

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 IJABR 2025; SP-9(2): 117-123
www.biochemjournal.com
 Received: 13-12-2024
 Accepted: 18-01-2025

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Effect of dietary supplementation of spirulina and ashwagandha on metabolic indicators in Bidri goats

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DOI: <https://doi.org/10.33545/26174693.2025.v9.i2Sb.3712>

Abstract

This research work was designed to find out the effect on blood biochemical parameters by supplementing ashwagandha and spirulina @ 1mg/kid/day to Bidri goat kids. Eighteen Bidri goats of more than one month of age were taken from farm and randomly grouped and feeding trials done for three months. Kids were divided in three groups that is group I (control group), group II (Spirulina treated) and group III (Ashwagandha treated). Dietary supplementation of spirulina and ashwagandha also improved haematobiochemical parameters like blood glucose, total protein, albumin, creatinine, triglycerides, cholesterol and BUN. Blood Biochemical parameters like total protein and albumin levels showed increase in level significantly. Blood biochemical parameters like blood glucose, cholesterol, triglycerides, creatinine and BUN values of spirulina and ashwagandha fed groups were declined or lesser when compared to control group. The findings and interpretation of present study suggested that, spirulina and ashwagandha have similar effect on all the parameters measured. However, from economic point of view cheaper and easily available diet can be recommended for addition in kids diet.

Keywords: Spirulina, Ashwagandha, Haematobiochemical parameters and Bidri goats

Introduction

The domestic industry is regulated by government agencies such as the Ministry of Livestock Dairy and Fisheries, the National Dairy Development Board (NDDB) and the Food Safety and Standards Authority of India (FSSAI). Traditionally goat has served as source of livelihood and financial security to large section of Indian society, mainly comprising of resource-poor people. Considering the changing agro-climatic conditions, this small ruminant has an enormous potential to be considered the 'animal of the future'. Backyard goat farming is becoming a fast-developing livestock sector in the countryside for rural and urban wealth (DAHD). Demand for animal products is increasing with changes in consumer tastes and expanding markets; particularly in developing countries where affluence is spreading [8]. So there is challenge for animal scientist to meet the demand of people with limited available feed resources facing climatic change. The identification of new feed resources is crucial for continued animal production viability into the future. In a perfect world, the new feed resource would have high nutritive value and conversion efficiency, optimise animal product qualities, and utilize land and water productively [16].

Spirulina is emerging as a potential candidate to fulfil these criteria. Spirulina (*Arthrospira platensis*) is a blue-green microalga that has received increasing attention in recent years thanks to its high nutritional value. It is a source of protein (65-70% crude protein) of high biological value [11], vitamins (especially vitamin B12 and provitamin A), minerals (especially iron), and essential fatty acids, mostly C18:3n-6 (GLA) [6]. Spirulina is likewise a source of bioactive mixes, for example, β -carotene, phycocyanin and allophycocyanin with antioxidant activity, sulphated polysaccharides with antiviral properties, and sterols, which are mainly responsible for anti-microbial activity [23]. Due to its nutritional content, Spirulina is widely available in the market as food supplement for both humans and animals. Spirulina has been shown to reduce oxidative stress and hypercholesterolaemia in rabbits fed a high-cholesterol diet [3], feed intake of rabbit also greater fed Spirulina levels 5 and 10% of diets than control [15] whereas in chickens it has been seen to enhance humoral and cell-mediated immune functions.

Withania somnifera also known as Ashwagandha or Indian Ginseng is a medicinal plant belong to family Solanaceae. Most of herbal medicine are derived from the roots of Ashwagandha. Rumen pH remained unaltered on account of addition this herb. Milk supplemented with Ashwagandha has been reported to increase total proteins and body weight and the plant alone helps in inducing tolerance and dependence. Herbal feed additives like *Spirulina platensis* and Ashwagandha are becoming popular because of high nutritional content, antibacterial and antifungal properties. Hence, keeping in view the importance of Spirulina and Ashwagandha as supplements in Bidri Goats on metabolic indicators is being studied.

Materials and Methods

The aim of trial was to identify the beneficial effects of Ashwagandha and Spirulina on biochemical parameters of Bidri goats.

