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EFFECT OF DIFFERENT COMBINATIONS OF SUPPLEMENTAL CONCENTRATE AND SOYBEAN OIL ON RICE STRAW BASED DIET ON RUMEN PARAMETERS OF GROWING CATTLE

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Abstract

Rumen parameters (pH, NH3 -N, and VFA) are immensely important in ruminants. This study examined the effect of feeding supplemental concentrate and soybean oil at different intensities on rumen parameters in growing cattle. Speculative diets consisted of different combinations of concentrate and soybean oils, which are 15% & 3%, 15% & 6%, 30% & 3%, and 30% & 6%, respectively. Better rumen parameters were observed with 30% concentrates than feeding 15% concentrate. A high level of soybean oil (6%) had no considerable effect on rumen parameters. Rumen parameters (NH3 -N and volatile fatty acid) considerably increased with the combination of high and low fat (30% concentrate and 3% soybean oil). When formulating feed for growing cattle, it might be advisable to incorporate a concentrate diet at a level higher than that of a maintenance diet, while also considering lower fat content. Additional research could be undertaken to uncover various formulation recommendations.

Keywords: Rumen parameters, growing cattle, concentrate diet level, soybean oil level.

Introduction

Cattle farming and beef fattening are important tools for poverty elevation, employment generation and women's empowerment in Bangladesh. In the rural agribusiness system cattle farming plays an important role in poverty alleviation for landless and destitute women (Ahmed et al., 2010). The major benefit of cattle farming in Bangladesh is the availability of low-cost roughage, mainly rice straw. As Bangladesh is one of the major countries producing rice, rice straw is abundant as a byproduct. This fibrous roughage is used as a major feed ingredient for ruminants. Cattle farming in Bangladesh mainly endure on a straw-based diet. Meager supplementation of green grass along with inadequate concentrated diet. To meet the maintenance requirements of animals, rice straw is considered a low-grade feed source, and it alone cannot even fulfill the elemental nutritional requirements. High concentration of indigestible fiber of straw contributes to low-energy intake by cattle. This affects meat and milk production. Apart from the low content of readily available energy, other important nutrients like protein, fat, minerals, and vitamins are also scarce in straw-based diets. Rumen fermentation does not provide indispensable nutrients to the animal for productive purposes if they are fed alone or constitute a higher proportion of a roughage-based diet (Liu, 1995). For improving the feeding merit of the overall ration, typically rice straw or other fibrous roughages are frequently supplemented either with concentrates or vegetable fats. Use of supplementary fat sources like soybean oil can be an alternative to increase the energy density of straw-based diets. Feeding cattle and other ruminants with high-concentrate diets requires an acclimatization of rumen microorganisms to the changed environment. High dry matter results in lactic acid and volatile fatty acid production in rumen (Valente et al., 2017), so we should be careful in feeding regime in cattle. Low and moderate levels of concentrate-based diet brought beneficial ramifications to the cattle for its optimum rumen function along with high levels of forage (Brown et al., 2006). Extensive research efforts are ongoing to reveal the effects of concentrated diet levels and fat levels in ruminants, especially cattle globally. The microbial fermentation pattern of cattle must be well evaluated in Bangladesh while feeding high concentrate diet and fat supplementation.

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Knowing the correlation between concentrate feeding and oil supplementation straw-based diet is important to optimize the feeding regime for the desirable production in growing indigenous cattle is also important. Considering all the above facts and studies a research protocol was developed to investigate the rumen parameters of raising cattle by supplementing discrete levels of soybean oil.

Materials and Methods

A feeding trial was conducted at the Animal Nutrition Field Laboratory of the Department of Animal Nutrition, Faculty of Animal Husbandry, Bangladesh Agricultural University, Mymensingh, Bangladesh, from January to April 2003.

Experimental animals, feeding, housing and management

For the feeding trail, four growing cattle were used. The average age of the animals was two and a half years. One of these animals was cannulated in the rumen for the ease of collection of rumen liquor. The average live weights of the animals were approximately 159.4±7.8 kg. Generic anthelmintic Albendazole was fed to the animals for deworming before proceeding to the feeding trial. A well-ventilated "face out stanchion barn" was used to keep individual animals in pens. Individual animals had their respective stalls, manger, and water trough. Animal welfare issues were taken care of, and sufficient space was provided to keep them in a pleasant ambiance.

