*J Bangladesh Agril Univ 21(4):**533-541**, 2023* https://doi.org/10.5455/JBAU.169945

ISSN 1810-3030 (Print) 2408-8684 (Online)

Journal of Bangladesh Agricultural University

Journal home page: http://baures.bau.edu.bd/jbau

Research Article

Effects of Garlic and Neem Extract on Growth Performance and Blood Biochemical Indices in *Sonali* Chicken

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ARTICLE INFO

Article history
Received: 19 September 2023
Accepted: 13 December 2023
Published: 31 December 2023

Keywords
Garlic,
neem,
growth,
blood biochemical,
Sonali

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ABSTRACT

This study was conducted to investigate the effect of garlic and neem with water on growth performance and blood biochemical indices of *Sonali* chicken. An experiment was done for a period of 11 weeks with 1000-day old straight run *Sonali* chicks. The chicks were divided into four groups each of 250, replicated to five sub-groups each of 50 birds. First group of chicks was considered as control (without additives), the second group of chicks supplied garlic extracts, third group of chicks supplied neem extracts, the remaining group of chicks supplied antibiotic growth promoter. Results showed that supplementation of neem and garlic in water increased ($P<0.05$) body weight and body weight gain compared with the control group. Feed intake was not significantly ($P>0.05$) different among the treatments. Improved ($P<0.05$) FCR was observed in garlic and neem supplemented groups compared to the control group. There were no significant differences ($P>0.05$) in dressing parameters except thigh meat. Thigh meat was significantly higher ($P<0.05$) in garlic extract group compared to the antibiotic group. There were no significant ($P>0.05$) differences in cholesterol and triglyceride among different treatment groups whereas, garlic extract, neem extract and antibiotic group showed the lower ($P<0.05$) glucose level compare to the control group. Based on the results of this study, it may be suggested that the garlic and neem could be used in the water of *Sonali* chicks as alternative to antibiotic.

Introduction

In the developing world, the livestock sector can act as a gateway towards alleviating poverty, empowering the rural female and enhancing food security (Tornton, 2010; Otte *et al*., 2012). Poultry production system of Bangladesh might be divided into four main categories, namely traditional rural backyard scavenging system; semi-scavenging system; commercial farming system and contract farming (Dolberg, 2008). Due to hardness, good taste and rumors against broiler, many consumers favored local chicken meat than broiler which grown in the rural area of country using backyard scavenging and semi-scavenging production systems. However, the production performance of local chicken is very low (Barua and Yoshimura, 1997; Chowdhury, 2013). To fulfill the customer's demand *Sonali* chicken was developed by crossing Rhode Island Red male and Fayoumi female for better production of egg and meat with indigenous taste, rapid growth and low mortality under different farming systems (scavenging, semi-scavenging and intensive) since 1986 (Rahman *et al*., 1997). The better adaptability of *Sonali* chicken in the climatic conditions of Bangladesh than the broiler of foreign origin and phenotypic similarity with indigenous chicken, *Sonali* chicken rearing become a vital part of livestock sector of Bangladesh. Hossen *et al.* (2012) mentioned that about 76% of *Sonali* chicken farmers improved their socio-economic conditions through rearing this type of bird. Now a day, *Sonali* chicken rearing has started commercially in different parts of the country. For maximizing the production, a group of antibiotic drugs and growth promoters have supplemented to the *Sonali* chicken as food additive which has shown many drawbacks like high cost, residual effect and adverse effect on birds and human health. With a view to minimize or eliminate the above mentioned drawbacks, medicinal plants extracts were developed and proposed for use in animal culture (Hsieh *et al*., 2001). According to Manesh *et al.* (2012)

Cite This Article
Roy, A., Rahman, M.R., Siddiqua, M.T. and Hossain, M.E. 2023. Effects of Garlic and Neem Extract on Growth Performance and Blood Biochemical Indices in *Sonali* Chicken. *Journal of Bangladesh Agricultural University,* 21(4): 533-541. https://doi.org/10.5455/JBAU.169945

and Guo (2003), uses of herbs, medicinal plants and spices as feed additives might be act as natural alternatives to antibiotics, due to their wide range potential beneficial effects. Garlic and neem are two herbal plants that locally available in Bangladesh, can be used as feed additives in poultry feed (Gbenga *et al*., 2009; Hasanain *et al*., 2018).

