Pak. J. Agri. Sci., Vol. 58(3), 1033-1040;2021
ISSN (Print) 0552-9034, ISSN (Online) 2076-0906
DOI: 10.21162/PAKJAS/21.972
http://www.pakjas.com.pk

EFFECT OF EMULSIFIER (LYSOPHOSPHOLIPID) SUPPLEMENTATION IN BROILERS DURING DIFFERENT PHASES ON GROWTH PERFORMANCE, BLOOD PROFILE, DIGESTIBILITY, ECONOMICS AND MEAT QUALITY

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The current work was planned to explore the effect of a natural emulsifier (Lysophospholipid) supplementation on growth performance, nutrient digestibility, blood serum, meat quality, carcass characters and economics in broilers. Total research period was divided in starter, grower and finisher phases. A total of 1530, day old Ross- 308 chicks were purchased from local hatchery and divided into five treatments in such a way that each treatment had six replicates and each replicate had fifty-one birds. Treatments were (1) diet with emulsifier during overall (0-35 days) period; (2) diet without emulsifier during overall (0-35 days) period; (3) diet with emulsifier during starter (0-10 days) phase only; (4) diet with emulsifier during grower (11-25 days) phase only; (5) diet with emulsifier during finisher (26-35 days) phase only. Results explored that feed intake was not affected ($P>0.05$) by any dietary treatment in starter and finisher phase. However, feed intake decreased in broilers fed emulsifier supplemented diet during grower phase only ($P<0.05$). Diets with emulsifier addition throughout life and during finisher phase only showed highest ($P<0.05$) body weight and better feed conversion ratio. At day 35th % nutrient digestibility (dry matter, crude protein and ether extract) was improved by emulsifier addition in diet ($P<0.05$). Total cholesterol and triglycerides in blood serum were not affected ($P>0.05$) by all dietary treatments but glucose was highest ($P<0.05$) in group fed diet without emulsifier during all phases. Relative organs weight like liver, heart, spleen and gizzard were not affected ($P>0.05$) by all dietary treatments while, dressing (%) and meat quality were better ($P<0.05$) by supplementation of emulsifier in diet during finisher phase and overall period. Profit percentage and feed economic efficiency per bird were increased ($P<0.05$) by emulsifier supplementation throughout the life of broilers and during finisher phase only. Based on the findings of current study it is recommended that natural emulsifier should be added in broilers diet during finisher phase for better growth performance, meat quality, digestibility, economics and dressing percentage.

Keywords: Emulsifier, broilers, growth, blood profile, digestibility.

INTRODUCTION

Fats and oils are main energy sources in broiler's diet. In chicks, bile salts and lipases secretion organs are under developed which results in less secretion of endogenous bile salts and lipases that leads to reduce absorption and digestion of fats (Boekholt *et al.*, 1994). In the aqueous environment of small intestine of broilers, hydrophobic fatty acids agglomerate and form micelle for absorption in intestine. However, due to high fat contents in broiler's feed, endogenous secretions (bile salts and lipases) are not enough to compete the digestion process (Wiseman, 2013). Therefore, to enhance the utilization of fats in the diet of broilers different emulsifiers are added in the feed to improve the formation of lipid micelle (Shahid *et al.*, 2020). Reis *et al.* (2009) reported that emulsifier also enhances the active surface area of the lipids which is important factor for the improvement of absorption of fats. Similarly, Kamran *et al.* (2020) reported that exogenous emulsifier (EE) in the diet of broilers improved the digestibility of lipids. It may improve the feed cost and growth performance of the broilers (Kamran *et al.*, 2020).

Exogenous emulsifier (Lysophospholipid) supplemented diet improved body weight gain (BWG)and decreased the feed conversion ratio (FCR) of broilers (Kamran *et al.*, 2020). Similarly, Neto *et al.* (2011) reported that increased BWG in

broilers by addition of emulsifier in diet with different fat sources during all phases of life. Siyal *et al.* (2017) also reported decreased FCR and feed intake (FI) and increased BWG in broilers by dietary supplementation of soy lecithin. It was concluded that supplementation of lysolecithin emulsifier (3.50 g/kg) improved BWG and FCR but did not show any effect on the FI of broilers (Zaefarian *et al.*, 2015). Similarly, Upadhaya *et al.* (2018) documented that BWG and FCR were ameliorated by increasing the level of emulsifier (0.05%, 0.075% and 0.10%) in the diet of broilers during 0-35 days. Ho Cho *et al.* (2012) reported that BWG was increased and FCR was not affected by emulsifier supplemented (0.05%) diet in broilers.

