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Growth performance of feedlot Nellore brown ramlambs fed diets with different levels of *Azolla*

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Abstract

The present study was targeted to find the changes in Growth, Body condition score and cost Economical variables of lambs with *Azolla* meal supplementation under intensive system of rearing. In order to ensure uniform average group weights, twenty-four weaned ram lambs were split into three treatment groups, T₁, T₂ and T₃. Each group consisted of eight lambs. While *Azolla* was supplied at rates of 10% as well as 20% of dry matter intake in T₂ and T₃, respectively, T₁ group was the control group and did not receive any *Azolla* supplementation. The trial feeding period lasted for 120 days. The DMI (g/day), ADG(g) and FCR recorded along with weights at fortnightly times. The final body weights and average daily gain showed significance difference among the treatments. The DMI (g/day), ADG(g), FCR, and DMI (g/day) did not reveal any discernible differences between the groups. The Body condition scores were found to be significant ($p < 0.05$) among the treatments. Relatively low cost of feeding was observed among both T₂ and T₃ groups but high cost of feeding per kg of weight gain noticed in control group. It was concluded that *Azolla* can be supplemented in the diet of growing staged Nellore brown ram lambs at 10% level without any detrimental effect on the performance of the animals.

Keywords: Nellore brown sheep, ram lamb, *Azolla*, growth parameters, body condition score, cost economics

Introduction

Ensuring optimal nutrient supply and its bioavailability is key for improvising livestock production. However, shortage of land for fodder production has resulted in the shortage of land for feeding resources. Relieving the fodder shortage issue particularly during summer season remains a challenge. Urbanisation and enhanced population statistics prevented the growing of green fodder in cultivation land in order to conserve groundwater resources. Non-conventional resources and feed has become an emerging demand in many countries, especially those suffer from the issue of lack of cultivation land (Mohammed *et al.*, 2021)^[13]. It has become imperious for the public and private sector to explore alternative high quality and cheap livestock feed resources to help address feed shortage and maximize profit for farmers. Therefore, finding non-conventional resources that can fill the nutrient requirement of livestock will make the continuous production from livestock.

However, to reduce the cost of animal production, nutritionist are searching for easily accessible and reasonably priced substitutes for concentrate and fodder, which are becoming increasingly scarce and expensive. With a few preventive measures and inexpensive production costs, nutritionists come up with the alternate unconventional feed resources. Deduction of feed cost has become major importance in meat Industry. In mutton production feed cost alone constitutes almost 50-60% of the total expenditure. Since, *Azolla* constitutes most of the nutrients required for all animals including poultry (Basak *et al.*, 2002)^[2]. *Azolla* is very rich in proteins (25–30%), essential (EAA) amino acids (7-10%), fat and water soluble vitamins (A, B12 and β carotene), anti-oxidants and growth promoting substances and mineral, vitamins, Ca, phosphorus, potassium, iron, copper, magnesium etc. Because it has little lignin and a high protein content (approximately 20–25%), it is easily digested by cattle. Numerous non-traditional feedstuffs are available that are used as a source of protein and energy for *Azolla* is a free-floating aquatic fern found in tropical, subtropical, and temperate freshwater habitats.

It is a member of the Azolaceae family, order Pteridophyta. It supplies nitrogen to systems of paddy farming. It has significant effects on aquatic ecosystems and biodiversity, due to its symbiotic association with *Anabaena Azollae*, a blue-green alga that fixes nitrogen. Because of this, *Azolla* is among the greatest substitute feed components. Despite being an invasive plant, *Azolla pinnata* is a wonderful option to feed animals because of its copious supply and tasty nature as a supplement to green fodder.

This research evaluates the new resources for alternative feed raw materials, specifically the *Azolla* plant, with goal of offering a more cost-effective and sustainable approach for using the fern as a substitute for natural feeds in the feed industry. Thus, the aim of this study is to find the growth performance, BCS and cost economics of feeding *Azolla pinnata* to growing Ram lambs as protein supplement.