Garlic (*Allium sativum*) is widely used as spice and herbal medicine due to various pharmacologic properties which has been proven to lower serum and liver cholesterol (Qureshi *et al*., 1983), inhibit bacterial growth (Cavallito *et al*., 1994) and reduce oxidative stress (Horie *et al*., 1992). Rashid *et al.* (2019), Hossain and Hossain (2020) and Tollba and Hassan (2003) found that garlic as a natural feed additive which improved broilers growth, feed conversion ratio and serum biochemical parameters. Neem (*Azadirachta indica*) contains several active ingredients, which has antibacterial and hepatoprotective properties. Sadekar *et al.* (1998) reported that neem leave extract possess antiviral properties against, fowl pox, IBD and New Castle Disease Virus (NDV) and significantly enhances the antibodies production against the IBD and NDV. Some scientists reported the use of neem dry leaf as protein source and for controlling infections (Wankar *et al*., 2009 and Onyimonyi *et al*., 2012). Hossain *et al*. (2021) observed higher body weight and better FCR in neem leaf powder-0.25% fed broilers. Moreover, Islam *et al*. (2019) reported higher body weight in both the garlic and neem groups whereas, garlic in feed and water and neem in feed groups showed better FCR ($P<0.05$) compared to the control groups. They also observed that supplementation of garlic with feed and water significantly decreases cholesterol, triglyceride and LDL compared to the other groups.

The use of garlic and neem as a source for human and some extend in broiler medicine are familiar but in *Sonali* chicken it is not common. There is scarcity of information on the effect of feeding garlic and neem on *Sonali* chicken's performance under Bangladesh condition. Moreover, to get the safe poultry products, the poultry feed industry need adequate information on the use of different medicinal plant extract to ameliorate commercial green chicken production in Bangladesh. Therefore, the proposed study was attempted to generate information on the effects of garlic and neem leaves extract on growth performance and serum biochemical parameters of *Sonali* chicken.

Materials and Methods

Experimental layout and bird management

The present experiment was conducted at Bangladesh Agricultural University Poultry Farm, Mymensingh. A total number of 1000 day-old straight run *Sonali* chicks were collected from a local hatchery and reared for 77 days. The chicks were divided into four dietary groups each of 250, replicated to five sub-groups each of 50 birds. The layout of the experiment has shown in Table 1. Two types of commercial diets namely; starter and grower diets were used for the experiment. Starter diet was provided from day old to 21 days of old and then grower diet was provided up to the end of the experiment. The experimental diets were purchased from local market of Mymensingh. Feeders were cleaned in every week and drinkers were cleaned twice daily. *Ad-libitum* feed was offered to the birds and was supplied two times daily. Fresh and clean water was made available at all times. The vaccination was performed during the experimental period. A gable type open sided house was used for this experiment. The experimental room was prepared before the chick arrival. For room preparation, cleaning was done by using bleaching powder at a rate of 1kg/500 square feet and disinfecting was carried out by 1% TH4+ solution (0.1 litter diluted solution per square feet), manufactured by Sogeval, France. Feeders, drinkers, buckets and all other necessary equipment were also properly washed and disinfected by 0.5% TH_4^+ solution. A strict bio-security measure was maintained inside and outside of the experimental shed as a most effective part of the disease prevention program. Fresh and dried rice husk was used as litter material and spread over the floor at a depth of about 3 cm. Brooding was done by electric brooder. The birds were exposed to a continuous lighting period of 23 hours and a dark period of 1 hour in each 24 hours.

Table 1. Layout of the experiment

Treatments	Chicks per replication					Total
	R1	R2	R3	R4	R5	
T1= Control (Basal feed + without additives)	50	50	50	50	50	250
T2= Garlic extract (Basal feed + 1 garlic clove (Av. 3g) per L water)	50	50	50	50	50	250
T3= Neem extract (Basal feed + 2ml neem leaf extract per L water)	50	50	50	50	50	250
T4= Antibiotic (Basal feed + antibiotic)	50	50	50	50	50	250
					Total=	1000

Sample preparation

For preparing garlic sample, medium sized fresh garlic cloves (average 3g) were collected, cleaned, smashed and 3g of garlic extract was used per 1 litter of water. Neem leaves extract was prepared using the procedure described by Mollah *et al.* (2012) and 2ml of neem leaves extract was used per 1 litter of water. The antibiotic used in this experiment was oxytetracycline and the inclusion rate of the product was 200g/ton of feed.