Previous researchers conducted the experiments on effect of addition of EE in the diet of the broilers on the growth performance, nutrient digestibility, FCR and carcass parameters of broilers and found variable results. (Bontempo *et al.*, 2018; Papadopoulos *et al.*,.2018; Arshad *et al.*, 2020; Kamran *et al.*, 2020). Moreover, previous researchers focused on supplementation of the emulsifiers in the diet throughout the life of broilers (0-35 days). According to our knowledge no study has been executed up till now to investigate the influence of a dietary emulsifier on the growth performance, blood profile, digestibility, economics and meat quality of broilers during starter, grower and finisher phases separately. Therefore, a study was planned to verify the influence of natural emulsifier on the growth performance, blood profile, digestibility, economics and meat quality of broilers during starter, grower and finisher phase only.

MATERIAL AND METHODS

This study was performed at Research and Development Farm of Shamim Feed Mills Samma Satta Link Road, Bahawalpur (Pvt. Ltd.).

***Housing and experimental Design*:** A total of 1530, day old Ross- 308 chicks were purchased from local hatchery and divided into five treatments in such a way that each treatment had six replicates and each replicate had fifty one birds. Treatments were: (1) diet with emulsifier during overall (0-35 days) period; (2) diet without emulsifier during overall (0-35 days) period; (3) diet with emulsifier during starter (0-10 days) phase only; (4) diet with emulsifier during grower (11-25 days) phase only; (5) diet with emulsifier during finisher (26-35 days) phase only. All birds were reared on floor with rice husks litter material. The house was equipped with 24 hours supply of fresh portable water and feed ad libitum. Temperature of the shed was 95 ^{0}F during 1st week and later it was reduced weekly by 5 ^{0}F till it reached 75 ^{0}F when trial ends. Proper moisture and ventilation system was sustained according to Ross standards. Mortality was noted and postmortem was performed on daily basis. All the experimental feeds were formulated by Shamim Feeds by using raw materials according to the nutritional standards of Ross as shown in Table 1. Thrust free environment, freedom of hunger and normal behavior were accommodated to the birds as describes in recent study (Rahman *et al.*,.2019).

Table 1. Ingredient and nutrient composition (g/kg) of broiler diets.

Ingredients	Starter	Grower	Finisher
Corn.	51.96	55.64	56.38
[1]SBM.	35.96	26.04	18.41
[2]CM	5.00	10.00	15.00
Tallow.	2.50	3.80	5.40
[3]MDP	-	1.20	1.10
[4]DCP	1.50	-	-
Limestone.	1.15	1.30	1.20
L-lysine.	0.43	0.50	0.74
DL-Methionine.	0.41	0.41	0.51
L-Threonine.	0.19	0.20	0.32
L-Tryptophan.	-	0.01	0.04
$NaHCO_3$.	0.10	0.10	0.10
Salt.	0.30	0.30	0.30
[5]Vitamin premix	0.20	0.20	0.20
[6]Mineral premix	0.20	0.20	0.20
Choline	0.10	0.10	0.10
Total	100.00	100.00	100.00
Chemical Composition			
[7]ME (kcal./kg)	3000.00	3100.00	3200.00
[8]CP (%)	23.76	21.28	19.98
[9]CF (%).	4.82	6.31	8.02
Methionine (%).	0.72	0.66	0.71
Lysine (%).	1.50	1.28	1.25
Calcium (%).	0.92	0.84	0.80
Phosphorous (%).	0.45	0.42	0.40
Emulsifier (Lysophospholipid) @500 g/ton			

