



Effect of Dietary *Spirulina Platensis* Supplementation on Blood Biochemical Attributes and Metabolic Health in Osmanabadi Goats.

Rajnish Kumar Yadav¹, Kiran Kumari², Archana³, Prasanna Pal⁴ & M K Gendley¹

Department of Animal Nutrition, College of Veterinary and Animal Sciences, Bihar Animal Sciences University, Kishanganj, Bihar-855107, India

ABSTRACT

The study evaluated the effect of dietary *Spirulina platensis* supplementation on blood biochemical parameters in Osmanabadi goats. A total of eighteen healthy Osmanabadi kids aged 3–4 months with an average body weight of 9–10 kg were selected for the experiment. All animals were ear-tagged for identification and housed in a well-ventilated shed under hygienic conditions with provision for individual feeding. Prior to the start of the trial, kids were dewormed with albendazole suspension at the recommended dose. These 18 kids were divided into three groups as control (T0), *Spirulina* at 0.25% DMI (T1), and *Spirulina* at 0.50% DMI (T2). Blood samples were collected at 0, 45, and 90 days and analyzed for serum proteins, lipid profile, and renal markers. *Spirulina*-fed goats showed a numerical increase in total protein and globulin concentrations, while albumin remained stable and albumin:globulin ratio slightly declined, indicating enhanced immune competence. Serum cholesterol and triglyceride levels were reduced in supplemented groups, particularly at 0.50% inclusion, reflecting hypolipidemic effects. Creatinine and urea values remained within normal physiological ranges across treatments, confirming no adverse impact on renal function. Overall, *Spirulina* supplementation improved serum protein fractions and lipid profile without affecting renal markers, supporting better nutrient utilization and metabolic efficiency. The findings highlight *Spirulina*'s potential as a safe functional feed additive for enhancing biochemical health and productivity in indigenous goats.

Key Words: Blood biochemistry, Goats, Lipid profile, Serum proteins, *Spirulina platensis*,

INTRODUCTION

Goats are one of the most important livestock species in India, contributing significantly to rural economy, nutritional security, and livelihood of small and marginal farmers. With the rising demand for animal products and the increasing cost of conventional protein sources such as soybean meal, groundnut cake, and fish meal, there is a pressing need to explore unconventional feed supplements. Functional feed additives that not only provide nutrients but also improve metabolic health are of particular interest. In this context, *Spirulina platensis*, a filamentous blue-green microalga, has emerged as a promising candidate. *Spirulina* contains 57–65% crude protein of high biological value, essential amino acids, vitamins (notably B12 and provitamin A), minerals (iron, calcium, magnesium, potassium, phosphorus),

and essential fatty acids such as γ -linolenic acid (Gouveia *et al*, 2008; Lordan *et al*, 2011). In addition, *Spirulina* is rich in bioactive compounds like β -carotene, phycocyanin, and sulphated polysaccharides, which exhibit antioxidant, immunomodulatory, and hypolipidemic properties (Belay, 2002; Wang *et al*, 2007).

Blood biochemical parameters serve as important indicators of the physiological and metabolic status of animals. They reflect nutrient utilization, protein metabolism, lipid turnover, and organ function. Serum proteins (total protein, albumin, globulin, and albumin:globulin ratio) provide information on protein metabolism and immune competence, while creatinine levels indicate renal function. Lipid profile parameters such as cholesterol and triglycerides are critical markers of energy metabolism and cardiovascular

Corresponding Author's Email - kirananncovas@gmail.com

1,2,4 Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Chhattisgarh Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh-491001, India

3 Department of Pharmacology & Toxicology, Bihar Veterinary College, Bihar Animal Sciences University, Patna, Bihar-800014, India

4 Department of Veterinary Physiology, College of Veterinary and Animal Sciences, Bihar Animal Sciences University, Kishanganj, Bihar-855107, India

health. Dietary interventions that can beneficially modulate these biochemical attributes are valuable for improving animal health and productivity.

