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Studies on urea treated rice milling waste and its application as animal feed

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The composition of urea treated rice milling waste and its application as animal feed was studied. The proximate analysis of the urea treated rice milling waste showed that it contained 94.90% dry matter, 10.38% crude protein, 5.89% crude fibre, 0.16% ether extract, 7.47% ash, and 54.81% nitrogen-free extracts. The untreated rice milling waste contained 94.34% dry matter, 9.11% crude protein, 6.37% crude fibre, 0.18% ether extract, 8.11% ash, and 54.69% nitrogen-free extracts. Four experimental diets were prepared containing two different levels (30 and 35%) each of untreated and urea treated rice milling waste mixed with commercial pelletized chick mash to assess their effects on weaner rabbits. Data on the feed intake, growth rate, and feed conversion ratio (FCR) of weaner rabbits fed diets containing two different levels each of untreated and urea treated rice milling waste were compared using two-way analysis of variance (ANOVA). There were no significant effects (P > 0.05) of dietary treatment and level of inclusion for average feed intake, average body weight gain, and the FCR. The study indicated that rabbits can be successfully raised on a commercial chick mash mixed with 35% rice milling waste treated or untreated without any adverse effect on growth.

Key words: Rice milling waste, weaner rabbit, proximate analysis, analysis of variance, animal feed, urea.

INTRODUCTION

Rice milling waste is one of the commonest agro-industrial wastes generated in large quantities in most parts of Nigeria. Rice processing generates a great volume of by-products that constitute a large proportion of agro-industrial waste in many parts of the world (NAERLS and PCU, 2004). Although, one can hardly classify rice milling waste among hazardous wastes, its treatment is very important in view of the great volume of waste materials involved. Waste treatment techniques are normally employed to alter the physical, chemical, or biological characteristics of waste and make it safer for disposal. These include composting, pyrolysis, gasification, and combustion. In Nigeria and many other developing countries, where the bulk of rice produced is for consumption, the most common waste treatment technique employed is combustion which has several disadvantages including environmental pollution (Thipwimon et al., 2004; Bhattacharya et al., 1999). Moreover, some countries under the environmental protection legislation now strongly oppose and even prohibit this practice.

Rice milling waste is believed to contain various nutrients that would enable it to serve as animal feed. The major challenges are however, its high level of fibre and low protein and energy. Studies have shown that the nutritional value of rice milling waste can be significantly improved by processing/treatment techniques such as mechanical treatment, ensilage, biological treatment, and

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chemical treatment with alkalis and urea (Belewu and Babalola, 2009; MacDonald et al., 1987a) since urea treatment increases rice milling waste utilization and fibre fraction degradation .In developed countries, the by-products of the rice industry are separated into different components and converted into value-added products. In Nigeria, however, these by-products are largely dumped together. The quantity of rice milling by-products generated in Nigeria annually was estimated at about 1,032,993.6 metric tons (NAERLS and PCU, 2004). A large amount of these by-products is dumped as waste thereby posing disposal problems and bringing about methane emissions (Thipwimon et al., 2004; Bhattacharya et al., 1999). The disposal problems posed by rice milling waste have led to indiscriminate burning of the waste and subsequent accumulation of ash in rice producing areas resulting in environmental pollution and loss of land. Rice milling waste can also cause respiratory problems due to its characteristics (Thipwimon et al., 2004; Beagle, 1978).

