Shiraz University

Iran Agricultural Research (2023) 41(2)109-116

Research Article

Effect of dietary fat source and pellet binder on growth performance, prececal nutrient digestibility, and carcass traits in Ross 308 broilers

M. Dorrani, M. R. Rezvani*

Department of Animal Science, School of Agriculture, Shiraz University, Shiraz, I. R. Iran

* Corresponding Author: rezvani@shirazu.ac.ir

DOI: 10.22099/IAR.2023.42659.1477

ARTICLE INFO

***Article history*:**

Received **01 January 2022**

Accepted **07 May 2023**

Available online **12 June 2023**

***Keywords*:**

Broilers

Fat and oil

Glomatin® pellet binder

Physical quality

Prececal digestibility

ABSTRACT- This research aimed to compare the effect of two sources of fat and three levels of a pellet binder on pellet quality, growth performance, prececal nutrient digestibility, carcass, and economic traits in Ross 308 broilers. Two hundred and forty-day-old broiler chickens were applied in a 2 × 3 factorial arrangement in a completely randomized design with four replicates and ten birds in each replicate. The dietary treatments were two fat sources (soybean oil and fat powder) and three levels of a commercial binder named Glomatin® (0, 2, and, 4% in grower and 0, 3, and 6% in finisher diets). The data were subjected to the procedure of General Linear Models (GLM) of SAS, version 9.4 ($P \leq 0.05$). Birds fed the soybean oil-containing diet with the second level of Glomatin® binder (2% in grower and 3% in finisher diets respectively) showed the best feed conversion ratio (FCR) in the whole period, and the highest prececal dry matter digestibility, ether extract digestibility, and economic profit. It concluded that increasing the physical quality of the pellet diet by adding a binder in soybean oil-containing diets had an optimum level (2% in grower and 3% in finisher diets respectively). Over that optimum level, it could harm FCR, prececal nutrient digestibility, and finally, profitability.

INTRODUCTION

Worldwide collected statistics indicated that the number and performance of broilers grown by pellet feeds have increased over time (Abdollahi et al., 2012, 2018 a, b). One of the main reasons for this issue is the significant improvement in pellet physical and chemical characteristics. Pellet physical quality can be measured by Pellet Durability Index (PDI) and pellet hardness indices. The PDI represents the amount of pellet residue after processes such as mechanical mixing due to air pressure. Pellet hardness indicates the power required to crush the pellet over a given time (Thomas and van der Poel 1996). Improvement in these indicators can significantly affect the broiler's performance (Glover et al., 2015).

Pellet Binders are added to the diet to improve PDI and pellet hardness and subsequently enhance the physical quality of pellets. Bentonite, carboxyl methylcellulose, lignosulfonates, and even wheat are among the most common pellet binders (Thomas et al. 1998). It has been reported that using three % pellet binder in a diet containing large particles improve performance and positively affected broiler chicks' intestinal tissue (Mohammadi Ghasemabadi et al., 2018). In other studies conducted in this regard, the difference in broiler chicken's performance between low-quality physical pellet feed and mash feed was not found (Lemme et al., 2006; Dozier III et al., 2010).

It has been reported that various factors, such as the level and source of dietary fat, reduce the physical quality of a pellet diet (Thomas et al. 1998). Fat sources in the diet can reduce the pressure on the feed particles when they are present in the Dai section and rollers of the pelletizing machine by creating a lubrication effect. It can follow by reducing the feed particle stickiness and decreasing the physical quality of the pellet (Thomas et al. 1998). External fats increased the pellet production rate due to the fluidity between the feed and Die surface and reduced the mechanical energy (Kwh / ton) required for pellet production (Walter, 1990). Researchers have also shown that the gelatinization of starch or proteins in high temperature, high pressure, and humidity conditions can be led to improve bonding of pellet particles (Beaman et al., 2012). External fats can hurt starch gelatinization, resulting in a reduction in the hardness and durability of pellets (Abdollahi et al., 2012).

There is no possibility of completely removing fat from the diet of broiler chickens. The reasons for not being able to remove fats from poultry diets are their caloric and non-caloric effects. The caloric impact is associated with the high-energy content of fats compared with other feed components such as carbohydrates. Fat has non-caloric effects as an improvement agent in the digestive tract and increases absorption of other fat-soluble vitamins or increased the palatability of diets (Thomas and van der Poel 1996). Therefore, different sources of fat can have different effects; for example, it has been shown that various sources of external fat such as Palmi fat powder in the diet, and soybean oil had more positive effects on broiler performance than the other sources (Naeini et al., 2013; Zollitsch et al., 1997). It noted that the change in the physical quality of the pellet affected the profitability of the production unit.

