International Journal of Animal Science and Technology
2023; 7(1): 5-10
http://www.sciencepublishinggroup.com/j/ijast
doi: 10.11648/j.ijast.20230701.12
ISSN: 2640-1282 (Print); ISSN: 2640-1312 (Online)

Effects of Probiotic and Organic Acids with Yeast Extract on Body Weight Gain and Hemato-Biochemical Parameters in Broilers

Abdus Sattar[1], Jannatun Nime[2], Syed Ali Azmal[3, *], Atikur Rahaman[4], Shiekh Mohammad Abdul Matin[5], Akramul Haque[6], Huzzat Ullah[7], Liakot Hossen[4], Nazim Ahmad[1]

[1]Department of Physiology, Bangladesh Agricultural University, Mymensingh, Bangladesh

[2]Department of Microbiology, Bangladesh Agricultural University, Mymensingh, Bangladesh

[3]Department of Genetics and Animal Breeding, Sirajganj Government Veterinary College, Sirajganj, Bangladesh

[4]Department of Biochemistry, Physiology & Pharmacology, Sirajganj Government Veterinary College, Sirajganj, Bangladesh

[5]Department of Medicine and Surgery, Sirajganj Government Veterinary College, Sirajganj, Bangladesh

[6]Department of Animal Science and Nutrition, Sirajganj Government Veterinary College, Sirajganj, Bangladesh

[7]Department of Microbiology, Sirajganj Government Veterinary College, Sirajganj, Bangladesh

Email address:

syed.azmal@yahoo.com (Syed Ali Azmal)

[*]Corresponding author

To cite this article:

Abdus Sattar, Jannatun Nime, Syed Ali Azmal, Atikur Rahaman, Shiekh Mohammad Abdul Matin, Akramul Haque, Huzzat Ullah, Liakot Hossen, Nazim Ahmad. Effects of Probiotic and Organic Acids with Yeast Extract on Body Weight Gain and Hemato-Biochemical Parameters in Broilers. *International Journal of Animal Science and Technology*. Vol. 7, No. 1, 2023, pp. 5-10.
doi: 10.11648/j.ijast.20230701.12

Received: February 14, 2023; **Accepted**: March 2, 2023; **Published**: March 15, 2023

Abstract: The research was conducted to observe the effect of a probiotic and organic acid with yeast extract on growth performance (body weight gain, meat yield percentage, and organ weight), hematological (Hb, ESR, and PCV) and biochemical parameters (Urea, Uric acid, and Creatinine) as an indication of kidney function. A total of 18 broiler chicks (Cobb-500) 7 days old were assigned to 3 treatment groups as group A (control group, n=6) was fed with standard commercial feed, and Group B (n=6) was fed with probiotics (Gut-pro®). Group C (n=6) was fed with probiotics, organic acids, yeast extract, and normal commercial ration. Chicks were reared for 35 days. Body weights were recorded weekly. Broilers were sacrificed by cervical dislocation and blood samples were collected for analysis. Serum samples were separated for biochemical tests. Whole meat, liver, viscera and skin were collected and weighed. Total body weight, weight of whole meat, liver, viscera and skin increased significantly ($P < 0.01$) in birds of group C (organic acid with probiotics) and group B (probiotic) than that of the control group A. Packed cell volume and hemoglobin concentration were increased significantly ($P < 0.01$) in birds of group B (probiotic) and group C (probiotic and organic acid with yeast extract) than that of the control group A. Erythrocyte Sedimentation Rate (ESR) increased significantly ($P < 0.01$) in control group A than that of probiotic and organic acid-treated groups. Uric acid and Creatinine concentrations decreased significantly ($P > 0.01$) in probiotic and organic acid-treated groups than in the control group. Urea levels in group B (probiotic) and group C (probiotic and organic acid with yeast extract) were similar to that of control group A.

