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Effects of Initiation Age of Skip-A-Day Feed Restriction on Skeletal Development in Broiler Breeder Males

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Primary Audience: Poultry Extension Personnel, Researchers, Broiler Integrators

Summary

This experiment was conducted over an 18-week period to determine the effects of initiating a skip-a-day (SAD) feed restriction program at 2, 4, and 6 weeks of age on male broiler breeders. For each of the SAD treatments, feed intake was manipulated so that the breeder's recommended target weight was reached by all groups at 18 weeks of age. Males were evaluated for shank and keel length and head width at 7 and 18 weeks of age.

The results of this experiment show that starting a SAD feeding program at 2, 4, or 6 weeks of age will decrease shank and keel length as well as head width. Feed restriction affected keel length and head width in a very similar manner; shank length was not as sensitive to the time of initiation of the SAD feed restriction program.

Key words: Broiler breeder, skip-a-day, body weight, shank, keel, head width

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Description of Problem

Restriction of feed intake by broiler breeders during the growing and laying periods is a common industry practice to prevent excess body weight, which may prove detrimental to reproduction. The fact that these restriction programs can reduce body weight and improve feed efficiency, livability, egg production, fertility, and hatchability is well documented [1, 2, 3, 4, 5, 6, 7]. However, specific effects on the male are not as well documented. It has been shown that severe feed restriction (42 to 72%) of controls decreases volume, concentration, and fertilizing capacity of semen from Rhode Island Red males [8]. Restricted feeding has been shown to have no effect on the reproductive performance of breeder males. Although testes size decreased as the level of feed restriction increased, this did not affect fertility and hatchability [9]. A moderate increase in feed restriction over the recommended level (15% greater than the rec-

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ommended level) produced the greatest semen volumes but did not affect fertility and hatchability [10]. In a similar study, significant reductions in semen volume, sperm cell numbers in ejaculate, and testes weight were reported with no effect on fertilizing capacity [11].

When cockerals were fed at 1.25 times the recommended pullet level, a significant increase was shown in sperm number and volume compared with the group fed at the pullet level [12]. Semen characteristics have been shown to be unaffected by feeding schedule or grower diet protein level [13].

Skip-a-day feeding is one of the most commonly used methods of feed restriction during the growing period. Although there has been a significant amount of research conducted on the effects of feed restriction on body weight, there is virtually no research on the effects of restricted feeding programs such as SAD on frame size or skeletal development, especially for broiler breeder males. When a SAD program is used, commercial broiler breeders are placed on SAD feeding regimen at varying weeks of age by different primary breeders and are directed toward a target weight with little regard for the physiological impact that the SAD program may have on skeletal development. Modern programs for broiler breeders require an early start to body weight control, and control of feed intake should start as early as 3 weeks of age [1, 14]. If the SAD program is used, some researchers recommend that it be implemented at the age of 5 weeks [1, 14]. The objective of this study was to determine what effects, if any, age of initiation of SAD feed restriction has on male broiler breeder skeletal development as determined by head width and shank and keel length.

Materials and Methods

Two hundred eighty male Arbor Acres broiler breeders were randomly assigned to four treatment groups and were observed for 18 weeks. The four treatment groups were a full feed control group (SAD-NO) and groups with SAD feeding initiated at 2 weeks (SAD-2), 4 weeks (SAD-4), and 6 weeks (SAD-6) of age. Birds were housed accordingly: 14 birds per pen with five pens per treatment. The feed was administered so that all birds on the SAD feeding programs reached the Arbor Acres recommended 18-week target weight of 2.71 kg [15] regardless of the time of initiation of the SAD program. All birds were fed standard broiler breeder diets (Table 1).

TABLE 1. Percentage composition and calculated analysis of experimental diets used for all treatments

INGREDIENT	STARTER (0 to 4 weeks)	DEVELOPER (5 to 18 weeks)
	(%)	
Corn	62.35	81.25
Soybean meal (49%)	31.00	12.34
Alfalfa meal (20%)	2.50	2.50
Ground limestone	1.36	1.30
Microingredients[A]	0.50	0.50
Iodized salt	0.35	0.35
Dicalcium phosphate	1.94	1.76
Total	100.00	100.00
Calculated analysis		
Crude protein (%)	21.5	14.00
ME (kcal/kg)	2,928	3,126
Calcium (%)	1.10	1.00
Total phosphorus (%)	0.75	0.65
Sodium (%)	0.15	0.15
Chloride (%)	0.25	0.25

