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Effect of dietary supplement of seed of a halophyte (*Suaeda glauca*) on feed and water intake, diet digestibility, animal performance and serum biochemistry in lambs

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ABSTRACT

Twenty-four six month old male Chinese Northeast Merino lambs (23.0 ± 3.3 kg) were randomly allotted to one of four supplemental treatments to evaluate the effect of different amounts of dietary seed of a halophyte (*Suaeda glauca*) on feed and water intakes, diet apparent digestibility, live weight gain and serum biochemistry. Individual lamb in the control group (CT) was offered 300 g/d concentrate feed on air dry basis, and those in T150, T300 and T450 treatments were offered the same amount of concentrate feed than the control group supplemented with 150 g/d, 300 g/d and 450 g/d seed of *S. glauca* (on air dry basis) respectively, and *Leymus chinensis* hay was offered ad *libitum* for any group. The lambs were kept on the experimental diets for 80 days. Concentrate feed and seed were added separately to animals in two equal portions at 8:00 h and 16:00 h. Fresh water was offered ad *libitum* throughout the experimental period. Seeds of *S. glauca* contained in g/kg of dry matter (DM): 97.6 crude protein (CP), 86.5 ether extract (EE), 264.6 ash, 44.6 sodium (Na) and 12.6 potassium (K). Inclusion of seed of *S. glauca* did not negatively impact the performance of lamb in terms of average daily weight gain (ADG) and health status. However, daily dry matter (DM), organic matter (OM) and water intakes have been significantly increased ($P<0.05$) when the lambs were fed 150 g/d, 300 g/d and 450 g/d seed of *S. glauca* in diet, and the DM digestibility (DMD) for T300 group has been significantly ($P<0.05$) improved than that of control group, in addition, the OM digestibility (OMD) for T300 and T450 groups was higher ($P<0.05$) than other treatments. The EE digestibility was improved noticeably ($P<0.05$) with increase the seed of *S. glauca* in diet, but no significant differences ($P>0.05$) for digestibility of CP, neutral detergent fiber (NDF) and acid detergent fiber (ADF) were found among these treatments. The contents of Na, K, Cl and Mg in serum were not influenced significantly by seed of *S. glauca* inclusion, but the concentrations of alanine transaminase (ALT), aspartate aminotransferase (AST), triglyceride (TG), cholesterol (CHOL), glucose (GLU), blood urea nitrogen (BUN), and uric acid (URIC) in serum have been improved obviously in T150 or T450 groups, however all values are near to physiological range. This study shows that the seed of *S. glauca* might be used at levels up to 450 g/d in lamb diets without compromising their feedlot performance, but the relatively suitable supplement level was 300 g/d for lambs according to the trend of diet digestibility and feed conversion ratio(FCR).

1. Introduction

Saline–alkali grassland is widely distributed in the northern grassland of China, especially in Songnen grassland, of which two-thirds of the area is salinized and alkalinized, including mild, moderate and heavy saline-alkali soil, which

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accounted for 31.69% , 27.06% and 41.25%, respectively (Li and Zheng, 1997). The carrying capacity in Songnen grassland was only 16.6% of the actual grazing capacity of the livestock, the fodder provided by the grassland was not enough for the local need of the livestock industry (Wu and Zhang, 2006). Developing and exploring new and unconventional feed resources is becoming very urgent in this region.

Suaeda glauca, an annual halophyte, which could survive at soils with salt concentration equal to or greater than 2% (Shao and Li, 1998), and which formed a large scale community around the saline–alkali lake and heavily degraded environment, is one of the 12 typical halophytes growing in Songnen grassland (Li et al., 2002; Li and Yang, 2004). The researches on salt-tolerant ability and the gene cloning, structure analysis, and function relevant to salt tolerance of this plant have attracted much attention in recent years (Li et al., 2003; Ma et al., 2002; Wang et al., 2002), but little has been reported on its feeding value. This plant has been ranged as a low grade forage growing in Songnen grassland (Li and Yang, 2004), which is possibly related with the lignification during maturity and high salt content. Sun et al. (2008) reported that the *in vitro* DMD of *S. glauca* was about 71%, higher than other forage collected from Songnen grassland. The enriched oil content, especially linoleic acid and linolenic acid in the seed and plant is also an important character for this halophyte (Sun and Zhou, 2008; Yu et al., 2005). Zheng et al. (2003) reported the anti-inflammation function of methanol/chloroform extracts from the seed and seedlings of another species *Suaeda salsa* (L.) Pall of Suaeda genus for rats. Zhang et al. (2008) found that the seed oil of *suaeda* had some effects on reducing blood-fat and improves immunity of rat. All these valuable effects of the seed or plant of *S. glauca* on livestock should be evaluated deeply as a grazing ruminant potential feed resource.