Keywords: Probiotic, Organic Acid, Yeast Extract, Body Weight, Hemato-Biochemical, Broiler

1. Introduction

Poultry production plays an important role in solving unemployment and malnutrition. About 15% of the human population suffers from malnutrition. The success of the poultry industry depends on how rapidly the birds attain the

maximum marketable weight at a minimum period. The feed accounts for about 75% of the total cost of a poultry enterprise. Hence, it is necessary to improve the efficacy of feed at a minimum cost. To enhance the production of broiler additional feed supplement is necessary. The term 'probiotic' is derived from the Greek language meaning 'for life'. A probiotic refers to a live microbial feed supplement that beneficially affects the host animal by improving its microbial intestinal balance [1]. The probiotic approach, therefore, advocates the supplement of food products with live microbial additions. Probiotic as feed additive enhances the immune response and stimulates growth in chickens. It increases antibody levels and macrophage activity. Thus, probiotics can be used as immunomodulators that stimulate host immunity and make them resistant to different infections.

The use of antibiotics to maintain animal well-being, enhance growth and improve efficiency has been practiced for more than 50 years. However, as early as the 1950s, scientists identified concern about the development of resistant bacteria for the antibiotics streptomycin and tetracycline used in turkeys and broilers respectively. These findings laid the groundwork for agricultural officials to impose stricter regulatory parameters on the use of antibiotics in poultry feeds. Probiotics are live microorganisms included in the diet of animals as feed additives or supplements. Commonly known as a direct-fed microbial, probiotics provide beneficial properties to the host, primarily through action in the gastrointestinal tract (GIT) of the animal. Supplementation of probiotics in the diet can improve animal health and performance, through contributions to gut health and nutrient use [2-5]. Feed additives and nutritional supplements are attaining importance nowadays in the poultry industry, as well as in healthcare systems, because of their wide spectrum of beneficial impacts, such as promoting growth and production, immune enhancement, and health protection [6-13].

Supplementing poultry diets with organic acids has become an important nutritional strategy to improve the performance and health status of poultry. Organic acids have made a tremendous contribution to the probability of intensive husbandry and are providing people with healthy and nutritious poultry products [14]. Organic acids stimulate endogenous enzymes, regulate gut microbial flora, and help in maintaining animal health. The basic principle on the mode of action of organic acids on bacteria is that non-dissociated (non-ionized, more lipophilic) organic acids can penetrate the bacterial cell wall and disrupt the normal physiology of certain types of bacteria [15]. Organic acids, e.g., acetic, citric, lactic, formic, sorbic, ascorbic, propionic, fumaric, and malic acids have been used in diets as biotechnological agents for their positive effect on the health and growth of birds. The usage of organic acids is becoming more acceptable to feed manufacturers, poultry producers, and consumers. Organic acids also improve the digestibility and absorption of proteins, minerals, and other nutrients in the diet. Administration of organic acids decreases the pH of the gastrointestinal tract which causes maximum utilization of protein and inhibits harmful population. By modifying intestinal pH, organic acids improve the solubility of the feed ingredients resulting in increased digestion and absorption of nutrients [14, 16].

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in "Abdur Rahim Poultry Farm", Gollamari, Khulna, Bangladesh, and Finix Agro-health Care Laboratory, Moilaputa, Khulna, Bangladesh to evaluate the effects of commercially available probiotic (Gut-pro®) and organic acids with yeast extract (Nutrilac IGA®) on the performance of broiler chicks in terms of weight gain and blood biochemical parameters.

2.2. Experimental Design

A total of 18 broiler chicks of 7 days old were randomly divided into groups A, B, and C; each consisting of 6 birds and were reared in the well-partitioned area under strict hygienic management. Group A was considered as control and fed with commercial ration and fresh drinking water. Group B was additionally supplied with a probiotic @ 1 gm. probiotic/liter of drinking water after the first week to end and Group C was also given with probiotic (Gut-pro®) and organic acids with yeast extract (Nutrilac IGA®) @ 1.5 ml/liter with the control diet. Initial body weight and body weight at 7 days intervals were recorded up to the end of the 35 days (experimental period) and the birds were sacrificed to collect blood for (ESR, Hb, and PCV) and serum for (Uric acid, Uria and Creatinine).