Location and details of the study

The present study was carried out at University Goat Farm and Department of Livestock production management on Indian dairy goat breed. Healthy goats were selected from Private Bidri goat farm near Shahpur gate Bidar. District Bidar, Karnataka. The kids was reared in intensive system of rearing having the arrangement for individual kid feeding. Three months growth trial was carried out to see the effect of Ashwagandha and Spirulina Powder supplementation on animals performance measured in the form of body weight, body length, body height and chest girth. Dry root powder of Ashwagandha and Spirulina was taken from market. It was further dried until the moisture content reached upto 10-15% and stored at dried and room temperature. Measurements of linear conformation traits were taken on day 0 of the experiment followed by 15th, 30th, 45th, 60th, 75th and 90th day. Feeding trials on selected animals were performed till three months regularly and periodically in same schedule and following traits were studied during trials.

Table 1: Experiment design as follow

Group	Number of goat kids	Serve as	Supplementation rate
Group-1	6	Control	Control Basal Diet (CBD)
Group-2	6	Spirulina supplemented grown	CBD + Spirulina @1g/kid/day
Group-3	6	Ashwagandha supplemented grown	CBD + Ashwagandha @1g/kid/day

Biochemical parameters

The millilitre blood sample was collected from jugular vein from all the kids under study at the start of study period and at 15 day intervals i.e. day 0, 15, 30, 45, 60, 75, 90. About 9ml of blood was collected aseptically from jugular vein of each experimental animal in heparinized vacutainer and brought to laboratory on ice. The blood sample were centrifuged at 3,000 rpm for 15 min and plasma was collected into cryovials and stored at -20°C until laboratory test were performed. Collected plasma was analysed for blood biochemicals. Serum thus obtained was utilized for assessing biochemical parameters such as glucose, total protein, albumin, cholesterol, triglycerides, urea nitrogen

and creatinine indicative of metabolism were analysed using commercially available reagent kits.

- **Blood glucose:** Whole blood sample was collected from jugular vein for evaluation of blood glucose levels. The normal range of blood glucose level in goats is between 42-80 mg per 100cc; adult ruminants have lower level than in newborn, normal blood level is termed as euglycaemia.
- **Total protein:** Total protein was estimated in blood plasma.
- **Albumin:** Albumin level play a vital role in the health of goats. Albumin levels average 33g/l (range 30-38).
- **Cholesterol:** In goats' cholesterol is naturally produced in liver and intestinal wall and is considered as source of energy.
- **Triglycerides:** Effect of spirulina and ashwagandha was studied on triglycerides.
- **BUN:** Blood urea nitrogen indicator of kidney function test was analysed to see the effect of spirulina and ashwagandha. Normal range of BUN is between 25 and 60 mg/dl.
- **Creatinine:** Used to evaluate kidney function. Urine creatinine levels can be used as a screening test to evaluate kidney function, or can be part of the creatine clearance test.

Table 2: Nutritional facts of Ashwagandha

Serving size 5g Serving per container 200g	
Amount per serving calories	18
	% daily value
Total fat 0.02g	<1%
Saturated fat 0.01%	<1%
Total carbohydrate 4.33g	1%
Dietary fiber 1.77g	7%
Protein 0.22g	
Sodium 10.83g	<1%

Table 3: Nutritional facts of Spirulina

	Amount per serving	% daily value
Calories	10	
Protein	2g	4%
Vitamin E	0.7mg	4%
Niacin	0.4mg	2%
Folate	108 mcg DFE	45%
Iron	2.7mg	15%
Zinc	0.5 mg	5%
Sodium	42 mg	2%

Statistical analysis

The data obtained from the present study analyzed using Two-way ANOVA with Bonferroni Post Test utilizing Graph Pad Prism version 5.0 software to compare the groups at the level significance $p < 0.05$. Bonferroni Post Test is a type of multiple comparison test used in statistical analysis. When performing a hypothesis test with multiple comparison, eventually a result could occur that appears to demonstrate statistical significance in the dependent variable.

Graph Pad Prism version 5.0 software used for comprehensive curve fitting (non-linear regression), understand statistical and data organization, while it won't replace a heavy-duty statistics program, prism lets us easily perform basic statistical tests commonly used by laboratory and clinical research.