This experiment was conducted to study the optimum level of Glomatin® pellet binder and appropriate fat source and the possible interaction effect between pellet binder and fat source on growth performance, prececal nutrient digestibility, and carcass traits in Ross 308 broilers.

MATERIALS AND METHODS

The animal welfare authorities at Shiraz University approved the arrangements for this experiment. In this experiment, 240 mixed male and female day-old Ross 308 broilers were divided into 24 groups of 10 birds. The chickens were kept in ground cages with dimensions of 1 × 1 × 1 meter. The birds were fed from 11 to 42 days of age by dietary treatments.

The experiment was carried out in a 2 ×3 factorial arrangement in a completely randomized design (CRD) with four replicates considered of two fat sources (soybean oil and fat powder) and three levels of Glomatin® pellet binder (0, 2, and 4 percent in grower and 0, 3 and 6 percent in finisher diets).

Birds were vaccinated against infectious bronchitis, Newcastle disease, and Infectious bursal disease. Chickens followed the lighting program of Ross 308 strain commercial recommendations. Room temperature was 32˚C during the first wk of age and then it reduced by 2.8˚C per wk, reaching a final temperature of 20˚C using a fan jet and gas heater. Air humidity was adjusted to around 70% until the end of the experiment using the steam generator.

All diets in each period were adjusted to be iso-caloric and iso-nitrogenous. The diets were arranged to meet the nutrient requirements of broiler chickens according to the Ross broiler 308 Tables (Aviagen, 2014), using Amino Chick Software®, and then pelletized in Rad Ard Pars feed mill company, Shiraz. A pellet diet (2 to 3 mm diameter) was prepared in a pellet press.

A properly designed conventional steam-conditioned pelleting system provided high-quality 97% steam to the conditioner, enabling a conditioning temperature of at least 88°C. The diet in the starter period (1 to 10 days) was similar to commercial crumble for all treatments. The compositions and nutrients of experimental diets in the grower (12 to 21 d) and finisher (22 to 42 d) periods are shown in Tables 1 and 2, respectively.

Table 1. Feed ingredients (g kg-1) and feed components in the grower period (12 to 21 d) of production

Ingredients	Grower (12 to 21 d) diet formulation					
	FP_1	FP_2	FP_3	SO_1	SO_2	SO_3
Glomatin®	0.00	20.00	40.00	0.00	20.00	40.00
Corn	599.92	582.73	565.54	596.33	579.20	562.10
Soybean meal	310.99	308.59	306.19	311.63	309.22	306.81
Gluten Meal	30.00	30.00	30.00	30.00	30.00	30.00
Fat powder	10.14	9.95	9.76	0.00	0.00	0.00
Soybean oil	0.00	0.00	0.00	10.41	10.21	10.01
L-Threonine	0.38	0.39	0.39	0.38	0.39	0.39
DL-Methionine	2.16	2.14	2.11	2.16	2.14	2.12
L-Lysine	1.64	1.65	1.65	1.63	1.64	1.64
Choline chloride	0.70	0.70	0.70	0.70	0.70	0.70
Mono-calcium phosphate	5.00	5.00	5.00	5.00	5.00	5.00
Di-calcium phosphate	7.98	7.88	7.79	8.00	7.90	7.80
Oyster Powder	9.06	9.00	8.95	11.73	11.62	11.51
Bentonite	10.00	10.00	10.00	10.00	10.00	10.00
Salt	1.86	1.83	1.80	1.87	1.84	1.81
Baking soda	2.27	2.24	2.22	2.26	2.24	2.21
Vitamin supplement[2]	2.00	2.00	2.00	2.00	2.00	2.00
Mineral supplement[3]	2.00	2.00	2.00	2.00	2.00	2.00
Probiotic & Prebiotic (Oleobiotic)	3.90	3.90	3.90	3.90	3.90	3.90
Total	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Dry matter (%)	92.76	92.76	92.76	92.76	92.76	92.76
Metabolic energy (Kcal / kg)	2945.00	2945.00	2945.00	2945.00	2945.00	2945.00
Crude protein (%)	19.82	19.88	19.95	19.82	19.88	19.95
Crude fiber (%)	3.36	3.33	3.29	3.36	3.32	3.28
Calcium (%)	0.84	0.84	0.84	0.84	0.84	0.84
Available Phosphorous (%)	0.42	0.42	0.42	0.42	0.42	0.42
Sodium (%)	0.19	0.19	0.19	0.19	0.19	0.19
Digested Threonine (%)	0.68	0.68	0.68	0.68	0.68	0.68
Digested ़Lysine (%)	1.05	1.05	1.05	1.05	1.05	1.05
Digested ़Methionine (%)	0.50	0.50	0.50	0.50	0.50	0.50