2.3. Experimental Birds and Diets

A total of 18 seven days old "Cobb-500" broiler chicks were purchased from CP Bangladesh Co. Ltd. and were brought to "Abdur Rahim Poultry Farm", Gollamari, Khulna, in well-ventilated paper cartons. The broiler chicks were fed with standard commercial ration (Nourish Feed) according to age. The chicks were fed with standard broiler starter, broiler grower, and broiler finisher ration of Nourish Feed, Nourish Poultry, and Hatchery Ltd.

2.4. Probiotic and Organic Acids with Yeast Extract

Gut-Pro® with a minimum of 2×10^9 colony forming units (CFU)/ gm. was collected from Avon Animal Health Co. Ltd. The chicks were fed with Nutrilac IGA® marketed by Novartis (Bangladesh) Ltd.

2.5. Processing of Broilers and Record Keeping

All the birds were kept without feed but water for 12 hours and allowed to bleed for 2 minutes after slaughter. Weights of organs were recorded for each bird.

2.6. Measurement of Body Weight of Birds

The body weight of each bird was measured using the balance on day 7 of age and subsequently at 7 days intervals up to the end of the experiment (day 35).

2.7. Blood Collection

A series of sterile test tubes containing anticoagulant (4% Sodium Citrate) at a ratio of 1:10 was taken. 5 ml of blood was collected from each bird through slaughtering. The biochemical studies were performed within two hours of blood collection.

2.8. Collection and Preparation of Serum Samples

About 5 ml of blood was collected in the sterile glass test tubes. The blood-containing tubes were placed in a slanting position at room temperature for clotting. The tubes were then placed in the refrigerator at 4°C overnight. The serum was collected and then stored at -20°C until analysis.

2.9. Determination of Hematological and Biochemical Parameters

Hematological parameters, e.g., hemoglobin (Hb), packed cell volume (PCV), and erythrocyte sedimentation rate (ESR) were determined using blood samples, whereas, biochemical parameters, e.g., urea, uric acid, and creatinine were determined from the serum samples.

2.10. Statistical Analysis

The data were collected and the Mean ± SE was calculated by using descriptive statistics. A randomized complete block (RCB) design with more than one observation per cell was applied. An analysis of variance (ANOVA) table had been constructed with the help of the computer package MSTAT for identifying any statistically significant difference among the groups. The mean difference among the treatments was determined as per Duncan's multiple-range tests [17].

3. Results

The effect of probiotics and organic acids with yeast extract on growth hematological and biochemical parameters was found significant in this study.

3.1. Effects on the Body Weight (gm.)

The body weight of different groups of birds is presented in Table 1 and Figure 1. Body weight on day 7 was more or less similar. The body weight was 270.74 ± 2.05 gm. in group A, 272.47 ± 3.28 gm. in group B and 271.54 ± 2.69 in group C. The body weights of groups A, B, and C on day 14, were 538.23c ± 1.50, 565.99b ± 2.21, and 592.81a ± 1.76 gm.; on day 21, were 860.00c ± 2.71, 905.50b ± 1.75 and 953.67a ± 3.35 gm.; on day 28, was 1215.70c ± 5.62, 1255.03b ± 4.73 and 1290.53a ± 4.64 gm.; and on day 35, were 1505.70c ± 5.62, 1552.03b ± 4.73 and 1598.53a ± 4.64 gm. respectively.

Table 1. *Effects of probiotic (Gut-Pro®) and organic acid with yeast extract (Nutrilac IGA®) on body weight (Mean ± SE) in broilers.*

Group	Initial body weight (gm.)	Post treatment body weight (gm.)			
	Day 7	Day 14	Day 21	Day 28	Day 35
A	270.74 ± 2.05	538.23c ± 1.50	860.00c ± 2.71	1215.70c±5.62	1505.70c±5.62
B	272.47 ± 3.28	565.99b ± 2.21	905.50b ± 1.75	1255.03b±4.73	1552.03b±4.73
C	271.54 ± 2.69	592.81a ± 1.76	953.67a ± 3.35	1290.53a±4.64	1598.53a±4.64

Values with different letters in a column differ significantly ($p<0.01$).