[A]Supplied per kilogram of diet: vitamin A, 11,000 IU; vitamin D3, 1,650 IU; vitamin E, 8.25 U; menadione sodium bisulfite, 0.73 mg; thiamine, 1 mg; riboflavin, 4.4 mg; niacin, 33 mg; d-pantothenic acid, 8.1 mg; folic acid, 0.45 mg; biotin, 0.05 mg; pyridoxine, 2.2 mg; vitamin B12, 0.01 mg; choline, 400 mg; manganese, 60 mg; zinc, 44 mg; iron, 20 mg; copper, 2 mg; iodide, 1.2 mg; and cobalt, 0.20 mg.

Individual body weight measurements were taken weekly for the duration of the experiment, and uniformity was calculated as the percentage of the birds weighing ±10% of the average weight for a group at a given age. Body conformation measurements were taken at Weeks 7 and 18; 35 birds per treatment (seven birds per pen) were measured at 7 weeks, and all birds were measured at 18 weeks. The body conformation measurements were shank length, keel length, and head width. Shank length was taken from the top of the back toe to the middle of the hock joint with a vinyl metric measuring tape. Keel length was also measured with a vinyl metric measuring tape. Head width was determined using an electronic digital caliper directly behind the eyes.

Analysis of all data was by ANOVA [16]. When treatment effects were found to be sig-

TABLE 2. The effect of age of initiation of SAD (skip-a-day) feed restriction on body weight of male broiler breeders at different weeks of age

	WEEKS OF AGE								
TREATMENT[A]	2	4	6	8	10	12	14	16	18
	Body weight (kg)								
SAD-NO	0.41[a]	1.16[a]	2.15[a]	3.19[a]	3.92[a]	4.32[a]	4.99[a]	5.41[a]	5.98[a]
SAD-2	0.41[a]	0.81[b]	1.40[b]	1.68[c]	1.83[c]	1.92[c]	2.24[b]	2.49[b]	2.72[b]
SAD-4	0.41[a]	1.15[a]	1.48[b]	1.73[c]	1.91[c]	2.03[c]	2.25[b]	2.48[b]	2.75[b]
SAD-6	0.41[a]	1.17[a]	2.17[a]	2.36[b]	2.40[b]	2.42[b]	2.45[b]	2.48[b]	2.73[b]
$p < F$	0.92	0.05	0.04	0.02	0.03	0.05	0.01	0.002	0.003

[A]SAD-NO = full feed, SAD-2 = SAD feeding beginning at 2 weeks, SAD-4 = SAD feeding beginning at 4 weeks, and SAD-6 = SAD feeding beginning at 6 weeks.
[a,b,c]Means within a column with no common letter are significantly different ($p < 0.05$).

nificant, Duncan's multiple range test was used to separate the means.

Results and Discussion

The initiation of SAD feed restriction programs at 2, 4, or 6 weeks of age initially caused differences in body weight among those groups (Table 2). At 4 weeks of age, birds on the SAD-NO, SAD-4, and SAD-6 treatments weighed more than the breeder recommended level of 0.88 kg [15]. At 6 weeks of age, when the last SAD treatment was initiated, only the SAD-NO and SAD-6 birds weighed considerably more than the breeder recommended weight of 1.28 kg [15]. Manipulating feed intake (Table 3) to reach the Arbor Acres recommended 18-week body weight of 2.71 kg [15] compensated for these differences, and, by 18 weeks of age, only the body weights of SAD-NO birds were significantly different from those of any of the birds in the other SAD groups. From the initiation of the study until 18 weeks, uniformity remained above 80% and was not significantly different among treatment groups at any week (Table 4). These body weight data agree with the results of an experiment conducted on broiler breeder hens, which found that body weight was initially different among SAD groups, but, by 24 weeks, all groups had the same body weight [17].

At 7 and 18 weeks of age, head width and keel length were found to be significantly smaller in the SAD-2, SAD-4, and SAD-6 groups than in the SAD-NO group (Table 5). There were no significant differences between the SAD-2 and SAD-4 groups in head width and keel length at 7 and 18 weeks. At 18 weeks of age, there was also no significant difference between the SAD-2 and SAD-6 groups in head width and keel length, although SAD-6 birds had greater head width and keel length than SAD-4 birds at both 7 and 18 weeks.

