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Effect of feeding fresh *Azolla* (*Azolla pinnata*) on growth performance of male goat kids of Osmanabadi goat

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Abstract
The present investigation on studies on effect of feeding fresh Azolla (*Azolla pinnata*) on growth performance of male goat kids of Osmanabadi goat was conducted at Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur for period of 63 days. Six goat kids between (6 to 9) months of age were divided into 3 equal groups on the basis of nearness to age and body weight as T_1 (Natural Grazing + Conc. mixture 200 gm), T_2 (4 hrs Grazing + Conc. mixture of 150 gm + Fresh Azolla 100 gm) and T_3 (4 hrs Grazing + Conc. mixture of 100 gm + Fresh Azolla 200 gm), respectively. The average daily gain in body weight of experimental kids was more in T_3 (0.038 kg) followed by T_2 (0.036 kg) and less in T_1 (0.030 kg). The average total gain in body measurement (body height, body length and chest girth) was higher in treatment T_3 as compared to T_2 and T_1. From the result it may be concluded that supplementation of green Azolla (*Azolla pinnata*) and concentrate in the diet is beneficial to increase body weight gain and health of the experimental goat kids.

Keywords: *Azolla pinnata*, Chemical composition, Body weight gain, Body height, Body length, Chest girth

1. Introduction
Goat is one of the major livestock species contributing to 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 adverse environments (Dev *et al*., 2022) [4]. Among the diverse goat breeds present in India, Maharashtra is home to five notable breeds, namely Osmanabadi, Sangamneri, Surti, Konkan Kanyal and Berari. Osmanabadi, specifically found in regions Latur, Tuljapur and Udgir talukas of Osmanabad district and other districts of Marathwada, is primarily raised for meat production. The breed is considered useful both for meat and milk. Average meat yield is 40 to 45% and milk production is 180 lits in 210 days of lactation period. This breed holds significant market demand for its meat among the registered goat breeds in India, reflecting the preference for Osmanabadi goat meat.
Growth is a basic and shared characteristic of all living things. Every animal has a specific amount of growth and production potential of these hereditary traits can only be realized with appropriate management and nutrition to achieve sufficient growth. Genetics only account for thirty per cent growth, the remaining seventy per cent is determined by nutrition and management. Fodder and feed are used to supply protein source to the animals and also supplying energy, water, vitamins, minerals, different type's essential and non-essential amino acids. The search for alternatives to concentrates led to a wonderful plant Azolla, which the promise of providing a sustainable feed for livestock (Dongare *et al*., 2019) [5].
Azolla contents Crude protein 26.4%, Ether extract 3.42%, Crude fiber 15.96%, Nitrogen free extract 41.06% and total ash 14.86%. The carbohydrate and fat content of Azolla is very low. Its nutrient composition makes it a highly efficient and effective feed for livestock. It has been used for many years throughout to Asia and parts of Africa to feed pigs, ducks, chickens, cattle, fish, sheep and goat and rabbits. Animals fed with Azolla showed improved growth and overall health status.

2. Materials and Methods

The present investigation on studies on effect of feeding fresh Azolla (*Azolla pinnata*) on growth performance of male goat kids of Osmanabadi goat was conducted at Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur for period of 63 days. Six Osmanabadi goat kids between the age group of 6 to 9 months and weighing between 12 to 15 Kg were divided into 3 equal groups of 2 goat kids, in such a way that all the group were having approximately same body weight at the beginning of experiments.

Table 1: Details of allotment of treatment in feeding trials

Treatments	Details
T_1	Natural Grazing + Recommended dose of conc. mixture 200 gm
T_2	4 hrs Grazing + Conc. mixture of 150 gm + Fresh Azolla 100 gm
T_3	4 hrs Grazing + Conc. mixture of 100 gm + Fresh Azolla 200 gm

(Feeding of ad-lib Gram straw common in all treatments)

2.1 Records of observation

2.1.1 Weekly body weight

The body weight of experimental goat kids was recorded at the start of experiment for 3 consecutive days and then at weekly interval. The weight was taken in morning hours i.e. between 8 to 9 am before watering and feeding of goat kids on weighing balance.

2.1.2 Body measurement: Along with weight gain the following linear body measurement were taken at the end of each period for knowing the increment in growth of experimental goat kids. The measurements were recorded in centimeters by using standard tape.