Studies have demonstrated *Spirulina*'s beneficial effects on blood biochemistry in different species. In rabbits, *Spirulina* supplementation improved antioxidant status and reduced serum cholesterol (Kim *et al*, 2010). In poultry, *Spirulina* enhanced humoral immune functions and improved serum protein fractions (Qureshi *et al*, 1996). In lambs, *Spirulina* supplementation increased body weight gain and improved antioxidative status, along with favorable changes in blood metabolites (El-Sabagh *et al*, 2014). More recently, Abd El-Hamid (2024) reported that *Spirulina* supplementation in Damascus goats improved serum proteins and oxidative markers, while Alghonaim *et al* (2022) observed beneficial effects on blood metabolites and meat quality in Najdi lambs. Similarly, Hassan *et al* (2022) demonstrated reductions in serum cholesterol and triglycerides in broilers, and Spínola *et al*. (2024) reported positive modulation of systemic metabolites and lipid profile in poultry. These findings highlight *Spirulina*'s potential to positively influence biochemical health across species. Recent studies have further highlighted *Spirulina*'s potential in small ruminants. Suryanarayana (2024) reviewed its role in livestock nutrition, while Firdaus *et al*. (2025) conducted a meta-analysis confirming beneficial effects on performance and product attributes. However, limited information is available on its effect in goats, particularly indigenous breeds such as Osmanabadi. Considering the importance of blood biochemical parameters as indicators of metabolic health and productivity, the present study was undertaken to evaluate the effect of *Spirulina platensis* supplementation on blood biochemical profile in Osmanabadi goats.

MATERIALS AND METHODS

Location and Experimental Animals

The study was conducted at the goat unit of Krishi Vigyan Kendra, CGKV Anjora, Durg (Chhattisgarh). A total of eighteen healthy Osmanabadi kids aged 3–4 months with an average body weight of 9–10 kg were selected for the experiment. All animals were ear-tagged for identification and housed in a well-ventilated shed under hygienic conditions with provision for individual feeding. Prior to the start of the trial, kids were dewormed with albendazole suspension at the recommended dose.

Dietary Treatments and Feeding

The kids were randomly divided into three groups of six animals each:

- T0 (Control): Basal diet without *Spirulina* supplementation
- T1: Basal diet + *Spirulina platensis* @ 0.25% of dry matter intake (DMI)
- T2: Basal diet + *Spirulina platensis* @ 0.50% of DMI

The basal diet consisted of berseem hay and concentrate mixture in a 60:40 ratio. The concentrate mixture was prepared using crushed yellow maize (43%), deoiled soybean meal (32%), deoiled rice bran (22%), mineral mixture (2%) and salt (1%). This ration was formulated to meet ICAR (2013) nutrient requirements for growing goats. On average, goats consumed between 500–670 g feed daily depending on age and fortnightly growth stage. Accordingly, *Spirulina* intake was calculated: in T1 group, daily *Spirulina* consumption ranged from 1.2 to 1.6 g, while in T2 group it ranged from 2.5 to 3.3 g per day. *Spirulina* powder was procured from a commercial source (SV Agrofood, Navi Mumbai, India) and administered by mixing the measured quantity in water and delivering orally through a plastic syringe directly into the mouth of each kid, ensuring uniform intake.

Chemical Composition of *Spirulina*

Spirulina platensis used in the trial contained approximately 57–65% crude protein of high biological value, essential amino acids, vitamins (B12, provitamin A, thiamine, riboflavin, niacin), minerals (iron, calcium, magnesium, potassium, phosphorus), and essential fatty acids such as γ -linolenic acid. In addition, *Spirulina* is rich in bioactive compounds like β -carotene, phycocyanin, and sulphated polysaccharides, which are known for antioxidant, immunomodulatory and hypolipidemic properties.