The problems associated with rice milling waste can be greatly reduced if the waste can be effectively utilized as animal feed. Effective utilization of rice milling waste as animal feed has not been possible and reports have shown that the major constraints to this utilization include low crude protein, energy and mineral content (Belewu and Babalola, 2009; MacDonald et al., 1987b; Maikano, 2007; Yakubu et al., 2007). However, some research findings indicated that rice milling wastes contain moderate level of crude protein, and also have low crude fibre and high metabolizable energy (Crampton and Harris, 1969; Ambasankar and Chandrasekan, 2002; Singh and Marwaha, 1968). Crude fibre consists of cellulose, hemicelluloses and lignin (Yakubu et al., 2007) which are not well utilized by monogastric animals (Amdt et al., 1980). Lignin, which envelopes some nutrients, is highly resistant to chemical and enzymatic degradation and is poorly degraded by rumen microbes (Belewu and Babalola, 2009; MacDonald et al., 1987a). Strong chemical bonds exist between lignin and many plant polysaccharides and cell wall proteins, which render these compounds unavailable during digestion. These bonds are however, broken by chemical treatment thereby increasing the digestibility of fibrous feeds (Belewu and Babalola, 2009; MacDonald et al., 1987b; Rexen and Vestergaard, 1976). Among the chemicals that have been utilized, sodium hydroxide has proven to be the most effective in improving digestibility but lacks nitrogen. Furthermore, there is increased sodium load in animals fed with diets treated with sodium hydroxide (Adeniji, 2010). Another effective chemical that has been used successfully in achieving this is ammonia, which weakens the hard cell walls, allowing better penetration by rumen microorganisms to produce more effective fermentation and liberation of nutrients (Chenost, 1995). In developing countries like Nigeria, one of the more successful procedures available to improve the digestibility and therefore nutritional value of fibrous feeds is urea treatment since this requires little equipment or expenses, even subsistence farmers can apply urea treatment. Chemical treatment of rice milling waste with urea can lead to significant improvement in nutritional quality and therefore greater utilization (Taiwo et al., 1992). The effective utilization of rice milling waste as animal feed will greatly reduce its disposal problems and contributes towards value addition in the rice sector. This research was therefore designed to study the urea treated rice milling waste and its application as animal feed.

MATERIALS AND METHODS

Rice milling waste collection

The sample was obtained from Naka rice processing industry waste dump 25 km from Makurdi, Benue State, Nigeria. Random sampling technique was employed to collect samples of the waste taken at depths of 10 cm from different points using a clean plastic container and shovel. The sub-samples were pooled together, mixed thoroughly and packed into an empty 10 kg polyethene bags which were conveyed to animal laboratory.

Sources of feed and experimental animals

The rice milling waste was obtained from Naka rice processing industry dumpsite along Makurdi road. 5.0kg of urea (fertilizer grade) was purchased from a certified dealer. The experimental animals (16 weaned rabbits) were purchased at the University of Agriculture Quest House, Makurdi. A small quantity (2 kg) of commercial chick mash was obtained from a certified dealer at Wurukum, Makurdi and fed to the rabbits before the experiment began. 25 kg of the commercial feed was later obtained at Asaba, Delta State and used for the experimental feed preparation. The experiment was conducted at the Federal College of Education (Technical) Asaba, in the animal unit using a metabolic cage constructed under the supervision of certified animal scientist and biochemist.

Sample treatment

The rice milling waste was treated by dissolving 2.5 kg of urea in 50 dm^3 of water and applied to 50 kg of rice milling waste. The treated rice milling waste was placed in a plastic container and made airtight by covering it with polyethene sheets and the container's lid. It was then allowed to ferment for 3 weeks after which it was removed and sun dried for several days (Adeniji, 2010; Sundstol and Coxworth, 1984). A portion of the rice milling waste was left untreated and used for the control experiment.

Feed preparation

Four diets (Diets 1, 2, 3, and 4) were prepared by thoroughly mixing the rice milling waste samples and the commercial pelletized chick mash in different ratios. Diet 1 contained 30% urea treated rice milling waste and 70% commercial diet, Diet 2 contained 30% untreated rice milling waste and 70% commercial diet, Diet 3 contained 35% untreated rice milling waste and 65% commercial diet while Diet 4 contained 35% urea treated rice milling waste and

Table 1. Chemical composition of urea treated and untreated rice milling waste.

Parameter	Components (%)					
	DM	CP	CF	EE	Ash	NFE
UTRMW	94·90	10.38	5·89	0.16	7.47	54.81
UNTRMW	94·34	9.11	6·37	0.18	8.11	54.69

UTRMW = Urea treated rice milling waste; UNTRMW = untreated rice milling waste; DM = dry matter; CP = crude protein; CF = crude fibre, EE = ether extract; NFE = nitrogen-free extracts.

65% commercial diet. Diets 2 and 3 served as the first and second control (2 for Diet 1 and 3 for Diet 4), respectively.

Experimental animals design and diets

In this experiment, 16, weaned, mixed breeds male rabbits of age 28 days were used. The rabbits were kept for a week and fed with commercial diet and fresh potato (*Ipomoea batatas)* leaves under laboratory conditions. They were then fed with the experimental diets for an adaptation period of 2 weeks. During this period, no data on feed intake and body weight was recorded. The rabbits weighed between 530 and 560 g when the experiment started. The rabbits were randomly assigned to four treatment diets with four rabbits per treatment after balancing for body weight. The rabbits were housed in a metabolic cage constructed and partitioned with wood and wire gauze.

