EFFECT OF SUPPLEMENTATION OF DRIED BOVINE SPLEEN IN THE DIET OF BROILER CHICKEN

By
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THESIS

Submitted in partial fulfilment of the
requirement for the degree

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DECLARATION

I hereby declare that the thesis entitled **"EFFECT OF SUPPLEMENTATION OF DRIED BOVINE SPLEEN IN THE DIET OF BROILER CHICKEN"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Mannuthy
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CERTIFICATE

Certified that the thesis, entitled **"EFFECT OF SUPPLEMENTATION OF DRIED BOVINE SPLEEN IN THE DIET OF BROILER CHICKEN"** is a record of research work done independently by Shri. K.V. Shibu, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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Introduction

INTRODUCTION

The Indian poultry industry achieved tremendous growth during the last three decades transforming itself from the age-old backyard system to an increasingly sophisticated enterprise. Poultry farming emerged into a thriving industry that supply quality human food and organic manure for agricultural crops, providing employment and income to the under privileged rural masses of India.

The broiler industry registered spectacular growth from 4 million broilers in 1971 to 30 million in 1980 and was projected to 330 million broilers in 1995 (Anon, 1997). By the turn of the century the annual production is likely to reach the level of 622.5 million broilers (Ahmed, 1995). During the last decade, the annual growth rate in the production of broilers was estimated to be 20 per cent (Kotaiah, 1996).

The per capita consumption of poultry meat could increase from 220 g per annum in 1971 to 521 g in 1991 and was projected to 707 g in 1996. Taking into consideration meat from all sources, per capita availability amounts to 1.5 kg per year in India as against the ICMR recommendation of 10.8 kg per annum at the rate of 30 g of meat per day. With the limited scope for increasing meat from other sources, poultry meat offers vast scope for filling the gap. Based on the anticipated growth of the broiler industry in the coming years there will be a chance for the export of meat and their bye products.

The major constraint in the further development of poultry industry is the high cost of production since the feed alone accounts for 70 to 80 per cent of the total production cost (Vaidya, 1997). Currently the country has to meet the demand of about five million tonnes of poultry feed per annum for the industry (Anon, 1997). Very often the issue being raised is that poultry compete with human beings in their requirement of feed ingredients. The constant effort to produce human foods from animal sources more efficiently at lower cost has stimulated, continued search for more suitable combination of known nutrients and new additives which will increase the efficiency and rate of growth and level of production.

To satisfy the increased demand for broiler meat in our country, nutritionists embarked on ambitious programmes which led to the use of antibiotics, enzymes, hormones, ionophores and probiotics as growth promoters. The potential ill effects due to the residues of antibiotics and chemicals administered as growth stimulants in the animal products have necessitated the invention of relatively harmless agents. In this context certain natural organic substances like animal tissues are identified as biostimulators.

Biostimulators are preparations of animal tissues such as spleen, liver and embryo which are given orally or injected periodically in small quantities for stimulating growth and for improving performance of economic traits. Injectable form cannot be recommended for field application since an average poultry producer will not be in a position to inject all the birds with the preparation at frequent intervals and it will not be economic as well. As such the biostimulator was prepared in dried form which could be mixed with the feed. In Kerala bovine spleen is readily available from slaughter houses. There are reports claiming the practical use of biostimulators which are cheaper and safer for enhancing production in poultry.

In view of this, the present study was planned to investigate the effects of supplementation of dried bovine spleen as growth stimulator in the broiler ration.

Review of Literature

REVIEW OF LITERATURE

The action of biostimulators is not yet exactly found out. Biostimulators contain certain principles known as 'Promin and Retine' which are responsible for stimulating the metabolism of the body, and helps to utilize the nutrients with better efficiency (Kukde and Thakur, 1992). The role played by a biostimulator in a biological system is 'Catalytic' in nature rather than its additive influence in the form of a nutrient (Agarwal and Chakrabarty, 1985). Thus the calories and proteins which are supplied to the growing organism through imbalanced diets, can be utilised more efficiently by supplementing them with biostimulators because it helps in triggering the metabolism of the body in such a way that a better conversion rate is achieved with the intake of the recommended calories and proteins in the diet. It is possible to improve the feed utilization by the use of biostimulators in poultry diet. Here, an attempt has been made to review the available literature related with supplementation of biostimulators on the performance of broiler chicken.

Body weight

Iopa *et al.*(1958) reported that subcutaneous injection of tissue preparation improved the average daily weight gain in pigs, bullocks and adult cattle than the untreated controls.

Scerbakov (1959) reported that the extract from cattle spleen when injected subcutaneously into pigs, 5 ml weekly for a month increased the weight gain.

Zabolotuyj (1959) recorded increased body weight gain in healthy and anaemic pigs when liver and spleen extracts were injected twice with an interval of 8 to 10 days, at a level of 0.1 to 0.2 ml per kg body weight.

Doroskov (1962) observed that tissue preparations of cattle liver and placenta improved the daily weight gain in pigs by 22 and 26 per cent respectively than controls, although later the average gain became less.

Furtunescu (1963) reported that spleen and liver tissue preparations could increase the weight gain in pigs and cattle; optimum results were obtained with pigs in which growth was retarded due to disease.

Nica (1964) observed that the pig spleen extract injection at an interval of 10 to 15 days increased the body weight of pigs by 10 per cent than controls.

Doroskov (1965) demonstrated increase in body weight gain in large white female piglets injected with tissue preparations; body measurements were also greater for the experimental groups.

Granat *et al.* (1965) opined that the injections of spleen extract and bull testis extract have no appreciable effect on the growth rate of cockerels during fattening, and no significant differences in testis weight.

Balun *et al.* (1966) in their experiments with chickens and hens observed that tissue preparations improved gain in live weight and laying rate.

Stepin (1966) suggested that administration of cattle spleen emulsion at a level of 0.6 to 1 ml. per kg body weight in rabbits increased weight gain during 35 days of experimental period.

Voronenkov and Nefedov (1966) in their experiment on cockerels with cattle spleen preparation at 2 and 4 ml per head, at 3 day interval for 5 times shows that the average weight gains were 265 and 253 gram respectively versus 240 gram in controls. When 6 ml of the preparation was fed, there was reduction in growth rate than controls.

Haitov *et al.* (1967) found that injection of spleen preparation on calves twice at a 20-day interval with 4 ml, stimulated growth. Doses of less than 4 ml had no effect, and 3 doses each of 10 ml depressed growth.

Pichelauri and Cikadze (1967) studied the effect of biostimulator feeding on chicks and found that after 3 to 4 weeks of biostimulation, the body weight of the experimental chicks exceeded by 18 to 110 gram than controls. The biostimulators used were bovine or equine liver and spleen powdered or fresh tissue and pig embryo tissue.

Voronenkov and Nefedov (1967) observed that growth of cockerels was increased by 5.4 to 10.4 per cent by feeding 2 to 4 ml of cattle spleen preparation per head at every 3 days, and doses of 6 ml decreased growth rate.

Konstantinov (1969) carried out an experiment in pigs and calves with injections of Filatov's preparation (saline tissue extract) and observed improvement in weight gain.

Psota (1969) found that supplementation of tissue preparations in the feed for 60 days improved the daily weight gain in pigs but the effect was small for the whole period.

Rebreanu *et al.* (1969) reported that intramuscular injection with 0.05 ml spleen extract per kg live weight, every 7th day for 6 months in Romanian simmental calves improved the weight gain.

Haritonov and Volckov (1970) reported that piglets injected with agar-tissue preparation at the rate of 1 ml per kg live weight gained 18.6 per cent more weight than controls.

Mahapatro and Roy (1970) reported that on equalised feeding of concentrates, the daily gain of calves in biostimulator treated group and control were 239 and 228 gram respectively, and the difference was statistically non-significant.

Suljumova *et al.* (1970) through their experiments with 1200 chicks fed on diets supplemented with dried tissue preparation found increase in weight gain by

21.5 to 23.3 per cent in the first 30 days of life, and by 10.8 to 11.1 per cent in the next 30 days than controls.

Gorlova (1971) carried out a study in fowls at 60 days of age for 20 days with dried tissue preparations and testosterone and recorded 6 and 19 per cent increase in body weight respectively than controls.

Kovbasenko (1971) through his experiment with layers showed that the feeding of 1 gram of dried tissue preparation daily increased the egg weight by 2 to 5.8 per cent than controls.

Rebreanu (1971b) compared the effect of intramuscular administration of different doses of liver extract in calves and found that 0.1 ml liver extract per kg live weight given at weekly intervals for 6 months increased the weight gain than those with 0.05 or 0.7 ml liver extract per kg body weight and untreated control.

Safarov (1971) reported that administration of biostimulator in ewes improved post-natal growth of their offsprings

Zarkov (1971) reported significant improvement in the weight gain among rabbits injected with single doses of 0.23 and 0.22 ml of agar-spleen lysate and agar-spleen preparation respectively, per kg body weight for 30 days.

Gladkova (1972) studied the effect of agar tissue preparation of cattle and pig spleen on growth of young sheep, and found that over a 36 day period, weight gain averaged 4.93 and 4.95 kg respectively versus 4.20 kg in the controls.

Vasilisin (1973) conducted an experiment on pigs with agar-tissue preparation of fresh and stored cattle spleen, and found that animals treated with both preparations had an average daily gain of 19.4 and 14.7 per cent higher than that of controls.

Denovski and Nikolov (1976) reported that the injection with 0.2 ml pig spleen and liver tissue preparations weekly for 2 months increased the weight gain in pigs than untreated controls.

James and Gangadevi (1991) from their investigation on dried spleen as growth stimulator for laboratory animals observed that incorparation of dried spleen at a rate of 0.1 per cent in the ration increases the growth rate in rabbits and rats.

Rakshit and Rao (1994) reported that the tissue preparations used as feed additive had been proven to be effective as growth promoters in poultry. Extensive studies had been conducted in Russia with various tissues and found that the spleen and liver had very good effect in stimulating growth.

Shyama (1994) reported that incorporation of dried spleen in the ration enhanced the growth performance of goats, especially in animals maintained on low level of protein.

Sagathevan (1995) reported that addition of dried spleen biostimulator at a rate of 0.1 per cent in the ration did not have any effect on growth, feed efficiency and haematological value in crossbred cattle.

Feed intake

Smanckov (1964) reported that administration of an extract from the spleen of healthy animals stimulated fattening in pigs and calves and reduced the feed required for rearing them to market weight.

Radkevic *et al.* (1965) reported that subcutaneous injection of cattle spleen emulsion on yearling bullocks improved the body weight gain by 16.8 per cent, reduced the feed intake, and had less bone in carcass than untreated controls.

Mahapatro and Roy (1970) conducted an experiment with injections of spleen as biostimulator in Hariana calves and suggested that biostimulator treated group require 25 per cent less concentrate than controls to get almost comparable average daily gain of 225 and 228 gram, respectively.

Agarwal and Chakrabarti (1985) reported that feeding of biostimulators increased the growth rate and reduced the feed intake in albino rats.

Feed efficiency and protein efficiency

Petruskin and Dahkiljgova (1963) reported that a better feed efficiency and increased egg production by 11.3 per cent in laying hens by feeding spleen tissue preparations.

Capa and Kondrahina (1965) reported that administration of tissue preparations in pigs increased the feed conversion efficiency, and average daily weight gain by 129 to 195 gram than controls.

Haritonov and Volckov (1970) reported that piglets injected with 1 ml of agar - tissue preparation per kg live weight had improved weight gain, better feed conversion and higher dressing percentage than controls.

Gerasinov and Petrov (1972) observed better feed efficiency in steers fed an agar preparation containing cattle spleen as biostimulator.

Krasilnikova (1972) observed that feeding of biostimulator increased feed conversion efficiency in layers by increasing egg production and egg weight than controls, with out affecting the body weight adversely.

Spiridon and Florescu (1974) reported that the feeding of 5 ml spleen preparation per head daily, at 10-day interval increased weight gain and feed conversion efficiency in sheep by 25 .7 and 21.3 per cent, respectively than controls.

Shah (1984) reported that feeding of buffalo carcass meal in broiler diet increased the nitrogen and energy retention, and their efficiency of utilization per kg live weight gain.

Agarwal and Chakrabarti (1985) opined that the role played by a biostimulator in a biological system is catalytic in nature rather than its additive influence in the form of a mineral or element in action. When preparations of liver, spleen and chick embryo were fed to rats the feed efficiency ratio was 7.35, 9.85, 9.75 respectively versus 9.06 in controls and protein efficiency ratio was 1.42, 2.08 and 1.90 respectively versus 1.15 in controls. Protein efficiency was maximum for rats fed on spleen biostimulator indicating that the protein metabolism is stimulated by the biostimulator.

James and Gangadevi (1991) found that feed efficiency and protein efficiency were better in rats and rabbits maintained on diets containing 0.1 per cent spleen biostimulator.

Kukde and Thakur (1992) studied the effect of biostimulator on metabolizability of feed energy in broilers and reported that the biostimulators improved the metabolizability of dietary energy, thereby better utilization of nutrients and consequent higher gain in body weight and feed efficiency.

Shyama (1994) reported better feed conversion efficiency and protein efficiency in goats fed with dried spleen biostimulator.

Blood parameters

Zobolotuyj (1959) reported that subcutaneous injection of liver or spleen extract increased haemoglobin concentration in healthy and anaemic pigs.

Chushkov *et al.* (1977) reported that injection of Filatov tissue preparation in calves had no effect on serum protein concentration.

Agarwal and Chakrabarti (1985) observed that there was no marked difference in the haemoglobin content of the biostimulator treated rats.

Shukla and Mahapatro *et al.* (1990) concluded that feeding of biostimulator did not affect the packed cell volume (PCV) in goats.

Shyama (1994) reported that feeding of dried buffaloe spleen had no significant effect on haemoglobin concentration in goats.

Sagathevan (1995) studied the effect of biostimulator feeding in calves and found that there was no significant difference in Hb, PCV and erythrocyte count between the treatment groups. The overall average value was within the normal range.

Slaughter studies

Komissarov (1971) reported that the biostimulator administration in young cross bred cattle increased the weight gain and dressing percentage.

Kovalesvskaja and Gluhoreev (1971) observed a positive effect when dry biostimulator was fed at a rate of 0.2 gram per kg body weight in rabbits. On slaughter, the yield of edible cuts from the carcasses was 64.6 per cent versus 59.1 per cent for controls.

Kovbasenko (1971) observed that addition of 1 gram dried tissue preparation in the feed daily from 8 to 18 months of age on layers increased the weight gain and total egg mass produced, and there was a higher dressing percentage and ready-to-cook yield.

Rebreanu (1971a) studied the effect of spleen extract on dressing percentage in young male and female calves and observed that dressing percentage averaged 54.1 and 51.6 respectively versus 52.7 and 49.9 respectively in untreated controls.

Livability

Voronenkov and Nefedov (1967) reported that daily administration of spleen preparation, in the feed or drinking water at the rate of 1 ml per chick from 20 to 60 days of age decreased the disease incidence and mortality by 10 to 12 per cent.

Konstantinov *et al.* (1973) reported that rabbits experimentally infected with *Eschericia coli* showed quicker recovery when the extract of liver and spleen were injected as compared to the control.

Dikon (1987) reported that extract from liver, kidney, spleen and whole fry of rainbow trout inhibited plaque production of infectious pancreatic necrotic virus in cell cultures. The inhibition may be caused by preventing or reducing the attachment of viruses to the cell surface or the tissue extract may cause aggregation of the virus and thereby reducing the number of available infectious units.

Economics

Mahapatro and Roy (1970) opined that administration of spleen biostimulator was economic in Hariana calves by reducing 25 per cent of the concentrate consumption with almost comparable growths to the controls.

Shah (1984) reported that the broiler diet containing 5 per cent buffalo carcass meal and 5 per cent fishmeal was economical in terms of cost of feed per kg live weight gain.

Materials and Methods

MATERIALS AND METHODS

An experiment was conducted in the Department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy, during December 1998 and January 1999 to evaluate the effect of supplementation of dried bovine spleen in the diet of broiler chicken.

Experimental materials

Experimental birds

One hundred and ninety two, day-old straight-run broiler chicks (Varna, Pb1 X Pb2 - coloured) procured from the Commercial Hatchery, Centre for Advanced Studies in Poultry Science, College of Veterinary and Animal Sciences, Mannuthy formed the experimental subjects.

Experimental rations

Standard broiler ration with different inclusion levels of dried bovine spleen was fed to the birds. The standard broiler ration (SBR) was formulated as per BIS (1992) specifications. The feed ingredients used for the formulation of the experimental diets were yellow maize, groundnut cake (expeller), gingelly oil cake, unsalted dried fish, rice polish, mineral mixture and salt. Broiler starter rations were fed up to the end of six weeks of age and then switched over to broiler finisher diets till the end of the experiment i.e., end of eight weeks.

