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The Effect of Colostrum Powder Supplementation on Performance, Intestinal Morphology, Blood Biochemical Parameters, Immunity and Antioxidant Status of Broilers

Research Article

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ABSTRACT

This experiment was conducted to investigate the effects of different levels of colostrum powder supplementation on performance, blood biochemical parameters, immunity, and antioxidant status of broilers. Colostrum powder is only added in the first ten days of the broiler's breeding period in their diets. Colostrum powder had significant effects on performance, carcass traits, intestinal cell morphology, blood biochemical parameters, immunity, and antioxidant status of broilers (P<0.05). The highest amount of weight gain in the starter period and the best feed conversion ratio were observed with 1.5 and 1% of colostrum powder. In the total period at 42 days, the lowest amount of feed intake was obtained with 1% of colostrum powder (P<0.05). The highest percentages of carcass and spleen belonged to the group fed with 2% of colostrum powder (P<0.05). The lowest level of blood total cholesterol, low-density lipoprotein (LDL), and the highest level of total protein of blood were obtained with 1% and 1.5% of colostrum powder (P<0.05). Broilers had the best immunity reactions by adding 2% of colostrum powder to their diets (P<0.05). The highest levels of superoxide dismutase (SOD) and glutathione peroxidase (GPX) were resulted with adding 2% of colostrum powder in broilers diets (P<0.05). Colostrum powder had no significant effects on the intestinal morphology of broilers (P>0.05). The overall results showed that in broilers, using colostrum powder up to 1.5% of their diets in the starter period had beneficial effects on their performance, carcass traits, blood biochemical parameters, immunity, and antioxidant status.

KEY WORDS antioxidant, broilers, carcass traits, immunity, performance.

INTRODUCTION

Colostrum is a liquid lactated by female mammals' mammary glands for the first three days after birth (Odle *et al.* 1996). Colostrum contains nutrients such as protein, carbohydrates, fats, vitamins, minerals, and various bioactive components such as growth and antimicrobial factors (Godhina and Patel, 2013). Two of the most important components contained in colostrum are immune and growth factors. Immune factors are the substances that reduce the effects of microorganisms causing diseases, protect from diseases and help the body health (Gopal and Gill, 2000; Kelly, 2003). Growth factors contain components that increase healing effects by building and aiding the recovery of bones, muscles, fibers, and cartilage, stimulating fat metabolism, sustaining blood glucose level balance, and regulating brain chemicals controlling a state of mind (Uruakpa *et al.* 2002). Also, it is rich in oligosaccharides, natural antimicrobials, immune regulations, and anti-oxidative factors (Calderón-Díaz *et al.* 2021). Mammal's colostrum contains immuno-globulins such as IgG, IgM, IgA, IgD, IgE. IgG and IgM functions areare in systemic infections while IgA function is in the internal body surfaces such as the intestine (Muller and Ellinger, 1981; Morales-Dela Nuez *et al.* 2011). Colostrum and later milk play an important nutritional role for neonatal growth and development in all mammals (Kelly, 2003; Malik *et al.* 2015; Cilek and Gotoh, 2015). Colostrum is responsible for important morphological and functional improvements in the gastrointestinal tract, tissue, and organ development, and repair and changes in newborn calves, lambs, and pigs (Rawal *et al.* 2008). Moreover, colostrum has a greater antioxidant capacity than normal milk (Zarban *et al.* 2009).

Fortunately, colostrum containing a lower amount of lactose compared to normal milk, and conversely, other compounds such as fat, protein, and ash is higher in it (Pakkanen, 1998). Colostrum is rich in vitamins A (retinol), E (tocopherol), and C (which are considered anti-stress vitamins), and therefore their use in feeding broilers in conditions of thermal stress is likely to benefit the immune system, reducing casualties and improving growth (Quigley and Dlewry, 1998).

