Asian Journal of Poultry Science

ISSN 1819-3609

Academic Journals Inc.

www.academicjournals.com

OPEN ACCESS Asian Journal of Poultry Science

ISSN 1819-3609
DOI: 10.3923/ajpsaj.2016.96.103

Research Article
Growth Performance and Serum Biochemical Responses of Commercial Broilers Fed Diets Containing Rubber Seed and Yeast

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Abstract

This study was conducted to investigate the effect of diets formulated with Rubber Seed Meal (RSM) (*Heve abrasiliensis*) and Saccharomyces yeast on the growth performance and serum biochemical profile of broilers. The main objective was to establish use of these two unconventional feed stuffs in broiler diet. Day-old broiler chicks were distributed randomly into three dietary treatments T_0 (control), T_1 (RSM+yeast) and T_2 (yeast). Birds were reared in an open-sided house with similar management condition up to 35 days. Data were collected for feed intake, body weight, body weight gain, Feed Conversion Ratio (FCR), dressing percentage and mortality rate. Blood was collected from 18 randomly selected birds (6 birds from each group and 2 birds from each replicate) at 12 days intervals and analyzed for serum biochemical parameters. Results indicated that the live weight was increased significantly ($p<0.05$) in T_1 (RSM+yeast) group. A significantly ($p<0.05$) improved FCR and dressing percentage were also obtained in the same dietary treatment group. Serum glucose, cholesterol and triglyceride levels were found significantly ($p<0.05$) higher in T_1 and T_2 groups than the control. However, serum uric acid was significantly higher ($p<0.05$) in control. No significant ($p>0.05$) differences were observed between control and T_2 (yeast) groups in the activity of aspartate transaminase (AST) and alanine transaminase (ALT). It can be concluded that inclusion of rubber seed meal and yeast together in poultry diet would be advantageous for better growth performance of broilers with no detrimental effects.

Key words: Rubber seed, yeast, hematology, biochemical profiles, broiler

Received: December 07, 2015 **Accepted:** February 08, 2016 **Published:** March 15, 2016

Citation: Babu Kanti Nath, Mohammad Abul Hossain, Md. Saiful Bari, Mukti Barua, Kamrul Islam and Gouranga Ch. Chanda, 2016. Growth performance and serum biochemical responses of commercial broilers fed diets containing rubber seed and yeast. Asian J. Poult. Sci., 10: 96-103.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Bangladesh is agriculture based country and at present agricultural sector contributes about 22% of GDP of this country (BBS., 2009). In Bangladesh, around 9% of total protein for human being consumption comes from livestock and poultry, which constitutes about 30% of animal protein and estimated to be to 40% within 2015. Poultry industry has become very fast growing industry since 1990. Huge amount of quality poultry feeds and their correct formulation and efficient utilization are the prime considerations for successful and profitable poultry rearing. Alternative sources of feed ingredients should be explored, which are not utilized as poultry feed. The rising prices of livestock feeds and the scarcity of conventional proteins and energy concentrates for the formulation of feeds have forced the animal scientists to search for alternative, cheaper and readily available protein and energy sources (Mmereole, 2008). There are large resources of conventional and non-conventional feeds in Bangladesh that can profitably be used in stimulating particularly for poultry production. Rubber seed can be a prominent non-conventional poultry feed resource in Bangladesh. At this moment, the country possesses the potentiality of producing a huge amount of rubber seeds and the quantity will increase considerably when young plantations begin to produce fruits and with the creation of new plantations. Rubber seed meal and the cake are higher in total digestible nutrients than soybean meal and are highly promising as a protein supplement. Rubber seed meal has a high level of lysine and tryptophan, making it a good companion for maize in poultry and pig rations (Ensminger and Olentine, 1978). The major factors for successful poultry production are high genetic potential, balanced nutrition and health maintenance.

