Research Article

The Impact of Different Dietary Forms (Mash, Crumble and Pellets) on Some Growth Traits and Carcass Characteristics of Broilers

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Abstract | This study was conducted to investigate the effect of different physical forms of diet (mash, crumble, and pellets) on some growth traits and carcass characteristics of broilers. Chicks (n=300, Ross 308) were distributed in a factorial arrangement with 3 treatments and 2 replicates (50 birds/replicates). The weight gain (WG), feed intake (FI), feed conversion ratio (FCR), and mortality rate were measured during the experimental periods (1-42 d). Some carcass traits were recorded at the end of the experiment (42 days) including weight of carcass, thigh, breast, and abdominal fat. Results revealed that WG and FI were significantly (P<0.05) improved and FCR was significantly (P<0.05) lower in broiler fed crumble and pellet diet than mash during the three periods (22-32 d, 33-42 d and 1-42 d). The significant (P<0.05) improvement was also found in carcass weight, thigh and breast. The superiority of broiler fed crumble and pellet was extended to include each of Performance Index (PI), European Production Efficiency Factors (EPEF) and European Broiler Index (EBI). The mortality rate was not significantly differed across all three diet forms. The results of the present study give an impression that crumble and pellet form of feed is better than mash for the productive performance of commercial broiler during the age of 21 to 42 days.

Keywords | Diet form, Growth traits, Broiler, European Broiler Index, Performance Index

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INTRODUCTION

In the modern broiler industry, all efforts were focused on rapid growth rate along with lowering of the production cost. The rapid growth rate depends on feed intake. Moreover, the feed play an essential role in the cost of broiler production and it could represent 70% of the total cost (Behnke and Beyer, 2002). The dietary physical forms (mash, crumble, and pellets) considered as one of the most important factor that could affect the growth rate (Jafarnejad et al., 2010). However, diet forms are directly influences the cost of feed and production performance of broiler (Zohair et al., 2012). The cost of feed will arise due to the process of preparation the different dietary forms. Moreover, Julian (1993) reported a high mortality rate in broilers fed pellet diet, due to an increased incidence of ascites syndrome. Generally, the diet could be offered in three forms, Mash, crumble and pellet. Mash is finely ground and mixed ingredients. This form of diet will not allow the birds to easily separate out the ingredients; each mouthful provides a well- balanced diet and will lead to better uniformity of growth and more economic revenue. However, ground feed is not so palatable and does not retain its nutritive value as compared with ungrounded feed (Jahan et al., 2006).

Crumble and pellet diet are really a modification of the mash. Pellets prepared by mechanical pressing of mash into hard dry form. When pellets regrinding to small and smallest pieces we will get crumble and mash, respectively.

Pellets have several advantages compared to mash such as improving of feed conversion, feed intake and broiler performance (Behnke, 1994; Nir et al., 1995; Amerah et al., 2008; Chewning, 2010).

There is a confliction in results concerning the impact of the diet form on the performance of broiler. Reece et al. (1984) observed that best feed conversion was obtained with a feeding of crumble form, while Mendes et al. (1995) showed that birds fed mash diets had better feed conversion efficiency than those given the pellet. Jahan et

al. (2006) reported that crumble form of feed is better than mash and pellet form for the production of the commercial broiler for the age duration of 21 to 56 days. These results were confirmed by Ommati et al. (2013) and Lv et al. (2015). On the other hand, Lal and Atapattu (2007) and Ahmed and Abbas (2012) concluded that the growth traits of broiler did not affect significantly by the inclusion of different forms of diets.