Body weight increased significantly ($p<0.01$) in all groups irrespective of treatments. The highest body weight was recorded in treated group C followed by groups B and A. Significantly ($p<0.01$) different body weights were recorded among the groups on all sampling days (14, 21, 28, and 35).

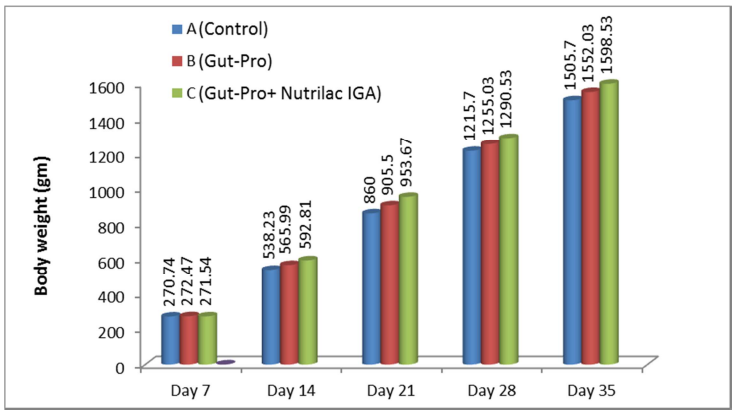

Figure 1. *Effects of probiotic (Gut-Pro®) and organic acid with yeast extract (Nutrilac IGA®) on body weight (Mean ± SE) in broilers.*

3.2. Effects on Organs Weight (gm.)

The weights of organs for dietary treatments are presented in Table 2. The whole meat weight in control group A was 995.36a ± 0.55 gm. and in the treated group B was 960.25b ± 0.39 gm. and in the treated group C was 905.47c ± 0.47 gm. The whole meat weight increased significantly ($P<0.01$) in all groups. The whole meat weight increased slowly in the control

group A but higher meat weight was noticed in treated group C followed by group B. The treated group C showed an increase (P<0.01) in liver weight (43.59a ± 1.03 gm.) compared to either group A (39.24ab ± 0.99 gm.) or group B (40.12b ± 0.47 gm.). The treated group C showed an increase (P<0.01) in visceral weight (241.22a ± 1.20 gm.) compared with either the control group A (212.36c ± 1.18 gm.) or the probiotic group B (230.40b ± 1.11 gm.). The treated group C showed an increase (P<0.01) in skin weight (300.47a ± 0.51 gm.) compared with either the control group A (229.09c ± 0.49 gm.) or probiotic group B (266.12b ± 0.77 gm.).

Table 2. *Effects of probiotic (Gut-Pro) and organic acid with yeast extract (Nutrilac IGA) on the (Mean ± SE) weight of Meat yield, Liver, Viscera and Skin.*

Group	Organ weight (gm.)			
	Whole Meat	**Liver**	**Viscera**	**Skin**
A	905.47c ± 0.47	39.24ab ± 0.99	212.36c ± 1.18	229.09c ± 0.49
B	960.25b ± 0.39	40.12b ± 0.47	230.40b ± 1.11	266.12b ± 0.77
C	995.36a ± 0.55	43.59a ± 1.03	241.22a ± 1.20	300.47a ± 0.51

Values with different letters in a column differ significantly (p<0.01).

