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Supplementation of different emulsifiers on performance of broilers

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Abstract
This study was planned to evaluate two emulsifiers Orffa energizer-01 (OE1) and Orffa energizer-02 (OE2) having different Hydrophilic-lypophilc balance (HLB) values for diets with two different oil sources, soybean oil and rice bran oil on the performance of broilers. The trial was conducted on 240, Cobb-430 broiler chicks for the period of six weeks (0-6 weeks). Day-old commercial broiler chicks were randomly divided into six dietary treatments (T1 to T6), each consist of four replicates with 10 chicks in each replicate. T1 received control diet (Without emulsifier) prepared with soybean oil and T2 received control diet (Without emulsifier) prepared with rice bran oil. The chicks from group T3 and T5 received feed containing soybean oil with addition of OE1 and OE2, respectively @ 350 g/Ton in each of the diets. Whereas, the chicks from T4 and T6 received feed containing rice bran oil with addition of OE1 and OE2, respectively @ 350 g/Ton in each of the diets. Both emulsifiers showed on both vegetable oils a significant positive effect on body weight gain over the whole period and both emulsifiers improved both the energy metabolizability and feed conversion ratio. The group T6 (Rice bran oil + OE2) performed best on body weight, overall body weight gain, energy metabolizability and feed conversion ratio. At the end of the trial the birds were between 69 and 175 g heavier depending on the treatment. The feed conversion ratios were by consequence recalculated to a body weight of 2500 g to compensate for the big differences in body weight. Recalculated feed conversion ratios showed a feed sparing effect of 37 and 56g per kg weight gain for the OE2 treatments on soybean oil and rice bran oil respectively. Hence, it is concluded that the effect of emulsifier EO2 on rice bran oil is higher than the effect on soybean oil. Rice bran oil with OE2 resulted in the highest body weight gain, feed intake and feed conversion ratio in broiler diet.

Keywords: Emulsifier, soybean oil, rice bran oil, energizer, feeds

Introduction
The ingredients used in the formulation of poultry diet are costly due to their demand for human foods. Hence, the alternative sources to formulate energy dense diets for chicken must be explored. Fats and oils are energy dense nutrient compounds which produce more than twice the energy produces by either protein or carbohydrates on equal weight basis. Fats are also important to provide essential fatty acids which have crucial importance in making prostaglandins and local hormones, which help in combating infections and stress.

Besides supplying energy, fats in the diet improve absorption of fat-soluble vitamins, increases the palatability of the feed and efficient utilization of energy. It also reduces the passage rate of the digesta in the gastrointestinal tract, which allows a better absorption of all nutrients present in diet [10, 12]. In order to balance dietary energy content fats are being added into the diet of chicken. The digestion of fat is mediated by the enzymes lipase and co-lipase, but these enzymes cannot act unless the fats are emulsified. The process of emulsification is performed by emulsifiers like bile acids which serve as natural emulsifier. With the added fats in the diet, bile acids produced in the body found insufficient for its emulsification. Emulsifier supplementation in poultry diets reduces the size of larger fat globules into smaller micelles which increase the surface area for enzymatic action to improve their digestion [6].

An emulsifier molecule has two parts of which one part loves water and other part loves oil. The water loving part is known as hydrophilic and oil loving part is known as lipophilic. The hydrophilic-lipophilic balance (HBL) of emulsifier is maintained by their molecular weight [1]. The soybean oil and rice bran oil are two commonly used oils in poultry feed. Thus, this study was conducted for evaluation of suitable emulsifier for soybean oil and rice bran oil on broiler chicken performance.

Materials and Methods

The study was conducted for comparative evaluation of two different emulsifiers on soybean oil and rice bran oil diets in broiler chicken. The trial was conducted on 240, Cobb-430 broiler chicks for the period of six weeks (0-6 weeks). Day-old commercial broiler chicks were randomly divided into six dietary treatments (T1 to T6), each consist of four replicates with 10 chicks in each replicate. T1 received control diet (without emulsifier) prepared with soybean oil, T2 received control diet (without emulsifier) prepared with rice bran oil. The chicks from group T3 and T5 received feed containing soybean oil with addition of Orffa energizer-01 (OE1) and Orffa energizer-02 (OE2), respectively @ 350 g/Ton in each of the diets. Similarly, the chicks from T4 and T6 received feed containing rice bran oil with addition of Orffa energizer-1 (OE1) and Orffa energizer-2 (OE2), respectively @ 350 g/Ton in each of the diets.