[1]FP: stands for fat powder, SO: stands for soybean oil, and 1, 2 and 3 are the three levels of Glomatin® binder (0, 2 and 4 percent)

[2]Each g of vitamin supplements including: Vitamin A, 7500 IU; Vitamin D3, 3000 IU; Vitamin E, 10 IU; Vitamin K, 2 mg; Vitamin B12, 12.5 µg; folic acid, 0.5 mg; pantothenic acid, 8 mg; pyridoxine 1.8 mg; riboflavin, 5.3 mg; thiamine, 2 mg; and biotin, 0.15 mg;

[3]Each g of mineral supplements including iodine; 1 mg; selenium, 0.15 mg; niacin, 24 mg; choline, 350 mg; copper; 6 mg; iron, 30 mg; zinc, 50 mg; and manganese, 80 mg.

Table 2. Feed ingredients (g kg^{-1}) and feed components in the finisher period (22 to 42 d) of production

Ingredients	Finisher (22 to 42 d) diet formulation					
	FP_1	FP_2	FP_3	SO_1	SO_2	SO_3
Glomatin®	0.00	30.00	60.00	0.00	30.00	60.00
Corn	654.15	627.27	600.17	645.75	620.05	593.34
Soybean meal	283.05	279.65	277.28	284.55	280.94	278.23
Fat powder	19.50	20.42	20.35	0.00	0.00	0.00
Soybean oil	0.00	0.00	0.00	21.25	20.96	20.82
L-Threonine	0.45	0.46	0.46	0.45	0.46	0.46
DL-Methionine	2.09	2.06	2.02	2.10	2.07	2.03
L-Lysine	1.21	1.22	1.19	1.18	1.19	1.18
Choline chloride	0.70	0.70	0.70	0.70	0.70	0.70
Mono-calcium phosphate	5.00	5.00	5.00	5.00	5.00	5.00
Di-calcium phosphate	5.31	5.17	5.01	5.36	5.21	5.06
Oyster Powder	7.93	7.52	7.38	13.05	12.89	12.73
Bentonite	10.00	10.00	10.00	10.00	10.00	10.00
Salt	2.00	1.96	1.92	2.01	1.97	1.93
Baking soda	2.11	2.07	2.02	2.10	2.06	2.02
Vitamin supplement[2]	2.00	2.00	2.00	2.00	2.00	2.00
Mineral supplement[3]	2.00	2.00	2.00	2.00	2.00	2.00
Fit Max Cox	1.00	1.00	1.00	1.00	1.00	1.00
Betaine	0.30	0.30	0.30	0.30	0.30	0.30
Behsam 200	0.50	0.50	0.50	0.50	0.50	0.50
Probiotic & Prebiotic (Oleobiotic)	0.70	0.70	0.70	0.70	0.70	0.70
Total	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Dry matter (%)	92.76	92.76	92.76	92.76	92.76	92.76
Metabolic energy (Kcal / kg)	3050.00	3050.00	3050.00	3050.00	3050.00	3050.00
Crude protein (%)	17.82	17.92	18.05	17.82	17.92	18.04
Crude fiber (%)	2.87	2.83	2.78	2.86	2.82	2.77
Calcium (%)	0.81	0.81	0.81	0.81	0.81	0.81
Available Phosphorous (%)	0.40	0.40	0.40	0.40	0.40	0.40
Sodium (%)	0.17	0.17	0.17	0.17	0.17	0.17
Digested Threonine (%)	0.62	0.62	0.62	0.62	0.62	0.62
Digested Lysine (%)	0.94	0.94	0.94	0.94	0.94	0.94
Digested Methionine (%)	0.46	0.46	0.45	0.46	0.46	0.45

[1]FP: stands for fat powder, SO: stands for soybean oil, and 1, 2 and 3 are the three levels of Glomatin® binder (0, 3 and 6 percent).
[2]Each g of vitamin supplements including: Vitamin A, 7500 IU; Vitamin D3, 3000 IU; Vitamin E, 10 IU; Vitamin K, 2 mg; Vitamin B12, 12.5 µg; folic acid, 0.5 mg; pantothenic acid, 8 mg; pyridoxine 1.8 mg; riboflavin, 5.3 mg; thiamine, 2 mg; and biotin, 0.15 mg;
[3]Each g of mineral supplements including: iodine; 1 mg; selenium, 0.15 mg; niacin, 24 mg; choline, 350 mg; copper; 6 mg; iron, 30 mg; zinc, 50 mg; and manganese, 80 mg.

