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Effect of spirulina (*Spirulina platensis*) on growth performance and haemato-biochemical parameters of Osmanabadi kids

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Abstract

The objective of the present investigation was to study the effect of spirulina (*Spirulina platensis*) on growth performance of Osmanabadi kids in 90 days experimental period. In the present investigation a total of sixteen Osmanabadi kids of 3 months old age and similar average live body weight of 7.85 ± 0.10 kg were selected and randomly divided into four similar groups (4 animals each) T₁ (control), T₂, T₃ and T₄ in such a way that groups had no significant difference in respect of average body weight and body conformation. The diet of all the experimental kids was similar but T₂, T₃ and T₄ were additionally drenched with *Spirulina platensis*. The treatments T₂, T₃ and T₄ were delivered as 0.5g/5ml, 1g/10ml and 1.5g/15ml solution of water, respectively. Completely randomised design was used for statistical analysis of means. The results showed that Spirulina (*Spirulina platensis*) drenched treatments were found significantly improved ($P < 0.05$) live body weight, total weight gain, average daily weight gain, body length, body height and chest girth. Levels of total protein, globulin, haemoglobin and white blood cells are also found significant in spirulina supplemented groups. It was concluded that the drenching of 1g/10ml solution of water per day was beneficial and safe for the improvement of live body weight, body weight gain and body conformation of goat kids.

Keywords: biochemical parameters, drenching, growth performance, haematology, Osmanabadi kids, *Spirulina platensis*

Introduction

Nutrition of animal plays vital role in livestock production and management. Many livestock producers facing the problem of cost effective and sustainable way of nutrition supplement for profitable and healthy livestock production. The application of new nutritional sources is crucial for livestock production and viability. There are many synthetic nutritional products are available in market for improving animal production and performance but they can cause adverse effect on health of animals. So the nutritional supplement must be safe, high in nutritional value and must have the ability to improve the quality of animal products. Hence herbal products are mostly used for livestock nutrition. Spirulina (*Spirulina platensis*) is getting attention as a nutritional supplement and additive because of its nutritional aspects. It is blue green cyanobacterial algae which contains 60-70 per cent protein on dry matter basis (Belay *et al.*, 1993; Doreau *et al.*, 2010) [4].

Spirulina (*Spirulina platensis*) is highly nutritious which contains 60 per cent protein, 20 per cent carbohydrate, 5 per cent lipids, 3-6 per cent moisture and 7 per cent minerals which makes it highly nutritious food (Habib *et al.*, 2008) [8]. Apart from highly nutritious content it has many other properties such as anti-inflammatory, anti-viral, anti-bacterial and anti-parasitic properties (Khan *et al.*, 2005) [14]. It is also rich in carotenoids and gamma linoleic acid (GLA) (Howe *et al.*, 2006) [12]. Spirulina thought to be suitable natural antioxidant and immune-stimulant for both animals and humans. It also has less side effects and higher cost effective than synthetic nutritional supplements (Abdel-Daim *et al.*, 2013) [1].

Spirulina platensis is considered as a source of protein of which is rich in biological values viz. minerals, vitamins and essential fatty acids and its dietary supplementation improves the animal health and productivity (Holman and Malau-Aduli, 2012) [10]. Apart from all of its beneficial properties it is safe and promising natural anti-oxidant with less negative effects and higher cost effective than synthetic anti-oxidants (Abdel-Daim, 2014) [2]. Spirulina supplementation in animal feed is becoming popular over the years and recently it showed significant improvement in animal production. Therefore, more research and trials with spirulina supplementation in ruminants and small ruminants is crucial for the healthy and

economic livestock production. Keeping in view of above facts, the present study was conducted to elucidate the effect of *Spirulina platensis* on growth performance and haematobiochemical parameters of Osmanabadi goat kids.

Materials and Methods

Location and Materials

The experimental study of this research was conducted at Goat unit, Department of Animal Husbandry and Dairy Science, VNMKV, Parbhani-431402 (M.S), India. *Spirulina platensis* powder was obtained from Krishi Vigyan Kendra (PIRENS), Babhaleswar, Dist. Ahmadnagar, Maharashtra.

Research animal and experimental design

Sixteen Osmanabadi kids of 3 months old and similar average live body weight of 7.85 ± 0.10 kg were selected and randomly divided into four similar groups (4 animals each) T₁ (control), T₂, T₃ and T₄ in such a way that groups had no significant difference in respect of average body weight and body conformation. During the experimental period of 90 days the kids of treatments T₂, T₃ and T₄ were daily given spirulina suspension at 0.5g/5ml, 1g/10ml and 1.5g/15ml solution of water, respectively. Completely randomized design method was used for the analysis of growth parameters such as live body weight, body weight gain, daily weight gain, body length, body height and chest girth of kids at $P < 0.05$ significance level.

