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Effect of yeast culture supplementation on nutrient digestibility of Awassi sheep.

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Abstract

Two apparent digestion trials were conducted to determine the effect of yeast culture (YC) supplementation on nutrient digestibility of Awassi lambs. In trial 1, nine 3 years old Awassi rams (65.8 ± 2.3 kg) were used as experimental animals in apparent digestion trial. They were allocated for three treatments (3 per treatment) at random within live weight. Treatments were 0, 5, and 10 g/d of a YC with basal diet containing 70% wheat straw (WS) and 30% commercial concentrate pellet feed (CCPF) with low CP level. The diet was offered 2.5% of body weight as fed basis. In trial 2, the same rams in trial 1 were used as experimental animals. They were allocated for three treatments which were 0, 10, and 20 g/d of a YC with a basal diet that contains 30%WS and 70% CCPF with high CP level. The basal diet was offered 2.1% of body weight as fed basis. Yeast culture supplementation did not change DM, OM, and ash digestibility in both in vivo digestion trials (P>0.05). The YC supplementation of 20g/d in trial 2 increased ruminal pH and NH_3-N. As a result, there was no advantage of supplementing YC on DM, OM, and ash digestibility of diets.

Key Words: Yeast culture, nutrient digestibility, Awassi sheep

Introduction

The recent banning of a number of in-feed antibiotic digestive enhancers within the European Union has generated the need for research in finding suitable non-antibiotic alternatives. Usage of feed additives containing live microorganisms and (or) their metabolites to improve the feed efficiency of production in ruminants has increased in response to demands for using more "natural" growth-promoting substances (Kung, 2001). Many research studies have been conducted to determine the efficiency and mechanism of yeast action. *Saccharomyces cerevisiae* plays a prominent role in increasing bacterial viability via removing of oxygen from the rumen environment (Wallace, 1994). Additionally, YC provides various growth factors, pro-vitamins, and/or micronutrients that help stimulate the growth of the ruminal bacteria in the rumen (Newbold et al., 1995). In contrast to these reports, the YC supplementation had no effect on nutrient digestibility (Avendano et al., 1997; Garcia et al., 2000) and ruminal fermentation (Arcos-Garcia et al., 2000).

The aim of this study was to determine the effects of YC (Diamond V 'XP'; Diamond V Mills. P.O. Box 74570. Cedar Rapids. IA. USA) on nutrient digestibility and ruminal parameters of Awassi rams fed different level of WS and CCPF

Materials and Methods

Trial 1. Nine 3 years old Awassi rams (65.8 ±2.3 kg) were equally allocated for three treatments at random within live weight. Treatments were 0, 5 and 10 g/d of a YC.

Basal diet contained 70% WS and 30% CCPF (Gurdal Feed Mill Company in Kahramanmaras –Turkey) with low CP level and it was offered 2.5% of body weight on as fed basis. Ingredients and chemical composition of diets fed to rams are presented in Table 1. Apparent digestion trial consisted of a 15-day diet adaptation and a 7-day feces collection period. During the collection periods, the experimental animals had free access to water at all times. Collection of feces was accomplished by housing the animals in crates and animals were fitted with specialized harnesses and bags, which facilitate total collection of feces. Feces were collected after excretion and bulked daily for total weight determination and a 10% representative sample of faeces was composted for individual animals. All the diet and fecal samples were preserved in sealed polyethylene bags stored in freezers until chemical analyses.

Rumen fluid was collected by the use of an oral stomach tube following 3 h feedings and pH values were measured immediately by pH meter (AD-100, ADWA, P.O. Box 28, Sheringham, Norfolk, NR 11, 7WA). Rumen fluid was filtered through four layers cheesecloth and 10 ml of filtrate was stored at 4 C in refrigerator after addition of 2-3 drops of formaldehyde for counting of microorganisms. Ten ml filtrate was also used to determine NH_3-N according to AOAC, (1980). Protozoa were counted using the method described by Boyne et al., (1957). Dry matter (DM), organic matter (OM) and crude protein (CP) of diet and fecal samples were determined (AOAC, 1990). Acid detergent fibre (ADF) was determined as described by Goering and Van Soest (1970).