A. Body height: It was recorded as the perpendicular distance between the ground level and point of wither. While measuring the height, the goat kid was made to stand easily on four legs on leveled ground.

B. Body length: It was recorded as the straight-line distance between the point of shoulders and the pin bone.

C. Chest girth: It was recorded as a circumference of chest and was measured just behind the elbow point passing through the wither point.

2.2 Statistical methods

The data was arranged in switch over design and analyzed by standard statistical method as per Amble (1975) [2].

Each experimental feed was given to the group of two goat kids in switch over manner for a period of 63 days. At the time of switch over of treatment to other period of 7 days was considered as an adjustment period. This was done to avoid the carry over effect of earlier treatment.

3. Results and Discussion

3.1. Chemical composition

Chemical composition of feedstuffs used in experimental period for feeding the goat kids is tabulated in Table 2.

Table 2: Chemical composition of experimental feeds fed to Osmanabadi goat kids (per cent on DM basis)

Sr. No.	Attributes	Concentrate mixture	Roughages	
			Azolla	Gram straw
1	DM	90.85	04.23	92.18
2	CP	18.20	23.45	06.05
3	CF	09.37	14.60	34.30
4	EE	07.99	03.80	05.50
5	NFE	55.36	33.63	46.15
6	Ash	08.36	24.22	08.00

It is observed from table 2 that, Azolla had higher CP content (23.45%) than concentrate mixture (18.20%) and gram straw (06.05%). The above result indicates that Azolla contains more protein than concentrate mixture and gram straw. However, CF content in Azolla and gram straw were 14.60 and 34.30 per cent while that of concentrate mixture which was 09.37 per cent. Moreover, the EE and NFE content of concentrate mixture was more than the content of Azolla and gram straw. The ash per cent Azolla and gram straw were 24.22 and 08.00 per cent while that of concentrate mixture was 08.36 per cent.

The majority of past research workers like Cherryl *et al.* (2014) [3], Gowda *et al.* (2015) [6], Roy *et al.* (2016) [9], Gupta *et al.* (2018) [7] and Prasad *et al.* (2021) [8] reported more or less similar type of composition of Azolla fed to ruminants. Thus, it can be revealed from Table 2 that Azolla is reasonably good source of energy and high source of protein to the animals.

3.2 Growth performance of Osmanabadi goat kids

The performance of goat kids by feeding Azolla, gram straw and along with concentrate mixture feedings was judged in terms of body weight and body measurement.

3.2.1 Body weight

The body weight gain of goat kids is shown in table 3.

Table 3: Mean gain in body weight of goat kids during experimental trial (kg)

Treatments	Initial body weight	Final body weight	Daily weight gain	Weekly weight gain
T_1	14.13	14.77	0.030	0.213
T_2	14.04	14.80	0.036	0.253
T_3	14.07	14.87	0.038	0.266
'F' test	N.S.	Sig.	N.S.	Sig.
S.E.(m)±	_	0.07	_	0.04
C.D. at 5% level	_	0.21	_	0.12

It was seen from data presented in table 3 that, the weight of kids at the beginning of the experimental trial, the initial body weight of kids in treatment T_1, T_2 and T_3 were 14.13, 14.04 and 14.07 kg, respectively while at the end of experimental period it was 14.77, 14.80 and 14.87 kg in treatment T_1, T_2 and T_3, respectively. The values observed for daily gain in body weight per goat kid were 0.030, 0.036 and 0.038 kg in treatment T_1, T_2 and T_3, respectively. The variation among different treatments was found statistically non-significant ($p<0.05$). Higher daily body weight gain (0.038) was noticed

in T_3 followed by T_2 and T_1. The corresponding values for average weekly body weight gain were 0.213, 0.253 and 0.266 kg in treatment T_1, T_2 and T_3, respectively. The variation among different treatments was found statistically significant ($P<0.05$). The average weekly body weight gain (0.266) was significantly ($P<0.05$) higher in goat kids of treatment group T_3 followed by T_2 and T_1. Higher total gain was noticed in T_3 indicated that supplementation of Azolla increased the growth rate of experimental goat kids.
More or less similar results noticed by Uparikar *et al*. (2012) [11].

Toradmal (2017) [10] recorded weekly gain in body weight per kid were 0.480, 0.487, 0.610 and 0.687 kg in treatment T_1, T_2, T_3 and T_4, respectively. The variation among different treatments was found to be statistically significant ($P<0.05$). The body weight gain was significantly ($P<0.05$) higher in goat kids of treatment group T_4, followed by T_3, T_2 and T_1.
The results are comparable with the findings of present study.