On the other hand, there is a major demand to produce high quality poultry meat and egg at low price without relying on antibiotics and other drugs in poultry feed and water. Yeast (*Saccharomyces cerevisiae*) as a probiotic and fermenter may be used to improve feed quality and enhance feed nutrient utilization of broilers. Baker's yeast (*Saccharomyces cerevisiae)* is readily available and cheap, which is rich in B-complex vitamins, amino acids and minerals particularly chromium (Pelicia *et al*., 2004). Yeast boosts immune level resulting in a better protection against infections (Panda *et al*., 2000). Many researchers referred to an advantage of feeding culture yeast as responsible for the production of vitamin B complex and digestive enzymes and for enhancing intestinal mucosal immunity and increasing protection against toxins produced by pathogenic microorganisms (Amezcua *et al*., 2004; Silversides *et al*., 2006). Some studies have confirmed that the effect of yeast culture could be an alternative to antibiotic-based drugs in feed for broiler chicks (Stanley *et al*., 2004). It has been reported that feeding yeast to chicks improves body weight gain and feed/gain ratio (Onifade *et al*.,1999). Agawane and Lonkar (2004) reported that improvement in serum albumin concentration could be due to probiotic supplementation to broiler feed. Probiotics could contribute to the regulation of serum cholesterol concentrations by deconjugation of bile acids. Also, Klaver and Van Der Meer (1993) suggested that co-precipitation with bile acids might be of importance for decreasing of serum cholesterol concentrations.

It has been noted that significant changes in the serum biochemical parameters can be done to assess both the pathological and nutritional status of individual animals (Akpodiete and Ologbodo, 1998). Consequently, the effects of any feed ingredient on the hematological indices of chickens are of immense assistance in deciding whether or not such a feed ingredient should be used in poultry feed. Information on the effects of feeding rubber seed meal on the serological profiles of the broiler is, however, scanty (Akpodiete and Ologbodo, 1998). This study was, therefore, carried out to investigate the effects of Rubber Seed Meal (RSM) and yeast (*Saccharomyces cerevisiae*) on the growth performance and serological indices of broiler chickens.

MATERIAL AND METHODS

Experimental design: A total of 180 day old Arbor acres strain broiler chicks were used for this study for a period of 5 weeks. The birds were randomly allotted to three dietary treatments of 3 replicates each. Each replicate was consists of 20 birds. Completely randomized design was used in this study. The treatments were T_0 (control), T_1 (10 % rubber yeast+1% yeast) and T_2 (1.0 % yeast).

Diet formulation with management: Iso-caloric and iso-nitrogenous diets were formulated for two phases (starter and finisher) with the feed ingredients that were available in local market (Table 1 and 2). Initially 15 days were considered as first phase and the birds were supplied starter diet. The experimental birds were fed finisher diet in remaining periods (16-35 days). All pens were bedded with saw dust litter and equipped with feeders and drinkers. Fresh feed and fresh water was supplied *ad libitum*.

Recording of data: Performance data (feed intake, weight gain and feed conversion ratio) was taken weekly. Dressing percentage and dressed carcass mass were also recorded at

Table 1: Starter diet composition fed the birds up to 15 days

Ingredients (%)	T_0 (Control)	T_1 (RSM+yeast)	T_2 (yeast)
Maize	51.5	47.8	54
Full fat soya	2	2	1
Soyabean oil	1.5	0	1
Rice polish	8	14	12
Rubber seed meal		10	0
Soyabean meal	33.5	20	26
Yeast	0	1	1
Meat and bone meal	1	5	4
Lime stone	2	0.5	1.3
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.2
Vitamin-mineral premix	0.25	0.2	0.25
Table salt (NaCl)	0.25	0.25	0.25
Total	100	100	100
Nutrient composition			
ME (Mj)	12.21	12.21	12.35
CP (%)	21.06	21.15	21.07
CF (%)	4.36	4.34	4.5
EE (%)	5.27	5.43	5.24
Ca (%)	1.00	0.9	1.09
Av.P (%)	0.59	0.8	0.77
Lysine (%)	1.22	1.44	1.15
Methionine (%)	0.33	0.44	0.33

ME: Metabalize Enesgy, CP: Crude Protein, CF: Crude Fibre, AV: Average, EE: Ether extraction, CA: Calcium

Table 2: Finisher diet composition fed the birds from 16-35 days

Ingredients (%)	T_0 (Control)	T_1 (RSM+yeast)	T_2 (yeast)
Maize	56.9	50	58.5
Full fat soya	7	4.5	3.5
Soyabean oil	3	3	3
Rice polish	7	11	11
Rubber seed	0	10	18
Soyabean meal	20.4	16	4.3
Yeast	0	1	1
Meat and bone meal	4.0	3.75	4.3
Lime stone	1.0	1	1.0
Lysine	0.25	0.25	0.25
Methionine	0.20	0.25	0.20
Vitamin-mineral premix	0.25	0.25	0.25
Table salt (NaCl)	0.25	0.25	0.25
Total	100	100	100
Nutrient composition			
ME (Mj)	13.17	13.07	13.28
CP (%)	19.05	19.48	19.18
CF (%)	3.90	3.88	4.17
EE (%)	7.54	8.34	7.47
Ca (%)	0.96	0.92	0.95
Av.P (%)	0.71	0.74	0.75
Lysine (%)	1.08	1.34	0.99
Methionine (%)	0.30	0.41	0.30