The cage was raised above the ground to allow for separation of urine and faeces. The animals were fed twice daily (morning and evening). Clean water was provided *ad libitum* and Anupco Vitalyte Extra (a combination of vitamins, electrolyte, and amino acids), Embazin-forte (anticoccidial with vitamin K) and Neotreat WSP (antibiotics and vitamins) were added to the water at intervals and according to the manufacturer's prescription throughout the experimental period of 9 weeks.

Data collection

The animals were weighed when the experiment started and then once weekly during the growth period. The weekly body weights were determined by weighing the animals individually. This was usually done early in the morning prior to feeding. The quantity of feed offered as well as the leftover was weighed each day to determine the daily intake. The daily feed consumption was recorded as the quantity of feed served minus the leftover. Data on feed intake, weight gain, and feed conversion ratio (FCR) were computed. Nutrient digestibility study was done on the 9th week of the experiment.

Digestibility study

The faeces were collected individually during 4 consecutive days. The faecal samples from each experimental unit were bulked, sun dried, and analysed for proximate composition.

Proximate analysis

The proximate compositions of the treated and untreated rice waste samples as well as the faecal samples were determined according to official methods of analysis (AOAC, 1980). All samples were ground to pass a 1-mm sieve prior to analysis.

RESULTS AND DISCUSSION

Chemical composition of urea treated and untreated rice milling waste

The results of the chemical compositions of the urea treated and the untreated rice milling waste are presented in Table 1.

Chemical composition of diets

The result of the chemical compositions of the experimental diets is presented in Table 2.

Feed intake of weaner rabbits

The results of the weekly average feed intake (g) of the weaner rabbits fed with different levels of untreated and urea treated rice milling waste based diets are presented in Table 3. The average feed intakes were comparable among the four groups of rabbits.

Weekly weight of weaner rabbits

The result of the average weekly live weight (g) of weaner rabbits fed with the experimental diets is presented in Table 4.

Performance of the weaner rabbits fed with the experimental diets

The performance of the weaner rabbits fed with varying levels of rice milling waste based diets is shown in Table 5.

The feed conversion ratio was calculated as: $\frac{\text{Feed intake}}{\text{Weight gain}}$

Coefficients of digestibility of nutrients were determined according to the formula:

$$\frac{[(\text{quantity of feed} \times \text{nutrients of feed}) - (\text{quantity of faeces} \times \text{nutrients of faeces})] \times 100}{(\text{Quantity of feed} \times \text{nutrients of feed})}$$

Table 2. Chemical composition of the experimental diets.

Component (%)	Diet 1	Diet 2 (T1)	Diet 3 (T2)	Diet 4
Dry matter	96.20	96.07	96.37	96.27
Crude protein	15.71	15.33	14.89	15.33
Crude fibre	5·97	6·26	6·13	6·11
Ether extract	6.00	6.00	5.59	5.59
Ash	3.85	4.11	4.33	4.04
NFE	59.28	59.25	58.92	58.96

T1 = Control 1; T2 = Control 2; NFE = Nitrogen-free extracts.