To measure the physical quality of the pellet samples, 100 g of each feed sample was mixed in an English Holman machine at a pressure of 70 mV for 60 seconds. Then, it has been bolted with a 2 mm diameter bolt that was fixed on the device. The pellet durability index (PDI) was measured using equation 1 (Thomas and van der Poel 1996).

Equation 1:

$$PDI\% = \frac{\text{Pellet weight after placing on the machine} \times 100}{\text{Pellet weight before placing on the machine}}$$

The measured parameters were the body weight at the start and end of each period and feed intake in each pen. The feed conversion ratio (FCR) was calculated by dividing feed intake by weight gain. At the end of the experiment, the chickens of each pen, after weighing sent to the slaughterhouse. Before slaughtering, one male broiler in each pen was weighed. After slaughtering, the weight of the gizzard, intestine (from Meckel's diverticulum up to 2 cm before the junction of the ileum to the cecum), pancreas, and carcass weight without viscera were measured. Other broilers of each pen were slaughtered, and the length of the intestine was measured from Meckel's diverticulum up to 2 cm before the cecum.

Digesta samples were obtained from the last two-thirds of the intestine between Meckel's diverticulum and 2 cm before the cecum and were kept at a temperature of - 20 °C. The nutrient components in feed and digesta samples were measured in the nutrition laboratory using the approximate analysis method (AOAC, 2006). Acid Insoluble Ash (AIA) was measured using De Coca-Sinova et al. (2011) method. The prececal nutrient digestibility was calculated based on equation.2

Equation 2:

Percentage of Prececal Nutrient digestibility =
100 – (100× ((diet nutrients/prececal nutrients) × ((prececal AIA/diet AIA))

To calculate the net profit and costs, all costs, including chicken's price, feed, drugs, hygienic materials, personnel, etc., and, the cost of the pellet were calculated one by one for each replicate. The deduction of the proceeds from the sale price of live weight was considered as profit.

Equation 3:

Economic profit per kg live weight = ((Live weight price) – (chicken's price + feed cost + drugs cost+ hygienic materials price + personnel price + cost of the pelleting procedure)) / Kg live weight

In all parameters, except prececal nutrient digestibility and weight of the internal organs, birds' weight at the first of the experiment (12th d of age) was considered as a covariate. Statistical analysis of data was performed using the GLM procedure of SAS, version 9.4 (SAS, 2013), and mean least squares of treatments were compared at 5% probability level. All data were analyzed for statistical normality using the Shapiro-Wilk test before statistical analysis. The statistical model was as follows.

Equation 4:

$$y_{ijk} = \mu + A_i + B_j + AB_{ij} + \beta (W_{ijk} - \overline{W}_{ijk}) + e_{ijk}$$

where $y_{ijk} = y^{th}$ is observation in the i^{th} level of treatment A (fat source), the j^{th} is level of treatment B (Glomatin® binder) and k^{th} is level of replication, μ = overall mean, A_i = effect of i^{th} level of treatment A, B_j = effect of j^{th} level of treatment B, $\underline{AB_{ij}}$: interaction effect of treatment A and B, β = regression coefficient of the studied traits on body weight at 12^{th} d, W_{ijk} = Body weight of i^{th} level of treatment A, j^{th} level of treatment B, and k^{th} level of replicate, $\underline{\overline{W}_{ijk}}$= average body weight of birds at 12 d and e_{ijk} = residual effect with mean 0 and normal distribution.

RESULTS AND DISCUSSION

The results showed that the type of fat, different levels of the binder, and their interactions had no significant effect on daily feed intake and daily weight gain in both periods of the grower, and finisher, as well as the whole period (Table 3). However, the main effects of fat source in the grower, and the whole periods, and binder level in the whole period on feed conversion ratio (FCR) were significant (Table 3). On the other hand, the soybean oil and level two of the binder treatments were better than the other treatments ($P \leq 0.05$). The results of the interaction effect have shown the best FCR by soybean and level two of Glomatin® binder in the finisher and whole periods.

