Society of Krishi Vigyan
www.iskv.in

J Krishi Vigyan 2025, 13(4) : 653-657

DOI: 10.5958/2349-4433.2025.00115.5

ISSN 2319-6432 (Print)
ISSN 2349-6433 (Online)

Effect of *Spirulina platensis* Supplementation on Growth Performance and Nutrient Utilization in Osmanabadi Goats

Rajnish Kumar Yadav, Kiran Kumari[1], Archana[2], Prasanna Pal[3] and M K Gendley
Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry,
Chhattisgarh Kamdhenu Vishwavidyalaya, Durg-491001, (Chhattisgarh), India

ABSTRACT

An experiment was conducted to evaluate the effect of *Spirulina platensis* supplementation on growth performance and nutrient utilization in Osmanabadi goats. Eighteen healthy kids (3–4 m old, 9–10 kg BW) were divided into three groups: T0 (control, basal diet), T1 (basal diet + 0.25% Spirulina), and T2 (basal diet + 0.50% Spirulina). The feeding trial lasted 90 d, followed by a 7-day metabolism trial. Parameters studied included body weight gain, average daily gain (ADG), dry matter intake (DMI), nutrient digestibility, nitrogen balance, and feed conversion ratio (FCR). Spirulina supplementation improved body weight gain and ADG numerically, with Group T2 showing higher values compared to control. Digestibility coefficients of DM, CP, CF, EE, and NFE were statistically similar across groups, while nitrogen retention (%) was significantly higher in T1 compared to T0 and T2. It may be concluded that Spirulina supplementation up to 0.5% of dry matter intake can be safely included in the diet of Osmanabadi goats without adverse effects on growth performance and/or nutrient utilization.

Keywords: Growth performance, Nutrient utilization, *Spirulina platensis*, Osmanabadi goats.

INTRODUCTION

Goats are important livestock species contributing to rural economy, nutrition security, and livelihoods of small and marginal farmers in India. They are often referred to as the poor man's cow due to their wide ecological adaptability and role in sustaining landless laborers and marginal households. India ranks second globally in goat population, with about 135.7 million goats, representing 15.36% of the world's goat population (Bharathidhasan *et al,* 2013). Osmanabadi goats, a recognized dual-purpose breed, are valued for both meat and milk production and play a significant role in smallholder farming systems.

The rising demand for animal products, coupled with the increasing cost and limited availability of conventional protein sources such as soybean meal, groundnut cake, and fish meal, has created the need to explore unconventional feed supplements. Identification of new feed resources with high nutritive value, better conversion efficiency, and functional properties is crucial for sustainable livestock production (Godfray *et al,* 2010; Poppi and McLennan, 2010).

Spirulina platensis, a filamentous blue-green microalga, has emerged as a promising alternative feed resource. It contains 65–70% crude protein of high biological value (Lordan *et al,* 2011), essential amino acids, vitamins (notably B12 and provitamin A), minerals (especially iron), and essential fatty acids such as γ-linolenic acid (Gouveia *et al* 2008). In addition, Spirulina is rich in bioactive compounds like β-carotene, phycocyanin, and polysaccharides, which exhibit antioxidant, immunomodulatory, and hypolipidemic properties (Belay, 2002; Wang *et al,* 2007). These attributes make Spirulina a functional feed supplement for both humans and animals.

Previous studies have demonstrated beneficial effects of Spirulina supplementation in different species. In poultry, Spirulina enhanced egg yolk pigmentation, feed efficiency, and immune functions (Qureshi *et al,* 1996; Mariey *et al,* 2012). In rabbits, inclusion of Spirulina improved carcass traits and nutrient digestibility (Peiretti and Meineri, 2011). In lambs, Spirulina supplementation significantly increased body weight gain, feed intake, and antioxidative status (El-Sabagh *et al,* 2014). However, limited information is available on its effect in goats,

Corresponding Author's Email - kumarikiran723@gmail.com
1 Department of Animal Nutrition, College of Veterinary and Animal Sciences, Bihar Animal Sciences University, Kishanganj, Bihar-855107, India
2 Department of Pharmacology & Toxicology, Bihar Veterinary College, Bihar Animal Sciences University, Patna, Bihar-800014, India
3 Department of Veterinary Physiology, College of Veterinary and Animal Sciences, Bihar Animal Sciences University, Kishanganj, Bihar-855107, India

Table 1. Ingredient composition of concentrate mixture and berseem hay.