Table 1. Percentage ingredient composition of experimental rations

Sl. No.	Ingredients	Standard broiler ration (SBR)	
		Starter	Finisher
1	Yellow maize	44	53
2	Groundnut cake (expeller)	31	26
3	Gingelly oil cake	4	0
4	Unsalted dried fish	9	8
5	Rice polish	10	11
6	Common salt	0.25	0.25
7	Mineral mixture[1]	1.75	1.75
	Total	100.00	100.00
	Added per 100 kg of feed		
8	Vitamin mixture [2](g)	25	25
9	Lysine hydrochloride (g)	240	120
10	Methionine (g)	150	80
11	Manganese sulphate (g)	6	6
12	Choline chloride (g)	50	30
13	Coccidiostat [3] (g)	25	25

1. Mineral mixture composition
   Calcium 32%, phosphorus 6%, magnesium 1000 ppm, cobalt 60 ppm, zinc 2600 ppm, iron 0.1%, iodine 100 ppm, copper 100 ppm, manganese 2700 ppm

2. Vitamin mixture composition
   Each gram contains: Vitamin A 40,000 IU, Vitamin B_2 20 mg and Vitamin D_3 5000 IU

3. Coccidiostat composition
   Each gram contains: Maduramycin ammonium 20 mg

Table 2. Percentage chemical composition of experimental rations (on dry matter basis)

Sl. No.	Ingredients	Standard broiler ration (SBR)	
		Starter	Finisher
	Analysed values [1]		
1	Moisture	9.28	9.32
2	Crude protein	23.48	20.12
3	Ether extract	6.43	6.53
4	Crude fibre	5.11	4.92
5	NFE	53.97	57.51
6	Total ash	11.58	11.65
7	Acid insoluble ash	2.41	2.48
8	Calcium	1.34	1.30
9	Phosphorus	0.71	0.68
	Calculated values		
10	ME (Kcal/kg)	2830	2942
11	Lysine	1.2	1.03
12	Methionine	0.6	0.52
13	Manganese (mg/kg)	95	94

1. Average of eight samples

The ingredient composition and the chemical composition of the experimental rations are presented in Tables 1 and 2 respectively.

Dried bovine spleen

The bovine spleen used in this study was procured from the Meat Technology Unit, College of Veterinary and Animal Sciences, Mannuthy. The fresh spleen was collected, sliced, dried at 60°C for 18 hours in a Hot air oven and pulverised.

Experimental methods

Housing of birds

The experimental house, feeders, waterers and other equipments were cleaned thoroughly and disinfected prior to housing the chicks. The chicks were weighed and wing banded.

Experimental design

The chicks were randomly divided into sixteen groups of twelve chicks each. These groups were allotted randomly to four treatments viz., T_1, T_2, T_3 and T_4 with four replications in each treatment. The birds in each treatment were assigned to each of the four rations viz., SBR, SBR with three different levels of dried bovine spleen viz., 0.1, 0.15 and 0.2 per cent. The details of treatment particulars are presented in Table 3.

Table 3. Distribution of the different dietary treatments

Treatment	Replication	No. of birds	Ration	Level of DBS inclusion (%)
T1	R1	12	SBR	0
	R2	12	SBR	0
	R3	12	SBR	0
	R4	12	SBR	0
T2	R1	12	SBR	0.1
	R2	12	SBR	0.1
	R3	12	SBR	0.1
	R4	12	SBR	0.1
T3	R1	12	SBR	0.15
	R2	12	SBR	0.15
	R3	12	SBR	0.15
	R4	12	SBR	0.15
T4	R1	12	SBR	0.2
	R2	12	SBR	0.2
	R3	12	SBR	0.2
	R4	12	SBR	0.2

Management

Feed and water were provided *ad libitum* throughout the experiment and the birds were maintained under deep litter system. Brooding was carried out till the end of fourth week. Standard managemental procedures were adopted during the entire experimental period. The duration of the experiment was for a period of 56 days from day-old.

Climatic parameters

The wet and dry bulb thermometer readings were taken at 8 a.m and 2 p.m daily. The maximum and minimum temperatures were recorded at 8 a.m. in all days throughout the experimental period. From these data, weekly mean maximum and minimum temperatures and per cent relative humidity were arrived at.

Body weight

The weight of individual birds was recorded at fortnightly intervals from day-old to study the pattern of body weight gain under different feeding regimes.

Feed consumption

Feed intake of the birds was recorded replication-wise at the end of each week. From the data, the average feed intake per bird per day was calculated for the treatment groups.

Feed conversion ratio

Feed conversion ratio (kg of feed consumed/kg body weight gain) was calculated based on the data on body weight gain and feed intake.

Protein efficiency

Protein efficiency (gram gain in body weight/gram protein intake) was calculated based on the data on body weight gain and protein intake.

Blood parameters

At the end of eight weeks, blood was collected from one male and one female bird from each replicate at the time of slaughter. The haemoglobin, packed cell volume and erythrocyte sedimentation rate were estimated using Sahli's acid-haematin, Westergren and Wintrobe methods respectively.

Slaughter studies

At the end of the experiment, one male and one female from each replication were randomly selected and sacrificed to study the dressing percentage and losses as per procedure described by Bureau of Indian standards (BIS, 1973). Percentages of dressed yield and ready-to-cook yield were calculated from the data.

The weight of gizzard, heart, liver and spleen were taken and worked out the percentage of these organs on live weight.

Livability

The mortality of birds from different treatment groups were recorded and post-mortem examination was conducted in each case to find out the cause of the death.

Cost-benefit analysis

Cost of feed, cost of bovine spleen, sale price of chicken, live weight of broilers and quantity of feed consumed by birds in each treatment group were used to carry out the cost-benefit analysis.

Statistical analysis

Data collected on various parameters were statistically analysed as per the methods described by Snedecor and Cochran (1980).

Results

RESULTS

The results of the experiment conducted to evaluate the effect of supplementation of dried bovine spleen (DBS) as growth stimulator fed with standard broiler ration in commercial broilers are presented in this chapter.

4.1 Climatic parameters

The mean maximum and minimum temperatures and per cent relative humidity during different weeks from December 1998 to January 1999 are presented in Table 4. During this period of eight weeks, the mean maximum temperature ranged from 29.90 to 33.35°C and the minimum temperature from 21.12 to 24.17 °C. The per cent relative humidity in the morning varied from 72.00 to 82.86, while in the afternoon it ranged from 32.29 to 73.00. The overall mean values of maximum and minimum temperature were 32.56 and 22.89° respectively and the relative humidity in the morning and afternoon was 77.04 and 49.73 per cent respectively. In general, the variation in the climatic profile was very negligible between different weeks of the experimental period.

4.2. Body weight

Data on mean body weight at fortnightly intervals as influenced by different treatments viz., standard broiler ration (T_1) standard broiler ration with 0.1 per cent dried bovine spleen (DBS) (T_2), standard broiler ration with 0.15 per cent DBS (T_3)

Table 4. Mean daily meteorological data during the experimental period (2nd December 1998 to 27th January 1999)

Period (weeks)	Temperature (°C)		Relative humidity (%)	
	Maximum	Minimum	8 a.m.	2 p.m.
1	33.04	23.68	80.00	56.43
2	29.90	24.17	82.86	73.00
3	32.56	23.60	79.86	58.86
4	31.98	22.04	73.71	45.86
5	33.34	22.84	73.29	45.86
6	33.14	21.12	81.29	44.00
7	33.35	22.90	73.29	41.57
8	33.16	21.75	72.00	32.29
Overall mean ± SE	32.56 ± 0.41	22.89 ± 0.31	77.04 ± 1.54	49.73 ± 4.44

and standard broiler ration with 0.20 per cent DBS (T_4) are charted out in Table 5. It is evident from the table that the body weights of the day-old chicks were almost similar. The second week body weight of the different treatment groups were more or less uniform. Statistical analysis of the mean body weight data also confirmed this finding.

At fourth week of age, the highest body weight (997.08 g) was noted in birds fed diets containing 0.1 per cent DBS (T_2), whereas lowest body weight (952.96 g) was noted in birds fed diet containing 0.2 per cent DBS (T_4). Statistical analysis of the fourth week body weight data (Table 6) showed significant difference only between treatments T_2 and T_4 ($P<0.05$).

During the sixth week, the mean body weight was highest (1780.38 g) in groups fed diet with 0.1 per cent dried bovine spleen (T_2) and was lowest (1685.41 g) in birds received diet with 0.2 per cent DBS (T_4) (Table 5). Other groups maintained body weights in between these two treatments. Statistical analysis of the sixth week mean body weight data (Table 6) indicated the same trend noticed at fourth week and there was significant ($P<0.05$) difference between treatment groups T_2 and T_4. It was significantly ($P<0.05$) higher in birds fed diet with 0.1 than 0.2 per cent DBS. But T_2 was statistically comparable with groups fed a standard broiler diet without DBS (T_1) and a diet having 0.15 per cent DBS (T_3).

Table 5. Effect of DBS supplementation on mean fortnightly body weight (g) of broilers

Treatments		Age in weeks				
		0	2	4	6	8
T1	R1	43.33	306.83	1007.5	1785.83	2560.83
	R2	42.91	292.83	964.16	1762.50	2489.16
	R3	42.66	279.66	941.66	1689.16	2415.00
	R4	43.16	315.00	986.66	1749.16	2521.66
	Mean SE	43.02^a ± 0.15	298.58^a ± 7.80	974.99^{ab} ± 14.21	1746.66^{ab} ± 20.61	2496.66^a ± 30.92
T2	R1	43.83	298.00	997.5	1786.6	2515.83
	R2	43.00	307.16	976.66	1714.16	2423.33
	R3	43.75	297.83	1011.66	1824.16	2531.66
	R4	43.50	310.50	1002.50	1796.60	2569.16
	Mean SE	43.52^a ± 0.19	303.37^a ± 3.22	997.08^a ± 7.41	1780.38^a ± 23.46	2509.99^a ± 30.98
T3	R1	43.33	303.83	965.83	1656.66	2375.00
	R2	43.08	291.66	977.50	1767.50	2529.16
	R3	42.66	308.66	980.83	1757.16	2422.50
	R4	43.58	295.00	964.16	1720.00	2487.50
	Mean SE	43.16^a ± 0.20	299.79^a ± 3.92	972.08^{ab} ± 4.16	1725.83^{ab} ± 25.28	2453.54^a ± 34.16
T4	R1	43.58	280.50	942.50	1653.33	2453.34
	R2	43.83	295.66	970.83	1690.83	2450.83
	R3	43.08	277.16	950.83	1716.66	2503.33
	R4	43.50	282.00	947.50	1680.83	2300.00
	Mean SE	43.50^a ± 0.16	283.83^a ± 4.07	952.96^b ± 6.21	1685.41^b ± 13.09	2426.86^a ± 43.99
	LSD	-	-	27.24	65.10	-

Means bearing the same superscript within the same column did not differ significantly

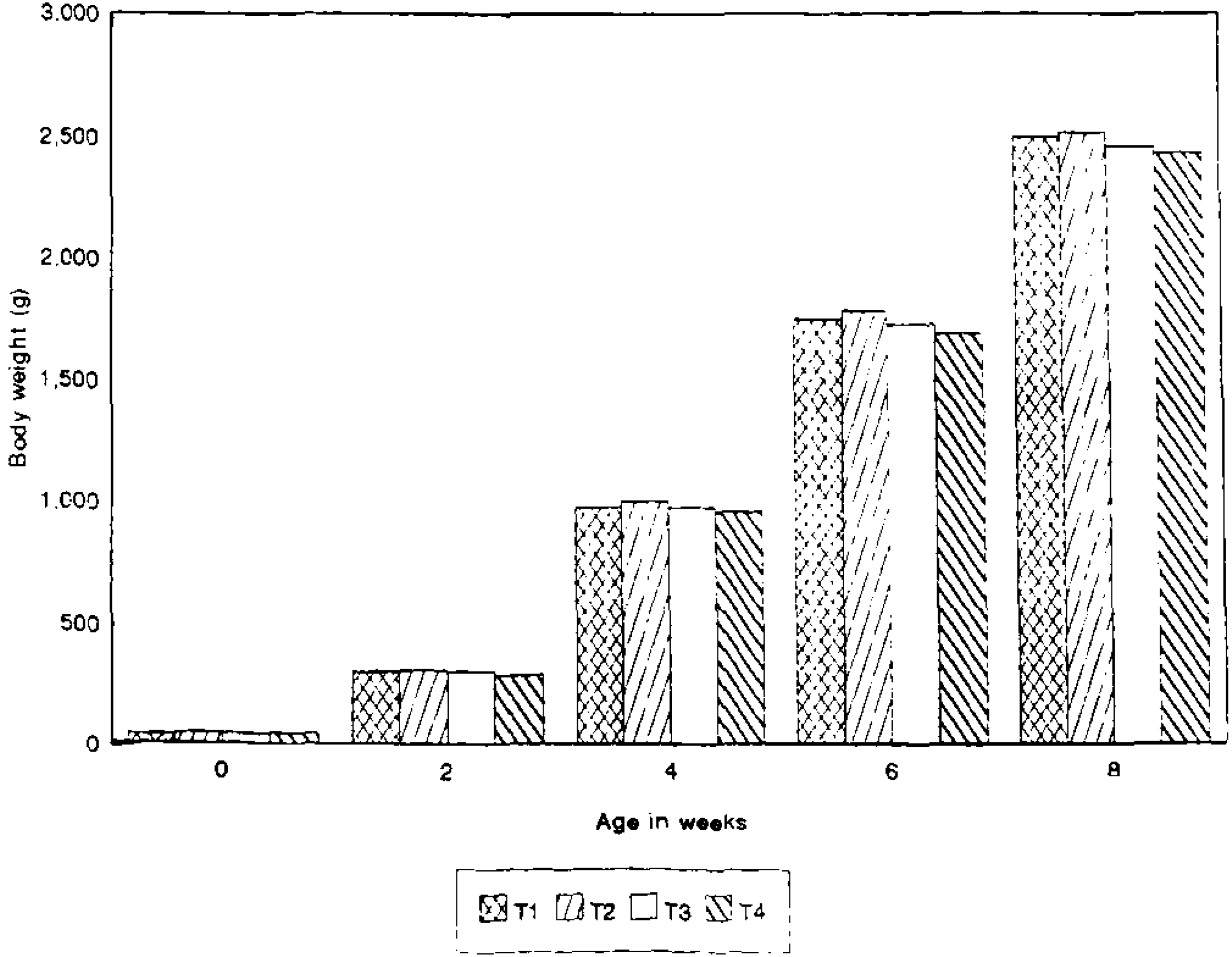
Table 6. Effect of bovine spleen supplementation on fortnightly body weight of broilers - ANOVA

Week	Source	d.f.	SS	MSS	F value
0	Treatment	3	0.750	0.250	
	Error	12	1.430	0.119	2.098 NS
	Total	15	2.181		
2	Treatment	3	891.391	297.130	2.884 NS
	Error	12	1236.352	103.029	
	Total	15	2127.744		
4	Treatment	3	3926.611	1308.870	4.187*
	Error	12	3751.192	312.599	
	Total	15	7677.803		
6	Treatment	3	18950.539	6316.846	3.538*
	Error	12	21423.038	1785.253	
	Total	15	40373.577		
8	Treatment	3	17714.699	5904.900	1.177 NS
	Error	12	60202.671	5016.889	
	Total	15	77917.370		

* Significant ($P<0.05$)

NS – Not significant

Fig.1 FORTNIGHTLY BODY WEIGHT AS EFFECTED BY DBS SUPPLEMENTATION



Birds maintained on a diet having 0.2 per cent DBS level (T_4) registered significantly ($P<0.05$) lower body weight than groups maintained on diet with 0.1 per cent DBS. However, birds reared on standard broiler ration (T_1) and broiler ration with 0.15 per cent DBS (T_3) were statistically comparable having intermediary body weights in between the treatments T_2 and T_4.

Eighth week mean body weight for the treatments T_1, T_2, T_3 and T_4 were 2496.66, 2509.99, 2453.54 g and 2426.86 g respectively (Table 5). The data showed similar trend in the order of body weight numerically among various treatments but all the treatment groups were statistically comparable.

Mean fortnightly body weight of broiler chicks as influenced by dried bovine spleen supplementation and the low body weights at 0.2 per cent level is depicted in Fig.1.

4.3 Body weight gain

The mean fortnightly body weight gain of broiler chicks maintained on different dietary regimen during the experimental period is shown in Table 7.

The gain in weight when the birds attained two weeks of age was 255.57, 259.85, 256.63 and 240.33 g for the treatments T_1, T_2, T_3 and T_4 respectively.

Statistical analysis of the mean body weight gain data (Table 8) of four treatment groups at second week revealed that it was statistically comparable.