Table 3. Daily feed intake (g/bird), daily weight gain (g), and feed conversion ratio in the grower period, finisher period, and the whole period of production

Treatment [1]		Daily feed intake (g/bird)			Daily weight gain g/bird)			Feed conversion ratio		
Fat Source	Pellet binder level	The grower period	The finisher period	The whole Period	The grower period	The finisher period	The whole Period	The grower period	The finisher period	The whole Period
					Main effect of fat source					
FP		77.91	150.33	117.08	56.78	77.38	68.04	1.34[a]	1.94	1.67[a]
SO		78.33	154.82	119.13	59.25	79.45	70.92	1.29[b]	1.97	1.60[b]
SEM		6.09	10.00	7.77	5.82	9.32	5.98	0.06	0.17	0.09
P-value		0.8504	0.2724	0.5000	0.2581	0.5696	0.2483	0.0479	0.0662	0.0490
					Main effect of pellet binder					
	1	81.58	148.94	118.91	60.28	78.08	69.94	1.31	1.96	1.67[ab]
	2	76.10	152.83	118.04	56.49	83.77	71.45	1.32	1.88	1.63[b]
	3	78.31	154.06	117.30	58.67	75.65	69.06	1.32	2.07	1.72[a]
SEM		5.83	10.28	8.37	5.71	8.95	6.12	0.06	0.17	0.09
P-value		0.3235	0.7827	0.9874	0.5666	0.3720	0.7074	0.9919	0.2306	0.0500
					Interaction effect of fat source ×pellet binder					
FP	1	83.61	153.09	123.05	62.52	75.94	69.59	1.30	2.03[b]	1.71[a]
SO		79.55	144.79	114.77	58.04	80.21	70.29	1.32	1.89[bc]	1.63[bc]
FP	2	72.77	150.65	114.75	53.48	82.07	69.29	1.33	1.93[bc]	1.66[bc]
SO		79.42	155.01	121.34	59.50	85.46	73.61	1.31	1.84[c]	1.60[c]
FP	3	77.06	151.10	117.03	54.50	78.31	67.66	1.39	2.00[b]	1.72[a]
SO		79.56	157.03	117.56	62.83	72.98	70.46	1.25	2.14[a]	1.72[a]
SEM		5.73	8.66	7.48	5.48	9.03	6.06	0.06	0.14	0.08
P-value		0.4840	0.2973	0.2631	0.3816	0.7323	0.9764	0.0619	0.0500	0.0498

[1]FP: stands for fat powder, SO: stands for soybean oil, and 1, 2, and 3 are the three levels of Glomatin® binder (0, 2, and 4 percent in grower period from 12 to 21 days of age and 0, 3, and 6 percent in finisher period from 22 to 42 days of age).

[a, b, c] Means within a column that do not have a common superscript are significantly different ($P \leq 0.05$).

The feed conversion ratio (FCR) of the grower period and the whole period were significantly affected by fat source. In addition, soybean oil treatment was significant ($P \leq 0.05$) better than soybean oil in other treatments This reaction indicated that soybean oil can be a higher quality ingredient to have better FCR than fat powder and could lead to the better digestibility and metabolism efficiency. This finding was according to the current experiment and other research such as Zollitsch et al., 1997 and Naeini et al., 2013. The greatest improvement in FCR was observed by the interaction effect of soybean oil and Glomatin® binder level two in the finisher and whole periods. This finding agrees with nutrient digestibility and PDI, as will be shown consequently.

The dry matter and crude protein digestibility in the soybean oil-containing diets was significantly higher than that of fat powder in the diet (Table 4). The results showed that the nutrient digestibility reduced significantly ($P \leq 0.05$) when the binder level increased from level one to level three better dry matter and ether extract digestibility were shown by soybean oil and level two of Glomatin® binder in compression level three of pellet binder in the diet. The measured parameters related to the carcass analysis of birds, including the gizzard, liver, and weight and length of intestine were not affected by the type of fat and different levels of the binder (Table 4).

A significant effect of fat source on nutrient digestibility can be due to the better profile of soybean oil fatty acids than fat powder (Zollitsch et al., 1997, Naeini et al., 2013). This effect may lead to better FCR, dry matter, ether extract digestibility by soybean oil and level two of a pellet binder containing diet. In previous studies, it was also found that the change in these parameters required changes in the form of feed consumed (Engberg et al., 2002), while in this study, all treatments were used as pellets.

The results showed that increasing the binder level could enhance the PDI of pellet samples and improve their physical quality. Besides, the average pellet durability was higher in soybean oil with level two of pellet binder. The treatment with soybean oil containing diet and level two of a pellet binder had the lowest cost and the highest profit compared with the other treatments (Table 5).

