% basal + 75% concentrate)
T_2 (25% basal + 37.5% concentrate +37.5% rice waste)
T_3 (25% basal + 75% rice waste)

Serum biochemical parameters of pigs fed diet supplemented with rice waste

It was observed from Table 4 that the total protein in the serum of the experimental pigs were not significantly (P<0.05) different across the treatments, with value ranging from 4.58g/dl on pigs from Treatment 2 to 5.93g/dl on pigs from Treatment 3.

The albumin result shows that there was significant (P<0.05) difference observed with Treatment 1 having the highest value of 4.31g/dl and the least value of 2.13 from those on Treatment 2. Significant difference was observed on creatinine value of pigs. Treatment 3 had 1.09mg/dl which was higher compared to other Treatments (Treatment 1 as 0.38mg/dl and Treatment 2 as 0.65mg/dl). The urea result from the table shows significant (P<0.05) difference between the treatments with Treatment 1 having the highest value of 14.09mg/dl and the Treatment 3 having the lowest value of 6.39mg/dl. Significant (P<0.05) difference were observed for the value of blood glucose and the value ranges from 60.15mgdl (Treatment 1) to 77.35mgdl (Treatment 3).

The result of cholesterol from the table shows significant (P<0.05) difference across the treatments with the highest value of 179.80mg/dl from Treatment 3 and the least value of 112.23 mg/dl from Treatment 1.

Table 4: Serum biochemical parameters of pigs fed diet supplemented with rice waste

Parameters/Treatment	Ref values	T1	T2	T3	SEM
Albumin (g/dl)	2.30-4.00	4.31^{a}	2.13^{b}	3.16^{ab}	0.24
Creatinine (mg/dl)	0.80-2.30	0.38^{c}	0.65^{b}	1.09^{a}	0.20
Total protein (g/dl)	5.83-8.32	5.81	4.58	5.93	0.64
Urea (mg/dl)	8.20-24.60	14.09^{a}	11.07^{b}	6.39c	0.45
Glucose (mg/dl)	66.40-116.10	60.15^{c}	70.47^{b}	77.35^{a}	3.17
Cholesterol (mg/l)	81.40-134.10	112.23^{c}	122.35^{b}	179.80^{a}	1.13
AST (µl)	32.00-84.00	23.16^{b}	46.72^{a}	19.57^{c}	0.70
ALT (I.U/L)	31.00-58.00	40.80^{a}	35.45^{ab}	33.63^{ab}	1.01

AST (Aspartate Amino Transferase), ALT (Alanine Amino Transferase)
Reference serum values of pigs (11)
T_1 (25% basal + 75% concentrate)
T_2 (25% basal + 37.5% concentrate +37.5% rice waste)
T_3 (25% basal + 75% rice waste)

DISCUSSION

The mean intake of the pigs on the three diets did not show any significant (P>0.05) differences. However, there was a significant (P>0.05) difference in the result of the feed conversion ratio. The feed conversion ratio increased with more rice waste incorporated into the diet and was lowest in the control which contains no rice waste. The increase in the feed conversion ratio as the level of rice waste increased showed that the animals on the test ingredient had almost a similar feed intake with those on the control diet but gained less weight. Kwak and Kang (2006) observed a high feed intake due to relatively low energy levels in food waste mixture. However, there was a decrease in feed efficiency as the level of food waste mixture incorporated into the diet increased**.** Myer *et al*. (1999) and Westerdorf *et al*. (1998) reported that feeding food waste and energy supplement to finishing pigs resulted in lower feed intake and similar weight gain. Chae *et al*. (2000) reported that when 40% of food waste was fed to growing and finishing pigs, feed intake and weight change was reduced. Kim *et al.* (2011) found out that feed intake in the control treatment was numerically higher than other treatments of rats fed dried and fermented restaurant food residue. However, the result of this study possibly suggests that the rice waste was poor in nutritive value but it however improved the appetite of the animals while increasing their satiety threshold. Kwak and Kang (2006) observed a decrease in final body weight when food waste, broiler litter and bakery by-product mixture were fed to pigs.

Although the feed conversion ratio (FCR) was significantly higher for pig fed waste supplemented diets, the cost of production was reduced. Based on the cost benefit, it is evident that the control diet (T1) was the most expensive to feed. However, the cost of feed to produce 1kg of pork was most economical in Treatment 2 due to a similar feed conversion ratio and weight changes but at a lesser cost compared to the control diet (T1).

Heamatological parameters are good indicators of the physiological changes in animals (Adenkola and Durotoye, 2004). And are also an excellent medium for the measurement of potential biomarkers (Adenkola *et al.*, 2009). The blood consisting of blood cells and plasma fulfills the transport, regulatory, protective and homeostatic functions (Nasyrova *et al.*, 2006). From the results of hematological parameters in this study PCV, Hemoglobin and RBC of the pigs fed the

different dietary treatments were within normal range of 26 to 35%, 8 to 13g/dL and 5 to 7(x 10^6/µL) respectively, as documented by Mitruka and Rawnsley (1977).

It was also observed that pigs fed dietary treatment 2, had the highest WBC counts (12.83 x 10^3/µL) which was significantly higher when compared to values obtained for pigs fed dietary treatments 1 and 3. However, the observed increase in WBC counts for pigs on dietary treatment 2 is unclear. Apart from the toxic constituent in a diet, a key factor that has been documented to affect WBC counts and its differential components is the level of protein in the diet (Unigwe *et al*., 2016). Significant differences were observed in lymphocytes, monocytes and neutrophils of the pigs but all observed values fell within normal physiological range reported by Mitruka and Rawnsley (1977).

Pigs on dietary treatment 2 had significantly higher blood platelet concentration (271.50 x 10^3µ/L) when compared to values obtained for pigs on dietary treatments 1 (125 x 10^3µ/L) and 3 (154 x 10^3µ/L). This might have been the cause of the varied degree of blood clotting of the pigs fed the respective diets. Observed values for serum total protein in the current study were 5.81, 4.58 and 5.93 g/dL for pigs on treatments 1, 2 and 3, respectively. It is worth noting that obtained serum total protein results were within normal physiological ranges reported in Mitruka and Rawnsley (1977). However observed albumin (a component of serum total protein) values of pigs were significantly affected by supplementation of diets with rice waste. Significant differences were observed in serum glucose concentration of the pigs, serum glucose concentrations increased as the inclusion of rice waste in the diets increased, values for serum glucose were within the normal physiological range documented in Mitruka and Rawnsley (1977).

CONCLUSION

There was a great reduction in production cost of the pigs using rice waste which was readily acceptable to the pigs. Therefore, utilization of the waste by the pigs will lead to its disappearance from refuse dump, thus environmental friendliness. It was also established that the levels of rice waste in the experimental diets did not indicate any adverse effect on the haematological and blood biochemical indices of the pigs. Therefore, rice waste (house hold waste) can be included in the diet of weaner pigs at 37.5 % without any adverse effects on the performance and health status of the animal.

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