The nutritive compositions of the urea treated and untreated rice milling waste are presented in Table 1. The results showed that the both feedstocks have comparable nutrient profile although the urea treated rice milling waste had a higher crude protein value (10.38%) than the untreated rice milling waste (9.11%). This suggests that urea treatment increased the crude protein content of rice milling waste. The treatment of rice milling waste with urea increased its nitrogen content due to the addition of non-protein nitrogen. This collaborate the reports of other studies that urea ammoniation increases the crude protein content of feed materials (Yakubu et al., 2007; Ambaye, 2009; Amaefule et al., 2003, 2006; Oluokun, 2005). The percentage increase in crude protein (13.94%) due to urea treatment in this study is lower than the values reported by Yakubu et al. (2007) and Ambaye (2009). This may be attributed to the higher content of crude protein in the original material. The crude protein value of 9.11% for the untreated rice milling waste is within the range, 7.8 and 9.4% reported by Ambasankar and Chandrasekan (2002) and Crampton and Harris (1969), respectively. It is however, higher than the 5.03, 5.83, and 6.00% previously reported by Maikano (2007), Yakubu et al. (2007), and Aduku (2004). The crude fibre content of the urea treated rice milling waste was slightly lower than that of the untreated rice milling waste. The reduction in crude fibre content of the urea treated rice milling waste is in agreement with the report of Yakubu et al. (2007). The crude fibre value of 6.37% obtained in this present study is higher than the 0.96% reported by Ambasankar and Chandrasekan (2002) and 3.14% reported by Singh and Marwaha (1968) but much lower than the 30.39, 42.15, and 33.00% obtained by Maikano (2007), Yakubu et al. (2007), and Aduku (2004), respectively. The dry matter, ether extract, ash, and nitrogen-free extract values are 94.90, 0.16, 7.47, and 54.81% for the urea treated rice milling waste and 94.34, 0.18, 8.11 and 54.69% for the untreated rice milling waste, respectively. The urea treated rice milling waste had slightly higher dry matter and nitrogen-free extract contents but lower ether extract and ash contents than the untreated rice milling waste. The dry matter content of the untreated rice milling waste in this study was quite similar to that (94.42%) published by Maikano (2007) but higher than the 89.50 and 90.53% previously reported by Yakubu et al. (2007) and Ambasankar and Chandrasekan (2002), respectively. Maikano (2007), Yakubu et al. (2007), Ambasankar and Chandrasekan (2002), and Aduku (2004) reported ether extract values of rice milling waste of 3.40, 6.45, 3.20, and 5.60% and Maikano (2007), Yakubu et al (2007), and Aduku (2004) reported ash content of 16.67, 21.76 and 19.10%, respectively. The rice milling waste used in the present study contained considerably less ether extract and ash. The nitrogen-free extract (54.69%) obtained in this experiment was higher than the 46.10 and 30.05% reported by Maikano (2007) and Yakubu et al. (2007), respectively but considerably lower than the value (85.26%) reported by Aduku (2004). The variations between the proximate compositions of different rice milling waste have been attributed to the rice variety, growing conditions, pre-treatment before milling, milling system, degree of milling, and the proportion of husk (Saunders, 1990; Farell, 1994).

The proximate compositions of the experimental diets (Table 2) showed that the four dietary treatments have comparable nutrient compositions. The dry matter content of the four dietary treatments ranged from 96.07 to 96.37%, crude protein ranged from 14.89 to 15.71%, crude fibre ranged from 5.97 to 6.26%, ether extract ranged from 5.59 to 6.00%, ash ranged from 3.85 to 4.33%, and nitrogen-free extract ranged from 58.92 to 59.28%. The comparable nutrient compositions of the experimental feed may be attributed to the initial quality of the treated material. It has been reported that the effect of urea treatment is more pronounced for materials whose initial quality is very poor compared to those with better original quality (Chenost, 1995).

The result of the average daily feed intake of the weaner rabbits from Week 1 to 8 is shown in Table 3. The average daily intake did not follow any defined pattern. The least average daily intake (61.65 ± 11.34 g, 57.29 ± 10.32 g, 55.65 ± 3.76, and 58.57 ± 13.45 g for Diets 1, 2, 3, and 4, respectively) was recorded in Week 1. The highest average daily intake recorded (79.68 ± 14.10 g, 76.29 ± 22.36 g, 67.35 ± 12.01 g, and 75.45 ±

Table 3. Weekly average feed intake (g) of the weaner rabbits fed with different levels of untreated and urea treated rice milling waste based diets.

Week	Diet 1	Diet 2	Diet 3	Diet 4
1	61.65 ± 11.34	57.29 ± 10.32	55.65 ± 3.76	58.57 ± 13.45
2	65.15 ± 6.07	61.96 ± 16.01	58.24 ± 6.73	60.75 ± 12.49
3	79.68 ± 14.10	76.29 ± 22.36	65.71 ± 10.18	75.45 ± 9.32
4	66.86 ± 12.20	63.57 ± 13.45	60.35 ± 5.59	62.14 ± 12.20
5	64.65 ± 9.51	62.05 ± 11.67	64.09 ± 8.70	65.10 ± 8.00
6	70.45 ± 11.10	68.55 ± 6.55	63.70 ± 11.32	69.15 ± 13.25
7	75.39 ± 7.69	71.93 ± 9.65	67.35 ± 12.01	74.65 ± 11.30
8	67.26 ± 10.12	63.28 ± 13.00	61.30 ± 7.07	63.45 ± 9.78
Total	551.29 ± 22.65	524.92 ± 18.56	496.39 ± 13.17	529.26 ± 23.50

Values measured as mean ± standard deviation, n = 7.

