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Original Research

Effect of Feeding Green Azolla (*Azolla pinnata*) on Growth Performance in Sirohi Male Kids

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Abstract

The aim of this study was to determine the effect of feeding green Azolla (Azolla pinnata) on growth performance in Sirohi male kids. A feeding trial of ninety days was conducted on 16 Sirohi male kids of 4-6 months of age. The experimental kids were distributed randomly in four treatment groups viz. T1 - Control (Basal roughage + concentrate); T2 (Basal roughage + concentrate + 150gm green Azolla); T3 (Basal roughage + concentrate + 250 gm green Azolla); and T4 (Basal roughage + concentrate + 350 gm green Azolla). There was highly significant (P<0.01) effect of green Azolla (Azolla pinnata) feeding on periodical body weight change, average daily gain and feed conversion ratio in different treatments and periods. It was concluded that green Azolla (Azolla pinnata) improved the growth performance of Sirohi kids when fed @ 250gm along with concentrate diet.

Keywords: Azolla, Feeding, Growth, Sirohi Male Kids

Introduction

Goat is one of the major livestock species contributing to the livelihood and nutritional security. Goat rearing has the potential to emerge as a very good source of income and employment for the rural youth especially in the adverse environments (Sharma *et al.,* 2020). According to National Bureau of Animal Genetics Resources (ICAR-NBAGR), there are 34 registered breeds of goat in India. The Sirohi goats are valuable germ- plasm because of its better production performance in the harsh climatic conditions (Sharma *et at.,* 2016). Sirohi goats are dual-purpose animals, being reared for both milk and meat. These are resistant to major diseases and are easily adaptable to different climatic conditions.

There is huge potential in enhancing the productive performance of Sirohi goats through nutritional interventions. There are various newer and non-conventional feeds which may be incorporated for goat feeding such as Azolla. *Azolla pinnata* may become an alternative to green fodder and as supplementary protein diet. *Azolla pinnata* is an aquatic free-floating fern belonging to the family Azollaceae. Azolla hosts symbiotic blue-green algae, *Anabaena azollae,* which is responsible for the fixation and assimilation of atmospheric nitrogen. Azolla, in turn, provides the carbon source and favourable environment for the growth and development of the algae. It is this unique symbiotic relationship that makes Azolla, a wonderful plant with high protein content (Yadav *et al*., 2014).

In recent years, Azolla has attracted the attention of researchers because of its high potential as a feed resource for livestock (Kathirvelan *et al.,* 2015). Azolla has the potential to become economic and efficient feed substitute and a sustainable feed for livestock. There are reports on the use of Azolla as feed supplement for livestock, in which normal feed protein sources have been replaced by Azolla (Chatterjee, 2013; Kumar and Chander, 2017; Arvindraj *et al.*, 2017). The present investigation was under taken to study the effect of Azolla (*Azolla pinnata*) feeding on growth performance in Sirohi kids.

Materials and Methods

Production of Azolla

For present experiment, Azolla was produced in water troughs of size 12.5 m X 1.0 m X 0.40 m. About 2-2.5 kg of cow manure was dissolved in 3.5 liters of water and spread evenly in the water trough. Fresh Azolla seeds were inoculated in water troughs at 0.5kg/m^2. Azolla was spread all over trough within 15 days and build up a thick met like structure. Azolla was harvested and washed for three times to avoid the superfluous material before feeding to kids.

Experimental Animals and Design

Sixteen male Sirohi kids of almost same age group (4-6 months) and of uniform affirmation were selected randomly. These male kids were divided in to four groups for feeding trial. Each group had four kids. These animals were given measured amount of experimental feed and fresh and clean drinking water *ad lib*. The kids were stall fed throughout the experimental period. The experimental Sirohi male kids were distributed by completely randomized block design on the basis of body weight into four groups of four kids in each and subjected to different treatment.

Experimental Feeds

Experimental Sirohi kids were fed with the basal roughage (methi straw), concentrate mixture with and without green Azolla (*Azolla pinnata*). Experimental kids were divided in four treatment groups viz.T_1 - Control (Basal roughage + concentrate); T_2 (Basal roughage + concentrate + 150gm green *Azolla*); T_3 (Basal roughage + concentrate + 250 gm green *Azolla*); and T_4 (Basal roughage + concentrate + 350 gm green *Azolla*).

The experimental animals were fed as per ICAR (2013) feeding standard to meet their nutrient requirement.