Table 7. Effect of DBS supplementation on mean fortnightly body weight gain (g) and cumulative body weight gain (g)

Treatments		Age in weeks				Cumulative body weight gain upto	
		2	4	6	8	6^{th} week	8^{th} week
T1	R1	263.50	700.67	778.33	775.00	1742.50	2517.50
	R2	249.92	671.33	798.34	726.66	1719.59	2446.25
	R3	237.00	662.00	747.50	725.84	1646.50	2372.34
	R4	271.84	671.00	762.50	772.50	1706.00	2478.50
	Mean ± SE	255.57^{a} ± 7.66	676.25^{a} ± 8.42	771.67^{a} ± 10.89	750.00^{a} ± 13.73	1703.65^{ab} ± 20.49	2453.65^{a} ± 30.77
T2	R1	254.17	699.50	789.10	729.23	1742.77	2472.00
	R2	264.16	669.50	737.50	709.17	1671.16	2380.33
	R3	254.08	713.83	812.50	707.50	1780.41	2487.91
	R4	267.00	692.00	794.10	772.56	1753.10	2525.66
	Mean ± SE	259.85^{a} ± 3.36	693.71^{a} ± 9.26	783.30^{a} ± 16.08	729.615^{a} ±15.14	1736.86^{a} ± 23.30	2466.48^{a} ± 30.84
T3	R1	260.50	662.00	690.83	718.34	1613.33	2331.67
	R2	248.58	670.34	790.00	761.66	1724.42	2486.08
	R3	266.00	672.17	778.33	663.34	1716.50	2379.84
	R4	251.42	669.16	755.84	767.50	1676.42	2443.92
	Mean ± SE	256.63^{a} ± 4.03	668.42^{a} ± 2.23	753.75^{a} ± 22.14	727.71^{a} ± 24.10	1682.67^{ab} ± 25.39	2410.38^{a} ± 34.14
T4	R1	236.92	662.00	710.83	800.01	1609.75	2409.76
	R2	251.83	675.17	720.00	760.00	1647.00	2407.00
	R3	234.08	673.67	765.83	786.67	1673.58	2460.25
	R4	238.50	665.50	733.33	619.17	1637.33	2256.5
	Mean ± SE	240.33^{a} ± 3.94	669.09^{a} ± 3.18	732.50^{a} ± 12.04	741.46^{a} ± 41.61	1641.92^{b} ± 13.18	2383.83^{a} ± 44.03
	LSD	-	-	-	-	65.014	-

Means bearing the same superscript within the same column did not differ significantly

However, Table 7 indicated that numerical differences existed in body weight gain between various treatments employed in this experiment. It was numerically higher (259.85 g) among birds offered a standard broiler diet with 0.1 per cent DBS (T_2) and lower (240.33 g) in birds maintained on a diet with 0.2 per cent DBS (T_4). All other groups gained weight in between these two values.

A perusal of the mean body weight gain data after four weeks of age (Table 7) revealed that it was numerically higher (693.71 g) in birds fed a standard broiler diet with 0.1 per cent level of DBS (T_2) and was lower (668.42 g) in birds offered a diet having 0.15 per cent DBS (T_3). All other groups were in between these two treatment groups. Statistical analysis of the fourth week mean body weight gain did not show any significant difference among treatment groups.

Sixth week mean body weight gain data as influenced by DBS supplementation presented in Table 7 indicated that numerical differences existed between various treatments employed in this experiment. It was numerically higher (783.3 g) among birds offered a standard broiler diet with 0.1 per cent DBS (T_2) and was lower (732.5 g) in birds maintained on a diet having a DBS level of 0.2 per cent (T_4). Other groups (T_1 & T_3) gained weight in between these two values. When the magnitude of difference in weight gain between the treatments were tested statistically, it revealed that sixth week body weight gain was not significantly ($P<0.05$) different among the treatments viz., T_1, T_2, T_3 and T_4.

Data on the influence of DBS supplementation on eighth week body weight gain, presented in Table 7 showed that a maximum gain of 750 g obtained with birds offered a standard broiler diet (T_1) and a minimum gain of 727.71 g with birds offered a diet having, a level of 0.15 per cent DBS (T_3). The gain in weight of all other treatments were intermediary. Statistical analysis of the eight week body weight gain data (Table 8) also showed no significant differences between treatments.

The mean body weight gain for the period from 0 to 6 weeks and 0 to 8 veeks as influenced by supplementation of DBS are presented in Table 7. The veight gain at sixth week of age was 1703.65, 1736.86, 1682.67 and 1641.92 g for the treatment groups T_1, T_2, T_3 and T_4 respectively. Highest gain in weight (1736.86 g) was noticed with birds offered a standard broiler diet with 0.1 per cent level of DBS (T_2) and lowest (1641.92 g) in the group fed a diet with 0.2 per cent level of DBS (T_4). Statistical analysis of the data showed that the differences in weight gain among the treatment groups were statistically significant (Table 9). Significantly higher ($P<0.05$) weight gain was noted with groups fed a standard diet with 0.1 per cent level of DBS (T_2) and it was statistically comparable with groups fed a standard diet (T_1) and standard diet with o.15 per cent level of DBS (T_3). Significantly lower weight gain was observed in the group fed a diet containing 0.2 per cent level of DBS (T_4) and was comparable with groups T_1 and T_3.

Table 8. Effect of DBS supplementation on fortnightly body weight gain – ANOVA

Week	Source	d.f.	SS	MSS	F value
2	Treatment	3	908.428	302.809	2.977 NS
	Error	12	1220.629	101.719	
	Total	15	2129.057		
4	Treatment	3	1663.748	554.583	3.232 NS
	Error	12	2059.166	171.597	
	Total	15	3722.914		
6	Treatment	3	5896.401	1965.467	1.942 NS
	Error	12	12143.432	1011.953	
	Total	15	18039.834		
8	Treatment	3	1318.405	439.468	0.161 NS
	Error	12	32748.965	2729.080	
	Total	15	34067.369		

NS – Not significant

Table 9. Effect of DBS supplementation on cumulative body weight gain – ANOVA

Source	d.f.	SS		MSS		F value	
		Cumulative body weight gain		Cumulative body weight		Cumulative body weight gain	
		6th week	8th week	6th week	8th week	6th week	8th week
Treatment	3	18966.291	17755.830	6322.097	5918.610	3.551*	1.183 NS
Error	12	21365.581	60018.921	1780.465	5001.57		
Total	15	40331.873	77774.751				

* Significant (P<0.05)
NS Not significant

Fig.2 FORTNIGHTLY BODY WEIGHT GAIN AS EFFECTED BY DBS SUPPLEMENTATION

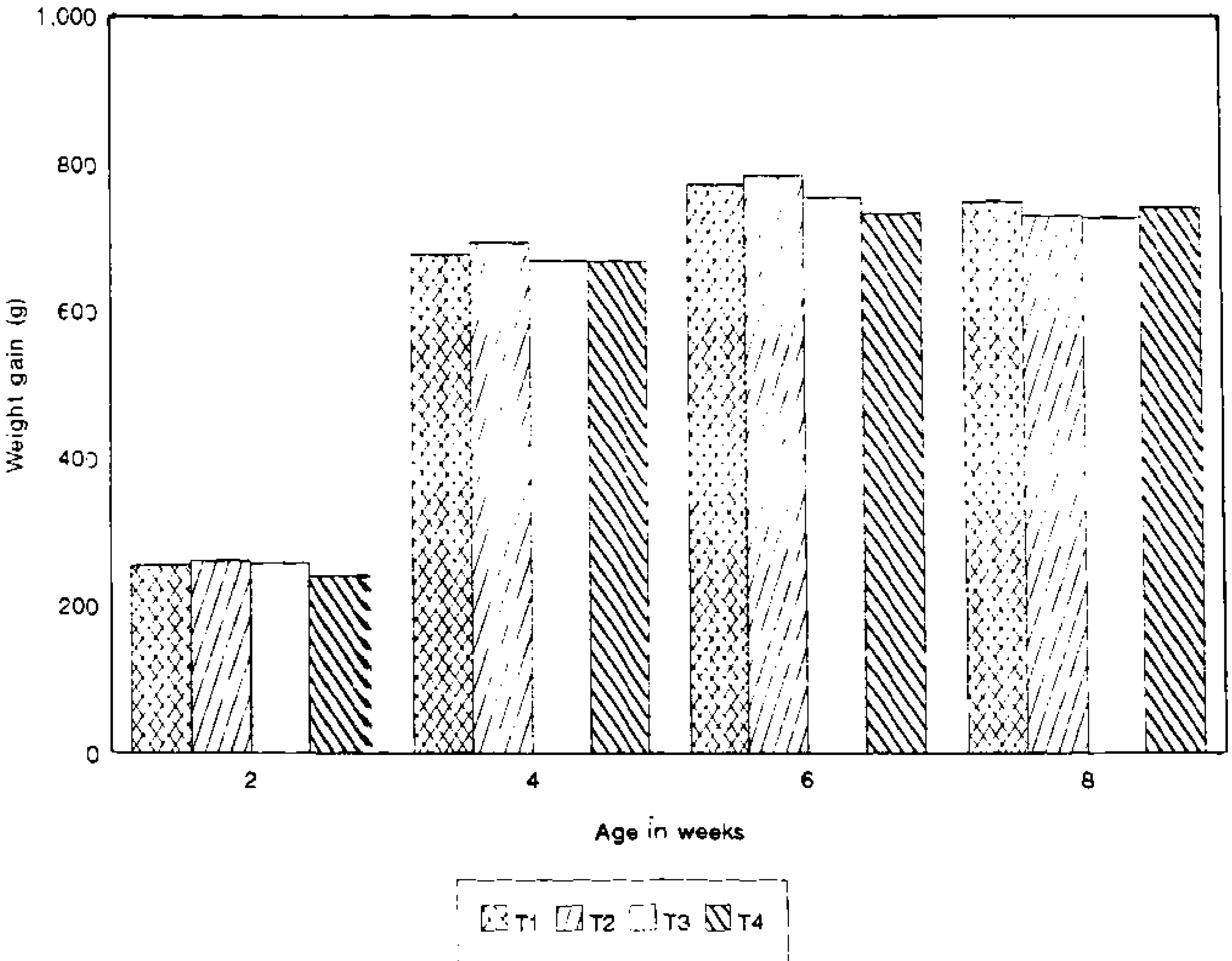
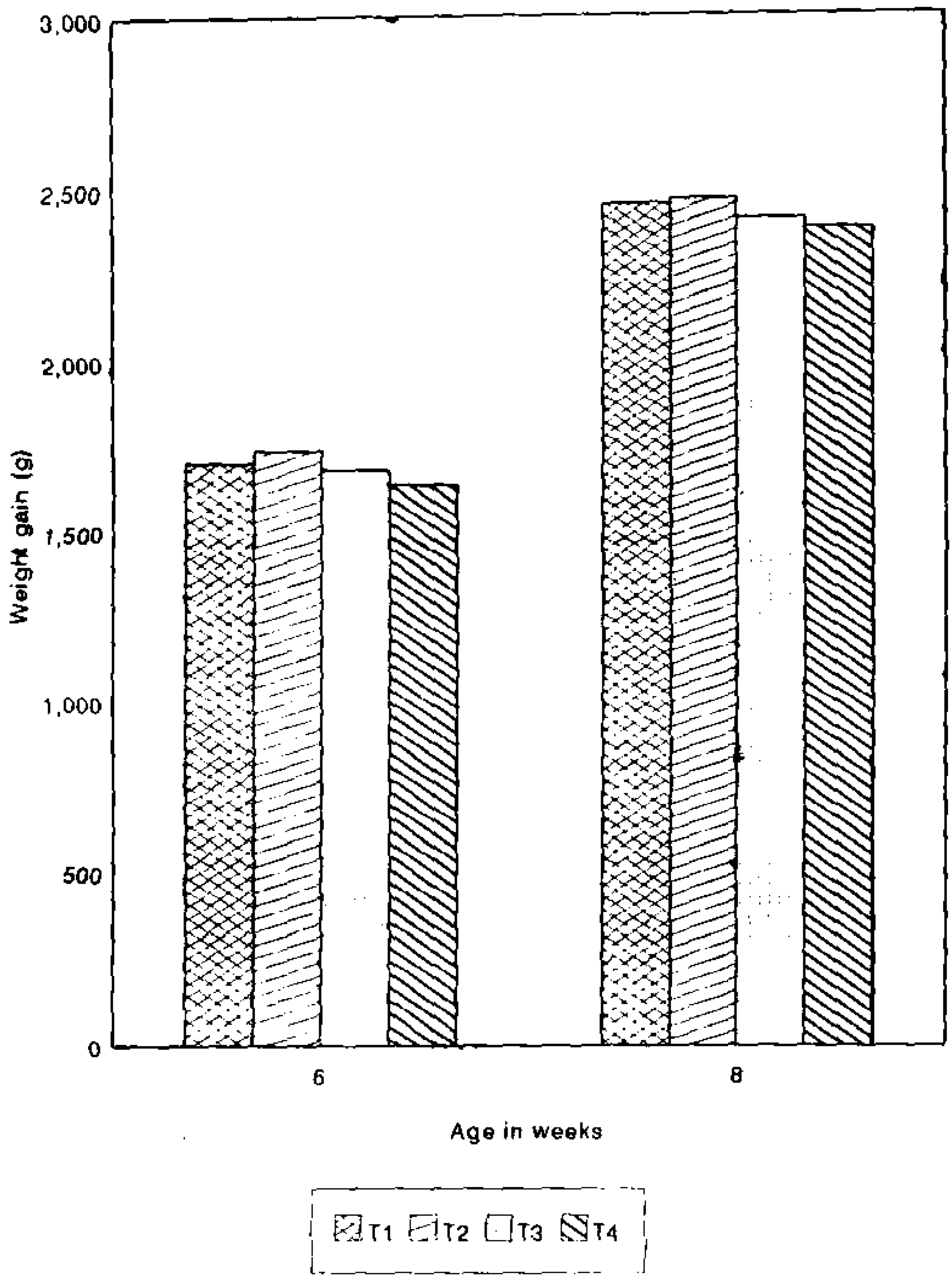


Fig.3 CUMULATIVE BODY WEIGHT GAIN AS EFFECTED BY DBS SUPPLEMENTATION



Cumulative weight gain from 0 to 8 weeks presented in Table 7 showed that the weight gain among the different treatment groups were comparable. Weight gain at 0-8 weeks for the treatments T_1, T_2, T_3 and T_4 were 2453.65, 2466.48, 2410.38 and 2383.38 g respectively. Maximum gain (2466.48 g) was obtained for the birds fed a standard diet with 0.1 per cent level of DBS (T_2) and the lowest gain in the group fed a diet containing 0.2 per cent level of DBS (T_4). Statistical analysis of the 0-8 weeks weight gain data showed that no significant ($P<0.05$) difference existed between the treatments.

The mean fortnightly and cumulative body weight gain of birds as influenced by bovine spleen supplementation are shown in Fig.2 and 3, respectively.

4.4 Feed intake

Daily feed intake

The mean daily feed intake per bird during the eight weeks period among different treatment groups are given Table 10.

The mean daily feed intake per bird among the treatment groups T_1, T_2, T_3 and T_4 were 142.26, 137.20, 133.33 and 130.06 g during the sixth week and 169.04, 158.33, 153.87 and 149.70 g during the eighth week respectively.