Table 4. Nutrient digestibility (percent) and carcass parameters (%)

Treatment[1]		**Digestibility**			***Carcass factors***				
Fat source	**Pellet binder**	**Dry matter (%)**	**Crude protein (%)**	**Ether extract (%)**	**Gizzard Weight (%)**	**Liver Weight\ (%)**	**Intestine (cm)**	**Intestine Weight (%)**	**Carcass (%)**
Main effect of fat source									
FP		54.56[b]	54.64[b]	65.83	0.90	2.14	87.25	0.878	62.60
SO		68.49[a]	66.13[a]	73.23	0.78	2.08	92.06	0.872	65.80
SEM		7.92	7.46	9.57	0.203	0.233	8.873	0.139	5.720
P-value		≤0.0001	≤0.0001	0.1125	0.1219	0.5023	0.1550	0.8996	0.1444
Main effect of pellet binder									
	1	65.50[a]	68.28[a]	73.94[a]	0.93	2.097	90.50	0.95	62.48
	2	64.42[a]	61.80[b]	70.38[ab]	0.79	2.015	88.12	0.81	68.52
	3	54.66[b]	51.08[c]	64.27[b]	0.78	2.145	88.00	0.83	65.32
SEM		10.14	7.20	8.63	0.753	0.893	35.391	0.510	23.015
P-value		≤0.0001	0.0001	0.0098	0.4214	0.4592	0.7892	0.1352	0.0675
Interaction effect of fat source ×pellet binder									
FP	1	62.40[c]	63.03	72.27[b]	0.92	2.13	86.50	0.890	63.00
SO		68.60[ab]	73.54	75.62[ab]	0.94	2.06	94.50	1.025	61.95
FP	2	55.09[cd]	55.22	62.32[c]	0.83	1.99	84.00	0.848	63.57
SO		73.75[a]	68.39	78.44[a]	0.74	2.030	92.25	0.773	73.46
FP	3	46.21[d]	45.68	62.90[c]	0.82	2.15	90.00	0.833	62.10
SO		63.12[b]	56.48	65.65[bc]	0.74	2.13	86.00	0.832	68.55
SEM		4.24	4.08	4.89	0.166	0.212	0.012	8.533	0.122
P-value		0.0363	0.7668	≤0.0001	0.4239	0.8577	0.1939	0.5008	0.3408

[1]FP: stands for fat powder, SO: stands for soybean oil, and 1, 2 and 3 are the three levels of Glomatin® binder (0, 2, and 4 percent in grower period from 12 to 21 days of age and 0, 3 and 6 percent in finisher period from 22 to 42 days of age)

[a, b, c] Means within a column that do not have a common superscript are significantly different ($P \leq 0.05$)

Table 5. The pellet durability index (percent) of pellet samples in different periods, costs and profit (Toman per kg live weight) during whole period

Treatment [1]		Pellet durability index			Costs and profit	
Fat source	Pellet binder level	The grower period	The finisher period	The whole Period	Costs (Toman per kg live weight)	Profit (Toman per kg live weight)
FP	1	43.7	60.9	52.3	17434.8	6565.2
SO		43.9	79.2	61.2	17506.8	6493.2
FP	2	73.2	78.4	75.8	18295.2	5704.8
SO		76.7	90.8	78.7	16370.7	7629.3
FP	3	81.4	93.8	87.6	17638.8	6361.2
SO		85.1	94.7	88.9	19045.5	4954.5

[1]FP: stands for fat powder, SO: stands for soybean oil, and 1, 2 and 3 are the three levels of Glomatin® binder (0, 2 and 4 percent in grower period from 12 to 21 days of age and 0, 3 and 6 percent in finisher period from 22 to 42 days of age).

Increasing the level of binder could enhance the PDI of pellet samples and improve their physical quality (Table 5). Besides, the PDI was higher in soybean oil than that in fat powder-containing diets. These findings were in agreement with previous studies by Parsons et al., 2006; Loar II and Corzo, 2011; and Abdollahi et al., 2012. Various factors are involved in the economic profitability of bird production. As was indicated in this study, the daily weight gain and feed intake did not affect by the dietary treatments. However, level two of pellet binder and soybean oil source had the best FCR and nutrient digestibility and this fact may be the reason for better economic outcomes in the soybean oil-containing diet supplemented with the second level of Glomatin® binder (2% in grower and 3% in finisher diets). The higher physical quality in level two of the binder and soybean oil-containing diet could prevent pellet from degrading in the gastrointestinal tract and increase nutrient digestibility.