The enhancing of broiler performance fed crumble or pellet could be attributed to increased digestibility, decreased ingredient segregation, decrease feed wastage, reduced energy utilization during prehension and improved palatability (Behnke, 1998). Bolton and Blair (1977) reported that feed intake of broilers could be up to 10 per cent greater with crumble or pellets compared with mash. However, pellets are about 10% more expensive than the mash. Besides, it was found that the incidence of sudden death syndrome was significantly higher for broilers fed pellet than mash (Proudfoot and Hulan, 1982). Furthermore, Atapattu et a1. (2005) found that the broilers fed on crumble diets are less active than the birds fed on mash diets suggesting possible welfare implications associated with pelleted diets. When mash diets are pelleted, starch and proteins in the diets are subjected to thermal modifications. These changes considered among the possible reasons for improved performance of broilers when fed with pellets (Behnke, 1994). In the present experiment, we fed broiler chicks with pellets, crumble and mash form of the same diet by regrinding the pellets, to test the hypothesis that the feeding of pelleted diet, crumble and mash form diet resulting from the regrinding of the same pellets should give similar performance.

MATERIALS AND METHODS

This study was conducted at the poultry farms, Faculty of Agriculture / University of Thi-Qar for the period from 5/9/2015 to 16/10/2015. A total of three hundreds one day-old commercial broiler chicks (Ross, 308) were used. They were distributed randomly into three groups. Each group with two replicated pens and each pen included 50 chicks. All groups were fed the diet (mash) for the first three weeks, then one of these groups still fed the mash till the end of experiment, whereas, the second and third groups fed crumble and pellets respectively. The pellets of the same diet were ground to get two forms of ration (crumble and mash).

The chicks were used with an average weight of 42.24 ± 1.29 gm and 2.7% coefficient of variation (CV). Vaccination for Mark's disease performed at the hatchery while vaccinations for Newcastle and infections bronchitis disease were done at 5 and 27 day of age. Vaccination for infections bursal disease fallowed at 11 and 20 day of age. The diet of birds was formulated according to the NRC (1994) recommendations to meet the nutrient requirements of broilers. The composition of broiler starter and finisher diets are shown in Table 1 and 2.

Table 1: The composition of broiler starter diet

Ingredients	%
Maize	65.20
Ground nut meal	27.40
Wheat bran	1.50
Super concentrates*	5.00
Dicalcium phosphate	0.50
Sodium chloride	0.10
Mycotoxin binder	0.10
Organic acids	0.20
Calculated analysis	
ME (kcal/kg)	2904.12
CP%	20.51
Crude fiber%	5.20
Ca%	0.49
Available phosphorous%	0.44
Lysine%	1.00
Methionine%	0.43
Methionine + Cystine%	0.76
Determined analysis	
DM%	97.75
CP%	22.20
Crude fiber%	3.55
EE%	3.75
Ash%	6.25

*Cp 40% ME 2000 kcal/kg, C. fiber 3%, EE 3%, Ash 34%, Ca 8%, Av. P 1.38%, Lysine 12%, Methionine 3%, Methionine+Cystine 3.5%, Vitamin A250000 IU/kg, Vitamin D3 50000 IU/kg, Vitamin E 500 mg/kg, Vitamin K3 60 mg/kg, Vitamin B1/ thiam in 20 mg/kg, Vitamin B2/Riboflavin 100 mg/kg, Niacin Vitamin PP 600 mg/kg, Pantothenic acid/ Vitamin B3 160 mg/kg, Vitamin B6/ Pyridoxine 40 Mg/kg, Vitamin B12 300Mcg/kg, Biotin, Vitamin H 2000 Mcg/kg, Choline 10000 Mg/kg, Vitamin C 4000 Mg/kg, Folic Acid 30 Mg/kg Iron 800 Mg/kg, Manganese 1400 Mg/kg, Copper 120 Mg/kg, Zinc 1000 Mg/kg, Iodine 6 Mg/kg, 12 mg/kg, Selenium 3 Mg/kg.

Statistical Analysis

Statistical analysis of the data was carried out using SAS software. One-way analysis of variance (ANOVA) was performed and least significant difference (LSD) was used to detect significant differences between means. ($P<0.05$) was considered significant.