But the prominent character of most halophytes is containing high content of salt, mainly including sodium, potassium, and chlorine (Masters et al., 2005), all these affect the feeding value of the halophyte forage for ruminant animal (El-Shatnawi and Abdullah, 2003). The high dietary salt loads for sheep possibly bring a series of negative impact, including reducing the efficiency of energy use for production (Arieli et al., 1989), voluntary feed intake (Masters et al., 2005; Blache et al., 2007) and productivity (Warren and Casson, 1993). The objective of the study was to evaluate the effects of different amounts seed of *S. glauca* supplement on feed and water intakes, digestibility, performance and hematology parameters of Chinese Northeast Merino lambs, providing systemic data for feeding of this kind of unconventional halophyte resource.

2. Materials and methods

2.1. Animals and experiment design

The experiment was a randomized block design with twenty-four Chinese Northeast Merino male lambs (23.0 ± 3.3 kg BW), divided into four treatments and each contained six animals. Four treatment groups received, during the experimental period of 80 days, the same quantity of 300 g/d concentrate feed with different nutrient contents and supplemented with 0 g/d, 150 g/d, 300 g/d and 450 g/d seeds of *S. glauca* for each lamb respectively, and chopped *L. chinensis* hay was offered *ad libitum* to the animals for all groups. This feeding scheme aimed to make different treatment groups of lambs obtain approximately similar energy and protein intakes based on predicting the intake for lambs.

2.2. Diets and feeding management

Concentrate feeds were formulated as shown in Table 1. The plant of *S. glauca* was harvested in autumn 2007 from a degraded grassland in Heilongjiang province of China, air-dried in the shade and the seed separated from the stem and leaf, but not removing the seed capsule. The chemical composition of the seed of *S. glauca* is presented in Table 2. The chemical composition of *L. chinensis* hay included in g/kg of dry matter (DM): 8.66 MJ/kg ME (estimated), 942.7 OM, 44.0 CP, 18.5 EE, 727.27 NDF, and 466.44 ADF. The lambs were housed individually in 6 pens/treatments. Diets and fresh water was offered using a feeding trough and buckets twice a day (two equal meals at 08:00 and 16:00). The amount of feed and water offered and refused was recorded daily and animal pens were cleaned daily. Lambs weight was recorded in two or three week intervals before 08:00. ADG was calculated using the difference of the final and initial weights divided by the number of days.

The whole experiment included 15 days of adaptation period, 58 days of formal feeding experiment and 7 days of apparent digestibility trials. During digestion trial, animals were fitted with specialized harnesses and bags which facilitated collection of feces. Feces were collected after excretion and bulked daily for total weight determination and then a 10% representative sample was taken to make the chemical composition samples for individual animals. All the diet and feces samples were preserved in sealed polyethylene bags stored in freezers until chemical analyses. Representative samples of seed, concentrate feed and *L. chinensis* hay offered and refusals were taken and pooled over the experimental period (these samples were specifically

Table 1
Composition of concentrate feed (%, as air dry basis).

Ingredients	Treatments			
	CT	T150	T300	T450
Maize flour (%)	67	72.32	79	82.34
Soybean meal (%)	30	26.68	20	16.66
Vitamin and mineral premix (%) [a]	1	1	1	1
Salt (%)	2			
Total	100	100	100	100
Chemical component (g/kg)				
DE (MJ/kg)	13.93	14.22	14.24	14.24
DM	869.5	861.2	864.2	862.5
OM	825.3	842.4	842.7	842.8
CP	124.7	117.4	100.8	92.5
EE	30.7	29.4	26.2	24.6
NDF	109.9	106.0	104.3	103.3
ADF	51.9	50.7	46.8	44.8
Ca	1.04	0.95	0.76	0.66
P	3.21	3.21	3.08	3.02

[a] Contained (g/kg): S (10), Zn (0.13), Cu (0.05), Se (0.0008), Co (0.0008), Mn (0.1), Fe (0.2). (IU/kg): Vitamin A (8000), Vitamin D (600), and Vitamin E (50).