3.3. Effects of Hematological Parameters

The hematological parameters are presented in Table 3. The treated group B was 7.74ab ± 0.11 gm. /dl and group C was 8.19a ± 0.07 gm./dl. The highest value of hemoglobin content was recorded in group C and the lowest value of hemoglobin content was in group A. The treated groups B and C had significantly (P<0.01) higher Hb than that of the control group A. The erythrocyte sedimentation rate (ESR) values of groups A, B, and C were 2.155a ± 0.005, 1.375b ± 0.065, and 0.845c ± 0.075 mm in 1st hour respectively. The lowest value was found in group C and the highest was in group A. The values of control group A were significantly (P<0.01) increased than treated groups B and C. The values of PCV of groups A, B, and C were 20.52ab ± 0.525%, 22.07b ± 0.975%, and 24.13a ± 0.97% respectively. The highest value was found in group C and the lowest was in control group A. The value of treated group C was significantly (P<0.01) higher than the control group A.

Table 3. *Effects of probiotic (Gut-Pro®) and organic acid with yeast extract (Nutrilac IGA®) on hematological parameters in broilers.*

Group	Hematological parameters		
	Hb (gm/dl)	**ESR (mm in 1st hour)**	**PCV (%)**
A	7.54b ± 0.22	2.155a ± 0.005	20.52ab ± 0.525
B	7.74ab ± 0.11	1.375b ± 0.065	22.07b ± 0.975
C	8.19a ± 0.07	0.845c ± 0.075	24.13a ± 0.97

Values with different letters in a column differ significantly (p<0.01).

3.4. Effects of Biochemical Parameters

The biochemical parameters are presented in Table 4. The creatinine level of groups A, B, and C were 0.65b ± 0.035 mg./dl, 0.53a ± 0.11 mg./dl, and 0.51c ± 0.06 mg./dl respectively. The highest value was found in control group A and the lower values were in treated groups B and C. The value of control group A was significantly (P<0.01) higher than the treated group B and C. Urea levels in treated group B (probiotic) and group C (probiotic and organic acid with yeast extract) were almost similar to control group A. Uric acid level in group A was 6.58ab ± 0.93 mg./dl, in group B, was 6.355b ± 0.31 mg./dl and in the group, C was 6.20a ± 0.275 mg./dl. The uric acid level in control group A was significantly (P<0.01) higher than in the treated group B and C.

Table 4. *Effects of probiotic (Gut-Pro®) and organic acid with yeast extract (Nutrilac IGA®) on biochemical parameters in broilers.*

Group	Biochemical parameters		
	Creatinine (mg./dl)	**Urea (mg./dl)**	**Uric acid (mg./dl)**
A	0.65b ± 0.035	31.65b ± 1.205	6.58ab ± 0.93
B	0.53a ± 0.11	31.64b ± 1.66	6.355b ± 0.31
C	0.51c ± 0.06	31.63a ± 1.19	6.20a ± 0.275

Values with different letters in a column differ significantly (p<0.01).

4. Discussion

4.1. Effects on the Body Weight (gm.)

The present research was undertaken to study the growth performance and haemato-biochemical parameters of broilers fed with probiotics (Gut-Pro®) and organic acid with yeast extract (Nutrilac IGA®) through drinking water. Birds supplemented with the probiotic and organic acid with yeast extract had a greater (P < 0.01) body weight compared with the control and probiotics-treated group. The increased body weight gain in the treated groups might be due to increased

feed consumption, better digestion, absorption, and metabolism of supplied feed probiotics for their health and body weight. The increased weight recorded in the present study resembles with some of other investigators [18-20]. Cavazzoni et al. [21, 22] stated that body weight was higher (P<0.05) in the probiotic-fed chickens than in the control group. However, Sjofjan's *et* al. [23] study can't exactly suggest the dose optimum for using this probiotic, but using probiotic as replacement of antibiotic growth promoters (AGPs) are not more than 1% from total feed formulation. Their findings is supported by several other researchers [24, 25]. But the present findings differ from Ergun et al. [26] who stated that supplementation of probiotics had no effect on body weight.

4.2. Effects on Organs Weight (gm.)

The weight of whole meat, liver, viscera, and skin weight increased significantly (P < 0.01) for birds supplemented with probiotic and organic acid with yeast extract groups than the control and probiotic bird groups. The results are in agreement with the findings of Wageha et al. [27] and Bohm et al. [28]. Mohnl et al. [29] stated that the liver weight was greater (P<0.01) for probiotic and organic acid with yeast extract-fed birds compared to normal ration-fed birds.