Table 4. Average weekly weight per diet (g) of the weaner rabbits fed with treated diets.

Average weight (g)	Diet 1	Diet 2	Diet 3	Diet 4
Initial weight	550.00	555.00	540.00	540.00
Week 1	665.00	662.00	638.00	641.00
Week 2	776.00	798.00	760.00	761.00
Week 3	895.00	900.00	875.00	867.00
Week 4	1021.00	1020.00	1000.00	1002.00
Week 5	1161.00	1151.00	1137.00	1145.00
Week 6	1303.00	1295.00	1284.00	1284.00
Week 7	1456.00	1444.00	1434.00	1429.00
Week 8	1616.00	1601.00	1580.00	1584.00
Weekly average	133.25 ± 18.63	130.75 ± 19.75	130.00 ± 18.25	130.50 ± 19.42

Values measured as mean weight of four animals, except for weekly average, which equals Mean ± standard deviation of eight measurements.

9.32 g for animals on Diets 1, 2, 3, and 4, respectively was on different weeks.

The average daily feed intake (Table 5) of the rabbits fed with the four treatment diets, D1, D2, D3, and D4 (in grams) for the experimental period of eight weeks are 68.89, 65.62, 62.05, and 66.16, respectively. The rabbits fed with diets containing urea treated rice milling waste (D1 and D4) consumed more feed than those fed with diets containing untreated rice milling waste (D2 and D3). The trend of the average daily feed intake showed that D1 > D4 > D2 > D3. The higher feed intake of animals on D1 and D4 may be due to urea treatment, which is believed to increase intake (Preston and Leng, 1987). The higher intake however, did not result in better growth performance of rabbits. The 2-way analysis of variance (ANOVA) result of Tests of Between-Subjects Effects [TBSE (Table 6)] showed no significant main effect (P > 0.05) of treatment and level of inclusion. There was also no significant interaction effect between the treatment and level of inclusion (P > 0.05). The parallel lines of the marginal means in the profile plot (Figure 1) further illustrate the non-significant interaction effect.

The average weekly weight gains of the experimental rabbits per treatment diet are recorded in Table 4. The TBSE result (Table 7) indicated that average weekly weight gain was not significantly affected (P > 0.05) by the dietary treatments and the level of inclusion of rice milling waste. The interaction effect was also not significant as revealed by the profile plots of the marginal means (Figure 2). The average weekly weight gain per diet (g) over the eight weeks are 133.25, 130. 75, 130.00, and 130.50 (Tables 4) for D1, D2, D3, and D4, respectively. The pattern for the weight gain per diet revealed that D1 > D2 > D4 > D3. Generally, the animals in this study irrespective of the dietary treatment and the level of inclusion of the rice milling waste did not record significant (P > 0.05) difference in the average weekly weight gain. There were however, significant effects of initial weight on performance of animals during the first 2 weeks with the heavier animals having a higher rate of gain. Similar findings were reported for growing rabbits fed low protein diets supplemented with or without urea

Table 5. Performance of the weaner rabbits fed with different levels of untreated and urea treated rice milling waste based diets.

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	SEM	SL
No. of days of trial	56	56	56	56		
No. of animals	4	4	4	4		
Average initial live weight (g)	550.00	555.00	540.00	540.00		
Average final live weight (g)	1616.00	1601.00	1580.00	1584.00		
Total weight gain (g)	1066.00	1046.00	1040.00	1044.00		
Average weekly weight gain (g)	133.25	130.75	130.00	130.50	3.36	NS
Average daily weight gain (g)	19.04	18.67	18·57	18.64		
Total feed intake (g)	3859.03	3674.44	3474.73	3704.82		
Average daily feed intake (g)	68.89	65.62	62.05	66.16	1.01	NS
FCR	3.62	3.51	3.34	3.55	0.11	NS

FCR = Feed conversion ratio; SEM = Standard error of the mean; SL = Significance Level, NS = not significant.

Table 6. ANOVA tests of between-subjects effects

Source	Type iii sum of squares	df	Mean square	F	P/Sig.
DT	108.892	1	108.892	3.367	0.077
LI	79.286	1	79.286	2.452	0.129
DT * LI	1.399	1	1.399	0.043	0.837
Error	905.472	28	32.338		

Dependent Variable: Feed Intake, (α = 0.05); DT = Dietary treatment; LI = Level of inclusion; df = Degrees of freedom.

