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Original research article

Effects of different levels of urea supplementation on nutrient intake and growth performance in growing camels fed roughage based complete pellet diets

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ABSTRACT

The utilization of urea in camels has beneficial and negative effects. The aims of this study were to investigate the effects of different levels of urea supplementation on nutrients intake, digestibility, growth performance, feed efficiency and economics in growing camels fed roughage based complete pellet diets. In the present study, eighteen growing camels with an average live body weight of 306.17 ± 2.05 kg were randomly assigned in three treatments: T1 = roughage complete pellet diet without urea, T2 = T1 plus 1% urea, and T3 = T1 plus 2% urea. The results showed that the urea supplementation significantly affected average daily feed and nutrient intake of dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF) ($P < 0.05$). On the contrary, the average daily intake of nitrogen free extract (NFE) and water were not influenced by increasing urea supplementation ($P > 0.05$). Similarly, digestion coefficient of DM, CP, ether extract (EE), crude fiber (CF) and ADF was influenced by increasing urea level ($P < 0.05$), while the digestion coefficient of OM, NFE and NDF was not affected by increasing urea level ($P > 0.05$). The intake of digestive nutrients was similar among all treatment groups. Total body live weight gain and average daily gain were significantly higher in urea supplemented groups ($P < 0.05$) than in the control group. The supplementation of urea at 1% in low quality roughage complete pellet diets significantly improved ($P < 0.05$) the feed efficiency. In conclusion, these results indicated that the incorporation of urea at 1% in roughage based complete pellet diets could positively improve nutrients intake, digestibility, growth performance and feed conversion efficiency of growing camels.

1. Introduction

Potential production of the cereals in tropic areas is very important (Zhang et al., 2012). Thus, most ruminants are fed low-quality roughages, agricultural crop-residues and industrial byproducts (Wanapat et al., 2013). However, roughages are low in nutritive value, protein level, high content of ligno-cellulose and low digestibility (Freeman et al., 1992; Mawuenyegah et al., 1997), thus resulting in low voluntary feed intake (Wanapat et al., 2012). The improvement of low quality roughages can be fulfilled by

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supplementation of true protein sources (McCollum and Horn, 1990) and non-protein nitrogen (NPN) like urea (McAllen, 1991; Huntingto and Archibeque, 1999). In addition, the efficiency of protein utilization should always consider economical as well as environmental aspects (Yin et al., 2010).

Urea in rumen is converted to ammonia by urease and the ammonia released from urea has the capacity to weaken the lignified outer walls, allowing better penetration by rumen microorganisms to produce more effective fermentation and liberation of nutrients (Chenost, 1995). However, the addition of urea to animal diet should be done under limitations to avoid the risk of hyper ammonia. The hydrolysis of urea to NH_3 in the rumen by microbial enzymes is rapid and occurs at a faster rate than NH_3 utilization by the rumen bacteria (Highstreet et al., 2010). This results in the accumulation of NH_3 in the rumen and the transformation of this product in urea by liver cells (Golombeski et al., 2006). In normal conditions, ammonia is detoxified in the hepatocytes through urea cycle (Visek, 1968). But when its concentration is elevated in the rumen, blood, cerebrospinal fluid and other tissues, it is resulting in ammonia poisoning by overwhelm hepatocytes capacity of detoxification through inhibiting the Krebs cycle (Davidovich et al., 1977).

An effort to improve the low quality of straws and to slow down the ammonia release from urea has been initiated by making roughage based complete pellet diets. Therefore, a study was needed to generate reliable information of feeding complete pellet diet with supplemental nitrogen from urea in camels. This study was designed to measure the optimum level of urea that could be incorporated in the diets of growing camels.

2. Material and methods

2.1. Animals and experimental diets

Three complete pellet diets with different levels of urea were prepared for eighteen growing camels. Animals were distributed equally in three groups (6 camels in each group, 3 males and 3 females), fed a complete pellet diet containing 0 (T1), 1 (T2) and 2% (T3) of urea, respectively. Composition analysis of the diets can be found in Table 1. The complete pellet diets were produced as following: crop residues (groundnut and wheat straws) were chaffed to 1 to 5 cm and concentrate ingredients (bajra grains and mustard cake) were coarsely ground separately. Urea was dissolved in hot water at 1 L to 1 kg urea and the solution of urea was then mixed with 5% molasses. The whole mass of urea-molasses and remaining ingredients were transferred into a vertical mixer in order to obtain homogenized total mixed ration. Care was taken for the mixture of ingredients to be uniform. Finally, the desired quantity of total mixed ration was pulled in a plate dye roughage based complete pellet making machine for densification of the ingredients.