Data collection and record keeping

Average body weight gain of the *Sonali* in each replication was calculated by deducting initial live weight from the final body weight. The amount of feed consumed by the birds was calculated for every week by deducting the amount of left over feed from the amount supplied for that particular week. FCR was calculated as the unit of feed consumed per unit of body weight gain. At the end of experiment, one male and one female *Sonali* chickens of average pen body weight were taken from each replication for recording meat yield parameters. Birds were slaughtered and allowed to bleed for 2 minutes. After that, the birds were immersed in hot water (51-55°C) and de-feathering was done manually. Then head, shank, viscera, giblet (heart, liver and gizzard) and abdominal fat were removed for determination of meat yield parameters. Dressed *Sonali* birds were cut into different parts such as breast, thigh, drumstick and wing. Finally, every cut up parts were weighed and recorded separately for male and female *Sonali* of all replications.

A series of sterile blood collection tubes containing anticoagulant EDTA at a ratio of 1: 10 was used to collect 3 or 4 ml of blood sample from each replication. Blood sample was collected from the wing vein of the bird with the help of one-time disposable syringe and was poured gently in blood collection tubes. The Serum biochemical analyses were performed within two hours of blood collection at Professor Muhammad Hossain Central Laboratory, BAU, Mymensingh. Tubes were placed in a slanting position (45°angles) at room temperature for clotting. After 2 hours separated blood serum was transferred to an Eppendorf tube and centrifuged at 3000 rpm for 10 minutes. The serum was then transferred into another Eppendorf tube and preserved at -20°C until analysis.

Results and Discussion

Body weight and body weight gain

Body weight of *Sonali* chicken of different treatment groups presented in Figure 1, which indicated only the 10th week body weight showed significant difference ($P<0.05$) among the treatment groups. At the 10th week of age, control group showed the lowest body weight (746g) compared to the antibiotic (777.80g), neem extract (770g) and garlic extract (764g) groups. At the 11th week of the experiment, there was no significant difference between antibiotic (858.20g) and neem extract (849.90g) group. But antibiotic (858.20g) showed numerically higher body weight than garlic extract (839g) and control (817.80g) groups. There was significant variation ($P<0.05$) on body weight gain at 9-10 week, 11th week and total among the treatment groups (Table 2 and Figure 2). At 9-10 week, antibiotic (187.80g) and neem extract (187.20g) group showed higher body weight gain compared to the garlic extract (174.80g) and control (156.00g) group. At 11th week of age, antibiotic (80.40g) and neem extract (79.90g) group showed higher body weight gain compared to the garlic extract (75.00g) and control (71.80g) group. Considering the total body weight gain, antibiotic group showed higher (828.90g) body weight gain compared to the garlic extract (809.60g) and control (788.42g) group.

Table 2. Body weight gain (g/bird) of *Sonali* chicken among different treatments

Age	Treatments				P value	LS
	Control	Garlic extract	Neem extract	Antibiotic		
0-2 week	123.22±1.27	125.20±1.64	120.22±2.84	121.50±2.34	0.39	NS
3-4 week	141.20±1.83	139.40±1.21	144.20±3.54	142.20±2.67	0.59	NS
5-6 week	144.20±4.65	138.20±5.30	138.80±5.31	144.00±5.98	0.78	NS
7-8 week	152.00±8.60	157.00±2.07	150.20±5.41	153.00±5.57	0.87	NS
9-10 week	156.00^{c}±2.45	174.80^{b}±2.58	187.20^{a}±3.43	187.80^{a}±2.40	0.01	*
11th week	71.80^{b} ±0.97	75.00^{ab} ±2.10	79.90^{a} ±2.18	80.40^{a} ±2.16	0.02	*

^{a,b,c} = values with different superscripts in the same row differ significantly, *= P<0.05, LS = Level of significant