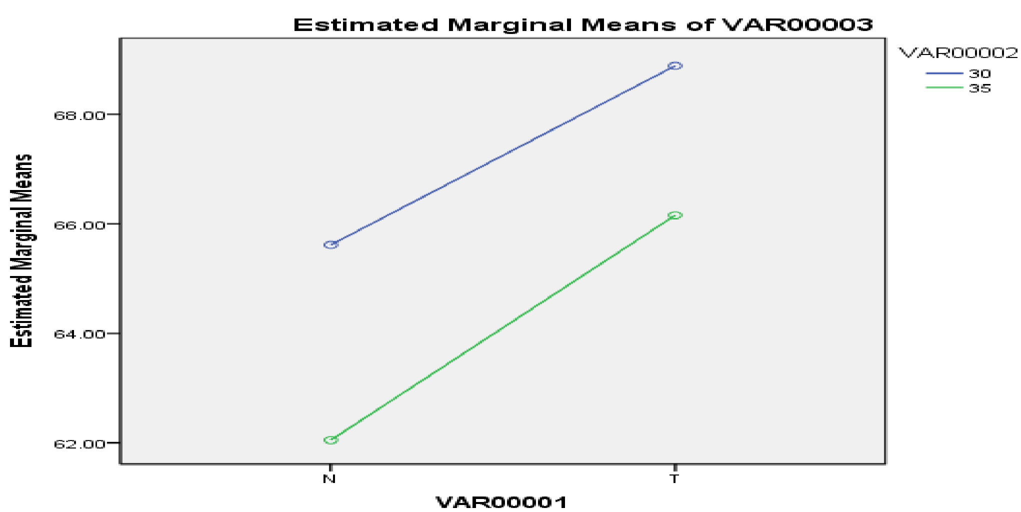

Figure 1. Profile plots of marginal means of feed intake. N = Untreated diets, T = Treated diets, VAR00001 = Dietary treatment, VAR00002 = Level of inclusion, VAR00003 = Dependent variable (Feed Intake).

or methionine (Raharjo, 1986).

The FCR obtained (Table 5) showed the same trend as the average daily feed intake: D1 > D4 > D2 > D3. The FCR of 3.67, 3.59, 3.39, and 3.62 for the rabbits on D1, D2, D3, and D4, respectively did not show significant (P > 0.05) (Table 8) interaction within the dietary treatments

Table 7. ANOVA tests of between-subjects effects.

Source	Type III sum square	df	Mean square	F	P/Sig
DT	18.000	1	18.000	0.050	0.825
LI	24.500	1	24.500	0.068	0.797
DT * L	I 8.000	1	8.000	0.022	0.883
Error	10135.000	28	361.964		

Dependent variable: Weight Gain, (α = 0.05); TM = Dietary treatment, LI = Level of inclusion, df = Degrees of freedom.

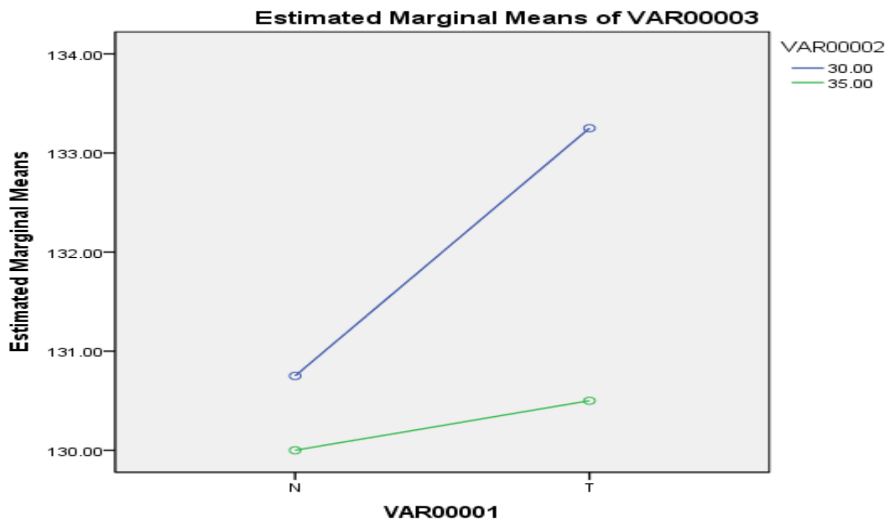

Figure 2. Profile plots of marginal means of weight gain. N = Untreated diets, T = Treated diets, VAR00001 = Dietary treatment, VAR00002 = Level of inclusion, VAR00003 = Dependent variable (Weight Gain).