Experiment

A feeding trial of 90 days was conducted on 16 Sirohi male kids divided in to four treatment groups of four kids in each group to study the effect of feeding green *Azolla* (*Azolla pinnata)* on growth performance of male kids. Body

weight and body measurements (body height, body length and chest girth) were also recorded fortnightly.

Feed Conversion Ratio

Feed consumption and body weight gain were recorded at 15th day in all treatment group up to 90 days. Feed conversion ratio was calculated by dividing the feed intake by body weight gain of Sirohi kids for every 15 days.

Statistical Procedure

The data obtained in the experiment were analyzed using statistical procedures as suggested by Snedecor and Cochran (1994) and significance of mean difference was tested by Duncan's New Multiple Range Test (DNMRT) as modified by Kramer (1957).

Results and Discussion

Periodical Body weight change and Average Daily Gain

The mean of periodical body weight changes were found to increase from to 12.42 to 17.84 Kg with overall mean of 15.54 Kg in T_1; 12.36 to 19.24 Kg with overall mean of 16.44 Kg in T_2; 12.47 to 20.15 Kg with overall mean of 17.04 Kg in T_3 and 12.44 to 19.45 Kg with overall mean of 16.68 Kg in T_4 group (Table 1). The overall mean of body weight change at different fortnight intervals (0 to 90 days) were observed 12.42 (0 day) to 19.17 kg (90 day).

Table 1: Body weight (Kg), ADG (g), body height (cm), body length (cm), chest girth (cm) in Sirohi male kids in different treatment groups

Treatment / Mean	T_1	T_2	T_3	T_4	SE ±Mean
Body Weight	15.54^{d}	16.44^{bc}	17.04^{a}	16.68^{b}	0.336
Average Daily Gain	60.29^{d}	76.44^{c}	85.33^{a}	77.88^{b}	1.654
Body Height (cm)	54.36^{c}	54.71^{b}	55.33^{a}	54.40^{c}	1.133
Body Length (cm)	48.04^{c}	48.54^{b}	49.58^{a}	48.56^{b}	1.021
Chest Girth (cm)	53.93^{c}	54.75^{b}	55.71^{a}	55.72^{a}	1.151
FCR	10.53^{a}	9.13^{c}	8.7^{d}	9.18^{b}	0.4

Mean with different superscript in a row differ significantly

The statistical analysis of data revealed highly significant (P<0.01) effect of feeding green Azolla (*Azolla pinnata)* in different treatment groups as well as in periods (Table 2). The comparison of means in body weight change in different treatment groups showed significantly highest body weight change in T_3 group i.e., concentrate feed with 250 gm green Azolla (*Azolla pinnata)* followed by T_4 (16.68) i.e., concentrate feed with 350 gm green Azolla and T_2 (16.44) i.e., concentrate feed with 150 gm green Azolla. The lowest values were observed in T_1 group i.e., concentrate feed without green Azolla. T_4 group was comparable with T_2 group (Table 1).

It was concluded that there was significant effect of feeding green Azolla (*Azolla pinnata)* with concentrate diet on body weight changes in Sirohi kids. The findings of present study are in agreement with the previous reports of Jyoti *et al.* (2016) in kids, Shekh *et al.* (2016) in lambs, Sireesha (2017) in rabbits and Akhud *et al.* (2017) in Nagpuri buffalo calves in kids. In contradictory, Kumar *et al*. (2012), Kumar *et al*. (2017) Chandewar *et al.* (2018) and Nanthini *et al*. (2020) observed non-significant effect of Azolla supplementation on periodical body weight changes in buffalo bulls, male kids, crossbred cows and chicks, respectively.

The overall mean of average daily gain (ADG) in different treatment groups i.e., T_1, T_2, T_3 and T_4 were found to be 60.29, 76.44, 85.33 and 77.88 g/d, respectively (Table 1). Whereas, overall mean of average daily gain at different fortnight intervals (15 to 90 days) were found to be 98.00, 121.32, 84.16, 71.36, 48.55 and 26.52 respectively. The statistical analysis of data (Table 2) revealed highly significant (P<0.01) effect of green Azolla (*Azolla pinnata)* supplementation in concentrate diet on ADG in different treatments as well as periods.