[1]Soyabean meal, [2]Canola meal, [3]Mono-dicalcium phosphate, [4]Dicalcium.phosphate, [5]Vitamin mixture MN-VIT-96 per kg supplies: 16,800 IU vitamin E, 5,600,000 IU vitamin A, 1,760,000 IU vitamin D3, 3.2 g riboflavin, 0.7 g menadione dimethyl pyrimidinol bisulfite, 7.2 mg vitamin B12, 6.4 g d-calcium pantothenate, 80 mg biotin, 2.0 g pyridoxine, 0.7 g folic acid and 36 g niacin, [6]Mineral premix: Se, 0.30 mg/kg; Fe, 8.5 mg; Cu, 66 mg; Mn, 88 mg; Zn, 88 mg, [7]Metabolizable Energy, [8]Crude protein, [9]Crude fat

***Growth Performance*:** Feed intake and BWG were measured after completion of the each phase (starter (at day 10th), grower (at day 25th), and finisher (at day 35th)) for the calculation of FCR during the trial.

$$\text{Feed intake} = \text{Daily feed intke} - \text{Ort}$$

$$\text{Feed conversion ratio} = \frac{\text{Feed intake}}{\text{Body weight}}$$

***Nutrient Digestibility*:** Digestibility of crude protein (CP), dry matter (DM) and ether extract (EE) were calculated. For this purpose an external marker Celite was added in the diet @ 1 % of feed for three days at end of each phase. Feces was

collected after 24 hours for three days on polythene sheets and samples were mixed, composite sample was obtained and clean from any type of foreign particles and litter material and stored in polythene sampling bags as discussed in the previous studies (Haq *et al.*, 2019; Shahzad *et al.*, 2019). Sample was oven dried at 65 ^{0}C and dried sample was sieved as described in recent research (He *et al.*, 2018; Hussain *et al.*, 2018; Bajwa *et al.*, 2020; Chen *et al.*, 2020; Hussain *et al.*, 2020; Muhmmad *et al.*, 2020). Then, sample was used for the analysis of nutrient digestibility (DM, EE and CP), ash and acid insoluble ash as the methods defined by AOAC (2000) with some developed techniques discussed by researchers (Muhammad *et al.*,.2016; Niu *et al.*,.2017)

Digestibility was measured by the formula as shown below:

$$\text{Digestibility \%} = 100 - \frac{(100 * \%\ \text{marker (feed)} \times \%\ \text{nutrient (feces)})}{\%\ \text{marker (feces)} \times \%\ \text{nutrient (feed)}} \times 100$$

***Blood profile*:** On day 35th two birds from each pen were arbitrarily selected and slaughtered. Blood (5ml) was drawn from each bird and serum was collected by centrifugation in eppendrof tubes. Then serum was stored at 4 ^{0}C which was analyzed for blood serum glucose, total cholesterol and triglycerides estimation with the help of BIOMED diagnostics commercial kits as the methods describes by recent researchers (Su *et al.*, 2013; Dong *et al.*, 2019).

***Carcass characters*:** At day 35th, two birds from each replicate were picked and butchered by using halal method. Weighed before and after slaughtering, weight of fat, weight of organs like spleen, liver, heart and gizzard were measured for the determination of dressing (%) and weight of relative organs.

***Meat quality*:** For meat quality meat sample of breast muscles from each bird per replicate was taken and stored at -18 ^{0}C. After 24 hours meat samples were analyzed for pH by pH meter in the meat solution as method discussed by (Arshad *et al.*, 2020).

Water Holding Capacity (WHC) % of breast muscles was calculated by the procedure of Zhang *et al.*, (1995) with some improvements. Samples were analyzed after 24 hours of slaughtering. For this purpose 15 g of meat sample was chopped and 0.6 N NaCl (22.5 ml) was added and homogenized. Then, the weight of meat sample with solution was noted (W1) and centrifuged at 5000 rpm at 4 ^{0}C for 10 minutes. After this water was removed and sample was weighed (W2) and WHC % was determined by this the formula described below:

$$\text{Water Holding Capacity \%} = \frac{W_1 - W_2 - \text{weight of sample}}{\text{weight of sample}} \times 100$$

***Economics*:** For the economics, cost of feed was calculated with and without emulsifier during starter, grower and finisher phases for each replicate. A total cost was summation of chick cost, litter cost, electricity, gas, labor, medication, vaccination, water, fuel and other miscellaneous expenses. The revenue was consisted of the price of litter after trial and price of broilers at day 35th. Profit percentage was calculated using total cost and revenue. Feed Economic Efficiency (FEE) was evaluated by using the formula:

$$\text{Feed Economic Efficiency} = \frac{\text{Revenue}}{\text{Feed intake cost}}$$

***Statistical Design*:** Completely randomized Design with analysis of Variance (ANOVA) was exploited for the inspection of data and Tukey's test was applied for the comparison of mean values (Steel *et al.*, 1997). Probability values were used as the standards for significance of results.