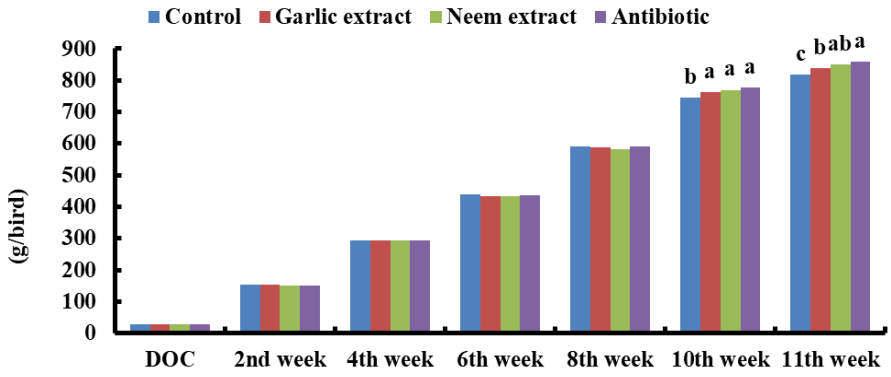

Figure 1. Weekly body weight of *Sonali* chicken among different dietary treatments

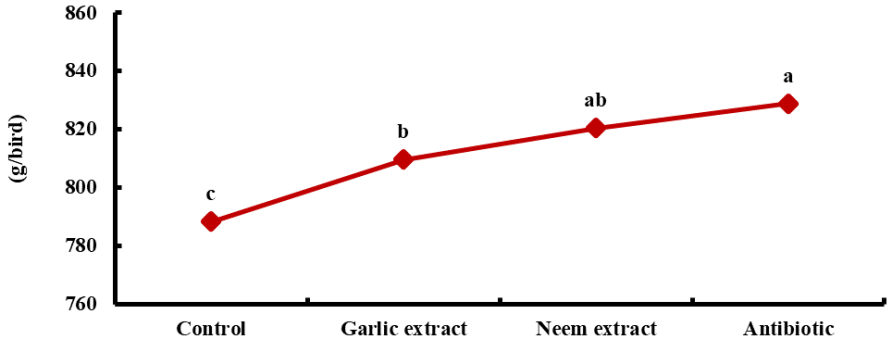

Figure 2. Total body weight gain of *Sonali* chicken among different dietary treatments

In the present study, supplementation of garlic and neem extract significantly improved the body weight gain than control which was in agreement with some previous studies (Hossain *et al.*, 2021; Islam *et el.*, 2019; Durrani *et al.*, 2008), who reported that supplementation of neem enhanced body weight gain. Neem leave possessed anti-protozoal and immune stimulatory properties (Wankar *et al.*, 2009) and suppressed the growth of harmful organisms (Adeyemo and Akanmu, 2012) which help to reduce the microbial load and create a favorable gut environment, thus give better performance. While some earlier reports revealed that supplementation of neem leaves in broiler feed had no significant difference in weight gain (Nidaullah *et al*., 2010; Bonsu *et al*., 2012; Nnenna and Okey, 2013). On the contrary, Deore *et al*. (2005) reported that addition of neem extract in chicken feed exhibited poor performance and lower body weights. In case of garlic supplementation, positive influence on the body weight and body weight gain of *Sonali* chicken was observed. This result was in agreement with previous research of Zekic *et al*. (2014), Islam *et al.* (2019) and Rashid *et al.* (2020) who also got similar positive influence. Hossain and Hossain (2020) reported that addition of garlic in water showed higher (P<0.05) body weight as such as antibiotic and control groups compare to the garlic in feed group. Pourali *et al*. (2010) and Fayed *et al*. (2011) reported that allicin inhibited growth of intestinal bacteria and inhibit aflatoxins producing fungi of the intestine thus improve the weight gain of garlic supplemented birds. The results of the present study contradicted to some of the previous observations that indicated garlic had no effect on body weight gain (Karim *et al.*, 2017; Issa and Omar, 2012; Choi *et al*., 2010).