As mammals, chickens tend to lose weight immediately at neonatal first days after hatching, which has adverse effects on subsequent growth (Qureshi *et al.* 2004). This refers to nutritional limitations immediately after hatching and unexpected changes in feed type and adaptation of the gut to rigid feed (Campbell *et al.* 2003). Nonetheless, integrating nutrition with the development and growth of chickens after hatching is a challenge. The first days after hatching are critically important in maintaining and surviving newly hatched chickens (Campbell *et al.* 2003; Godhina and Patel, 2013). Substitution of the yolk (the endogenous diet) with a solid (exogenous diet) ratio causes large metabolic and physiological changes and resulted in to delay in growth rates (Xu, 1996). As the amount of colostrum production of commercial dairy cows is extra more than their newborn calves needs, it may be used as a feed additive of broilers diets in an early stage of their breeding periods (Afzal *et al.* 2018). Adding colostrum powder up to 2% in broiler diets positively changed their intestinal cell morphology (King *et al.* 2005). In broilers adding liquid colostrum up to 2% of their diets significantly increased the amount of body weight, reduced the mortality percentage, and had positive economic production, increasing the profit margins (Afzal *et al.* 2018). The current study was performed based on adding linearly increasing colostrum powder to broiler's diets and investigating its affect performance, intestinal morphology, blood biochemical parameters, immunity, and antioxidant status.

MATERIALS AND METHODS

A total of 240 male Ross-308 broilers (one-day-old) were sexed and weighed before starting the trial from between 900 chicks of both sexes, divided into a completely randomized design with five treatments, four replicates (12 chicks in each replicate). Diets conformed to the advised levels of nutrients, as established by the Ross-308 broiler nutrition specification, and using the UFFDA software program (Table 1).

Liquid colostrum supplied from an early gestated Frisian cow (6 hr after gestation) and powdered on the base of (Alpha Lipid Lifeline Colostrum Powder, Manukau, New Zealand). Colostrum powder contained 13% crude protein, 0.3% fat, and 59% carbohydrate (Bayril *et al.* 2017). After calculating the amounts of colostrum powder in each treatment, it was added and extremely mixed with other ingredients. In all experiment periods, the diets and water were provided *ad libitum* for chicks. During the experimental periods, the lighting program consisted of 23 hours of light and 1 hour of darkness. The environmental temperature was gradually decreased from 33 ˚C to 25 ˚C on day 21 and was then kept constant.

Sample and data collection

Growth performance

The amounts of body weight gain (BWG) and feed intake (FI) of chicks in each pen were recorded during the starter, growing, and finishing periods. The average BWG and FI were adjusted for mortality and calculated feed conversion ratio (FCR).

Carcass traits

At 42 days of age, two chicks from each replicate were randomly chosen based on the group's average weight and sacrificed. Dressing yield was calculated by dividing eviscerated weight by live weight. Abdominal fat, gizzard, liver, spleen, bursa of fabricius, breast, and thighs were collected, weighed, and calculated as a percentage of carcass weight (King *et al.* 2005).

Intestinal morphology

Two chicks per pen were randomly selected and sacrificed at 42 d of age. To examine the structure of the small intestine villi, segments of the jejunum (2 cm tissue sample from the middle of the jejunum) were cut off, washed with physiological saline solution, and fixed in 10% buffered formalin (100 mL of 40% formaldehyde, 4 g phosphate, 6.5 g dibasic sodium phosphate and 900 mL of distilled water) for 24 h, and then the 10% buffered formalin was renewed.

