



Research Article

Effects of Cysteamine Hydrochloride Supplementation on Nutrients Digestibility in Beetal Bucks

Muhammad Noman Tariq¹, Saeed Ahmed¹, Ghazanfar Ali Chishti¹, Muhammad Shahbaz Zafar¹, Muhammad Saadullah², Muhammad Usman¹, Mohsin Ali¹ and Ghulam Qadir¹

¹Department of Animal Nutrition, Faculty of Animal Production and Technology, University of Veterinary and Animal Sciences, Lahore, 54000, Pakistan; ²Department of Livestock Management, Faculty of Animal Production and Technology, University of Veterinary and Animal Sciences, Lahore, 54000, Pakistan.

Abstract | The research was conducted to study the effect of Cysteamine Hydrochloride (CSH) Supplementation on nutrients digestibility in Beetal bucks. The CSH is a feed additive that increases the baseline growth hormone level by decreasing the somatostatin level. A total of Twenty-four Beetal bucks, aged 12±1 months, with an average body weight of 30±5 kg, were selected and distributed among 04 treatments in a completely randomized design under 2×2 factorial arrangements. There were two roughage levels with concentrates (80% and 20%) and two dietary levels of CSH (0 and 80 mg/kg/head/day). Digestibility of dry matter (DM), crude protein (CP), and ether extract (EE) were calculated using total tract digestibility. Results indicated that CSH supplementation (80 mg/kg) significantly improved ($P < 0.05$) the digestibility of crude protein (CP) by 2.87%, ether extract (EE) by 5.98% and NDF by 5.65% in bucks fed a high concentrated diet, compared to those fed non-supplemented diets. It was concluded that CSH supplementation with roughage: concentrates (20:80) resulted in increased digestibility of CP, EE and NDF which can improve the growth performance, reduce nutrients loss and decrease the production cost in Beetal bucks.

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***Correspondence** | Saeed Ahmed, Department of Animal Nutrition, Faculty of Animal Production and Technology, University of Veterinary and Animal Sciences, Lahore, 54000, Pakistan; **Email:** saeed.ahmed@uvas.edu.pk

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Keywords | Cysteamine HCL, Nutrients digestibility, Beetal bucks, Roughage, Concentrate, Ratio



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Introduction

Nutritional and genetic improvement are used to increase the efficiency of feed and turn it into valuable animal products while minimizing nutrients loss and greenhouse gases emissions in the environment (Velazco *et al.*, 2014). Hormonal modification through feed additives is one of the methods to im-

prove growth, nutrients uptake, and gain maximum output from the animals. Direct injection of exogenous hormones has been banned, whereas, indirect enhancement of growth hormone (GH) levels via certain regulatory mechanisms has become a research focus.

According to existing research exogenous CSH quick-

ly and selectively inhibits the activity of somatostatin (SS) in mice, rats, and sheep and increases the baseline level of GH and other hormones suppressed by SS, improves digestive tract peristalsis, enzyme production and thereby improves feed utilization (Sagar *et al.*, 1982; Barnett and Hegarty 2014). Researchers have discovered that CSH supplementation improves the performance of bucks by regulating the levels of a hormone known as somatostatin in their bloodstream (Bin *et al.*, 2003). This leads to various beneficial effects, including better utilization of feed, improved digestion of dry matter, increased production of microbial proteins in the rumen, and enhanced growth rates, wool/fur production, and milk production (Bin *et al.*, 2003).

NDF is a major factor in forage-based diets. It reduces feed intake through its gut filling effect and low passage rate, which limits the DMI. This results in low supply of nutrients to meet their requirements of highly growing animals and low growth rates (Pinho *et al.*, 2018). This lower DMI results in poor growth rates and requires an extended period to reach the targeted market weight (Bahtti 2013). An intensive production system offers feed with a low forage-to-concentrate ratio, which increases the passage rate due to its small particle size and low NDF. Consequently, there is a need to increase the digestibility of the nutrients through increased gastrointestinal track secretions. The objective of the current study is to evaluate the effects of CSH supplementation on nutrient digestibility in Beetal bucks fed different forage-to-concentrate ratios.