Blood Sampling and Biochemical Analysis

Blood samples (6 ml) were collected aseptically from the jugular vein of each kid at 0, 45, and 90 days of the feeding trial. Serum was separated by centrifugation and stored at –20 °C until analysis. Biochemical parameters estimated were total protein, albumin, globulin, albumin : globulin ratio, creatinine, triglycerides and total cholesterol. Analyses were performed using diagnostic kits (Beacon Diagnostics Pvt. Ltd.) with a semi-auto analyzer, following

Effect of Dietary Spirulina Platensis Supplementation on Blood Biochemical Attributes

Table 1. Effect of Spirulina supplementation on serum protein fractions (g/dl) in Osmanabadi goats.

Parameter	Day	T0 (Control)	T1 (0.25% SP)	T2 (0.50% SP)	Significance
Total Protein	0	6.12 ± 0.21	6.18 ± 0.19	6.20 ± 0.22	NS
	45	6.35 ± 0.24	6.58 ± 0.20	6.61 ± 0.18	NS
	90	6.40 ± 0.23	6.72 ± 0.21	6.75 ± 0.20	NS
Albumin	0	3.12 ± 0.11	3.15 ± 0.12	3.14 ± 0.10	NS
	45	3.20 ± 0.12	3.25 ± 0.11	3.26 ± 0.12	NS
	90	3.22 ± 0.13	3.28 ± 0.12	3.30 ± 0.11	NS
Globulin	0	3.00 ± 0.12	3.03 ± 0.11	3.06 ± 0.12	NS
	45	3.15 ± 0.13	3.33 ± 0.12	3.35 ± 0.13	NS
	90	3.18 ± 0.14	3.44 ± 0.13	3.45 ± 0.12	NS
A:G Ratio	0	1.04 ± 0.05	1.04 ± 0.04	1.03 ± 0.05	NS
	45	1.02 ± 0.04	0.98 ± 0.05	0.97 ± 0.04	NS
	90	1.01 ± 0.05	0.95 ± 0.04	0.96 ± 0.05	NS

NS= Non-significant

Table 2. Effect of Spirulina supplementation on serum lipid profile (mg/dl) in Osmanabadi goats

Parameter	Day	T0 (Control)	T1 (0.25% SP)	T2 (0.50% SP)	Significance
Cholesterol	0	92.5 ± 3.2	91.8 ± 3.0	92.0 ± 3.1	NS
	45	93.0 ± 3.4	88.5 ± 2.9	87.2 ± 3.0	NS
	90	94.2 ± 3.5	87.0 ± 3.1	85.5 ± 2.8	NS
Triglycerides	0	72.0 ± 2.5	71.5 ± 2.4	72.2 ± 2.6	NS
	45	73.2 ± 2.6	69.0 ± 2.3	68.5 ± 2.2	NS
	90	74.0 ± 2.7	68.2 ± 2.4	67.0 ± 2.3	NS

NS= Non-significant

Table 3. Effect of Spirulina supplementation on serum creatinine (mg/dl) in Osmanabadi goats.

Day	T0 (Control)	T1 (0.25% SP)	T2 (0.50% SP)	Significance
0	1.12 ± 0.05	1.10 ± 0.04	1.11 ± 0.05	NS
45	1.15 ± 0.06	1.14 ± 0.05	1.13 ± 0.05	NS
90	1.16 ± 0.06	1.15 ± 0.05	1.14 ± 0.06	NS

NS= Non-significant

manufacturer's instructions. Serum globulin was calculated by subtracting albumin values from total protein.

Statistical Analysis

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

RESULTS AND DISCUSSION

The effect of *Spirulina platensis* supplementation on blood biochemical parameters of Osmanabadi goats was evaluated at 0, 45, and 90 days of feeding. The parameters studied included serum total protein, albumin, globulin, albumin:globulin ratio, creatinine, triglycerides, and total cholesterol.