All the diets (Pre-starter, starter and finisher) were *iso-caloric and iso-nitrogenous* prepared with BIS-2007 (Table 1). Feed intake, body weight and livability of broilers were recorded at weekly interval. The body weight gain and feed conversion ratio were calculated. Feed conversions were recalculated to a standard end weight of 2500 g using the 20g feed conversion for each 100g weight difference calculation model. A metabolic trial was conducted for 3 days at the end of experiment to know the energy metabolizability. Feed ingredients were analyzed for proximate composition as per AOAC (2000) [2]. The gross energy of feed and faecal samples was estimated by using bomb calorimeter. The performance of all the groups receiving diet containing different oils with or without different emulsifiers were compared to find if there is significant effect of treatment (diet). The data on various parameters were analyzed by ANOVA employing complete randomized design [11].

Results and Discussion

Body weight gain

The body weight of the broilers fed soybean and rice bran oil with or without emulsifier in the diet is presented in Table 2. The dietary inclusion of emulsifiers did not bring any significant change on average body weight at 1st and 2nd week. At the end of 3rd week, the average live body weight in group T1 was 894.9 g which is numerically lower than the birds in T2 (902.9 g). However, the inclusion of emulsifiers resulted into an increase in body weight as compared to the control groups. The body weight of the birds at the end of 4th week (28th day) of age was numerically higher in emulsifier included groups but the results were comparable. At the end of 5th week, body weight was significantly (P<001) improved in birds fed with emulsifiers as compared to control (without emulsifier). The birds supplemented with emulsifiers *i.e.* T3, T4, T5 and T6 groups had a significant higher body weight at the end of trial. The T6 group (Rice bran oil + OE2) resulted into highest body weight among the treatment groups.

The data pertaining to average weekly gain in weights of the birds from groups receiving soybean and rice bran oil with or without emulsifier in the diet from first to sixth week of age and phase wise is presented in Table 3. The body weight gain was comparable among different treatment groups up to four weeks of age. The body weight gain during fifth week of age was significantly (P<0.001) better in T6 followed by T4. The body weight gain during starting phase (0-3 weeks) was better (<0.05) in emulsifier fed birds of T3, T4, T5 and T6 as compared to birds in T1 and T2. The birds supplemented with emulsifiers *i.e* T3, T4, T5 and T6 groups had a significantly higher body weight at the end of the trial (P<0.001).The overall body weights gain of broilers in T1, T2, T3, T4, T5 and T6, during the six weeks trial were 2623.4, 2658.1, 2691.1, 2728.1, 2730.8 and 2833.3 g, respectively. The birds from group T6 receiving rice bran oil and OE2 in the diet recorded the highest gain in weight at the end of sixth week.

The feed intake was found highest in the Rice bran oil supplemented group with OE2 followed by OE1. The actual trial showed, irrespective of the emulsifier, that Rice bran oil performed better when compared to soybean oil in all the aspects.

At the end of the trial the birds were between 69 and 175 g heavier depending on the treatment. The feed conversion ratios were by consequence recalculated to a body weight of 2500 g to compensate for the big differences in body weight. Recalculated feed conversion ratios showed a feed sparing effect of 37 and 56 g per kg weight gain for the OE2 treatments on soybean oil and rice bran oil respectively. Hence, it is concluded that the effect of the emulsifier EO2 on rice bran oil is higher than the effect on soybean oil. Rice bran oil + OE2 resulted in the highest body weight gain, feed intake and feed conversion ratio. Broilers fed the diet containing soybean oil and emulsifier presented higher body weight. Similarly, emulsifier supplementation having beneficial effects on BW, feed intake and FCR in broilers [8]. On the contrary, the body weight was not affected by exogenous supplementation of emulsifiers in broilers at 21 and 42 days [3].