Trial 2. Same rams of trial 1 were used as experimental animals in apparent digestion trial 2. Treatments were 0, 10 and 20 g/d of a YC. Basal diet contained 30%WS and 70% CCPF with high CP level and diet was offered 2.1% of body weight as fed basis. Apparent digestion trial, sample collections and chemical analyses were done using the same methods explained in trial 1.

Statistical analysis. Data for nutrient digestibility and rumen parameters in apparent digestibility trials and fattening trial were analyzed using a model for completely randomized design (CRD) using GLM procedure and means were compared using Fisher's least significant differences (SAS, 1989).

Results

In trial 1, the effects of YC supplementation on nutrient digestibility and rumen parameters of rams fed 70:30 ratios of WS and CCPF are presented in Table 2. Yeast culture supplementation did not affect digestibility of DM, OM, ash, and NDF ($P>0.05$), but decreased ADF and CP digestibility ($P<0.05$). Moreover, ruminal fluid pH and NH_3-N did not change by treatments ($P>0.05$), but ruminal protozoa number was increased by yeast culture supplementation ($P<0.05$).

In trial 2, the effect of YC supplementation on nutrient digestibility and rumen parameters of rams fed 30:70 ratio of WS and CCPF are presented in Table 2. Yeast culture supplementation did not affect digestibility of DM, OM, and ash ($P>0.05$), but increased ADF, NDF, and CP digestibility ($P<0.05$) Moreover, ruminal fluid pH and NH_3-N increased by YC supplementation ($P<0.05$), but ruminal protozoa number was only numerically increased by yeast culture supplementation ($P>0.05$).

Discussion

Yeast culture supplementation did not change DM, OM, and ash digestibility in both in vivo digestion trials ($P>0.05$). The supplementation of YC had no effect on nutrient digestibility previously reported by some researchers (Arcos-Garcia et al., 2000; Kavas et al., 2005), but positive effect on nutrient digestibility has been observed

in vivo or *in situ* in other studies (Plata et al., 1994; Haddad and Goussous, 2005). Inconsistency with YC supplementation can be explained with characteristics of the strain (Newbold et al., 1995), differences among commercial additives (Mendoza et al., 1995) and diet composition (Wallace, 1994). In current study, even different diet composition did not affect DM and OM digestibility in the in vivo digestion trials. The benefits related to yeast are associated to a more active population in the rumen, which is resulted from 0_2 removing activity of yeast and improvement of anaerobisosis in the rumen (Wallace, 1994). It can be concluded that role of YC on rumen fermentation is very limited under many circumstances for sheep according the current study.

While digestibility of ADF and CP was decreased with 10 g/d YC supplementation in trial 1, digestibility of NDF and CP with 20g/d YC supplementation was improved ($P<0.05$) in trial 2. Improvement in NDF digestibility by addition of YC to low quality forages has been reported previously (Plata et al., 1994), but Roa et al., (1997) showed that more benefits in NDF digestibility can be obtained with good quality roughage. In current study high straw level might have suppressed yeast culture effect on fiber digestion in trial 1, but decreasing straw level revealed YC affect in trial 2, which is in an agreement with Roa et al., (1997). The improved digestion of ADF, NDF,and CP in the low straw fed diet in trial 2 might be associated with an increase in the number of rumen cellulolytic bacteria (Gomez-Alarcon et al., 1990) due to high pH with YC addition to basal diet.

Ruminal pH was not affected by yeast culture supplementation in several studies (Plata et al., 1994; Garcia et al.. 2000) which is in an agreement with high straw fed trial 1. In contrast, other studies reported an increase in ruminal fluid pH with yeast addition (Roa et al.. 1997; Kamra et al., 2002) which supports results of low WS containing trail 2.

