



# **Evaluating the Behaviour of Sahiwal Calves under *Azolla pinnata* Feeding During the Cold Season**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The purpose of the present research was to evaluate the feeding behaviour of Sahiwal calves raised under *Azolla pinnata* feeding throughout the cold season in the morning hours. Eighteen female Sahiwal calves weighing 56 kg at four months of age were used for this experiment, and they were split into three treatment groups. Treatment groups T1 and T2 received 15% and 30% of their concentrate's protein supplementation from *Azolla pinnata*, respectively, whereas the control group received diet that was complied with ICAR, 2013 feeding guidelines. Feeding behaviour of calves were analysed with the help of instantaneous scan sampling technique and weekly 8 hours of behaviour was recorded ( 2 hours in a day, four times per week) in early morning hours from

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09.00 to 11.00 am. Eating behaviour at 1st month of study was statistically significant in treatment groups T1 ( $26.5\pm 0.29$ ) and T2 group ( $26.5\pm 0.20$ ) as compared to control group ( $24.375\pm 0.23$ ) while numerically higher in treatment groups over the whole study period as *Azolla pinnata* has better mineral profiling and protein rich source, rumination time period was higher in T1 and T2 group and it might be due to the better resting behaviour in the treatment groups. However, better health status was reported in treatment groups over the control groups. From, this study it may be concluded that *Azolla pinnata* feeding may acts as an alternate protein source by improving the feeding and resting behaviour without affecting the overall performance of calves.

**Keywords:** *Azolla pinnata*; behaviour; calves; morning; Sahiwal.

## 1. INTRODUCTION

With the largest animal population in the world, India is mostly an agrarian country. One of the primary occupations in India that provides milk, manure, and draught power for agriculture is keeping animals. The fact that the offer of domesticated animals in agribusiness increased from 19% in 1980–81 to 26.4% in 2017–2018, despite the fact that the offer of farming division in the Indian GDP fell from 37% in 1980–81 to 27% in 2010–11, demonstrates the importance of domesticated animals. It makes up between 8.5 and 9.0 percent of the country's GDP [1]. Over two-thirds of the rural population in India depend on animal husbandry for their living, making it a vital component of the country's agriculture. Animals give nutrient-rich dairy products, draught energy for work, manure as an organic source and fuel, hides and skin, and are a consistent source of economic revenue for rural people. Cattle (35.94%), Buffalo (20.45%), Sheep (13.87%), Goat (27.80%), Pig (1.69%), and others (0.23%) made up the majority of the overall livestock population, according to the 20th Livestock Census. Sahiwal accounts for around 3.28% of the entire indigenous population according to the 19<sup>th</sup> Livestock Census. Sahiwal dairy cattle breed is regarded as one of the finest dairy in India. The breed gets its name from the Sahiwal region in Pakistan's Punjab district of Montgomery. Scarcity of green feed and fodder is seen as a key limitation to animal production in India, particularly in rural resource-poor areas. The biggest drawback in livestock production is a lack of feed, which is responsible for over half of all animal manufacturing losses in India. By 2025, it's expected that the 25% dry food and 65% green fodder shortage will be affecting native stocks [2]. With a 2% annual growth rate and the second-largest human population in the world, India is also responsible for the lack of feed and fodder. Of the country's total arable land, only 4% is used for fodder cultivation, which leads to a sharp decline in fodder accessibility.

Since feed is the largest outlay in animal husbandry, it plays a major role in determining profitability. Therefore, in most of India, crop residues—which are high in fibre, low in crude protein, and poor in nutritional quality—serve as the main source of feed for livestock. In these conditions, azolla can thrive since it requires little effort, occupies little ground, and yields year-round, high-quality nutrients. Azolla is the most widely distributed species in India and other tropical and temperate regions of the world. It grows everywhere in the world—in swamps, ponds, ditches, hot temperate and tropical climates, and even still, calm lakes and rivers [3]. Azolla is a high-protein source of provitamins and plant protein that can be fed to animals [4]. The nutritional value of azolla is widely acknowledged, as it provides nearly all essential amino acids needed for animal nutrition, especially lysine, and also includes macronutrients like calcium, magnesium, and potassium as well as vitamins like B12 and vitamin A (beta-carotene precursor) [5]. In situations when there is a shortage of green fodder, azolla can be a useful addition to dairy cattle's green feed to increase production in terms of development, milk, meat, etc. [6]. Till date very scanty literature is available on the effect of *Azolla pinnata* feeding on the behaviour of Sahiwal calves in early morning hours during cold season thus this research work was planned with the following objectives:

1. To study the effect of *Azolla pinnata* feeding on the feeding behaviour of Sahiwal calves
2. To investigate the effect of *Azolla pinnata* feeding on the incidence of health disorders

## 2. MATERIALS AND METHODS

In this investigation, eighteen Sahiwal female calves, weighing an average of  $56\pm 0.68$  kg at

birth, were used. Three experimental groups were randomly assigned to the calves, with six calves in each group. The animals were housed in separate pens on a concrete floor in a room with good ventilation. Before the trials began, the animals received the appropriate vaccinations and deworming treatments. The study ran for ninety days, or thirteen weeks, from November 1, 2018, to January 29, 2019. After a two-week adaptation period on the standard diet, the groups were fed the three different treatments for the duration of the 13-week (or 90-day) trial period. Treatment group (T1 and T2) was fed by replacing the 15%, 30% protein content of the concentrate with the *Azolla pinnata* and control group Tc was fed as per ICAR feeding standard (2013). Every group received iso-nitrogenous and iso-caloric diets, and each animal was fed on its own. Feeding was done three times a day, with concentrate mixture mixed with *Azolla* available at 9:00 AM and roughage mixed with wheat straw at 11:00 AM. Water and a mineral supplement were provided on an as-needed basis during the study. The left over feed was weighed every morning.

Behaviour of female Sahiwal calves was assessed in the morning hours from 09.00 to 11.00 am by using Sony handy-cam four times per week for whole study period immediately after providing concentrate mixture mixed with *Azolla pinnata*. Each treatment group was offered with separate feed alley and one feed alley was used for 6 calves. Behaviour was analysed by instantaneous scan sampling technique for the above mentioned time period i.e. 8 hrs/week (Total 13\*8= 104 hrs). Data were analysed with the help of SPSS software version 16.

### 3. RESULTS AND DISCUSSIONS

Feeding behaviour of Sahiwal calves under *Azolla pinnata* feeding at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> month of experiment is depicted below in Tables 1, 2, 3 and in the Figs. 1, 2 and 3, respectively.

#### 3.1 Feeding Behaviour in Different Months

Eating behaviour at 1<sup>st</sup> month of study was statistically significant in treatment groups T<sub>1</sub> (26.5±0.29) and T<sub>2</sub> group (26.5±0.20) as compared to control group (24.375±0.23) while numerically higher in treatment groups over the study period as *Azolla pinnata* has better mineral profiling and protein rich source and yet so far no work has been done related to our study. But, some researchers had done work on different feeding regimens and our results are in agreement with the results obtained by [7,8,9,10,11,12,13]. Rumination time period was higher in T<sub>1</sub> and T<sub>2</sub> group in the whole experiment period and it might be due to the better resting behaviour in the treatment groups. Our results are in contradictory to the results obtained by [14,15]. Thus, higher resting time period was observed in *Azolla pinnata* treatment groups and calves spent more time in resting and lesser standing duration as calves prefers to eat concentrate mixture mixed with *Azolla pinnata*. However, the overall average eating, rumination and resting behaviour were better and numerically higher in treatment groups while lower standing behaviour was observed in treatment groups.

