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EFFECT OF SUPPLEMENTING DIFFERENT LEVELS OF CORN STEEP LIQUOR ON THE POST-WEANING GROWTH PERFORMANCE OF PAK-KARAKUL LAMBS

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ABSTRACT

Corn steep liquor (CSL) is a liquid by-product of wet milling process of maize-starch industry. A trial was conducted to examine the effect of supplementing various levels of CSL in the diet of 30 Pak-Karakul lambs. These lambs were randomly divided into five experimental groups. The control group (A) was fed on basal diet having no CSL. The experimental groups B, C, D and E were fed on diets supplemented with CSL at the rate of 5, 10, 15 and 20% of the diet, respectively. The experimental diets were fed *ad libitum* to the experimental animals for 90 days. Results showed that supplementation of CSL at 5% of the diet improved both body weight gain and feed:gain. Corn steep liquor at higher supplemental rates i.e., 10 or 15% of the basal diet had non-significant effect on the growth or feed:gain of lambs. However, supplementation of CSL at 20% of the diet significantly depressed growth ($P < 0.01$) and feed:gain ($P<0.01$). Growth rate in male lambs was significantly ($P < 0.01$) higher than those of female lambs. Female lambs consumed more ration for each unit body weight gain than males. The results of the trial demonstrate that supplementation of CSL at 5% of the diet is useful for growth and feed:gain but higher levels of CSL considerably depress growth and increase feed:gain, leading to increased cost of production.

Key words: Corn steep liquor, lambs, growth performance.

INTRODUCTION

Corn steep liquor (CSL) is a by-product of wet milling process of maize-starch industry. It is viscous slurry with light to dark brown colour, having ensiled odour and acidic pH. It has been reported to be a good source of protein, energy and minerals for the animals (Filipovic *et al*., 2002). The product is practically free from fat, fibre and silica and contains 20-25% lactic acid (Wagner *et al*., 1983; Talpada *et al*., 1987; Gupta *et al*., 1990). Corn steep liquor has been fed to beef and dairy cattle as a liquid source of protein (Gill, 1997) and has been reported not to affect performance when fed to finishing steers (Trenkle, 2002). Other studies suggest that it supports better weight gains and feed efficiency in steers kept on high roughage rations. The present project was designed to examine the effect of supplementing various levels of CSL in the diet of Pak-Karakul post-weaning lambs on their growth and feed:gain under intensive feeding system.

MATERIALS AND METHODS

Thirty Pak-Karakul post-weaning lambs of almost similar age (6 months) and weights (19.2 ± 0.39 kg) were randomly selected from a bigger flock raised on irrigated fodders and jungle grazing at the Sheep and Goat Development Centre, Rakh Khairewala, District Layyah, Pakistan. The area comprises of shifting sand dunes with very poor annual precipitation and depleted range land. The day temperature often rises to 50°C during summer. The animals were raised in open sheds. The lambs were randomly divided into five equal groups and two blocks. One block on each treatment had three males, while the other had three female lambs. The lambs of control group (A) were fed on basal diet (no CSL supplemented). Animals in groups B, C, D and E were fed on basal diets supplemented with CSL at the rate of 5, 10, 15 and 20% of the diet, respectively. The composition of the basal diet is given in Table 1.

The experimental diets were fed *ad libitum* during the trial which lasted for 90 days. The first 10 days were allowed to the experimental animals for dietary adaptation to the experimental diets containing CSL. Animals in each treatment were housed in partition cabins. They were weighed individually at the start and then at 30, 60 and 90 days of the trial. Feed refused was weighed daily and feed intake computed. Feed:gain was calculated from the data on weight gain and feed intake. Corn steep liquor and the basal diet were analyzed for proximate composition following AOAC (1990).

The data on growth and feed:gain were statistically analyzed by General Linear Model (Minitab 13.1, Minitab Inc., State College, PA, USA), where main effects were treatments and sex of the lambs (male and

female) and initial body weights at the start of the experiments were considered as co-variate in the model. In case of significant effect (P<0.05), the treatment means were compared by Tukey's LSD (Steel and Torrie, 1980).

Table 1: Ingredient composition (%) of basal diet[1]

Ingredients	Amount
Barley	30.0
Wheat bran	18.5
Wheat straw	8.0
Rape seed cake	14.0
Maize gluten feed	22.0
Molasses	5.0
Mineral premix[2]	2.0
Urea	0.5
Total	100.0

[1]Chemical composition of the basal diet:
CP (%) 16.0, CF (%) 9.5, ME (MJ/kg) 10.0, Ca (%) 1.1, P (%) 0.7
[2]Each kg of mineral premix contained:
Ca (%) 18.0, P (%) 8.8, Na (%) 4.7, Mg (%) 3.8, Cu (g) 0.26, Zn (g) 1.45, Fe (g) 1.46, Mn (g) 1.62, Co (mg) 19.3 and I (mg) 9.7

RESULTS AND DISCUSSION

The proximate analysis of CSL suggested that it was high in crude protein and ash content/mineral matter and virtually free from crude fibre (Table 2). The supplementation of CSL in animal diets greatly improved the texture and reduced the dustiness of the compound feed.

Table 2: Chemical composition of corn steep liquor

Component	Concentration
Dry matter (%)	50.0
Protein (%)	40.0
Ash (%)	10.0
Nitrogen free extract (%)	16.0
Lactic acid (%)	21.0
pH	3.7

When added to the diet of post-weaning experimental lambs at 5%, CSL resulted in improved weight gain during 1-30 days (P>0.20), 31-60 days (P>0.40) and 61-90 days (P>0.051) as compared to control (Table 3). The results were unsurprising since CSL had a high protein, energy, B vitamins and minerals (Gill, 1997). It has previously been reported to support better weight gains and feed efficiency in steers kept on high roughage rations.