4.3. Effects of Hematological Parameters

Packed cell volume and hemoglobin concentration increased significantly (P < 0.01) in probiotic and organic acid-treated groups than the control group. The erythrocyte sedimentation rate increased (P < 0.01) in the control group than in probiotic and organic acid-treated groups. The hematological parameters were decreased in the control group and higher values in the probiotic treated group resemble with some other scientists [30, 31].

4.4. Effects of Biochemical Parameters

Uric acid and creatinine concentrations decreased significantly (P < 0.01) in probiotic and organic acid-treated groups than the control group. Urea levels in probiotics and probiotics and organic acid with yeast extract were almost similar. Increased uric acid in the treated groups resembles Swain and Johri [32] who detected that uric acid levels increased significantly (P<0.01) with probiotics supplementation. Kumar and Rawat [33] showed that the uric acid concentration in blood serum increased with the advancement of age. This study also agreed with Huff et al. [34] who reported that supplementation of probiotics increased uric acid and creatinine level.

5. Conclusions

Based on the findings of the present study on the effects of probiotic and organic acids with yeast extract on body weight gain and hemato-biochemical parameters in broilers, it can be concluded that probiotic and organic acid with yeast extract supplementation has a significant effect on growth performance and certain haemato-biochemical parameters. Therefore, it can be used by farmers in broiler ration at an acceptable range of percentage to obtain large profit.

Conflict of Interest

The authors declare that they have no conflict of interest.

Authors' Contribution

All authors contributed equally and approved the final manuscript.

Acknowledgements

The authors would like to thank the Abdur Rahim Poultry Farm", Gollamari, Khulna, Bangladesh, and Finix Agro-health Care Laboratory, Moilaputa, Khulna, Bangladesh who provided the birds and participated in our study. The authors are highly acknowledged and inspired and assisted during the experiment.

References

[1] Fuller R. 1989. Probiotic in man and animal. Journal of Applied Bacteriology, 66: 365-378.

[2] Mohamed E. Abd El-Hack, Mohamed T. El-Saadony, Manal E. Shafi, Shaza Y. A. Qattan, Gaber E. Batiha, Asmaa F. Khafaga, Abdel-Moneim E. Abdel-Moneim, Mahmoud Alagawany. 2020. Probiotics in poultry feed: A comprehensive review. https://doi.org/10.1111/jpn.13454.

[3] Chun Ik Lim, Ju Eun Kim, Kyu Bang Lee. 2023. Interactive effects of dietary supplementation between illite and probiotic on productive performance, intestinal microflora, and blood profiles of laying hens, Animal Science Journal, 10.1111/asj.13805, 94, 1.

[4] Joanna Xuan Hui Goh, Loh Teng‐Hern Tan, Jodi Woan‐Fei Law, Hooi‐Leng Ser, Kooi‐Yeong Khaw, Vengadesh Letchumanan, Learn‐Han Lee, Bey‐Hing Goh. 2022. Harnessing the potentialities of probiotics, prebiotics, synbiotics, paraprobiotics, and postbiotics for shrimp farming, Reviews in Aquaculture, 10.1111/raq.12659, 14, 3, (1478-1557).

[5] S. Lengliz, M. S. Abbassi, A. Rehaiem, N. Ben Chehida, T. Najar. 2021. Characterization of bacteriocinogenic Enterococcus isolates from wild and laboratory rabbits for the selection of autochthonous probiotic strains in Tunisia, Journal of Applied Microbiology, 10.1111/jam.15047, 131, 3, (1474-1486).

[6] Alagawany, M., Abd El-Hack, M. E., Farag, M. R., Sachan, S., Karthik, K., & Dhama, K. 2018. The use of probiotics as eco-friendly alternatives for antibiotics in poultry nutrition. Environmental Science and Pollution Research, 25, 10611–10618. https://doi.org/10.1007/s11356-018-1687-x.