Table 2: ANOVA of body weight, ADG, body measurements

Attributes	SOV	DF	MSS	F - Value	Sig
Periodical Body Weight Change	Block	3	0.82	1.812	NS
	Treatment	3	11.5	25.5	**
	Periods	6	103.9	230.417	**
	TxP	18	0.6	1.403	NS
	Err	81	0.5		
Average Daily Gain (g/d)	Block	3	6.83	0.624	NS
	Treatment	3	2668.2	243.957	**
	Periods	5	18627.9	1703.159	**
	TxP	15	1973.5	180.435	**
	Err	72	10.9		
Body Height (cm)	Block	3	6.23	1.141	NS
	Treatment	3	6.2	1.14	NS
	Periods	5	307.1	56.207	**
	TxP	15	0.4	0.077	NS
	Err	69	5.5		
Body Length (cm)	Block	3	7.57	1.814	NS
	Treatment	3	11.7	2.807	*
	Periods	6	261.4	62.684	**
	TxP	18	0.8	0.196	NS
	Err	81	4.2		
Chest Girth (cm)	Block	3	6.08	1.131	NS
	Treatment	3	20.9	3.888	*
	Periods	5	22	4.085	**
	TxP	15	0.2	0.038	NS
	Err	69	5.4		

*NS = Non-Significant; * = Significant at 5% level of probability (P<0.05); ** = Significant at 1% level of probability (P<0.01)*

On comparing the means, highest average daily gain was recorded in Sirohi kids of T_3 groups (fed concentrate diet supplemented with 250 gm green Azolla) followed by T_4 group (fed concentrate diet supplemented with 350 gm green Azolla), T_2 group (fed concentrate diet supplemented with 150 gm green Azolla). The lowest mean ADG values were recorded in T_1 group (fed concentrate diet supplemented without green Azolla) (Table 1).

Thus, it was concluded that green Azolla (*Azolla pinnata)* supplementation in concentrate diet resulted in significantly higher average daily gain in Sirohi kids. Similar findings were reported by Agare *et al.* (2015), Jyoti *et al.* (2016) and Toradmal *et al.* (2017) in kids. The results of present study also showed agreement with Shekh *et al.* (2016) in lambs and Akhud *et al.* (2017) in Nagpuri buffalo calves, and Chandewar *et al.* (2018) in crossbred cows, Katole *et al.* (2017) and Arvindraj *et al.* (2017) in crossbred cattle. Ahmed *et al.* (2016) reported non-significant effect of feeding Azolla on ADG in Corriedale sheep.

Periodical Body Measurements

Body Height

The body height change in Sirohi kids in different treatment groups (i.e., T_1, T_2, T_3 and T_4) were found to be 54.36, 54.71, 53.33 and 54.40 cm, respectively (Table 1). The overall mean body height change at different fortnight intervals (15 to 90 days) were found to be 48.94, 50.55, 51.88, 54.29, 56.31, 58.61 and 62.34 cm, respectively.

The statistical analysis of data revealed that there was non-significant effect of feeding Azolla on body height in different groups in Sirohi goat kids but the effect of feeding Azolla on body height in different periods (0-90 days) were found to be highly significant (Table 2).

On comparison of means, lowest body height change was recorded in kids of T_1 group (fed concentrate diet without green Azolla (*Azolla pinnata*) which was comparable with T_4 group (fed concentrate diet with 350 gm green Azolla (*Azolla pinnata*), followed by T_2 group (fed concentrate diet with 150 gm green Azolla (*Azolla pinnata*). The highest values of mean body height were observed in T_3 groups (fed concentrate diet with 250 gm green Azolla (*Azolla pinnata*) (Table 1). Similar findings were also reported by Jyoti *et al.* (2016) in Osmanbadi goat kids and Akhud *et al.* (2017) in Nagpuri buffalo calves. However, the results of present study were not in agreement with that of Shekh *et al.* (2016) in lambs.

Body Length

The overall mean of body length of Sirohi kids were found to be 48.04 cm in T_1, 48.54 cm in T_2, 49.58 cm in T_3 and 48.56 cm in T_4 treatment groups (Table 1). The overall mean of body length at different fortnight intervals (0 to 90 days) were found to be 43.67, 44.74, 46.31, 48.40, 50.77, 52.42 and 54.45 cm, respectively. The statistical analysis of data showed that there was significant ($P<0.05$) effect of feeding green Azolla (*Azolla pinnata)* along with concentrate diet in Sirohi goat kids in different treatment groups. Further there was highly significant ($P<0.01$) effect of feeding Azolla in Sirohi goat in different fortnight intervals (periods) (Table 2).