Feed intake and FCR

Feed intake data was presented in Table 3 which showed no significant effect (P>0.05) during the experimental period among the treatment groups**.** Considering the total feed intake, control group showed numerically higher feed intake (1770g) followed by garlic extract (1759g), neem extract (1740g) and antibiotic (1727g) group, respectively. Result from Table 4 and Figure 3 indicated that there were significant variations (P<0.05) on 11th week and total feed conversion ratio among different treatment groups. At 11th week, antibiotic (2.11), neem extract (2.10), garlic extract (2.16) group showed better (P<0.05) FCR than control (2.45) group. At the end of the experiment, better FCR (P<0.05) was obtained in antibiotic group (2.08) and neem extract (2.12) compared to the garlic extract (2.17) and control (2.25) group.

Table 3. Feed intake (g/bird) of *Sonali* chicken among different treatments

Age	Treatments				P value	LS
	Control	Garlic extract	Neem extract	Antibiotic		
0-2 week	258.00±3.74	250.00±3.54	237.00±6.04	232.00±5.15	0.06	NS
3-4 week	303.00±7.35	294.00±4.30	290.00±7.07	295.00±5.00	0.06	NS
5-6 week	324.00±10.72	320.00±10.77	315.00±10.70	328.00±10.05	0.92	NS
7-8 week	352.00±16.85	352.00±8.60	346.00±17.20	342.00±8.60	0.93	NS
9-10 week	357.00±26.06	377.00±32.08	375.00±4.47	364.00±12.08	0.90	NS
11th week	176.00±6.00	162.00±3.74	168.00±6.63	170.00±5.48	0.39	NS
Total (0-11 week)	1770.00±29.03	1759.00±39.29	1740.00±20.92	1727.00±7.68	0.68	NS

LS = Level of significant

Table 4. Weekly feed conversion ratio (feed/gain) of *Sonali* chicken among different treatments

Age	Treatments				P value	LS
	Control	Garlic extract	Neem extract	Antibiotic		
0-2 week	2.09±0.02	2.0±0.04	1.97±0.06	1.91±0.03	0.16	NS
3-4 week	2.15±0.06	2.11±0.04	2.02±0.07	2.08±0.06	0.44	NS
5-6 week	2.25±0.01	2.35±0.10	2.34±0.07	2.26±0.11	0.74	NS
7-8 week	2.32±0.03	2.24±0.06	2.30±0.06	2.24±0.06	0.66	NS
9-10 week	2.28±0.14	2.16±0.19	2.01±0.05	1.94±0.07	0.25	NS
11th week	2.45^{a}±0.06	2.16^{b}±0.02	2.10^{b}±0.03	2.11^{b}±0.02	0.01	*

^{a,b,c} = values with different superscripts in the same row differ significantly, *= P<0.05, LS = Level of significant

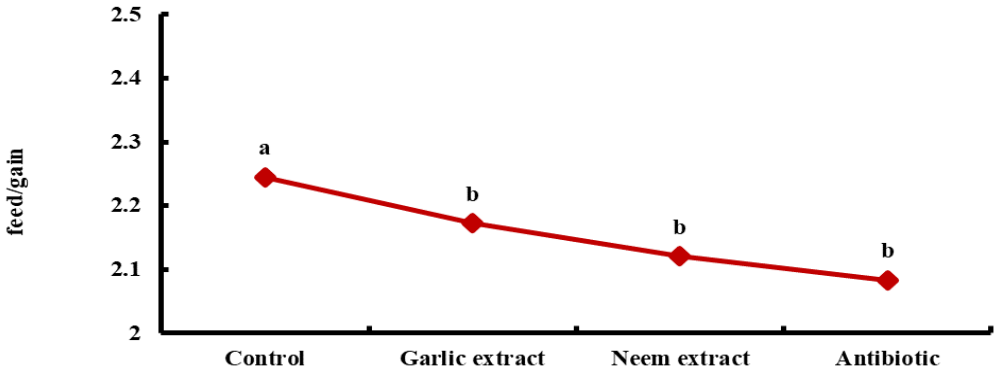

Figure 3. Total feed conversion ratio of *Sonali* chicken among different dietary treatments