Results and Discussion

Effect of Spirulina supplementation on metabolic biochemical indicator in Bidri goats

Spirulina platensis effect on blood glucose level (Table 4 and Figure 1) were studied and it showed significance positive effect. In control group at 0th day values were 39.52±0.49 on 90th day it reached to 40.22±0.75. In present study on 0th day average albumin (Table 6 and Figure 3) reported was 2.84±0.06 which is less than calculated on 90th day in spirulina treated group that is 3.36±0.14. Cholesterol level (Table 7 and Figure 4) on 0th day was 71.00±1.75 which showed not much significant increase, the average values were 71.66±1.93. A recent study using *S. platensis* reported potential protective activity against fat induced apoptosis and decreasing intestinal cholesterol absorption (Yigit *et al.* [24]). However, in the present chronic study, administration of butanol fraction of *S. platensis* for 28 d in type 2 diabetic rats significantly increased liver glycogen content and HDL, while it reduced LDL substantially. Interestingly, chronic treatment also enhanced plasma insulin and pancreatic insulin content in type 2 diabetic rats. Therefore, the stimulation of insulin release from β -cells as well as insulin action is possibly thereby correlated with the improvement of hepatic glucose uptake.

In present study in goats, plasma total protein (Table 5 and Figure 2) on 0th day it was 6.96±0.08 and on 90th day 7.54±0.07 which were significantly higher than control group 7.12±0.09. *S. platensis* can improve nutritional absorption through its function as a growth stimulus for gut pathogens. Adding *S. platensis* in the diet may improve animal performance and meat quality (Holman and Madeira) [7], due to its high content of all essential amino acids and protein, up to 70% by dry weight (Salmeán *et al.*, [20]). *S. platensis* supplements provide goats with a premix of vitamins and minerals that are not often available in conventional diets.

Triglycerides (Table 8 and Figure 5) on 0th day calculated was 37.12±1.54 which significantly increased on 90th day calculated as 39.82±1.64. Studies in this research was also performed to evaluate effect on BUN (Table 9 and Figure 6) on 0th day it was 7.60±0.27, value showed decline on 90th day by Spirulina supplementation by value 7.14±0.14. The beneficial effects of additive Spirulina related to the highest protein (El-Sabagh, Abd Eldaim, Mahboub, & Abdel-Daim) [5], vitamin as β -carotene minerals mixture (Ahmad Fazel *et al.*, [11] and energy (Kumar, De, Saxena, & Naqvi) [10]).

This research also involved values of creatinine (Table 10 and Figure 7) on 0th day it was 0.84±0.06 by feeding spirulina till 90th day the value of creatinine showed decline and the value reported was 0.63±0.04. El-Deeb *et al.*, [4] in a Serum tests recorded also significantly ($p < 0.01$) higher values of glucose, total protein, globulin, Urea-N, cholesterol and total lipids in the treated group than those in the control ones. While albumin as well as liver enzymes (AST and ALT) were not significantly differed between the two experimental groups. The positive results in some blood hematological parameters obtained herein can be attributed to the rich content of SP from crude protein, vitamin B₁₂, Fe as well as other essential macro-and micro-elements.

Effect of Ashwagandha supplementation on metabolic biochemical indicators in Bidri goats

Mean values of biochemical parameters observed in the present study were found within the normal range as given by Radostits *et al.* [18] and Simenew *et al.* [21].

In apparently healthy volunteers was done by giving *W. somnifera* capsules (aqueous extract 8:1) daily in two divided doses with increase in daily dosage every 10 days for 30 days. Clinical, haematological and biochemical examination of all volunteers revealed no clinical abnormality in clinical examination and all haematological and biochemical parameters revealed no significant change and all the parameters were found within the normal range. Thus, the formulation was found to be safe on biochemical organ function tests (Raut *et al.*) [19]. Haemoprotective effect of *W. Somnifera* in broiler chicks might have been due to its positive influence on haemopoiesis through stimulation of stem cell proliferation and increase in bone marrow cellularity (Aphale *et al.* Mishra *et al.*) [2, 13]. The haemoprotective effect of *W. somnifera* root powder may be due to its antioxidant activity protecting RBC from oxidative stress and improving erythrocytic enzyme activity (Sujatha *et al.*) [22].

A study done in geriatric dogs with hepatic dysfunction showed a significant increase in total protein concentration after 14 days of treatment with *Withania somnifera* extract (Nabi *et al.*) [14]. Animal and human studies have reported significant increases in Hb levels (Malik *et al.*, [12], Ziauddin *et al.*, [25] Priyanka *et al.*, [17]). None included in this systematic review, however, identified improvements in haematological markers during Ashwagandha supplementation (Kuchewar *et al.*, [9]). Improvements in Hb levels were observed with Ashwagandha supplementation in mice with myelosuppression (Ziauddin *et al.*, [25]).