Productive Index (PI) was calculated according to the following formula (Euribrid, 1994):

$$\text{Performance Index (PI)} = \frac{\text{Live weight in kg}}{\text{Feed conversion ratio}} \times 100$$

European Production Efficiency Factors (EPEF) and European Broiler Index (EBI) were calculated according to the following formulas (Marcu et al., 2013):

$$\text{EPEF} = \frac{\text{Viability (\%) x BW (kg)}}{\text{Age (day) x FCR(kg feed/kg gain)}} \times 100$$

$$\text{EBI} = \frac{\text{Viability (\%) x ADG (g/chick/day)}}{\text{FCR (kg feed/kg gain) x 10}}$$

Where:
BW=body weight
FCR=feed conversion ratio
ADG=average daily gain
Variability= the survival rate

RESULTS AND DISCUSSION

Table 3 showed the different parameters of growth performance including WG, FI, FCR, and mortality rate of broiler chicks fed on crumble, pellet and mash diets. Results revealed that broilers fed crumble and pellet diet grew faster ($P \leq 0.05$), consumed more ($P \leq 0.05$) feed and have lower FCR from 22 to 32 d, 33 to 42 d, and 1 to 42 d as compared with mash. Broiler chicks fed crumble had the highest WG (1037.45 g), FI (2085.28 g) and lowest FCR (2.01) in 22-32 d. The corresponding estimations for WG, FI and FCR were 573.21 g, 1369.97 g and 2.38 in 33-42 d and 2093.75 g, 4300.07 g and 2.05 in 1-42 d respectively. These results confirmed the superiority of crumble and pellet diets compared with mash which was reported by

Table 2: The composition of broiler finisher diet

Ingredients	%
Maize	67.10
Ground nut meal	22.50
Wheat bran	4.50
Super concentrates*	5.00
Dicalcium phosphate	0.50
Sodium chloride	0.10
Mycotoxin binder	0.10
Organic acids	0.20
Calculated analysis	
ME (kcal/kg)	2896.45
CP%	19.00
Crude fiber%	5.00
Ca%	0.39
Available phosphorous%	0.41
Lysine%	0.90
Methionine%	0.37
Methionine + Cystine%	0.68

* The same as in Table 1

Table 3: Some productive traits of broiler fed on crumble, pellet and mash

Period/day	Treatments			
	Crumble	Pellet	Mash	P
Starter (1-21 d)				
WG/g	483.09±20.66	478.11±21.95	493.54±17.23	NS
FI/g	845.40±31.22	841.47±29.58	858.75±26.23	NS
FCR	1.75	1.76	1.74	NS
Grower (22-32 d)				
WG/g	1037.45±24.88^a	994.76±29.87^a	892.64±28.66^b	<0.05
FI/g	2085.28±202.2^a	2009.41±166.54^a	1874.54±144.21^b	<0.05
FCR	2.01^b	2.02^b	2.10^a	<0.05
Finisher (33-42 d)				
WG/g	573.21±66.61^a	565.33±73.88^a	495.76±92.72^b	<0.05
FI/g	1369.97±133.21^a	1345.48±111.08^a	1274.10±174.49^b	<0.05
FCR	2.38^b	2.39^b	2.57^a	<0.05
Total (1-42 d)				
WG/g	2093.75±205.23^a	2038.20±211.64^a	1881.94±187.99^b	<0.05
FI/g	4300.65±322.78^a	4196.36±277.41^a	4007.76±256.43^b	<0.05
FCR	2.05^b	2.06^b	2.13^a	<0.05
Mortality rate (%)	8.3	7.5	6.7	NS

Means with different subscript letter in the same row differ significantly.