Table 1 Ingredients and calculated nutrient contents of diets in broilers

Feed ingredients	Feeding periods						
	Starter (1 to 10 d)					Grower (11 to 24) d)	Finisher (25 to 42 d)
Corn	57.66	57.87	57.46	57.98	57.99	63.35	65.93
Soybean meal	37.64	37.01	36.37	35.73	35.11	32.08	28.06
Soybean oil	0.14	0.1	0.69	0.34	0	0.50	2.18
Colostrum powder	0	0.50	1.00	1.50	2.00	0	0
Oyster shell	1.18	1.18	1.19	1.19	1.19	1.07	1.00
Dicalcium phosphate	1.89	1.88	1.87	1.87	1.86	1.63	1.45
Vitamin premix[1]	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral premix[2]	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Sodium chloride	0.3	0.3	0.3	0.3	0.3	0.23	0.23
DL-Methionine	0.29	0.28	0.27	0.26	0.25	0.24	0.22
Lysine-HCl	0.30	0.28	0.25	0.23	0.20	0.25	0.24
Sodium bicarbonate	0.1	0.1	0.1	0.1	0.1	0.15	0.15
Calculated composition							
Metabolizable energy (ME) (kcal.kg)			2860.00			2890.00	3000.00
Crude protein (CP) (%)			21.98			20.00	18.50
Calcium (%)			0.917			0.81	0.74
Avail. P (%)			0.458			0.41	0.37
Sodium (%)			0.16			0.15	0.16
Lysine (%)			1.38			1.20	1.09
Met + Cys (%)			1.03			0.92	0.86
Met (%)			0.67			0.59	0.55

[1] Vitamin premix per kg of diet: vitamin A (retinol): 2.7 mg; vitamin D_3 (cholecalciferol): 0.05 mg; vitamin E (tocopheryl acetate): 18 mg; vitamin K_3: 2 mg; Thiamine: 1.8 mg; Riboflavin: 6.6 mg; Panthothenic acid: 10 mg; Pyridoxine: 3 mg; Cyanocobalamin: 0.015 mg; Niacin: 30 mg; Biotin: 0.1 mg; Folic acid: 1 mg; Choline chloride: 250 mg and Antioxidant 100 mg.

[2] Mineral premix per kg of diet: Fe ($FeSO_4.7H_2O$, 20.09% Fe): 50 mg; Mn ($MnSO_4.H_2O$, 32.49% Mn): 100 mg; Zn (ZnO, 80.35% Zn): 100 mg; Cu ($CuSO_4.5H_2O$): 10 mg; I (K_1, 58% I): 1 mg and Se ($NaSeO_3$, 45.56% Se): 0.2 mg.

Tissues were dehydrated by transferring through a series of alcohols with increasing concentrations, placed into xylol, and embedded in paraffin. A microtome was used to make five cuts that were 5 µm. The cuts were stained with hematoxylin-eosin. Measurements of villus height, width, and crypt depth were performed with an Olympus light Microscope using the digital lens (Dino-eye, AM-7023, 5Mp, Taiwan). A minimum of eight measurements per slide was made for each parameter and averaged into one value (Chichlowski *et al.* 2007).

Blood biochemical parameters

At the end of the experiment, two chicks from each replicate were randomly chosen for blood collection. Approximately 5 mL blood samples were collected from the brachial vein of randomly chosen birds. The blood samples were centrifuged to obtain serum for determining the blood lipids, which included glucose, cholesterol, triglyceride, low-density lipoprotein (LDL), and high-density lipoprotein (HDL). Kit packages (Pars Azmoon Company; Tehran, Iran) were used for determining the blood biochemical parameters using Anision-300 auto-analyzer system (Nazifi, 1997).

Blood immunity tests

At 27 and 36 days of age, sheep red blood cell (SRBC) suspension was injected in the breast muscle of 8 chicks per treatment.

Total antibody (Ab) titers to SRBC were determined by agglutination according to Boa-Amponsem *et al.* (2001) in serum from all 40 chicks. Therefore, 12, 24, and 48 h after sensitization, antibody titers against SRBC were measured and expressed as the log of the reciprocal of the highest serum dilution giving complete agglutination.

At 42 days of age, relative weights of immune organs (spleen and bursa of fabricius) as two immune indexes were determined.

Blood antioxidant status

At the end of the experiment (d 42), two chicks from each pen were slaughtered, thigh muscles were taken/obtained to assess meat quality parameters. Thigh muscle lipid peroxidation was estimated as thiobarbituric acid-reactive substance (TBARS) concentrations in samples using Hosseini-Vashan *et al.* (2012). Values were reported as the concentration of malondialdehyde (MDA).