RESULTS

Table 2. Effect of emulsifier in starter, grower and finisher phase on the growth performance in broilers.

Items	[1]EA	[2]WEA	[3]ES	[4]EG	[5]EF	[9]SEM	[10]P Value
Starter Phase (1-10 days)							
[6]FI (g)	281.99	275.68	279.46	274.67	274.42	2.4800	0.159
[7]BWG (g)	246.07	239.80	243.76	237.06	239.93	3.0000	0.259
[8]FCR	1.15	1.15	1.15	1.16	1.14	0.0147	0.955
Grower Phase (11-25 days)							
FI (g)	1370.29^{ab}	1352.54^{ab}	1377.38^{a}	1340.13^{b}	1348.17^{ab}	8.2900	0.020
BWG (g)	1004.53	990.52	1015.20	985.11	996.75	8.0400	0.102
FCR	1.36	1.37	1.36	1.36	1.35	0.0006	0.560
Finisher Phase (26-35 days)							
FI (g)	1501.40	1478.90	1492.90	1481.60	1472.10	13.8000	0.585
BWG (g)	947.19^{a}	882.22^{b}	874.63^{b}	886.50^{b}	933.58^{a}	9.4100	0.000
FCR	1.59^{b}	1.68^{a}	1.71^{a}	1.67^{a}	1.58^{b}	0.0136	0.000
Overall (1-35 days)							
FI (g)	3153.70	3107.10	3158.00	3096.40	3094.70	20.7000	0.088
BW (g)	2197.80^{a}	2112.50^{c}	2133.60^{bc}	2108.70^{c}	2170.30^{ab}	13.2000	0.000
FCR	1.43^{b}	1.47^{a}	1.48^{a}	1.47^{a}	1.43^{b}	0.0058	0.000

[1]EA: Emulsifier in all phases, [2]WEA: Without emulsifier in all phases, [3]ES: Emulsifier in starter phase only, [4]EG: Emulsifier in grower phase only, [5]EF: Emulsifier in finisher phase only, [6]FI: Feed intake, [7]BWG: Body weight gain, [8]FCR: Feed. conversion ratio, [9]SEM: Standard error mean, [10]Different superscripts within a row differ significantly ($P < 0.05$)

***Growth performance*:** Effect of natural EE (Lysophospholipid) on the growth performance of broilers during starter (1 to10. days), grower (11 to 25. days) and finisher (26 to 35 days) phases is presented in the Table 2. Results revealed that FI was affected (P<0.05) during grower (11-25 days) phase. Broilers receiving emulsifier during only grower phase showed decreased in FI as compared to other treatments. However, in starter, grower, and overall period FI was not affected by any of dietary treatments (P>0.05). Results further showed that BWG was enhanced by EE enrichment during finisher (26 to 35 days) and overall period of trial (1 to 35) (P<0.05). However, BWG was not improved (P>0.05) with or without supplementation of EE in the ration of starter and grower phase of broilers. Results of FCR showed that it was improved by supplementation of natural emulsifier during finisher (26-35 days) phase only as well in that group which was supplemented with emulsifier in overall phases (P<0.05). However, during starter and grower phases FCR was not affected by any of the dietary treatments (P>0.05)

***Digestibility*:** The effect of supplementation of EE on digestibility of the broilers is presented in Table 3. Data revealed that EE supplementation in starter phase have not affected (P>0.05) digestibility of EE, CP and DM. However, digestibility was effected (P<0.05) at the end of the grower (11-25 days) phase. Dry matter, EE and CP digestibility (%) were decreased in broilers supplemented by emulsifier in diet as compared to group without any supplementation of emulsifier. Effect of emulsifier addition in diet of broilers on nutrient digestibility at day 35th is shown in Table 4. Data showed that nutrient digestibility (DM, CP and EE) was significantly affected (P<0.05) by EE supplementation. Digestibility of CP and DM was decreased by emulsifier addition in diet during finisher phase only. However, the digestibility of EE was improved (P<0.05) by addition of emulsifier in the diet of broilers during finisher phase only as well as throughout the life.

