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The effect of replacement of part of dietary crude protein with urea on the performance and carcass characteristics of grasscutters (*Thryonomys swinderianus*) in captivity

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A 24 week feeding trial was conducted to evaluate the effect of replacing a portion of protein requirement of grasscutters with urea on growth performance, carcass characteristics and microbial composition of the caecum. In all, forty grassscutters of age 3- months old were used. There were four dietary treatments with ten replicates in a randomised complete block design. The treatments were; control (U0%-P) which had protein from plant sources only. Treatment 2 (U30%-P) had 70% plant protein and 30% urea, Treatment 3 (U25%-P) had 75% protein from plants and 25% from urea and Treatment 4 (U0%-AP) had 10% protein from animal source and 90% from plant source. Parameters measured included, feed intake, feed wastage, carcass characteristics, caecal pH and caecal microbial composition and meat quality. The data collected was subjected to the analysis of variance with SAS (2008) and significant difference separated at 5% level. The results obtained showed that daily feed intake, feed wastage, and feed conversion ratio were not significantly different (P > 0.05) among dietary treatments. However, daily feed wastage was higher than feed intake. Daily weight gain 9.82, 9.70, 9.27 and 10.9 g/day respectively for U0%-P, U30%-P, U25%-P and U0%-AP was not significantly (P > 0.05) different among dietary treatments. The protein, fat and moisture content of the meat were influenced by urea supplementation. Dressing percentage was significantly (P < 0.05) influenced by dietary treatments but weight of organs to body weight did not differ significantly (P > 0.05). Caecal pH ranged from 5.9 - 6.0 and was not significantly (P > 0.05) influenced by urea supplementation. Microbes observed in the caecum were mainly *Bacillus* sp. Protein and fat content of the meat was influenced (P < 0.05) by dietary treatments but not pH. Urea supplementation of U30%-P and U25%-P reduced the variable cost by 31 to 44% and 36 to 48% respectively making the use of urea economical in the diet of grasscutters. It was concluded that urea can be used in grasscutters diet without any deleterious effects on their general performance or carcass characteristics but renders the production more economical.

Key words: Urea supplementation, grasscutters, plant protein, caecal pH, caecal microbes.

INTRODUCTION

The animal industry plays a very vital role in any country in meeting the protein requirements of the population. The current rate of population growth indicates that the world population might hit 9 billion by the year 2040 of which developing countries are considered the most populous (UNDESA, 2013). There is therefore the need to improve on technology as well as managerial skills to be able to produce enough to feed the rising population. An average Ghanaian consumes 59.8 g of protein per day of which 16.7 g (27.9%) is from animal origin (FAO, 2007). This falls short of the recommended daily protein requirement of 70 to 80 g of which 50% should be of animal origin (FAO, 1990). Malnutrition is therefore prevalent in many communities in Ghana.

The rather low intake of animal protein is mainly attributed to low production of animals which has created a shortfall in the supply of meat, and as a result has led to the influx of imported animal products onto the Ghanaian market to meet this demand (Fialor, 2010). Efforts are being made to increase the production of existing breeds of animals including ruminants. However, increasing the production of the existing breeds of ruminants cannot be achieved rapidly due among other reasons, poor reproductive rate, poor growth rate and poor nutrition (Thrupp, 1998). There is the need for rodents that are tractable and prolific to be domesticated to augment the existing meat supply (Mbah, 1989). The development of the grasscutter or cane rat as an alternative source of meat has gained increasing importance lately in Ghana because of its delicacy. Grasscutter meat contributes considerably towards the alleviation of protein shortages in some parts of Africa (Ntiamoah-Baidu, 1998). However, there are some challenges confronting grasscutter farming in Ghana (Adu et al*.,* 1999). These include the provision of balanced diets to the animals, acquisition of improved genetic breeds and the control of diseases such as Staphylococcosis, Enterotoxaemia and Cestodiasis among others (Adu et al*.,* 1999). Prominent of these is the provision of diets containing adequate nutrients. Work done by Adu and Wallace (2003) and Kusi et al. (2012) indicated that the protein contents of these feeds are often far below the 15 to 18% deemed to be required by the grasscutter for growth and reproduction. However, conventional protein sources such as fish meal and oil seed cakes such as soyabean meal are very expensive (Minson, 1997) and most farmers cannot afford them. There is therefore the need to look for available alternative but suitable cheaper protein sources or use to some limited extent non-protein nitrogenous sources that can equally promote growth and productive performance.