Feed ingredients	Treatment groups		
	T_0 (control)	T_1 0.25 % SP	T_2 0.5% SP
Ingredient composition of concentrate mixture			
Yellow maize	43	43	43
Deoiled soybean meal	32	32	32
Deoiled rice bran	22	22	22
Mineral mixture	2	2	2
Salt	1	1	1
Total	100	100	100
Composition of diet (% on DM basis)			
Concentrate mixture	40	40	40
Berseem hay	60	60	60

Table 2. Chemical composition of concentrate mixture, Berseem hay and *Spirulina platensis* (% on DM basis).

Particulars	Concentrate mixture	Berseem hay	*Spirulina platensis*	Total mixed feed
DM	89.57	87.69	98.58	88.74
Moisture	10.43	12.31	1.42	11.26
CP	19.26	13.10	57.68	14.25
EE	2.75	1.30	1.18	1.88
CF	6.50	26.91	4.73	20.42
Total Ash	11.94	13.54	6.43	9.68
Ca	1.35	2.03	0.21	1.98
P	1.56	0.28	0.13	1.02

particularly indigenous breeds such as Osmanabadi. Therefore, the present study was undertaken to evaluate the effect of *Spirulina platensis* supplementation on growth performance and nutrient utilization in Osmanabadi goats.

MATERIALS AND METHODS

The study was conducted at the goat unit of Krishi Vigyan Kendra, Chhattisgarh Kamdhenu Vishwavidyalaya, Anjora, Durg (Chhattisgarh). A total of eighteen healthy Osmanabadi kids aged 3–4 m with an average body weight of 9–10 kg were selected for the experiment. The animals were ear-tagged for identification and housed in a well-ventilated shed under hygienic conditions with provision for individual feeding.

Dietary Treatments

The kids were randomly divided into three groups of six animals each. The treatment groups were: T0 (Control): Basal diet without Spirulina supplementation,T1**:** Basal diet + *Spirulina platensis* @ 0.25% of dry matter intake (DMI) and T2: Basal diet + *Spirulina platensis* @ 0.50% of DMI. The basal diet consisted of berseem hay and concentrate mixture in a 60:40 ratio. Concentrate mixture consisted of commonly available feed ingredients: crushed yellow maize 43%, soya deoiled cake 32%, deoiled rice bran 22%, mineral mixture 2% and salt 1% (Table 1). Water was provided ad libitum. Spirulina powder was procured from a commercial source and administered daily to the treatment groups. All the animals were stall-fed with a basal diet to meet their nutrients requirements for growth of 40-70 g/d. Out of the three groups, first group served as control (T0). In case of control group (T0) no supplementation of Spirulina was done. While, in treatment groups of goats Spirulina was supplemented @ 0.25% (T1) and 0.5% (T2) of DMI, respectively. Chemical composition of concentrate mixture, Berseem hay and *Spirulina platensis* (% on DM basis) has been presented in Table 2.

Experimental Design and Duration

The feeding trial was carried out for 90 d. After 75 d of feeding, a metabolism trial of 7 d duration was conducted to assess nutrient digestibility and nitrogen

Table 3. Effect of *Spirulina platensis* supplementation on fortnightly dry matter intake (g/day/goat) in different groups of goats

Period (day)	Treatments groups			Sig
	T_0 (Control)	T_1 (0.25 % SP)	T_2 (0.50 % SP)	
0-15	359.50±42.74	346.50±32.11	362.50±32.67	NS
15-30	431.83±31.40	395.33±18.80	413.00±24.23	NS
30-45	465.67±29.40	515.00±12.10	477.00±31.56	NS
45-60	602.16±32.46	569.67±35.35	594.34±36.32	NS
60-75	620.83±9.84	615.83±18.53	606.00±28.75	NS
75-90	669.50±18.15	657.50±15.35	660.16±37.04	NS

NS= non-significant

Table 4. Growth performance in different groups of goats during the feeding trial (90 days).

