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INFLUENCE OF DIFFERENT FEED FORMS AND PARTICLE SIZE ON EFFICIENCY OF BROILER PRODUCTION

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ABSTRACT: The influence of different feed forms and particle size on feed and water intake, live body, carcass weight, internal organs weight and the performance in broiler chicks was examined. A total one hundred and fifty chicks were distributed into groups A, B and C. Group A was served with mash feed, and group B and C were fed with crumble feed of 1, 2 and 3 mm and 1.5, 2.5 and 3.5 mm particle size each at a pre-starter, starter and finisher phases, respectively. Result show that feed forms had significant influence on the growth of broilers. Feed and water intake also live body weight in crumble fed group C were higher ($P<0.05$) than group B and A. Alongside carcass weight in group C was also higher than group B and A. The broiler liver, heart, gizzard and intestine weight found higher in group C than group B and A significantly ($P<0.01$). In conclusion, the crumble feed form showed improvement of growth in broiler chicken. The crumble feed form of 1.5, 2.5 and 3.5 mm particle size at pre-starter, starter and finisher ration may be preferred for higher production and feed conversion ratio in broiler chicken.

Keywords: Broiler, Crumble, Feed form, Mash, Pellet, Production

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INTRODUCTION

The feed cost is estimated at 60-70 percent of total production costs in broiler farming. The feed processing contributes a significant portion of feed cost (Nolan et al., 2010). Beyond the nutritional adequacy the physical form of feed are important factor in yielding meat of broiler (Behnke and Beyer, 2004). Feeding a pelleted diet improves animal performance and feed conversion ratio as compared with feeding a meal form of a diet, pellet attributed to decreases feed wastage, selective feeding, ingredient segregation also less time and energy expended for feed prehension, destruction of pathogenic organisms and improved palatability (Behnke, 1994). Various strategies can be employed to satisfactory feed particle adhesion, nutrient availability as well manufactured high physical quality pellets; yet, challenges remain in the employment of such schemes (Moritz and Lilly, 2010).

The feed intake of broiler chicken has been reported to be ten percent more than in crumble feed form as compared with mash. Crumble is a type of feed form prepared at the feed mills through crushing the pelleted feeds forms to a consistency coarser than mash feed (Mirghelenj and Golian, 2009). Mash form gives a better unification of growth, less loss and more economical. The ground feed is not much palatable and does not retain their nutritive value as well as ungrounded feed (Jahan et al., 2006). Generally as compared to mash feed form the feeding of pellets feed forms improves broiler growth rate with an increased feed intake (Nir et al., 1994).

Pellet can improve the early growth rate and performance of broiler production as extending the feeding period. Mash or crumble feed followed by pellets has been resulted in similar growth performance in later stage of the age periods (Cerrate et al., 2008). Current study was planned to the influence of different physical feed forms and particle size on broiler performance, feed and water intake, live body and carcass weight, and weight of internal organs in broiler chicks was examined moreover, beneficial effects in different phases of broiler production.

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MATERIALS AND METHODS

Chick sexing

All the experiments were conducted in accordance with the Sindh Agricultural University Tandojam Animal health care committee guidelines. 1 Day-old Hubbard male broilers (n=150) were obtained from commercial hatchery. Immediately, after arrival of chicks at the research station sexing was performed by feather sexing method, from the primary and secondary feathers located on the chick's wings. The broiler chicks were initially weighed, and equally divided into three (n=50) groups namely A, B and C. All the chicks were reared up to 42 days on three different feed forms. Standard housing requirements for broiler chicks were allocated.

Chicks grouping and feed ration

The chicks in group A were fed with mash as control. Group B with crumble feed 1, 2, and 3 mm particle size to pre starter, starter and finisher ration respectively, and Group C was fed with crumble feed 1.5, 2.5 and 3.5 mm particle size to pre starter, starter and finisher ration respectively. Broiler fed in starter diets containing 22% CP, 3000 kcal/Kg/ME and finisher diet 19% CP, and 3200kcal/Kg/ME to all forms of feed. *Ad libitum* standard feed and fresh water were supplied to the birds. Refusal of feed and water was deducted from feed and water offered; finally, the daily water consumption was recorded. Mortality was recorded daily, at the age 4th and 6th week, ten broilers from each group were selected randomly euthanized by cervical dislocation to calculate the weight of carcass and weight of edible and non-edible parts. Based on dressing carcass, dressing percentage was calculated. For assessment of incomes and net returns from the experimental rations in relation to feed forms per bird cost for each group was worked out, and net returns were calculated.

Statistical Analysis

Assessment between mean values of all the experimental groups were carried out using one way ANOVA followed with student t test and presented as means ± standard error of means (SEM). The differences were considered statistically significant if $P<0.05$.