Urea has been used to replace part of the protein in the diet of cattle, sheep and other ruminants because of the micro-organisms (bacteria, protozoa and fungi) present in their rumen (Preston and Leng, 1987). The grasscutter is a non-ruminant herbivore (Akinnusi et al*.,* 2009) and has microbes in part of the gastro intestinal tract (caecum) for fermentation and microbial protein synthesis (McDonald et al*.,* 2010). The microbes are retaken through coprophagy (Pond et al*.,* 1995) and they may benefit from substituting part of the protein in the diet with urea just like ruminants. If urea, a non-protein nitrogen can be utilized by grasscutter as the case is with ruminants then this will cut down cost of protein in feed (Sewell, 1993). The study was therefore undertaken to determine if grasscutters during the growing phase could benefit from substituting part of the protein requirements with urea (NPN).

MATERIALS AND METHODS

Experimental location

The experiment was conducted at the grasscutter Unit of the Department of Animal Science Education of the College of Agriculture Education, University of Education, Winneba, Mampong –Ashanti, Ghana. Geographically, the study area lies on latitude 07° 04'N and longitude 01° 24'W with an altitude of 457 m above sea level. Mampong-Ashanti is found in the North West of the Transitional Zone of the forest and the savannah regions of Ghana. The climate of Mampong is the wet semi-equatorial type, which experiences a bi-modal rainfall pattern with maximum and minimum temperatures of 30.6 and 21.2°C respectively (MSD, 2010).

Experimental animals and design

Forty weaned grasscutters made up of twenty females and twenty males obtained from local farmers in Sunyani- Ghana, were used for the experiment. The grasscutters were put into groups of similar body weights and were randomly allocated to four dietary treatments in a randomized complete block design. There were ten replications of each treatment. Each animal constituted a replicate.

Housing

The grasscutters were housed singly in wooden three tier cages. Each cage had dimension of 60 x 50 x 40 cm. The cages were partitioned with crimped wire mesh. The floor of the cages was covered with wire mesh underneath which was a drawer into which faeces and wasted feed could pass. The cages were placed in a well-ventilated cement block walled house roofed with asbestos sheets to protect the animals from bad environmental conditions such as rainfall and cold conditions.

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Table 1. Percentage composition and calculated values of dietary treatments.

Ingredients	U 0%-P	U30%-P	U25%-P	U0%-AP
Wheat bran	30.35	36.25	34.68	30.28
Dry cassava chips	44.13	50.98	49.67	44.07
Soyabean meal	24.00	9.2	11.92	20.08
Fish meal(Tuna)	-	-	-	4.04
Vitamin mineral premix²	0.5	0.5	0.5	0.5
Dicalcuim phosphate	0.5	0.5	0.5	0.5
Common salt	0.5	0.5	0.5	0.5
Urea	-	2.05	1.73	-
Sodium sulphate	-	0.0426	0.32	-
Calculated analysis in (%)				
Nitrogen	2.88	2.88	2.89	2.88
Calcium	0.23	0.20	0.21	1.06
Phosphorus	0.64	0.55	0.57	0.96
Crude protein	18.00	18.00	18.05	18.00

²Vitamin mineral premix provided the following per kilogram of diet; Vitamin A 8,000 000 u.1, Vitamin D3 1,500 000 u.1, Vitamin E 2500 mg, Vitamin K3 100 mg, Vitamin B2 2000 mg, Vitamin B12 5 mg, Folic acid 500 mg, Nicotinic acid 8000 mg, Calcium Panthotenate 2000 mg, Choline 50000 mg, Magnesium 50000 mg, Zinc 40000 mg, Copper 4500 mg, Cobalt 100 mg, Iodine 1000 mg, Selenium 100 mg.

Experimental diets

Four diets were formulated to contain approximately 18% crude protein. Diet 1 designated as U0%-P had all the protein derived from plant sources. Diet 2 designated as U30%-P had 70% of the protein derived from plant sources while 30% was from urea. Diet 3 designated as U25%-P had 75% of the protein derived from plant sources while 25% was from urea. Diet 4 designated as U0%-AP contained 10% animal protein with the rest from plant sources. Sodium Sulphate was added to the diets that contained urea in order to obtain a nitrogen to sulphur (N:S) ratio of 10:1. The composition of the experimental diets is presented in Table 1.

Data collection

Parameters measured included feed intake, feed wastage, water intake, body weight gain, carcass characteristics, caecal pH and mircrobial composition and meat quality. Feed and water for the animals were given *ad libitum*.