ME: Metabolize energy, CP: Crude protein, CF: Crude fibre, EE: Ether extraction, CA: Calcium, Av. P: Average protein

35 days. Dead birds were daily recorded. Body weight of chicks were recorded initially and then weekly for each replication. The birds were vaccinated against Newcastle disease and infectious bursal disease (Table 3).

Collection of bloods and serum: Blood was collected from 6 (2 birds from each replicate) birds, which were randomly selected and slaughtered from each group at 12th, 24th and 35th day. Blood (minimum of 5 mL) was collected through the jugular vein and drained into falcon tubes. Serum was collected by first allowing the blood to clot, followed by centrifugation at 5000 rpm. Serum samples were taken into 2 mL eppendorf tube and stored under -20°C until assayed.

Table 3: Vaccination schedule of broiler

Age	Name and type of the vaccine	Name of disease	Route of administration
5th day	BCRDV[a]	Newcastle disease	One drop in each eye
2th day	IBD [b]	Gumboro disease	One drop in each eye
18th day	Booster dose BCRDV[a]	Newcastle disease	One drop in each eye
23rd day	IBD [b]	Gumboro disease	One drop in each eye

[a]Baby Chick Ranikhet Disease (BCRD) vaccine produced by Livestock Research Institute (LRI), Mohakhali, Dhaka, [b]Gumboro vaccine is produced by Intervet, Netherlands

Table 4: Feed Intake (FI), Body Weight Gain (BWG), Feed Conversion Ratio (FCR), mortality and dressing percentage of broiler fed diets formulated with rubber seed and yeast from day 1-35

		Treatments (Mean±SE)			
Parameters	Age (days)	T_0 (control)	T_1 (RSM+yeast)	T_2 (yeast)	p-values
FI (g d^{-1})	1-7	110.00±2.31	105.67±5.36	117.00±1.53	0.15
	8-14	351.00±19.52[a]	356.00±1.00[a]	398.00±1.15[b]	0.05
	15-21	498.33±9.28[a]	539.33±5.46[b]	644.00±5.03[c]	0.00
	22-28	1082.0±49.37	1064.0±56.00	1021.7±18.78	0.64
	29-35	1650.0±28.87	1503.3±52.39	1543.3±47.02	0.13
BWG (g b^{-1})	1-7	85.67±4.87	89.87±5.13	97.90±0 .91	0.18
	8-14	244.72±12.29[a]	255.23±1.88[a]	281.90±1.19[b]	0.03
	15-21	336.23±12.29[a]	377.60±6.12[b]	441.50±3.03[c]	0.00
	22-28	694.53±39.45	733.38±37.79	701.82±23.15	0.71
	29-35	904.80±36.07	938.77±38.07	931.95±22.97	0.75
FCR	1-7	1.29±0.05[b]	1.18±0.01[a]	1.19±0.01[ab]	0.05
	8-14	1.44±0.01[b]	1.39±0.01[a]	1.41±0.01[ab]	0.06
(Feed:gain)	15-21	1.48±0.03	1.43±0.01	1.46±0.01	0.18
	22-28	1.56±0.04	1.45±0.03	1.46±0.03	0.08
	29-35	1.83±0.04[b]	1.60±0.06[a]	1.65±0.01[a]	0.02
Mortality (%)	35	10.00±2.89	3.33±1.67	8.33±1.67	0.15
Dressing (%)	35	62.33±0.60[a]	65.67±0.44[b]	63.17±0.44[a]	0.01

Data represent Means±SE of 20 birds per replicate group from day 1-35 days, [a,b]Means bearing different superscripts within a row differ significantly at $p<0.05$, $p<0.01$, and $p<0.001$

Serum biochemical profiling: The estimation of the serum biochemical value was performed in the post graduate laboratory under the department of Physiology, Biochemistry and Pharmacology, CVASU. Serum enzymes (aspartate transaminase, AST; Alanine transaminase; ALT), glucose, total protein, albumin, triglyceride, cholesterol, creatine and uric acid were determined using standard kits (Bio-Mereux, France) and automatic analyzer (Humalyzer300, Merck®, Germany) according to the manufacturers' instructions.

