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INFLUENCE OF FEED RESTRICTION REGIMES ON GROWTH PERFORMANCE OF BROILERS WITH DIFFERENT INITIAL WEIGHT CATEGORIES

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ABSTRACT

A total of 1440 day-old broiler (Hubbard) chicks with 4 initial body weight categories i.e. small (31-34gm), medium (35-38gm), A (39-42gm) and A+ (43-46gm) were subjected to 4 feed restriction regimes i.e. ad-libitum, 1, 2, and 3 hour restriction with 3,2, and 1 hour feeding, respectively, after observing one week adjustment period. These 16 treatment groups were replicated 6 times making a total of 96 experimental units having 15 chicks each. The experiment was laid out in Completely Randomized Design (CRD) with two factors. Weekly data on feed intake, body weight gain, FCR, mortality and production efficiency factor (PEF) were analyzed using SAS 9.1. Birds with 1-hr feeding-3hrs off showed better performance with significantly ($P<0.05$) improved FCR having overall lower mortality rate, whereas, chicks from A+ weight category showed significantly better FCR. A better PEF was recorded in birds from medium weight category in 3hr feeding-1hr off feeding regime, while, A+ category with1-hr feeding-3hrs off showed the best economic efficiency.

Key word: feed restriction, growth performance, economics, production efficiency factor

INTRODUCTION

One of the most dynamic agribusiness trades of the world is poultry industry. About 60 to 70% of the cost of poultry production is the feed cost (Wilson and Beyer, 2000); therefore, it has become critical to make concerted efforts to reduce feed cost without compromising the overall productivity. Broiler meat is quickest and economical source of animal protein. The success of raising broilers for maximum weight gain depends not only upon the strain of the birds and management but also on feeding patterns and quality. Therefore, any improvement in the performance of broilers due to diet can inevitably have a profound effect on profitability of broiler farming. Feed restriction strategy in broilers can improve feed efficiency; reduce feed cost and mortality along with the production of quality meat at cheaper rates (Zubair and Leeson, 1996). Moreover, it can reduce the chances of metabolic disorders like ascities, a common problem in broilers, which otherwise may lead to high mortality and make the enterprise unprofitable (Arce *et al*. 1995). Presently, there are about ten different feeding programs under investigation. These include in-ovo feeding, hatchery or early feeding, pre-starter diet, three fixed NRC phases, multi phased feeding, feeding time period, sequential feeding, choice feeding, restriction feeding, nutrient (mineral and vitamins) withdrawal, replacer finisher feed (withdrawal supplement feed) and/or pre slaughter feed (removal) and enrichment feed (Shariatmadari, 2012).

Birds subjected to feed restriction generally eat less feed than ad-libitum control birds (Lee and Leeson, 2001). On the contrary, Beer and Coon (2007) reported that restricted feeding had little effect on feed consumption and it also negatively influenced the growth performance as the severity of restriction increased (Makinde, 2012).

Keeping in view the preceding inconsistent findings on effect of feed restriction in broilers, it seemed necessary to make further investigations on this subject. Therefore, the present study was undertaken with the objectives to find out appropriate feed restriction strategy with proper day-old chick weight for obtaining efficient and economical growth performance in broiler.

MATERIALS AND METHODS

The present study involved 1440 commercial (Hubbard) day-old broiler chicks of different initial body weight categories ranging from 31-34g (small), 35-38g (medium), 39-42g (A-grade) and 43-46g (A+ grade).These birds were offered *ad-libitum* feeding and different restricted feeding regimes i.e.1-hour feeding and 3-hours off, 2-hours feeding and 2- hours off and 3-hours feedings and 1-hour off after observing one week adjustment period. Phase feeding was practiced with the same metabolize-able energy level 2800kcal/kg and varying crude protein (CP) levels during different age periods in birds. They were maintained under optimum conditions of temperature, humidity and ventilation as per recommendations of Hubbard broiler management guide

(Hubbard, 2012) and were reared at 0.6 sq. ft/bird stocking density. The birds were maintained up to age of 42 days and had free access to clean and fresh drinking water. A 24 hour lighting schedule was provided. The weekly data on feed intake, body weight gain, FCR, mortality and production efficiency factor (PEF) were collected. Economic impacts/benefits of the study were worked out by calculating the cost of feed, final body weight, mortality and meat production/unit area. The experiment plan has been presented in Table 1. Nutrient profile of the broiler diets are presented in Table 2.

The data thus collected were analyzed using Analysis of variance (ANOVA) technique in Completely Randomized Design with two factors (Steel *et al*. 1997). Comparison of means was worked out using Duncan's Multiple Range (DMR) test (Duncan, 1955).

