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IN SITU DRY MATTER AND FIBRE DEGRADATION OF SALT TOLERANT SPOROBOLUS GRASS HAY IN CAMELS FED YEAST CULTURE

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ABSTRACT

In situ trial was conducted to investigate the effect of varying levels (0, 20, 50 and 150 g/day) of yeast culture as supplement in camel's diets on DM and NDF degradation of salt tolerant sporobolus grass (*Sporobolus verginicas*) and rhodes grass hays. Two mature dromedary camels fitted with rumen fistula were used in four periods (23 day/ period). In the first period camels were fed rhodes grass hay and concentrate (no yeast culture). In the second, third and fourth period, camels were fed the same diet plus 20, 50 or 150 g/day yeast. Five grams from each grass were placed into a nylon bags and incubated for 0, 6, 12, 24, 48 and 72 hours and placed in rumen. NDF, ADF and ash contents were higher in sporobolus grass. DM disappearance of both grasses increased significantly ($P<0.05$) when camels received 20 g/day yeast compared to camels received no yeast after the 6 and 12 hours of incubation times. Addition of 20g/day of yeast increased NDF disappearance of sporobolus grass after 6 and 12 hours of incubation compared to all other levels of yeast supplements in both grasses. Feeding camels 20 or 50 g/day yeast improved the degradability of insoluble but degradable DM of sporobolus grass, while increasing the level of yeast supplement to 150 g/day resulted in lower insoluble but degradable DM than that of zero level in both grasses. The dromedary camels may benefit from the yeast culture by improving DM and fibre degradation of grasses especially salt tolerant grasses.

Key words : Degradation, dromedary, dry matter, fibre, rhodes grass, salt tolerant sporobolus grass hay, yeast

Halophytic grasses have long been important forage resources especially for sustaining grazing livestock when other feeds are scarce (Squires and Ayoub, 1994). Recently attention has been given to the possibility of growing halophytes as irrigated crops (Glenn *et al*, 1991; Glenn and Watson, 1993; Miyamoto and Singh, 1994 and Alhadrami *et al*, 2000). sporobolus grass (*Sporobolus virginicus*) are well known for its high tolerance to salt and are successfully grown as irrigated forage under high salinity conditions of the United Arab Emirates (Alhadrami *et al*, 2000).

The benefits related to the use of yeast culture *Saccharomyces cerevisiae*, *Aspergillus oryzae* or both in the diets of ruminants are associated to a more active microbial population in the rumen and an increased number of cellulolytic bacteria (Weidmeier *et al*, 1987; Wallace, 1994). An increase has been observed in numbers of anaerobic bacteria after supplementation of hay or grain diets with *S. cerevisiae* (Dawson, 1989). The addition of yeast cultures to adult ruminant diets increases digestion of dry matter, neutral detergent fibre, acid detergent fibre, crude protein and *in vivo* and *in vitro* (Arambel *et al*, 1987 and Wiedmeier *et al*, 1987 and Gomez-Alarcon *et al*, 1990). The improvement in NDF digestibility has been reported (Ayala *et al*, 1992; Plata *et al*, 1994; Sommart *et al*, 1993). No study has been conducted on the influence of yeast culture on the degradability of salt tolerant grasses in camels. The objectives of this study were to determine the effect of feeding varying levels of yeast culture to dromedary camels on the *in situ* DM and fibre degradation of sporobolus grass hay in the rumen (first compartment) of the dromedary camels.