Chemical assay

The proximate content of the diets were determined according to the procedures of the (AOAC, 1990).

Carcass parameters

Four animals made up of two males and two females were randomly selected and sacrificed at the end of the feeding trial for carcass analysis. Prior to slaughtering, the animals were fasted overnight but had access to water. After slaughter, the carcasses were eviscerated, weighed and chilled at 4°C for 24 h to obtain the cold carcass weight.

Caecal pH

The pH of the digesta from the caecum was measured for the respective replicates with a digital pH meter. Five grams of caecal digesta from the respective replicates was collected in a previously labeled beaker. The probe of the digital pH meter was rinsed with distilled water before inverting into each of the replicate caecal digesta (EUTECH, 1999).

Caecal microbial composition

One gram of caecal digesta of the various experimental animals was taken when the grasscutters were sacrificed for carcass assessment. In the determination of the microbes, an agar solution was prepared. This was done by dissolving six nutrient agar pours in a boiling water bath of 200 ml until they were liquefied and was placed in a 50°C water bath until it was used. The samples containing the caecal digesta of the various treatments were shaken to ensure an even distribution of micro organisms. 10 ml of melted agar was aseptically poured into a previously labeled petri plate that contained the respective samples that had been diluted. The respective petri plates were swirled to mix the sample with the agar while making sure that the agar did not run over the edges of plate. The lid of the respective plates was replaced and was allowed to cool and solidify. The inverted plates were then incubated at 30°C for 24 h. After incubation, the microbial colonies on each plate were stained with Ruthenium, observed under a light microscope which was previously fitted with a camera on the eyepiece. The colonies observed were photographed and the print out was compared with a chart which aided the identification of the observed colonies (Kamra and Pathak, 1996).

Statistical analysis

Data collected was subjected to analysis of variance using SAS (2008) and differences among treatment means isolated at 5%

Table 2. Proximate composition of experimental diets.

Parameter	U 0%-P	U 30%-P	U 25%-P	U0%-AP
Crude protein (%)	18.4	18.2	18.3	18.1
Crude Fibre (%)	4.95	5.98	5.36	4.56
Ether Extract (%)	5.50	4.50	4.00	5.00
Nitrogen free extract (%)	50.12	50.88	50.88	51.46
Ash (%)	8.42	8.42	8.56	8.12
Moisture (%)	12.61	13.36	12.90	12.76

significant level using least significant difference (Table 1).

RESULTS AND DISCUSSION

Proximate composition of diets

The crude protein content of the experimental diets analysed was similar to the calculated values and met the crude protein requirements of growing grasscutters (18%) (Kusi et al*.,* 2012). This indicated that the crude protein content was iso-nitrogenous and therefore no undue advantage was given to any particular treatment. The results of the proximate composition of experimental diets are presented in Table 2.

Effect of urea on growth performance

Feed intake, water intake and feed conversion were not significantly influenced (P>0.05) by dietary urea supplementation. Body mass gain was however significantly influenced by urea supplementation (Table 3). Also sex of the grasscutters and time of experiment did not influence these parameters. Daily feed intake ranged from 77.5 to 83.4 g. These similar feed intakes are attributed to similar protein levels of the experimental diets. However, the values of feed intake obtained in this study are higher as compared with 53.8 to 66.2 g reported by Karikari and Nyameasem (2009). Feed wastage by grasscutters was not significantly influenced by dietary treatments, however a high percentage of 60% of feed offered was wasted confirming the observation that grasscutters are wasteful feeders. Water intake of dietary treatments ranged from 167 to 172 ml. Urea supplemented diets had lower water intake as compared to the control but were not significantly different due to similar moisture content of the diets and it is consistent with observation made by Ward (2007). The daily body weight gain of grasscutters fed diet that contained plant and animal protein (U0%-P) and (U 0%-AP) respectively were heavier (P<0.05) as compared with the other dietary treatments. This could probably be as a result of the animal protein which is of higher quality in its amino acid profile than both plant and microbial protein (Rahjhan, 1993). Feed conversion ratio ranged from 7.44 to 8.53. However, grasscutters fed (U0%-AP) were most efficient (7.44) in converting feed to body mass. However, figures obtained in this study are high as compared with 5.1% reported by Karikari and Nyameasem (2009). The relatively higher feed conversion ratio values obtained in this study could be attributed to the wooden cages used in this study which makes grasscutters aggressive in the presence of humans and caretakers which provides a hiding area that allows grasscutters hide from human sight (Karikari and Nyameasem, 2009).