Table 1. Experimental Design

Experiment	Group	Treatments	Day old chick weights(g)	Replicate
Restricted feeding and day old chick weights	**A**	*Ad-libitum*	31-34(S) 35-38(M) 39-42(A) 43-46(A^+)	4x4x6x15 = 1440 birds Treatments = 04 Chick weights = 04 Replicates = 06 Birds in each Replicate =15
	B	1 hr feeding - 3hr off	31-34(S) 35-38(M) 39-42(A) 43-46(A^+)	
	C	2 hr feeding -2hr off	31-34(S) 35-38(M) 39-42(A) 43-46(A^+)	
	D	3 hr feeding - 1hr off	31-34(S) 35-38(M) 39-42(A) 43-46(A^+)	

Table 2. Nutrient profile of broiler diets.

Days	1-10 days	11-20 days	21-34 days	35-42 days
ME (Kcal/kg)	2800	2800	2800	2800
CP (%)	21.00	20.0	18.11	17.1
Fat(%)	3.00	4.11	3.79	4.25
Fiber(%)	4.65	4.31	4.14	4.42
Calcium(%)	0.88	0.82	0.78	0.77
Phos. Avail(%)	0.44	0.4	0.4	0.4
Lysine dig. (%)	1.17	1.05	0.99	0.95
Meth dig. (%)	0.50	0.49	0.46	0.45
M+C dig. (%)	0.80	0.77	0.72	0.69
Argindig(%)	1.20	1.1	1.02	0.98
Threo dig. (%)	0.70	0.66	0.63	0.59
Tryp dig. (%)	0.20	0.18	0.16	0.15
Isoleu dig. (%)	0.70	0.68	0.62	0.56
Valine dig. (%)	0.83	0.76	0.68	0.64

RESULTS AND DISCUSSION

Feed Intake (gm): Different feed restriction regimes used in the present study had significant ($P<0.05$) effect on feed intake of birds (Table 4). The maximum feed intake was recorded in *ad-libitum* and 3hrs fed birds than those of 1-hr or 2hrs access to feed. This could be attributed to ample time available with full-fed and 3hrs feeding as compared to limited access birds which could have resulted in higher feed consumption. Similarly, Mahmood *et al.* (2007) also reported significantly higher feed intake in full fed birds as compared to restricted ones. Day-old chick weights did not significantly affect ($P>0.05$) feed intake in birds (Table 4). However, interaction between feed restriction and day-old chick

weight (Table 4) showed significantly higher (P<0.05) feed in take in birds fed ad-libitum in medium weight (35-38gm) category, while, it was the lowest in 1-hr feeding, A category (39-42gm) chicks than those of others.

Table 4. Influence of feed restriction regimes (FR) and day old chick (DOC) weight categories on feed intake (gm) in broilers

FR DOC(g)	Ad libitum	1 hr feeding-3 hr off	2 hr feeding-2 hr off	3 hr feeding-1 hr off	Mean
31-34 (S)	4557±49^{abc}	4514±76^{abc}	4647±145^{abc}	4669±109^{ab}	**4597.05±241.91**
35-38 (M)	4767±54^{a}	4483±57^{bc}	4535±81^{abc}	4637±51^{abc}	**4605.94±180.83**
39-42 (A)	4567±126^{abc}	4377±30^{bc}	4471±45^{bc}	4612±57^{abc}	**4507.36±194.32**
43-46 (A^+)	4567±161^{abcd}	4495±27^{abc}	4555±44^{abc}	4576±33^{abc}	**4548.48±199.94**
Mean	**4615±264.77^{a}**	**4467±130.40^{ab}**	**4552±214.15^{ab}**	**4623±162.02^{a}**	

Different alphabets on means show significant differences (P < 0.05), S (Small), M (Medium), A (grade), A^+ (grade)

Body Weight (gm): The results of the present study showed that day-old chick body weight categories significantly (P<0.05) influenced the subsequent body weight gain in broilers (Table 5). A+ chick category (43-46gm) gained the highest body weights, followed by A (39-42 gm) and rest of the two categories (M and S). It could be attributed to positive correlation between day-old chick weight with final body weight, greater the DOC weight; higher will be the body weight gain in birds at the market time. Similar findings have also been reported by Lacy (2001) that small weight at the hatching time resulted into smaller final body weight in broilers. While in the present study, feed restriction regimes did not significantly influence (P>0.05) the overall weight gain (Table 5). However, A+ chick weight category when coupled with 1hr feeding and 3hrs off feed restriction regimes showed the maximum body weight and small chick with *ad-libitum* feeding regime gained the lowest body weight.