Statistical analysis

Data were subjected to analysis of variance procedures for a completely randomized design using SAS's General Linear model procedures (SAS, 2005). Pen served as the experimental unit for performance parameters and chick as the experimental unit for blood biochemical parameters, intestine morphology, immune and antioxidant status. Duncan's multiple range tests separated differences between means, and statistical significance was determined at a probability of $P < 0.05$.

RESULTS AND DISCUSSION

The effects of dietary supplementation with colostrum powder on chickens' growth performance are shown in Table 2. In the starter period (first ten day), colostrum powder inclusion into the diets without change in feed intake significantly improved the weight gain and feed conversion ratio of broilers ($P<0.05$). The highest amount of weight gain and the best feed conversion ratio in this period were observed in group 3 with adding 1% of colostrum powder into diets. In the growing period, the highest amount of feed intake was obtained by consumed 2% of colostrum powder ($P<0.05$). Simultaneously, the amount of weight gain and feed conversion ratio did not change in this experimental period ($P>0.05$). Adding colostrum powder into starter period diets of broilers could not change broilers' performance in the finishing period ($P>0.05$). However, at the end of the experimental period, broilers had the highest amount of feed intake by using 0.5% of colostrum powder in their diets ($P<0.05$) as colostrum contains not only nutrients such as protein, carbohydrate, fats, vitamins, and minerals but also various bioactive components such as growth and antimicrobial factors (Odle *et al*. 1996; Godhia and Pate, 2013). So, the main reasons for high weight gain and the best feed conversion ratio improving in the starter period may be related to these components. As colostrum was used only in the starter period, the improving effect occurred in this period. Improving broiler performance by adding colostrum powder agrees with previous research (Bayril *et al.* 2012).

Their suggestion of using feed additives such as probiotics in broiler diets affected their performance for up to 28 days. As in broilers, the digestive tract, especially the intestine, has the best condition for nutrients digestion and absorption rate immediately after hatching and offspring periods. Colostrum powder has been used in this period, so high performance occurred in this period via optimum using of colostrum nutrients contents. Not improving the weight gain and feed conversion ratio of broilers in 2 other periods may be related to withdrawal of colostrum powder and occurring digestion limitations.

Improving body weight gain, feed intake, and feed conversion ratio agree with colostrum application results in quails' diets reported by Bayril *et al*. (2017). Unlike Afzal *et al*. (2018), who reported colostrum powder, up to 2% of broiler diets had no significant effect on their daily feed intake and feed conversion ratio. Different n results may be related to the form, amount, length of colostrum using, and colostrum composition used in these experiments. Using colostrum powder in laying hens diets linearly increased daily feed intake and egg production parameters (Bayril *et al*. 2017). The significant effect of colostrum powder on the amount of daily feed intake of broilers in growing and total period may be related to removing and powdering practices, developing the digestive tract, and improving the immunity and health status of experimental groups.

The effect of using different colostrum powder levels on carcass traits of broilers at the end of the experimental period is shown in Table 3. Colostrum powder supplementation significantly affected the carcass traits of broilers ($P<0.05$). Broilers achieved colostrum powder had a high carcass percentage in contrast with the control group. The highest carcass percentage was obtained in group 5, receiving 2% of colostrum powder by starter diets also spleen percentage affected by colostrum powder supplementation. The highest spleen percentage belonged to 5 experimental groups, receiving 2% of colostrum powder. As colostrum is a rich source of protein, essential amino acids, carbohydrates, fatty acids, minerals, and vitamins (Odle *et al*. 1996; Godhina and Patel, 2013), so using it in broiler diets caused the best growth and improving the carcass percentage. This result is in agreement with Bayril *et al*. (2017) results. They found that using liquid colostrum up to 5% of quail's diets improved the quail's carcass yield. Spleen is an immune organ, and enlarged it in the current experiment depends on special immunity containing colostrum (Uruakpa *et al*. 2002). Bovine colostrum contains immuno-globulins such as IgG, IgM, IgA, IgD, and IgE. IgG and IgM function in systemic infections, while IgA functions within internal body surfaces such as the intestine (Muller and Ellinger, 1981).

