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Urinary Urea Elemination Following Feeding of Low and High Protein Diets to Camels (*Camelus dromadarious*)

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Abstract: Feeding of urea-treated wheat straw to camels resulted in significantly increased concentration of plasma urea compared to their counterparts that fed straw only. P-aminohippuric acid, inulin and urea clearances and filtered urea were also significantly higher in animals fed urea treated straw than in animals fed straw. It is suggested that in camels fed straw, the renal urea spare could serve for ruminal recycling of urea to compensate for low nitrogen diet.

Key words: Urea, urine, protein, diet, camel, wheat straw

INTRODUCTION

It is well known that in ruminants, endogenous urea is partly recycled in the forestomach. This process is nutritionally adavntageous for ruminants because ruminal bacteria are able to use urea nitrogen to synthesis protein that will be absorbed in the small intestine (Von Engelhardt and Schnider, 1977). Urea treatment of poor quality roughages has emerged as promising technology for improving their feeding value (Majumdar *et al*., 2003). Urea is hydrolysed to ammonia due to the action of urease enzyme. The generated ammonia, react with the cell walls of roughages (Klopferstein, 1978), increasing the crude protein content (Roseler *et al*., 1993; AL-Shami and AL-Sultan, 2006).

Wheat straw is the most abundant agriculture in Saudi Arabia. It is widely used as cheap source of bulk feed to ruminants. The feed value of wheat straw is, however limited by its low available energy, low protein, minerals and vitamins (Saddullah *et al*., 1981). It is now established practice in some parts of the world to upgrade the protein content of low quality roughage by urea treatment (AL-Shami and AL-Sultan, 2006).

Camels graze different kinds of pastures with variable levels of nitrogen content throughout the year. This study was undertaken to investigate the importance of renal mechanisms to control urea losses in camels fed low or high urea-treated straw.

MATERIALS AND METHODS

Urea treatment of wheat straw: One ton of wheat straw (tibin) was treated with 4% w w^{-1} urea (Saudi Basic Industries Corportion) solution (12.5%) and subjected to urealysis by anaerobic storage for 8 weeks. This treatments of urea was expected to increase the crude protein content of straw from 3% in straw to 8% in urea treated straw (AL-Shami and AL-Sultan, 2006).

Experimental animals and treatments: Twelve mature (2-4 years old) and weigh 300-400 kg body weight camels were used in the study. They were divided equally into 3 groups.

Group 1: Animals were given wheat straw as a sole diet for 21 days. Water and mineral salt licks were provided *ad libitum*.

Group 2: Animals were treated similar to group1 but in addition were given each 1 kg urea-treated straw and 2 kg of concentrates.

Group 3: Animals were treated similar to group 1 but in addition were given each 2 kg urea-treated straw and 2 kg of concentrates.

On the last day of the feeding period the renal function was studied. Both jugular veins of each animal

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were catheterized. One vein was used for perfusion and the other one for blood sampling. In order to measure renal plasma flow and the glomerular filtration rate, a primed constant infusion of 0.5 mL min^{-1} of P-aminohippuric acid (PAH, 8 mg/ml/min) and inulin (70 mg/ml/min) (Sigma, UK) in 0.9% saline, was made into a jugular vein. Bladder urine was collected for each period and a heparinized blood sample (5 mL) was obtained at the midpoint of each period. Blood samples were centrifuged at 3000 rpm for 5 min, to obtain plasma which was stored until analysis.

Plasma and urine were analysed for urea (urease Kit, Wiener, Austria), inulin and PAH (Tebot *et al*., 2002). Renal plasma flow (as PAH clearance), glomerular filtration rate (as inulin clearance) and urea clearance were calculated as the product of urine flow and urinary concentration divided by plasma concentration. Fractional excretion of urea (as urea/inulin clearances) and filtered load of urea (as inulin clearance by plasma urea concentration) were determined.

Results were subjected to Analysis of Variance (ANOVA) using least significance difference for comparing differences between means (SAS, 1985).

RESULTS

Effects of feeding urea-treated straw on plasma urea concentrations and kidney functions are given in Table 1. Feeding of urea treated straw resulted in significantly ($p<0.05$) increased concentration of plasma urea in group 2 and 3 animals compared to group 1. Significantly ($p<0.05$) increased losses of nitrogen in urine was seen in animals in group 2 and 3 compared to those in group 1. PAH, inulin and urea clearances and filtered urea were also significantly ($p<0.05$) higher in group 2 and 3 animals compared to those in group 1. Fractional urea excrection was significantly ($p<0.05$) higher in animals of group 1 than in animals of group 2 and 3. No adverse effect of feeding urea-treated straw was shown in camels.

Table 1: Urea kinetics in camels fed urea-treated wheat straw

Parameter	Group 1	Group 2	Group 3
Plasma urea			
concentration (mg dL^{-1})	10.1±0.6a	30.2±2.1b	35.3±2.3c
Nitrogen losses in urine (g day^{-1})	16.2±1.3a	29.0±2.6b	34.0±2.5c
PAH clearance (mL min^{-1})	602±22.0a	405±20.0b	426±21.0b
Inulin clearance (mL min^{-1})	16.3±13.0a	52.1±2.3b	54.3±2.4b
Urea clearance (mL min^{-1})	13.1±0.6a	36.6±1.4b	38.3±1.6b
Filtered urea (mg min^{-1})	3.2±0.06a	16.2±1.3b	17.6±1.5b
Fractional urea excretion	0.81±0.03a	0.65±0.04b	0.61±0.03b

a,b,c means bearing different letters in the same row differe significantly $p<0.05$

DISCUSSION

The results of the present study indicate that feeding of urea-treated straw increased blood urea concentration. The increased value of blood urea level in animal fed urea-treated straw was due to consumption of more amount of easily degradable non-protein nitrogen available through ammoniated straw which was in normal physiological range, thus no adverse effect of feeding urea treated straw diets were visible (Bhatt *et al*., 2004; Singh *et al*., 2007). Animal fed wheat straw of low protein content were adapted by reducing glomerular filteration, urea clearance and filtered load of urea. Similar finding were reported in sheep on restricted protein intake (Tebot *et al*., 2002). Data on nitrogen balance indicated that loss of nitrogen through urine was significantly more in urea supplemented groups, indicating that ammonia-nitrogen could not be utilized completely due to less available energy. Similar nitrogen excretion was reported in crossbred calves and buffaloes fed diet containing higher than optimal amount of protein (Dass and Arora, 1989) and with various levels of urea with molasses (Ali and Mirza, 1986). This suggests that the ammonia-nitrogen utilization depends on the activity of rumen microflora and rumen microbes are maximum in quantity when there is matching supply of energy to the available nitrogen (Toppo *et al*., 1997). Changes in tubuler handling of urea (fractional excretion) induced by feeding wheat straw was also evident. An enhanced capacity for urea reabsorption from tubules and the renal pelvis was noticed when protein intake was restricted (Cirio and Biovin, 1990). This adaptive process prrevents an excessive reduction of blood urea pool (Mcknight, 1994). The camel often re-uses nitrogenous waste by returning urea to the stomach via bloodstream and liver, rather than voiding it.

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