The analysis of variance of the data on daily feed intake presented in Table 11 indicated that from fifth week onwards this trait was significantly ($P<0.01$) influenced by different treatment groups. The mean daily feed intake data revealed

Table 10. Effect of DBS supplementation on mean daily feed intake per bird (g)

Treatments		Age in weeks							
		1	2	3	4	5	6	7	8
T1	R1	19.76	45.11	76.19	104.16	134.52	146.42	163.09	172.61
	R2	17.85	41.66	78.57	101.19	130.95	142.85	159.52	169.04
	R3	19.04	41.07	79.76	100.59	125.00	138.09	152.38	164.28
	R4	21.42	42.26	76.19	102.97	129.76	141.66	194.28	170.23
	Mean	19.52 ± 0.75a	42.53 ± 0.89a	77.69a ± 0.89	102.23a ± 0.82	130.06a ± 1.97	142.26a ± 1.72	159.82a ± 2.68	169.04a ± 1.75
T2	R1	1726	47.61	77.38	102.38	120.23	135.71	152.38	161.90
	R2	19.04	41.66	77.38	98.80	114.28	139.28	142.85	152.38
	R3	21.42	43.45	70.83	103.57	113.09	136.90	147.61	160.71
	R4	19.04	40.48	77.97	100.00	113.09	136.90	146.42	158.33
	Mean	19.19 ± 0.86a	43.30 ± 1.56a	75.89a ± 1.69	101.19a ± 1.09	115.17b ± 1.71	137.20b ± 0.75	147.32b ± 1.97	158.33b ± 2.12
T3	R1	18.45	41.07	77.38	92.85	111.90	132.14	142.83	151.19
	R2	22.02	42.85	72.61	104.16	116.66	134.52	148.80	154.76
	R3	21.42	41.07	75.00	102.97	113.09	133.33	142.81	157.14
	R4	20.83	41.66	75.00	98.21	109.52	133.33	136.90	152.38
	Mean	20.68 ± 0.78a	41.66a ± 0.42	74.99a ± 0.98	99.55a ± 2.58	112.71b ± 1.49	133.33c ± 0.49	142.84bc ± 2.43	153.87bc ± 1.32
T4	R1	18.45	39.28	79.16	95.23	109.52	128.57	141.66	151.19
	R2	19.64	39.28	74.40	101.19	113.09	130.95	139.28	152.38
	R3	17.85	41.66	74.40	100.59	114.28	132.14	144.04	158.33
	R4	17.85	37.50	76.19	98.21	107.14	128.57	130.95	136.90
	Mean	18.45 ± 0.42a	39.43a ± 0.86	76.04a ± 0.86	98.81a ± 1.13	111.01b ± 1.64	130.06c ± 0.89	138.98c ± 2.85	149.70c ± 4.55

Means bearing the same superscript within the same column did not differ significantly

Table 11. Effect of DBS supplementation on daily feed intake – ANOVA

Week	Source	d.f.	SS	MSS	F value
1	Treatment	3	10.359	3.453	1.664 NS
	Error	12	24.904	2.075	
	Total	15	35.263		
2	Treatment	3	33.566	11.189	2.701 NS
	Error	12	49.713	4.143	
	Total	15	83.279		
3	Treatment	3	14.967	4.989	0.850 NS
	Error	12	70.441	5.870	
	Total	15	85.048		
4	Treatment	3	28.895	9.632	0.933 NS
	Error	12	123.896	10.325	
	Total	15	152.790		
5	Treatment	3	908.744	302.915	25.928**
	Error	12	140.194	11.683	
	Total	15	1048.938		
6	Treatment	3	330.659	110.220	24.260**
	Error	12	54.520	4.543	
	Total	15	385.179		
7	Treatment	3	983.158	327.719	13.080**
	Error	12	300.670	25.056	
	Total	15	1283.828		
8	Treatment	3	830.703	276.901	9.250**
	Error	12	359.237	29.936	
	Total	15	1189.940		

** Significant ($P<0.01$)
NS – Not significant

definite trend from fifth week onwards based on different feeding regimen employed in this study.

Cumulative feed intake

The mean cumulative feed consumption per bird for different treatment groups T_1, T_2, T_3 and T_4 were 3599.75, 3443.50, 3381.25 and 3316.25 g during 0-6 weeks and 5901.50, 5582.75, 5472.75 and 5337.00 g during 0-8 weeks period respectively (Table 12).

Six weeks total feed consumption was more with T_1 (3599.75 g) and less with T_4 (3316.25 g) and the values for other treatments were intermediary, T_1 continued to consume more feed (5901.50 g) for the whole eight weeks period and it was less for T_4 (5337.00 g).

The analysis of variance of the total feed consumption for six weeks and eight weeks presented in Table 13 revealed that it was statistically different among various treatment groups. Six weeks feed consumption was significantly ($P<0.01$) more in the group fed a standard broiler ration (T_1) and was significantly less in the group fed a standard diet with 0.2 per cent level of DBS (T_4). The groups fed with standard broiler ration (T_1) differed significantly ($P<0.01$) from all other treatment groups. Feed consumption data of the groups offered a diet with 0.1 and 0.15 per cent level of DBS (T_2 & T_3, respectively) were statistically comparable to each

Table 12. Effect of DBS supplementation on cumulative feed intake per bird (g)

Treatments		Cumulative feed consumption (g)	
		Sixth week	Eighth week
T1	R1	3683.00	6032.00
	R2	3591.00	5891.00
	R3	3525.00	5742.00
	R4	3600.00	5941.00
	Mean ± SE	3599.75a ± 32.39	5901.50a ± 60.65
T2	R1	3504.00	5704.00
	R2	3433.00	5499.00
	R3	3425.00	5583.00
	R4	3412.00	5545.00
	Mean ± SE	3443.50b ± 20.63	5582.75b ± 43.92
T3	R1	3317.00	5375.00
	R2	3450.00	5575.00
	R3	3408.00	5566.00
	R4	3350.00	5375.00
	Mean ± SE	3381.25bc ± 29.65	5472.75bc ± 56.47
T4	R1	3291.00	5341.00
	R2	3350.00	5392.00
	R3	3366.00	5482.00
	R4	3258.00	5133.00
	Mean ± SE	3316.25c ± 25.24	5337.00c ± 73.99
	Grand Mean	3435.19 ± 59.54	5573.50 ± 120.155
	LSD	84.26	184.00

Means bearing the same superscript within the same column did not differ significantly

Table 13. Effect of DBS supplementation on cumulative feed intake – ANOVA

Week	Source	d.f.	SS	MSS	F value
6	Treatment	3	176821.188	58940.396	19.706 **
	Error	12	35891.250	2990.938	
	Total	15	212712.438		
8	Treatment	3	695009.500	231669.833	16.236**
	Error	12	171224.500	14268.708	
	Total	15	866234.000		

** Significant ($P<0.01$)

Fig.4 DAILY FEED INTAKE AS EFFECTED BY DBS SUPPLEMENTATION

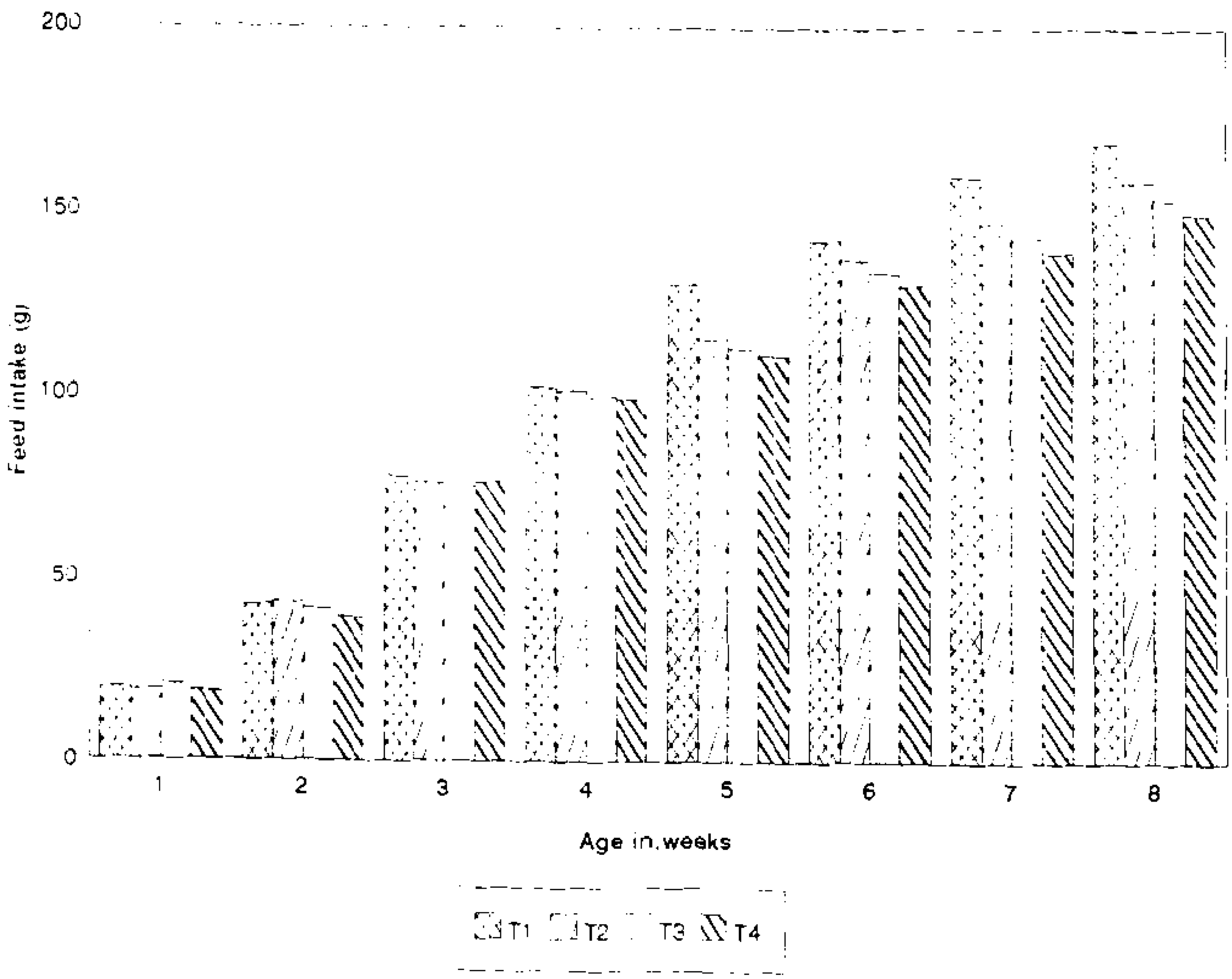
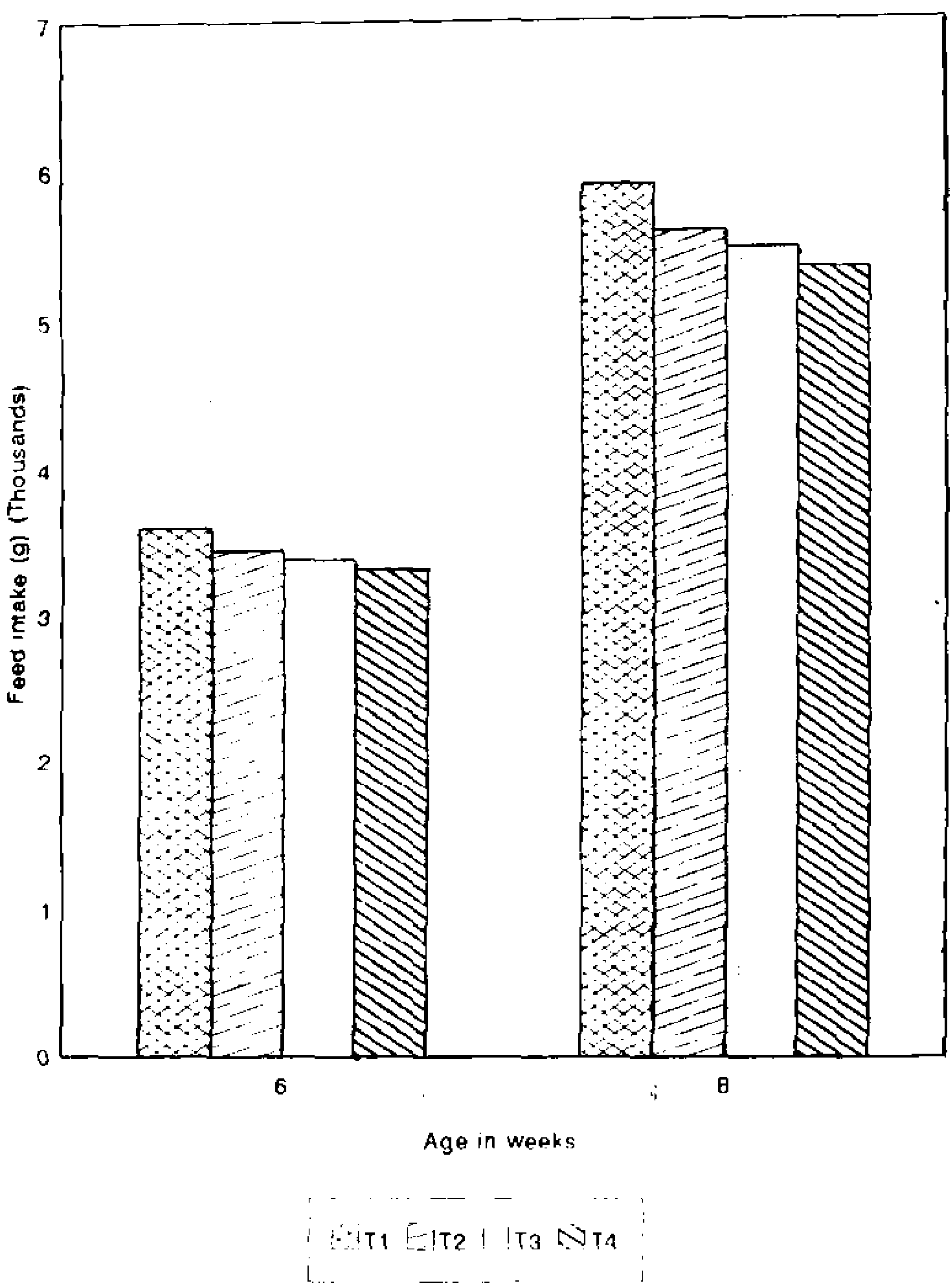


Fig.5 CUMULATIVE FEED INTAKE AS EFFECTED BY DBS SUPPLEMENTATION



other and groups fed with a diet having 0.15 and 0.2 per cent level of DBS (T_3 and T_4 respectively) were also statistically comparable to each other.

Cumulative feed consumption at eighth week was significantly (P<0.01) higher with T_1 (standard broiler ration fed group) and differed significantly (P<0.01) from all other treatment groups and less with T_4 (standard broiler ration with 0.2 per cent DBS fed group). The feed consumption of the treatment groups T_2 and T_3 were statistically comparable to each other and groups T_3 and T_4 were also statistically comparable to each other.

The mean daily feed intake in each week and cumulative feed intake per bird as influenced by DBS supplementation are presented in Figures 4 and 5, respectively.

4.5 Feed conversion ratio

The data on fortnightly as well as the cumulative feed conversion ratio (FCR) among different treatment groups are set out in Table 14.

Statistical analysis of the fortnightly feed conversion ratio (Table 15) revealed significant (P<0.05) differences among various treatments only at sixth week of age. At this age, the FCR in all DBS supplemented groups were statistically comparable and the groups fed 0.1 and 0.15 per cent DBS were significantly better than that recorded in the control group.

Table 14. Effect of DBS supplementation on mean fortnightly feed conversion ratio

Treatments		Age in weeks				Cumulative feed efficiency	
		2	4	6	8	6^{th} week	8^{th} week
T1	R1	1.72	1.80	2.52	3.03	2.06	2.35
	R2	1.66	1.87	2.40	3.16	2.03	2.36
	R3	1.77	1.90	2.43	3.05	2.09	2.38
	R4	1.63	1.86	2.49	3.03	2.05	2.36
	Mean ± SE	$1.70^{a} \pm$ 0.03	$1.86^{a} \pm$ 0.02	$2.47^{a} \pm$ 0.025	$3.07^{a} \pm$ 0.03	$2.06^{a} \pm$ 0.01	$2.36^{a} \pm$ 0.005
T2	R1	1.78	1.87	2.27	3.01	1.96	2.27
	R2	1.60	1.84	2.40	2.91	2.00	2.27
	R3	1.78	1.71	2.15	3.05	1.88	2.20
	R4	1.56	1.80	2.20	2.76	1.90	2.16
	Mean ± SE	1.68a ± 0.06	$1.81^{a} \pm$ 0.035	$2.26^{b} \pm$ 0.055	$2.93^{a} \pm$ 0.065	$1.94^{b} \pm$ 0.03	$2.23^{b} \pm$ 0.025
T3	R1	1.59	1.80	2.47	2.86	2.00	2.26
	R2	1.82	1.84	2.22	2.78	1.95	2.20
	R3	1.64	1.85	2.21	3.16	1.94	2.30
	R4	1.73	1.81	2.24	2.63	1.85	2.16
	Mean ± SE	$1.70^{a} \pm$ 0.05	$1.83^{a} \pm$ 0.01	$2.29^{b} \pm$ 0.06	$2.86^{a} \pm$ 0.11	$1.96^{b} \pm$ 0.02	$2.23^{b} \pm$ 0.03
T4	R1	1.70	1.84	2.34	2.56	1.99	2.17
	R2	1.63	1.82	2.37	2.68	1.98	2.20
	R3	1.77	1.81	2.25	2.69	1.96	2.19
	R4	1.62	1.83	2.50	3.02	1.94	2.23
	Mean ± SE	$1.68^{a} \pm$ 0.35	$1.83^{a} \pm$ 0.001	$2.37^{ab} \pm$ 0.05	$2.74^{a} \pm$ 0.10	$1.97^{b} \pm$ 0.01	$2.20^{b} \pm$ 0.01
	LSD	-	-	0.1541*	-	0.04872**	0.06890**

Means bearing the same superscript within the same column did not differ significantly

Table 15. Effect of DBS supplementation on mean fortnightly feed conversion ratio – ANOVA