RESULTS

Feed and Water consumption

Effects of different feed forms on broiler feed and water consumption are shown in Table 1. The present findings indicate that the broiler of group C fed crumble feed of 1.5, 2.5 and 3.5 mm particle size consumed more feed and water as compared to group B (crumble feed of 1, 2 and 3 mm particle size) and control group-A, However, the differences were statistically non-significant ($P>0.05$) between groups, but highly significant ($P<0.05$) for weeks (Table 1).

Live body weight and FCR

Effect of different feed forms on live body weight of broiler was highly significant ($P<0.01$) live body weight was higher in broiler of group C (2248.04 g/b) than group B and A (Table 2). The feed conversion ratio was remarkably superior (1.72) in group C, while being moderate (1.81) in broiler of group B, a relatively poor feed conversion ratio of 1.89 was recorded in broiler of group A fed mash feed.

Carcass weight and dressing percentage

Average carcass weight and dressing percentage of broiler fed different feed forms at the age of 4th week and 6th week are presented in Tables 3 and 4, respectively. Carcass weight of 815.60 g/b after 4 weeks age with 59.86 dressing percentage was higher in group C broiler significantly ($P<0.01$) than group B and A in both parameters at 4th-week of age, although the broiler fed mash feed produced lowest carcass weight of 557.20 g/b from 1024 g/b live body weight with 54.16 dressing percentages. At the end of the experiment at the age of 6th week the carcass weight was also higher (1366 g/b) with 60.39 dressing percentage in group C broiler than group B broiler (1278 g/b) with 59.33 dressing percentages and group A (1150 g/b) with 57.68 dressing percentages significantly ($P<0.05$).

Internal organs weight

Internal organs weights of broiler fed different feed forms at the age (4th week), and final periods (6th week) is presented in Tables 03 and 04. The liver, heart, gizzard and intestine weights after 4 weeks of slaughtering were higher significantly ($P<0.05$) in group C broiler i.e. 42.60, 10.80, 38 and 90 g/b than 38, 9.80, 34.60 and 88.60 g/b in group B and lowest weights of 37.60, 7.80, 31.20 and 68.40 g/b in group A broiler was recorded respectively

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(Table 3). Similarly, after six weeks age, the liver, heart, gizzard and intestine weights were higher in group C significantly (P<0.05), i.e. 51.55, 11.02, 39.55 and 127 g/b than 50.78, 10.38, 36.43 and 122.60 g/b in group B and lowest weights of 47.82, 9.61, 34.27 and 117.20 g/b in group A, respectively (Table 4). Statistically, the differences in both periods were significant between groups (P<0.05).The net returns of broiler after selling was beside studied, the broilers in group C generated greater net profit than group B and A with more net return (data not shown).

Table 1.

Age (Week)	A		B		C	
	Feed	Water	Feed	Water	Feed	Water
1	114.24	266.98	117.11	297.22	119.56	305.97
2	274.47	644.00	284.27	735.00	289.38	777.98
3	496.51	1727.02	526.40	1477.98	502.95	1484.00
4	768.32	2167.97	776.09	2177.00	788.69	2221.03
5	968.10	2536.03	997.78	2825.97	1016.26	2814.00
6	1108.24	3178.00	1112.86	3353.98	1138.76	3566.01
Total	3729.88 [a]	10220.00[b]	3814.51 [a]	10867.15[b]	3855.60 [a]	11168.99 [b]

Average feed (g/b/week) and water (ml/b/week) consumption of broiler fed different feed particle size and forms (n=50). Means followed by different letters in the rows are significantly different (P<0.05)

Table 2.

Age (Week)	A	B	C
0	37.710	38.250	38.970
1	135.30	153.83	164.14
2	285.26	351.56	369.58
3	600.12	725.68	766.86
4	1128.42	1288.3	1345.5
5	1624.02	1751.2	1785.6
6	1977.54 [c]	2110.66 [b]	2248.04 [a]

Average live body weight of broiler fed different feed forms (g/b/week). [abc] Means followed by different letters. [abc] in the rows is significantly different (P<0.05)

Table 3.

Groups	Live weight	Carcass	Dressing %	Liver	Heart	Gizzard	Intestine
A	1024 [b]	557.20 [b]	54.16 [b]	37.60 [b]	7.80 [a]	31.20 [b]	68.40 [a]
B	1346 [a]	789.20 [a]	58.63 [a]	38.0 [ab]	9.80 [a]	34.60 [a]	88.60 [a]
C	1363 [a]	815.60 [a]	59.86 [a]	42.60 [a]	10.80 [a]	38.00 [a]	90.00 [a]

Average live weight, carcass, dressing %age, liver heart, gizzard and intestine weights (gm) of broiler fed different feed forms at an early period (4th week). [ab]Means followed by different letter in the column are significantly different (P<0.05)

Table 4.