The decrease in the AST and ALT and creatinine values demonstrated the safety and tolerability of the Ashwagandha root extract by the animals. The reduced level of IL-6 demonstrated the anti-inflammatory impact of Ashwagandha (Priyanka *et al.*, [17]).

Table 8: The Mean \pm SE values of blood glucose level (mg/dL in Bidri goats during the study period (N= 6).

Study period	Group I (Control)	Group-II (Spirulina)	Group-III (Ashwagandha)
0 day	39.52 ^[14] 0.49 ^b	40.22±0.75 ^b	40.21±0.72 ^b
15 days	40.59±0.51 ^b	38.99±0.88 ^b	38.58±1.55 ^b
30 days	40.87±1.17 ^b	37.87±0.84 ^b	36.65±1.26 ^a
45 days	41.27±1.34 ^b	37.87±0.47 ^b	37.29±0.82 ^a
60 days	40.77±0.93 ^b	37.90±0.80 ^b	36.60±1.53 ^a
75 days	41.42±0.47 ^b	38.12±0.92 ^b	37.28±0.36 ^a
90 days	40.56±1.00 ^b	38.99±0.79 ^b	36.88±0.96 ^a

Means with different superscripts (a, b) within a row differ significantly ($p < 0.05$)

Table 9: The Mean \pm SE values of plasma total protein (g/dL) in Bidri goats during the study period (N= 6)

Study period	Group I (Control)	Group-II (Spirulina)	Group-III (Ashwagandha)
0 day	6.96±0.08	6.97±0.14	6.99±0.18
15 days	6.93±0.15	6.98±0.13	7.02±0.18
30 days	6.99±0.12	7.14±0.16	7.07±0.12
45 days	7.07±0.06	7.21±0.09	7.23±0.10
60 days	7.15±0.10	7.44±0.13	7.40±0.20
75 days	7.20±0.08	7.53±0.08	7.43±0.05
90 days	7.12±0.09	7.54±0.07	7.44±0.05

Table 10: The Mean ± SE values of plasma albumin (g/dL) in Bidri goats during the study period (N= 6)

Study period	Group I (Control)	Group-II (Spirulina)	Group-III (Ashwagandha)
0 day	2.87±0.05	2.84±0.06	2.88±0.12
15 days	2.86±0.19	2.97±0.05	2.98±0.10
30 days	2.93±0.12	3.09±0.11	3.00±0.08
45 days	3.00±0.12	3.21±0.07	3.11±0.06
60 days	2.98±0.18	3.21±0.12	3.07±0.14
75 days	3.00±0.10	3.27±0.12	3.17±0.14
90 days	3.08±0.11	3.36±0.14	3.29±0.09

Table 11: The Mean ± SE values of plasma total cholesterol (mg/dL) in Bidri goats during the study period (N= 6)

Study period	Group I (Control)	Group-II (Spirulina)	Group-III (Ashwagandha)
0 day	71.73±1.19 ^b	71.00±1.75 ^b	71.89±1.90 ^b
15 days	73.79±2.07 ^b	74.17±2.19 ^b	71.68±1.80 ^b
30 days	76.45±2.28 ^b	74.70±1.59 ^b	75.36±2.15 ^b
45 days	77.89±2.94 ^b	74.52±1.62 ^b	71.65±2.30 ^b
60 days	80.52±2.43 ^b	74.56±2.63 ^b	71.99±2.83 ^b
75 days	83.18±3.43 ^b	70.94±2.40 ^a	69.95±2.42 ^a
90 days	83.70±3.62 ^b	71.66±1.93 ^a	70.01±2.23 ^a

Means with different superscripts (a, b) within a row differ significantly ($p < 0.05$).

Table 12: The Mean ± SE values of plasma triglycerides (mg/dL) in Bidri goats during the study period (N= 6)

Study period	Group I (Control)	Group-II (Spirulina)	Group-III (Ashwagandha)
0 day	38.30±1.67 ^b	37.12±1.54 ^b	38.02±1.08 ^b
15 days	41.11±1.62 ^b	39.77±0.65 ^b	40.65±0.88 ^b
30 days	43.05±1.37 ^b	40.59±0.64 ^b	41.08±0.81 ^b
45 days	44.61±1.55 ^b	42.65±1.19 ^b	42.42±0.49 ^b
60 days	46.77±1.60 ^b	41.18±0.89 ^a	41.23±0.77 ^a
75 days	49.68±1.61 ^b	41.20±0.84 ^a	41.70±0.63 ^a
90 days	51.58±1.55 ^b	39.82±1.64 ^a	41.17±0.43 ^a

Means with different superscripts (a, b) within a row differ significantly ($p < 0.05$).