Feed intake and energy metabolizability (%)

Average weekly and phase wise feed intake of the birds from the different groups receiving soybean and rice bran oil with or without emulsifier in the diet from day-old to six weeks of age and energy metabolizability % is presented in Table 4. The total feed intake per bird at 6 weeks of age for groups T1, T2, T3, T4, T5 and T6 was 4347, 4400, 4410, 4484, 4483 and 4632 g, respectively. Dietary inclusion of emulsifiers did not bring any significant effect on feed intake at 1st, 2nd, 3rd and 4th week of age. During 5th week of age the feed intake was significantly (P<0.001) higher when birds were fed with the diet containing emulsifier. The birds in group T6 resulted in maximum feed intake followed by T4 wherein the birds were fed with same oil with different OE2 and OE1, respectively. During the 6th week of age the feed intake was comparable among groups T1, T2, T3 and T4 but, was significantly (P<0.001) higher in T5 and T6 groups. The feed intake was comparable among different treatment groups during staring phase (0-3 week) but the significant increase in feed intake was observed during finishing (3-6 weeks) and overall (0-6 weeks) growth phases when birds were fed the diet containing OE2. The energy metabolizability % for groups T1, T2, T3, T4, T5 and T6 was 74.61, 75.68, 76.05, 76.46, 76.76 and 80.20, respectively. Dietary inclusion of emulsifiers had significant (P<0.001) effect on energy metabolizability. Energy metabolizability was highest in group T6. This reflects that the emulsifiers have positive role on energy metabolizability. Energy metabolizability was also found highest in Rice bran oil + OE2 fed group.

Supplementation of emulsifier improves apparent metabolizable energy (AME) values in the diets [7, 13]. Similarly, digestibility of dry matter, ether extract and protein in chickens fed diet with soya lecithin was significantly improved in as compared to control [8, 9].

Feed conversion ratio

Average weekly and phase wise feed conversion ratio in terms of feed intake per unit body weight gain for the birds from the groups receiving different oils with or without emulsifier are presented in Table 5. The feed conversions recalculated to a standard end weight of 2500 g are depicted in Graph 1. The overall growth performance of broilers is presented in Table 6. The FCR of 1st, 4th week and during finishing (3-6 week) phase of age was comparable among the different treatment groups. Dietary inclusion of emulsifiers resulted in improved FCR (P<0.05) during 2nd, 3rd, 5th and 6th week of age. The overall (0-6 week) feed conversion ratio for birds from groups T1, T2, T3, T4, T5 and T6 were 1.66, 1.66, 1.64, 1.64, 1.64 and 1.64, respectively. The birds receiving rice bran oil + OE2 in the diet recorded marginally (P<0.013) better FCR.

In present study (0-42 d) FCR ranged from 1.635 to 1.657 and the best FCR found in the group supplemented with Rice bran oil + EO2. The results demonstrated that the addition of emulsifiers enhanced the performances of broilers. The observation obtained in this study support the hypothesis that a nutritional emulsifier improves feed efficiency of the diets in broilers. The practical utility of the study was that to improve feed efficiency that may lead to lower feed usage and costs. Similarly, FCR was reported improved in emulsifiers supplemented group as compared to control [7].

Mortality

The percent mortality in groups T1, T2, T3, T4, T5 and T6, were 5, 2.5, 2.5, 2.5, 2.5 and 2.5, respectively. The total mortality within a period of six weeks in all the groups was well within limits of the average mortality on the farm under field conditions. Upon post-mortem, none of the dead birds showed any specific lesion suggestive of any specific disease or disease condition.

Therefore, inconsistent results on growth performance and nutrient utilization of the birds fed with plant oil and emulsifier might be associated with fatty-acid composition of fat source and its effects on fat digestion and absorption. Some previous studies indicated that the activities of lipase increase with age [5, 12]. Inconsistency in the obtained results can be regarded due to different sources of lipids and various levels of emulsifiers used in the diet [1, 4].

Table 1: Ingredients and nutrient composition of basal diet

Ingredients	Prestarter	Starter	Finisher
Maize	54.767	55.778	59.81
Soy DOC	39.18	36.87	31.81
Oil	2.38	3.77	4.779
Limestone	0.89	0.87	0.85
Dicalcium Phosphate	1.78	1.83	1.9
Salt	0.3	0.3	0.3
DL-Methionine	0.148	0.131	0.106
L-Lysine	0.13	0.036	0.03
Trace mineral premix	0.11	0.1	0.1
Vitamin premix	0.15	0.15	0.15
B complex	0.015	0.015	0.015
Choline chloride	0.05	0.05	0.05
Toxin binder	0.05	0.05	0.05
Coccidiostat	0.05	0.05	0.05
Total	100.00	100.00	100.00
Nutrient composition (As fed basis)			
Crude Protein %	23.00	22.00	20.00
ME, kcal/kg	3000.13	3099.95	3200.35
Calcium, %	1.00	1.00	1.00
Available Phosphorous, %	0.45	0.45	0.45
Lysine, %	1.338	1.201	1.06
Methionine, %	0.531	0.501	0.4507

