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Original Research

The effect of different physical form feeds and stocking density on performance characteristics of carcass and immunity of broiler chickens

Authors:
Mohammad Mehdi Reyhani[1],
Seyed Naser Mousavi[1],
Ali Afsar[2] and
Hosein Amirabdollahian[3]

Institution:
1. M.Sc. in Animal Nutrition, Islamic Azad University, Varamin Branch. Iran.

2. Ph.D in animal nutrition, Islamic Azad University, Varamin Branch. Iran.

3. M.Sc. in Poultry Breeding and Production Management, Islamic Azad University, Garmsar Branch. Iran.

Corresponding author:
Mohammad Mehdi Reyhani

Email Id:
M.m.reihani@gmail.com

ABSTRACT:

The effect of different physical form feeds (pellet and mash) and stocking density on the growth performance characteristics of carcass and immunity of Ross-308 broiler chicks were studied. A total of 1800 one day-old ross-308 mixed-sex broilers were used in a completely randomized design with six treatments and four replicates of 75 birds each. They were arranged in a 2×3 factorial design: two feed forms (mash and pellet) and three stocking density (10, 14 and 18 bird/m^2). Live body Weight (LW), Weight Gain (WG), Feed Intake (FI) and Feed Conversion Ratio (FCR) were measured periodically (0-10, 11-24 and 25-42 days). Carcass components and litter quality were recorded at the end of the trial (day 45). Also antibody titer against SRBC, and heterophil to lymphocyte ratio were measured in 45 day of age. The highest body weight in grower period was observed in the pellet diet form (p<0.05). Also the highest Body Weight (BW) and Body Weight Gain (BWG) in the starter period was observed in the lowest stocking density treatment (10 bird/m^2) (p<0.05). Physical form of diet had no significant effect on feed intake, BW and FCR throughout the periods. However the broiler feed intake was significantly influenced by stocking density and a decrease in the high stocking density group (18 bird/m^2). Different types of feed and stocking density had no significant effect on carcass characteristics, antibody titer and H:L ratio. Use of pellet form diet and high stocking density treatment (18 bird/m^2) significantly increased broiler litter moisture (P<0.05).

Keywords:
Broiler, density, mash, pellet, performance, stocking.

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INTRODUCTION

Feed constitutes around 60-70 percent of the total cost of broiler production and different commercial feed form (mash, crumble and pellet) are delivered in poultry industry (Banerjee, 1998). The effective utilization of feed is critical in broiler production. Mash is a finely ground and blended feed that gives more prominent unification of growth and is more economical. Pellet is a type of complete feed that is compacted and expelled to around 1.8 inch in diameter and 1.4 inch in long (Banerjee, 1998). Pelleting of feed has a few advantages: expanding the mass thickness of feed and enhancing feed flow capacity. Be that as it may, by and large, pellet or crumble costs somewhat more than a similar proportion in mash form.

Contrasted with mash, pellets enhance bird performance by diminishing feed wastage, mitigating selective feeding, destroying pathogens, enhancing palatability and expanding nutrient digestibility. Some disadvantages of the pellet are pelleting costs about 10% more than producing mash feed and the litter moisture increase when the feed pellets are used (Jahan *et al.,* 2006). Previously, Mingbin *et al.,* (2015) reported higher average daily gain and average daily feed intake for birds fed with the crumble-pellet diets than for those fed the mash diets during starter, grower and the entire experimental period. Chewning *et al*. (2012) announced that broilers fed pelleted diets have higher BW and enhanced feed conversion than those fed mash feed. However, feeding pelleted apportions isn't sufficient to guarantee upgraded performance of poultry. The nature of pellets must be considered too.

Stocking density assumes a critical part in broiler production. Higher mortality, bring down meat production, more noteworthy rate of leg disorders and cannibalism happen at higher stocking densities in broilers. Negative impacts of high stocking densities on broiler performance have been accounted for in past investigations (Dozier *et al*., 2005 and 2006). A lessening in the wind stream at the bird level, which happened at the high stocking densities, could diminish the dispersal of body heat to the air. A lessening in access to water and feed, enhancement ammonia and an unfavorable air quality as a result of reduced air exchange are different components that could adversely impact bird performance. (Feddes *et al.,* 2002). Also, high stocking densities make a strees condition for bird and may decrease immune function, too. Eriflir *et al*. (2002) detailed that there was a critical difference in immune response with an expansion in stocking density in Japanese quails.

The objective of this study was to investigate the effects of feed form (mash and pellet) and different stocking density (10, 14 and 18 bird/m^2) on the performance, immunity and carcass characteristics of the broiler chickens.