Table 13: The Mean ± SE values of blood urea nitrogen (mg/dL) in Bidri goats during the study period (N= 6)

Study period	Group I (Control)	Group-II (Spirulina)	Group-III (Ashwagandha)
0 day	7.51±0.32 ^b	7.60±0.27 ^b	7.73±0.23 ^b
15 days	7.60±0.36 ^b	7.47±0.25 ^b	7.66±0.29 ^b
30 days	7.74±0.27 ^b	7.71±0.37 ^b	7.79±0.23 ^b
45 days	8.00±0.28 ^b	7.42±0.17 ^b	7.53±0.31 ^b
60 days	8.36±0.20 ^b	7.21±0.24 ^a	7.33±0.25 ^b
75 days	8.13±0.40 ^b	6.97±0.17 ^a	7.17±0.12 ^b
90 days	8.29±0.31 ^b	7.14±0.14 ^a	6.94±0.25 ^a

Means with different superscripts (a, b) within a row differ significantly ($p < 0.05$).

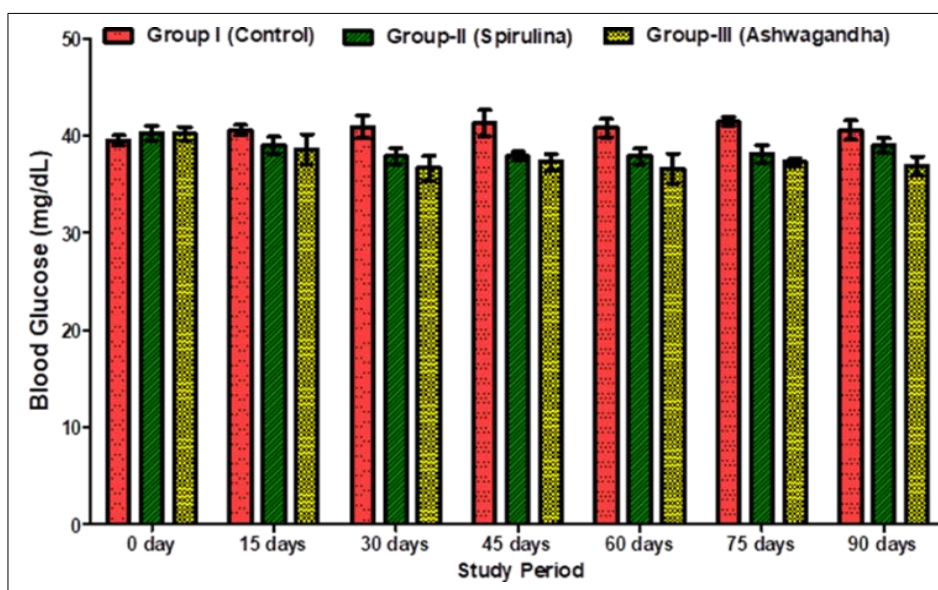


Fig 1: Blood glucose levels in Bidri goats during the study period

Table 14: The Mean ± SE values of plasma creatinine (g/dL) in Bidri goats during the study period (N= 6)

Study period	Group I (Control)	Group-II (Spirulina)	Group-III (Ashwagandha)
0 day	0.89±0.06 ^b	0.84±0.06 ^b	0.88±0.05 ^b
15 days	0.91±0.03 ^b	0.96±0.04 ^b	0.90±0.04 ^b
30 days	0.88±0.06 ^b	0.85±0.03 ^b	0.91±0.05 ^b
45 days	0.95±0.03 ^b	0.75±0.06 ^a	0.78±0.05 ^b
60 days	0.96±0.03 ^b	0.75±0.04 ^a	0.66±0.03 ^a
75 days	0.93±0.08 ^b	0.69±0.03 ^a	0.63±0.07 ^a
90 days	0.90±0.05 ^b	0.63±0.04 ^a	0.64±0.04 ^a

Means with different superscripts (a, b) within a row differ significantly ($p < 0.05$).

