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Effects of Different Forms of Cattle Colostrum for Broiler Chickens

Research Article

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ABSTRACT

This experiment was conducted to investigate the effects of different forms of cattle colostrum as fresh, frozen, and sour on performance, carcass traits, blood biochemical parameters, intestinal morphology, immunity, and antioxidant status of broiler chicks. In this experiment, 240 Ross-308 broiler chicks were used from 1 to 42 days in three experimental periods including: starter (1-10 days), grower (11-24 days) and finisher (25-42 days) in 4 treatments and 5 replicates (12 birds per replicate) in a completely randomized design. Treatments included: 1) control (without using colostrum), 2) 2% of fresh colostrum, 3) 2% of frozen colostrum and 4) 2% of sour colostrum. Colostrum was only added in the first ten days of broiler's rairing period in the diets. Colostrum had significant effects on performance, carcass traits, blood biochemical parameters, immunity, and antioxidant status of broiler chicks ($P<0.05$). In the starter period, the highest daily feed intake was observed with fresh colostrum ($P<0.05$). Fresh colostrum increased the spleen percentage ($P<0.05$). Total blood cholesterol and low-density lipoproteins significantly increased by adding fresh colostrum in diet ($P<0.05$). The blood level of glutathione peroxidase increased in broilers fed colostrum ($P<0.05$). Adding colostrum upgraded the immunity status of broiler chicks ($P<0.05$). Intestinal morphology did not change by adding colostrum ($P>0.05$). The overall results showed that using 2% of colostrum in the starter period, especially fresh form has beneficial effects on broiler performance, carcass traits, blood biochemical parameters, immunity, and antioxidant status.

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

INTRODUCTION

In female mammals, colostrum is the valuable liquid secreted by female mammals' mammary glands for the first three days after birth (Odle *et al.* 1996). It plays an important nutritional role for neonatal growth and the body organs development in mammals (Kelly, 2003; Malik *et al.* 2015). Colostrum contains high levels of essential nutrients such as protein, carbohydrates, fats, vitamins and minerals, various bio-active components such as growth and antimicrobial factors but also the amounts of carbohydrates especially lactose, potassium, and some lipids is low than milk (Godhia and Pate, 2013). Immune and growth factors are the most important components contained in colostrum.

Upgrading of immune status and reducing diseases caused by microorganisms are the main role of these valuable substances (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). Mammal's colostrum contains immuno-globulins such as IgG, IgM, IgA, IgD, IgE. IgG and IgM functions are 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). Fortunately for the prevention of oxidation, colostrum has a greater antioxidant capacity than normal milk (Zarban *et al.* 2009). Vitamins A (retinol), E (tocopherol), and C (which are considered anti-stress vitamins) are at higher level in colostrum than in normal milk 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). Weight loses in chickens immediately after hatching is usually high, and this has adverse effects on performance (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 of life are critically important in maintaining and surviving newly hatched chickens (Campbell *et al.* 2003; Godhia and Patel, 2013). 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 cells 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). As the maintaining of fresh colostrum for long period is not possible, so, changing it to other forms such as freezing and sour may be effective methods in making longed period of its use.

In the present study, the effects of different forms of colostrum as fresh, frozen, and sour are investigated on performance, intestinal morphology, blood biochemical parameters, immunity, and antioxidant status of broiler chicks.

MATERIALS AND METHODS

A total of 240 male Ross-308 broilers (one-day-old) were sexed and weighted then divided into a completely randomized design with four treatments, five replicates (12 chicks in each replicate). Experiment groups included: 1) control group without colostrum, 2) group with 2% of fresh colostrum, 3) group with 2% of freeze colostrum, 4) group with 2% of sour colostrum. Breeding periods were: starter (1-10 days), grower (11-24 days), and finisher (25-42 days). Colostrum was only used in the starter period. In 2 other experimental periods, all groups were fed with the same formulated diets. Diets conformed to the advised levels of nutrients for different experimental periods, as established by the Ross-308 broiler nutrition specification (2014). Diets feed ingredients analysis (NRC, 1994), by using the UF-FDA software program as a ration formulation platform (Table 1). The whole experimental colostrum was supplied from a new gestated Holstein cow, one part of fresh colostrum, frozen at freezing temperature, and another part soured at room temperature. After determining the using amount of them in each diet, carefully weighted, added, and mixed with other feed ingredients.

