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Effect of Feeding Soybean Curd Residue on Performance of Male Grower Rabbits

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ABSTRACT

A six week experiment was conducted to determine the effect of feeding soybean curd residue (SCR) on performance of male grower rabbits. Fifty (50) cross-bred male grower rabbits at 5 weeks of age were randomly assigned into five dietary treatments (T1-T5). Each treatment had 10 rabbits, individual housed in a completely randomized design. Treatment 1 had 0% SCR which served as control whereas diets 2- 5 had soybean meal (SBM) replaced with SCR by 5%, 10%, 15% and 20%, respectively. Feed and water were offered ad libitum. Rabbits fed T5 significantly (p<0.05) had highest live body weight and total weight gain (3.29±0.08kg and 2.55±0.09kg, respectively) whereas those fed T1 had lowest (2.83±0.44 and 2.10±0.18kg, respectively). Rabbits fed T5 alongside T4 significantly (p<0.05) had the best feed conversion ratio (1.84±0.13) whereas those fed T1 had worst (2.18±0.27). Other parameters such as Feed intake, Carcass and organs' weights, haematological traits and serum biochemical were not significantly (P>0.05) affected by treatments. The cost of feed per 25kg decreased with increased SCR in the diets. Treatment 1 had higher costs (#1781.20/$4.88) while T5 had lower (#1704.55/$4.67). Similarly, cost of feed per weight gain decreased from T1 to T5 (#73.00/$0.44 to #69.35/$0.40). It was concluded that 20% SCR can be added in male grower rabbits' diets without negative effect on performance.

INTRODUCTION

Food insecurity is a major challenge in many developing countries in the phase of rapidly growing population [1]. The demand for animal proteins outweighs supply and this may continue in the future as many factors militating against livestock production persist [2]. One of such factors is high cost of feed beyond the purchasing power of most farmers particularly those practising small to medium scale production that dominate the livestock industry. This category of resorted to serve animals with compromised feeds and others resorted to close their farms. Thereby, it becomes difficult to bridge the existing gap between supply and demand of animal proteins [3],

[4]. The high cost of feed is due to competing demand on conventional feedstuffs between humans and livestock particularly non-ruminant species (pigs, rabbits and poultry) [5], [6]. Ruminants (e.g. cattle, sheep and goats) may not require bulk of conventional feedstuffs but their start-up capital is high [5]. Owing to the low start-up of non-ruminant coupling with short generation intervals it becomes necessary to work on the high cost of feed in order to bring back farmers that have closed their farms. Alabi *et al.* [6] and [7] reiterated that the use of cheap and locally available ingredients reduced cost feed.

Many by-products have been incorporated in rabbits' diets. Examples, Sudik [3] used 15% iburu (*Digitaria iburua*); Lounaouci-Ouyed [8] used field bean and pea at 26% and 30%, respectively; Onakpa [9] used maize bran up to 35% and Bhatt [10] used rice bran at 5%. However, other by-products have not been utilized. One of such by-products is soybean curd residue (also called soybean waste), a by-product of soybean obtained when producing soy foods such as soy milk, "Awara" ("tofu") etc. [11], [12]. Awara in particular is commonly seen in northern part of Nigeria and SCR is usually produced in large quantity thrown as waste untapped. Information on its use as feed resource in rabbits' diet has not been well reported. The objective of this paper is to determine the effect of feeding soybean curd residue (SCR) on performance of male grower rabbits.

MATERIALS AND METHODS

The experiment was conducted at the Rabbitry Unit of Plateau State College of Agriculture, Garkawa. Garkawa is in Mikang Local government Area (LGA) and Mikang is one of the LGAs in the Plateau State Southern Zone. It is located on latitude 8.8955^{o}N and longitude 9.4537^{o}E. The annual average temperature is usually 27.7^{o}C and annual average precipitation is usually 1178mm [13].

Sample of Soybean curd residue was analyzed for chemical composition as presented in Table 1. Crude protein and crude fibre were determined by the method described by AOAC [14]. The calcium content was determined by Flame Photometry and phosphorus content was determined using an Auto-analyzer. Gross energy was. Amino acid profile was by ion exchange chromatography using the Technicon Sequential Multisample (TSM) Amino Acid Analyser (Technicon Instruments Corporation, New York) as described by Beniter [15].