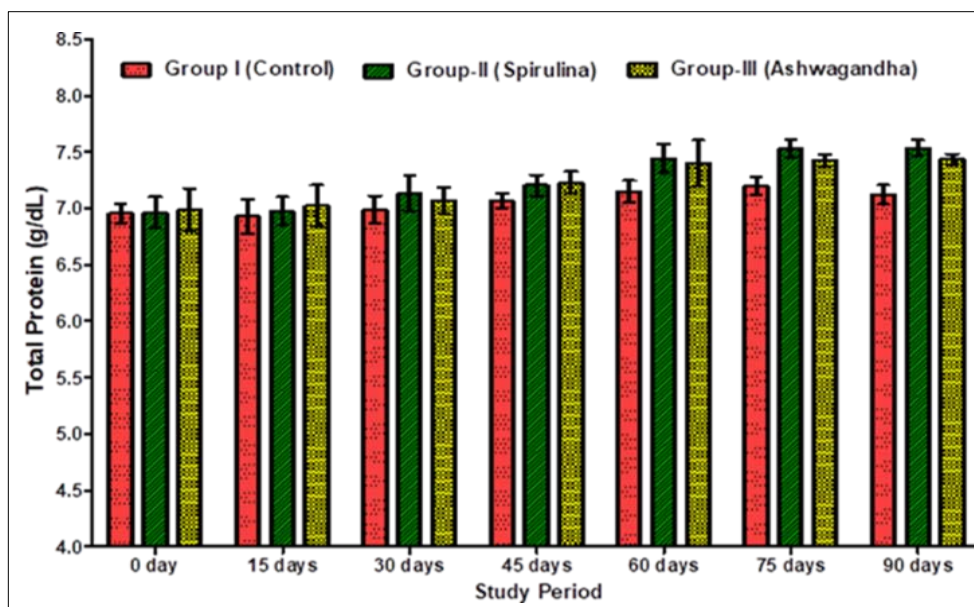


Fig 2: Plasma Total protein in Bidri goats during the study period

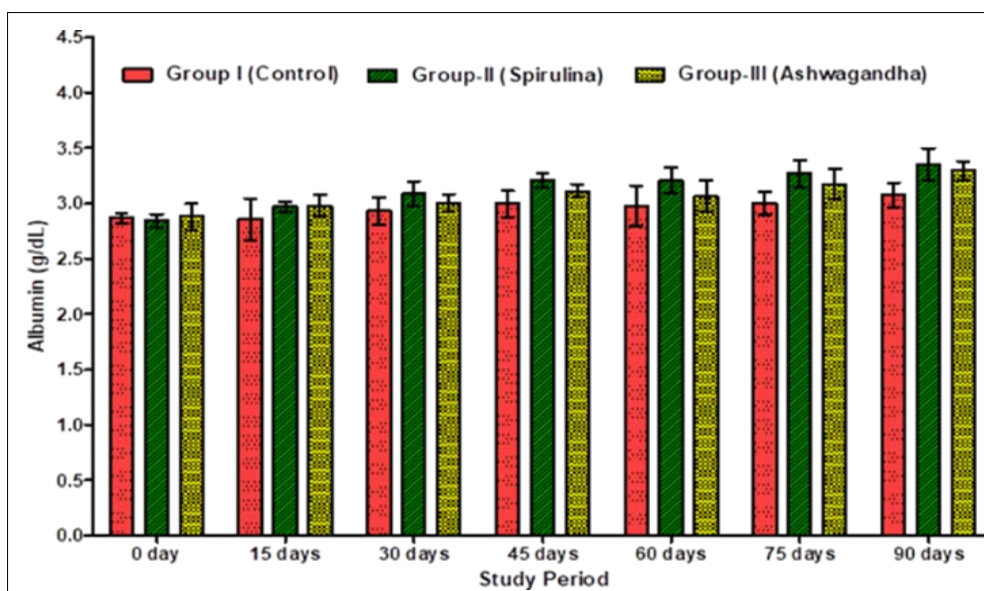


Fig 3: Plasma albumin levels in Bidri goats during the study period

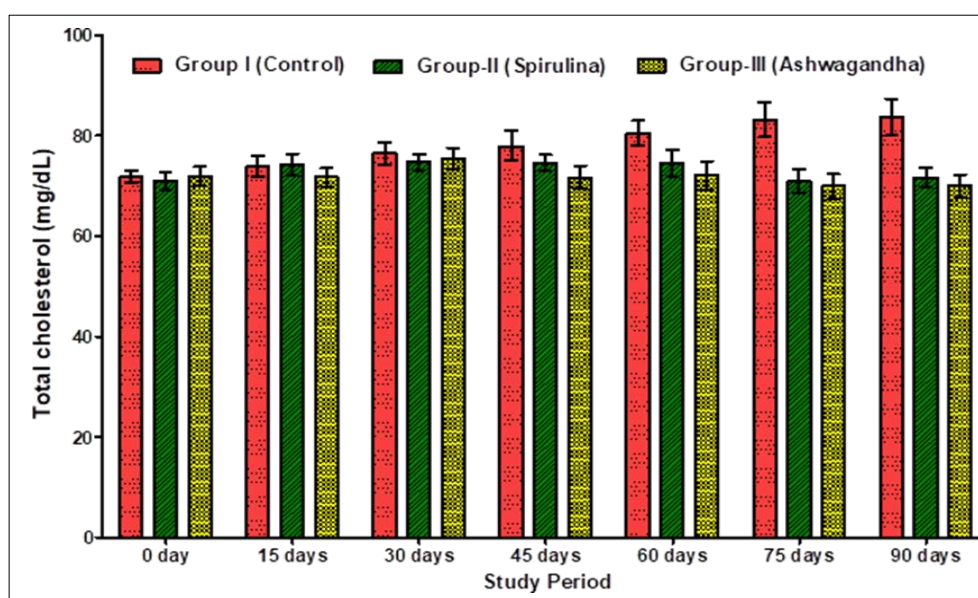


Fig 4: Plasma cholesterol levels in Bidri goats during the study period

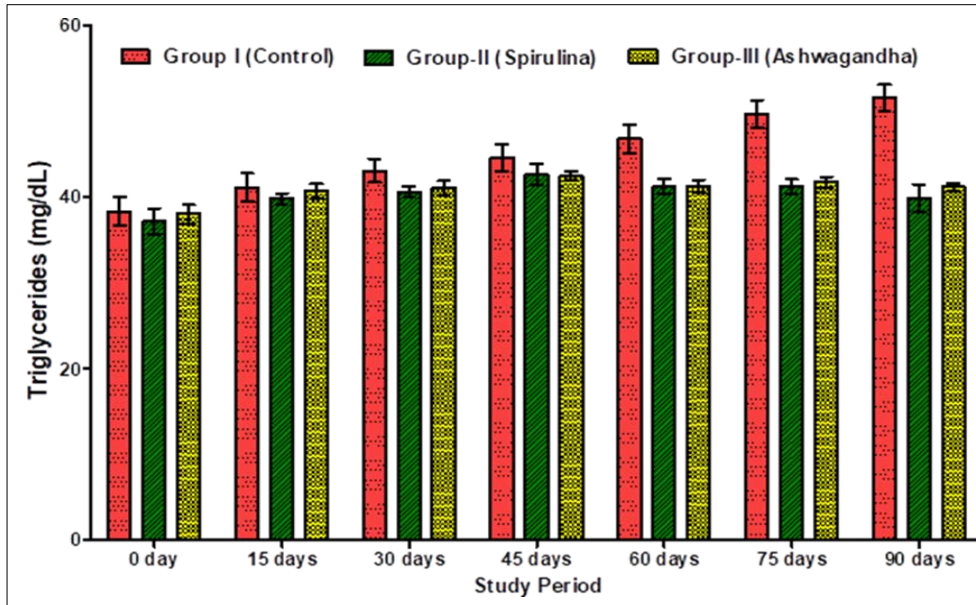


Fig 5: Plasma triglycerides levels in Bidri goats during the study period

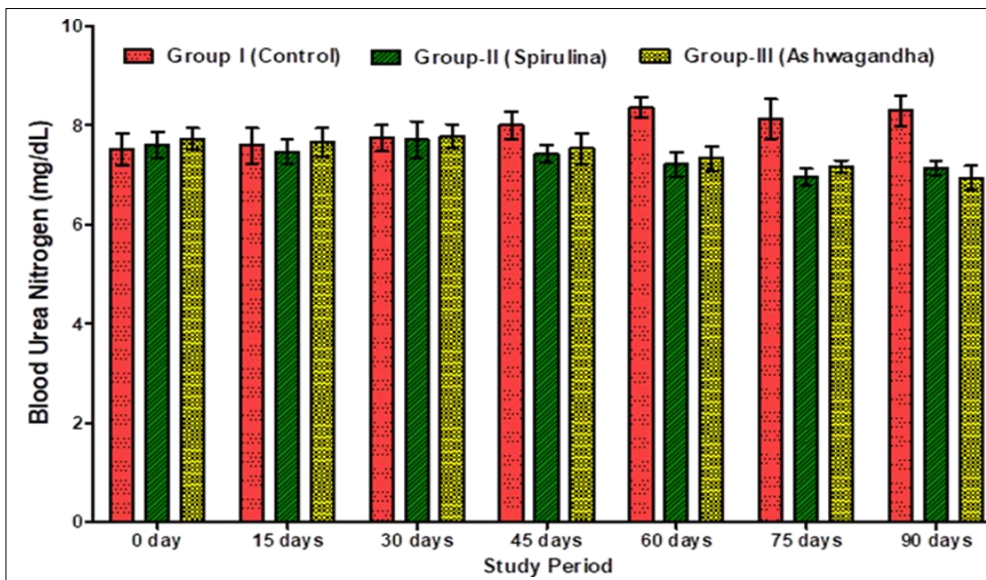


Fig 6: Blood urea nitrogen (BUN) in Bidri goats during the study period