The diets and water were provided *ad libitum* for birds during experimental periods. 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 were used to calculate 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 Fabricious, 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. 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 were made for each parameter and averaged into one value (Chichlowski *et al.* 2007).

Table 1 Feed ingredients and chemical compositions of broiler diets used in different breeding periods (as fed)

Feed ingredients	Starter (1-10 d)				Grower (11 to 24 d)	Finisher (25 to 42 d)
Corn	57.66	57.87	57.87	57.87	63.35	65.93
Soybean meal	37.64	37.49	37.49	37.49	32.08	28.06
Soybean oil	0.14	0.1	0.1	0.1	0.50	2.18
Colostrum	0	0.02	0.02	0.02	0	0
Oyster shell	1.18	1.18	1.18	1.18	1.07	1.00
Dicalcium phosphate	1.89	1.88	1.88	1.88	1.63	1.49
Vitamin premix[1]	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
Sodium chloride	0.3	0.3	0.3	0.3	0.23	0.23
DL-methionine	0.20	0.28	0.28	0.28	0.24	0.22
Lysine-HCl	0.30	0.28	0.28	0.28	0.25	0.24
Sodium bicarbonate	0.1	0.1	0.1	0.1	0.14	0.15
Calculated composition						
Metabolizable energy (Kcal.kg)	2860.00	2860.00	2860.00	2860.00	2890.00	3000.00
Crude protein (%)	21.98	21.98	21.98	21.98	20.00	18.50
Calcium (%)	0.917	0.917	0.917	0.917	0.81	0.74
Avail. P (%)	0.458	0.458	0.458	0.458	0.41	0.37
Sodium (%)	0.16	0.16	0.16	0.16	0.15	0.16
Lysine (%)	1.38	1.38	1.38	1.38	1.20	1.09
Met + Cys (%)	1.03	1.03	1.03	1.03	0.92	0.86
Met (%)	0.67	0.67	0.67	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; Se ($NaSeO_3$, 45.56% Se): 0.2 mg.

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 48h 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 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 different forms of colostrum on chickens' growth performance are shown in Table 2.

In the starter period (first ten-day), colostrum inclusion into the diets only changed the amount of daily feed intake of broilers (P<0.05). The highest amount of feed intake belonged to 2 experimental groups with 2% of fresh colostrum (P<0.05). Colostrum adding to diets did not significantly change weight gain and feed conversion ratio (P>0.05). An increase in the amount of feed intake with fresh colostrum may be related to physical conditioning and improvement of feed palatability. No changes in the amount of weight gain and feed conversion ratio may be related on a short period of colostrum use, liquid form of colostrum, and other diets feed ingredients. These results are not in agreement with the previous studies. On the base of Baran *et al*. (2017), a corporation of liquid cow colostrum up to 4% in quail's diets improved their weight gain, feed intake, and feed conversion ratio. Different results can be associated with bird strain, colostrum using period and diets specification. Recently Gorbannejad Parapary *et al*. (2020) reported that using cow colostrum powder up to 2% in broiler chick's diets in the first ten days of their breeding, without having any significant effects on other performance parameters, improved their body weight gain. 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. No significant effects of colostrum use on other performance parameters in the starter and 2 other breeding periods may be related to the amount, forms, and periods of use. If the colostrum administration continued up to grower and finisher periods, or the used level is high, maybe obtained results were positively different form yet. On the other hand, like Bryail *et al*. (2017), inserted colostrum prolonged to 10 days, the beneficial results in laying quails showed them clearly. No improving change in performance of broilers in 2 other periods may be related to withdrawal of colostrum and occurring digestion limitations. In another experiment that was done by Afzal *et al*. (2018), using colostrum powder up to 2% of broiler diets had no significant effect on their amount of daily feed intake and feed conversion ratio.