Attribute	Treatments groups			Sig.
	T_0 (Control)	T_1 (0.25 % SP)	T_2 (0.50 % SP)	
Initial BW (kg)	9.58±0.69	10.35±0.67	10.08±0.73	NS
Final BW (kg)	14.26±0.36	15.03±0.40	15.09±0.84	NS
TBW gain (kg)	4.68±0.77	4.70±0.27	5.01±0.29	NS
ADG (g/d)	52.00±4.62	52.22±4.71	55.67±6.81	NS
Avg. DMI (g/d)	524.63±9.41	516.50±4.16	518.83±6.32	NS
FCR	10.26±0.65	10.21±0.48	9.64±0.53	NS

NS= Non-significant

balance. During the trial, animals were housed in metabolic cages designed for separate collection of feed residues, faeces, and urine.

Parameters Studied

The parameters recorded were growth performance (Body weight, average daily gain (ADG), feed conversion ratio (FCR)), nutrient utilization (Dry matter intake (DMI), nutrient digestibility, nitrogen balance), blood and biochemical parameters (Hematology, serum protein fractions, creatinine, lipid profile), antioxidant status (Erythrocytic catalase and superoxide dismutase activities) and immunity (Cell-mediated immune response assessed by phytohaemagglutinin (PHA) skin test).

Statistical Analysis

Data were analyzed using analysis of variance under a completely randomized design. Differences among treatment means were tested using Duncan's multiple range test (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Growth Performance

The results pertaining to growth performance of Osmanabadi kids under different dietary treatments are presented in Table 4. The initial body weight of Osmanabadi kids ranged between 9.58–10.35 kg across groups. At the end of the 90-day feeding trial, the final body weights were 14.26 kg (T0), 15.03 kg (T1), and 15.09 kg (T2). Average daily gain (ADG) was numerically higher in Spirulina-supplemented groups, with T2 recording 55.67 g/day compared to 52.00 g/day in control. Feed conversion ratio (FCR) was improved in T2 (9.64) compared to T0 (10.26), although the differences were not statistically significant.

These results indicate that Spirulina supplementation had a positive influence on growth performance, though the improvement was modest. El-Sabagh *et al* (2014) observed significant increase in body weight and ADG in lambs supplemented at higher levels of supplementation. The variation across species may be attributed to differences in dosage and physiological response.

Table 5. Digestibility coefficients (%) of dry matter, crude protein, crude fibre, ether extract and NFE in Osmanabadi kids fed diets with *Spirulina supplementation.*

Treatment	DM	CP	CF	EE	NFE
T0	62.10	65.45	58.20	60.12	63.50
T1	63.00	66.10	59.00	61.00	64.20
T2	62.50	65.80	58.70	60.50	63.80

Table 6. Nitrogen retention, calcium balance and phosphorus balance in Osmanabadi kids under different levels of *Spirulina supplementation.*

Treatment	N Retention (%)	Ca Balance (g/day)	P Balance (g/day)
T0	72.09	2.15	1.08
T1	73.85	2.20	1.10
T2	68.81	2.18	1.09

Nutrient Utilization

To assess the effect of Spirulina supplementation on feed utilization efficiency, digestibility trials and balance studies were conducted. The digestibility coefficients of dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), and nitrogen-free extract (NFE) did not differ significantly among the treatment groups. Values ranged between 62.10–63.00% for DM, 65.45–66.10% for CP, and 58.20–59.00% for CF, indicating that Spirulina supplementation had no marked effect on nutrient digestibility.

Nitrogen balance results revealed significant differences among treatments. Nitrogen retention was highest in T1 (73.85%), followed by T0 (72.09%), while T2 recorded the lowest value (68.81%). Calcium and phosphorus balances remained comparable across groups, with values ranging between 2.15–2.20 g/day for Ca and 1.08–1.10 g/day for P.

The improved nitrogen retention in T1 suggests better protein utilization at moderate Spirulina inclusion levels. Similar observations were made by Shaeid *et al* (2013) in pigs where Spirulina supplementation did not significantly alter nutrient digestibility but improved nitrogen balance. On the other hand, Zhang *et al* (2010) reported reduced ruminal degradation of crude protein in dairy cows supplemented with Spirulina, highlighting species-specific responses.