MATERIALS AND METHODS

The experiment was divided into three phases, i.e., starter (d 1 to 10), grower (d 11 to 24) and finisher (d 25 to 45). A sum of 1800 one day-old Ross 308 blended sex broiler were utilized as a part of a completely randomized design with six treatments and four duplicates of 75 birds each. They were arranged in a 2×3 factorial design: two feed forms (mash and pellet) and three stocking density (10, 14 and 18 bird/m^2). Initial room temperature was 34°C and was then diminished by 2°C every week until the point that a temperature of 26°C was accomplished. Feed and water were provided ad libitum. On day 1, 11, 25 and 45, chicks were weighed by pen and feed consumption was recorded. Body Weight (BW), Body Weight Gain (BWG), Feed Intake (FI) and Feed Conversion Ratio (FCR) including mortality weight, were calculated for each phase. The compositions of the experimental diets are presented in Table 1.

On day 45, four birds per treatment were randomly selected, weighed and then killed. After

Table 1. Composition of the experimental diets

S. No	Ingredients	Starter (0-10)	Grower (11-24)	Finisher (25-42)
1	Maize	48.53	48.94	52.93
2	Soybean meal	36.5	30.16	25.3
3	Wheat	8	15	15
4	Soybean oil	1.86	1.56	2.52
5	$CaCO_3$	1.74	1.44	1.43
6	Monocalcium phosphate	1.53	1.35	1.27
7	Common salt	0.32	0.27	0.237
8	$NaHCO_3$	0.1	0.1	0.15
9	DL-Methionine	0.32	0.25	0.23
10	Lysine hydrochloride	0.22	0.16	0.174
11	Threonine	0.09	0.06	0.06
12	Vitamin[1] and Mineral[2] Premix	0.3	0.3	0.3
13	Choline chloride	0.1	0.08	0.07
14	Plate binder	0.2	0.15	0.15
15	Coccidio acetate	0.025	0.025	0.025
16	Sorbatox	0.05	0.05	0.05
17	Lupeol	0.1	0.1	0.1
18	Digestrom	0.012	0.012	0.012
	Total	100	100	100

1. The vitamin premix supplied the following per kilogram of diet: vitamin A (retinyl acetate), 8,000 IU; vitamin D3, 1,000 IU; vitamin E (dl-α tocopherol), 30 IU; vitamin K3, 2.5 mg; vitamin B1, 2 mg; vitamin B2, 5 mg; vitamin B6, 2 mg; vitamin B12, 0.01 mg; niacin, 30 mg; d-biotin, 0.045 mg; vitamin C, 50 mg; d-pantothenate, 8 mg, folic acid, 0.5 mg.
2. The mineral premix supplied the following per kilogram of diet: Mn, 70 mg; Fe, 35 mg; Zn, 70 mg; Cu, 8 mg; I, 1 mg, Se, 0.25 mg; Co, 0.2 mg

removal of feathers, feet and head, carcass yield was determined. Cut-up parts such as thigh, breast, thigh, back neck and abdominal fat were weighed. Meanwhile, gizzard, small intestine, heart, liver, spleen and bursa of fabricius were removed and weighed. Blood samples were collected at the 45th day of the study. A total of 8 arbitrarily chosen chickens from each group were tenderly expelled from their rooms and blood samples (0.5 ml) were taken into EDTA tubes for heterophil and lymphocyte counts. Blood smears were prepared utilizing May-Grunwald-Giemsa stain, and heterophil and lymphocytes were checked to total of 60 cells. (Gross and Siegel, 1983). The serum of blood samples in the second tube was separated and used to measure antibody titer against SRBC by ELISA. Antibody titer data were logarithmically transformed before analyses. For the litter quality measurement, litter samples were collected from four points of each replicate and their moisture were measured with oven dray method (1050C for 24h). Data were subjected to 2-way ANOVA by using the GLM procedure of SAS (SAS Institute, 2005).