Table 1: Nutrient composition of soybean curd residue

Crude Protein (%)	Energy	Calcium	Phosphorus	Lysine	Methionine	Crude fibre
26.35	1560.3	0.72	0.08	8.6	4.7	15.28 (%)

A basal diet (D1) was formulated to meet the nutrient requirements of male grower rabbits Zsolt *et al*. [16] .Thereafter, 4 other treatments (T2 - T5) were formulated by replacing soybean meal (SBM) with SCR by 5%, 10%, 15% and 20%, respectively (Table 2).

Fifty (50) Cross-bred male grower rabbits at 5 weeks of age were purchased from a reputable Farm in Jos, Plateau state. They were allowed to acclimatized to the new environment for three 3 days during which they were served with maize and fresh leaves of *Moringa oleifera* and *Tridax procumbent* and were administered multivitamins reduce the stress incurred from transportation. Thereafter, they were randomly assigned into the 5 treatment groups. Each treatment had 10 rabbits individually housed in hutch equipped with feeder and drinker. Feed and water were supplied *ad libitum*. Antibiotics, coccidiostats and anti-stress were occasionally administered as prophylactic measures. The experiment lasted for 6 weeks. APA [17] Ethics in Research with Animals were strictly observed.

At the beginning of the experiment, each rabbit was weighed to determine the initial weights and thereafter, at weekly interval to monitor body weight changes. Total weight gain (TWG) was calculated by subtracting the initial weight from the final weight. Daily weight gain (DWG) was calculated by dividing the TWG by 42 days. Feed consumption was determined daily by subtracting feed leftover from feed supplied. Total feed intake (TFI) was the cumulative of daily feed consumed. Daily feed intake (DFI) was calculated by dividing TFI by 42 days and feed conversion ratio (FCR) was calculated by dividing feed consumed by weight gain.

Table 2: Gross composition and calculated values of the experimental diets

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Maize	13.06	13.06	13.06	13.06	13.06
Rice offal	3.75	3.75	3.75	3.75	3.75
Palm kernel meal	2.50	2.50	2.50	2.50	2.50
Soybean meal (42)	2.50	2.38	2.25	2.13	2.00
Soybean curd residue	0.00	0.13	0.25	0.38	0.50
Groundnut cake	1.38	1.38	1.38	1.38	1.38
Fish meal	0.50	0.50	0.50	0.50	0.50
Bone meal	0.63	0.63	0.63	0.63	0.63
Oyster shell	0.25	0.25	0.25	0.25	0.25
Premix	0.06	0.06	0.06	0.06	0.06
Methionine	0.03	0.03	0.03	0.03	0.03
Lysine	0.03	0.03	0.03	0.03	0.03
Salt	0.08	0.08	0.08	0.08	0.08
Soy oil	0.25	0.25	0.25	0.25	0.25
Total	**25.00**	**25.00**	**25.00**	**25.00**	**25.00**
Crude protein	17.79	17.71	17.64	17.56	17.48
Energy (kcal/kg)	2810.55	2804.85	2799.15	2793.45	2787.75
Calcium	1.42	1.43	1.43	1.43	1.43
Average phosphorus	0.98	0.97	0.97	0.97	0.97
Lysine	1.33	1.34	1.34	1.34	1.34
Methionine	0.86	0.86	0.86	0.85	0.85
Crude fibre	5.19	5.23	5.28	5.32	5.37

At the close of the experiment, samples of blood were collected through marginal ear vein using 22 gauge needles as described by Moore [18] into bijou bottles containing speck of dried ethyldiaminetetraacetic acid (EDTA) powder as ant-coagulant for haematological study and some blood into plain bottles without ant-coagulant for serum biochemical determination. The blood samples were stored below 4^{o}C in deep freezer prior to analysis. The haematological parameters and serum biochemical were determined as described by Benjamin [19]. After blood collection, four (4) rabbits per treatment were randomly selected and were starved for 12 h but provided with water. Thereafter, each was weighed and anaesthetized with mild chloroform vapor inside desiccators before slaughtering. After slaughtering the carcass was scalded in 60^{o}C warm water for 30 seconds before removing the wool. Thereafter, the carcass was opened and the organs (liver, kidneys, heart and lungs) were excised.

The dressed weight was calculated using the formula below:

$$\%\ \text{dressed weight} = \frac{\text{dressed weight}}{Live\ weight} x \frac{100}{1}$$

Each organ was weighed and expressed as percentage of the dressed weight.