Shank length was determined to be significantly shorter in the SAD-2 and SAD-4 groups than in both the SAD-NO and SAD-6 groups at 7 and 18 weeks of age (Table 5). There was no

TABLE 3. Feed consumption (grams·bird·day) at selected ages of male broiler breeders given either ad libitum feed or a SAD (skip-a-day) feeding program beginning at 2, 4, or 6 weeks of age

	WEEKS OF AGE								
TREATMENT[A]	2	4	6	8	10	12	14	16	18
	Feed consumption (g·bird·day)								
SAD-NO	47	100	170	237	288	307	331	356	397
SAD-2	49	55	66	70	74	80	95	102	119
SAD-4	47	99	73	80	84	82	95	102	119
SAD-6	48	103	167	96	100	98	100	102	119

[A]SAD-NO = full feed, SAD-2 = SAD feeding beginning at 2 weeks, SAD-4 = SAD feeding beginning at 4 weeks, and SAD-6 = SAD feeding beginning at 6 weeks.

TABLE 4. Uniformity (percentage) at selected ages of male broiler breeders given either ad libitum feed or a SAD (skip-a-day) feeding program beginning at 2, 4, or 6 weeks of age

	WEEKS OF AGE								
TREATMENT[A]	2	4	6	8	10	12	14	16	18
	Uniformity (%)								
SAD-NO	93	91	87	86	86	87	89	90	89
SAD-2	91	87	86	84	86	83	86	84	87
SAD-4	93	90	89	83	84	86	86	84	86
SAD-6	94	91	90	86	84	83	84	86	86
$p > F$	0.64	0.42	0.37	0.51	0.82	0.76	0.74	0.42	0.61

[A]SAD-NO = full feed, SAD-2 = SAD feeding beginning at 2 weeks, SAD-4 = SAD feeding beginning at 4 weeks, and SAD-6 = SAD feeding beginning at 6 weeks.

TABLE 5. Influence of age of initiation of a SAD (skip-a-day) feeding program on body structure measurements of broiler breeder males at 7 and 18 weeks of age

	7 WEEKS OF AGE			18 WEEKS OF AGE		
TREATMENT[A]	Head width	Keel length	Shank length	Head width	Keel length	Shank length
	(cm)					
SAD-NO	3.0[a]	9.2[a]	3.5[a]	4.9[a]	17.0[a]	6.1[a]
SAD-2	2.8[c]	8.4[c]	3.1[b]	4.1[bc]	14.5[bc]	5.5[c]
SAD-4	2.8[c]	8.3[c]	3.1[b]	4.0[c]	14.1[c]	5.3[c]
SAD-6	2.9[b]	8.9[b]	3.4[a]	4.2[b]	14.8[b]	5.8[b]
$p > F$	0.04	0.05	0.05	0.01	0.01	0.02

[A]SAD-NO = full feed, SAD-2 = SAD feeding beginning at 2 weeks, SAD-4 = SAD feeding begining at 4 weeks, and SAD-6 = SAD feeding beginning at 6 weeks.
[a,b,c]Means within a column with no common letter are significantly different ($p < 0.05$).

significant difference in shank length at 7 weeks of age between SAD-NO and SAD-6 groups; however, shank length of SAD-6 birds was significantly shorter than that of SAD-NO birds at 18 weeks. This finding agrees with findings of past studies that found that feed restriction reduced shank length in female broiler breeders [4, 18]. The SAD-4 group had significantly lower measurements (shank and keel length and head width) at both 7 and 18 weeks than did SAD-6 birds. Thus, the extra 2 weeks of ad libitum feeding allowed for increased skeletal development.

Shank and keel length are generally accepted as good measures of frame size and skeletal development [19, 20, 21]. The data collected in this experiment suggest that all three body structure measurements are reasonably good indicators of skeletal development. They all demonstrate similar findings that show that 18-week body weight may be the same across all of the SAD treatments, but skeletal development is significantly different. Shank length does not appear to be as sensitive to feed restriction as are keel length and head width. Keel length and head width seem to follow the same pattern of growth, suggesting that head width could be substituted as an easier method of measuring skeletal development than keel length or shank length.

Conclusions and Applications

1. Skip-a-day feeding significantly decreases various body confirmation measurements very shortly after initiation.
2. Skip-a-day feeding initiated at 2 or 4 weeks of age does not produce significantly different effects.

3. Head width may be a good indicator of skeletal development and is easier to obtain than either keel length or shank length; it is a more precise, less variable measurement.
4. Further studies should be conducted to study the post maturity effects of time of initiation of SAD feeding in male broiler breeders.

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