Week	Source	d.f	SS	MSS	F value
2	Treatment	3	0.001	0.000	0.037 NS
	Error	12	0.098	0.008	
	Total	15	0.099		
4	Treatment	3	0.006	0.002	1.032 NS
	Error	12	0.022	0.002	
	Total	15	0.028		
6	Treatment	3	0.108	0.036	3.571*
	Error	12	0.121	0.010	
	Total	15	0.230		
8	Treatment	3	0.229	0.076	2.797 NS
	Error	12	0.328	0.027	
	Total	15	0.557		

* Significant (P<0.05)
NS – Not significant

Table 16. Effect of DBS supplementation on cumulative feed conversion ratio – ANOVA

Week	Source	d.f.	SS	MSS	F value
6	Treatment	3	0.034	0.011	9.379**
	Error	12	0.015	0.001	
	Total	15	0.049		
8	Treatment	3	0.066	0.022	11.470**
	Error	12	0.023	0.002	
	Total	15	0.088		

** Significant (P<0.01)

Table 17. Effect of DBS supplementation on production performance at six and eight weeks of age

Treatments		Initial body weight (g)	Upto six weeks			Upto eight weeks		
			Body weight (g)	Cumulative feed consumed (g)	Cumulative feed efficiency	Body weight (g)	Cumulative feed consumed (g)	Cumulative feed efficiency
T1	R1	43.33	1785.83	3683	2.06	2560.83	6032	2.35
	R2	42.91	1762.50	3591	2.03	2489.16	5891	2.36
	R3	42.66	1689.16	3525	2.09	2415.00	5742	2.38
	R4	43.16	1749.16	3600	2.05	2521.66	5941	2.36
	Mean SE	43.02a ± 0.15	1746.66ab ± 20.61	3599.75a ± 32.39	2.06a ± 0.01	2496.66a ± 30.92	5901.50a ± 60.65	2.36a ± 0.005
T2	R1	43.83	1786.60	3504	1.96	2515.83	5704	2.27
	R2	43.00	1714.16	3433	2.00	2423.33	5499	2.27
	R3	43.75	1824.16	3425	1.88	2531.66	5583	2.20
	R4	43.50	1796.60	3412	1.90	2510.16	5545	2.16
	Mean SE	43.52a ± 0.19	1780.38a ± 23.46	3443.50b ± 20.63	1.94b ± 0.03	2510.00a ± 30.98	5582.75b ± 43.92	2.23b ± 0.025
T3	R1	43.33	1656.66	3317	2.00	2375.00	5375	2.26
	R2	43.08	1767.50	3450	1.95	2529.16	5575	2.20
	R3	42.66	1759.16	3408	1.94	2422.50	5566	2.30
	R4	43.58	1720.00	3350	1.95	2487.50	5375	2.16
	Mean SE	43.16a ± 0.20	1725.83ab ± 25.28	3381.25bc ± 29.65	1.96b ± 0.015	2453.54a ± 34.16	5472.75bc ± 56.47	2.23b ± 0.03
T4	R1	43.58	1653.33	3291	1.99	2453.34	5341	2.17
	R2	43.83	1690.83	3350	1.98	2450.83	5392	2.20
	R3	43.08	1716.66	3366	1.96	2503.33	5482	2.19
	R4	43.50	1680.83	3258	1.94	2300.00	5133	2.23
	Mean SE	43.50a ± 0.16	1685.41b ± 13.09	3316.25c ± 25.24	1.97b ± 0.01	2426.88a ± 43.99	5337.00c ± 73.99	2.20b ± 0.01
	LSD	-	65.10	84.26	0.04872	-	184.00	0.06890

Means bearing the same superscript within the same column did not differ significantly

Fig.6 FORTNIGHTLY FEED CONVERSION RATIO AS EFFECTED BY DBS SUPPLEMENTATION

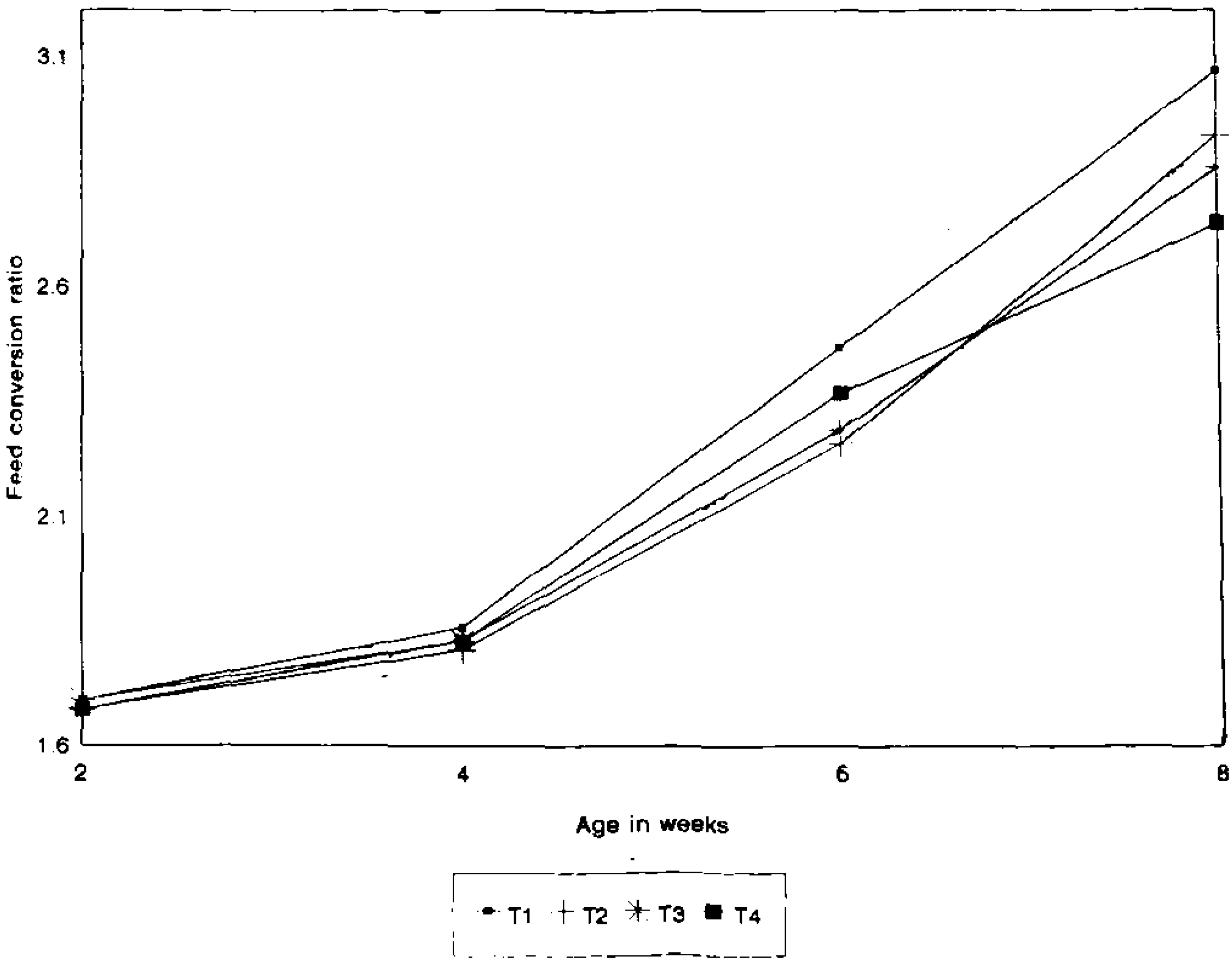
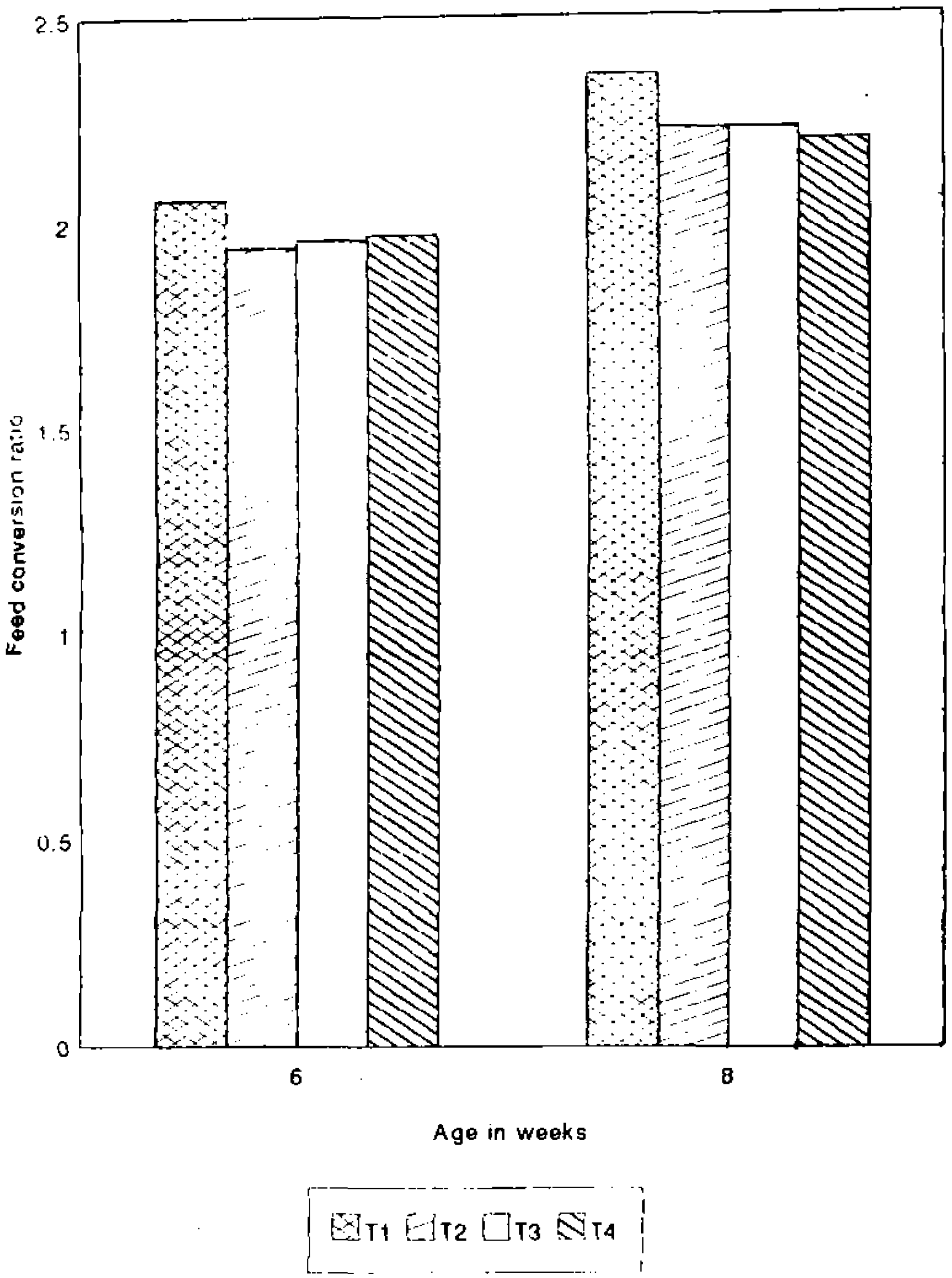


Fig.7 CUMULATIVE FEED CONVERSION RATIO AS EFFECTED BY DBS SUPPLEMENTATION



The cumulative feed conversion ratios recorded in different treatment groups T_1, T_2, T_3 and T_4 were 2.06, 1.94, 1.96 and 1.97 at the end of sixth week and 2.36, 2.23, 2.23 and 2.20 at the end of eighth week respectively.

At sixth week, the cumulative FCR recorded in all DBS supplemented groups were comparable statistically among each other and all these values were significantly superior over the control diet ($P<0.01$). The same trend was maintained at the end of eighth week also (Table 16).

The mean fortnightly feed efficiency for different dietary treatment groups during the eight weeks period and cumulative feed efficiency at sixth and eighth week age are depicted in Figures 6 and 7 respectively.

4.6 Protein efficiency ratio

The data on fortnightly protein efficiency ratio (PER) among different treatment groups are set out in Table 18.

Statistical analysis of the fortnightly protein efficiency ratio (Table 19) at second, fourth and eighth week of age revealed no significant difference among various treatment groups and at sixth week of age significantly ($P<0.05$) superior protein efficiency ratio (1.88) was noted with the group offered a diet containing 0.1 per cent level of DBS (T_2) and this value was statistically comparable with the treatment groups T_3 and T_4 (1.87 and 1.85, respectively), whereas the group fed a

Table 18. Effect of DBS supplementation on mean fortnightly protein efficiency and cumulative protein efficiency ratio

Treatments		Age in weeks				Cumulative protein efficiency	
		2	4	6	8	6th week	8th week
T1	R1	2.47	2.36	1.69	1.64	2.17	2.04
	R2	2.55	2.27	1.77	1.57	2.20	2.04
	R3	2.40	2.23	1.73	1.63	2.12	2.00
	R4	2.60	2.28	1.71	1.63	2.20	2.06
	Mean ± SE	2.51^{a} ± 0.05	2.29^{a} ± 0.03	1.73^{b} ± 0.02	1.62^{a} ± 0.02	2.17^{b} ±0.02	2.04^{b} ±0.15
T2	R1	2.38	2.37	1.86	1.65	2.20	2.06
	R2	2.64	2.31	1.76	1.68	2.24	2.10
	R3	2.38	2.49	1.98	1.62	2.28	2.12
	R4	2.74	2.37	1.93	1.80	2.35	2.21
	Mean ± SE	2.53^{a} ± 0.09	2.39^{a} ± 0.04	1.88^{a} ± 0.05	1.69^{a} ± 0.04	2.27^{a} ± 0.03	2.12^{a} ±0.03
T3	R1	2.68	2.38	1.72	1.73	2.26	2.13
	R2	2.33	2.32	1.92	1.79	2.19	2.09
	R3	2.60	2.30	1.93	1.58	2.28	2.10
	R4	2.45	2.29	1.90	1.88	2.21	2.13
	Mean ± SE	2.52^{a} ± 0.08	2.32^{a} ± 0.03	1.87^{a} ± 0.05	1.75^{a} ± 0.07	2.24^{ab} ± 0.02	2.11^{a} ± 0.01
T4	R1	2.50	2.31	1.81	1.94	2.21	2.14
	R2	2.60	2.31	1.80	1.83	2.23	2.13
	R3	2.40	2.34	1.89	1.84	2.21	2.12
	R4	2.60	2.32	1.88	1.64	2.27	2.11
	Mean ± SE	2.53^{a} ± 0.05	2.32^{a} ± 0.01	1.85^{a} ± 0.30	1.81^{a} ± 0.07	2.23^{ab} ±0.15	2.13^{a} ± 0.01
	LSD	-	-	0.1193	-	0.06890	0.04872

Means bearing the same superscript within the same column did not differ significantly

Table 19. Effect of DBS supplementation on mean fortnightly protein efficiency ratio – ANOVA

Week	Source	d.f.	SS	MSS	F value
2	Treatment	3	0.002	0.001	0.031 NS
	Error	12	0.221	0.018	
	Total	15	0.222		
4	Treatment	3	0.021	0.007	2.546 NS
	Error	12	0.033	0.003	
	Total	15	0.055		
6	Treatment	3	0.062	0.021	3.694*
	Error	12	0.067	0.006	
	Total	15	0.128		
8	Treatment	3	0.083	0.028	2.838 NS
	Error	12	0.117	0.010	
	Total	15	0.199		

* Significant (P<0.05)
NS – Not significant

Table 20. Effect of DBS supplementation on cumulative protein efficiency ratio – ANOVA

Week	Source	d.f.	SS	MSS	F value
6	Treatment	3	0.019	0.006	3.089*
	Error	12	0.024	0.002	
	Total	15	0.043		
8	Treatment	3	0.022	0.007	5.594*
	Error	12	0.016	0.001	
	Total	15	0.038		

* Significant (P<0.05)