Materials and Methods

An Experiment was conducted at Krishi Vigyan Kendra, Kalyandurg, Anantapur district, Andhra Pradesh. The experiment was carried out in the months of June to Sep 2023 at KVK. Eighteen weaner ram lambs in the age of 4 months were identified on the criteria of body weights and were randomly distributed into 3 groups (T₁, T₂ and T₃) of eight lambs each in a CRD. The lambs of T₁, T₂ and T₃ were fed with CoFs-31, Stylo, Hedge lucerne legume fodders and concentrate feed. The concentrate feed was fed 100g/day to fill their nutrient requirement for the body weight gain. Subsequently, *Azolla* was given as whole nutritive supplement at the rate of 0, 10 and 20% of dry (DMI) matter intake to the T₁, T₂ and T₃ groups, respectively and no *Azolla* was given to T₁ group (control). The trial period last for 120 days. *Azolla* was grown in Six pits, each with a dimension of 6 m x 3 m with 0.8 m depth. Ram lambs were given *Azolla* after it was carefully cleaned with clean water and retrieved from each pit in turn.

At the start and halfway through the study, all of the lambs received deworming treatment with albendazole at a dose of 8-10 mg /kg B.wt. All the animals were kept in a well ventilated shed with adequate space requirement providing access to ad libitum hygienic water. The shed was routinely cleaned and disinfected with bleaching water, and it was given enough time to dry.

Body weight gain

The lambs were fed according to the proposed diets at 9:00 and 15: 00 hours by weighing in digital electronic balance and the leftover if any was recorded the next day morning to calculate dry matter intake (DMI). Regular weighing of the lambs was practiced prior to feeding and watering at fortnightly intervals to know the effect of experimental diets on average daily gain (ADG) and feed efficiency.

$$ADG(g) = \frac{\text{Final weight (kg)} - \text{Initial weight (kg)}}{\text{No. of days of growth trail}} \times 1000$$

$$FCR = \frac{\text{Feed consumed (kg)}}{\text{Gain in body weight (kg)}}$$

BCS

Body Condition Score (BCS) was analysed by careful palpation of the spinous and transverse process in loin area, immediately behind the last rib (1~5 with 0.5 increment) (Thompson and Meyer, 1994). The BCS of the lambs were assessed at the same time of body weight recording.

Statistical analysis

The results were subjected to analysis through software (version 23.0; SPSS, 2015) by using one-way ANOVA through generalized linear model and the treatment means were ranked using Duncan's (DMRT) multiple range test with a significance at $p < 0.05$. All the statistical procedures were performed as per Snedecor and Cochran (1994) [15].

Results and Discussion

Nutrients composition

The proximate composition of *Azolla* and Concentrate mixture are presented in Table 1. *Azolla* and Concentrate mixture contains 20.31% and 20.11% Crude protein, 4.17% and 3.2% Ether extract respectively. As the total ash was 19.82%, the organic matter of the *Azolla* was found to be low in the *Azolla* i.e. 80.18%. The nutrient composition values are similar with Ahmed *et al.* (2016) [1]. The total ash and crude fibre content were 19.65 and 14.25% respectively.

Table 1: Chemical Composition of feed ingredients (%)

S. no.	Composition	<i>Azolla</i>	Concentrate
1	Dry matter (DM) %	88	89.55
2	Organic matter (OM) %	80.18	91.14
3	Crude Protein (CP) %	20.31	20.11
4	Crude Fibre (CF) %	18.62	7.96
5	Ether Extract (EE) %	4.17	3.2
6	Total Ash (TA) %	19.82	8.86
7.	Nitrogen free extract (NFE) %	37.08	59.87

Table 2: Composition of Concentrate mixture (kg)

Particulars	Quantity
Maize	55 kg
GNC	23kg
DORB	17kg
Jaggery	2 kg
Mineral mixture	2 kg
Salt	1 kg

Growth studies and Dry matter intake

In the current study, *Azolla* at 0, 10%, and 20% of the feed significantly increased body weight gain and average daily gain (ADG) ($p < 0.05$) as compared to the control group; however, feed conversion ratio and DMI (g/day) displayed no statistically significant differences (Table 3). The amount of crude fibre rose whereas the amount of organic matter in the rations reduced as the proportion of *Azolla* increased. This could be because *Azolla* had greater levels of crude fibre and total ash in our study (19.82 and 18.62 percent, respectively). These statements were also agreed by Ahmed *et al.* (2016) [1].