Statistical analysis: Data was incorporated in Microsoft excel sheet (2007) and analyzed using one-way ANOVA of SPSS v.16 for windows and least square means was compared by Duncan's multiple range test. A p value of <5% was accepted as significant level.

RESULTS

The results showed that use of yeast on T_2 group had significant effect ($p<0.05$) on feed intake at 2-3 weeks of broiler but not at finishing stage compared to control. Feed intake at 2 and 3 weeks of age was also significantly increased in yeast treatment group. However, feed intake was found higher in T_0 group (control) at 5 weeks of age, which was not significant. No significant differences were observed in the values of the weight gain of the birds on the different dietary treatments. However, rubber seed and yeast created a meaningful differences in body weight gain ($p<0.05$) at 2 and 3 weeks of rearing. Highest body weight gain was found in T_1 (RSM+yeast) group at finishing stage, which was not significant. Effect of three treatments on Feed Conversion Ratio (FCR) of broilers significantly ($p<0.05$) differed at finishing stage. A significant improve FCR (1. 60) was obtained in T_1 group at 5 weeks of age. Use of rubber seed had significant effect ($p<0.05$) on dressing percentage at finisher stage of broiler. Dressing percentage was significantly increased in T_1 group, where rubber seed and yeast was added at a rate of 10 and 1%, respectively. Mortality rate was not varied significantly ($p>0.05$) between treatments but lower mortality rate was found in T_1 group (Table 4).

Effect of rubber seed and yeast on serum biochemical parameter of broiler: The results of biochemical parameters as a further measure of the response of chickens to different dietary treatments are presented in Table 5. Serum concentrations of glucose, cholesterol, triglyceride and uric

Table 5: Effect of rubber seed and yeast on serum biochemical parameter of broiler

Parameters	Period (days)	Treatments (Mean±SE) T_0 (control)	T_1 (RSM+yeast)	T_2 (yeast)	p-values
Glucose (mg dL^{-1})	12	366.98±9.36	362.45±19.05	334.78±15.91	0.34
	24	440.08±29.79	394.05±20.31	369.25±44.24	0.37
	35	325.25±43.63[a]	658.18±28.79[b]	551.53±67.53[b]	0.01
Total protein (mg dL^{-1})	12	34.95±6.64	36.00±3.62	35.00±4.01	0.99
	24	27.83±2.59	33.83±3.53	33.17±3.09	0.38
	35	34.33±2.03[a]	42.83±3.84[a]	42.67± 3.09[a]	0.16
Albumin (mg dL^{-1})	12	26.10±3.18	27.42±1.71	18.93±2.39	0.11
	24	38.72±13.51	37.93±11.39	57.25±21.87	0.66
	35	11.97±0.87	11.32±0.41	12.10±0.06	0.59
Cholesterol (mg dL^{-1})	12	185.50±22.68[a]	350.55±19.19[b]	188.15±67.57[a]	0.05
	24	271.75±18.46	285.15±8.5	235.82±77.48	0.75
	35	204.43±17.26	205.55±11.17	213.63±32.09	0.95
Triglyceride (mg dL^{-1})	12	179.55±29.32[a]	271.88±39.27[ab]	415.15±80.06[b]	0.06
	24	215.88±51.82	137.73±28.47	109.82±26.57	0.19
	35	104.03±4.07	157.88±34.05	146.73±20.39	0.29
AST (IU L^{-1})	12	317.33±39.22	287.02±18.15	263.03±16.62	0.41
	24	237.62±14.44	259.92±38.73	267.13±31.27	0.78
	35	244.22±22.20	204.22±21.11	239.67±36.35	0.56
ALT (IU L^{-1})	12	99.82±51.14	59.32±37.19	26.22±8.92	0.42
	24	17.47±3.14	17.48±2.86	13.65±1.98	0.55
	35	18.42±2.31	15.58±3.18	15.05±2.09	0.63
Creatinine (mg dL^{-1})	12	0.97±0.03	1.01±0.54	0.63±0.04	0.67
	24	0.33±0.04	0.37±0.06	0.38±0.08	0.86
	35	1.12±0.03	1.35±0.10	1.57±0.23	0.18
Uric acid (mg dL^{-1})	12	25.53±2.66	41.15±23.76	20.44±4.13	0.58
	24	15.49±0.67[a]	13.55±1.25[a]	11.81±0.03[a]	0.05
	35	8.29±0.07[b]	6.74±1.67[ab]	8.34±1.69[a]	0.66