The effect of using different levels of colostrum on carcass traits of broilers at the end of the experimental period is shown in Table 3.

Colostrum supplementation only significantly affected the spleen percentage of broilers (P<0.05). Broiler chickens that are received colostrum had a high spleen percentage in contrast with the control group. The highest spleen percentage could be related to immune upgrading effects of colostrum. Colostrum is a rich source of immune improvers (Muller and Ellinger, 1981). Gorbannejad Parapary *et al*. (2020) recently reported that addition of colostrum powder in broiler diets increased the size of the bursa of fabricious. Colostrum treatments had no significant effects on the other carcass traits. These results could be related to the forms and long of colostrum using, and other feed ingredients. As spleen is an immune organ, so, by receiving highly levels of immune agents, it grow up and enlarged. In quails, liquid colostrum insert had no significant effects on their organs weights (Baran *et al*. 2017). As colostrum is a rich source of protein, essential amino acids, carbohydrates, fatty acids, minerals and vitamins (Odle *et al*. 1996; Godhia and Pate, 2013), using it in broiler diets caused the best growth and improved the carcass percentage. This result agrees with Bryail *et al*. (2017) results. 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 had no significant effects on broilers' intestinal morphology.

No significant changes in intestinal cells morphological characteristics of broilers with experimental diets may be related to the amount, duration using, method of colostrum processing, colostrum composition, and other ration ingredients. The current findings are in contrast with King *et al*. (2005) report that adding colostrum powder up to 2% in broiler diets enhanced intestinal morphology. Experimental condition, colostrum source and processing, periods of use, and other feed ingredients maybe be the same reasons for these different observations.

The effect of different levels of colostrum powder on blood biochemical parameters was presented in Table 5.

Using colostrum in broiler diets significantly changed some of the blood biochemical parameters (P<0.05). Using fresh colostrum in diets in contrast with the control group increased the levels of cholesterol and LDL (P<0.05). But the processing of colostrum as freeze and sour forms modulated this condition. As colostrum contains high levels of saturated fats and newborn chicks have seriously limitations in fat digestion (an especially saturated form of them), so, receiving high level of it, could not be effectively digested and can alleviate some blood related agents such as total cholesterol and LDL. Freeze and souring maybe related to fat sources treated in colostrum and affect it well digestion and consumption. For solving this problem, using other colostrum treatment methods, especially adding especial lipase enzymes in broiler diets when high level and a prolonged period of colostrum use may be suggest. In contrast with current study results, on the base of Gorbannejad Parapary *et al*. (2020) report using different levels of colostrum powder in broiler diets had decreasing effect on blood cholesterol. The lowest amount of it (122 mg/dL) was observed using 1% of colostrum powder. Low density of lipoprotein (LDL) was another blood parameter that affects by colostrum powder.

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

Treatments	1	2	3	4	SEM	P-value
Duration						
BWG (1-10 days)	15.704	16.182	15.914	15.572	0.4300	0.7660
BWG (11-24 days)	51.576	51.128	52.256	51.878	0.5242	0.4974
BWG (25-42 days)	67.512	66.176	63.956	68.062	1.9512	0.4736
BWG (1-42 days)	44.930	44.640	43.972	45.622	0.6743	0.4061
FI (1-10 days)	17.596^{bc}	19.010^{a}	18.106^{b}	16.876^{c}	0.2896	0.0007
FI (11-24 days)	55.122	56.796	56.526	56.294	1.1902	0.7661
FI (25-42 days)	142.976	144.840	145.822	145.824	2.0599	0.6761
FI (1-42 days)	71.916	73.544	72.462	73.788	0.9479	0.2723
FCR (1-10 days)	1.126	1.180	1.140	1.088	0.0348	0.3439
FCR (11-24 days)	1.070	1.102	1.084	1.082	0.0247	0.8353
FCR (25-42 days)	2.124	2.194	2.224	2.142	0.0624	0.5362
FCR (1-42 days)	1.600	1.648	1.646	1.620	0.0246	0.4809