The results corroborate those of Dev *et al.* (2022) [6], who found that supplementing sun-dried *Azolla* meal (at a 10% replacement rate of concentrate feed) enhanced the growth performance of young Sirohi goats. Ahmed *et al.* (2016) [1] found that feeding Corriedale sheep 6% *Azolla* instead of 25% linseed cake boosted the sheeps' body weight. Basak *et al.* (2002) [2], Bhattacharyya *et al.* (2016) [4], Sinha *et al.* (2018) [20] have also observed improved weight increase in poultry birds. In a similar vein, Toradmal *et al.* (2017) [21] found that adding fresh *Azolla* up to 300 g to an intense system significantly increased the ultimate body weight. In contrast to the study, Kqumari *et al.* (2021) [11] who reported that the goat kids of Black Bengal breed were fed with *Azolla* up to 20% level in concentrate as a part of

protein replacement diet and gained significantly more body weight with 20% *Azolla*. From the results of our study, it is clarified that the supplementation of *Azolla* as a part of protein improves the body weight at early age, so that the farmers will get benefitted as they can do early marketing instead of holding and increasing cost of production. In contrast to the study, Ahmed *et al.* (2016) [1] reported that *Azolla* supplementation resulted in non-significant effect in Corriedale sheep on Average daily gain.

Results are in agreement with the findings of Dev *et al.* (2022) [6] the inclusion of Sun dried *Azolla* meal @ 10% level in concentrate feed enhanced the daily gain of Sirohi goat kids. Sharma *et al.* (2021) [18] revealed that the supplementation of *Azolla* to concentrate of goat kids (male) in the ration improved the growth traits @ 150gm, 250gm and 350 gm, such that Average daily gain improved by 21.13%, 29.34% and 22.59%, respectively, on comparison with control. Bhatt *et al.* (2021) [3] concluded that 15% of concentrate replacement with *Azolla* to female calves enhanced average daily gain. The results obtained were

found contrast to the findings of Wadhvani *et al.* (2010) [22], Shekh *et al.* (2016) [19] when *Azolla* was included in TMR rations of lambs.

Sankar *et al.* (2020) [17] revealed that replacement of 10% of protein in concentrate feed by sun-dried meal of *Azolla* as Dry matter in Mecheri sheep improved weight gain. The results in the present study reveals that, significant results were noticed in ADG might be due to *Azolla* which was palatable, revealed that high feed intake, ensured optimum absorption of nutrients showed significant results in weight gain and proved to be economical to shepherds.

Further, the DMI (g/day) and Feed conversion ratio were found to be statistically non-significant (Table 3). Total dry matter intake g/animal /day was found to be non-significant by feeding of complete pellet feed (25% of concentrate mixture was replaced) with sun-dried *Azolla* was reported by Kumari *et al.* (2021) [11]. Thus, it was revealed that *Azolla* inclusion as a part of replacement in concentrate feed in Sirohi breed goats resulted in improved average daily gain.