Caecal pH and microbial composition

The pH of the caecum was not significantly affected by dietary urea supplementation. The pH of the caecum ranged from 5.8 to 6.0 (Table 4) which is considered slightly acidic and was therefore not surprising to have bacillus which was able to thrive under these conditions. The caecal pH values obtained in this study are in the range of rumen p^H reported for cattle, sheep and goats by McDonald et al*.*(2010). This indicated that the caecal environment as influenced by p^H might be similar to the rumen environment of cattle, sheep and goats. The microscopic examination of the digesta obtained from the caecum of grasscutters fed the various diets was indifferent in caecal microbial composition. The microbial colonies observed from the microscopic examination appeared to be the same for all dietary treatments. This indicates that urea supplementation is not likely to affect microbial composition in the caecum. Microbes identified in the caecum were mainly bacteria which were dominated by Bacillus species. No fungi or protozoa were identified in this study. Studies as regards microbial composition in the caecum of grasscutters are limited and therefore this study cannot strictly say that the only microbes in the caecum are bacteria. There is therefore the need to take caecal samples from grasscutters in the wild other than those in captivity and analyse for microbial composition in order to establish the variety of microbes present in the caecum of grasscutters obtained from the natural environment (wild) of the grasscutter.

Carcass characteristics

Dressing percentage was significantly (P<0.05) affected by dietary treatments (Table 5). Grasscutters fed diet

Table 3. Effect of experimental diets on the performance of grasscutters.

Fixed effect	Daily feed intake (g)	Daily feed wastage (g)	Initial body weight (g)	Final body weight (g)	Total weight gain (g)	Daily weight gain (g)	Feed conversion efficiency	Daily water intake (ml)
Sex								
Male	80.6±2.3	119.6±2.5	787.5±22.7	2836.6±57.1	2049.1±50.6	9.7+0.24	8.37±0.29	161.6±4.5
Female	78.9±2.3	120±2.5	787.9±22.7	2920.9±57.1	2133.0±50.4	10.1±0.23	8.04±0.29	177.8±4.6
Time of experiment								
18-01-2010	78.06± 2.42	120.90± 2.59	752.91 ± 23.5	3024.25 ±59.31	2271.34±52.50	10.76± 0.25	7.25± 0.31	161.64± 4.93
02-09-2010	81.37± 2.30	118.81± 2.46	822.51 ±22.47	2733.30 ± 56.34	1910.79 ± 49.87	9.06± 0.246	9.17± 0.29	177.76 ± 4.69
Treatment								
U0%-P	79.63 ± 3.30	117.49± 3.54	773.56 ± 32.33	2845.50 ± 81.07[a]	2071.94 ± 71.75[a]	9.82± 0.34[a]	8.42± 0.42	172.21 ± 6.74
U30%-P	78.34 ± 3.36	121.82± 3.59	781.3 ± 32.83	2827.59 ± 82.33[a]	2046.21 ± 72.87[a]	9.70± 0.35[a]	8.16± 0.43	166.58 ± 6.85
U25%-P	77.50 ± 3.29	124.50± 3.52	794.40 ± 32.16	2751.00 ± 80.65[a]	1956.60 ± 71.38[a]	9.27± 0.34[a]	8.53± 0.42	170.70± 6.71
U0%-AP	83.40 ± 3.29	115.60± 3.52	801.50 ± 32.16	3091.00 ± 80.65[b]	2289.50 ±71.38[b]	10.9± 0.134[b]	7.44± 0.42	169.30± 6.71

Means bearing different superscript in the same column are significantly (P < 0.05) different.

Table 4. Caecal pH and microbial composition.

Parameter	U0%- P	U30%-P	U25%-P	U0%-AP
Caecal p[H]	5.9± 0.06	6.0± 0.06	5.8± 0.06	6.0± 0.06
Microbial composition				
Bacteria (Bacillus)	√	√	√	√
Fungi	x	x	x	x
Protozoa	x	x	x	x

X=Absent, √=present.