The standard of ARC & CAB (1980) was followed during the formulation of the experimental diets. Four formulations were made with concentrate and roughage as the basic ingredients and soybean oil as an adscititious fat source. To fulfill the bulkiness, other ingredients were wheat bran, mustard oil cake, molasses, salt, DCP and rice straw. The green roughage part comprised German grass (Echinoclora grousgali). The experimental diet used two levels of Concentrate (15% and 30%). This diet was supplemented with 3% and 6% soybean oil. Four animals were fed hypothetically formulated rations. A 4x4 randomized Latin Square Design was initiated so that each animal gets all combinations of the rations at least one time. The feeding period of 15 days was divided into two segments: adjustment period of 8 days and the later part of 7 days was a digestibility trial where faeces were collected. On the other hand, cannulated animals had an adjustment period of 8 days, and the collection period of rumen liquor was 4 days.

Quantification of the Experimental Parameters

The daily feed intake by the animal was calculated by deducting the feed repudiated by each animal during 24 hours from the feed provided to the animals. The calculation was done on dry matter basis and was recorded as daily feed intake. A fifteen-day period of conventional digestion trial was conducted, and faeces were collected for 7 days. The experimental diets were replicated four times by changing the animals. All necessary data were recorded precisely from the digestion trial, e.g., feed and faeces revoked by the animals. All feed ingredient samples were collected during the digestibility trial for further analysis. All samples were sun-dried, ground to pass through a 20 mm sieve and conserved in the airtight zipper poly bags except soybean oil for chemical analysis. Fresh faeces samples were analyzed immediately in the laboratory to reveal crude protein. Rumen liquor was collected from a cannulated animal by inserting a tube directly through the fistula, and liquor was drawn out using a pump and collected into a graduated conical flask. Rumen liquor was collected at 0, 3 and 6 hours of feeding. A clean linen cloth filtered the rumen liquor immediately after collection.

During the experimental study period, approximately 200 ml of liquor was collected from the cannulated animal each time. This rumen liquor was collected in a clean, separate plastic bottle to measure ammonia and VFA. The same collected rumen liquor was preserved with the same amount of 10% (V/V) H SO solution to analyze NH3N concentration. For VFA measurement, the sample was stored in deep freeze without adding any preservatives till further analysis.

Chemical analysis

Proximate components of different combinations of feed used during the feeding trail and faeces collected from the animals during the digestibility trial went through chemical analysis following the methods of AOAC (1990).

Statistical analysis

The statistical analysis of collected data of the experiment was analyzed using software "MSTAT" X to complete the analysis of variance (ANOVA) for a 2X2 factorial design.

Results and Discussion

We know the staple food for cattle is either green or dry roughage. But with the increasing demand for milk and meat, they need to supplement them with additional nutrients like protein and fat. In this study, fundamental work was conducted in Bangladesh. So far, limited numbers of investigations have been conducted to evaluate different combinations of concentrate and soybean supplementation on growing cattle in Bangladesh. This particular filed research will help to find more intensive data to validate the present information and conclude a better suggestion for feeding growing cattle based on roughage feeding.

Rumen pH

The results revealed in this study are given in Table 1. An increasing concentrate diet level (from 15 to 30%) reduced the pH value sampled between 0, 3 and 6 hours after feeding. This might be due to elevated production of lactic acid and other acids by increasing concentrate feeding. Soybean oil values at different levels did not affect pH values at 0, 3, and 6 hours of feeding. The effect of concentrate levels on rumen pH was found to diminish rumen pH values in available literature (Wang et al., 2002) and concur with the present findings. The present study also agrees with the findings communicated by the scientists (Beaulieu et al., 2002) that oil has no effect on pH in the rumen.

Rumen NH3 -N concentration

As shown in Table 1, the concentrate level did not affect the ammonia value at 0 and 6 hours after feeding the facts, after 3 hours of feeding, a higher level of concentrate (30%) resulted in a higher NH3-N concentration in the rumen than a lower level of concentrate (15%). This is because the concentrates contain a higher amount of protein than that of roughage. The present study's findings agree with the findings of Vargas et al. (2001). Similarly, increasing soybean oil levels decreased ruminal NH -N concentration. Oil had a suppressive effect on protein breakdown by the microbes, which is indicated from the non-significant reduction of CP digestibility due to oil, as seen in Table 1. The combination of high concentrate (30%) and low oil (3%) resulted in increased ammonia production during 3 hours of feeding (Fig. 1).

Table 1: Rumen pH, NH_3-N (mg/l), and Total Volatile Fatty Acid (TVFA) production (mM/l) in growing cattle after feeding different levels of concentrate and soybean oil.