Table 3: Effect of feeding *Azolla* on Growth performance in Nellore ramlambs

Particulars	T ₁	T ₂	T ₃
Initial of body weight (kg)	12.52 ^a ± 1.4	12.56 ^a ± 0.2	12.99 ^b ± 0.3
Final of body weight (kg)	24.90 ^a ± 1.1	26.7 ^b ± 1.6	26.8 ^b ± 1.5
Gain in body weight (kg) in 120 days	12.4 ^a ± 1.1	14.19 ^b ± 1.7	13.8 ^{ab} ± 1.6
Average daily gain (g/d)	103.4 ^a ± 9.5	118.3 ^b ± 14.3	115.7 ^{ab} ± 13.8
FCR	12.2 ± 0.9	11.01 ± 1.58	11.45 ± 1.44
ADFI (kg/day)	1.25 ± 0.82	1.28 ± 0.13	1.31 ± 0.13
Total feed intake (kg)	150.6 ± 9.8	154.6 ± 16.3	157.6 ± 16.1
DMI (g/day)	379.2 ± 31.9	393.4 ± 14.5	386.7 ± 13.9
Cost of concentrate feeding per kg	81.52	76.48	72.35

Cost economics of *Azolla* production

The Cost economics of *Azolla* production were presented in Table 4. The Cost/ kg of concentrate mixture was found to be lowest in T₃ (72.35%) when it is replaced by the concentrate mixture with 20% *Azolla*. The amount/kg body weight gain (Rs) for T₁, T₂ and T₃ were found to be 81.52, 76.48 and 72.35, respectively. Lowest cost/kg weight gain was noticed in 20% *Azolla* group lambs followed by 10% *Azolla* group and was higher in 0% *Azolla* group. Inclusion of *Azolla* reduced the requirement of costly protein supplements. Here in the ration 10% and 20% of concentrate mixture is replaced with *Azolla*, hence saved Rs 5.04 and 9.17, respectively per kg weight gain in Nellore brown lambs. The present study findings were in agreement with the findings of Ahmed *et al.*, (2016) [1], reported savings of Rs 2/kg of weight growth in comparison with control. The cost of ration/kg weight gain was Rs.68.06, 64.42, and 59.28 fed with 0%, 15%, and 20% levels of *Azolla* in pigs, respectively (Cherryl *et al.*, 2013) [5] agreed with present findings. The results reported by Indria *et al.*, (2009) [8] and

in calves (buffalo) also consistent with present findings by Kumar *et al.*, (2012) [9].

Table 4: Economics of *Azolla* production

Economical parameter	Cost (Rs.)
Construction of Precast structure of <i>Azolla</i>	1500/-
<i>Azolla</i> 2 kg @50/-	100/-
Cow dung 5/- kg (20kg)	100/-
Super phosphate 500gm	20/-
Mineral mixture	75/-
Total	1795/-

Body condition score of ram lambs

Body condition score of ram lambs before and after the experiment were presented in table 5. The initial body condition score of ram lambs for T₁, T₂ and T₃ were 2.72, 2.76 and 2.93 respectively. The final body condition score of ram lambs for T₁, T₂ and T₃ were 3.1, 3.38 and 3.59 respectively. The final body condition scores were found to be significant ($p < 0.05$).

Table 5: Body condition score of ram lambs

Attributes	T ₁ (0%)	T ₂ (10%)	T ₃ (20%)
Initial body condition score (1~5)	2.72 ^a ± 0.19	2.76 ^{ab} ± 0.18	2.93 ^b ± 0.14
Final body condition score (1~5)	3.1 ^a ± 0.20	3.38 ^b ± 0.12	3.59 ^c ± 0.21

a, b and c, Means in the same row with different superscripts are significantly different at ($p < 0.05$)

Conclusion

According to the study, inclusion of *Azolla* as a protein supplement up to 20% of the DMB under an intensive management system results in improved body weights,

which is advantageous for sheep farmers in terms of both economy and early slaughter age. In the T₂ and T₃ groups, feeding costs were comparatively low, but in the T₁ (control) group, feeding costs per kilogramme of gain were

greater. Results conclude that, *Azolla* inclusion in a ration at 10% level of concentrate enhances the ADG of Nellore brown ram lambs without having a negative impact on their voluntary feed intake or general health.

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Conflict of Interest

There is no conflict of interest.

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