In several studies, as in trial 1, YC had no effect on ruminal ammonia nitrogen (Plata et al., 1994; Newbold et al., 1995). However, others found increases as in trial 2 (Ayala et al., 1992) or reduction (Molaney and Dreman, 1994). Moleney and Drenan (1994) reported that there were no changes in rumen ammonia concentration when YC was included in a high NDF and low CP diet as in trial 1, but the effects were present with low NDF and low CP diet as the in case of trial 2.

Plata et al. (1994) reported that protozoa counts were elevated with the YC addition in to low quality diets as in the case with trial1. In contrast, no effect was detected in other studies (Miranda et al., 1996; Acros-Garcia et al., 2000). Miranda et al., (1994) reported that interactions between microbial cultures and forage level as a factor that affects the rumen protozoa counts.

It is very difficult to conclude that adding YC could stimulate rumen fermentation, activity of the bacteria, especially of cellulotic strains according to two *in vivo* digestion trials with high and low WS levels in current study.

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Table 1. Ingredients and chemical composition of diets consumed by rams and lambs in apparent digestion trials and fattening trial.

Item	Diet I (Trial I)	Diet II (Trial II)
Ingredient composition	% as fed basis	
Wheat straw	70	30
Commercial con. pellet feed (low CP)	30	-
Commercial con. pellet feed (high CP)	-	70
Chemical composition (on DM basis)		
Dry matter	92.84	92.23
Organic matter	89.91	91.35
Crude protein	7.17	12.55
ADF	46.23	29.64
NDF	60.18	44.60

Table 2. Effect of yeast culture supplementation on nutrient digestibility and rumen parameters of rams fed high and low level straw containing diets.

	Trials							
	Trial 1 Yeast supplementation				Trial 2 Yeast supplementation			
Item	Control	5 g/d	10 g/d	SE	Control	10 g/d	20 g/d	SE
Number of rams (n)	3	3	3	-	3	3	3	-
Body Weight (kg)	65.67 [a]	65.00 [a]	66.67 [a]	2.13	64.66 [a]	64.76 [a]	63.47 [a]	4.29
Feed Intake (kg)	1.646 [a]	1.627 [a]	1.640 [a]	0.044	1.347 [a]	1.360 [a]	1.333 [a]	0.043
DM intake (kg)	1.529 [a]	1.510 [a]	1.523 [a]	0.041	1.243 [a]	1.255 [a]	1.231 [a]	0.039
Digestibility (%)								
DM	54.28 [a]	54.35 [a]	53.84 [a]	0.77	61.57 [a]	63.03 [a]	63.54 [a]	0.76
OM	54.30 [a]	54.36 [a]	53.77 [a]	0.73	64.32 [a]	65.84 [a]	66.38 [a]	0.81
Ash	30.78 [a]	30.93 [a]	30.52 [a]	1.56	28.92 [a]	29.99 [a]	29.19 [a]	2.64
ADF	42.91 [a]	42.60 [a]	38.79 [b]	0.65	25.24 [b]	29.33 [ab]	30.07 [a]	1.31
NDF	43.73 [a]	44.50 [a]	41.22 [a]	1.19	38.98 [b]	41.57 [b]	45.95 [a]	1.15
CP	52.82 [a]	44.65 [b]	41.62 [b]	1.41	67.13 [b]	73.06 [a]	74.10 [a]	0.96
Ruminal Parameters								
pH	6.33 [a]	6.37 [a]	6.13 [a]	0.11	5.63 [a]	5.93 [ab]	6.07 [b]	0.09
NH_3-N mg/100ml	31.77 [a]	29.50 [a]	30.73 [a]	1.40	42.28 [b]	44.03 [b]	49.61 [a]	0.89
Protozoa number per ml of rumen fluid	75000 [b]	190833 [a]	185833 [a]	29077	24777 [a]	27222 [a]	60222 [a]	40284

[ab]= Means within a row in each trial with different superscripts differ ($P<0.05$).