Garlic supplementation had no effect on feed intake in the present study which was similar with the findings of some previous observations (Yalcın *et al*., 2006; Canogullar *et al*., 2009; Raeesi *et al*., 2010). In contrast, Rashid *et al*. (2020), Abd El-Latif *et al*. (2013) and Galib and Huda (2013) reported that garlic had positive effect on broilers feed intake which might be due to improvement of palatability of diets. Feed intake of neem extract group was lower compared to the control group. The findings of present study were similar with the findings of Gowda *et al*. (1998) and Mollah *et al*. (2012), who reported significantly lower feed intake for diets with neem extract which might be due soluble polyphenolics (have a bitter and astringent taste) (Kumar and D'Mello, 1995 and Iheukwumere *et al*., 2008). On the contrary, Islam *et al.* (2019) and Hossain *et al.* (2021) observed no significant difference in feed intake while, Upadhyay *et al.* (1990) reported non-significant increase in feed intake in the neem fed groups which might be due to antimicrobial and antiprotozoal properties of neem leaves reduced the microbial load of birds and thus improved the feed consumption and feed efficiency (Kale *et al*., 2003).

The significant effect of garlic on FCR of *Sonali* was in agreement with Rashid *et al.* (2020), Hossain and Hossain (2020), Abd El-Latif *et al*. (2013) and Galib and Huda (2013) who reported that supplementation of garlic in feed had better FCR. However, Karim *et al.* (2017) observed no significant difference but Raeesi *et al*. (2010) reported that supplementation of garlic powder decreased FCR in broiler. In case of neem extract, improved FCR was observed. This result was in agreement to the findings of Islam *et al.* (2019) and Hossain *et al.* (2021). However, Nidaullah *et al*. (2010), Nnenna and Okey (2013) and Amouzmehr *et al*. (2012) observed no significant effect of FCR by supplementing neem leaves.

Dressing parameters of Sonali

Results from Table 5 indicated no significant differences (P>0.05) in dressing percentage, skin, head, leg, liver, heart, gizzard, breast meat, drumstick meat, wing meat and drumstick bone weight in relation to body weight among different treatment groups but thigh meat showed significant difference (P<0.05). Thigh meat in garlic extract group (4.09) showed higher significant values (P<0.05) than the neem extract (3.56) and antibiotic group (3.43), and thigh meat in control group (3.85) showed better significant value (P<0.05) than the antibiotic group (3.43). No significant differences in dressing parameters were in agreement with Hossain *et al.* (2021), Bonsu *et al*. (2012) and Amouzmehr *et al*. (2012). On the contrary with these findings, a significant increase in average dressing percentage with supplementation of garlic (Fayed *et al*., 2011) and neem (Zanu *et al*., 2011) was also reported. Thigh meat in garlic extract group showed higher significant value than the antibiotic group. Newall *et al*. (1996) reported that garlic contains at least 33 sulfur compounds, several enzymes, 17 amino acids and minerals such as selenium which might be a cause of better performance.

Table 5. Dressing parameters of *Sonali* chicken among different treatments (% relation to body weight)

Parameter	Treatments				P value	LS
	Control	Garlic extract	Neem extract	Antibiotic		
Dressing yield	57.07±0.36	57.57±0.55	57.64±0.75	57.79±0.61	0.83	NS
Skin	2.55±0.17	3.42±0.39	2.93±0.17	2.65±0.36	0.21	NS
Head	3.79±0.13	3.87±0.10	3.83±0.14	3.82±0.08	0.97	NS
Leg	3.84±0.06	3.86±0.11	3.88±0.09	4.09±0.31	0.71	NS
Liver	2.88±0.11	2.87±0.18	2.85±0.09	3.06±0.17	0.41	NS
Heart	0.56±0.07	0.61±0.12	0.46±0.06	0.54±0.02	0.60	NS
Gizzard	2.22±0.16	2.28±0.30	2.00±0.14	2.14±0.12	0.77	NS
Breast meat	4.52±0.10	4.69±0.39	4.28±0.27	4.41±0.38	0.82	NS
Thigh meat	3.85^{ab}±0.07	4.09^{a}±0.21	3.56^{bc} ±0.11	3.43^{c}±0.09	0.01	*
Drumstick meat	3.22±0.27	2.84±0.25	2.96±0.33	3.03±0.05	0.76	NS
Wing meat	3.95±0.14	3.65±0.16	3.79±0.18	3.82±0.15	0.63	NS
Thigh bone	1.32±0.07	1.34±0.06	1.14±0.07	1.09±0.09	0.08	NS
Drumstick bone	1.52±0.05	1.53±0.08	1.80±0.08	1.58±0.12	0.13	NS

^{a,b,c} = values with different superscripts in the same row differ significantly, *= P<0.05, LS = Level of significant

Serum biochemical parameters

The data represented in Figure 4 indicated that there were no significant (P>0.05) differences in cholesterol and triglyceride among different treatment groups. However, significant (P<0.05) difference in glucose content was among different treatment groups. Garlic extract (92.52), neem extract (92.92) and antibiotic (100.54) groups showed the lowest glucose value compare to the control (115.64) group.