As shown in Table 4, supplementation of colostrum powder had no significant effects on broilers' intestinal morphology. However, in contrast, to the control group, adding colostrum powder numerically increased the villi height and ratio of villi/crypt ratio. No significant changes in intestinal cells morphological characteristics of broilers with experimental diets may be related to the amount, duration using, method of colostrum powdering, colostrum composition, and other ration ingredients. Current results do not agree with (King *et al*. 2005) that adding colostrum powder to 2% in broiler diets improves intestinal morphology.

Table 2 Effect of supplementation of colostrum powder on weight gain (WG; g/chick/duration), feed intake (FI, g/chick/duration), and feed conversion ratio (FCR, chick/duration)

Duration	1	2	3	4	5	SEM	P-value
WG (1-10 days)	143.13[c]	147.05[bc]	150.38[ab]	**152.84[a]**	146.82[bc]	1.59	0.0017
WG (11-24 days)	680.11	681.17	660.72	667.33	674.28	5.47	0.0588
WG (25-42 days)	1258.83	1285.80	1281.11	1307.35	1240.53	26.19	0.4517
WG (1-42 days)	2082.05	2114.01	2092.20	2127.52	2062.69	26.20	0.2417
FI (1-10 days)	175.05	170.17	168.25	171.70	174.88	2.21	0.1524
FI (11-24 days)	847.81[ab]	852.75[ab]	812.88[b]	811.12[b]	880.24[a]	14.57	0.0087
FI (25-42 days)	2215.29	2316.03	2193.82	2281.31	2213.71	35.39	0.1598
FI (1-42 days)	3233.37[bc]	3322.12[a]	**3215.47[c]**	3262.68[bc]	3275.58[ab]	18.60	0.003
FCR (1-10 days)	1.22[a]	1.16[bc]	1.12[c]	**1.12[c]**	1.19[ab]	0.0153	0.0001
FCR (11-24 days)	1.24	1.25	1.23	1.21	1.31	0.0245	0.1021
FCR (25-42 days)	1.76	1.81	1.79	1.75	1.71	0.0576	0.9422
FCR (1-42 days)	1.55	1.57	1.54	1.54	1.59	0.0206	0.2755

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 3 Effect of supplementation of colostrum powder on carcass traits of broilers at 42 days (%)

Carcass traits	1	2	3	4	5	SEM	P-value
Carcass	73.36[b]	74.01[b]	73.26[b]	73.00[b]	75.86[a]	0.3868	0.0001
Abdominal fat	3.34	3.36	3.32	3.41	3.05	0.1369	0.5498
Gizzard	3.30	3.33	3.04	3.24	3.13	0.1079	0.2810
Liver	3.45	3.59	3.35	3.50	3.51	0.1980	0.8678
Spleen	0.13[b]	0.15[b]	0.15[b]	0.13[b]	0.17[a]	0072	0.0031
Burs	0.07	0.08	0.10	0.08	0.090	0.0079	0.3608
Thighs	21.22	20.99	20.61	20.41	20.36	0.3432	0.3330
Breast	25.88	27.39	27.04	26.23	26.05	0.4216	0.0639

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 4 Effect of supplementation of colostrum powder on intestinal morphology at 42 days (µm)

Carcass traits	1	2	3	4	5	SEM	P-value
Villi hight	1092.75	1050.50	1095.85	1189.40	1176.87	77.40	0.6930
Crypt	196.02	169.49	179.24	183.02	166.45	11.05	0.4161
Villi/crypt	5.62	6.28	6.23	6.57	7.13	0.5960	0.5818
Goblet	41.60	49.60	39.45	47.60	38.00	5.18	0.4355

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Experimental condition, colostrum powder source and processing, periods of use, and other feed ingredients maybe are some reasons for these different observations.