When CSL was supplemented at higher rate i.e., 10 or 15% of diet, it did not affect the growth or feed:gain. However, supplementation of CSL at 20% of diet significantly (P<0.01) depressed the growth of lambs. The response of sex of the lambs on growth, which was inconsequential (NS) in the initial period of the trial (1-30 day) became very evident in subsequent days of the trial (31-60 days and 61-90 days) when growth rate in male lambs was significantly (P<0.01) higher than that of female lambs (Table 3). The response of sex and diet from 1-90 days was also highly significant (P=0.006; P<0.001, respectively)

The supplementation of CSL at 5% of diet numerically improved feed:gain in lambs during 1-30 days (P>0.14), 31-60 (P>0.54) and 61-90 days (P>0.19). The feed:gain at higher inclusion rates i.e., 10 and 15 and 20% of the diet was unaffected. The response of diet and sex of the lambs from 1-90 days on feed:gain was significant (P<0.01; P=0.002 respectively) (Table 4). Female lambs consumed considerably more ration for each unit gain in weight than males. The interaction (diet×sex) on both body weight gain and feed:gain, remained non-significant during all phases of growth. Gupta *et al*. (1990) observed poor growth performance and poor efficiency of feed utilization in calves fed CSL. Wagner *et al*. (1983) also reported weight losses in cows fed CSL. It was reported that supplementation of CSL resulted in higher rumen ammonia 1 h and 4 h post-feeding with a drop in rumen pH, greater soluble carbohydrate concentration and lower ruminal acetate and higher butyrate. It is well documented that when rumen pH is 7.2 or higher, rumen NH_3 is rapidly converted to free ammonia and is absorbed across the rumen walls. In contrast, an acidic pH combined with greater availability of NH_3 and soluble carbohydrates promotes greater microbial protein synthesis in the rumen. Besides, excess sulphur present in the CSL (0.70% of the dry matter) could also impair animal growth performance. The problem could arise when the sulphur is above 0.40%, estimated to be the maximum tolerable concentration (NRC, 1980).

The results of the present trial demonstrate that supplementation of CSL at 5% of the diet is useful for growth and feed:gain. However, higher levels of CSL considerably depress both growth and feed:gain, leading to increased cost of production. Further experimentation with regard to its effect on ruminal fermentation pattern, microbial protein synthesis and digestibility of dietary nutrients is suggested.

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Table 3: Growth response (Mean ± SE) of experimental lambs during different phases of their growth in response to CSL supplementation[1]

Factors	Body weight gain (Kg/animal)			
	1-30 days	31-60 days	61-90 days	1-90 days
Diet				
Control (A)	4.59 ± 0.51	3.80 ± 0.52	3.86 ± 0.64	12.25 ± 0.863[ab]
B	4.84 ± 0.64	4.35 ± 0.65	4.71 ± 0.81	13.91 ± 1.09[a]
C	3.58 ± 0.45	3.82 ± 0.46	3.25 ± 0.57	10.65 ± 0.73[b]
D	4.74 ± 0.45	4.49 ± 0.46	3.16 ± 0.57	12.40 ± 0.73[ab]
E	3.87 ± 0.68	2.86 ± 0.69	1.12 ± 0.85	7.84 ± 1.16[c]
Sex				
Male	4.56 ± 0.32	4.92 ± 0.32[a]	4.23 ± 0.40[a]	13.71 ± 0.54[a]
Female	4.08 ± 0.42	2.81 ± 0.42[b]	2.21 ± 0.52[b]	9.10 ± 0.71[b]
Significance level				
Diet	*NS*	*NS*	*NS*	*0.006*
Sex	*NS*	*0.001*	*0.007*	*<0.001*
Diet × sex	*NS*	*NS*	*NS*	*NS*

[1]Means are corrected for initial body weights i.e., 19.17 Kg.
[abc]Values with uncommon superscripts within a column are different from each other (P<0.05).

Table 4: Feed:gain (Mean ± SE) of experimental lambs during different phases of their growth in response to CSL supplementation

Factors	Feed:gain			
	1-30 days	31-60 days	61-90 days	1-90 days
Diet				
Control (A)	6.26 ± 0.85	17.31 ± 2.92	12.50 ± 4.82	8.72 ± 0.93[a]
B	6.03 ± 1.08	9.88 ± 3.70	7.37 ± 4.81	7.75 ± 0.93[a]
C	8.38 ± 0.76	11.02 ± 2.61	12.15 ± 4.32	9.53 ± 0.83[ab]
D	6.38 ± 0.76	11.33 ± 2.61	13.17 ± 4.32	8.74 ± 0.83[a]
E	7.91 ± 1.14	16.03 ± 3.92	24.97 ± 5.30	12.79 ± 0.02[b]
Sex				
Male	6.78 ± 0.53	9.03 ± 1.83[a]	9.79 ± 3.01	7.86 ± 0.58[a]
Female	7.20 ± 0.70	17.20 ± 2.39[b]	18.26 ± 3.24	11.16 ± 0.62[b]
Significance level				
Diet	*NS*	*NS*	*NS*	*0.012*
Sex	*NS*	*0. 015*	*NS*	*0.002*
Diet × sex	*NS*	*NS*	*NS*	*NS*

[ab]Values with uncommon superscripts within a column are different from each other (P<0.05).

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