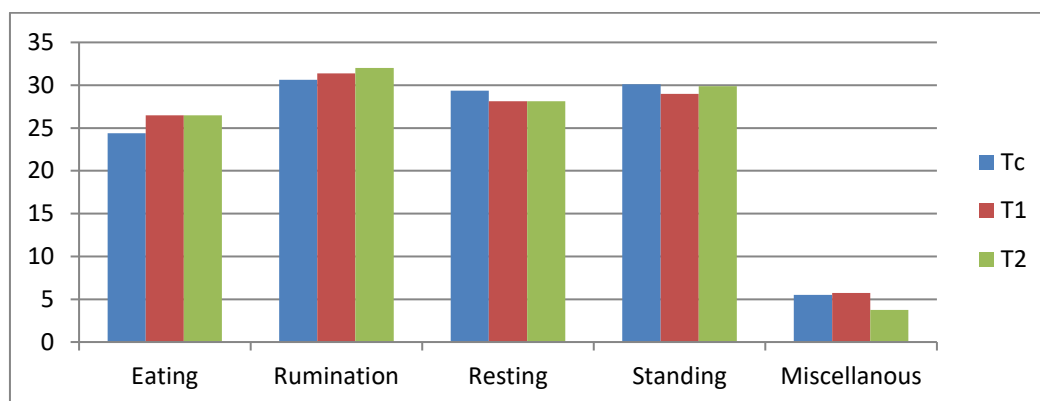
#### 3.2 Health Incidence

The number of health disorders reported in the study in terms of Diarrhoea, Pneumonia, parasitic infestation and mortality are depicted in the table 5. The number of diarrhoeal cases in all the groups was similar and it might be due the reason that *Azolla pinnata* feeding has higher moisture content and low dry matter. While, no case of pneumonia was reported in treatment groups and 1 case was reported in control group however, 3 cases of parasitic infestation reported in control group and 1, 2 cases were reported in T<sub>1</sub> and T<sub>2</sub> respectively due to *Azolla pinnata* feeding which is rich source of Antioxidants, better mineral profiling and acts as good immunomodulator. Our results of health incidence were in agreement to the results obtained by [16,17].

**Table 1. Feeding behaviour of Sahiwal calves under *Azolla pinnata* feeding at 1<sup>st</sup> month of experiment**

Parameters (Time in minutes)	Tc (n=6)	T1 (n=6)	T2 (n=6)
Eating	24.37 <sup>a</sup> ±0.23	26.50 <sup>b</sup> ±0.29	26.50 <sup>b</sup> ±0.20
Rumination	30.62±0.21	31.37±0.37	32.00±0.13
Resting	27.37±0.27	28.12±0.31	28.12±0.12
Standing	32.12±0.24	29.00±0.40	29.87±0.17
Miscellaneous	5.52±0.00	5.01±0.32	3.51±0.32

(Mean with different superscripts in a row differ significantly  $p < 0.05$ )

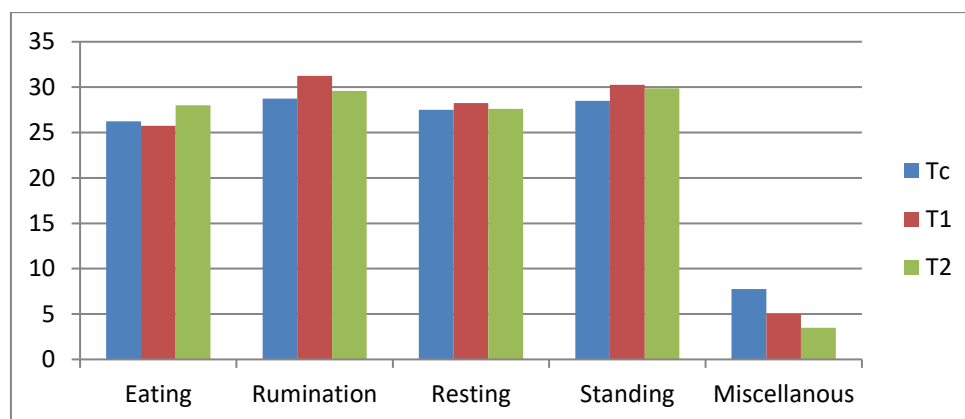


**Fig. 1. Feeding behaviour of Sahiwal calves under *Azolla pinnata* feeding at 1<sup>st</sup> month of experiment (X Axis-Different feeding behaviour parameters and Y Axis-Time duration (minutes))**