Materials and methods

In situ trial was conducted to investigate DM and NDF degradation of rhodes grass and sporobolus grass hays in camels fed yeast culture. Two mature dromedary camels (average body weight 450 Kg) fitted with ruminal (first compartment) fistula were used in four periods

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(23 days/period). Camels were fed *ad libitum* rhodes grass hay plus a 1.5 Kg/day commercial camel pelleted concentrate which consisted of corn, barley, wheat bran, soyabean meal, molasses and mineral-vitamins premix. In the first period camels were fed rhodes grass hay and concentrate (No yeast culture). In the second, third and fourth periods, camels were fed the same diet plus 20, 50 or 150 grams per day yeast culture (Diamond V "XP", Diamond V mill, Cedar Rapids, IA, USA), respectively. Camels were housed in shaded pens and had free access to water and salt blocks. Sporobolus grass hay was grown and baled from marginal land and the salinity level of the underground water that was used for irrigation was 20,000 ppm. Rhodes grass hay used as control for comparison was grown and baled at United Arab Emirates University, experimental station. The rhodes grass was irrigated with underground water (salinity level 2,500 ppm). Samples from both grasses were dried at 60°C for 48 hours in forced air oven to determine DM content then ground in a Wiley Mill (Arthur H. Thomas, Philadelphia, PA). CP and total ash contents were determined for both grasses according to AOAC (1990). Neutral detergent fibre and acid detergent fibre were determined by the procedures of Goering and Van Soest (1970).

Approximate amount of 5 g from each grass was weighed and placed into a nylon bag (40 µm pore sizes and measuring 7.5 x 15 cm). In each incubation time duplicate bags were placed into the rumen of the camels in a reverse sequential order of incubation times for both grasses. All bags were removed from the rumen at the same time and rinsed immediately with tap water. Two bags of both forages were not exposed to rumen fermentation but were rinsed with tap water. The DM from these non-incubated bags that were lost by rinsing were considered as water soluble matter (potentially rapid degradable fraction), while the residue was the slow degradable fraction. Incubation times were the 0, 6, 12, 24, 48 and 72 hours. After rinsing all the bags were dried at 60°C and weighed. Residues in bags were determined for DM and NDF.

The non-linear regression procedure based on the Marquardt method (SAS, 1991) was used to determine ruminal degradation for DM and NDF. The model was described by Orskov and Mac Donald (1979) as given below :

$$D = a + b[1 - \exp(- ct)]$$

Abbreviations used :

D - degradation curve at time zero

b - slow degradable fraction

c - rate constant of degradation

t - incubation time.

Statistical analyses were performed using the general linear models (GLM) procedures of SAS (1991). Since the periods' effects cannot be separated statistically from the effect of yeast levels due to the confounding, the statistical analyses were performed to quantify the effect of yeast only. The differences in DM and NDF degradation were analysed using 4 x 2 factorial analyses with yeast level and plants as factors. Means were tested for significance using Duncan's multiple range tests.

Results and Discussion

Chemical composition of salt tolerant sporobolus grass and rhodes grass hays are shown in table 1. Usually, per cent CP in sporobolus grass hay is lower than what reported in this trial (11.6%). This may be due to the effect of fertilising the sporobolus field with urea few weeks prior to harvesting. Alhadrami *et al* (2000) reported 6.0 % Crude protein in sporobolus grass harvested from the same field. Neutral detergent fibre, ADF and Ash contents were higher in sporobolus grass hay. However, ash contents was considered very low when compared with other halophytic plants which may reach up to 40%. Even though, sporobolus grass is considered salt tolerant grass, it does not accumulate salt in its leaf but exclude the salt at the roots level. This would make sporobolus grass attractive alternative forage for hay production in the future in the saline coastal and sub-coastal areas of the world. It is expected

Table 1. Chemical composition of sporobolus and rhodes grass hays.

Parameters	sporobolus grass	rhodes grass
Crude protein (%)	11.6	13.3
Ether extract (%)	2.1	3.0
Neutral detergent fibre (%)	75.2	70.7
Acid detergent fibre (%)	40.6	36.1
Ash (%)	17.7	11.8

that many countries facing fresh water shortage in the arid zones may be forced to resort to growing halophyte especially grasses for forage production.