The effect of different levels of colostrum powder on blood biochemical parameters was presented in Table 5. Using colostrum powder in broiler diets significantly changed some of the blood biochemical parameters (P<0.05). Using colostrum powder in diets had a decreasing effect on blood cholesterol. The lowest amount (122 mg/dL), was observed in group 3 using 1% of colostrum powder. Low-density lipoprotein (LDL) was another blood parameter that affects by colostrum powder. Such total cholesterol, the lowest LDL level (44.25 mg/dL) was observed in group 3 with adding 1% of colostrum powder into diets.

In comparison, it has a positive effect on blood total protein level. The highest level of blood total protein (14.44 g/dL) belonged to group 4 fed 1.5% of colostrum powder. Without these parameters, colostrum powder could not change other blood biochemical parameters (P>0.05). A significant decrease in total cholesterol and LDL may be related to the positive reforming of the population of the intestinal microorganisms (Kelly, 2003). As colostrum is a rich source of nutrients and other helpful constitutes, maybe these caused beneficial changes in the intestinal microorganism population. It has been reported that intestinal microorganisms are very active and have a special ability on decomposing fats and cholesterol for use as metabolically orders (Chichlowski *et al.* 2007).

Table 5 Effect of supplementation of colostrum powder on blood biochemical parameters of broilers at 42 days

Carcass traits	1	2	3	4	5	SEM	P-value
Glucose (mg/dL)	180.50	181.25	186.75	182.75	177.50	3.18	0.3573
Triglyceride (mg/dL)	91.75	91.25	91.00	101.75	89.75	5.8487	0.5976
Cholesterol (mg/dL)	137.75^{a}	123.50^{ab}	122.00^{b}	134.50^{a}	129.75^{ab}	3.53	0.0352
HDL (mg/dL)	55.50	59.00	59.25	57.75	60.50	1.34	0.1146
LDL (mg/dL)	63.75^{a}	51.00^{bc}	44.25^{c}	56.75^{ab}	42.25^{bc}	3.50	0.0045
VLDL (mg/dL)	18.35	18.25	18.20	20.35	17.25	1.79	0.8736
Albumin (g/L)	1.20	1.29	1.20	1.17	1.18	0.04	0.2567
Total Protein (g/L)	11.90^{c}	13.22^{ab}	12.15^{bc}	14.44^{a}	13.46^{a}	0.43	0.0011

HDL: high-density lipoprotein; LDL: low-density lipoprotein and VLDL: very low-density lipoprotein.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 6 Effect of supplementation of colostrum powder on blood biochemical parameters of broiler chicks at 42 days (mg/dL)

Items	1	2	3	4	5	SEM	P-value
$SRBC_1$ 28 d	1.250^{b}	2.000^{b}	1.750^{ab}	2.500^{ab}	3.000^{a}	0.2739	0.0008
$SRBC_2$ 35 d	2.000^{b}	2.750^{ab}	2.750^{ab}	3.750^{ab}	4.500^{a}	0.3708	0.0003
PHA12 h	0.0150^{b}	0.0475^{a}	0.0150^{b}	0.0450^{b}	0.0400^{ab}	0.0086	0.0158
PHA 24 h	0.0150^{b}	0.0525^{a}	0.0300^{ab}	0.0450^{a}	0.0600^{a}	0.0061	0.0001
PHA 48 h	0.0125^{b}	00600^{a}	0.0375^{ab}	0.0575^{a}	0.0450^{a}	0.0101	0.0305
DNCB 12 h	0.0100^{b}	0.0275^{a}	0.0300^{a}	0.0275^{a}	0.0325^{a}	0.0032	0.0002
DNCB 24 h	0.0150^{b}	0.0425^{a}	0.0400^{a}	0.0325^{ab}	0.0400^{a}	0.0068	0.0281
DNCB 48 h	0.0125^{b}	0.0415^{a}	0.0500^{a}	0.0450^{a}	0.0525^{a}	0.007	0.002

