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The Effect of Diet with Low Protein and Intermittent Lighting on Ascites Induced by Cold Temperatures and Growth Performance in Broilers

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Abstract: In this study we aimed to investigate the effect of intermittent lighting and feed with low protein on ascites induced by cold temperatures and subsequent effect on growth performance of young male and female broiler chickens. A total of 300 male and 300 female broiler chickens aged one day were used for the treatment. Research was conducted as three groups [intermittent lighting, low protein (18 %), and control] with four replicates. All of the groups were fed *ad-libitum*. Intermittent lighting application was started on the 8 day of study. On the 21 day of the treatment, chicks in all groups were divided into two parts and moved to compartments in cold house (16°C) to induce ascites. From the live weight point of view the highest value were determined from the control and intermittent lighting groups and followed by low protein-diet group. Feed consumption was determined as highest in the control group, and lowest in the low protein-diet group. Live weight gain were determined highest in the control and intermittent light groups. The best feed conversion ratios were determined from intermittent lighting groups. Weight gain was higher in males than females. Body weight was higher in birds kept in the cold house during the study. At the end of the experiment it was determined that, no mortality was recorded due to ascites in low protein-diet group. It was concluded that low protein-diet was effective for preventing ascites in cold stress.

Key words: Broiler, low protein-diet, ascites, intermittent lighting, growth performance

Introduction

Ascites is described as a condition in which accumulation of severe fluid in the body cavity (Dale and Villacres, 1988; Shlosberg *et al*., 1991; Acar *et al*., 1995) leading to carcass deformation or death (McGovern *et al*., 1999). Acar *et al*. (1995) suggested that ascites syndrome is a costly major problem in broiler industry all over the world.

The etiology of ascites may include housing environment such as cold temperature, dust concentration, CO_2 and O_2 levels of the air (McGovern *et al*., 1999), and diseases (Wideman, 1988). Dale and Villacres, (1988) reported that the incidence of ascites is higher in the colder environmental temperatures because birds increase metabolic rate to maintain body temperature. It has reported that cold temperature is one of the most effective factors on ascites (Wideman and Robert, 1999).

Mortality due to ascites is highest in flocks exposed to continuous light up to 23 hours. Continuous lights have the potential to allow increase feed intake and support faster growth rate (Petek, 1999). Buys *et al*. (1998) reported that intermitted lighting schedule reduced the ascites. Mirsalimi *et al*. (1992) recorded that the diets with low energy and protein content reduced the ascites intensity in broilers kept at same environmental conditions. In order to minimize ascites, Shlosberg *et al*., (1991) and Wideman (1988) suggested long term solutions such as a breeding for resistance to ascites and short term solutions such as adequate ventilation, avoid excessive exposure to cold, concern over ensuring minimum levels of sodium, and lighting programs and feeding regimens. This study was designed to investigate to effect of intermitting lighting low density protein on ascites in induced by cold temperatures, and consequently body weight, weight gain, feed consumption, feed conversion, hematocrit value, hemoglobin values.

Materials and Methods

In this study, a total of 600 day-old (300 male and 300 female) broiler chickens (Ross PM3) were used for three (intermittent lighting, low protein and control) groups with four replicates. The chickens were weighted on the first day and into the pens (1x2 m^2) each containing 25 chickens.

Control and intermittent lighting birds were fed with formulated starter (22.5 % CP and 3060 kcal ME/kg), and finisher (21 % CP and 3226 kcal ME/kg) diets, low protein birds were fed with formulated starter (18 % CP and 3060 kcal ME/kg), and finisher (18.1 % CP and 3221 kcal ME/kg) diets from 1 to 21 day and 22 to 42 day of age respectively. Feed and water was supplied at *ad libitum*. During the first 7 d, the lighting Schedule provided 23 h light/1 h dark. Starting from 8 d of age, the intermittent lighting group exposed to 1 light: 3 dark until the end of the experiment. The room temperature was adjusted to 35°C, 30°C and 27°C for the first, second and third week respectively. Half of the chickens from each pen were moved to eight cold compartments (16°C

Table 1: Composition of the diets used in the experiments

	Control		Diet with Low Protein	
	Starter	Finisher	Starter	Finisher
Corn	53.45	60.35	65.5	63.5
Soybean meal	32	23.69	19.54	19.54
Oil	4	4	4	5
Sunflower meal	2.5	4	4	4
Fish meal	3.5	3.5	3.5	3.5
Limestone	1	1	1	1
DCP	1	1	1	1
NaCl	0.36	0.36	0.36	0.36
Lysine	1.3	1.3	1.3	1.3
Vitamin Premix	0.65	0.65	0.65	0.65
Mineral Premix	0.15	0.15	0.15	0.15
Total	100	100	100	100
Calculated Analyses				
CP %	22.5	20.5	18	18.1
ME, Kcal/kg	3060	3226	3060	3221

Table 2: Means of body weight and weight gain of broilers.