CONCLUSIONS

The results of this study have shown that the treatment including soybean oil and Glomatin® binder level two (2% in the grower period and 3% in the finisher period) lead to a reduction in the costs of production and, consequently increased the net profit of broiler production. Over that optimum level, it could harm FCR, prececal nutrient digestibility significantly, and finally reduce economic profit.

ACKNOWLEDGMENTS

The authors would like to thank the Vice Chancellor for Academic Affairs of Shiraz University (Shiraz, Iran) for financial support, and Mr. Rohani, and Mr. Frozan (Rad Ard Pars Co., Shiraz) for material and facilities preparation.

REFERENCES

AOAC, Association of Official Agricultural Chemists international (2006). AOAC International guidelines for laboratories performing microbiological and chemical analyses of food and pharmaceuticals: An aid to interpretation of ISO/IEC 17025:2005. AOAC international. https://www.aoac.org/

Abdollahi, M., Ravindran, V., Wester, T., Ravindran, G., & Thomas, D. (2012). Effect of improved pellet quality from the addition of a pellet binder and.or moisture to a wheat-based diet conditioned at two different temperatures on performance; apparent metabolisable energy and ileal digestibility of starch and nitrogen in broilers. *Animal Feed Science and Technology*, 175, 150-157. doi.org/10.1016/j.anifeedsci.2012.05.001

Abdollahi, M., Zaefarian, F.,& Ravindran, V. (2018a). Feed intake response of broilers: Impact of feed processing. *Animal Feed Science and Technology*, 237, 154-165. doi.org/10.1016/j.anifeedsci.2018.01.013

Abdollahi, M., Zaefarian, F., Ravindran, V., & Selle, P., (2018b). The interactive influence of dietary nutrient density and feed form on the performance of broiler chickens. *Animal Feed Science and Technology*, 239, 33-43. doi.org/10.1016/j.anifeedsci.2018.03.005

Aviagen. (2014). Ross 308 broiler: Nutrition specification. Retrieved from:http://tmea.staging.aviagen.com/assets/Tech_Center/Ross_Broiler/Ross-308-Broiler-Nutrition-Specs-2014r17-EN.pdf.

Beaman, K., Lilly, K., Gehring, C., Turk, P., & Moritz, J. (2012). Influence of pelleting on the efficacy of an exogenous enzyme cocktail using broiler performance and metabolism. *Journal of Applied Poultry Research*, 21, 744-756. doi.org/10.3382/japr.2011-00430

De Coca-Sinova, A., & Mateos, G. G., González-Alvarado, J., Centeno, C., Lázaro, R., & JiménezMoreno, E. (2011).Comparative study of two analytical procedures for the determination of acid insoluble ash for evaluation of nutrient retention in broilers.*Spanish Journal of Agricultural Research*, 9, 761-768. doi.org/10.5424/sjar/20110903-439-10

Dozier III, W., Behnke, K., Gehring, C.,& Branton, S. (2010). Effects of feed form on growth performance and processing yields of broiler chickens during a 42-day production period. *Journal of Applied Poultry Research*, 19, 219-226. doi.org/10.3382/japr.2010-00156

Engberg, R.M., Hedemann, M. S., & Jensen, B. B. (2002). The influence of grinding and pelleting of feed on the microbial composition and activity in the digestive tract of broiler chickens. British Poultry Science, 43, 569-579.

Glover, B., Foltz, K., Holásková, I., & Moritz, J. (2015). Effects of modest improvements in pellet quality and experiment pen size on broiler chicken performance. *Journal of Applied Poultry Research*, 25, 21-28. doi.org/10.3382/japr/pfv054

Lemme, A., Wijtten P., Van Wichen, J., Petri, A., & Langhout, D. (2006). Responses of male growing broilers to increasing levels of balanced protein offered as coarse mash or pellets of varying quality. *Poultry Science*, 85, 721-730. doi.org/10.1093/ps/85.4.721

Loar II, R., & Corzo, A. (2011). Effects of feed formulation on feed manufacturing and pellet quality characteristics of poultry diets. *World's Poultry Science Journal*, 67, 19-28. doi.org/10.1017/S004393391100002X

Mohammadi Ghasemabadi, M. H., Moravej, H., Shivazad, M., Karimi Torshizi, M. A., & Kim, W. K. (2019). Effects of feed form and particle size; and pellet binder on performance; digestive tract parameters; intestinal morphology; and cecal microflora populations in broilers. *Poultry Science*, 98, 1432-1440. doi.org/10.3382/ps/pey488

Naeini, S. Z., Rezvani, M. R., Akhlaghi, A., Atashi, H., & Daryabari, H. (2013). Effects of different dietary fat and oil supplements on performance, carcass, and blood characteristics in broiler chickens. *European Poultry Science*, *77*(2), 90-95.