Table 5. Influence of feed restriction (FR) and day old chick (DOC) categories on body weight (gm) in broilers

FR DOC(g)	Ad libitum	1 hr feeding-3 hr off	2 hr feeding-2 hr off	3 hr feeding-1 hr off	Mean
31-34(S)	2230±25^{c}	2381±35^{c}	2338±26^{c}	2408±35^{c}	**2364.89±78.178^{c}**
35-38(M)	2400±35^{c}	2389±24^{c}	2357±46^{c}	2360±27^{c}	**2376.83±81.64^{c}**
39-42(A)	2446±40^{ab}	2456±74^{bc}	2441±25^{bc}	2532±34^{ab}	**2469.38±115.10^{b}**
43-46(A^+)	2555±15^{ab}	2630±43^{a}	2598±39^{a}	2575±43^{a}	**2589.79±90.47^{a}**
Mean	**2433±109.47**	**2464±150.42**	**2434±132.91**	**2496 ±121.27**	

Different alphabets on means show significant differences (P < 0.05) , S (Small), M (Medium), A (grade), A^+ (grade)

Production efficiency factor (PEF): Day- old chick weight and feed restriction regimes had significant (P<0.05) effect on PEF (Table 6). Significantly (P<0.05) improved PEF was recorded in medium weight chicks (35-38gm) and the poorest in small body weight category (31-34gm), while, in feed restriction regimes significantly the highest PEF was recorded in 3hrs feeding-1hr off birds and the lowest in birds fed *ad-libitum* (Table 6). As feed restricted birds consumed less feed and found ample time to properly digest, absorb and metabolize to make it part of the body and ultimately attained the similar weights comparable to those fed *ad-libitum*, this might have resulted into better PEF in feed restricted birds as compared to those fed *ad- libitum*. The results of present study have been fully substantiated by the findings of Mehmood (2012) who indicated that maximum PEF was obtained in feed restricted birds than those fed *ad-libitum*. In interaction, A+ chick category (43-46gm) birds fed at 1hr feeding and 3hrs off showed significantly (P<0.05) higher production efficiency factor than those maintained under other feeding regimes.

Feed Conversion Ratio (FCR): Birds from1-hr feeding and 3hrs off group showed significantly (P<0.05) better FCR than those of fed *ad-libitum* (Table 7). Poor FCR in *ad-libitum* fed birds could be attributed to availability of less time for digestion, whereas feed restricted birds might have found proper time (2-3hr) for utilization of nutrients in the feed more efficiently leading to better FCR than full-fed birds. Similar findings have been reported by Mehmood *et al.* (2012) and Lee and Leeson (2001) who also found better FCR in restricted fed broiler chicken.

Table 6. Influence of feed restriction regimes (FR) and day old chick (DOC) categories on PEF in broilers

FR DOC(g)	Ad libitum	1 hr feeding-3 hr off	2 hr feeding-2 hr off	3 hr feeding-1 hr off	Mean
31-34	262.94±0^{p}	288.97±0^{j}	267.84±0^{o}	286.78±0^{k}	**294.33±5.27^{d}**
35-38	282.36±0^{l}	291.39±0.51^{i}	281.09±0^{m}	278.34±0^{n}	**311.99^{a}±5.31^{a}**
39-42	300.28±0^{h}	315.15±0^{f}	306.37±0^{g}	319.38±0^{e}	**297.80±5.41^{c}**
43-46	331.74±0^{d}	352.46±0^{a}	335.90±0^{c}	336.57±0^{b}	**305.27±4.94^{b}**
Mean	**276.63±2.37^{d}**	**283.29±1.02^{c}**	**310.29±1.55^{b}**	**339.17±1.64^{a}**	

Different alphabets on means show significant differences (P < 0.05) S (Small), M (Medium), A (grade), A^{+} (grade)

Feed conversion ratio was also significantly (P<0.05) influenced by the initial chick body weight (Table 7). The best FCR was recorded in A^{+} chick category (43-46 gm), followed by A (39-42gm) and then rest of the two categories (small and medium) showing a positive correlation between initial chick weight and final FCR. A+ category chicks due to its better vigor and robustness exploited its growth potential maximum by utilizing the feed and nutrient more efficiently giving rise to the best FCR. Similar results have been reported by Whiting and Pesti (1983) who indicated better FCR in broilers over their respective control groups due to weight separation on day-old chick weight basis. A+ category chicks coupled with 1h feed restriction regime showed significantly better FCR (Table 7) than those of other interactive treatments of initial chick weight and feeding regimes.