	Body Weight (g)			Weight Gain (g)		
	1. d Mean± SEM	21.d Mean± SEM	42. d Mean± SEM	1- 21. days Mean± SEM	21 - 42. days Mean± SEM	1 - 42. days Mean± SEM
Groups	NS	**	**	**	**	**
Control	41.44±0.36	616.45±9.23^{a}	2160.2±29.70^{a}	575.01±7.8^{a}	1543.76±32.6^{a}	2118.77±45.8^{a}
Intermittent Lighting	40.34±0.41	599.39±9.53^{a}	2142.5±31.00^{a}	559.05±9.7^{a}	1543.14±38.7^{a}	2102.19±34.6^{a}
Low Protein	40.40±0.38	492.44±10.0^{b}	1822.87±17.56^{b}	452.04±8.7^{b}	1330.43±35.7^{b}	1782.47±32.6^{b}
Sex	NS	NS	**	NS	**	*
Male	39.33±0.50	561.14±14.94	2100.52±40.42	521.81±12.3	1539.38±31.7	2149.23±27.8
Female	41.35±0.16	577.71±12.36	1983.22±33.05	536.36±13.9	1405.51±23.7	1991.05±31.7
Temperature		NS	*		NS	
Normal	-	553.79±13.21	2009.13±35.77	-	1455.34±43.5	-
Cold	-	585.15±13.64	2074.61±40.65	-	1489.46±37.6	-

Table 3: Means of feed intake and feed conversion of broilers.

	Feed Intake (g)			Feed Conversion Rate (g/g)		
	1. d Mean± SEM	21.d Mean± SEM	42. d Mean± SEM	1- 21. days Mean± SEM	21 - 42. days Mean± SEM	1 - 42. days Mean± SEM
Groups	**	**	*	*	*	*
Control	831.3±13.4^{a}	2708.1±43^{a}	3539.4±56.7^{a}	1.44±0.23b	1.75 ± 0.23^{b}	1.61±0.21^{b}
Intermittent Lighting	779.2±14.1^{b}	2644.6±39^{b}	3423.8±49.0^{b}	1.39±0.12c	1.71 ±0.32^{c}	1.62±0.14^{b}
Low Protein	718.04±5.1^{c}	2452.6±19^{c}	3170.1±19.0^{c}	1.58±0.12a	1.84±0.32^{a}	1.77±0.13^{a}
Sex	NS	**	**	**	**	**
Male	756.66±17.8	2664.51±34.4	3421.17± 43.8	1.45±0.09	1.73 ± 0.23	1.59±0.36
Female	795.71±16.0	2538.35±39.9	3333.45±65.7	1.48±0.08	1.80 ± 0.24	1.67±0.43
Temperature			NS	*		
Normal	-	2527.50±54.1	-	-	1.73 ± 0.43	-
Cold	-	2675.47±48.7	-	-	1.79 ± 0.37	-

constant) on the 21st day and kept there until the end of the study. The other half of the chickens were housed to 25, 24 and 23°C at the week 4, 5 and 6 of the experiment respectively. The temperature of the room was controlled by heaters with thermostats. Body weight, feed consumption, feed conversion and weight gain were calculated and recorded on the day 1th, 21st and 42nd by electronic balance. Mortality caused by ascites was recorded daily. On the 21st and 42nd day of age, blood samples were taken to determine the hematocrit values.

Statistical analyses: Differences between groups were analyzed with one-way analysis of variance by using the statistical package SPSS for Windows (1999), version 10.0. Significant means were subjected to a multiple comparison test (Duncan) at α = 0.01 and 0.05 level.