Data represent Means±SE of 9 birds per replicate group from day 1-35 days, [a,b]Means bearing different superscripts within a row differ significantly at $p<0.05$, $p<0.01$, and $p<0.001$

acid were significantly affected by the treatments. But, serum concentrations of total protein, albumin, creatinine, AST and ALT were not significantly affected by the treatments. Serum glucose levels were found significantly ($p<0.05$) higher at 35th day in T_1 and T_2 groups compared to control. In present study, yeast supplementation had no significant effect ($p>0.05$) on albumins and total protein level in serum of broiler chickens. At 12th day, serum cholesterol and triglyceride level were found significantly ($p<0.05$) higher in T_1 and T_2 groups, respectively, in comparison with control group. At 24th day, serum uric acid was found significantly ($p<0.05$) higher in control group. The decrease in activities of serum ALT of the broiler chickens were recorded in all treatment groups. In this study, no significant differences ($p>0.05$) were observed between control group and yeast supplemented groups in the activity of AST.

DISCUSSION

Growth performance of broiler chickens fed on rubber seed meal and yeast diets: The huge potential of good quality food in promoting and maintaining adequate health has set the tone of research in the area of food for health world-wide (Kapila *et al*., 2006). Probiotics are mainly represented by mannan-oligosaccharides and fructo-oligosaccharides present in the cell wall of yeasts, such as *Saccharomyces cerevisiae*. Addition of probiotic to broiler feed resulted in significant improvement concerning hemato biochemical parameters (Agawane and Lonkar, 2004). Feed intake significantly ($p<0.05$) differed between dietary treatment at 2-3 weeks of broiler but not at finishing stage. Feed intake at 2 and 3 weeks of age were significantly ($p<0.05$) increased in diet 3 (1% yeast) in comparison with control. This is in agreement with the findings of Shareef and Al-Dabbagh (2009). However, feed intake was found higher in T_0 (control) group at 5 weeks of age, which was not significant. This is in accordance with the findings of Adebiyi *et al.* (2012) and Gao *et al.* (2008) but contradictory with the findings of Saied *et al.* (2011). They stated that birds supplemented with yeast consumed more and grew faster than broilers given feed without yeast. Onwurah and Okejim (2014) reported that broilers fed 0.5 and 1.0 g yeast in water had improved daily weight gain, daily feed intake and final live weight probably as a carry-over effect from the starter phase. Al-Mansour *et al.* (2011) reported that

yeast level did not significantly affect feed intake during the first three weeks of life. No significant differences were observed in the values of weight gain of the birds on the different dietary treatments. This is in agreement with the findings of Al-Mansour *et al.* (2011) and Saied *et al.* (2011). The authors reported that yeast levels did not significantly affect body weight gain at first three weeks of life. However, rubber seed and yeast created a meaningful differences in body weight gain ($p<0.05$) at 2 and 3 weeks of rearing. This is in agreement with the findings of Shareef and Al-Dabbagh (2009). The effects of three diets on Feed Conversion Ratio (FCR) of broilers significantly differed ($p<0.05$) at finishing stage. A significant ($p<0.05$) improvement in FCR was obtained in diet 2 at 5 weeks of age. This is in agreement with the findings of Shareef and Al-Dabbagh (2009), who reported that addition of 1% yeast on broiler ration significantly increased the FCR of broilers. They reported that baker yeast (*Saccharomyces cerevisiae)* supplementation of broilers, to the level of 1%, were significantly ($p<0.05$), increase feed conversion efficiency, compared to control group and group where 0.5 bakers yeast was added. Gao *et al.* (2008) reported that dietary supplemental yeast at the rate of 2.5 g kg^{-1} improves feed conversion and average daily gain during grower and overall periods. But Al-Mansour *et al.* (2011) reported that yeast level did not significantly affect in FCR during the first three weeks of life. Probiotics act by reducing the feed conversion, thereby resulting an increase of the daily live weight gain (Nilson *et al.*, 2004). Improvement in FCR might be due to efficient ilea digestibility of nutrients (Pelicia *et al.*, 2004). Bansal *et al.* (2011) reported significant and better weekly feed conversion efficiency on probiotic supplementation in the diet of commercial broiler chicks. Use of rubber seed had a significant effect ($p<0.05$) on dressing percentage at finisher stage of broiler. Dressing percentage was significantly increased in T_1 group, where rubber seed and yeast was added at a rate of 10 and 1%, respectively compared to control. This finding was similar to the findings of Gheisari and Kholeghipour (2005). They stated that treatments containing 0.3% powdery yeast had a higher dressing's percentage when compared with control. Mortality rate were not varied significantly between treatments but lower mortality rate was found in T_1 (RSM+yeast) group. Shareef and Al-Dabbagh (2009) found no mortality in different dietary treatments of yeast.

