Iran Agricultural Research 18:31-40 (1999)

THE RESPONSE OF BROILER CHICKEN TO DIET DILUTED WITH WHOLE WHEAT AT DIFFERENT AGES

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(Received: April 28, 1998)

ABSTRACT

This experiment was conducted to evaluate the replacement of 20 percent whole wheat in diet of broiler chicken starting at 28, 35, 42 and 49 d of age. All diets were fed up to age of 56 d. Whole wheat replacement did not have any significant effect on average weight gain until 49 d of age, but, the brids treated at 28 d of age were lighter than control or other treatments at 56 d of age. Feed consumptions and feed conversions were similar between control and treatment groups. Percentages of carcasses and fat pads were not significantly affected by whole wheat replacement or sex of the birds. Thus 20 percent whole wheat replacement starting at 28 or 35 d may have an economic value if the birds are slaughtered at 49 and 56 d of age, respectively, as whole wheat price is usually much higher than that of conventional broiler diets.

KEY WORDS: Broilers, Diet dilution, Finisher, Wheat.

تحقیقات کشاورزی ایران

۱۸:۳۱-۴۰ (۱۳۷۸)

پاسخ جوجه های گوشتی به جیره های غذایی رقیق شده بـــا دانـــه کامل گندم در سنین مختلف

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ابوالقاسم گلیان و علیرضا علوی

به ترتیب عضو هیئت علمی گروه علوم دامی دانشگاه فردوسی مشهد، مشهد، جمهوری اسلامی ایران و دانشجوی سابق دانشکده دامپزشکی دانشگاه آزاد اسلامی کازرون، کازرون، جمهوری اسلامی ایران.

چکیده

دراین آزمایش در هر یک از سن های ۲۸، ۳۵، ۴۲، و ۴۹ روزگی ۲۰ درصد دانه کامل گندم در جیره جایگزین و جوجه ها تا سن ۵۶ روزگی با آنها تغذیه شدند. جایگزینی دانه کامل گندم در جیره غذایی سن های مختلف تا ۴۹ روزگی تاثیر معنی داری بر میانگین افزایش وزن نداشت ولی گروهی که از ۲۸ روزگی دانه کامل گندم دریافت کرده بودند وزن کمتری در ۵۶ روزگی داشتند. مصرف خوراک روزانه جوجه ها در تیمارهای مختلف با گروه شاهد مشابه بود. بازده غذایی تحت تاثیر افزودن دانه کامل گندم در زمان های مختلف قرار نگرفت. درصد لاشه ودرصد چربی حفره بطنی بین تیمارهای آزمایشی و جنس های مختلف تفاوت معنی داری نداشت. بنابراین جایگزینی ۲۰ درصد دانه کامل گندم از سن ۲۸ روزگی برای کشتار ۴۹ روزگی ویا از سن ۳۵ روزگی برای کشتار ۵۶ روزگی، صرفه اقتصادی دارد، زیرا بطور معمول دانه کامل گندم از جیره معمول تجاری جوجه های گوشتی ارزان تر است.

INTRODUCTION

Feeding whole wheat to broilers has been practiced for more than a decade (4). Economic profit is the most important advantage of using whole wheat (1, 4, 5). Surprisingly, even when 35 to 40 percent of daily feed intake is whole wheat, no adjustment has been applied to levels of micronutrients or feed additives (5). In most studies, all feeds are made in the form of a pellet as this mixes well with the wheat grain. It seems that bird's self selection wheat can better balance their protein intake to match their nutritional requirements (3, 7). This feeding system may be exploiting a need for most nutrients in proprietary broiler diets to be slightly oversupplied. Dilution by whole wheat for a flock may, therefore, be a means of obtaining the optimum intake of costly limiting nutrients (7). This

study was conducted to determine the effect of time of adding whole wheat to the standard grower or finisher diets of broilers.