Sampling time (hour)	Concentrate Level		Soybean oil Level		SEM	Level of significance#		
	15%	30%	3%	6%		C	SO	C X SO
Rumen pH								
0	7.05	6.88	6.96	6.96	0.08	NS	NS	NS
3	6.59	6.41	6.55	6.45	0.06	*	NS	NS
6	6.79	6.54	6.66	6.66	0.06	**	NS	NS
NH_3 -N (mg/l)								
0	123.75	124.50	123.13	124.88	0.66	NS	NS	NS
3	249.00	252.75	252.50	249.25	0.84	**	*	NS
6	149.88	148.88	150.13	148.63	1.48	NS	NS	**
TVFA production (mM/l)								
0	91.38	92.00	91.38	92.00	0.53	NS	NS	**
3	403.38	404.00	404.00	403.38	1.18	NS	NS	NS
6	287.00	286.50	285.75	287.75	0.67	NS	NS	**

**#C = Outcome of concentrate level, SO = Outcome of soybean oil level, C X SO = Combined Outcome of concentrate and soybean oil level. SEM = Standard Error of the Mean, * Significant at P<0.05 level of probability, ** Significant at P<0.01 level of probability. NS = Not significant.

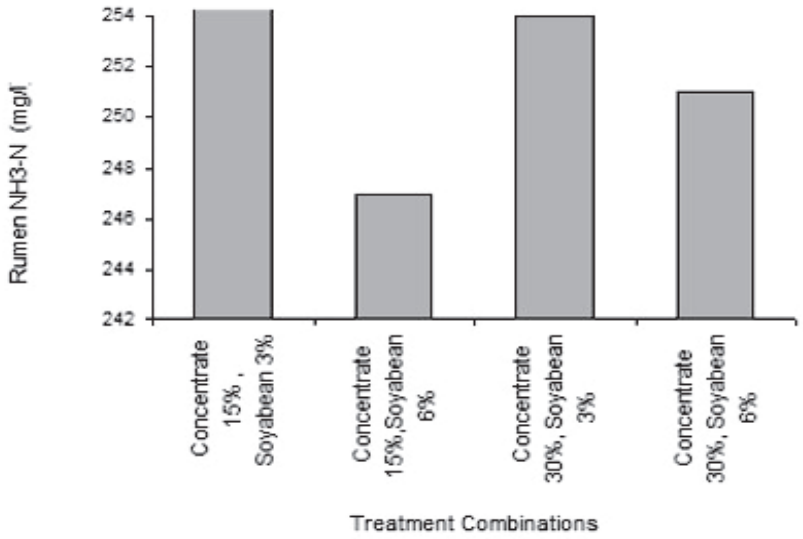

Fig. 1: Rumen ammonia production at 3 hours after feeding different levels of treatment combinations of concentrate and soybean oil in growing cattle.

Total volatile fatty acid (TVFA)

The level of concentration of the diet has efficacious consequences for total volatile fatty acid (TVFA) production in the rumen 3 hours after feeding (Table 1). VFA production increased at 3 hours after feeding with an increased level of concentrated diet but decreased at 6 hours. During this experiment, Soybean oil levels positively impacted the TVFA production. VFA production increased with an increase in oil levels from 3 to 6 per cent. Nevertheless, the combination of concentrate diet levels

and soybean oil significantly affected TVFA production. It is a factuality that a high concentrate diet invariably increases volatile fatty acid production. Consequently, the inclusion of fat or soybean oil is expected to elevate the fatty acid content. The same conclusions were observed in the study by other researchers. It was documented that four levels (0.83, 1.25, 1.67, and 2.08%, w/v) of concentrate slightly increased the total VFA production in the rumen of cattle (Wang et al., 2002). Lower pH was observed from strained rumen liquor (SRL) in a diet containing concentrate to roughage ratio of 60:40. In contrast, the concentration of total volatile fatty acids (TVFA) was higher with levels of concentrate in the diet (Santra and Pathak, 2001). In terms of soybean oil and rumen parameters, recent data indicate that supplementing a diet with soybean oil at 2.5, 5.0, or 7.5% (DM basis) did not affect ruminal pH or concentrations or the major VFA (Beaulieu et al., 2002). There are inconsistent results regarding rumen parameters while feeding variable levels of concentrate and fat source in ruminants. Total VFA was not affected by the infusion of different levels of soybean oil through rumen cannula in heifers (Krysl et al.,1991). Growing fattening bulls supplemented with soya oil at 33 g/kg lowered the pH (6.3 vs. 6.4) (Clinquart et al., 1995). On the other hand, with the same treatment, ammonia concentration was 73.1 and. 83.1 mg N/litre respectively and, reported increased concentrations of volatile fatty acids, 131.9 and 127.8 mmol/litre respectively, in rumen fluid.

Conclusion

As rice straw and green fodder is low in essential nutrients required for desired growth in cattle, it is suggested to supplement growing cattle feed with concentrate feed at moderate level. Supplementation with soybean oil requires more study to formulate an efficient diet. Nevertheless, bypassing fat sources would be beneficial to feed cattle.

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Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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