The market prices of ingredients during the experiment were used to determine cost of feed. The total cost of each 25kg dietary treatment was the sum of the price of individual ingredient. The cost of 1kg feed was determined by dividing the cost of a bag by 25. The cost of feed consumed per weight gain was determined by multiplying FCR by cost per 1kg feed. The data obtained were subjected to analysis of variance using SPSS 17.0 [20]. Treatment means with significant difference were separated using the Duncan Multiple Range Test at 5% level of probability [21].

RESULTS

Table 3 shows the growth performance of male grower rabbits fed with dietary treatments. Only live body weight (LBW), TWG and FCR were significantly (p<0.05) affected by treatments. Rabbits fed T5 had the highest LBW and TWG (3.29±0.08kg and 2.55±0.09kg, respectively) while those fed T1 had the lowest (2.83±0.44 and 2.10±0.18kg, respectively). But the rabbits fed on T5 with those on T4 had the best FCR (1.84±0.13 and 1.93±0.10, respectively) while T5 had the worst (2.18±0.27).

Table 4 shows carcass characteristics and organs' weights of male grower rabbits fed with dietary treatments. All the parameters were not significantly (P>0.05) affected by treatments.

Table 3: Performance of male grower rabbits fed dietary treatments

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
initial weight (kg)	0.73±0.02	0.78±0.02	0.75±0.02	0.76±0.02	0.74±0.02
Live body weight (kg)	2.83±0.44^{c}	2.86±0.04^{c}	3.00±0.01^{b}	3.14±0.08^{ab}	3.29±0.08^{a}
Total weight gain (kg)	2.10±0.18^{c}	2.13±0.12^{c}	2.25±0.12^{b}	2.38±0.08^{ab}	2.55±0.09^{a}
Daily weight gain (kg)	0.05±0.00	0.05±0.00	0.05±0.00	0.05±0.00	0.05±0.00
Total feed intake (kg)	4.58±0.70	4.61±0.30	4.62±0.04	4.60±0.04	4.70±0.03
Daily feed intake (kg)	0.11±0.00	0.11±0.00	0.11±0.00	0.11±0.00	0.13±0.00
Feed conversion ratio	2.18±0.27^{a}	2.16±0.13^{a}	2.05±0.18^{ab}	1.93±0.10^{b}	1.84±0.13^{b}
Mortality	0.00	0.00	0.00	0.00	0.00

Values are average of 10 male grower rabbits.
Row with difference superscripts are significance difference (P<0.05).

Table 4: Carcass characteristics and organs' weight of male grower rabbits fed dietary treatments

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Dressed weight (%)	73.60±036	73.64±0.31	73.67±0.45	72.74±0.29	71.09±0.21
Liver (%)	2.23±0.94	2.21±1.47	2.15±1.63	2.18±0.93	2.16±1.55
Kidneys (%)	0.78±0.75	0.71±0.71	0.68±1.08	0.71±1.82	0.77±0.69
Heart (%)	0.39±0.87	0.44±0.90	0.37±0.92	0.37±0.92	0.40±0.91
Lungs (%)	0.83±0.73	0.82±1.68	0.84±0.47	0.76±0.71	0.78±0.85

Values are average of 4 male grower rabbits.

Table 5 shows the haematological parameters of male grower rabbits fed dietary treatments. The entire haematological parameters were not significantly (P>0.05) affected by treatments. Table 6 shows the serum biochemical of male grower rabbits fed dietary treatments. Again, all the serum biochemical were not significantly (P>0.05) affected by treatments.

Table 7 shows cost implication of incorporating soybean curd residue in male grower rabbits' diets. The cost of feed/25kg decreased with increased SCR in the diets. Treatment 1 had the highest (₦1781.20/$**4.88**) while T5 had the lowest (₦1704.55/$4.67). The cost of 1kg feed also was highest in T1 (₦73.00/$0.20) while SCR-based diets had had the lowest (₦69.35/$0.19). In regard to cost of feed per weight gain, T1 had highest (₦160.60/$0.44-0.41) while T5 had the lowest (₦146.00/$0.40).