MATERIALS AND METHODS

Six hundred and twenty-five-day-old mixed sex commercial broiler chicks were randomly housed in twenty five- floor pens (1.25 × 1.5 m) in an environmentally controlled commercial type house. Initial room temperature was 32°C and was then gradually decreased according to usual brooding practices. Supplemental heat was provided by enforcement of hot air into the house. Every pen had 25 birds of mixed sexes. All birds were fed a commercial type starter and grower diets up to 28 d of age (Table 1). At this age all 25 pens were randomly assigned to five treatments of five replicates each. The treatments were time (28, 35, 42, and 49 d of age) of starting the mixing of whole wheat with the grower or finisher diet. One treatment was used as the control (no added wheat) diet. Water and feed were provided *ad libitum*. The fix ratio of 80:20 was used to mix the commerial type grower or finisher diet (Table 1) with the whole wheat at any time. All birds were weighed as a group for each pen at 28, 35, 42, 49 and 56 d of age. Feed intake was measured weekly starting at 28 days of age. Mortality was recorded daily and used to correct the feed intake and feed conversion.

Two males and two females from each pen, with body weights close to the average body weight of each sex, were slaughtered at 49 and 56 d. Abdominal fat pad was removed and weighed. Carcass weight as a percent of live body weight was determined.

The measured response variables were analyzed by a simple one way ANOVA (9). The carcass weight and abdominal fat pads as a percentage of live body weight were converted to arcsine value before statistical analysis. Duncan's multiple range test was used to identify differences among means when significant ($P<0.05$) treatment effect was detected (9).

Mortality averged 2.2 % across treatments during the 28 to 56 d of age, and was not affected by dietary treatments ($P<0.05$).

Table 1. Rations for the use of whole wheat in grower and finisher diets.

Ingredients	Starter (0-3 wk)	Grower (3-6 wk)	Finisher (6-8 wk)
Corn #2	64.300	70.200	74.000
Soybean meal, 44%	27.600	23.800	20.700
Fish meal 64%	5.000	3.260	2.800
Dicalcium Phosphate	1.200	0.670	0.600
Oyster shell	1.000	1.280	1.200
Premixes†	0.500	0.500	0.500
Salt	0.330	0.250	0.190
Methionine	0.072	0.017	0.000
Total	100.000	100.000	100.000
Calculated analysis§			
Protein (%)	20.860	18.500	17.200
ME_n (kcal kg^{-1})	2901.000	2967.000	3056.000
Ca (%)	0.920	0.830	0.760
AP(%)	0.470	0.330	0.290
Na(%)	0.180	0.140	0.110
Arginine (%)	1.400	1.220	1.110
Lysine (%)	1.240	1.050	0.940
Methionine (%)	0.460	0.350	0.320
Methionine+Cystine (%)	0.820	0.680	0.630
Linoleic acid (%)	1.530	1.650	1.710

† Provided per kg of diet: vitamin A, 8000 IU; vitamin D, 1600 IU; vitamin E, 11.0 mg; riboflavin, 9.0 mg; pantothenic acid, 11.0 mg; vitamin B12, 13.0 µg; niacin, 25.0 mg; choline, 900 mg; vitamin K, 1.5 mg; biotin, 0.25 mg; manganese 55 mg; zinc, 50 mg; iron, 30 mg; copper, 5.0 mg; and selenium, 0.1 mg.

§ Based on NRC-94 recommendations (6).

RESULTS AND DISCUSSION

The live body weight of broilers fed a mixed ration of 20% whole wheat started at any proposed age was not significantly ($P< 0.05$) different

when measured up to 49 d of age (Table 2). However, higher body weights were detected with those birds receiving the mixed diet at 35 and thereafter, when the weights were measured at 56 d of age. The birds receiving the mixed diet at 28 d of age had the lowest live body weight at 56 d of age. However, this difference was not significant as compared to the control birds. Therefore, mixing whole wheat at the rate of 20% after 28 d, had no effect on final body weight at 49 d.

Table 2. Effect of time of diluting broiler feeds with 20% whole wheat on body weight (g bird^{-1}).

	Age (d)				
Treatments†	28	35	42	49	56
Control	718.80^{a}§	1114.00^{a}	1438.90^{a}	1760.00^{a}	2287.00^{ab}
49	715.90^{a}	1149.90^{a}	1457.50^{a}	1914.00^{a}	2365.00^{a}
42	724.80^{a}	1105.40^{a}	1496.10^{a}	1864.00^{a}	2320.00^{ab}
35	720.50^{a}	1141.30^{a}	1432.70^{a}	1940.00^{a}	2350.00^{ab}
28	729.70^{a}	1147.90^{a}	1492.60^{a}	1878.00^{a}	2238.00^{b}
SE	7.22	11.61	11.72	14.47	16.78

† Age at which the diet dilution was started and continued up to the end of experiment.