Materials and Methods

The study was carried out at the Small Ruminant Research and Training Centre, University of Veterinary and Animal Sciences, Ravi campus, Pattoki, Pakistan. All the procedures in this experiment were under the recommendations of the ACUC, (Animal Care and Use Committee) UVAS, vide letter no. DR/172. The experimental duration was 20 days, excluding the 14-day adjustment and deworming period. Bucks were vaccinated against clostridium diseases (Enterotoxemia vaccine, Veterinary Research Institute, Lahore, Pakistan). In total, 24 Beetal bucks were selected with an age of 12±1 months and a body weight of 30±5 kg and divided into 4 treatment groups (n = 6/treatment) in a completely randomized design under 2×2 factorial arrangements of treatment with 2 levels

of roughage: concentrate (20 and 80%) and 2 levels of CSL (0 and 80 mg/kg/head). Dietary treatments were T₁ = 80:20 roughage to concentrate ratio (R:C) without CSH supplementation, T₂ = 80:20 R:C with CSH supplementation 80 mg/kg BW per day, T₃ = 20:80 R:C without CSH supplementation, and T₄ = 20:80 R:C with CSH supplementation 80 mg/kg BW per day. The bucks were offered feed twice daily at 8:00 am and 6:00 pm. Clean and fresh water was provided on *ad libitum* basis to the animals throughout the trial. Animals were fed at individual stalls.

Table 1: *Ingredient and chemical composition of TMR on Dry matter basis.*

Ingredients (%)	T ₁	T ₂	T ₃	T ₄
Oat silage	80.0	80.0	20.0	20.0
Maize grain	2.0	2.0	54.8	54.8
Soybean meal	14.0	14.0	15.0	15.0
Molasses	2.0	2.0	8.0	8.0
Mineral Mixture*	0.8	0.8	1.0	1.0
Limestone	0.2	0.2	0.5	0.5
Soda bicarb	1.0	1.0	1.0	1.0
CSH supplementation	--	80 mg/kg BW	--	80 mg/kg BW
Total	100	100	100	100
Composition (%)				
DM	41.86	41.86	74.63	74.63
CP	14.83	14.83	14.89	14.89
Energy Mcal/kg	2.52	2.52	2.67	2.67
NDF	45.05	45.05	24.84	24.84
NFC	41.10	41.10	59.73	59.73
Ca	0.66	0.66	0.62	0.62
P	0.45	0.45	0.46	0.46

*Each kg mineral mixture contains Vitamin A 250,000 IU, Vit D3 30,000 IU, Vit E 1500 IU, Calcium 270g, Magnesium 75g, Toxin binder 50g, Iodine 5mg, Cobalt Glucohepatonate 0.9mg, Iron 5000mg, Copper 45mg, Copper methionine 7.8mg, Manganese 875mg, Manganese Methionine 12.5mg, Zinc 875mg, Zinc Methionine 22.5mg, Selenium 5mg, and Chromium Methionine 0.5mg.

T₁: 80:20 R:C*; **T₂:** 80:20 R:C with 80mg/kg BW CSH; **T₃:** 20:80 R:C; **T₄:** 20:80 R:C with 80mg/kg BW CSH; *Roughage to Concentrate ratio.

Feeds were prepared to meet the nutrient requirements of small ruminants: sheep, goats, cervids, and new world camelids (Ruminants *et al.*, 2007). The chemical composition of total mixed rations (TMR) and feed ingredients are presented in Table 1. For-treatments T1 and T2, i.e., a high roughage diet in

Table 2: Effect of cysteamine hydrochloride on nutrient digestibility in Beetal bucks.