Table 5: Haematological parameters of male grower rabbits fed dietary treatments

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Red blood cell (x 10^{6}µL)	6.26±1.08	6.23±0.72	6.15± 0.68	6.25±1.04	6.23±0,53
Packed Cell Volume (%)	37.45±0.33	36.33±1.14	38.01±0.78	37.05±0.66	34.58±1.11
Haemoglobin (g/dL)	12.27±0.12	11.74±0.13	11.44±0.39	11.56±0.15	11.61±0.25
Mean Cell Volume (fL)	62.63±0.54	62.62±0.17	63.04±0.34	62.72±0.27	62.54±0.14
Mean Cell Haemoglobin (pg)	18.55±0.15	18.78±0.24	19.05± 0.37	19.22±0.13	19.11±0.51
Mean Cell Haemoglobin Concentration (%)	26.46±0.42	25.57±0.63	25.27±0.75	25.53±0.48	25.58±0.56
WBC (x10^{3}/mL)	4.12±0.22	4.10±0.64	4.19± 0.71	4.13±0.19	4.13±0.21
Neutrophils (%)	39.22±0.35	39.24±0.55	38.46±0.57	38.50±0.26	39.56±0.57
Lymphocytes (%)	30.50±0.61	31.52±0.67	31.47±0.35	32.01±0.38	31.66±0.56
Eosinophils (%)	2.55±1.19	2.82±0.83	2.24± 0.75	2.50±0.89	2.55±0.58
Basophils (%)	2.57±0.36	2.46±0.51	2.45±0.17	2.84±0.31	2.83±0.26
Monocytes (%)	7.12±0.12	7.13±0.16	7.13±0.16	7.16±0.22	7.16±0.15

Values are average of 4 male grower rabbits.

Table 6: Biochemical indices of male grower rabbits fed dietary treatments

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Alanine aminotransferase(u/l)	18.33±0.33	18.33±0.88	18.00±0.58	18.33±0.88	16.33±0.88
Alkaline Phosphatase (U/l)	100.33±0.88	100.66±0.66	100±0.88	100±1.16	100±1.16
Total protein (g/ 100ml)	9.17±0.44	9.17±0.27	9.90±0.06	9.87±0.15	8.33±3.15
Albumin (g/ 100ml)	3.93±0.44	3.77±0.17	3.80±0.12	3.80±0.12	3.56±1.11
Glucose (mg/100ml)	100.33±1.76	100.00±1.00	100.00±1.16	100.33±1.33	100.33±1.33
Total Cholesterol(mg/100ml)	100.33±1.20	99.00±1.5	102.67±1.76	104.67±1.45	104.67±1.45
Creatinine (mg/100ml)	0.79±0.03	0.79±0.03	0.79±0.02	0.79±0.02	0.77±0.02

Values are averages of 4 male grower rabbits

Table 7: Cost implication of incorporating soybean curd residue in male grower rabbits' diets

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Cost of 25kg feed (₦/$)	1781.20/**4.88**	1762.95/**4.83**	1744.70/**4.78**	1726.45/**4.73**	1704.55/**4.67**
Cost of kg feed (₦/$)	73.00/**0.20**	69.35/**0.19**	69.35/**0.19**	69.35/0.19	69.35/**0.19**
Cost of feed per weight gain (₦/$)	160.60/**0.44**	160.60/**0.44**	153.30/**0.42**	149.65/**0.41**	146.00/**0.40**

DISCUSSION

The highest LBW, TWG and best FCR observed in treatment 5 despite its lower crude protein and higher crude fibre content demonstrates that SCR can be added into male grower' rabbits diet up to 205. Rabbits have fermentation vat rich with microorganisms at the caecum that convert fibrous food materials into usable forms. The ability of rabbit to re-eat their faeces (coproghagy) might have been aided them to tolerate 5. Fibrous food material provides substrate for the microorganisms. This assertion is in agrees with Zotte[16] who reported that the anatomy of the digestive tract of rabbits particularly the large caecum has active microbiota for efficient utilization of dietary fibre. And not only do the microorganisms' utilized fibous food but their ability to synthesize micro nutrients such as lysine, methionine and vitamins for the benefit of the host animal. It is convenient to state that the micronutrients been synthesized augment the lower crude protein content of diet 5.

The insignificant difference observed in the carcass and organs' weights, haematological parameters, serum biochemical and non-mortality in this study indicate the safeness of SCR for male growing rabbits. The means values of these parameters are within those in literature [22], [23]. The drastic reduction in cost of feed observed indicates the economics of incorporating SCR in the diets of male grower rabbits.

CONCLUSION

The results obtained in this study show that SCR can be incorporated in the diets of male grower rabbits' up to 20% without negative effect on performance. This result cannot be used for female grower rabbits and/or odder rabbits, therefore further study to involve these categories of rabbits is recommended.

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Declaration of Conflicting Interests

The author declared that there is no conflict of interest of any form about this research.

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