1: control (without using colostrum); 2: 2% of fresh colostrums; 3: 2% of frozen colostrum and 4: 2% of sour colostrums.
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 different forms of cow colostrum on carcass traits of broiler chickens at 42 days (%)

Treatments	1	2	3	4	SEM	P-value
Carcass traits						
Carcass	72.47	72.54	73.42	71.09	0.95	0.4078
Abdominal fat	3.94	3.33	3.65	3.24	0.38	0.6156
Gizzard	3.41	2.71	3.44	3.57	0.28	0.1551
Liver	4.04	3.66	3.90	3.78	0.38	0.9038
Spleen	0.15^{b}	0.25^{a}	0.19^{ab}	0.16^{b}	0.02	0.014
Burs	0.12	0.09	0.07	0.02	0.02	0.3805
Thighs	27.73	26.83	28.14	28.39	0.59	0.2929
Breast	35.28	34.79	35.04	34.03	0.72	0.6351

1: control (without using colostrum); 2: 2% of fresh colostrums; 3: 2% of frozen colostrum and 4: 2% of sour colostrums.
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 different forms of cow colostrum on intestinal morphology of broiler chickens at 42 days (µm) 42 days (%)

Treatments	1	2	3	4	SEM	P-value
Intestinal morphology						
Villi height	1034.212	941.020	1040.920	959.680	79.5788	0.7276
Crypt	182.096	193.076	188.353	188.752	11.6729	0.9282
Villi/crypt	5.779	4.780	5.541	5.316	0.6225	0.7098
Goblet	48.100	42.430	46.260	43.700	2.2259	0.8033

1: control (without using colostrum); 2: 2% of fresh colostrums; 3: 2% of frozen colostrum and 4: 2% of sour colostrums.
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 5 Effect of supplementation of different forms of cow colostrum on blood biochemical parameters of broiler chickens at 42 days

Treatments	1	2	3	4	SEM	P-value
Blood parameters						
Glucose (mg.dL)	178.400	192.200	178.200	182.00	10.6049	0.7698
Triglyceride (mg.dL)	67.800	68.000	71.200	62.600	6.3392	0.7698
Cholesterol (mg.dL)	117.800^{b}	130.400^{a}	120.800^{b}	127.200^{ab}	3.1230	0.0276
High-density lipoprotein (HDL) (mg.dL)	60.000	59.200	59.800	60.400	2.4464	0.9882
Low-density lipoprotein (LDL) (mg.dL)	44.000^{b}	57.800^{a}	53.400^{ab}	50.000^{ab}	3.5855	0.0445
Albumin (g.L)	1.342	1.252	1.340	1.250	0.0798	0.7387
Total protein (g.L)	12.572	13.550	12.890	13.196	0.8109	0.8487

1: control (without using colostrum); 2: 2% of fresh colostrums; 3: 2% of frozen colostrum and 4: 2% of sour colostrums.
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.

Like total cholesterol, the lowest level of LDL (44.25 mg/dL) was observed with adding 1% of colostrum powder into diets. The difference in the results could be originated from the colostrum source, form. Processing, management programs, and other feed ingredients.

The effects of different forms of colostrum on the blood immunity of broilers are summarized in Table 6.