Groups	Live weight	Carcass	Dressing %	Liver	Heart	Gizzard	Intestine
A	1992 [b]	1150 [b]	57.68 [b]	47.82 [b]	9.61 [a]	34.27 [b]	117.20 [a]
B	2153 [a]	1278 [a]	59.33 [a]	50.78 [a]	10.38 [a]	36.43 [ab]	122.60 [a]
C	2261 [a]	1366 [a]	60.39 [a]	51.55 [a]	11.02 [a]	39.55 [a]	127.00 [a]

Average live weight, carcass, dressing %age, liver heart, gizzard and intestine weights (gm) of broiler fed different feed forms at an early period (6th week). [ab]Means followed by different letters in the column are significantly different (P<0.05)

DISCUSSION

There are various physical forms of broiler feed, which are commonly used, i.e. mash, pellet and crumble. Mash form of feed is a complete feed form, that is ground and mixed together thus the chicks cannot easily separate out different mixed ingredients (Jahan et al., 2006); a pellet feed form is a modification in the mash feeding form, the mechanically or automatically pressing the mash feed form into hard and dry pellets or artificial grains is called pellet feeding system or form (Nir et al., 1994). First few weeks after hatch feeding to broilers is typically important. Fed either mash or crumble, more frequently early age feeding is by crumbling or crushing the large pellet (crumble). Mash or crumble feed followed by pellets has resulted in similar production in later age

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periods, therefore the correlations in favor of processed feeding different feed forms is observed between performance at an early age and at slaughter age of broiler (Cerrate et al., 2008).

In our experiment feeding and weight gain significantly increased in the group fed larger particle crumble feed, there is evidence from the present investigation that coarser feed grinding to a uniform feed particle can improve the performance of broiler chicken as compared to those feeding on mash feeding system. This effect positive effect may result from the particle size on gizzard development. Developed of gizzard is related with improved grinding activity. Our results agree with results of Abdollahi et al. (2011), where pelleted diets significantly increased the live weight and consumed more feed than feeding mash feed form diets. Possibility birds fed pellet diets consumed greater digestible protein results in significantly increased the live weight (Abdollahi et al., 2011).

Results of the current study are also in agreement with those of Dozier et al. (2010); who studied the effect of different feed form on the feed quality and broiler efficiency and identified that crumble improved feed efficiency and consume more feed over the corresponding mash feed. While Johannes (2001) found chickens on crumbles had the highest body weight at 42 days of age, followed by the chickens on the mash diet.

The best feed conversion was achieved on crumbles and ensured the heaviest body weight and the most efficient feed conversion on any given feed specification (Johannes, 2001). Jahan et al. (2006) reported that the higher, middle and the lower body weight were observed by feeding crumble, pellet and mash feed forms, respectively, in addition the live body weight gain was also higher in crumble feeding group. While Amerah et al. (2007) highlighted this counterintuitive cause may results from on the gizzard development from the progressive effect of feed particle size. Developed of gizzard is associated with increased grinding activity, significant in increased gut motility and better digestion of nutrients. It was suggested particles more than one mm in poultry diets to stimulate the development of gizzard (Nir et al., 1994).

Christopher et al. (2006) recommended that any mash or pelleted feeding can be used depending on the farmers' preferences; while Galobart and Moarn (2005) used mash and pelleted feed for broilers and found no major difference in the growth rate at the early age of growth up to later period of age of the birds fed on mash and those fed on pellets.

Mortality during the present trial was insignificant only five out of the 150 birds died and the mortality was not linked to any definite treatment, the net profit were also more in pellet fed birds (Data not shown), The entire success of the broiler industry can be improved by the physical pellet quality, nutrient availability and feed manufacture (Moritz et al., 2010).

The current study illustrates the influence of particle size on broiler performance; particle size for broiler feed is important factor expected size should not compromise in chickens feed, Mash diet decreases feed efficiency than crumble feed. The feed, water intake and body weight gain are positively connected with the production of broiler. In conclusion, present study emphasized that crumble feed of 1.5, 2.5 and 3.5 mm particle sizes in pre-starter, starter and finisher ration are preferred for higher broiler weight gain and receiving more net incomes.

Author's contribution

F Nabi and MI Rind participated in the design of study. F Nabi and M Zulqarnain performed the experiments, IBM, MK Iqbal analyzed the data. MS and MR critically revised the manuscript for important intellectual contents. F Nabi wrote the manuscript. All authors read and approved the final manuscript.

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Competing interest

The authors have declared that no competing interests exist.

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