[7] Alagawany, M., Elnesr, S. S., & Farag, M. R. 2018. The role of exogenous enzymes in promoting growth and improving nutrient digestibility in poultry. Iranian Journal of Veterinary Research, 19, 157– 164.

[8] Alagawany, M., Elnesr, S. S., & Farag, M. R. 2019. Use of liquorice (Glycyrrhiza glabra) in poultry nutrition: Global impacts on performance, carcass and meat quality. World's Poultry Science Journal, 75, 293– 303.

[9] Alagawany, M., Elnesr, S. S., Farag, M. R., Abd El-Hack, M. E., Khafaga, A. F., Taha, A. E., Tiwari, R., Yatoo, M. I., Bhatt, P., Marappan, G., & Dhama, K. 2019. Use of licorice (Glycyrrhiza glabra) herb as a feed additive in poultry. Current Knowledge and Prospects. Animals, 9 (8), 536. https://doi.org/10.3390/ani9080536.

[10] Alagawany, M., Nasr, M., Al-Abdullatif, A., Alhotan, R. A., Azzam, M. M. M., & Reda, F. M. 2020. Impact of dietary cold-pressed chia oil on growth, blood chemistry, hematology, and antioxidant and immunity status of growing Japanese quail. Italian Journal of Animal Science, 19 (1): 896– 904. https://doi.org/10.1080/1828051X.2020.1807420.

[11] Arif, M., Hayat, Z., Abd El-Hack, M. E., Saeed, M., Imran, H. M., Alowaimer, A. N., Saadeldin, I. M., Taha, A. E., & Swelum, A. A. 2019. Impacts of supplementing broiler diets with a powder mixture of black cumin, Moringa and chicory seeds. South African Journal of Animal Science, 49 (3), 564–572. https://doi.org/10.4314/sajas.v49i3.17.

[12] Arif, M., Iram, A., Bhutta, M. A. K., Naiel, M. A. E., Abd El-Hack, M. E., Othman, S. I., Allam, A. A., Amer, M. S., & Taha, A. E. 2020. The biodegradation role of Saccharomyces cerevisiae against harmful effects of mycotoxin contaminated diets on broiler performance, immunity status, and carcass characteristics. Animals, 10 (2), 238. https://doi.org/10.3390/ani10020238.

[13] Shewita, R. S., & Taha, A. E. 2018. Influence of dietary supplementation of ginger powder at different levels on growth performance, haematological profiles, slaughter traits and gut morphometry of broiler chickens. South African Journal of Animal Science, 48 (6), 997– 1008.

[14] Patten and Waldroup. 1988. Bacillus subtilis C-3102 (Calsporin) improves live performance and microbiological status of broiler chickens. Journal of Applied Poultry Research. 9 (2): 149-155.

[15] Dhawale, A. 2005. Better eggshell quality with a gut acidifier. Poult. Int., 44: 18-21.

[16] Owings, WJ., DL. Reynolds, RJ Hasiak, and PR. Ferket. 1990. Influence of dietary supplements with Streptococcus faecium M-74 on broiler body weight, feed conversion, carcass characteristics and intestinal microbial colonization. Poultry Science, 69: 1257-1264.

[17] Gomez, KA. and Gomez AA. 1984. Duncan's Multiple Range Test. Statistical procedures for Agricultural Research. 2nd Edi. John Wiley and Sons. PP. 207-215.

[18] Mainckam, JP.; Jacob, JP. 1994. Alternatives to antibiotics for organic poultry production. Journal of Applied Poultry Research, 14: 750-756.

[19] Islam MW, Rahman MM, Kabir SML, Kamruzzaman SM and Islam MN. 2004. Effects of probiotics supplementation on growth performance and certain haemato-biochemical parameters in broiler chickens. Bangladesh Journal of Veterinary Medicine, 2: 39-43.