Digestibility (%)	Treatments				SEM	P-value		
	T1	T2	T3	T4		Additive	R:C	Additive*R:C
DM	68.24	71.78	74.77	75.43	1.27	0.1248	0.0017	0.2780
CP	78.25 ^c	80.44 ^b	81.13 ^b	84.01 ^a	1.06	0.0156	0.0004	0.3173
EE	77.84 ^b	82.50 ^a	78.45 ^b	82.86 ^a	1.91	0.0057	0.7267	0.9277
NDF	52.37 ^c	51.01 ^{bc}	54.03 ^{ac}	54.57 ^a	0.95	0.6749	0.0184	0.3409

DM: dry matter, **CP:** crude protein, **EE:** ether extract, **NDF:** neutral detergent fiber.

which 80% of the requirements of the animal were met through forages and 20% were met through concentrate feed. While in T3 and T4, i.e., the low-roughage diet, 20% of the requirements were met through forages and the remaining 80% were through concentrated feeding. In T1 and T3, there was no CSH supplementation, while T2 and T4 were supplemented with CSH 80 mg/kg BW per day.

At the last 6 days of trial, the total fecal collection was performed in order to calculate nutrient digestibility of DM, CP and EE by using total tract digestibility method. The animals were placed in individual feeding stalls and digestibility experiment was performed. Every day, the total amount of feed intake and fecal output were weighed and noted, and 100 g of the total day-to-day feces for 6 days were stored at -20°C until further examination (Blanco *et al.*, 2014). The apparent nutrient digestibility was determined using the following formula:

$$\text{Digestibility of nutrient (\%)} = \left[\frac{\text{Nutrient in feed} - \text{Nutrient in feces}}{\text{Nutrient in feed}} \right] \times 100$$

Chemical analysis

Feed and fecal samples from the experiment were analyzed for dry matter (DM) following AOAC (1995) method no. 945.15, ether extract (EE) using method no. 920.29, and crude protein (CP) via method no. 984.13 (AOAC, 1995). Individual feed ingredients and formulated feed samples were initially ground using a Willey mill (Arthur H. Thomas Co.), with particles passing through a 2-mm screen and then further ground with a 1-mm screen in the Cyclone Mill (CT 293 CYCLOTEC™). These samples were subsequently dried in a hot air oven (Universal oven UF260, Memmert GmbH + Co. KG) at 105°C for 24 hours to achieve a constant weight. The ground and dried samples were then analyzed for CP, EE, and Neutral Detergent Fiber (NDF). CP determination was carried out using the micro-Kjeldahl meth-

od, while the EE was measured using an Ankom fat extractor with petroleum ether (AOAC, 1995). The NDF content in the feed and fecal samples was determined using the AOAC (1995) method.

Statistical analysis

Data were analyzed using the MIXED procedure of SAS (version 9.4; SAS Institute Inc.). Treatments were structured as 2 × 2 factorial arrangements with 2 levels of roughage/concentrate and 2 levels of CSH supplementation (0 or 80 mg/kg/head/day). Significant differences were declared at $P \leq 0.05$ and the trend at $P \leq 0.10$.

Results and Discussion

This study was designed to find the effects of supplementation of CSH on nutrient digestibility in Beetal bucks. Table 2 presents the effect of CSH on nutrient digestibility. The digestibility of DM did not significantly change between T1 and T2, but we observed a trend ($P = 0.07$) in DM digestibility. Similarly, DM digestibility between T3 and T4 was not increased significantly ($P=0.72$). However, there was a significant increase in CP digestibility ($P = 0.05$) between the T1 and T2 groups. It was increased by 2.72% in the T2 group as compared to T1. Likewise, it increased significantly by 3.43% ($P = 0.01$) in the T4 group as compared to T3. In the same way, digestibility of EE was also increased significantly ($P = 0.03$) in both supplemented groups, i.e., T2 and T4, as compared to T1 and T3 respectively. It increased by 5.65% in T2 as compared to T1 and increased by 5.32% in T4 as compared to T3.