The use of *Saccharomyces cerevisiae* as a growth promoter for ruminants was first reported in 1925 (Eckles and Williams, 1925). Yeast cultures has been used as supplements in animal feeds to influence microbial activities in the rumen and enhances animal production. *In situ* DM degradation of sporobolus and rhodes grass hays in the rumen of camels received varying levels of yeast culture which are shown in fig 1.

Dry matter degradation of rhodes grass hay was significantly (P<0.05) higher than that of sporobolus grass hay in camels fed varying levels (0, 20, 50 and 150 g/day) of yeast culture during the 24, 48, and 72 hours of incubation times. Even though DM degradation was significantly different between both grasses at all levels of yeast supplementation at 24, 48 and 72 hours, there was no significant difference between levels within each grass. However, at 6 and 12 hour of incubation times, DM degradation of sporobolus grass hay at 20 g/day yeast was only significantly (P<0.05) lower than that of rhodes grass hay at 20 g/day yeast. It was clear from this work that DM degradation of both grasses increased significantly (P> 0.05) when camels received 20 grams of yeast per day compared to camels received no yeast after the 6 and 12 hours of incubation times. Increasing the levels of yeast to 50 or 150 grams did not improve DM degradation of both grasses during all incubation times.

Table 2. DM degradation kinetics of sporobolus and rhodes grass hays in the rumen of camels received varying levels of yeast.

Grass	Yeast (g/day)	A^1	B^2	C,%h^3	Lt,h^4	RSD^5
sporobolus	0	19.4	43.7^{c}	2.8^{ab}	3.1^{b}	2.3
	20	19.4	58.8^{ab}	1.1^{c}	0.1^{c}	1.9
	50	19.4	72.2^{a}	0.7^{c}	0.2^{c}	2.7
	150	19.4	43.2^{c}	2.3^{abc}	3.3^{b}	2.8
rhodes	0	26.7	67.0^{ab}	2.3^{abc}	5.3^{a}	4.9
	20	26.7	68.5^{ab}	1.3^{bc}	0.1^{c}	5.1
	50	26.7	63.7^{ab}	2.3^{abc}	6.7^{a}	3.8
	150	26.7	55.1^{bc}	3.3^{a}	5.8^{a}	2.8
SEM^6		NS	5.1	0.5	0.7	

a,b,c, Means within a column with different superscripts differ (P < 0.05); A^1 = water-soluble matter; B^2 = insoluble but degradable matter [B= (a+b) - A]; C,%h^3 = rate constant of degradation; Lt,h^4 = lag time before initiation of degradation; RDS^5 = residual standard deviation of fitting the mean of DM degradation to the exponential equation; SEM^6 = standard error of means.

Table 3. NDF degradation kinetics of sporobolus and rhodes grass hays in the rumen of camels received varying levels of yeast.

Grass	Yeast (g/day)	A^1	B^2	C,%h^3	Lt,h^4	RSD^5
Sporobolus	0	6.6	26.6^{b}	3.0	1.68	1.73
	20	6.6	37.2^{b}	0.8	0.00	2.64
	50	6.6	83.9^{a}	0.2	0.00	3.18
	150	6.6	26.8^{b}	4.3	0.00	2.37
Rhodes	0	2.4	32.5^{b}	5.3	0.58	3.92
	20	2.4	67.9^{a}	1.4	0.00	2.03
	50	2.4	20.1^{b}	6.4	1.33	3.52
	150	2.4	28.2^{b}	4.4	0.03	3.56
SEM^6		NS	7.5	3.7	0.60	

a,b,c, Means within a column with different superscripts differ (P < 0.05); A^1 = water soluble matter; B^2 = insoluble but degradable matter [B= (a+b) - A]; C,%h^3 = rate constant of degradation; Lt,h^4 = lag time before initiation of degradation; RDS = residual standard deviation of fitting the mean of DM degradation to the exponential equation; SEM^6 = standard error of means.