Fig.8 FORTNIGHTLY PROTEIN EFFICIENCY RATIO AS EFFECTED BY DBS SUPPLEMENTATION

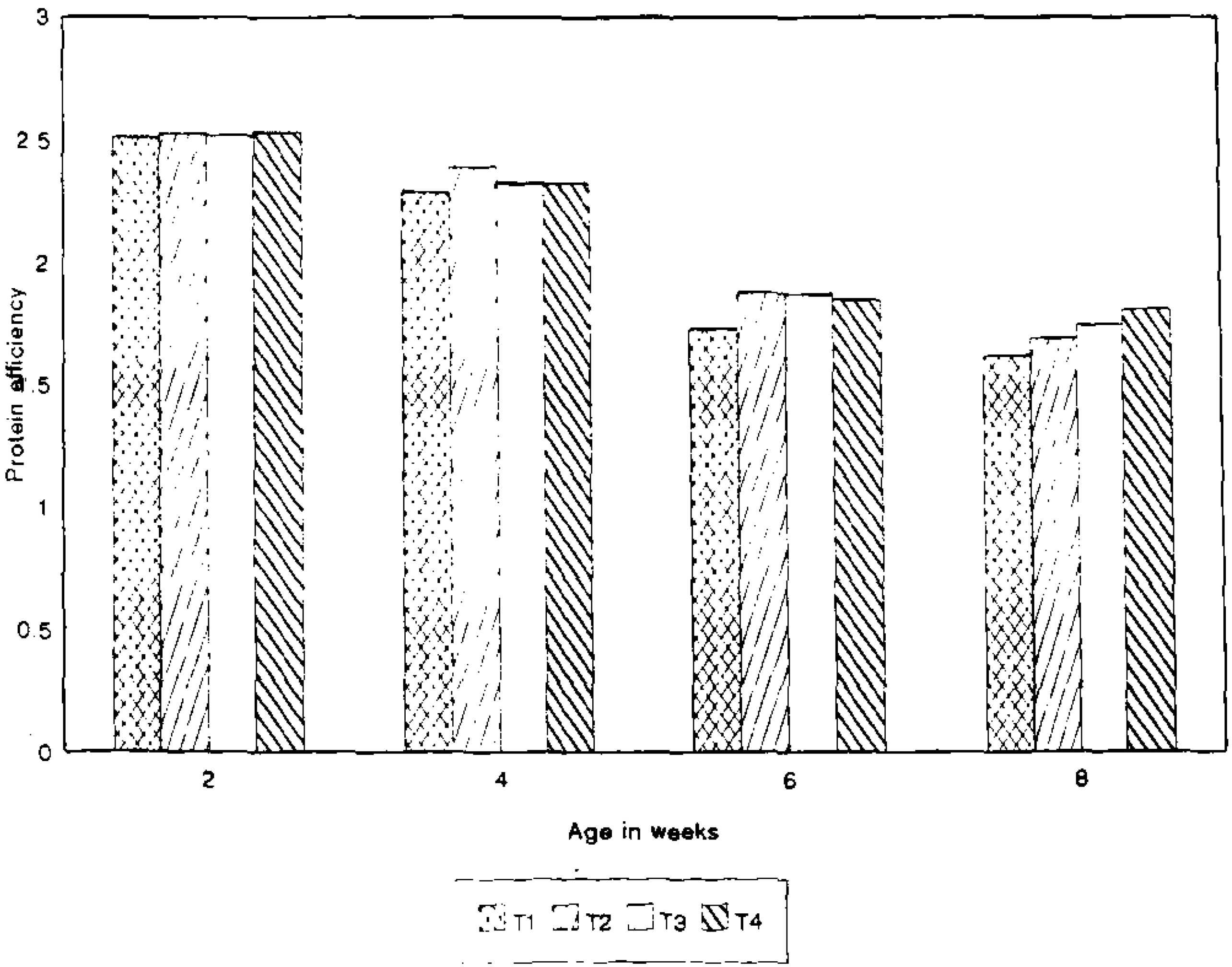
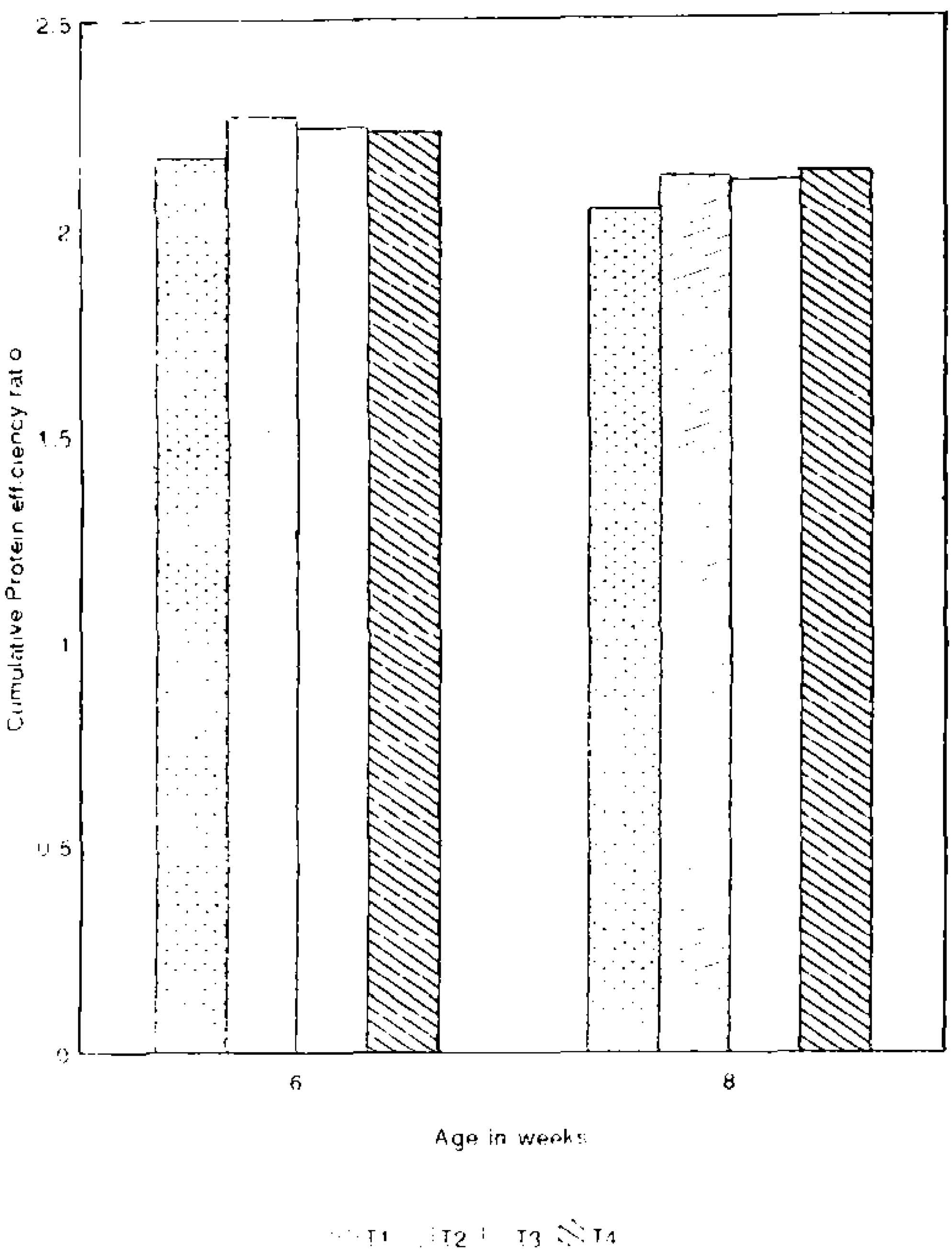


Fig 9 CUMULATIVE PROTEIN EFFICIENCY RATIO AS EFFECTED BY DBS SUPPLEMENTATION



standard broiler ration (T_1) exhibited significantly ($P<0.05$) inferior protein efficiency (1.73).

The cumulative protein efficiency at sixth week indicated that superior efficiency ($P<0.05$) was noted with T_2 (2.27) whereas it was significantly inferior with T_1 (2.17) and the other treatments were between these two and comparable also.

When the cumulative protein efficiency was considered for eight weeks of age, the DBS treated groups had significantly superior ($P<0.05$) efficiency than the untreated control.

The mean fortnightly protein efficiency ratio for different dietary treatment groups during the eight weeks period and cumulative protein efficiency at sixth and eighth weeks age are depicted in Fig.8 and 9.

4.7 Blood parameters

The data on blood parameters - Hb, PCV and ESR are presented in Table 21.

4.7.1 Haemoglobin

The percentage haemoglobin (gram per cent) of birds of treatments T_1, T_2, T_3 and T_4 were 9.56, 9.31, 9.44 and 9.38 respectively.

Table 21. Effect of DBS supplementation on blood parameters – Hb, PCV and ESR

Treatments		Hb(g%)	PCV (%)	ESR (mm/hr)
T1	R1	11.0	27.5	4mm
	R2	9.0	28.0	3.5mm
	R3	9.75	28.5	3.5mm
	R4	8.50	28.0	4mm
	Mean ± SE	9.56a ± 0.55	28.0a ± 0.21	3.75 a ± 0.15
T2	R1	10.50	27.5	3.5mm
	R2	9.0	27.5	4mm
	R3	9.0	28.5	4mm
	R4	8.75	28.5	3mm
	Mean ±SE	9.31a ± 0.40	28.0a ± 0.29	3.75a ± 0.15
T3	R1	10.25	27.5	4mm
	R2	8.75	28.0	3.5mm
	R3	10.25	28.5	4mm
	R4	8.50	28.5	4mm
	Mean ± SE	9.44a ± 0.47	28.13a ± 0.24	3.88 a ± 0.13
T4	R1	9.50	28.50	3.5mm
	R2	8.50	26.50	4mm
	R3	9.75	29.50	4mm
	R4	9.75	27.50	3.5mm
	Mean ± SE	9.38a ± 0.30	28.00a ± 0.65	3.75 a ± 0.15
	LSD	-	-	-

Means bearing the same superscript within the same column did not differ significantly

Table 22. Effect of DBS supplementation on haemoglobin (Hb%) - ANOVA

Source	d.f.	SS	MSS	F value
Treatment	3	3.137	0.046	0.059 NS
Error	12	9.203	0.767	
Total	15	9.340		

NS – Not significant

Table 23. Effect of DBS supplementation on Packed cell volume (PCV%) - ANOVA

Source	d.f.	SS	MSS	F value
Treatment	3	0.047	0.016	0.026 NS
Error	12	7.188	0.599	
Total	15	7.234		

NS – Not significant

Table 24. Effect of DBS supplementation on Erythrocyte sedimentation rate (mm/h) - ANOVA

Source	d.f.	SS	MSS	F value
Treatment	3	0.047	0.016	0.200 NS
Error	12	0.938	0.078	
Total	15	0.984		

NS – Not significant

The statistical analysis of the data on gram per cent haemoglobin (Hb) presented in Table 22 showed no significant ($P<0.05$) difference between treatments.

4.7.2 Packed cell volume

The percentage packed cell volume (PCV) of birds of treatments T_1, T_2, T_3 and T_4 were 28.00, 28.00, 28.13 and 28.00 respectively.

The statistical analysis of the data on per cent PCV presented in Table 23 showed no significant ($P<0.05$) difference between treatments.

4.7.3 Erythrocyte sedimentation rate (ESR)

The erythrocyte sedimentation rate (mm/h) of birds of treatments T_1, T_2, T_3 and T_4 were 3.75, 3.75, 3.88 and 3.75 respectively.

The statistical analysis of the data on ESR presented in Table 24 showed no significant ($P<0.05$) difference between treatments.

4.8 slaughter studies

4.8.1 Dressed yield and Ready-to-cook yield

Data on percentage dressed yield of birds among different treatment groups are given in Table 25.

The percentage dressed yield of birds of treatments T_1, T_2, T_3 and T_4 were 90.84, 91.49, 90.78 and 90.87 respectively.

Table 25. Effect of DBS supplementation on dressed yield (per cent)

Bird Number	Dressed yield (per cent)			
	T1	T2	T3	T4
1	92.00	89.91	93.02	90.74
2	89.58	93.28	90.34	90.63
3	91.22	92.74	90.83	90.61
4	89.37	90.33	90.47	90.90
5	90.90	92.73	91.24	90.21
6	91.78	90.23	89.74	91.29
7	91.11	90.61	90.61	90.00
8	90.83	92.09	90.00	92.59
Mean ± SE	90.84 ± 0.0332	91.49 ± 0.481	90.78 ± 0.360	90.87 ± 0.283

Table 26. Effect of DBS supplementation on dressed yield - ANOVA

Source	d.f.	SS	MSS	F value
Treatment	3	2.619	0.873	0.794 NS
Error	28	30.777	1.099	
Total	31	33.396		

NS – Not significant

The statistical analysis of the data on per cent dressed yield presented in Table 26 did not show any significant ($P>0.05$) difference between treatments. It was numerically more in the group fed a diet containing 0.1 per cent DBS (T_2) than all other groups. But, the differences in per cent dressed yield among the treatments T_1, T_2, T_3 and T_4 were not enough to make them statistically significant ($P<0.05$).

The data pertaining to ready-to-cook yield of birds as influenced by bovine spleen supplementation is presented in Table 27.

The per cent ready-to-cook yield of birds among treatments T_1, T_2, T_3 and T_4 were 77.87, 78.23, 78.05 and 78.02 respectively. Higher ready-to-cook yield was obtained for the treatment T_2, while T_1 recorded a lower ready-to-cook yield. However, when the differences in ready-to-cook yield among the treatments were analysed (Table 28), there was no significant difference between the treatments T_1, T_2, T_3 and T_4.

4.8.2 Organ weight percentage

4.8.2.1 Liver

The data pertaining to per cent liver weight of birds as influenced by DBS supplementation is presented in Table 29. Higher liver weight was obtained for the treatment T_2 (2.35 per cent), while T_1 recorded a numerically lower liver weight per cent of 2.16. When the differences in liver weight per cent among the

Table 27. Effect of DBS supplementation on Ready-to-cook yield (per cent)

Bird Number	Ready-to-cook yield (per cent)			
	T1	T2	T3	T4
1	80.00	78.64	79.42	79.00
2	75.50	79.50	75.74	78.55
3	78.42	76.52	79.01	76.98
4	75.65	79.50	76.95	78.69
5	78.82	79.49	78.46	77.31
6	79.50	79.16	77.85	77.17
7	81.06	74.36	78.87	78.50
8	74.04	78.69	78.13	77.92
Mean SE	77.87 ± 0.883	78.23 ± 0.654	78.05 ± 0.427	78.02 ± 0.276

Table 28. Effect of DBS supplementation on Ready-to-cook yield - ANOVA

Source	d.f.	SS	MSS	F value
Treatment	3	0.524	0.175	0.059 NS
Error	28	82.218	2.936	
Total	31	82.742		

NS – Not significant

Table 29. Effect of DBS supplementation on organ weight as percentage live weight of gizzard, heart, liver and spleen

Treatments		Liver	Gizzard	Heart	Spleen
T1	R1	2.17	2.33	0.70	0.40
	R2	2.11	2.68	0.89	0.48
	R3	2.32	2.44	0.80	0.48
	R4	2.04	2.32	0.81	0.55
	Mean ±SE	$2.16^{a} \pm 0.06$	$2.44^{a} \pm 0.09$	$0.80^{a} \pm 0.04$	$0.48^{a} \pm 0.03$
T2	R1	2.21	2.25	0.77	0.45
	R2	2.40	3.26	0.83	0.49
	R3	2.20	2.44	0.81	0.53
	R4	2.57	2.38	0.90	0.51
	Mean ±SE	$2.35^{a} \pm 0.09$	$2.58^{a} \pm 0.23$	$0.83^{a} \pm 0.03$	$0.49^{a} \pm 0.02$
T3	R1	2.40	2.58	0.96	0.49
	R2	2.58	2.24	0.78	0.48
	R3	2.34	2.47	0.89	0.49
	R4	1.98	2.15	0.73	0.45
	Mean ±SE	$2.33^{a} \pm 0.125$	$2.36^{a} \pm 0.10$	$0.84^{a} \pm 0.05$	$0.48^{a} \pm 0.01$
T4	R1	2.13	2.33	0.85	0.46
	R2	2.34	2.57	0.85	0.46
	R3	2.34	2.10	0.84	0.53
	R4	2.21	2.60	0.81	0.51
	Mean ±SE	$2.26^{a} \pm 0.05$	$2.40^{a} \pm 0.12$	$0.84^{a} \pm 0.01$	$0.49^{a} \pm 0.02$
	LSD	-	-	-	-

Means bearing the same superscript within the same column did not differ significantly

treatments were analysed (Table 30), there was no significant ($P<0.05$) difference between treatments.

4.8.2.2 Gizzard

The mean gizzard weight percentage of birds fed different dietary regimen is shown in Table 29. The group fed a standard broiler diet supplemented with 0.1 per cent level of DBS (T_2) had a greater per cent gizzard weight (2.58 per cent), while those maintained on a standard diet with 0.15 per cent level of DBS (T_3) had numerically less gizzard weight (2.36 per cent). The statistical analysis of the data on per cent gizzard weight presented in Table 31 did not show any significant ($P<0.05$) difference between treatments.

4.8.2.3 Heart

The mean per cent heart weight of birds fed different dietary regimen is shown in Table 29. The treatment groups T_3 & T_4 had a greater per cent heart weight (0.84 per cent, each), while those maintained on a standard diet without DBS (T_1) had numerically less heart weight per cent (0.80 per cent). Statistical analysis of the data on per cent heart weight did not show any significant ($P>0.05$) difference between treatments (Table 32).