Table 7. Influence of feed restriction regimes (FR) and day old chick (DOC) weight categories on FCR in broilers

FR DOC(g)	Ad libitum	1 hr feeding-3 hr off	2 hr feeding-2 hr off	3 hr feeding-1 hr off	Mean
31-34(S)	1.95±0.03^{ab}	1.89±0.04^{abcde}	1.99±0.07^{a}	1.93±0.03^{abc}	**1.94±0.12^{a}**
35-38(M)	1.98±0.04^{a}	1.87±0.03^{abcde}	1.92±0.05^{abcd}	1.96±0.03^{ab}	**1.94±0.10^{a}**
39-42(A)	1.87±0.07^{abcde}	1.79±0.05^{cdef}	1.83±0.01^{bcdef}	1.82±0.03^{bcdef}	**1.82±0.12^{b}**
43-46(A^{+})	1.78±0.05^{def}	1.71±0.02^{f}	1.75±0.02^{ef}	1.77±0.03^{def}	**1.75±0.09^{c}**
Mean	**1.90±0.15^{a}**	**1.81±0.12^{b}**	**1.87±0.14^{ab}**	**1.87±0.11^{ab}**	

Different alphabets on means show significant differences (P < 0.05) S (Small), M (Medium), A (grade), A^{+} (grade)

Mortality (%): In the present study, significantly (P<0.05) higher mortality was observed in *ad-libitum* fed birds than those of rest of the treatments. High incidence of diseases like Ascities, Sudden Death Syndrome (SDS) and leg abnormalities may cause increased mortality rate in broilers fed *ad-libitum* but less commonly found in feed restricted birds, therefore, mortality rate was lower in feed restricted birds (Saleh *et al*. 2005). Significantly least mortality in A^{+} chick weight category (43-46gm) could be attributed to better immune response and disease resistance as a consequent effect of their better vigor and robustness. A^{+} chick in interaction with feed restriction treatment synergies the soundness and healthiness of the birds and significantly (P<0.05) decreased the mortality (Table 8).

Table 8. Influence of feed restriction regimes (FR) and day old chick (DOC) weight categories on Mortality (%) in broilers

FR DOC(g)	*Ad-libitum*	1hr feeding-3 hr off	2 hr feeding-2 hr off	3 hr feedin-1 hr off	Mean
31-34(S)	3.00±0.44^{ab}	3.00±0.25^{ab}	3.50±0.42^{ab}	3.16±0.30^{ab}	**3.30±0.21^{a}**
35-38(M)	4.16±0.57^{a}	3.33±0.42^{ab}	3.83±0.60^{ab}	4.16±0.30^{a}	**3.24±0.28^{a}**
39-42(A)	3.33±0.61^{ab}	2.66±0.33^{ab}	2.83±0.47^{ab}	3.16±0.47^{ab}	**3.25±0.23^{a}**
43-46(A$^{+)}$	2.50±0.61^{b}	2.66±0.33^{ab}	2.83±0.30^{ab}	2.83±0.47^{ab}	**2.91±0.16^{b}**
Mean	**3.87±0.22^{a}**	**2.70±0.21^{b}**	**3.00±0.23^{b}**	**3.16±0.17^{b}**	

Different alphabets on means show significant differences (P < 0.05) S (Small), M (Medium), A (grade), A^{+} (grade)

Economics: The net profit per Kg live weight was 23, 25, 26 and 28, rupees in full, 3, 2 and 1 hour fed, respectively, showing increased profit with each step of increased restriction which developed a positive correlation between profit and severity of restriction. The net profit per Kg live weight was 21, 22, 27 and 31

rupees in small (31-34 gm), medium (35-38 gm), A (39-42 gm) and A+ (43-46 gm) initial chick body weight categories, respectively (Table 9). The profit margin was increased with improving the each grade of the chick. A+ chicks in interaction with 1hour feeding regime exhibited maximum profit and proved economically more beneficial as compared to those with other initial chick weight categories and feed restriction regimes.

Table 9. Effect of feed restriction and initial chick body weight on economics of broiler

Economics of broiler production								
	Treatments				Treatments			
Parameters	Ad-libitum	1hr feeding 3hr off	2hr feeding-2hr off	3hr feeding-1hr off	Small	Medium	A	A+
Cost of chick	35	35	35	35	35	35	35	35
Feed consumed (kg)	4.62	4.46	4.51	4.62	4.59	4.60	4.50	4.54
Feed price / kg(Rs)	39	39	39	39	39	39	39	39
Total feed cost (Rs)	180	174	176	180	179	179	176	176
Miscellaneous cost (Rs)	30	30	30	30	30	30	30	30
Total cost (Rs)	245	239	241	245	244	244	241	242
Total live weight (kg)	2.40	2.46	2.43	2.46	2.34	2.37	2.47	2.58
Sale price/ kg live weight Rs)	125	125	125	125	125	125	125	125
Cost / kg live weight (Rs)	102	97	99	100	104	103	98	94
Profit/ kg live weight (Rs)	23	28	26	25	21	22	27	31

Conclusions: It can be concluded from the present study that maximum initial chick weight and increasing restriction time group of birds either alone or in combination gives rise to better growth performance with decreased intake of feed, improves FCR and ends up with better turnover and profit margin.

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