Results and Discussion

Initial bird's body weights were average 40 g ± 1 for all groups. On the 21 and 42 days, the diet with low protein birds had a significantly lower body weight than the other

Table 4: Means of Hemoglobin and Hematocrit values of broilers

	Hemoglobin (g/100 ml)		Hematocrit (%)	
	21 Mean±SEM	42 d Mean±SEM	21. d Mean±SEM	42. d Mean±SEM
Groups	NS	NS	*	NS
Control	8.69 ± 0.44	10.67 ± 0.26	33.88 ± 0.79[a]	34.75 ± 0.66[a]
Intermittent Lighting	10.04±0.50	10.55 ± 0.17	33.53 ± 1.32[a]	33.15 ± 0.82[a]
Low Protein	9.22 ± 0.53	10.21 ± 0.19	32.16 ± 0.90[b]	32.40 ± 0.59[b]
Sex	NS	NS	NS	NS
Male	8.83 ± 0.49	10.52 ± 0.16	33.85 ± 0.77	33.50 ± 0.55
Female	9.80 ± 0.29	10.44 ± 0.60	32.52 ± 0.83	33.38 ± 0.63
Temperature	*	NS	*	**
Normal	8.69 ± 0.44	10.67 ± 0.19	31.64 ± 0.84	32.15 ± 0.42
Cold	9.94 ± 0.34	10.29 ± 0.15	34.77 ± 0.31	34.72 ± 0.63

NS: Not significant *: p<0.05; **: p< 0.01 a,b: Means having different superscripts in a column differ significantly

Table 5: Mortality rate due to ascites

	Mortality rate due to ascites %
Groups	*
Control	5
Intermittent Lighting	2
Low Protein	-
Sex	NS
Male	4.5
Female	2.5
Temperature	*
Normal	1.5
Cold	5.5

NS: Not significant *: p<0.05

groups. Control group and intermittent lighting group gained more weight than the low protein group between 1 and 21, 21 and 42, 1 and 42 days. Similarly to the present findings, Buys *et al.* (1998) reported that intermittent lightening did not have significantly negative effects on body weight and weight gain in broiler. However, Charles *et al.* (1992) and Blair *et al.* (1993) reported controversial results. On the 42 day, birds in the cold house had higher body weight and feed consumption than the normal groups (p<0.01).

In this study, it was found that male birds had higher body weight than male birds as reported by Cave *et al.* (1985) and Buyse *et al.* (1996). There were no significant differences between temperature groups in weight gain between 21 and 42 days (Table 2). Julian (1993) and Scheele *et al.* (1991) reported no significant differences in aspects of live weight gains between the groups exposed to either normal heating or low heating. However, Acar *et al.* (1995) reported that the animals kept at cold temperature had higher live body weight than the ones kept at normal conditions.

The control group had higher feed intake than other groups during the treatment. It was observed that the group with intermittent lighting had the best feed conversion during the study (Table 2). Feed intakes of the temperature groups were not different from 21 to 42 day of age (Table 2). The groups kept at normal temperature consumed the feed more effectively. However, Acar *et al.* (1995) and Scheele *et al.* (1991) reported that the animals kept at cold temperature consumed better than the ones kept at normal conditions.

Male broilers consumed feed more effectively and had higher feed conversions than the females in the present study.

Witzel *et al.* (1990) reported that increase in hematocrit and erythrocyte count due to increased demand for oxygen result in higher blood viscosity and cause pulmonary hypertension. A hypothesis that hematocrit value as an indicator of partial resistance to ascites syndrome. In the present study, hematocrit value of low protein group was lesser than other group at 21 day. Similarly Buys *et al.* (1998) and Mirsalimi *et al.* (1992) determined low hematocrit values from the birds feed diets with low protein. No significant differences were found between male and female groups with respect to hemoglobin and hematocrit values in the present study. On the 21 day, values of hemoglobin of cold house were higher than normal house. Hematocrit values of cold houses were higher than that of normal house at 21 and 42 days. This result was very similar with the work of Scheele *et al.* (1991).

Mortality caused by ascites was lower groups exposed to intermittent lighting than control group, and, no mortality was recorded due to ascites in low protein-diet group (Table 5). Similarly, Julian (1993) and Summers (1994) observed that the mortalities caused by ascites in animals fed with low proteins were relatively low. The differences were not important from the ascites incidence point of view between males and females. Robert *et al.* (1998) determined higher mortality rates caused by ascites in male birds than female birds. Compared to normal temperature, ascites incidences was higher in groups kept at cold temperature. Similarly, Acar *et al.* (1995) and Julian *et al.* (1989) reported that the mortality rates due to ascites were significantly higher in the animals kept at cold temperature.

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