Table 4: Carcass characteristics of broilers at 42 days age for the different dietary forms

Weight/g	Crumble	Pellet	Mash	P
Carcass weight	1465.36±132.54[a]	1406.08±133.21[a]	1279.55±155.23[b]	< 0.05
Thigh	439.51±14.22[a]	407.19±14.12[a]	377.10±12.32[b]	< 0.05
Breast	375.73±27.54[a]	366.44±25.77[a]	338.23±25.65[b]	<0.05
Abdominal fat	49.12±3.57[a]	47.77±3.22[a]	44.20±2.37[b]	< 0.05

Table 5: Performance index (PI %) of the broilers for the different dietary forms

Age	Treatments			
	Crumble (PI %)	Pellet (PI %)	Mash (PI %)	P
(d 1-21)	27.60	27.16	28.36	NS
(d 1-32)	75.41[a]	73.64[b]	66.14[b]	<0.05
(d 1-42)	87.56[a]	85.36[b]	73.12[c]	<0.05

Table 6: European Production Efficiency Factors (EPEF) of the broilers for the different dietary forms

Age	Treatments			
	Crumble (EPEF)	Pellet (EPEF)	Mash (EPEF)	P
(d 1-21)	126.19	125.47	126.82	NS
(d 1-32)	216.78[a]	205.98[b]	197.01[b]	<0.05
(d 1-42)	191.29[a]	186.92[b]	165.53[c]	<0.05

Table 7: European Broiler Index (EBI) of the broilers for the different dietary forms

Age	Treatments			
	Crumble (EBI)	Pellet (EBI)	Mash (EBI)	P
(d 1-21)	122.23	121.53	121.42	NS
(d 1-32)	211.48[a]	200.08[b]	192.38[b]	<0.05
(d 1-42)	186.33[a]	181.77[b]	160.92[c]	<0.05

several researchers (Amerah et al., 2007; Zang et al., 2009; Dozier et al., 2010; Zohair et al., 2012; Lv et al., 2015). The advantage of crumble and pellet may result from an increase in appetite and diet density and a decrease in feed waste (Jensen, 2000).

Skinner-Noble et al. (2005) indicated that pellet rations increased available dietary energy for WG, which improved feed efficiency by reducing the time spent eating and increasing the time spent resting. Nutrient digestibility may have been increased by pelleting in contrast to mash rations (Zelenka, 2003). Some most recent studies have used advanced techniques like nanotechnology that were also based on the same hypothesis as we have adopted in our study (Salah-Eldin et al., 2015). Greenwood et al. (2005) demonstrated a high rate of growth and increased digestible lysine requirements for optimal WG and feed efficiency in pellet-fed broilers compared with mash-fed broilers from 16 to 30 d of age.

However, our results disagreed with Jahan et al. (2005), Agah and Norollahi (2008) and Sogunle et al. (2013) who found that the effect of diet forms on the productive performance of broiler was not significant. Results also showed that the difference in mortality rate among the three diet forms was not significant. This result agree with the finding of several researchers (Nir et al., 1995; Engberg et al., 2002; Scott, 2002; Agah and Norollahi, 2008) but disagreed with result obtained by Brickett et al. (2007) who found that feeding mash decreased mortality (3.8%) compared with feeding pelleted feed (5.6%).

In our study, the superiority of broiler fed on crumble and pellet diets was extended to include carcass weight, thigh, breast and abdominal fat as all estimations of these traits were significantly (P< 0.05) higher than mash (Table 4). The highest estimations of carcass weight (1465.36 g), thigh (439.51 g) and breast (375.73 g) found in crumble form. Similar results were obtained by Brickett et al. (2007).

Results also showed that the three indexes (PI, EPEF, and EBI) for broiler chicks fed on crumble and pellet were significantly (P< 0.05) higher than mash. Similar results were found by Jahan et al. (2006) concerning PI. The results of the present study give an impression that crumble and pellet form of feed is better than mash for the productive performance of commercial broiler at the age of 21 to 42 days.

CONFLICT OF INTEREST

Author declares no conflict of interests for the contents in the manuscript.

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