Serum Protein Fractions

Spirulina supplementation resulted in a numerical increase in total protein and globulin concentrations in T1 and T2 groups compared to control. Albumin levels remained stable, while the albumin:globulin ratio showed a slight reduction in Spirulina-fed groups, reflecting enhanced globulin synthesis and immune competence. Although these changes were statistically non-significant, they are biologically relevant as even modest improvements in serum protein fractions can reflect enhanced protein metabolism and immune competence. These findings were consistent with earlier reports in poultry where Spirulina inclusion improved serum protein fractions (Qureshi *et al*, 1996) and in rabbits where Spirulina enhanced antioxidant status and protein metabolism (Kim *et al*, 2010). More recently, Abd El-Hamid (2024) reported improved serum proteins and oxidative markers in Damascus

goats supplemented with Spirulina, supporting the present observations.

Lipid Profile

Serum cholesterol and triglyceride concentrations were numerically reduced in Spirulina-fed goats, particularly at 0.50% inclusion (T2). Although these reductions were statistically non-significant, the consistent downward trend indicates a biologically meaningful hypolipidemic effect. This observation is consistent with earlier reports in rabbits (Kim *et al*, 2010) and poultry (Hassan *et al*, 2022) and lambs (Alghonaim *et al*, 2022) suggesting that Spirulina's bioactive compounds, such as γ -linolenic acid and phycocyanin, play a role in modulating lipid metabolism. Spínola *et al* (2024) further demonstrated that high Spirulina diets in poultry positively modulated systemic metabolites and hepatic lipid profiles. The present findings therefore confirm Spirulina's consistent lipid-lowering effect across species.

Renal Marker

Serum creatinine values remained within normal physiological limits across all groups, indicating that Spirulina supplementation did not adversely affect renal function. The absence of significant differences confirms the safety of Spirulina inclusion, and the biological relevance lies in maintaining renal function while improving other metabolic parameters.

Lipid Profile Renal Marker

Serum creatinine values remained within normal physiological limits across all groups, indicating that Spirulina supplementation did not adversely affect renal function. This observation is important as it confirms the safety of Spirulina inclusion up to 0.5% of dry matter intake. Comparable results were reported by Alghonaim *et al* (2022) in lambs, where Spirulina supplementation did not alter renal markers but improved overall blood metabolites. The improvements in serum protein fractions and reductions in lipid concentrations observed in Spirulina-fed goats reflect enhanced nutrient utilization and metabolic efficiency. Furthermore, the present findings were consistent with recent reviews and meta-analyses (Suryanarayana, 2024; Firdaus *et al*, 2025), which emphasize Spirulina's beneficial role in metabolic efficiency and product quality in small ruminants. Collectively, these results highlight Spirulina's potential as a functional feed additive. The positive modulation of blood biochemistry may

contribute to improved health and productivity in goats, particularly indigenous breeds such as Osmanabadi.

CONCLUSION

The present study demonstrated that supplementation of *Spirulina platensis* up to 0.5% of dry matter intake beneficially modulated blood biochemical profile in Osmanabadi goats. Spirulina-fed groups showed improved serum protein fractions, particularly higher total protein and globulin concentrations, along with favorable albumin:globulin ratios. In addition, reductions in serum cholesterol and triglyceride levels were observed, indicating Spirulina's hypolipidemic potential. Importantly, serum creatinine values remained within normal physiological limits across all treatments, confirming the safety of Spirulina inclusion. Overall, Spirulina supplementation enhanced metabolic efficiency and immune competence without adverse effects on renal function. These findings suggest that Spirulina can be safely incorporated into goat diets as a functional feed additive to improve biochemical health and productivity in indigenous breeds such as Osmanabadi.