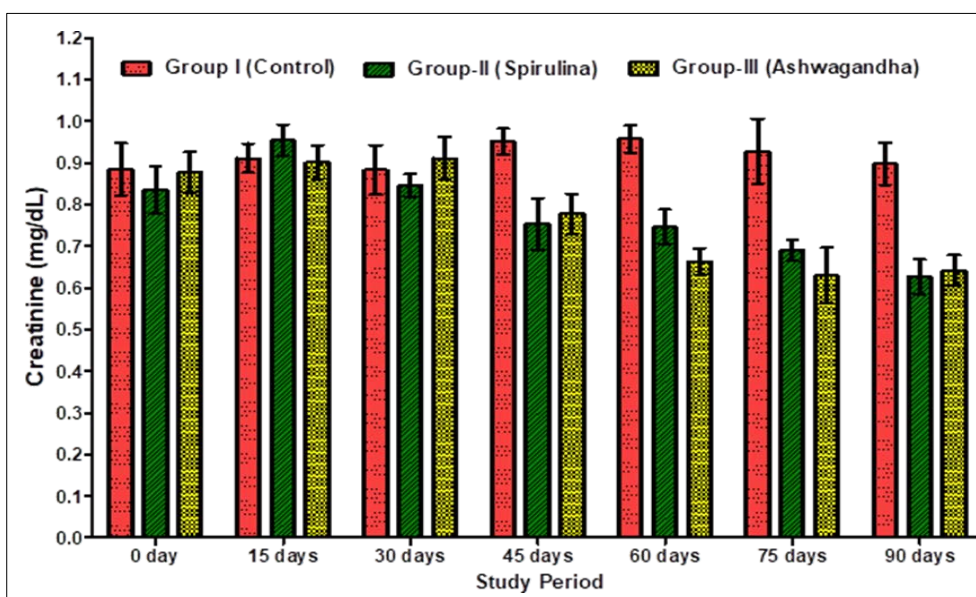


Fig 7: Plasma creatinine levels in Bidri goats during the study period

Conclusion

Dietary supplementation of spirulina and ashwagandha improved haemato-biochemical parameters like blood glucose, total protein, albumin, creatinine, triglycerides, cholesterol and BUN.

Blood Biochemical parameters like total protein and albumin levels showed increase in level significantly.

Blood biochemical parameters like blood glucose, cholesterol, triglycerides, creatinine and BUN values were declined or less compared to control group in spirulina and ashwagandha treated group.

The findings and interpretation of present study suggested that, spirulina and ashwagandha have similar effect on all the parameters measured. However, from economic point of view cheaper and easily available diet can be recommended for addition in kids diet.

Acknowledgments

The authors express their heartfelt gratitude to the Department of Livestock Production and Management, Veterinary College Bidar, Karnataka Veterinary Animal and Fisheries Sciences University for providing necessary facilities needed to conduct this study.

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