Parsons, A., Buchanan, N., Blemings, K., Wilson, M. &, Moritz, J. (2006). Effect of corn particle size and pellet texture on broiler performance in the growing phase.*Journal of Applied Poultry Research*, 15, 245-255. doi.org/10.1093/japr/15.2.245

Thomas, M. van der Poel, A. F. B. (1996). Physical quality of pelleted animal feed 1. Criteria for pellet quality. *Animal Feed Science and Technology*, 61, 89-112. doi.org/10.1016/0377-8401(96)00949-2

Thomas, M. van Vliet , T. & van der Poel , A. F. B. (1998). Physical quality of pelleted animal feed 3. Contribution of feedstuff components. *Animal Feed Science and Technology*, 70, 59-78. doi.org/10.1016/S0377-8401(97)00072-2

Walter, M. (1990). The inclusion of liquids in compound feeds. *Advances in Feed Technology*, 2, 36-48.

Zollitsch, W., Knaus, W., Aichinger, F., & Lettner, F. (1997).Effects of different dietary fat sources on performance and carcass characteristics of broilers. *Animal Feed Science and Technology*, 66, 63-73. doi.org/10.1016/S0377-8401(96)01126-1

تحقیقات کشاورزی ایران (۱۴۰۲) ۴۱(۲)۱۱۶-۱۰۹

مقاله علمی- پژوهشی

اثر منبع چربی و پلت چسبان در جیره غذایی بر عملکـرد رشـد، گوارش‌پذیری پـیش‌سـکومی مـواد مغـذی و خصوصـیات لاشـه جوجه‌های گوشتی راس ۳۰۸

محمد درانی و محمد رضا رضوانی*

بخش علوم دامی دانشکده کشاورزی، دانشگاه شیراز، شیراز، ج. ا. ایران

*نویسنده مسئول

اطلاعات مقاله

تاریخچه مقاله:

تاریخ دریافت: ۱۴۰۰/۱۰/۱۱

تاریخ پذیرش: ۱۴۰۲/۰۲/۱۷

تاریخ دسترسی: ۱۴۰۲/۰۳/۲۲

واژه‌های کلیدی:

پلت چسبان گلوتامین

جوجه های گوشتی

چربی و روغن

کیفیت فیزیکی

گوارش پذیری پیش سکومی

چکیده - این پژوهش، با هدف بررسی اثر دو منبع چربی و سه سطح یک پلت چسبان بر کیفیت پلت، عملکرد رشد، گوارش‌پذیری پیش‌سکومی مواد غذایی و صفات لاشه و اقتصادی جوجه های گوشتی راس ۳۰۸ انجام شد. آزمایش با استفاده از ۲۴۰ قطعه جوجه گوشتی یک روزه در قالب یک آزمایش فاکتوریل ۳×۲ بر پایه طرح کاملا تصادفی با چهار تکرار و ۱۰ پرنده در هر تکرار انجام شد. تیمارهای غذایی شامل دو نوع منبع چربی (روغن سویا و پودر چربی) و سه سطح از یک پلت چسبان تجاری بنام گلوماتین (صفر، دو و چهار درصد در دوره رشد و صفر، سه و شش درصد در دوره پایانی) بودند. داده ها با نرم افزار آماری SAS نسخه ۹/۴ با رویه مدل خطی واکاوی و در سطح احتمال پنج درصد($P \leq 0.05$) با هم مقایسه شدند. پرندگانی که با جیره حاوی روغن سویا و سطح دو پلت چسبان گلوماتین (دو درصد در مرحله رشد و سه درصد در مرحله پایانی) تغذیه شده بودند،دارای بهترین ضریب تبدیل خوراک در کل دوره و بیشترین گوارش پذیری ماده خشک، چربی و سوددهی اقتصادی بودند. بدین ترتیب مشخص شد که افزایش کیفیت فیزیکی پلت که از طریق افزودن پلت چسبان به جیره ی دارای روغن سویا حاصل شده بود دارای حد بهینه‌ای (دو درصد در مرحله رشد و سه درصد در مرحله پایانی) است. بنابراین، پلت بیش از حد بهینه می‌تواند آثار منفی بر ضریب تبدیل غذایی، گوارش پذیری مواد مغذی، و نهایتا سوددهی اقتصادی داشته باشد.