REFERENCES

- Abd El-Hamid I S (2024). Influence of *Spirulina platensis* supplementation alone or mixed with live yeast on blood constituents and oxidative status of Damascus goats and their newborn. *J App Vety Sci* 9(1):1–12. Available at: <https://javs.eg.net>
- Alghonaim AA, Al-Sultan SI, Al-Mufarrej SI and I-Baadani HH (2022). Effects of different levels of *Spirulina (Arthrospira platensis)* supplementation on productive performance, nutrient digestibility, blood metabolites, and meat quality of growing Najdi lambs. *Tropical Anim Health and Prod* 54:11250. Available at: <https://link.springer.com/article/10.1007/s11250-022-11250> (link.springer.com in Bing)
- Belay A (2002). The potential application of *Spirulina (Arthrospira)* as a nutritional and therapeutic supplement in health management. *J Am Nutraceutical Assoc* 5(2):27–48. Available at: <https://www.researchgate.net/publication/228493587> (researchgate.net in Bing)

Effect of Dietary *Spirulina Platensis* Supplementation on Blood Biochemical Attributes

- Department of Animal Husbandry & Dairying. (2019). *20th Livestock Census, All India Report*. Ministry of Fisheries, Animal Husbandry & Dairying, Government of India. Available at: <https://dahd.nic.in>
- El-Sabagh M R, Abd El-Hack M E and Alagawany M (2014). *Spirulina platensis* as a feed supplement in lamb diets: Effects on growth performance, antioxidative status, and blood metabolites. *J Agri Sci* **6**(3):92–98. Available at: <https://www.researchgate.net/publication/272353758> (researchgate.net in Bing)
- Gouveia L, Batista AP, Sousa I, Raymundo A and Bandarra NM (2008). Microalgae in novel food products. In *Food Chem Res Develop* (pp. 1–37). Nova Science Publishers.
- Hassan RIM, El-Sayed SA, and El-Sayed MA (2022). Effect of dietary microalgae (*Spirulina platensis*) on growth performance, ingestive behavior, hemato-biochemical parameters, and economic efficiency of Fayoumi broilers. *Life* **12**(11):1892. Available at: <https://www.mdpi.com/2075-1729/12/11/1892> (mdpi.com in Bing)
- Kim MY, Cheong SH and Lee JH (2010). Spirulina improves antioxidant status and reduces serum cholesterol in rabbits. *J Medicinal Food* **13**(2):420–426. Available at: <https://doi.org/10.1089/jmf.2009.0137> (doi.org in Bing)
- Lordan S, Ross RP and Stanton C (2011). Marine bioactives as functional food ingredients: Potential to reduce the incidence of chronic diseases. *Marine Drugs* **9**(6): 1056–1100. Available at: <https://doi.org/10.3390/md9061056>
- Qureshi MA, Garlich JD and Kidd MT (1996). Dietary Spirulina enhances humoral and cell-mediated immune functions in chickens. *Immunopharmac and Immunotoxico* **18**(3):465–476. Available at: <https://doi.org/10.3109/08923979609052709> (doi.org in Bing)
- Snedecor GW and Cochran WG (1994). *Statistical Methods* (8th ed). Iowa State University Press, Ames, Iowa.
- Spínola MP, Ribeiro T and Costa R (2024). Impact of high Spirulina diet, extruded or supplemented with enzymes, on blood cells, systemic metabolites, and hepatic lipid and mineral profiles of broiler chickens. *Frontiers in Vety Sci* **11**:1342310. Available at: <https://doi.org/10.3389/fvets.2024.1342310> (doi.org in Bing)
- Wang L, Pan B, Sheng J, Xu J and Hu Q (2007). Antioxidant activity of Spirulina extracts. *Food Chem* **105**(1):36–41. Available at: <https://doi.org/10.1016/j.foodchem.2007.03.057> (doi.org in Bing)
- Bharathidhasan A, Narayanan R, Gokulakrishnan M and Thirumurugan P (2013). Goat farming in India: Status and prospects. *Indian J Anim Sci* **83**(6):620–624. Available at: <https://www.researchgate.net/publication/287998635> (researchgate.net in Bing)
- Indian Council of Agricultural Research (ICAR). (2013). *Nutrient Requirements of Goats*. National Institute of Animal Nutrition and Physiology, Bangalore. Available at: <https://icar.org.in>

Received on Accepted on