Table 8. ANOVA tests of between-subjects effects.

Source	Type III sum of squares	df	Mean square	F	P/Sig.
DT	0.194	1	0.194	0.550	0.465
LI	0.137	1	0.137	0.387	0.539
DT * LI	0.047	1	0.047	0.134	0.717
Error	9.861	28	0.352		

Dependent Variable: Feed Conversion Ratio, (α = 0.05); TM = Dietary treatment, LI = Level of inclusion, df = Degrees of freedom.

and level of inclusion. The non significant level of interaction is demonstrated in the profile plots of the marginal means (Figure 3). This indicates similar utilization of nutrients by the experimental rabbits. The similar performance of rabbits observed in this study may be due to the similar proximate composition of the experimental diets.

The results of the nutrient digestibility of the rabbits are presented in Table 9. The feed dry matter, crude protein, crude fibre, and ash showed similar digestibility within the dietary treatments and the different levels of inclusion. The digestibility ranged from 77.25 to 78.55% for dry matter, 67.51 to 69.45% for crude protein, 49.80 to 50.45% for crude fibre, and 63.89 to 65.35% for ash. The similar nutrient digestibility recorded among the different group of the rabbits may be attributed to the similarity in the chemical composition of the diets. Report has shown that feed which vary relatively little in composition will show little variation in digestibility (McDonald et al., 1987 a, b). The values obtained in the present study are

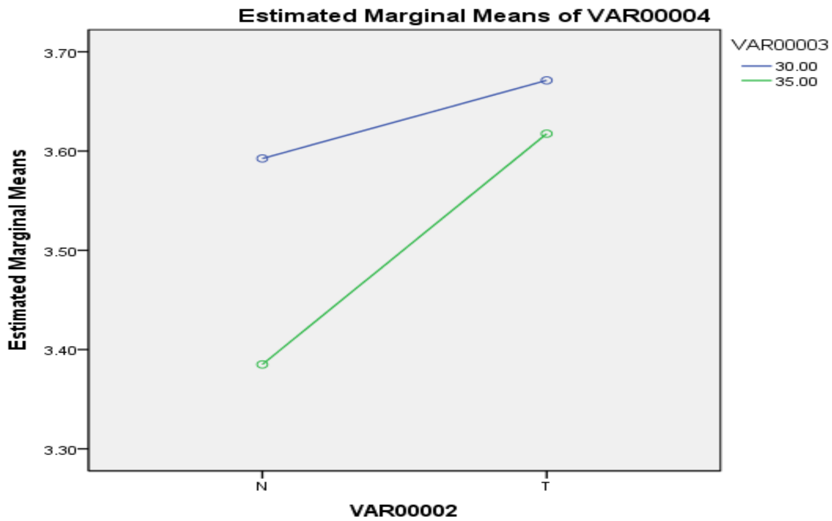

Figure 3. Profile plots of marginal means of feed conversion ratio. N = Untreated diets, T = Treated diets, VAR00002 = Dietary treatment, VAR00003 = Level of inclusion, VAR00004 = Dependent variable (Feed conversion ratio).

Table 9. Nutrient digestibility by rabbits fed different levels of untreated and urea treated rice milling waste based diets.

Parameter (%)	**D1**	**D2**	**D3**	**D4**
Dry matter	78.55	78.07	77.40	77.25
Crude protein	69.45	68.27	67.51	68.01
Crude fibre	50.03	51.15	49.80	50.45
Ash	65.35	64.27	63.89	64.02

comparable with those earlier reported for weaner rabbits fed with similar diets (Abonyi et al., 2012).

Conclusion

The result of this study indicated that the chemical composition of rice milling waste can be highly varied when treated with urea which resulted in modification of the chemical composition of the waste. The modification however, did not significantly affect the growth performance and nutrient digestibility of the experimental rabbits in this work. Thus, weaner rabbits can be successfully raised on a commercial chick mash diet blended with 35% rice milling waste with good initial quality treated or untreated without any adverse effect on growth performance and nutrient digestibility.

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