Kids body conformation measurements

Body conformation of each kid viz. chest girth (CG), Body height (BH) and body length (BL) was measured weekly. CG of kids was measured behind the forelegs body circumference (Afolayan *et al.*, 2006) [3]. BH was the distance between highest point on wither to the point of fore limb of hoof and BL was considered to be the span between the base of neck to the point of public bone (Sowande and Sobola, 2008) [18].

Blood collection and analysis of parameters

The blood samples were taken from jugular vein of each kid on 0th day and 90th day of experimental period. Haematological parameters viz. Haemoglobin, WBC count

and RBC count and biochemical parameters viz., total protein, serum globulin and serum albumin were analyzed at $P < 0.05$ significance level.

Statistical analysis

All the data obtained from the experiment was analyzed statistically by Completely Randomized Design (CRD) and difference between experimental groups was analysed by using analysis of variance (ANOVA) as per the procedure given by Snedecor & Cochran (1989) [17]. The analysis of variance analysed at significance level of $P < 0.05$, standard error (S.E.) and critical difference (C.D.) at 5% level is mentioned wherever required.

Result and Discussion

Growth performance

The effect of *Spirulina platensis* on growth performance of Osmanabadi kids during the experimental period are shown in Table 1. The data from the Table 1 showed drenching of spirulina significantly improved the final body weight, total weight gain and average daily weight gain of kids. The kids drenched with Spirulina showed significant ($P < 0.05$) results than the control group (T₁). Kids supplemented with Spirulina @ 1g/10ml water had the significant ($P < 0.05$) results in terms of final body weight, total weight gain and average daily weight gain. The result showed similarities with previous reports by (Holman *et al.*, 2012) [10] who reported greater live body weights in sheep supplemented with spirulina. The results are consistent with previous research that Spirulina supplementation of 1g/10kg weight per day improved final body weight and daily weight gain of lambs compared to control group (El-Sabagh *et al.*, 2014) [5]. The improvement in body weight gain and average daily weight gain of kids drenched with Spirulina solution may be related to the high nutrient density which may improve growth rate (Gershwin & Belay, 2008) [7]. It also stimulates the secretion of extracellular enzymes by the gut microflora of animal which results in growth promotion (Tovar-Ramirez *et al.*, 2002) [19]. However, the additional spirulina supplementation group T₄ (1.5g/15ml) didn't show any promising results over T₃ (1g/10ml) and T₂ (5g/5ml) group.

Table 1: Growth performance (Kg) of kids during experimental period

Particular	Treatments				SEM ±	CD @5%
	T ₁	T ₂	T ₃	T ₄		
Initial weight (Kg)	7.75	7.80	7.92	7.91	0.104	NS
Final weight (Kg)	10.43 ^b	10.87 ^{ab}	11.52 ^a	10.67 ^b	0.213	0.658
Total weight gain (Kg)	2.69 ^b	3.07 ^b	3.60 ^a	2.75 ^b	0.152	0.468
Average daily weight gain (g/day)	30.00 ^d	34.00 ^b	40.00 ^a	31.00 ^c	0.554	1.708

Mean values with different superscript in same row differs significantly ($P < 0.05$)

1) SEM = Standard Error of Means, 2) CD = Critical Difference

Body conformation

The body conformations viz. BH, CG and BL (cm) of kids during experimental period are illustrated in Table 2. The data presented in Table 2 showed that the BH, CG and BL of kids supplemented with spirulina algae had significantly higher ($P < 0.05$) values than control group (T₁). Body height and chest girth of T₃ showed higher gain (51.25 and 52.25 cm, respectively) over other treatment groups i.e T₂ (50.75 and 51.55 cm, respectively) and T₄ (50.25 and 50.75 cm, respectively) which shows compatibility with the recent reports that supplementation of spirulina significantly ($P < 0.05$) influences the body height and chest girth of

experimental animals (Holman *et al.*, 2012) [10]. The significantly ($P < 0.05$) longer body length was observed in T₃ (44.50 cm) followed by T₂ (43.75 cm), T₄ (43.50 cm) and T₁ (43.00 cm) respectively which showed similarities with (Kashani *et al.*, 2015) [13] who reported that the spirulina supplemented groups showed significant gain in body length than the control group.

It was clearly observed that all the groups supplemented with spirulina showed improvement in body measurements. Higher value of BH, CG and BL was observed in 1g/10ml spirulina drenched group (T₃).