RESULTS AND DISCUSSION

The results of broiler performance as affected by physical form of feed and stocking density are shown in Table 2. Body weight was significantly affected by physical form and stocking density ($p<0.05$). The highest body weight in grower period was observed in pellet diet form ($p<0.05$). Also, the highest Body Weight (BW) and

Table 2. Effect of different feed form (mash and pellet) and stocking density on broiler performance

	Body Weight (BW)			Body Weight Gain (BWG)				Feed intake				Feed conversion ratio			
	0-11	11-25	25-45	0-11	11-25	25-45	1-45	0-11	11-25	25-45	1-45	0-11	11-25	25-45	1-45
Feed Form															
Mash	260.5	764. 7^{b}	2523.2	221.1	504.2	1758.5	2485.7	314.1	806.8	3571.5	4692.6	1.4	1.6	2.02	1.8
Pellet	269.8	816.6^{a}	2608.7	230.3	547.5	1791.1	2569.1	317.5	820.8	3565	4703.4	1.3	1.5	1.9	1.8
SEM	4.5	14.5	49.2	4.2	15.5	52.5	49.2	6.4	21	113.2	111.4	0.03	0.04	0.03	0.02
Stoking Density															
10	276.0^{a}	787	2573.1	237.1^{a}	511	1786.1	2537.1	341.8^{b}	845.1	3522.6	4692.7	1.4	1.6	1.9	1.8
14	269.87^{ab}	783.8	2533.3	229.5^{ab}	514	1748.1	2491.7	323.3^{b}	806.2	3519.5	4648.8	1.4	1.5	2.01	1.8
18	249.6^{a}	801.2	2591.5	210.5^{b}	552.7	1790.2	2553.5	282.4^{b}	807.1	3662.7	4752.4	1.3	1.4	2.04	1.8
SEM	5.5	17.8	60.3	5.1	19.08	64.3	60.2	7.8	25.7	138.7	136.4	0.03	0.05	0.04	0.02
Mash 10	267.7	752.7	2502.5	228.5	485	1749.7	24.69	346.6	808.7	3407.5	4563.2	1.5	1.6	1.9	1.8
Pellet 10	284.2	821.2	2643.7	245.7	537	1822.5	2605.2	337.1	847.5	3637.7	4822.3	1.3	1.5	1.9	1.8
Mash 14	271.0	739.7	2509.7	231.07	468.7	1770	2469	312.1	792.5	3666.7	4771.1	1.3	1.6	2.06	1.9
Pellet 14	268.7	828	2557	228.1	559.2	1726.2	2513.7	334.3	820	3372.2	4526.3	1.4	1.4	1.9	1.8
Mash 18	242.7	801.7	2557.5	203.8	559	1755.7	2518.6	283.6	819.2	3640.2	4743.2	1.3	1.5	2.06	1.8
Pellet 18	256.5	800.7	2625.5	217.1	546.5	1824.7	2588.3	281.3	795	3685.2	4761.6	1.3	1.4	2.01	1.8
SEM	7.8	25.2	85.3	7.28	26.9	90.9	85.2	11	36.3	196.2	193	0.05	0.08	0.05	0.04

a,b Means in column not sharing a common superscript are significantly different ($P<0.05$)

Table 3. Effect of different feed form (mash and pellet) and stocking density on carcass characteristics and some inner organ weight (%)

Treatment		Breast	Thigh	Back	Gizzard	Small intestine	Abdominal fat	Heart	Liver	Spleen	Bursa
Feed form	Mash	20.19	20.66	16.03	1.92[a]	1.78	1.45	2.02	2.31	0.1	0.11
	Pellet	20.53	20.33	15.97	1.65[b]	1.89	1.48	0.53	2.24	0.1	0.11
SEM		0.3	0.1	0.3	0.04	0.03	0.07	1.00	0.03	0.03	0
Stock density											
	10	20.45	20.57	15.96	1.75	1.88	1.44	0.66	2.21	0.09	0.12
	14	20.55	20.50	15.49	1.80	1.80	1.46	2.7	2.29	0.1	0.11
	18	20.07	20.42	16.54	1.80	1.82	1.5	0.4	2.32	0.1	0.11
SEM		0.3	0.2	0.4	0.05	0.03	0.08	1.2	0.04	0.0	0.0
Interaction											
Mash	10	20.1	20.70	15.89	1.89	1.87	1.44	0.72	2.28	0.10	0.12
Pellet	10	20.8	20.44	16.04	1.61	1.89	1.43	0.60	2.15	0.09	0.11
Mash	14	20.93	21.04	15.65	2.01	1.71	1.38	4.96	2.36	0.09	0.11
Pellet	14	20.18	19.96	15.33	1.59	1.88	1.53	0.48	2.23	0.10	0.11
Mash	18	19.53	20.24	16.56	1.85	1.75	1.51	0.37	2.28	0.10	0.11
Pellet	18	20.60	20.59	16.53	1.75	1.89	1.49	0.52	2.35	0.10	0.11
SEM		0.54	0.29	0.61	0.07	0.05	0.12	1.76	0.06	0.005	0.001

a, b Means in column not sharing a common superscript are significantly different ($p<0.05$)

Body Weight Gain (BWG) in starter period was observed in the lowest stocking density treatment (10 bird/m^2) ($p<0.05$). Physical form of diet had no significant effect on feed intake, BW and Feed Conversion Ratio (FCR) throughout the periods. However the broiler feed intake was significantly influenced by stocking density and the decrease in the high stocking density group (18 bird/m^2).