4.8.2.4 Spleen

The data pertaining to per cent spleen weight of birds as influenced by DBS supplementation is presented in Table 29. Higher spleen weight was obtained for

Table 30. Effect of DBS supplementation on liver weight (per cent) - ANOVA

Source	d.f.	SS	MSS	F value
Treatment	3	0.084	0.028	0.938 NS
Error	12	0.357	0.030	
Total	15	0.441		

NS – Not significant

Table 31. Effect of DBS supplementation on Gizzard weight (per cent) - ANOVA

Source	d.f.	SS	MSS	F value
Treatment	3	0.113	0.038	0.452 NS
Error	12	0.998	0.083	
Total	15	1.110		

NS – Not significant

Table 32. Effect of DBS supplementation on heart weight (per cent) - ANOVA

Source	d.f.	SS	MSS	F value
Treatment	3	0.004	0.001	0.260 NS
Error	12	0.060	0.005	
Total	15	0.064		

NS – Not significant

Table 33. Effect of DBS supplementation on spleen weight (per cent) - ANOVA

Source	d.f.	SS	MSS	F value
Treatment	3	0.001	0.000	0.193 NS
Error	12	0.020	0.002	
Total	15			

NS – Not significant

the treatments T_2 & T_4 (0.49 per cent, each). While the groups T_1 & T_3 had a numerically lower spleen weight percentage (0.48 per cent, each). Statistical analysis of the data on per cent spleen weight did not exhibit any significant ($P>0.05$) difference between treatments (Table 33).

4.9 Livability

Livability pattern of birds in the different treatment groups showed that the percentage livability was 100 per cent in T_1, T_2 and T_3. One bird died during the entire period of study. Mortality was noted in the group fed diet supplemented with 0.2 per cent level of DBS (T_4). Necropsy of dead bird did not show any signs that were attributable to treatment effect. The over all mortality in the experiment was well within the standards prescribed for commercial broilers.

4.10 Economics

In order to assess the cost-benefit particulars of supplementation of DBS in standard broiler ration, the cost of different rations used in the study was calculated based on the actual price of feed ingredients which prevailed at the time of experiment and are presented in Table 34. Cost of rations computed for different treatments viz., T_1, T_2, T_3 and T_4 were 8.54, 8.60, 8.63 and 8.66 Rupees per Kg starter and 7.60, 7.66, 7.69 and 7.72 Rupees per kg finisher feed, respectively.

Table 34. Cost of experimental rations

Sl. No	Ingredients	Cost/kg* (Rs.)	Broiler starter ration				Broiler finisher ration			
			T1	T2	T3	T4	T1	T2	T3	T4
1	Yellow maize	5.08	223.52	223.52	223.52	223.52	269.24	269.24	269.24	269.24
2	Groundnut cake (exp)	9.45	292.95	292.95	292.95	292.95	245.70	245.70	245.70	245.70
3	Gingelly oil cake	9.45	37.80	37.80	37.80	37.80	-	-	-	-
4	Unsalted dried fish	10.50	94.50	94.50	94.50	94.50	84.00	84.00	84.00	84.00
5	Rice polish	4.75	47.50	47.50	47.50	47.50	52.25	52.25	52.25	52.25
6	Common salt	1.74	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
7	Mineral mixture	16.34	28.60	28.60	28.60	28.60	28.60	28.60	28.60	28.60
8	Vitamin mixture	441.00	11.03	11.03	11.03	11.03	11.03	11.03	11.03	11.03
9	Lysine hcl	183.00	43.92	43.92	43.92	43.92	21.96	21.96	21.96	21.96
10	Methionine	330.00	49.50	49.50	49.50	49.50	26.40	26.40	26.40	26.40
11	Choline chloride	161.00	8.05	8.05	8.05	8.05	4.83	4.83	4.83	4.83
12	Manganese sulphate	204.00	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
13	Coccidiostat	590.00	14.75	14.75	14.75	14.75	14.75	14.75	14.75	14.75
14	Dried bovine spleen	60.00	0.00	6.00	9.00	12.00	00.00	6.00	9.00	12.00
	Total cost/100 kg		853.78	859.78	862.78	865.78	760.41	766.42	769.41	772.41
	Cost/1 kg		8.54	8.60	8.63	8.66	7.60	7.66	7.69	7.72

*The rate contract approved by the Kerala Agricultural University was taken as cost of feed ingredients

The cost-benefit analysis for different dietary treatments is set out in Table 35 and 36. For the eight week period, feed cost for production of one kilogramme live weight worked out to Rs.19.32, 18.33, 18.45 and 18.26 for the treatments viz., T_1, T_2, T_3 and T_4 respectively. This revealed that the cost was lower in T_4 (Rs.18.26) and higher in T_1 (Rs.19.32). Total cost for the production of one kilogramme of live weight chicken was found to be Rs.25.73, 24.71, 24.98 and 24.85 for the treatments T_1, T_2, T_3 and T_4 respectively. It was highest in the group fed a standard broiler ration (T_1) and lowest in the treatment offered a diet with 0.1 per cent level of DBS (T_2). The net profit per kilogramme live weight was higher (Rs.15.29) in the group fed a diet containing 0.1 per cent level of DBS (T_2) than all other treatments.

The cost benefit analysis for the treatment groups at the end of six weeks (Table 36) also revealed that the net profit per kilogramme live weight was highest in the 0.1 per cent DBS supplemented group (T_2) and lowest in the control group (T_1).

Table 35. Cost benefit analysis per bird for the different treatment groups (8 weeks)

Sl.No.	Particulars	T1	T2	T3	T4
1	Live body weight (g)	2496	2510	2453	2427
2	Total feed consumption (g)	5902	5583	5473	5337
	(i) Starter ration (g)	3600	3444	3381	3316
	(ii) Finisher ration (g)	2302	2139	2092	2021
3	Feed cost (Rs.)	48.23	46.02	45.27	44.32
4	Feed and chick cost (Rs.)	61.23	59.02	58.27	57.32
5	Total cost (Rs.)*	64.23	62.02	61.27	60.32
6	Return from sale of broiler (Rs.)**	99.84	100.40	98.12	97.08
7	Profit over feed cost (Rs.)	51.61	54.38	52.85	52.76
8	Profit over feed and chick cost (Rs.)	38.61	41.38	39.85	39.76
9	Net profit per bird (Rs.)	35.61	38.38	36.85	36.76
10	Feed cost per kg body weight (Rs.)	19.32	18.33	18.45	18.26
11	Total cost per kg body weight (Rs.)	25.73	24.71	24.98	24.85
12	Profit over feed cost per kg body weight (Rs.)	20.68	21.67	21.55	21.74
13	Net profit per kg body weight (Rs.)	14.26	15.29	15.02	15.15

* Rs.3/- per bird was accounted as miscellaneous cost for vaccination, medicines etc.

** Sale price of broiler was Rs.40/- per kg body weight

Table 36. Cost benefit analysis per bird for the different treatment groups (6 weeks)

Sl.No.	Particulars	T1	T2	T3	T4
1	Live body weight (g)	1747	1780	1726	1685
2	Total feed consumption (g)	3600	3444	3381	3316
3	Feed cost (Rs.)	30.74	29.62	29.17	28.72
4	Feed + chick cost (Rs.)	43.74	42.62	42.17	41.72
5	Total cost of production (Rs.)*	45.74	44.62	44.17	43.72
6	Returns from sale of broiler**	69.88	71.20	69.04	67.40
7	Profit over feed cost (Rs.)	39.14	41.58	39.87	38.68
8	Profit over feed + chick cost	26.14	28.58	26.87	25.68
9	Net profit per bird (Rs.)	24.14	26.58	24.87	23.68
10	Feed cost per kg body weight	17.60	16.64	16.90	17.04
11	Total cost per kg body weight	26.18	25.07	25.59	25.95
12	Profit over feed cost per kg body weight (Rs.)	22.40	23.36	23.10	22.96
13	Net profit per kg body weight (Rs.)	13.82	14.93	14.41	14.05

* Rs.2/- per bird was accounted as miscellaneous cost for vaccination, medicines etc.

** Sale price of broiler calculated was Rs.40/- per kg body weight

Discussion

DISCUSSION

The results obtained from the study on the supplementation of dried bovine spleen in standard broiler diet on the performance of broilers and other related parameters, are discussed in this chapter.

5.1 Climatic parameters

The overall mean maximum and minimum temperatures recorded inside the experimental house during the trial period of eight weeks was 32.56°C and 22.89°C respectively. The mean relative humidity was 77.04 per cent in the morning and 49.73 per cent in the afternoon. These climatic observations indicated that the experimental period fell within the cold season of Kerala.

5.2 Body weight

The mean fortnightly body weight data indicated that among the different treatments, the group fed standard broiler starter and finisher rations with 0.1 per cent dried bovine spleen attained maximum body weights at all fortnights. When the magnitude of differences was tested statistically, it was evident that all the groups had comparable body weight except the groups fed with 0.1 and 0.2 per cent dried bovine spleen which differed significantly both at fourth and sixth weeksof age. At second and eighth weeks, all groups were comparable statistically.

Thus at fourth week, the group fed with 0.2 per cent DBS had comparable body weight with those fed the standard ration without DBS as well as the ration containing 0.15 per cent DBS. During the sixth week, however, birds fed the diet with 0.2 per cent bovine spleen exhibited significantly lower body weight than the birds fed the diet with 0.1 per cent of bovine spleen. The mean body weight of birds fed 0.2 per cent DBS was numerically lower than the control group at all fortnights studied.

The above finding is in agreement with those of Voronenkov and Nefedov (1967) who observed an increase in the growth rate of cockerels by 5.4 to 10.4 per cent on feeding cattle spleen preparation 2 to 4 ml per bird at every three days, decreased growth rate at the higher doses of 6 ml per bird.

Significant improvement in body weight among different species of animals fed diets supplemented with spleen biostimulator was also reported by Furtunescu (1963), Balun *et al.* (1966), Stepin (1966), Pichelauri and Cikadze (1967), Rebreanu *et al.* (1969), and James and Gangadevi, (1991).

On the other hand, Granat *et al.* (1965) opined that the injections of spleen extract had no appreciable effect on the growth rate of cockerels during fattening. Suljumova *et al.* (1970) observed that chicks fed on diets supplemented with dried tissue preparation attained increase in weight by 21.5 to 23.3 per cent in the first 30 days of life, which was reduced to 10.8 to 11.1 per cent in the next 30 days than the controls.

The results of the present study revealed an increase in body weight at 0.1 per cent inclusion of DBS while the higher level of 0.2 per cent inclusion depressed the growth rate significantly in comparison to 0.1 per cent inclusion at fourth and sixth week of age only.

The biostimulator supplemented at the rate of 0.1 per cent in the diet might have metabolised more energy into body mass than the control thereby resulting in better utilization of nutrients and consequent higher body weights. Decreased feed intake especially in the 0.2 per cent DBS supplemented groups leading to low nutrient intake might be the reason for lower body weights.

5.3 Body weight gain

The mean fortnightly weight gain data given in Table 7 revealed that there were no significant differences in weight gain among the different treatments. In the fortnights of second, fourth and sixth weeks, birds fed standard broiler diet with 0.1 per cent DBS (T_2) gained numerically higher weight than all other treatment groups. Whereas at eighth week of age, the group fed with standard ration without DBS gained more weight numerically than the DBS supplemented groups. In all the groups, irrespective of the treatment effects, birds gained statistically comparable fortnightly weight gains during the experimental period of eight weeks. The fact that the fortnightly weight gain data did not show any definite trend due to treatment effects necessitated a critical assessment of cumulative weight gain data to spell out meaningful conclusions.

A perusal of the mean cumulative body weight gain data at sixth week indicated that it was the highest (1736.86 g) for birds fed a standard diet with 0.1

per cent DBS (T_2). While those fed diets T_1, T_3 and T_4 gained 33.21, 54.19 and 94.94 g less than that of T_2 respectively. Statistical analysis of the data revealed significant difference only between the birds fed diet with 0.1 (T_2) and 0.2 per cent (T_4) DBS supplemented groups. All the other groups were comparable among each other.

Cumulative weight gain data upto eight weeks showed that the groups fed a standard ration with 0.1 per cent DBS (T_2) gained numerically more weight (2466.48 g) than all the other groups. Compared to T_2, the gain in weight was 12.83, 56.10 and 83.10 g less for the treatments T_1, T_3 and T_4 respectively. The cumulative weight gain from 0 to 8 weeks was statistically comparable among all treatment groups, shifting the pattern of cumulative gain noticed between T_2 and T_4 groups at sixth week of age. It implies that 0.1 per cent DBS supplementation is capable of making more weight gain upto six weeks and after that it elicits less effect through finisher ration.

This trend of results is similar to the findings of Doroskov (1962), and Psota (1969). They reported that administration of tissue preparations could improve weight gain in the initial stages but for a longer period the effect was less in pigs. Granat *et al.* (1965) observed that injection of spleen extracts had no appreciable effect on the growth rate of cockerels during fattening. Voronenko and Nefedov (1967) reported that small doses of cattle spleen preparation improved weight gain and large doses depressed growth in cockerels. Suljumova *et al.* (1970) found that supplementation of tissue preparation had more effect in the first 30 days than the next 30 days in chicks. James and Gangadevi (1991) reported that 0.1 per cent level of dried bovine spleen in the ration increased the growth rate in rabbits and rats. Improvement in body weight gain due to DBS supplementation observed in the present study can be related to the increased metabolizability of dietary energy for growth thereby resulting in better utilization of nutrients and consequent higher gains in body weight. Biostimulator supplementation in large doses reduced the weight gain due to reduced feed intake. Based on this observation, it is clear that the improvement in body weight gain in birds fed with 0.1 per cent DBS was possible due to early feeding and mean daily feed intake was not affected until fourth week of age.

5.4 Feed intake

The mean daily feed intake per bird was not significantly influenced by the different dietary treatments upto four weeks of age (Table 10). Fifth week onwards, the control group offered standard diet without DBS consumed significantly more feed than all other groups consistently in all weeks till the end of the experiment. From fifth week of age onwards there was specific pattern in daily feed consumption due to treatment effects. Feed intake was highest in standard diet fed group (T_1) followed by T_2, T_3 and T_4 groups, containing 0.1 0.15 and 0.2 per cent level of DBS in the diet respectively, in the descending order. As the level of DBS increased in the diet there was numerical decline in feed intake at all weeks mentioned above.

The overall mean cumulative feed intake per bird, irrespective of the treatments for six weeks and eight weeks was 3435.19 and 5573.50 g respectively (Table 12). The mean cumulative feed consumption per bird from 0 to 6 weeks and 0 to 8 weeks presented in Table 12 indicated that this trait was significantly influenced by DBS supplementation. The mean cumulative feed intake upto six weeks was significantly high in birds fed the standard diet (T_1) and was the lowest in birds fed standard diet with 0.2 per cent DBS (T_4). It was also observed that all DBS supplemented groups consumed significantly less feed than the control. Among the DBS fed groups, there was a declining trend in feed intake as the levels increased.

When the cumulative feed intake for the whole experimental period till eight weeks of age was considered, birds in T_1 consumed significantly higher quantity of feed (5901.50 g) than all other treatment groups. The treatments T_2, T_3 and T_4 consumed 318.75, 428.75 and 564.50 g feed less than that consumed by T_1 respectively. The magnitude of difference in T_3 was intermediary and was comparable with T_2 and T_4. But the difference between T_2 and T_4 was statistically significant.

A critical evaluation of the total feed intake data thus revealed that DBS supplementation at 0.2 per cent depressed the feed intake markedly. This might be due to the poor palatability of feed in higher level of DBS incorporation.

In the present study feed intake was significantly less with DBS supplemented groups when 0 to 6 weeks and 0 to 8 weeks total feed consumption was considered. At six weeks 4.33, 6.06 and 7.88 per cent reduction in feed intake was observed for the groups T_2, T_3, and T_4 respectively when compared to that of control. At the end of the experiment the reduction in feed intake was 5.40, 7.27 and 9.57 per cent for T_2, T_3 and T_4 respectively in comparison to that of control but with statistically comparable body weights at eighth week of age. Mahapatro and Roy (1970) conducted an experiment with Hariana calves by injecting cattle spleen extract as biostimulator and opined that biostimulator treated group required 25 per cent less concentrate than controls to get almost comparable average daily gain.

Smanckov(1964) reported that administration of an extract from the spleen of healthy animals stimulated fattening in pigs and calves and reduced the feed required for rearing them to market weight. Significantly lesser feed intake observed in DBS supplemented groups could be attributed to the efficient utilization of calories and protein which are supplied through the diets, by triggering the metabolism of the body.

5.5 Feed conversion ratio

Mean fortnightly feed conversion ratio given in Table 14 revealed that significant differences existed among different treatments at sixth week only. In the third fortnight, birds fed standard broiler diets with 0.1 per cent DBS exhibited significantly better feed efficiency than the control group.