The age of growing camels ranged between 18 and 24 months with an average live body weight of 306.17 ± 2.05 kg. Water and the diets based on complete pellet were offered ad libitum two times daily (at 0900 and 1500) during the experimental period of 120 days. Orts were weighed on the next day morning. Thus, the exact quantity of feed consumed during 24 h by the experimental animals was calculated by subtracting the weighed orts from the offered quantities. The water intake was recorded from the individual camels with 20 L graded buckets.

All diets were analyzed for chemical composition by the methods of the AOAC (1990; method ID 942.05) for dry matter (DM), organic matter (OM), ash, crude protein (CP), ether extract (EE), crude fiber (CF) and nitrogen free extract (NFE). Fiber content was tested using the procedures described by Goering and Van Soest (1970) for neutral detergent fiber (NDF) and acid detergent fiber (ADF).

Table 1
Composition and nutrient level of diets.

Item	Treatment[1]		
	T1	T2	T3
Ingredient, % (air-dry basis), %			
Groundnut straw	50.00	50.00	36.00
Wheat straw			14.00
Bajra grains	4.00	10.00	28.00
Rice bran	10.50	18.00	11.00
Soya churi	14.50	12.00	
Mustard cake	12.00		
Molasses	5.00	5.00	5.00
Mineral mixture[2]	2.00	2.00	2.00
Salt	2.00	2.00	2.00
Urea		1.00	2.00
Total	100.00	100.00	100.00
Nutrient level, % DM basis			
Dry matter	88.10	88.90	87.07
Organic matter	87.69	86.76	86.84
Crude protein	13.60	13.19	13.10
Ether extract	2.73	2.44	2.40
Crude fiber	22.02	25.01	25.32
Nitrogen free extract	51.02	46.27	45.95
Neutral-detergent fiber	41.32	40.77	40.30
Acid-detergent fiber	24.44	23.23	24.33
Energy (ME), Mcal/kg DM	0.98	0.95	0.96

[1] T1 = urea at 0, T2 = urea at 1% and T3 = urea at 2%.
[2] Containing 35% Ca; 27.4% P; 100 mg/kg of Co; 1,250 mg/kg of Cu; 1,795 mg/kg of Fe; 2,000 mg/kg of Mn; 15 mg/kg of Se; 5,270 mg/kg of Zn; and 90 mg/kg of I.

The body weights of all experimental animals were recorded by using a fixed electronic weighing balance in three consecutive days and the mean of the three observations was taken to represent the body weight during 120 days. Average daily gain (ADG) for individual growing camels was calculated by weekly total gain of experimental growing camels. Girth circumference (GC), hump girth (HG), height at withers (HW) and body length (BL) were measured monthly.

2.2. Sampling techniques

Feed and orts samples were taken from each camel during the digestion trial. To obtain a representative sample, 4 growing camels for each treatment were included in the experience. Fecal weight was recorded in the morning of the next day, mixed and stored at room temperature. The representative samples were pooled over the 7-day collection period for each treatment group. The digestion trial ran for 21 days and each experience period lasted for 7 days per each group after 30 days for adaption period.

2.3. Laboratory analyses

Feed, orts and fecal samples were dried at 105°C and ground through a 1 mm sieve before it was analyzed for DM, OM, CP, CF, EE, and NFE following AOAC (1990) procedures. Neutral detergent fiber and ADF fractions were determined with the procedure of Goering and Van Soest (1970).

2.4. Statistical analysis

All tests were performed using the computer package of the statistical analysis system (SSPS 16.0, Chicago, IL, USA). The data were analyzed by descriptive statistics and compared between groups by one way variance (ANOVA) and LSD method test. They were presented as mean ± standard error of mean (SEM).