**Table 2. Feeding behaviour of Sahiwal calves under *Azolla pinnata* feeding at 2<sup>nd</sup> month of experiment**

Parameters (Time in minutes)	Tc (n=6)	T1 (n=6)	T2 (n=6)
Eating	26.25±0.47	25.75±0.62	28.00±0.73
Rumination	28.75±0.43	31.25±0.69	29.57±0.75
Resting	27.50±0.28	28.25±0.14	27.62±0.37
Standing	28.50±0.23	30.25±0.17	29.87±0.51
Miscellaneous	9.00±0.32	4.50±0.54	4.94±0.20

(Mean with different superscripts in a row differ significantly  $p < 0.05$ )

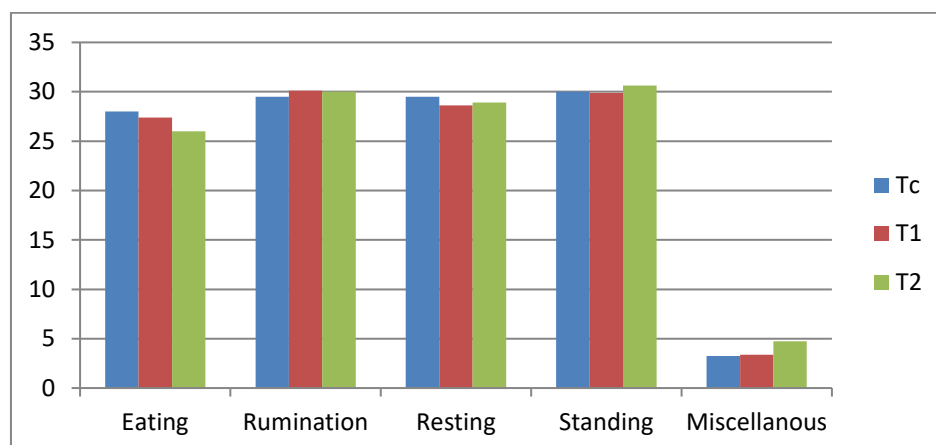


**Fig. 2. Feeding behaviour of Sahiwal calves under *Azolla pinnata* feeding at 1<sup>st</sup> month of experiment (X Axis-Different feeding behaviour parameters and Y Axis-Time duration (minute))**

**Table 3. Feeding behaviour of Sahiwal calves under *Azolla pinnata* feeding at 3<sup>rd</sup> month of experiment**

Parameters (Time in minutes)	Tc (n=6)	T1 (n=6)	T2 (n=6)
Eating	28.00±0.40	27.37±0.23	26.00±0.20
Rumination	29.50±0.36	30.12±0.21	30.00±0.17
Resting	27.50±0.20	28.62±0.55	28.90±0.33
Standing	32.02±0.18	29.87±0.57	30.62±0.31
Miscellaneous	2.98±0.32	4.02±0.23	4.48±0.32

(Mean with different superscripts in a row differ significantly  $p < 0.05$ )



**Fig. 3. Feeding behaviour of Sahiwal calves under *Azolla pinnata* feeding at 1<sup>st</sup> month of experiment(X Axis-Different feeding behaviour parameters and Y Axis-Time duration (minutes)**

**Table 4. Average Feeding behaviour of Sahiwal calves under *Azolla pinnata* feeding in the whole trial period**

Parameters (Time in minutes)	Tc (n=6)	T1 (n=6)	T2 (n=6)
Eating	26.20±1.04	26.54±0.46	26.83±0.60
Rumination	29.62±0.54	30.91±0.39	30.52±0.74
Resting	28.19±0.64	28.33±0.15	28.21±0.37
Standing	29.55±0.52	28.70±0.37	28.12±0.25
Miscellaneous	6.44±1.29	5.52±0.70	6.32±0.38

(Mean with different superscripts in a row differ significantly  $p < 0.05$ )

**Table 5. Health incidence *Azolla pinnata* (Numbers) reported during the study period**

Parameters	Tc	T <sub>1</sub>	T <sub>2</sub>
Diarrhoea	1	1	1
Pneumonia	1	0	0
Parasitic infestation	3	1	2
Mortality	0	0	0

#### 4. CONCLUSION

From, this study it may be concluded that *Azolla pinnata* feeding may acts as an alternate protein source by improving the feeding and resting behaviour without affecting the overall performance of calves.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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