In response to SRBC, using colostrum had no significant impact in this field (P>0.05). In reaction to PHA after 12 h injection, colostrum improved the immune status of broilers (P<0.05). The highest immunity level belonged to 4 experimental groups by using soured colostrum. The response of broilers against phytohemagglutinin (PHA) reaction after 24 and 48h injection no significant effects observed (P>0.05). The response of broilers against denitrochlorobenze (DNCB) after 12, 24, and 48 h of injection were significant (P<0.05). Bovine colostrum contain immunoglobulins 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). Also, colostrum is a rich source of immune upgrading vitamins such as A, D, and E vitamins. Improving the effects of colostrum inclusion in broiler diets could be related to these especial and valuable agents.

These results are in agreement with (Afzal *et al*. 2018; Gorbannejad Parapry *et al*. 2020) report.

The effect of different forms of colostrum added into broiler diets on their blood antioxidant levels are summarized in Table 7.

Colostrum had significant effect on blood antioxidant levels of broilers (P>0.1%). The highest amounts of superoxide dismutase (SOD) (29.800 mg/dL) and glutathione peroxidase (GPX) (1.856 mg/dL) resulted in group 4 using 2% of soured colostrum. The level of malondialdehyde (MDA) in broiler blood could not change by adding different forms of colostrum (P>0.05). Superoxide dismutase is an essential enzyme that is produced as an endogen and for each cell constituting the organism.

The first defense against free radicals within this organism is made with superoxide dismutase (SOD) enzyme.

It protects the organism from the harmful effects of oxidants by transforming superoxide radical, which causes cell injury, to less harmful hydrogen peroxide and molecular oxygen. In a study made on elderly 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. The results of our study show 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 (Przybylska *et al*. 2021). An increase in the level of blood immune parameters with the inclusion of colostrum into broiler diets in the current study is in agrees with the latest study in this respect (Gorbannejad Parapary *et al*. 2020).

CONCLUSION

On the basis of current study, using 2% of different forms of colostrum in broilers diets during the first ten days (starter period), have effects on their feed intake, carcass traits, improving blood biochemical parameters, immune status, and antioxidant indexes. The best results related to blood immune and antioxidant status were observed with soured colostrum.

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Table 6 Effect of supplementation of different forms of cow colostrum on blood immunity of broiler chickens (mg/dL)

Treatments	1	2	3	4	SEM	P-value
Blood immunity indexes						
PHA 12 h	25.58^{b}	26.65^{ab}	26.51^{ab}	29.80^{a}	1.10	0.0334
PHA 24 h	1.70	1.66	1.86	1.86	0.07	0.1473
PHA 48 h	0.45	0.48	0.39	0.55	0.07	0.4560
DNCB 12 h	0.06^{b}	0.21^{a}	0.14^{ab}	0.21^{a}	0.04	0.0472
DNCB 24 h	0.05^{b}	0.23^{a}	0.15^{ab}	0.20^{a}	0.04	0.0287
DNCB 48 h	0.07^{b}	0.23^{a}	0.13^{ab}	0.21^{a}	0.05	0.0494
SRBC1	1.20	2.00	1.80	1.80	0.4243	0.5847
SRBC2	2.40	3.00	2.60	3.20	0.6442	0.8099

1: control (without using colostrum); 2: 2% of fresh colostrums; 3: 2% of frozen colostrum and 4: 2% of sour colostrums.
PHA: phytohemagglutinin; DNCB: denitrochlorobenze and SRBC: sheep red blood cell.
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 different forms of cow colostrum on blood antioxidant parameters of broiler chickens at 42 days (mg/dL)

Treatments	1	2	3	4	SEM	P-value
Blood antioxidant parameters						
SOD	25.578[b]	26.654[b]	26.506[b]	29.800[a]	0.7327	0.0015
GPX	1.704[b]	1.660[b]	1.856[a]	1.856[a]	0.0475	0.0079
MDA	0.453	0.481	0.390	0.547	0.0680	0.4563

1: control (without using colostrum); 2: 2% of fresh colostrums; 3: 2% of frozen colostrum and 4: 2% of sour colostrums.
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.

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