Table 2: Effect of dietary inclusion of different emulsifiers (@350 g/ton) on weekly body weight (gram/bird)

Treatment	Day-Old	I WK	II WK	III WK	IV WK	V WK	VI WK
T1 (SO)	45.7	194.1	493.9	894.9a	1505.0	2136.0a	2669.0a
T2 (RB)	45.7	195.2	497.4	902.9ab	1516.7	2162.5a	2703.7ab
T3 (SO+OE1)	45.7	197.2	499.4	916.7b	1528.7	2208.4b	2737.8bc
T4 (RB+OE1)	45.6	197.4	501.4	921.2b	1531.6	2236.8b	2773.8cd
T5(SO+OE2)	45.6	198.5	504.7	921.6b	1533.4	2200.7b	2776.6cd
T6 (RB+OE2)	45.7	199.2	505.0	924.5b	1538.4	2297.4c	2878.9e
SEM	0.114	0.551	1.277	2.604	3.096	4.885	8.951
Prob.	NS	NS	NS	P<0.027	NS	P<0.001	P<0.001

Values bearing different superscripts differed significantly (P<0.05); NS= Non significant. SO, Soybean oil; RB, Rice bran oil; OE1, Orffa energizer-1; OE2, Orffa energizer-2; SEM, Standard error mean

Table 3: Effect of dietary inclusion of different emulsifiers (@350 g/ton) on body weight gain (gram/bird/week)

Treat	I WK	II WK	III WK	IV WK	V WK	VI WK	0-III WK	III-VI Wk	0-VI WK
T1 (SO)	148.5	299.9	401.0	610.1	631.0a	533.0a	849.3a	1774.1a	2623.4a
T2 (RB)	149.6	302.2	405.5	613.8	645.9ab	541.2ab	857.3ab	1800.8ab	2658.1ab
T3 (SO+OE1)	151.5	302.3	417.3	612.0	679.6bc	529.4a	871.0b	1821.1ab	2692.1bc
T4 (RB+OE1)	151.7	303.9	419.8	610.5	705.2c	537.0a	875.4b	1852.7bc	2728.1cd
T5(SO+OE2)	152.8	306.2	416.9	611.7	667.4abc	575.8ab	875.9b	1854.9bc	2730.8cd
T6 (RB+OE2)	153.5	305.8	419.6	613.9	759.0d	581.5ab	878.9b	1954.4d	2833.3e
SEM	0.582	1.394	2.828	4.154	5.690	9.198	2.602	9.259	8.948
Prob.	NS	NS	NS	NS	P<0.001	P<0.05	0.028	P<0.001	P<0.001

Values bearing different superscripts differed significantly (P<0.05); NS= Non significant SO, Soybean oil; RB, Rice bran oil; OE1, Orffa energizer-1; OE2, Orffa energizer-2; SEM, Standard error mean

Table 4: Effect of dietary inclusion of different emulsifiers (@350 g/ton) on Feed intake (gram/bird/week) and Energy metabolizability (%)

Treatment	I WK	II WK	III WK	IV WK	V WK	VI WK	0-III WK	III-VI Wk	0-VI WK	EM%
T1 (SO)	159	400	600	939	1165a	1084a	1159	3188a	4347a	74.61a
T2 (RB)	160	400	604	948	1189ab	1099a	1164	3236ab	4400ab	75.68ab
T3 (SO+OE1)	161	397	615	923	1247bcd	1067a	1173	3237ab	4410ab	76.05ab
T4 (RB+OE1)	161	398	615	929	1296d	1086a	1173	3311bc	4484bc	76.46abc
T5(SO+OE2)	162	401	610	928	1223abc	1159ab	1173	3310bc	4483bc	76.76bc
T6 (RB+OE2)	162	394	613	926	1379e	1157ab	1170	3462d	4632d	80.20e
SEM	0.707	1.760	2.038	4.843	12.863	14.980	2.662	18.539	19.266	0.383
Prob.	NS	NS	NS	NS	$P<0.001$	$P<0.001$	NS	$P<0.001$	$P<0.001$	$P<0.001$