The comparison of overall mean of in body length of Sirohi kids showed highest body length in T_3 group (i.e., concentrate diet with 250gm green Azolla (*Azolla pinnata)* and lowest body length of Sirohi goat kids in T_1 group (i.e., concentrate diet without green Azolla (*Azolla pinnata).* The body length of Sirohi goat kids in T_4 group (i.e., concentrate diet with 350 gm green Azolla (*Azolla pinnata)* was found comparable with T_2 group (i.e., concentrate diet with 150 gm green Azolla (*Azolla pinnata*) (Table 1). Similar findings were also reported by Jyoti *et al.* (2016) and Akhud *et al.* (2017).

Chest Girth

The Chest girth in different treatment groups was found to be 53.93 in T_1; 54.75 in T_2; 55.71 in T_3 and 55.72 cm in T_4, respectively (Table 1). However, overall mean of Chest girth at different fortnight intervals (0 to 90 days) were found to be 52.42, 53.73, 54.53, 55.33, 55.97, 56.40 and 56.81 cm, respectively. The statistical analysis of data revealed significant ($P<0.05$) effect of feeding green Azolla (*Azolla pinnata)* along with concentrate diet on chest girth in Sirohi kids of different treatment groups. Effect of feeding Azolla on chest girth of Sirohi goat kids was found to be highly significant ($P<0.01$) in different fortnight intervals (periods) (Table 2).

On comparing the means, highest Chest girth (cm) was observed in T_4 group (fed concentrate diet with 350gm green Azolla) which was comparable with T_3 group (fed concentrate diet with 250gm green), followed by T_2 group (fed concentrate diet with 150gm green Azolla). The lowest mean values of chest girth were observed in T_1 group (fed concentrate diet without green Azolla) (Table 1). Similar findings were also reported by Jyoti *et al.* (2016) and Akhud *et al.* (2017). Findings of Shekh *et al.* (2016) were not in agreement to the findings of present study.

Feed Conversion Ratio

The overall mean values of feed conversion ratio were found to be 10.53, 9.13, 8.70 and 9.18 in T_1, T_2, T_3 and T_4 groups, respectively (Table 1). The analysis of variance of data revealed highly significant ($P<0.01$) effect of green Azolla (*Azolla pinnata)* supplementation in concentrate diet on feed conversion ratio in different treatment group (Table 3). The comparison of means showed significantly superior feed conversion ratio in T_3 group (i.e., 250 gm green *Azolla pinnata* + concentrate diet) followed by T_2 group (i.e., 150 gm green *Azolla pinnata* + concentrate diet), T_4 group (i.e., 350 gm green *Azolla pinnata* + concentrate diet). The poor feed conversion ratio was recorded in T_1 group (i.e., concentrate diet without green *Azolla pinnata*) (Table 1).

Table 3: ANOVA of feed conversion ratio

Attributes	SOV	DF	MSS	F – value	Level of Sig.
FCR	Block	3	0.009	0.734	NS
	Treatments	3	2.516	195.491	**
	Error	9	0.013	-	-

*NS = Non-Significant; ** = Significant at 1% level of probability (P<0.01)*

Similar findings were also reported by Roy *et al*. (2016) in Hariana heifers; Ahmed *et al*. (2016) in sheep; Katole *et al*. (2017) in cattle; Sireesha *et al*. (2017) in rabbits; Indira *et al*. (2009) in buffalo calves and Hasan *et al*. (2008) in cattle calves. Anitha *et al.* (2016) found non-significant effect of green Azolla feeding on FCR in rabbits.

Conclusion

The statistical analysis of data showed highly significant (P<0.01) effect of feeding green Azolla on body weight change, ADG and FCR in different treatments and periods. The comparison of mean showed the highest body weight change and ADG in T_3 group followed by T_4, T_2 and T_1 group. Superior FCR was also observed in T_3 followed by T_2, T_4 and T_1 group. There was non-significant effect of feeding green Azolla on body height change (BH) in different treatment groups whereas significant (P<0.05) effect on body length and chest girth. There was highly significant (P<0.01) effect of feeding green Azolla on body height change, body length and chest girth over periods. It was concluded that green Azolla (*Azolla pinnata*) @ 250 gm along with concentate diet was a viable proposition to improve productivity of Sirohi kids in arid and semi-arid region.

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Conflict of Interests

There is no conflict of interest.

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