Fig 2 shows the NDF degradation of sporobolus grass and rhodes grass hays in camels receiving varying levels of yeast culture. In this experiment, NDF degradation of both grasses in camels supplemented with yeast culture has similar results. NDF degradation of rhodes grass hay was not significantly (P<0.05) different than that of sporobolus grass in camels fed 20, 50 and 150 g/day of yeast culture during the 24, 48, and 72 hours of incubation except for the zero level at 24 and 48 hours in rhodes grass were significantly (P<0.05) higher and 50 grams yeast at 72 hours was significantly (P<0.05) lower. Feeding of 20 grams of yeast per day to the camels increased significantly (P<0.05) the NDF degradation in sporobolus grass hay after the 6 and 12 hours of incubation times compared to all other levels of yeast supplements in both grasses.

In situ dry matter degradation kinetics over 72 hours for sporobolus and rhodes grass hays are presented in table 2. The degradability of water-soluble matter (A) was higher but not significant in rhodes grass compared to sporobolus grass hay. The degradability of insoluble but degradable dry

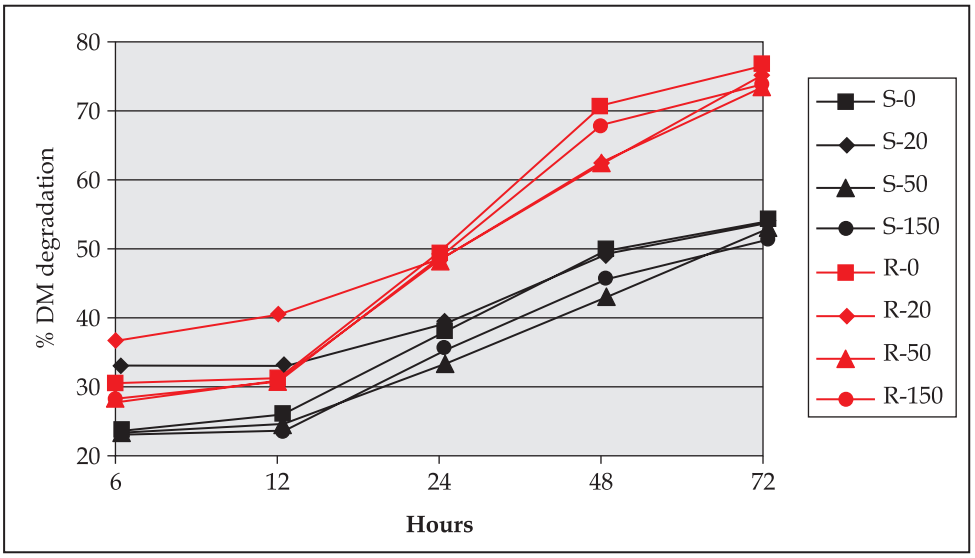

Fig 1. *In situ* dry matter degradation of sporobolus and rhodes grass hays in the rumen (C1) of camels received varying levels of yeast culture.