Values bearing different superscripts differed significantly ($P<0.05$); NS= Non significant SO, Soybean oil; RB, Rice bran oil; OE1, Orffa energizer-1; OE2, Orffa energizer-2; SEM, Standard error mean

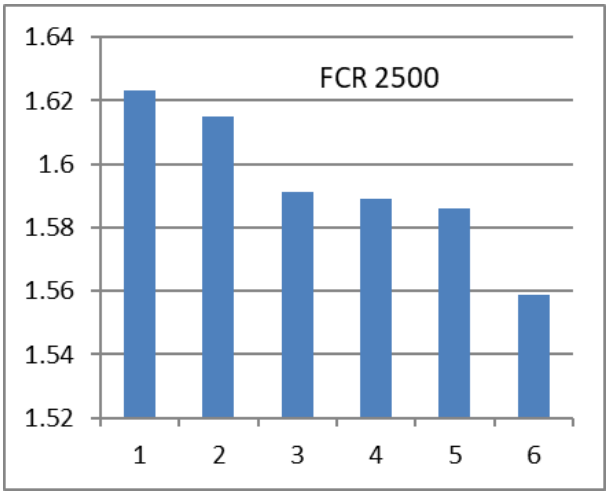
Table 5: Effect of dietary inclusion of different emulsifiers (@350 g/ton) on Feed Conversion Ratio

Treatment	I WK	II WK	III WK	IV WK	V WK	VI WK	0-III WK	III- VI Wk	0-VI WK
T1 (SO)	1.07	1.33c	1.50c	1.54	1.85d	2.03c	1.36d	1.80	1.657b
T2 (RB)	1.07	1.32c	1.49bc	1.54	1.84cd	2.03c	1.36cd	1.80	1.655b
T3 (SO+OE1)	1.06	1.31bc	1.47abc	1.51	1.84bcd	2.01b	1.34bc	1.78	1.638a
T4 (RB+OE1)	1.06	1.31bc	1.47ab	1.52	1.84 bcd	2.02bc	1.34b	1.79	1.644ab
T5(SO+OE2)	1.06	1.31bc	1.46ab	1.52	1.83abc	2.02bc	1.34b	1.79	1.642ab
T6 (RB+OE2)	1.06	1.29ab	1.46ab	1.51	1.82a	1.99a	1.33ab	1.77	1.635a
SEM	0.003	0.004	0.004	0.007	0.003	0.003	0.003	0.003	0.002
Prob.	NS	$P<0.003$	$P<0.03$	NS	$P<0.003$	$P<0.001$	$P<0.001$	NS	$P<0.013$

Values bearing different superscripts differed significantly ($P<0.05$); NS= Non significant SO, Soybean oil; RB, Rice bran oil; OE1, Orffa energizer-1; OE2, Orffa energizer-2; SEM, Standard error mean

Table 6: Effect of dietary inclusion of different emulsifiers (@350 g/ton) on overall performance

Treatment	End Weight(g)	FCR	FCR 2500g	Feed Intake	Body weight gain
SO	2669.0	1.657	1.623	4347	2623.1
RBO	2703.70	1.655	1.615	4400	2658.1
SOE1	2737.80	1.638	1.591	4410	2692.1
RBOE1	2773.80	1.644	1.589	4484	2728.1
SOE2	2776.60	1.642	1.586	4483	2730.8
RBOE2	2878.90	1.635	1.559	4632	2833.3



Graph 1: Effect of different treatment groups on recalculated FCR to a standard weight of 2500g (X axis: Age of broilers in weeks; Y axis: Feed conversion ratio)

Conclusion

The combination of rice bran oil with OE2 emulsifier was found the best supplement for the growth performance followed by soybean oil with OE2. The percent improvement of energy metabolizability and feed conversion ratio was also found highest using OE2. Rice bran oil with OE2 emulsifier was the best combination to be used in the broiler diet for better performance.

Thus, it may be concluded that vegetable oil mixing with emulsifier are better to improve growth performance and energy metabolizability as compared to without emulsifier supplementation.

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