***Blood Serum Profile*:** Effect of natural emulsifier addition on blood serum is appeared in Table 5. Results depicted that glucose level was significantly affected (P<0.05) by EE supplementation. However, the levels of total cholesterol and triglyceride were not showed any effect (P>0.05) by emulsifier addition in the diet of broilers.

***Carcass Characters and Meat Quality*:** Effect of EE in broilers on carcass characters is presented in Table 6. It was noticed that dressing (%) of broilers was significantly affected (P<0.05) by EE. However, percentage of fat and relative weight of gizzard, liver, spleen and heart were not affected (P>0.05) with or without emulsifier addition in the diet of broilers. Effect of EE in the diet of broilers chicks on the meat quality (pH and % WHC) is shown in Table 6. Results

Table 3. Effect of emulsifier on nutrient digestibility of broiler on starter and grower phase

Item	Without Emulsifier	With Emulsifier	[1]SEM	[2]P Value
Starter Phase (At Day 10th)				
DM Digestibility (%)	86.72	89.58	1.14	0.107
CP Digestibility (%)	52.63	54.38	2.26	0.595
EE Digestibility (%)	69.29	70.32	2.69	0.790
Grower Phase (At Day 25th)				
DM Digestibility (%)	95.51^{a}	92.93^{b}	0.52	0.005
CP Digestibility (%)	67.12^{a}	52.38^{b}	3.71	0.018
EE Digestibility (%)	90.34^{a}	85.16^{b}	1.06	0.006

[1]SEM: Standard error mean; [2]Different superscripts within a row differ significantly (P < 0.05)

Table 4. Effect of exogenous emulsifier on nutrient digestibility of broiler on Finisher Phase (At Day 35th)

Item	[1]EA	[2]WEA	[3]EF	[4]SEM	[5]P Value
DM Digestibility (%)	96.11^{a}	95.99^{a}	94.69^{b}	0.207	0.000
CP Digestibility (%)	69.60^{a}	72.01^{a}	59.04^{b}	1.400	0.000
EE Digestibility (%)	93.10^{a}	85.29^{b}	91.80^{a}	0.385	0.000

[1]EA: Emulsifier in all phases, [2]WEA: Without emulsifier in all phases, [3]EF: Emulsifier in finisher phase only, SEM: Standard error mean, [5]Different superscripts within a row differ significantly (P < 0.05)

Table 5. Effect of Emulsifier on Blood serum profile in broilers.

Item (mg/dl)	[1]EA	[2]WEA	[3]ES	[4]EG	[5]EF	[6]SEM	[7]P Value
Glucose	232.50^{b}	261.00^{a}	245.00^{ab}	232.17^{b}	240.00^{ab}	6.46	0.025
Total Cholesterol	129.17	129.33	126.67	130.50	125.67	4.78	0.948
Triglycerides	54.83	45.50	38.83	33.50	42.33	7.25	0.332

[1]EA: Emulsifier in all phases, [2]WEA: Without emulsifier in all phases, [3]ES: Emulsifier in starter phase only, [4]EG: Emulsifier in grower phase only, [5]EF: Emulsifier in finisher phase only, SEM: Standard error. Mean, [7]Different superscripts within a row differ significantly (P < 0.05)

Table 6. Effect of emulsifier on carcass characters, Relative organs weight and meat quality in broilers.