Table 2: Body conformation of Osmanabadi kids during experimental period

Body parameters	Day	Treatments				SEM ±	CD @5%
		T ₁	T ₂	T ₃	T ₄		
BH (cm)	0 day	45.75	46.25	46.50	46.00	0.379	NS
	90 day	50.00 ^b	50.75 ^{ab}	51.25 ^a	50.25 ^b	0.280	0.864
CG (cm)	0 day	46.00	46.00	45.50	45.25	0.239	NS
	90 day	50.25 ^c	51.55 ^b	52.25 ^a	50.75 ^c	0.206	0.635
BL (cm)	0 day	39.50	39.25	39.75	39.25	0.282	NS
	90 day	43.00 ^b	43.75 ^{ab}	44.50 ^a	43.50 ^b	0.297	0.915

Mean values with different superscript in same row differs significantly ($P < 0.05$)

1) BH = Body Height, 2) CG = Chest Girth, 3) BL = Body Length,

4) CD= Critical Difference, 5) SEM= Standard Error of Means

Blood parameters

Haematology

The data regarding haematological parameters viz. Haemoglobin, RBC count and WBC count are given in Table 3. Data showed significant difference ($P < 0.05$) in haemoglobin and WBC count of spirulina supplemented groups (T₂, T₃ and T₄) than non-supplemented group (T₁), which showed resemblance with El-Sabagh *et al.*, (2014) [5]; Opoola *et al.*, (2019) [15] reported inclusion of spirulina in animals diet results in higher values of Hb and WBC count. Highest haemoglobin observed in T₃ (11.07 g/dl) which was

significantly ($P < 0.05$) superior over T₂ (10.80 g/dl), T₄ (10.74 g/dl), and control group T₁ (10.30 g/dl). WBC count found higher in T₃ followed by T₄, T₂ and T₁, respectively. The increased WBC count may be due to the presence of phycocyanin and polysaccharide components in spirulina (Zhang, 1994) [20]. However, there was no significant ($P > 0.05$) difference observed in RBC count of experimental kids, the data supports the recent results that reported no significant difference ($P > 0.05$) observed in RBC count of spirulina supplemented experimental animals (Fathi *et al.*, 2018) [6].

Table 3: Effect of Spirulina platensis on haematological parameters of kids

Parameters	Period (day)	Treatments				SEM ±	CD @5%
		T ₁	T ₂	T ₃	T ₄		
Hb (g/dl)	0 day	9.28	9.50	9.67	9.44	0.136	NS
	90 day	10.30 ^b	10.80 ^{ab}	11.07 ^a	10.74 ^{ab}	0.170	0.524
WBC (10 ³ /μl)	0 day	15418	16313	17037	16625	711.64	NS
	90 day	13262 ^b	14712 ^{ab}	15425 ^a	15275 ^a	522.69	1610.7
RBC (10 ³ /μl)	0 day	9.20	8.20	8.65	8.20	0.322	NS
	90 day	9.68	10.13	10.20	9.95	0.502	NS

Mean values with different superscript in same row differs significantly ($P < 0.05$)

1) Hb = Haemoglobin, 2) RBC= Red blood cells, 3) WBC= White blood cells,

4) SEM = Standard Error of Means, 5) CD = Critical Difference

Biochemical parameters

Total protein, albumin and globulin level of kids at the beginning and at the end of experiment was given in Table 4.

The supplementation of spirulina platensis to kids showed significant ($P < 0.05$) difference in total protein and globulin concentration of kids over control group.

Table 4: Effect of Spirulina platensis on biochemical parameters of kids

Parameters	Period (day)	Treatments				SEM ±	CD @5%
		T ₁	T ₂	T ₃	T ₄		
TP (g/dl)	0 day	6.48	6.57	6.65	6.37	0.305	NS
	90 day	6.98 ^b	7.43 ^{ab}	7.95 ^a	7.57 ^{ab}	0.204	0.628
Albumin (g/dl)	0 day	2.55	2.37	2.49	2.46	0.210	NS
	90 day	2.84	3.07	3.19	2.92	0.255	NS
Globulin (g/dl)	0 day	3.38	3.50	3.41	3.32	0.204	NS
	90 day	3.62 ^b	4.01 ^{ab}	4.30 ^a	4.09 ^a	0.146	0.450

Mean values with different superscript in same row differs significantly ($P < 0.05$)

TP = Total protein

Maximum level of total protein and globulin was observed in 1g/10ml spirulina supplemented group (T₃). There was a slight decrease observed in total protein and globulin level of other two spirulina supplemented groups T₂ and T₄ compared to T₃. Shamsudin *et al.*, (2018) [16] reported higher total protein in spirulina supplemented groups. The increased globulin and total protein concentration in spirulina supplemented groups compared to control may be due to the high protein content of spirulina (Gershwin and Belay, 2008) [7]. The data from Table 4 found similar with Opoola *et al.*, (2019) [15]; El-Sabagh *et al.*, (2014) [5]. However, there was no

significant difference ($P > 0.05$) observed in albumin level of kids under different treatments. The data from Table 4 showed numerical increase in albumin level of spirulina drenched group with no significant difference compared to control group (Hassanien *et al.*, 2015) [9].

Conclusion

From the present research, it could be concluded that the supplementation of spirulina at 1g/10 ml water effectively improves the live body weight, average daily weight gain, body height, chest girth and body length of kids.

Supplementation of spirulina results in higher levels of haemoglobin, WBC count, total protein and serum globulin concentration.

Competing Interests

The Authors declare no conflicts of interest regarding the research.

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