CONCLUSION

The present study provides evidence on the effect of *Spirulina platensis* supplementation in Osmanabadi goats. Supplementation at 0.25% and 0.50% of dry matter intake did not significantly alter growth performance or nutrient digestibility, although numerical improvements in body weight gain, average daily gain, and feed conversion ratio were observed in the Spirulina-fed groups. Nitrogen retention was significantly higher at 0.25% inclusion, indicating better protein utilization at moderate levels. Calcium and phosphorus balances remain unaffected. It may be concluded that Spirulina supplementation up to 0.5% of dry matter intake can be safely included in the diet of Osmanabadi goats without adverse effects on growth or nutrient utilization. Further studies with higher levels of supplementation and larger sample sizes may help to establish its potential as a functional feed supplement in goat production systems.

REFERENCES

AOAC (2000). *Official Methods of Analysis*, 17th ed. Association of Official Analytical Chemists, Washington D.C., USA.

Belay A (2002). The potential application of Spirulina (*Arthrospira*) as a nutritional and therapeutic supplement in health management. *J Am Nutraceut Assoc* **5**: 27–48.

Bharathidhasan A, Vishwanthan K, Valli C, Pugazhenthi T R and Ezhilvalavan S (2013). Importance of feeding programs for goats to augment the production. *Pashudhan* **39** (6): 3–7.

El-Sabagh M R, Abd Eldaim M A, Mahboub D H and Abdel-Daim M (2014). Effects of *Spirulina platensis* algae on growth performance, antioxidative status and blood metabolites in fattening lambs. *J Agri Sci* **6** (3): 92–98.

Godfray H C J, Crute I R, Haddad L, Lawrence D, Muir J F, Nisbett N, Pretty J, Robinson S, Toulmin C and Whiteley R (2010). The future of the global food system. *Philos Trans R Soc B* **365**: 2769–2777.

Gouveia L, Batista A P, Sousa I, Raymundo A and Bandarra N M (2008). Microalgae in novel food products. In: Papadopoulos K N (Ed.) *Food Chemistry Research Developments*. Nova Science Publishers, Hauppauge, USA.

Lordan S, Ross R P and Stanton C (2011). Marine bioactives as functional food ingredients: potential to reduce the incidence of chronic diseases. *Mar Drugs* **9**: 1056–1100.

Mariey Y A, Samak H R and Ibrahem M A (2012). Effect of using *Spirulina platensis* algae as a feed additive for poultry diets: Productive and reproductive performance of local laying hens. *Egypt Poult Sci J* **32**(1): 201–215.

Peiretti P G and Meineri G (2011). Effects of diets with increasing levels of *Spirulina platensis* on carcass characteristics, meat quality and fatty acid composition of growing rabbits. *Livest Sci* **140**: 218–224.

Poppi D P and McLennan S R (2010). Nutritional research to meet future challenges. *Anim Prod Sci* **50**: 329–338.

Qureshi M A, Garlich J D and Kidd M T (1996). Dietary *Spirulina platensis* enhances humoral and cell-mediated immune functions in chickens. *Immunopharmacol Immunotoxicol* **18**: 465–476.

Shaeid A, Chojnacka K, Korniłłowicz D and Dobrzanski Z (2013). Effect of supplementation of *Spirulina maxima* enriched with Cu on production performance, metabolic and physiological parameters in fattening pigs. *J Appl Phycol* **25**: 1607–1617.

Snedecor G W and Cochran W G (1994). *Statistical Methods*, 8th ed. Iowa State University Press, Ames, Iowa, USA.

Wang L, Pan B, Sheng J, Xu J and Hu Q (2007). Antioxidant activity of *Spirulina platensis* extracts by supercritical carbon dioxide extraction. *Food Chem* **105**: 36–41.

Zhang J, Miao S, Huang S and Li S L (2010). Effect of different levels of Spirulina on ruminal internal environment and degradation of fibre in dairy cows. *China Cattle Sci* **36**: 32–36.

Received on 26/11/2025 Accepted on 18/12/2025