Similarly, Mingbin *et al*. (2015) indicated that the use of pellet form in broiler diet had positive effects on body weight. However, the pellet form diet had no significant effect on other performance parameters (BWG, feed intake and FCR). These results were in agreement with Salari *et al*. (2006), who found that the form of diet and particle size had no significant effect on weight gain and dry matter intake. This observation suggested that high pellet quality may be necessary to fully obtain benefits of pelleting. Birds at normal stocking density (10 birds/m^2) resulted in better body weight in starter period compared with the high stocking density (18 birds/m^2). This indicates to a greater degree of stress on the performance. However, other performance parameters in other periods weren't affected by different stocking density. Additionally, Buijs *et al*. (2009) detailed that at body weight 39 days of age was not significant between birds raised at various stocking densities (6, 15, 23, 33, 35, 41, 47 and 56 kg /m^2). Interestingly, Houshmand *et al*. (2012) revealed that amid the growing stage (22-42 days) broilers raised at a high density had a inferior FCR contrasted and birds housed at normal density.

As shown in Table 3, all carcass parameters (carcass, breast, thigh, back and neck), abdominal fat, some inner organ weight (small intestine, heart, liver, spleen and bursa of Fabricius) except for the gizzard percent weight were not significantly ($p>0.05$) influenced by the form of the diet and different stocking density. Use of mash diet significantly increased the gizzard percent weight ($p<0.05$). A similar observation was also recorded by Ravindran and Thomas (2004) who reported that carcass characteristics weren't affected by stocking density. Previously, Ghorbani *et al*. (2012)

Table 4. Effect of different feed form (mash and pellet) and stocking density on immunity and litter quality

S. No	Treatment		SRBC	H/L (%)	Litter moisture (%)
1	Feed form	Mash	9.52	0.31	9.55b
2		Pellet	9.47	0.31	12.12a
3	SEM		0.5	0.00	0.5
4	Stock density				
5		10	10.12	0.318	8.66[b]
6		14	9.20	0.306	8.11[b]
7		18	9.16	0.310	15.74[a]
8	SEM		0.7	0.008	0.7
9	Interaction				
10	Mash	10	10.91	0.32	9.26[b]
11	Pellet	10	9.33	0.31	8.07[b]
12	Mash	14	9.08	0.30	7.91[b]
13	Pellet	14	9.33	0.30	8.32[b]
14	Mash	18	8.58	0.30	11.5[b]
15	Pellet	18	9.75	0.32	19.98[a]
16	SEM		1.03	0.01	0.9

a, b Means in column not sharing a common superscript are significantly different ($p<0.05$)

reported that the relative weight of gizzard increases by mash diet in compared with pellet form diet. The increase in relative weight of gizzard may enhance the digestive capacity of broilers.

Mean antibody titers to sheep red blood cell, H: L ratio and litter moisture are presented in Table 4. Different physical feed type and stocking density had no significant effect on the antibody titers to sheep red blood and H/L ratio in the broiler chicks. However the litter moisture was significantly influenced by treatments ($p<0.05$). Use of pellet form diet and high stocking density treatment (18 bird/m^2) significantly increased broiler litter moisture ($P<0.05$). The H:L proportion is a typical marker of stress in poultry (Heckert *et al*. 2002), and the blood leukocyte profile is impacted by stress. Decrease in the quantities of lymphocytes and monocytes and improvement in the quantities of heterophils, which prompts a higher H:L proportion, have been accounted for stressed animals (Stevenson and Taylor, 1988). Previously, Houshmand *et al*. (2012) reported that density had no significant effect on the heterophil: lymphocyte ratio too. In high stocking density, especially in hot and wet weather, litter moisture also gets increased and causes the increase in bacterial activity and ammonia production. Increased mortality can be explained by decreased animal welfare, such as bad air and litter quality, poor immune response, and poor feed intake. Litter quality has a large effect on dermatitis (Haslam *et al*., 2006).

CONCLUSIONS

Results showed that the use of pellet form diet and normal stocking density (10 bird/m^2) can improve broiler body weight and litter quality.

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