The data on cumulative feed efficiency for six weeks (Table 14) indicated that all the DBS supplemented groups were significantly superior than the untreated control in converting feed to meat. The superior feed efficiency of 1.94 was observed in the T_2 group fed 0.1 per cent DBS followed by T_3 and T_4. When the cumulative feed efficiency upto eight weeks was considered, the trend was similar to that of sixth week. The cumulative feed efficiency at 8 weeks was 2.36, 2.23, 2.23 and 2.20 for the groups T_1, T_2, T_3 and T_4 respectively. The superior feed efficiency among the four treatments was recorded in birds fed with 0.2 per cent DBS in the diet and inferior in the control group.

The feed efficiency in the control group continued to be inferior when it was considered for the cumulative periods upto six weeks as well as eight weeks. At these ages the cumulative feed conversion ratio was statistically comparable among the DBS supplemented treatments T_2, T_3 and T_4. Therefore, it was quite clear from the data that in all DBS supplemented groups, feed efficiency was better when compared to the group fed standard broiler diet (T_1). The poor feed conversion ratio in control group can be attributed to the consistently higher daily mean feed intake from third week and significantly high from fifth week onwards.

The present results confirm the observations of Petruskin and Dahkiljgova (1963) in layers, Capa and Kondrahina (1965) in pigs, Gerasmov and Petrov (1972) in steers, Krasilnikova (1972) in layers and Agarwal and Chakrabarti (1985) in rats, who reported that administration of biostimulator could improve the feed efficiency. Kukde and Thakur (1992) attributed the biostimulatory effect of tissue preparations to the determining factors, 'promine and retine' for growth regulation of cells. Therefore better metabolizability of dietary energy, resulting in better utilization of nutrients might have contributed towards the higher feed efficiency obtained in the treatment groups in comparison to the controls.

The feed efficiency was significantly better with supplementation of different levels of DBS in the ration. Comparatively less feed intake and comparable body weight gain among the DBS supplemented groups led to favourable improvement in feed efficiency. It has been postulated that the growth stimulating factors 'promine and retine' in biostimulators are responsible for stimulating the metabolism of dietary energy, thereby increasing the utilization of energy which consequently lead to decreased feed intake and improved feed conversion efficiency.

5.6 Protein efficiency ratio (PER)

Mean fortnightly protein efficiency given in Table 18 revealed that birds fed DBS supplemented diet exhibited superior protein efficiency than the untreated control, throughout the experimental period. At the third fortnight protein efficiency exhibited significant superiority in T_2, T_3, and T_4 i.e., 1.88, 1.87 and

1.85 respectively than the control T_1 (1.73). The T_2, T_3, and T_4 had comparable protein efficiency.

The data on cumulative protein efficiency for six weeks (Table 18) indicated that DBS supplemented groups were superior in protein efficiency in which the 0.1 per cent DBS fed group was significantly superior than control. The cumulative protein efficiency for the whole experimental period was 2.04, 2.12, 2.11 and 2.13 for the groups T_1, T_2, T_3, and T_4 respectively. It showed significantly superior protein efficiency in DBS treated groups.

The present results indicated that DBS supplemented groups have better nutrient utilization and nitrogen retention, consequently higher feed efficiency and protein efficiency than the control. It is in agreement with the reports of Shah (1984), Agarwal and Chakrabarti (1985), James and Gangadevi (1991) and Shyama (1994) who suggested that biostimulators improved protein efficiency by stimulating protein metabolism. Mahapatro and Roy (1970) reported that biostimulators exerted a favourable influence on the nitrogen retention of animals, thereby better protein efficiency. The better protein efficiency ratio in DBS treated groups may be due to comparatively less feed intake, consequently less protein intake than the control and comparable body weight gain among the treatment groups at the end of the experiment. This led to favourable improvement in feed efficiency and protein efficiency by influencing the assimilation and metabolism of nutrients resulting in better efficiency in feed utilization and nitrogen retention, thereby better protein efficiency.

5.7 Blood parameters

The blood parameters viz. Hb, PCV and ESR were not influenced by dietary treatments. The per cent haemoglobin (gram per cent) value of treatments T_1, T_2, T_3, and T_4 were 9.56, 9.31, 9.44 and 9.38 respectively. This indicates no difference among the treatments and these values were near to the normal value of 9.9 (Chauhan and Sushovan, 1996). This finding was in close agreement with that of Agarwal and Chakrabarti (1985) and Shyama (1994) who reported that feeding of biostimulator had no significant effect on haemoglobin content in rats and goats respectively.

The packed cell volume per cent among the treatments T_1, T_2, T_3, and T_4 revealed no difference between them. This confirms the findings of Shukla and Mahapatro (1990) and Sagathevan (1995) who reported that biostimulator feeding had no effect on packed cell volume in goats and calves, respectively.

Erythrocyte sedimentation rate (ESR) data showed no difference among the treatments and these values were within the normal value of 3.86 (Sturkie, 1976). Chushkov *et al.* (1977) also reported injection of tissue preparation had no effect on serum protein concentration. Sagathevan (1995) observed that biostimulator feeding had no effect on erythrocyte count in calves. Comparable ESR values within the range may be due to the same serum protein concentration and erythrocyte count. This indicated that the birds fed on DBS added ration did not have any physiological change attributable to the diet.

5.8 Slaughter studies

The dressed yield and ready-to-cook yield were not influenced by the dietary treatments. The dressed yield in the DBS added group, T_2 was numerically higher than that of T_1, T_3, and T_4 groups, i.e., 91.49 (T_2), 90.87 (T_4), 90.84 (T_1) and 90.78 per cent (T_3). This slight increase in dressed yield for T_2 group might be due to numerically higher body weight of T_2 group.

Ready-to-cook yield was numerically higher by 0.36, 0.18 and 0.15 per cent in the T_2 T_3, and T_4 groups respectively than the control.

In the same line Kovbasenko (1971) reported that addition of one gram dried tissue preparation in the layer feed daily from eight to 18 months of age increased weight gain, dressing percentage and ready-to-cook yield.

The per cent organ weight data of liver, gizzard, heart and spleen revealed no significant difference among the dietary treatments. This indicates that there was no change in activity of the visceral organs due to the treatment effects. This is in agreement with the finding of Granat *et al.* (1965) who reported that spleen extract and bull testis extract had no appreciable effect in testis weight of cockerels.

Komissarov (1971), Kovalesvskaja and Gluharcev (1971), Kovbasenko (1971) and Rebreanu (1971) reported that feeding of biostimulator increased the slaughter weights in livestock. But the present study did not show any significant improvement in dressed yield, ready-to-cook yield and organ weight percentage consequent to DBS supplementation. Therefore, more studies are warranted before making a final conclusion.

5.9 Livability

The data on the per cent livability of birds under different dietary treatments revealed that it ranged from 98 to 100 per cent. During the entire course of the experiment covering eight weeks only one bird died. Hundred per cent livability was observed in control and groups fed 0.1 and 0.15 per cent DBS supplemented diets. Two per cent mortality was recorded among birds fed diet with 0.2 per cent DBS. Necropsy findings revealed that the cause of death was due to non-specific reasons. Thus it is evident that DBS supplementation did not have any detrimental effects on the physiological well being of broiler chicken.

Voronenkov and Nefedov (1967) reported that daily administration of spleen preparation on chicks decreased the disease incidence and mortality by 10 to 12 per cent. Konstantinov *et al.* (1973) reported that rabbits experimentally infected with *E. coli* showed quicker recovery when the extract of liver and spleen were injected. In the present study higher percentage of livability might be due to enhanced nutrient utilization, thereby better health status with DBS supplementation.

5.10 Economics

The cost of different rations employed in this experiment revealed that the standard broiler diet for both starter and finisher periods, formulated as per BIS specifications were cheaper than DBS supplemented diets. About one kg DBS can be prepared from 5 kg fresh cattle spleen which costs about 60 rupees. In order to prepare treatment diets the standard ration should be supplemented with 0.1, 0.15 and 0.2 per cent DBS thereby raising the cost of rations by 6, 9 and 12 paise per kg diet, respectively. The difference in feed cost was same in standard starter and finisher diets with equal level of DBS inclusion.

The cost of production per kg live weight on feed cost alone was calculated, it was observed that compared to the standard diet fed control (T_1) other dietary treatments T_2, T_3 and T_4 were cheaper. When the total cost per kg body weight was considered it was cheaper in DBS added groups and cheapest being the diet with 0.1 per cent DBS (T_2) due to slightly higher body weight than T_3 and T_4. The net profit per bird over the control was Rs.2.77, 1.24 and 1.15 in the T_2, T_3 and T_4 groups respectively.

The economic analysis points to the fact that fortification of the feed with dried spleen at the rate of 0.1 per cent on dry matter basis will give a minimum saving in the production cost of Rupees 1.03 per kg body weight.

The economic analysis at the end of six weeks showed that the saving in production costs for 0.1 per cent DBS added group was Rs.1.11 as against Rs.1.03 at the end of eight weeks period. It was found more economical to rear the broiler birds on 0.1 per cent DBS supplemented diet upto six weeks.

So this can be recommended as a prudent method for adopting the broiler producers.

Summary

SUMMARY

An investigation was carried out in the Department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy, using one hundred and ninety two, day-old commercial broiler chicks to assess the influence of dried bovine spleen supplementation in standard boiler diet on production performance of broilers and the economics thereon. The chicks were randomly distributed into four dietary treatments with each having four replicates of 12 birds each. The dietary treatments consisted of standard broiler ration (T1), standard broiler ration with 0.1, 0.15 and 0.2 per cent dried bovine spleen (T2, T3 and T4 respectively). All the diets were formulated as per BIS specifications.

Feed ingredients like yellow maize, groundnut cake (expeller), gingelly oil cake, unsalted dried fish, rice polish, mineral mixture and salt were used for the formulation of experimental diets. The birds were housed at random in individual pens and reared under deep litter system. Standard managemental procedures were adopted throughout the experimental period. The duration of the experiment was eight weeks. The body weight of individual birds were recorded at the beginning of the experiment followed by every fortnight till the end of the experiment. Replication wise weekly feed consumption was recorded. From the above data, the feed efficiency, protein efficiency and the body weight gain for different treatments were worked out.

At the end of the experimental period, one male and one female from each replication i.e., four males and four females from each treatment were sacrificed to study the blood parameters viz., Hb, PCV and ESR, slaughter studies viz., dressed yield, ready-to-cook yield and percentage live weight of liver, gizzard, heart and spleen. Mortality among the experimental subjects was recorded. Cost benefit analysis due to dried bovine spleen supplementation was worked out calculating the cost of production.

The overall performance of the birds fed different dietary regimen are presented in Table 37.

Based on the results obtained in this study, the following conclusions were made:

1. The mean body weight of the birds for different treatment groups, ranged from 1685 to 1780 g at six weeks and 2427 to 2510 g at eight weeks of age. The 0.1 per cent DBS supplemented group recorded significantly ($P<0.05$) higher body weight over 0.2 per cent DBS added group upto sixth week, at the end of eighth week all groups showed statistically comparable body weights, but a numerically higher value for 0.1 per cent DBS treated group.

2. Birds fed diet with 0.1 per cent DBS showed significantly ($P<0.05$) more body weight gain over 0.2 per cent DBS group and comparable to control and 0.15 per cent DBS group upto sixth week. At the end of the experimental period the body weight gain was comparable among different treatments.

3. The mean total feed intake per bird under different dietary treatments ranged from 3.316 to 3.60 kg upto six weeks and 5.337 to 5.902 kg upto eight weeks. The daily feed intake per bird was significantly (P<0.01) higher in birds fed with standard diet than all other groups. The feed intake in 0.1 per cent DBS treated group also was significantly more than that of 0.2 per cent DBS group. Feed intake of 0.15 per cent DBS group was comparable to those of 0.1 and 0.2 per cent DBS groups.

4. Significantly (P<0.01) poor feed conversion ratio (FCR) in the control group than all other groups was observed during the eight weeks period. The DBS supplemented groups showed a significant improvement in feed conversion. The highest FCR was in 0.1 per cent DBS group upto six weeks and it was highest in 0.2 per cent DBS group at the end of the experiment.

5. The data on mean fortnightly protein efficiency ratio (PER) showed that there was no remarkable difference among the treatment groups, except during the third fortnight. In the third fortnight the DBS supplemented groups showed significant improvement in PER over the control.

6. Data on blood parameters viz., Hb, PCV and ESR did not reveal any significant difference between the treatment groups.

7. Data on slaughter studies viz., dressed yield, ready-to-cook yield and percentage live weight of liver, gizzard, heart and spleen did not show any

significant difference among the treatments, but a numerically higher per cent ready-to-cook yield was observed in DBS treated birds.

8. The survivability of broiler chicken was not affected by DBS supplementation in their diets.

9. The feed cost per kg live weight varied from Rs.18.26 to Rs.19.32 for the different treatment groups, cost of production of broilers was lower in DBS supplemented groups when compared to the standard control, even with higher cost of DBS added diets.

10. Among the different treatment groups, the performance parameters of birds fed with standard diet having 0.1 per cent DBS was found to be the best.

Based on the results of this study it could be inferred that the addition of dried bovine spleen (DBS) in the standard broiler diet will reduce the feed intake upto 10 per cent with almost comparable growth. The supplementation of DBS will enhance the nutrient utilization by improving the metabolism of dietary energy, thereby resulting in better feed efficiency and protein efficiency than control with comparable body weight. The results also revealed that DBS inclusion in the diet has maximum beneficial effects upto six weeks and thereafter the effect was negligible. Supplementation of DBS may result in reduced feed requirement for rearing broilers to market weight (1.5 kg) thereby opening an avenue for lowering the cost of production and enhancing the profit.

Table 37. Effect of bovine spleen supplementation on the production performance and the economics thereon in broiler chicken

Sl.No.	Parameters	Dietary treatments			
		T1	T2	T3	T4
1	Live body weight (g)	2497	2510	2454	2427
2	Body weight gain (g)	2454	2466	2410	2383
3	Total feed consumed (g)	5902	5583	5473	5337
4	Cumulative feed efficiency	2.36	2.23	2.23	2.20
5	Cumulative protein efficiency	2.04	2.12	2.11	2.13
6	Blood parameters				
	a. Hb (gram per cent)	9.56	9.31	9.44	9.38
	b. PCV (per cent)	28.00	28.00	28.13	28.00
	c. ESR (mm/h)	3.75	3.75	3.88	3.75
7	Slaughter studies				
	a. Dressed yield (%)	90.84	91.49	90.78	90.87
	b. Ready-to-cook yield (%)	77.87	78.23	78.05	78.02
	c. Percentage live weight of				
	1. Liver (%)	2.16	2.35	2.33	2.26
	2. Gizzard (%)	2.44	2.58	2.36	2.40
	3. Heart (%)	0.80	0.83	0.84	0.84
	4. Spleen (%)	0.48	0.49	0.48	0.49
8	Mortality (%)	0.0	0.0	0.0	2.00
9	Cost per kg of feed (Rs.)				
	a. Starter ration	8.54	8.60	8.63	8.66
	b. Finisher ration	7.60	7.66	7.69	7.72
10	Feed cost per kg live weight production (Rs.)	19.32	18.33	18.45	18.26
11	Total cost per kg body weight (Rs.)	25.73	24.71	24.98	24.85
12	Net profit per kg body weight (Rs.)	14.26	15.29	15.02	15.15

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EFFECT OF SUPPLEMENTATION OF DRIED BOVINE SPLEEN IN THE DIET OF BROILER CHICKEN

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ABSTRACT OF A THESIS

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ABSTRACT

An experiment was conducted to study the effects of dried bovine spleen at different level supplementation viz., 0.1, 0.15 and 0.2 per cent in standard starter and finisher rations on production performance and the economics of broiler chicken, using one hundred and ninety two commercial day-old broiler chicks for a period of eight weeks. The birds were divided into four dietary treatment groups viz., standard broiler ration (T_1), standard broiler ration with 0.1 per cent dried bovine spleen (T_2), standard broiler ration with 0.15 per cent dried bovine spleen (T_3) and standard broiler ration with 0.2 per cent dried bovine spleen (T_4). Standard broiler ration was formulated as per BIS (1992) specification for broiler chicken feed. The observations monitored throughout the experimental period were body weight gain, feed intake, feed efficiency, protein efficiency and livability. At the end of the experiment the blood parameters, dressed yield, ready-to-cook yield and organ weights of gizzard, heart, liver and spleen were also determined. The results showed that 0.1 per cent dried bovine spleen supplemented groups attained a higher body weight and 0.15 and 0.2 per cent dried bovine spleen supplemented groups attained a lower body weight than control but not significantly so. The feed intake was significantly higher for the standard diet fed group from fifth week onwards. A positive response was observed in feed efficiency by bovine spleen supplementation which was statistically significant. Upto six weeks the feed efficiency was best for the group fed diet supplemented with 0.1 per cent dried