[20] Haque, M. M., Howladar, M. M. R., Begum, S., Hasan, M. M. I., Islam, S., Aktaruzzaman, M., Rahman., M. M. and Akanda, M. R. 2015. Effects of Probiotics on Live Weight and Hematobiochemical Parameters in Broiler. International Journal of Scientific Research in Agricultural Sciences, 2 (6), pp. 126-132.

[21] Cavazzoni V, Adami A. and Cstrivilli C. 1998. Performance of broiler chickens supplemented with Bacillus coagulans as probiotic. British Poultry Science, 39: 526-529.

[22] Shah SMT, Islam MT, Zabin R, Roy PC, Meghla NS, Jahid IK 2021. Assessment of novel probiotic strains on growth, hematobiochemical parameters, and production costs of commercial broilers in Bangladesh, Veterinary World, 14 (1): 97-103.

[23] Sjofjan O, Adli DN, Harahap RP, Jayanegara A, Utama DT, Seruni AP. 2021. The effects of lactic acid bacteria and yeasts as probiotics on the growth performance, relative organ weight, blood parameters, and immune responses of broiler: A meta-analysis. F1000Res. 2021 Oct 13; 10: 183. doi: 10.12688/f1000research.51219.3. PMCID: PMC8567689.

[24] Attia YA, Al-Harthi MA, El-Shafey, AS, et al.: Enhancing tolerance of broiler chickens to heat stress by supplementation with vitamin E, vitamin C and/or probiotics. Annals of Anim. Sci. 2017; 17 (4): 1155. https://doi.org/10.1515/aoas-2017-0012.

[25] Al-Sagan AA, Al-Yemni AH, Al-Abdullatif AA, et al.: Effects of different dietary levels of blue lupine (Lupinus angustifolius) seed meal with or without probiotics on the performance, carcass criteria, immune organs, and gut morphology of broiler chickens. Front.vet. sci.2020; 7; 124. https://doi.org/10.3389/fvets.2020.00124.

[26] Ergun A. Yalcin S. Sacakli P. 2000. The usage of probiotic and zinc bacitracin in broiler rations. Ankara Universilesi Veteriner Fakultesi Dergisi; 47: 271-280.

[27] Wageha A, Khaled G, and Josef B. 2008. Intestinal Structure and Function of Broiler Chickens on Diets Supplemented with a Synbiotic Containing Enterococcus faecium and Oligosaccharides. International Journal of Molicular Science, 9 (11): 2205-2216.

[28] Bohm J, Ghareeb K, Nitsch S, Pasteiner S, Abdel-Raheem S. and Awad WA. 2008. Effects of Dietary Inclusion of prebiotic, probiotic and synbiotic on the Intestinal Glucose Absorption of Broiler Chickens. Poultry Science; 7: 668-991.

[29] Mohnl M, Acosta AY Acosta OA, Rodriguez SB and Pasteiner S. 2007. Effect of synbiotic feed additive in comparison to antibiotic growth promoter on performance and health status of broilers. Journal of Poultry Science; 86 (1): 217.

[30] Kabir SML, Rahman MM, Rahman MB, and Ahmed SU. 2004. The dynamics of probiotics on growth performance and immune response in broilers. International Journal of Poultry Science, 3: 361-364.

[31] Vicente WA., Ghareeb K, Abdel-Raheem S and Bohm J. 2007. Effect of dietary inclusion of probiotic and synbiotic on growth performance, organ weights, and intestinal histomorphology of broiler chickens. Poultry Science, 88: 49-56.

[32] Swain and Johri. 2000. Effect of probiotic (Saccharomyces cerevisiae) on growth performance and haemato-biochemical parameters of broiler chicks. International Journal of Poultry Science, 2: 142-148.

[33] Kumar and Rawat. 1976. Effects of direct fed microbials on nutrient retention and parameters of Single White Leghorn pullets. Poultry Science, 62 (Suppl. 2): 71.

[34] Huff ML, Nakaue HS, and Mirosh LW. 1992. Effect of probiotic on performance and biochemical parameter in pullets. Journal of Poultry Science, 2006, 43: 296-300.