Serum biochemical profiles of broiler: The results of clinical chemistry as a further measure of the response of chickens to different dietary treatments are presented in Table 5. Serum concentrations of glucose, cholesterol, triglyceride and uric acid level were significantly affected by the treatments, whereas total protein, albumin and creatinine level were not significantly affected by the treatments. Serum total protein and albumin have been reported to be directly responsive to protein intake and quality (Onifade, 1998). Serum glucose level were found significantly ($p<0.05$) higher at 35th days in T_1 and T_2 groups compared to control group, which is in agreement with the findings of Aluwong *et al.* (2012). At present study, no adverse effect on health status of broiler was not found due to use of 10% rubber seed in ration. Mmereole (2008) found in a study that use of rubber seed meal more than 10% can cause reduction of serum proteins and WBC. Serum proteins and WBC are involved in the formation of immunoglobins responsible for the development of antibodies (Mmereole, 2008). In present study, yeast supplementation had no significant effect ($p>0.05$) on albumins and total proteins in serum of broiler chickens, which is in agreement with the findings of Aluwong *et al.* (2012). Shareef and Al-Dabbagh (2009) found that addition of yeast (*Saccharomyces cerevisiae*) at a rate of 1.5, 2 and 2.5% was responsible for a significant ($p<0.05$) increase of total serum protein and glucose levels. At 12th day serum cholesterol and triglyceride level were found significantly higher ($p< 0.05$) in diet 2 and diet 3 respectively compare to control diet. This finding is disagreed with the findings of Shareef and Al-Dabbagh (2009) and Aluwong *et al.* (2012), who stated that yeast supplementation has been responsible for the reduction of serum cholesterol and triglyceride level. Reduction in circulating cholesterol with supplemental yeast was remarkable (Onifade *et al.*, 1999). At 24th day serum uric acid were found significantly higher ($p<0.05$) in control diet. The decrease in activities of serum ALT of the broiler chickens was recorded in all treatment groups. The decrease in ALT activity obtained in the present study agrees with similar observations of Osman *et al.* (2007), who conducted a study on rats, in which addition of *Lactobacillus plantarum* and *Bifidobacterium infantis* to diets fed to rats decreased ALT activity. In this study, no significant differences ($p>0.05$) between control group and yeast supplemented groups were observed in the activity of AST. This result is similar with the findings of Panda *et al.* (2000). Any abnormal increase in serum levels of AST and ALT may imply liver damage (Yalcin *et al.*, 2012), therefore, the relatively stable levels of AST may be associated with hepato protective effects of the yeast probiotic.

CONCLUSION

Since the RSM and baker's yeast could be used to supplement broiler chicken performance and hematological

indices. This is because yeast inclusion improved performance without compromising the serum bio-chemical indices of broiler chickens. Use of rubber seed in broiler diet at the rate of 10% would not create any adverse effects on health status of broiler. It is important to improve the processing methods in such a way that all traces of anti nutritional factors are eliminated which are capable of distorting the hematological parameters. Rubber seeds that are abundant in the hilly areas of Chittagong and Southern parts of Bangladesh can be gathered and utilized at little costs, which in turns reducing cost of feed. From the above findings, it might be concluded that use of rubber seed meal and yeast has beneficial effects on growth performance of broiler. They also have no harmful effects on broiler. So, farmers can easily use the rubber seed meal as unconventional feed ingredients in formulation of least cost ration for broilers.

ACKNOWLEDGMENT

The author acknowledges University Grant Commission of Bangladesh for providing financial support for conducting this research.

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