§ Mean values within a column with no common letters are significantly different ($P<0.05$).

There was not any significant difference in weekly feed intake of birds up to 49 d of age (Table 3). However, the feed intake of birds receiving the mixed diet at 49 d, was significantly ($P<0.05$) higher than that of control group during the last week of experiment. The overall feed intake of birds during age of 28 to 56 d was not significantly different ($P<0.05$). Although, the control birds had the lowest daily feed intakes during the period of 28 to 56 d or zero to 56 d of age, there was no significant differences in feed intake between birds fed conventional feed or mixed diet during the whole period. Therefore, broilers tended to take up more energy and less protein when offered a conventional feed mixed with whole wheat. Because, the ratio of energy to protein in the whole wheat is larger than that

in the conventional diet. Similar results were obtained by Leeson and Caston (4).

The feed:gain ratios among the treatments were significantly ($P< 0.05$) changed during the period of 35 to 42; 28 to 56 and zero to 42 d of age (Table 4). Significantly higher ($P< 0.05$) feed:gain ratios during week 6 were detected when 35 d old birds started to receive a mixed diet (Table 4). But during w 7 and 8 the feed conversions were similar among all the treatments. The significant difference in feed conversion during the period of wheat consumption (28-56 d) was only observed between birds starting to receive the mixed diet at 28 and 49 d of age. There were not any significant differences among treatments for feed conversion during the 8th w of study. Thus feeding a commercial diet with whole wheat may not have a significant effect on feed conversion, but numerically higher efficiency values were observed in birds fed diet mixed with wheat as compared to control birds. Other reseachers found some significantly higher feed conversion, when they offered a conventional diet with whole wheat to brids from 10 or 11 d to slaughter age (4).

The average carcass weight of male and female as a percent of live body weights for 49 and 56 d of age were 70.1, 69.4, 68.2 and 68.4, respectively (Table 5). There was not any significant ($P> 0.05$) effect of whole wheat on carcass yield of two sexes at either 49 or 56 d.

The abdominal fat pad as a percent of live body weight was not significantly different for male and female receiving the treatments up to 49 d of age (Table 5). However, the male and female broilers receiving the mixed diet at 28 d of age had the highest fat pad at 56 d of age. It is therefore concluded that loose mixing of whole wheat at the rate of 20% with a relatively low energy, protein mash feed after 28 d, had no effect on final body weight at 49 or 56 d (Table 2). Thus dilution of the feeds used in this study did not sufficiently alter the nutrient content of the feed to depress live body weight. It has also been found that the body weights of either male or female were not affected by the amount of extra wheat added to a balanced pelleted feed from 5% at 11 d to 30% at 31 d of age (1, 8). In the present experiment, diluting the mash feed increased the feed: gain ratio of the mixed sexes. This increase in feed:gain ratio is perhaps due to

Table 3. Effect of time of diluting broiler diet with 20% whole wheat on feed intake (g $b^{-1}d^{-1}$).

Treatment[1]	Age (days)								
	0-21	28-35	35-42	42-490	49-56	28-42	28-49	28-56	0-56
Control	31.90[a§]	107.80[a]	132.00[a]	142.00[a]	169.70[b]	119.90[a]	127.30[a]	137.90[a]	91.30[a]
49	31.50 [a]	108.00[a]	134.80[a]	146.70[a]	186.50[a]	121.40[a]	129.80[a]	144.00[a]	94.20[a]
42	31.50 [a]	106.70[a]	132.30[a]	146.20[a]	180.70[ab]	119.50[a]	128.40[a]	141.50[a]	93.20[a]
35	31.50 [a]	110.30[a]	135.20[a]	147.30[a]	179.60[ab]	122.80[a]	130.90[a]	143.10[a]	94.00[a]
28	31.80 [a]	109.20[a]	134.80[a]	146.60[a]	177.90[ab]	122.00[a]	130.20[a]	142.10[a]	93.80[a]
SE	0.10	1.06	1.10	1.70	2.10	0.88	0.96	1.06	0.57

† Age at which the diet dilution was started and continued up to the end of experiment.
§ Mean values within a column with no common letters are significantly different ($P<0.05$).