3.2.2 Body measurement

The result obtained in the terms of the body height, body length and chest girth are presented in table 4 and graphically presented in fig.1.

Table 4: Mean gain in body measurement of experimental goat kids at the end of each period under different treatments (cm)

Treatments	Initial height	Final height	Initial length	Final length	Initial chest girth	Final chest girth
T_1	58.76	61.25 (2.49)	38.07	39.25 (1.18)	55.13	56.31 (1.18)
T_2	58.58	61.25 (2.67)	38.02	39.23 (1.21)	55.01	56.30 (1.29)
T_3	59.01	62.08 (3.07)	38.04	39.31 (1.27)	55.01	56.33 (1.32)
'F' test	_	Sig.	_	Sig.	_	Sig.
S.E.(m)±	_	0.11	_	0.03	_	0.04
C.D. at 5% level	_	0.33	_	0.09	_	0.12

A. Body height: The gain in body height at wither point was found to be 2.49, 2.67 and 3.07 cm for the treatments T_1, T_2 and T_3, respectively. The variation among different treatment groups was found statistically significant.

B. Body length: The gain in body length for the treatments T_1, T_2 and T_3 were found to be 1.18, 1.21 and 1.27 cm, respectively. The variation among different treatment groups was found statistically significant.

C. Chest girth: The gain in chest girth was found to be 1.18, 1.29 and 1.32 cm, for the treatments T_1, T_2 and T_3, respectively. The variation among different treatment groups was found statistically significant.
Uparikar *et al*. (2012) [11] also observed an average daily gain in growth performance parameter (Body weight, height, length and chest girth) when goat kids fed with Gliricidia protenious tree leaves. The results of these investigation are comparable with the results of present study.
On the contrary, Toradmal (2017) [10] who noticed the significantly higher mean gain in body measurement (Chest girth, Body length, Body height) 6.81, 6.20 and 6.63 cm when goat kids fed with green Azolla.

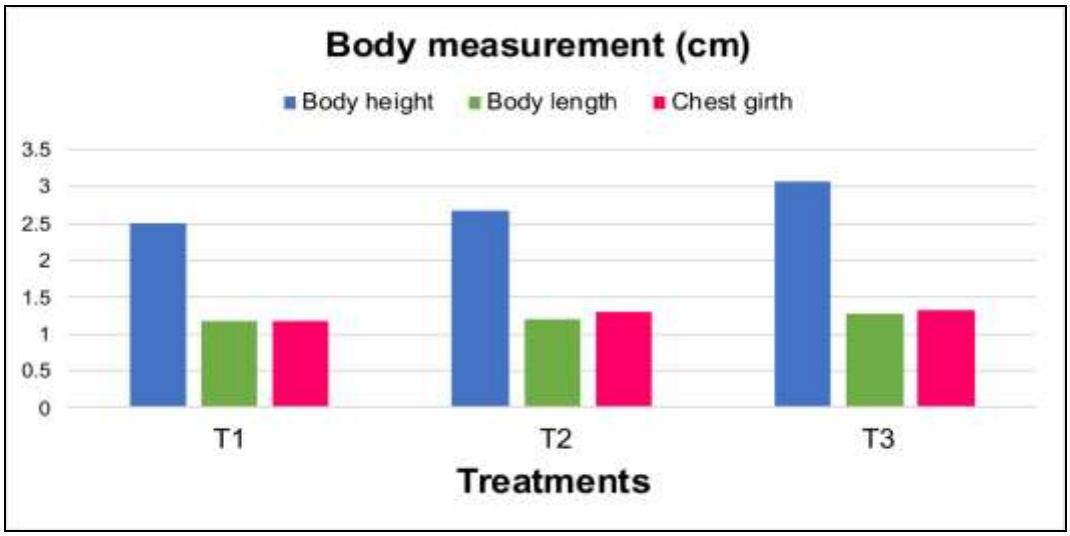

Fig 1: Mean gain in body measurement of experimental goat kids at the end of each period under different treatments (cm)

4. Conclusion

From the results it can be concluded that, the inclusion of Azolla in male goat kids of Osmanabadi goat as a feed supplementation was beneficial in improving the body weight and body measurement.

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