Item	[1]EA	[2]WEA	[3]ES	[4]EG	[5]EF	[6]SEM	[7]P Value
Dressing %	66.952^{ab}	66.540^{ab}	65.348^{ab}	65.226^{b}	67.769^{a}	0.601	0.028
Fat %	6.243	6.128	6.319	6.260	5.054	0.411	0.185
Relative Organs Weight							
Liver (%)	2.579	2.679	2.702	2.769	2.459	0.114	0.367
Spleen (%)	0.126	0.102	0.130	0.112	0.101	0.012	0.295
Heart (%)	0.540	0.535	0.527	0.545	0.589	0.030	0.622
Gizzard (%)	1.230	1.155	1.180	1.205	1.199	0.058	0.916
Meat Quality							
pH	5.590^{ab}	5.820^{a}	5.470^{bc}	5.270^{c}	5.610^{ab}	0.063	0.000
[8]WHC %	58.530^{ab}	51.260^{bc}	56.030^{ab}	63.810^{a}	44.400^{c}	4.410	0.048

[1]EA: Emulsifier in all phases, [2]WEA: Without emulsifier in all phases, [3]ES: Emulsifier in starter phase only, [4]EG: Emulsifier in grower phase only, [5]EF: Emulsifier in finisher phase only, SEM: Standard error. Mean, [7]Different superscripts within a row differ significantly ($P < 0.05$), [8]Water holding capacity

Table 8. Effect of emulsifier on Economics during (1-35 days) in broilers.

Item	[1]EA	[2]WEA	[3]ES	[4]EG	[5]EF	[6]SEM	[7]P Value
Feed Cost (Rs.) / bird	186.14	183.19	186.24	182.51	182.51	1.2300	0.075
Emulsifier + other costs (Rs.) / bird	99.55^{a}	97.50^{e}	97.68^{d}	98.37^{c}	98.46^{b}	0.0096	0.000
Total Cost (Rs.) / bird	285.70	280.69	283.93	280.88	280.96	1.2400	0.025
Revenue (Rs.) / bird	340.66^{a}	327.44^{c}	330.71^{bc}	326.84^{c}	336.39^{ab}	2.0400	0.000
Profit (Rs.) / bird	54.96^{a}	46.75^{b}	46.78^{b}	45.97^{b}	55.43^{a}	1.2800	0.000
Profit (%) / bird	19.24^{a}	16.65^{b}	16.48^{b}	16.36^{b}	19.72^{a}	0.4330	0.000
[8]FEE / bird	1.83^{a}	1.79^{b}	1.78^{b}	1.79^{b}	1.84^{a}	0.0074	0.000

[1]EA: Emulsifier in all phases, [2]WEA: Without emulsifier in all phases, [3]ES: Emulsifier in starter phase only, [4]EG: Emulsifier in grower phase only, [5]EF: Emulsifier in finisher phase only, [6]SEM: Standard error. Mean, [7]Different superscripts within a row differ significantly ($P < 0.05$), [8]Feed economic efficiency

revealed that pH and WHC (%) of meat showed significant ($P<0.05$) effect by addition of emulsifier in the broilers diet.

***Economics*:** Effect of EE in the diet of broilers on economics is shown in the Table 7. Results showed that emulsifier addition in diet showed significant effect ($P<0.05$) on economics during 0-35 days of the trial. Profit (%) and FEE per bird was improved ($P<0.05$) in broilers supplemented EE in diet throughout the life and during finisher phase (26-35 days) only.

DISCUSSION

The purpose of this experiment was to check the effects of fat sources inclusion in broiler diets with emulsifier on the feed intake, BWG, nutrient digestibility, carcass parameters, meat quality, blood metabolites on different phases of broiler life. The results in this study also supported the hypothesis emulsifier supplementation would enhance the performance of broiler chickens by increasing the nutrient digestibility in a specific phase.

In current study, it was observed that emulsifier addition in finisher diet and overall period improved the performance of broilers in terms of BWG and FCR. Broilers gained more BW by supplementation of emulsifier during overall period and finisher phase only. Similar results on growth performance were reported by Roy *et al.*.(2010) that BWG and FCR were improved by emulsfieir addiiton in the finisher diet. Other researchers also reported the similar results (Zosangpuii *et al.*, 2015; Bontempo *et al.*, 2018). However, in contrast to this, some researchers revealed that BWG and FCR were not affected by addition of EE in the finisher diet of broilers (Neto *et al.*, 2011; Azman and Ciftci, 2004). However, some resaerchers (Aguilar *et al.*,,2013 and Ge *et al.*, 2018) reported that FI was not effected by EE supplementation in the diet of broilers during 1-35 days. Similar findings were observed in the current study that emulsfieir addition during overall period and finisher phase had not effected the FI of broilers. In contrast to out study, Park *et al.* (2018) and Drażbo *et al.* (2019) revealed that FI was increased by EE supplementation in the diet of broilers. In the current study, during grower phase it was observed that FI was decreased by EE supplementation in the grower diet of broilers as compared to those received emulsifier in starter and finisher diet. Similar finding were reported by Hosseini *et al.*, (208). However, in the current study, during starter and grower phase BWG and FCR were not affected by emulsifier addition in the starter and grower diets of broilers. During starter and grower phases no effect on BWG and FCR could be justified due to the less development and low secretions of digestive organs that were unable to convert the nutrients into body mass.