The current research aimed to evaluate the effects of CSH supplementation on nutrient digestibility in Beetal bucks. It was hypothesized that dietary supplementation of CSH would positively impact the above-mentioned parameters, with a combination of CSH supplementation (80 mg/kg/head/day) and

roughage levels with concentrates (20:80) being more beneficial for these parameters in Beetal bucks.

There was a trend ($P < 0.10$) in the digestibility of DM between T1 and T2 and a non-significant difference between T3 and T4. Findings in the current study are in line with the findings of Villar *et al.* (2019), who reported a non-significant difference in DM digestibility at 80 mg/kg dose of CSH. However, the present study increases ($P = 0.05$) the digestibility of CP in T4. These findings are in accordance with the findings of Jia-dong *et al.* (2006) and Fan *et al.* (2016), who demonstrated the ability of CSH supplementation to improve the digestibility of CP, CF, NDF and overall energy in cattle. In beef cattle, diets supplemented with 30% coated CSH (20 g/day) for 63 days led to an 8.31% increase in CP digestibility and a 9.44% improvement in EE digestibility. Later authors reported an improvement in the digestibility of CP and EE, while the digestibility of NDF remained unchanged. Fan *et al.* (2016), also reported no significant increase in DM digestibility in CSH supplemented groups in male minks, while CP digestibility was significantly higher as compared to the control group. The use of 30% coated CSH (15 g/day) over a period of 56 days improved the digestibility of CP (by 1.97%), NDF (by 1.07%), and gross energy (by 11%) in Holstein cattle (Liu *et al.*, 2015). Zhou *et al.* (2017) reported increase in apparent protein digestibility when pigs were fed diets supplemented with CSH which may possibly due to increased trypsin activity in jejunum as most of the digestion and absorption take place here. In broilers CSH supplementation at 60 and 90 mg/kg increased the activity of protease, amylase and lipase in the small intestine and pancreas (Yang *et al.*, 2006). This could be the possible reason for the increase in the digestibility of CP and EE in present study.

Contradictory findings were reported by Meenongyai *et al.* (2023), who found no significant effect of CSH supplementation on nutrient digestibility as the major focus on digestibility at the rumen level, whereas the present study evaluated the total tract digestibility. Previous studies have shown that CSH supplementation may enhance digestive enzyme activity by inhibiting somatostatin, as reported by Sagar *et al.* (1982) and Barnett and Hegarty (2014). This suggests that the effects of CSH supplementation may vary depending upon the specific site of digestion being evaluated. This is because different studies have shown that CSH supplementation can enhance

different GIT enzymes through its inhibitory action on somatostatin (Sagar *et al.*, 1982; Barnett and Hegarty, 2014).

Conclusions and Recommendations

A limitation of the current study was the use of adult animals. Further research is needed to study the effects of CSH supplementation on different Forage: Concentrates ratios and younger age groups.

It is concluded that CSH supplementation (80 mg/kg/head/day) with roughage: concentrates (20:80) resulted in increased digestibility of CP, EE and NDF, which can improve the growth performance, reduce nutrient loss, and decrease the production cost in Beetal bucks.

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Novelty Statement

The use of CSH with varying level of roughage to concentrate ratio in Beetal bucks is not studied yet. As the use of exogenous hormones in animals can adversely affect human health. By supplementation of CSH, such adverse effects can be avoided.

Authors' Contribution

Muhammad Noman Tariq, Saeed Ahmed, Ghaz-anfar Ali Chishti: Data collection and analysis.

Muhammad Shahbaz Zafar, Muhammad Saadullah, Muhammad Usman, Mohsin Ali and Ghulam Qadir: Prepared the first draft and finalized the manuscript.

All the authors have read and finalized the research paper.

Conflict of interest

The authors have declared no conflict of interest.

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