U0%-AP (72.01%) had significantly (P<0.05) higher dressing percentage than those fed diets U30%-P (69.20%) and U25%-P (67.02%) but not those fed diet U0%-P, (71.96%). Grasscutters fed diet U0%- P, (71.96%) had significantly (P<0.05) higher dressing percentage than those fed diet U25%-P (67.02%). Dressing percentage is the live weight of the animal less the weight of the internal organs, head, legs, blood and fur. Consequently, the significant (P<0.05) difference between grasscutters fed diet U0%-AP (72.02%) and those fed the diets that contained urea U30%-P (69.20%) and U25%-P (67.02%) could probably be attributed to differences in the weight of the blood fur and feed in the gastro intestinal tract. The mean dressing percentage value of 70% obtained in this study is slightly lower than the mean dressing percentage of 76.98% reported by Omole et al. (2005), when eight grasscutters of mean total body weight of 2.65±0.006 kg were fed with diets which did not contain urea. Trimmable

Table 5. Carcass characteristics of grasscutters fed experimental diets.

Fixed effect	Mean dressing percentage	Trimmable fat (%)	Liver to body weight (%)	Kidney to body weight (%)	Heart to body weight (%)	Lungs to body weight (%)	Spleen to body weight (%)
Sex							
Male	70.69±0.82	1.60±0.59	2.00±0.56	0.26±0.64	0.54±0.47	0.54±0.87	0.07±0.66
Female	69.39±0.82	1.60±0.59	1.98±0.56	0.27±0.64	0.53±0.47	0.54±0.87	0.07±0.66
Time of experiment							
18-01-2010	66.61±4.04	1.58±0.03	1.97±0.03	0.28±0.01	0.54±0.07	0.55±0.01	0.08±0.00
02-09-2010	73.48±4.04	1.60±0.03	2.02±0.03	0.27±0.01	0.54±0.07	0.53±0.01	0.07±0.00
Treatment							
U0%-P	71.96±5.71^{ab}	1.59±0.04	1.98±0.05	0.28±0.21	0.55±0.01	0.53±0.01	0.08±0.01
U30%-P	69.20±5.71^{bc}	1.52±0.04	1.98±0.05	0.25±0.21	0.54±0.01	0.55±0.01	0.07±0.01
U25%-P	67.02±5.71^{c}	1.58±0.04	1.96±0.05	0.28±0.21	0.53±0.01	0.53±0.01	0.07±0.01
U0%-AP	72.01±5.71^{a}	1.65±0.04	1.98±0.05	0.26±0.21	0.54±0.01	0.54±0.01	0.08±0.01

Means in a column with different superscripts are significantly (P< 0.05) different.

Table 6. Chemical composition and pH of grasscutter meat.

Fixed effect	Protein %	Fat %	Ash %	Moisture %	P^{H}
Sex					
Male	28.43±0.49	4.24±0.09	0.55±0.04	67.08±1.05	5.62±0.02
Female	27.35±0.49	4.23±0.09	0.53±0.04	67.28±41.05	5.64±0.02
Time of experiment					
18-01-2010	27.26±0.48	4.22±0.09	0.53±0.04	65.65±1.05	5.47±0.02
02-09-2010	28.53±0.48	4.26±0.09	0.55±0.04	68.72±1.05	5.80±0.02
Treatment					
U0%-P	27.23±0.68^{b}	4.83±0.13^{ab}	0.53±0.05^{ab}	61.65±1.49^{b}	5.49±0.03
U30%-P	25.22±0.68^{bc}	3.76±0.13^{bc}	0.47±0.05^{bc}	74.16±1.49^{a}	5.84±0.03
U25%-P	25.28±0.68^{c}	2.80±0.13^{c}	0.45±0.05^{c}	69.33±1.49^{ab}	5.72±0.03
U0%-AP	33.85±0.68^{a}	5.58±0.13^{a}	0.72±0.05^{a}	63.61±1.49^{ab}	5.49±0.03

Means in a column with different superscripts are significantly (P< 0.05) different.

fat was not significantly (P>0.05) affected by dietary treatments. However, grasscutters fed diet U 0%-AP (1.65%) had a numerically higher fat deposition compared with those fed diets U0%-P (1.59%), U30%-P (1.52%) and U25%-P (1.58%). The mean trimmable fat (1.60%) in this study is however, higher than the value of (1.22%) obtained by Omole et al. (2005). The proportions of liver, kidney, heart, lungs and spleen to body weight of the animals were not significantly (P>0.05) affected by dietary treatments. Sex and time of the experiment did not significantly (P>0.05) affect carcass characteristics.