SRBC: sheep red blood cell; PHA: phenol hydro acid and DNCP: dinitrochlorobenzene.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 7 Effect of supplementation of colostrum powder on blood antioxidant parameters of broilers at 42 days (mg/dL)

Carcass traits	1	2	3	4	5	SEM	P-value
SOD	27.462^{ab}	27.182^{ab}	25.415^{b}	28.437^{ab}	31.100^{a}	1.154	0.0160
GPX	2.012^{ab}	1.770^{ab}	1.670^{b}	1.867^{ab}	2.125^{a}	0.0816	0.0027
MDA	0.470	0.457	0.502	0.407	0.392	0.0432	0.4393

SOD: superoxide dismutase; GPX: glutathione peroxidase and MDA: malondialdehyde.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Colostrum is a valuable source of protein and essential amino acids (Pakkanen, 1998) so, I thought that using it had an upgrading effect on broiler blood total protein level.

The effects of different colostrum powder levels on the blood immunity of broilers are summarized in Table 6. In reaction to SRBC, using colostrum powder had a significant impact in this field (P>0.05). The highest amount of SRBC in 2 stages was observed in group 5 by using 2% of colostrum powder. In reaction to phenol hydro acid (PHA) after 24 and 48h of injection, colostrum powder improved the immune status of broilers (P>0.05). The highest immunity level belonged to 4 and 5 experimental groups by inclusion 1.5 and 2% of colostrum powder. The response of broilers against dinitrochlorobenzene (DNCB) after 24 and 48 h of injection was significant (P>0.05) and (P>0.01). The best reactions were observed with 2% of colostrum powder using. Bovine colostrum contains immuno-globulins such as IgG, IgM, IgA, IgD, and IgE.

IgG and IgM function in systemic infections, while IgA functions within internal body surfaces such as the intestine (Muller and Ellinger, 1981). Improve immune status with an insert of colostrum powder into broiler diets related to these special immunity agents presented in colostrum powder. These positive results of colostrum feeding on broilers' immunity status are in agreement with the other research results (Afzal *et al.* 2018). The effect of different levels of colostrum powder adding to broiler diets on blood antioxidant levels are summarized in Table 7. Colostrum powder had a significant impact on broilers' blood antioxidant levels (P>0.001). The highest amounts of superoxide dismutase (SOD) (31.100 mg/dL) and glutathione peroxidase (GPX) (2.125 mg/dL) have resulted in group 5 using 2% of colostrum powder. The malondialdehyde (MDA) level in broiler blood could not change with adding colostrum powder (P<0.001). Superoxide dismutase is an essential enzyme produced as an endogen and for each cell constituting the organism. The first defense against free radicals within this organism is made with the SOD enzyme. It protects the organism from the harmful effects of oxidants by transforming superoxide radicals, which cause cell injury, to less harmful hydrogen peroxide and molecular oxygen. In a study made on older people, it was reported that the addition of cow colostrum to their diets caused an increase in the level of serum SOD. In a study made on mice, Mahenderan *et al.* (2012) reported that the level of SOD in the group fed with colostrum was higher when compared with the control group. Our study results showed similarity with the studies reporting that tissue and serum SOD level is higher in trial groups when compared with the control groups. Bovine colostrum has significant amounts of enzymatic and non-enzymatic antioxidants. Lactoperoxidase, catalase, superoxide dismutase, and glutathione peroxidase are the important enzymatic antioxidants present in bovine colostrum. The high levels of these oxidants in colostrum may cause an increase in SOD levels in trial groups (Calderón-Díaz *et al.* 2021).

CONCLUSION

Based on the current study, using colostrum powder in the first ten days up to 2% in broilers̓ diets during the starter period have improved broilers̓ the birds̓ performance, carcass traits, blood biochemical parameters, immune status, and antioxidant indexes.

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