Results of digestibility revealed that emulsifier addition in the diet of broilers affected the DM, CP and EE digestibility. In

the current study, results showed that at day 10th digestibility (DM, CP and EE) did not show any effect by emulsifier addition in diet. Similar findings were showed by Drażbo *et al.,* (2019). In the current study, the digestibility of DM and crude fat was improved with the external emulsifier which is in agreement with a study of Upadhaya *et al.* (2017) who stated that emulsifier enhance the DM and crude fat digestibility of the broiler diet. However, at day 25th and 35th digestibility of nutrients (DM, CP and EE) was decreased and increased respectively by addition of emulsifier in diet. Dierick and Decuypere, (2004) demonstrated that EE supplementation in diet decreased the nutrient digestibility (%) of broilers. The result of DM digestibility and fat digestibility in the current study proved the findings Upadhaya *et al.* (2017) that DM digestibility and fat digestibility had strong correlation. In our study, higher digestiblities of DM and fat were the reason of improved growth performance of broilers by emulsifier in finisher diet and during overall period. It was proposed that it might be due to the increase in the lipase and bile salts secretions that resulted in the development of digestive organs (Wiseman, 2013). However, in current study blood serum profile was not affected by EE addition in the diet of broilers. Similar results were documented by Neto *et al.* (2011) that level of total cholesterol and triglycerides in the serum of broilers were not affected by emulsifier addition in diet.

In the current study dressing percentage of meat was improved by emulsifier addition in the diet of broilers during finisher (26-35 days) phase only that was due to increase the growth of pectoral muscles which lead to improve the dressing percentage (Scheele, 1997). Fat percentage, weight of gizzard, liver, spleen and heart were not affected by dietary EE addition. Similar results were reported by Nobakht *et al.* (2011) and Aguilar *et al.* (2013). However, Boulos *et al.* (2011) revealed that carcass characteristics were improved by addition of 0.25 % Soy lecithin in the broilers diet. Moreover, it was also observed that the meat quality was not affected by the diet with or without EE supplementation (Bontempo *et al.*, 2018; Arshad *et al.,* 2020). In our study, meat quality was affected by the emulsifier supplementation in diet. Results showed that due to the dietary emulsifier supplementation, pH was decreased during grower (11-25 days) phase only and WHC (%) was decreased during finisher (26-35 days) phase only.

Abou-Elkhair *et al.* (2015) noticed that revenue, profit percentage and FEE showed positive effect by emulsifier supplementation in broilers diet. Similar results were observed in our study that revenue, profit percentage and FEE were enhanced by dietary emulsifier addition in broilers diet during finisher (26-35days) phase only or throughout the life as compared to groups supplemented diet with or without emulsifier during starter (1 to10 days) and grower (11 to 25 days) phases.

***Conclusion*:** Exogenous emulsifier supplementation in broilers diet showed significant effect on growth performance, nutrient digestibility, dressing percentage, meat quality (pH and WHC %) and economics during finisher phase. Therefore, it is recommended that emulsifier supplementation should be done during finisher (26-35 days) phase only in broilers.

***Acknowledgement*:** The authors acknowledged the financial assistance funded by Shamim Feed Industries, Bahawalpur, Pakistan. Also, authors like to thank to Dr. Waqar Khan (CEO Kemin, Pakistan) for providing Emulsifier.

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[Received 13 Aug 2020; Accepted 12 Nov. 2020; Published (online) 25 Jun 2021]