Chemical composition of grasscutter meat

The protein content of the grasscutter meat was significantly higher (33.85%) for the meat of grasscutters fed U%-AP diet as compared with 27.23% for U 0%-P, 25.22% for U30%-P and 25.28% for U 25%-P (Table 6). The significantly higher protein concentration in the grasscutter meat of those fed the U%-AP diet is attributed to the inclusion of fish meal and soya bean meal which might have supplied amino acids in adequate quantities and proportions which were used for tissue synthesis, which resulted in an increased concentration of protein in the meat (Ranjhan, 1993). The fat content of the grasscutter meat was significantly higher 5.58 and 4.83% for grasscutters that were fed U0%-AP and U0%-P respectively as compared with grasscutters fed urea supplemented diets.

The relatively higher fat deposition is attributed to the

Table 7. Benefit cost analysis.

Description	U0%-P	U30%-P	U25%-P	U0%-AP
Variable cost (Gh¢)	10.98	6.94	7.48	18.51
Fixed cost (Gh¢)	55.1	55.1	55.1	55.1
Cost of grasscutter (Gh¢)	20	20	20	20
Revenue accrued (Gh¢)	56.70	56.54	55.02	61.82
Discounted cost (Gh¢)	122	104.42	102.59	137.4
Discounted revenue (Gh¢)	118.05	117.70	114.35	128.79
Benefit cost ratio (Gh¢)	0.97	1.13	1.12	0.94

faster growth rate as compared with grasscutters fed diets that contained urea. The ash content of the grasscutters meat followed a similar pattern to that of fat and protein of the meat and is attributed to the high phosphorus (0.96%) and calcium (1.06%) of the fish meal. The moisture content of the meat was higher (74.16%) (P<0.05) for the meat of grasscutters fed U25%-P diet as compared to U0%-P but not U30%-P and U 0%-AP. The moisture content of the meat was affected significantly (P<0.05) by the experimental diets. The moisture content of the meat ranged from 61.65% to 74.16%. The moisture content in the meat of grasscutters fed diet U0%-P (61.65%) was significantly (P<0.05) lower than the moisture content of the meat of grasscutters fed diet U30%-P (74.16%) but not different from those fed diets U25%-P (69.33%) and U0%-AP (63.61%). The higher moisture content in the meat of grasscutters fed diet U30%-AP (74.16%) might be attributed to an increase in the size of the spaces between the filaments of the muscles in the meat which retained a lot of moisture. Water occupying this space is referred to as free water and is held there by steric effect and reported that a higher pH goes with higher meat moisture content (Qiao et al., 2001). Therefore, the relatively higher moisture content in the meat of grasscutters fed diet U30%-P (74.16%) could be attributed to a higher pH (5.84) although there were no significant (P>0.05) differences in the pH of the meat of grasscutters fed the various experimental diets.

Economics of production

The variable costs which were labour for feeding animals, cleaning the cages, record keeping and watering, feed, electricity and water amounted to GH¢ 10.98, GH¢ 6.94, GH¢ 7.48 and GH¢ 13.51 for U0%-P, U30%-P, U25%-P and U0%-AP respectively per grasscutter. The fixed costs amounted to GH¢ 55.10 per animal in each treatment. The revenue was obtained by multiplying the final body weight of each grasscutter by the selling price of the grasscutter which was GH¢ 20.00 per kilogram body weight. The following revenue GH¢ 56.70, GH¢ 56.54, GH¢ 55.02 and GH¢ 61.82 were obtained for U0%-P, U30%-P, U25%-P and U0%-AP respectively. Grasscutters mature and give birth to an average of two offspring at the end of the first year or at the beginning of the second year (4 month) of operation. Their offspring can thus be sold in the second year. Under such circumstances, if three grasscutters are sold, benefits (measured as revenue) which will be GH¢ 118.05, GH¢ 117.70, GH¢ 114.55 and GH¢ 128.71 will be accrued in the second year of operation for U0%-P, U30%-P, U25%-P, and U0%-AP respectively (Table 7). The BCR values were 0.97, 1.13, 1.12 and 0.94 for U0%-P, U30%-P, U25%-P and U0%-AP respectively for the four treatment lines. On the basis of the viability or the worthiness of the project, U30%-P, and U25%-P should be accepted since their values exceed the benchmark of 1.0. U0%-P and U0%-AP should be rejected because their values fall below the benchmark criteria of 1.0.

Conclusion

The results of the studies show that urea can be used in the grasscutters diet without any deleterious effects on their general performance or carcass characteristics. The use of urea in the grasscutters diet to replace part of the protein renders the production more economical and viable

Conflict of Interest

The authors have not declared any conflict of interest.

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