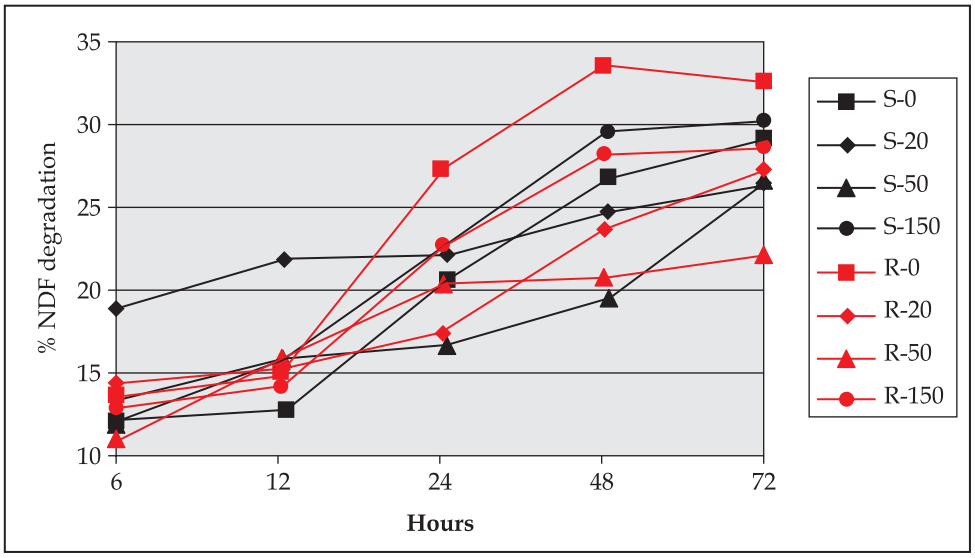

Fig 2. *In situ* neutral detergent fibre degradation of sporobolus and rhodes grass hays in the rumen (C1) of camels received varying levels of yeast culture.

matter (B) of rhodes grass hay was significantly higher than that of sporobolus grass hay in camels fed no yeast. However, when camels fed 20 or 50 grams of yeast culture per day, the degradability of insoluble but degradable dry matter improved in sporobolus grass and it was non-significantly different than that of rhodes grass. Increasing the level of yeast to 150 g/d lowered the insoluble but degradable dry matter than that of zero level in both grasses. For sporobolus grass, it seemed that feeding camels 50 grams yeast per day gave the highest level of DM degradation followed by 20 grams yeast per day. Degradation of DM in camels fed 150 grams per day was decreased and gave similar result to that of zero yeast. Hence, camels required less amount of yeast compared to cattle, the amount of yeast fed to camels on low quality forage should be increased which is similar to that reported in cattle.

Yeast culture supplementation did reduce the lag time significantly ($P<0.05$) at 20 g/day and 50 g/d in sporobolus grass and 50

g/day in rhodes grass hay. This agrees with Williams *et al* (1991) who reported that yeast supplementation tended to decrease lag time of hay digestion. Wallace and Newbold (1992) stated that the production benefits seemed to be caused by changes in ruminal fermentation by increased bacterial activity causing increased degradability of forages and flow of microbial protein from the rumen. In contrary, Robinson and Garrett (1999) reported that prepartum and postpartum supplementation with a *Saccharomyces cerevisiae* yeast culture did not modify ruminal fermentation. Variable responses of yeast culture supplementation reported in the literature might be due to the differences in the diets composition used (Wallace and Newbold, 1993) or may be due to the type of strains of yeast used. Different strains differ in their ability to increase the numbers of viable ruminal bacteria *in vitro* and *in vivo* (Newbold *et al*, 1995).

Neutral detergent fibre degradation kinetics of sporobolus and rhodes grass hay in the rumen of camels received varying levels of yeast are shown in table 3. Yeast supplementation did not affect rate or lag time of NDF at any level of yeast supplementation in both grasses. Degradability of water-soluble NDF was higher but not significant than that of rhodes grass. Insoluble but degradable NDF matter was significantly ($P<0.05$) higher in sporobolus grass with 50 g/day level compared to all other levels in both grasses except for the 20 g/day yeast supplement in rhodes grass. In some studies, *in situ* NDF degradability improved (Ayala *et al*, 1992; Sommart *et al*, 1993; Plata *et al*, 1994) whereas in other studies, changes were detected only at certain incubation times (Carro *et al*, 1992; Moloney and Drennan, 1994). The results of the NDF degradation kinetics of sporobolus grass in this study revealed that the addition of 50 g/day yeast culture to camel's diets will help in increasing fibre digestion of salt tolerant grasses by camels.

Conclusion

Low quality forages are major part of dromedary camel's diets. Because of the shortage of fresh water in the arid zones, camels may depend heavily on halophyte as source of forage in the future. The addition of yeast culture to camel's diets will improve dry matter and fibre degradation of salt tolerant grasses such as sporobolus grass.

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