Table 4. Effect of time of diluting broiler feed with 20% whole wheat on feed: gain ratio (kg kg^{-1}).

Treatments[†]	Age (days)									
	0-21	28-35	35-42	42-49	49-56	28-42	28-49	28-56	0-42	0-56
Control	1.660[a§]	1.910[a]	2.880[b]	2.410[a]	2.790[a]	2.330[ab]	2.350[a]	2.470[ab]	2.080[ab]	2.270[a]
49	1.620[a]	1.790[a]	3.130[ab]	2.270[a]	2.910[a]	2.300[ab]	2.280[a]	2.450[b]	2.060[ab]	2.290[a]
42	1.630[a]	1.960[a]	2.800[b]	2.880[a]	2.860[a]	2.180[b]	2.370[a]	2.490[ab]	2.000[b]	2.280[a]
35	1.680[a]	1.860[a]	3.300[a]	2.160[a]	2.900[a]	2.420[a]	2.300[a]	2.460[ab]	2.130[a]	2.270[a]
28	1.620[a]	1.850[a]	2.780[ab]	2.810[a]	3.600[a]	2.250[ab]	2.390[a]	2.640a	2.040[ab]	2.380[a]
SE	0.008	0.040	0.086	0.099	0.114	0.030	0.017	0.027	0.013	0.017

† Age at which the diet dilution was started and continued up to the end of experiment.
§ Mean values within a column with no common letters are significantly different ($P<0.05$).

the dilution and not an inability to digest whole wheat, because the feed:gain ratio of birds given feed diluted with high levels of whole wheat was the same (1). Another experiment with broiler chickens showed that there was no difference between the available metabolizable energy corrected to zero nitrogen (AME_n) of the whole or ground form of wheat (7).

Table 5. Effect of time of diluting broiler feed with 20% whole wheat on carcass yield and fat pad.

Treatments†	Carcass (% of LBW)				Fat pad (% of LBW)			
	49 d		56 d		49 d		56 d	
Control	71.70^{a}§	69.40^{a}	68.40^{a}	70.80^{a}	1.60^{a}	2.70^{a}	2.40^{ab}	2.90^{a}
49	70.60^{a}	69.30^{a}	68.70^{a}	65.50^{b}	2.10^{a}	2.40^{a}	2.00^{b}	3.10^{a}
42	70.30^{a}	68.50^{a}	68.70^{a}	68.70^{ab}	1.50^{a}	2.50^{a}	2.40^{ab}	2.60^{b}
35	68.00^{a}	70.20^{a}	67.10^{a}	67.20^{b}	2.30^{a}	2.00^{a}	2.50^{ab}	2.50^{b}
28	68.50^{a}	69.50^{a}	68.10^{a}	68.60^{ab}	1.80^{a}	2.50^{a}	3.20^{a}	3.30^{a}
SE	0.25	0.29	0.30	0.30	0.05	0.05	0.06	0.05

† Age at which the diet dilution was started and continued up to the end of experiment.

§ Mean values within a column with no common letters are significantly different ($P<0.05$).

Dilution of the nutrients and feed additives in the feed did not increase skeletal disorders or coccidiosis. Previous research has shown that complete removal of vitamins and micro-minerals or limestone and dicalcium phosphate in the last week before marketing broilers does not affect live bird's performance and so the limited amount of dilution in this study would not be expected to have serious consequences (2, 10, 11). In this experiment, the carcass yield and abdominal fat pad did not change by addition of 20% whole wheat to a grower or finisher mash balanced feed. It seems that the birds fed this relatively low energy, protein mash feed could adjust their nutrient intakes as their fat reserve would not be changed. Probably, higher essential nutrients especially those of methionine and

lysine in the balanced feed could be responsible for compensating the differences caused by the addition of the 20% whole wheat.

It is concluded that, addition of 20% whole wheat to a balanced grower or finisher mash feed may have some economic advantages by minimizing the extra nutrients in a normal commercial feed.

ACKNOWLEDGEMENT

The authors wish to acknowledge the financial support of Islamic Azad University of Kazeroon and farm guidance of Dr. F. Pyravian and Dr.G.H. Habibi.

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