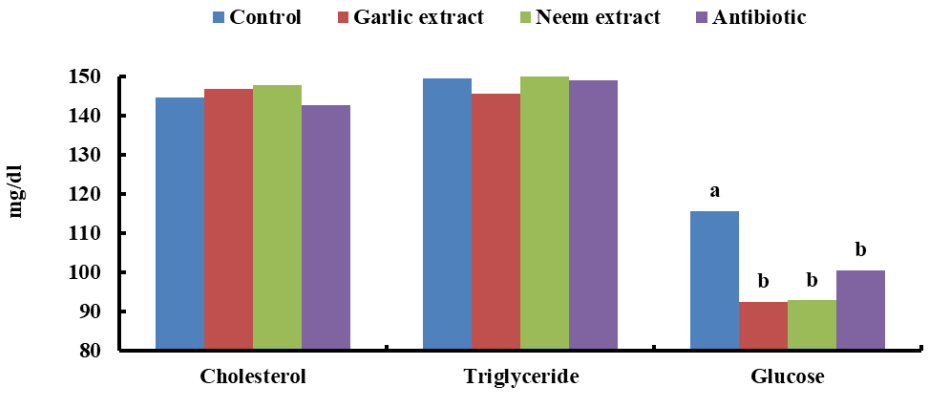

Figure 4. Serum biochemical parameters of *Sonali* chicken among different dietary treatments

The present study reports that there was reduction in the serum glucose concentration in garlic supplemented group when compared to the control group. These findings were similar to the findings of Karim *et al.* (2017), Ibrahiem *et al*. (2004) and Kamal and Daoud (2003) whom observed significant reduction in serum glucose concentration due to garlic supplementation. Chattopadhyay (1996) and Halim (2003) reported that decrease in serum glucose value for the presence of bioactive compounds contained in neem leaves which have the ability to block the energy metabolic pathway. Supplementation of garlic and neem extract showed no

significant effect on cholesterol and triglyceride content in this study. This result coincides with Hossain *et al.* (2021) who observed no significant difference in case of neem leaf powder. However, previous study reported a reduction of serum cholesterol upon supplementation of garlic (Rashid *et al.*, 2020; Islam *et al.*, 2019; Karim *et al.*, 2017) in broiler ration. This may probably be due to the possible effects of hypocholesterolaemic and hypolipidemic action of garlic products which depresses the hepatic activities of lipogenic and cholestero-genic enzymes such as malic enzyme, fatty acid syntheses, and glucose-6-phosphatase dehydrogenase (Chi *et al*., 1982). Moreover, Chowdhury *et al*. (2002) indicated that the sulphur containing bioactive compounds mainly allicin in garlic homogenates help to show cholesterol lowering effect. Allicin also inhibits the action of hydroxymethlygutaryl– CoA reductase, which might be the most important enzyme that participates in the synthesis of cholesterol and lipids (Lawson, 1998).

Conclusion

Supplementation of garlic and neem extracts had positive effect on body weight and body weight gain but no significant difference in feed intake. Improved FCR was observed in garlic and neem supplemented groups as like as antibiotic group compared to the control group. Dressing parameters were not affected upon supplementation of garlic and neem extract except thigh meat. Garlic extract, neem extract and antibiotic groups showed the lower glucose content compared to the control group whereas, cholesterol and triglyceride contents were not affected. Taken together, it may be concluded that supplementation with garlic and neem extract can be used in the water of *Sonali* bird to produce safe chicken meat for the consumer.

Acknowledgements

The authors acknowledge Ministry of Education, Government of the People's Republic of Bangladesh for funding this research project.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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