EFFECT OF DIET ON THE REPRODUCTIVE PARAMETERS OF WHITE LEGHORN COCKS

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ABSTRACT

Seventy-two Single Comb White Leghorn (SCWL) roosters were fed for 24 28-day periods with 13 and 15 percent crude protein diets containing soybean meal (SBM) and cottonseed meal (CSM) ratios of 100:0, 50:50 and 0:100 in each protein diet to determine the long-term effects of protein levels and cottonseed meal on the reproductive traits. The statistical analyses of the data indicated no significant differences among the protein levels for each ratio of SBM:CSM in mean body weight, daily feed consumption, semen volume, fertility, hatchability, percent dead embryo at 18 and 21 days of incubation, percent chicks pipped, semen concentrations, testicular weight, hematocrit and testosterone level. The reproductive traits of the roosters were not affected by either feeding the two protein levels in the diet or the sources of the vegetable protein for 24 28-day periods.

Keywords: Gossypol, Rooster, Soybean meal, Cottonseed meal.

INTRODUCTION

Ingram *et al.* (1950) indicated that chicks' responses from cottonseed meal feeding were correlated with enzymatic release of lysine and possibly tryptophan and cystine. Methionine and lysine combinations have been demonstrated to result in growth increases in several experiments involving cottonseed meal (Grau, 1946; Fisher *et al.*, 1962; Halloran and Pennington, 1963). Glycine supplementation of cotton seed meal-containing rations have been shown to increase body weight gain and feed efficiency in chicks (Machlin *et al.*, 1952; Arscott and Brown, 1961; Combs and Nicholson, 1962).

Waldroup *et al.* (1976) conducted experiments on the effectiveness of up to 15% cottonseed meal diets containing either corn or milo as the energy source. They obtained no differences in rate of egg production, egg weight, Haugh Units, in relation to either the level of cottonseed meal or the grain source used. Roberson (1970) found that the replacement of 50 or 100 percent of the soybean meal in the layers' diet by the glandless cottonseed meal had no adverse effects on the rate of egg production, feed utilization, egg weight, body weight gain or mortality. Quinsberry and Delfino (1971) conducted two studies with laying hens in which glandless cottonseed meal completely replaced the soybean meal in the diets. Significantly, better rates of egg production and feed utilization were observed in both experiments. Egg weights from hens fed cottonseed meal were slightly reduced in one experiment but were increased in the second study.

Watts (1970) demonstrated the importance of the source of cottonseed meal and concluded that free gossypol level up to 180 ppm resulted in no adverse effects on growth rate and feed utilization in broiler chicks.

In another study with broilers conducted by Waldroup *et al.* (1968), in which up to 100 percent of the soybean meal was replaced by glandless cottonseed meal, there was no adverse effect on growth or feed utilization when the diet was adequately supplemented with lysine. Degossypolized cottonseed meal could be used as a substitute for soybean meal in rations for growing and finishing turkeys. When cottonseed meal completely replaced soybean meal, no adverse effects were noted in growth rate, feed efficiency, uniformity, and livability (West, 1956). Kratzer *et al.* (1955)

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suggested that cottonseed meal could replace 50 percent of soybean meal in a turkey poult ration and still obtain satisfactory growth.

Arscott and Parker (1963) showed that protein levels between 6.9 and 16.9 percent had no adverse effect on semen volume, fertilizing capability of semen, and hatchability of total eggs, and the males on the high protein ration ate more feed and consequently gained higher body weight than those on the lower protein ration. Parker and Arscott (1964) experimented with different energy levels in diets fed to adult SCWL cocks. Semen volume, fertilizing capability of semen, body and testicular weights were significantly reduced with low energy diet. Hatchability, however, was not affected. Tripathi *et al.* (1968) pointed out that severe under-nutrition could cause decrease in the diameter of the seminiferous tubules and the cessation of spermatogenesis.

The Long-term effect of gossypol acetic acid (GAA) on the reproductive traits of adult Single Comb White Leghorn (SCWL) cocks were not reported; therefore, this study was carried out with two protein levels (13 and 15 percent) and in each protein level, CSM:SBM rations were 0:100, 50:50, and 100:0, respectively.

MATERIALS AND METHODS

Twenty-four week old Single Comb White Leghorn cocks were placed in individual cages (30.5 cm x 45.7 cm). The poultry cages were located about the floor in an enclosed positive pressure mechanically ventilated house and provided with 14 hours of incandescent light per day (0400-1800 hrs). The experiment was carried out in the temperate country.

Seventy-two of the experimental birds were randomly picked based on preliminary observations and grouped into six treatments of twelve birds per group so that each group had comparable fertility, hatchability, semen volume, semen concentration and body weight. Diets were assigned to the group as follows:

Treatments 1, 2, and 3 received diets containing 13 percent crude protein with the same ratio of SBM:CSM. The composition of

the diets are provided in Table 1. The cocks were fed these diets for 24 months. The birds were fed and provided water *ad libitum*.

Water was provided in continuous "U" trough for eight-15minute periods during the light period daily (0400-1745 hr) at approximately two-hour intervals starting at 0415 hr.

Body weight, feed consumption, semen volume, billion sperm per ml, fertility, hatchability, testosterone level, dead embryos at the 18 and 21 days of incubation were measured. Fertility was determined by ejaculating the cocks on the last Wednesday (at 1300 hr) of the week of each period using the message technique of Burrows and Quinn (1939), and inseminating three SCWL females within 30 minutes following ejaculation.

The hens and cocks were housed under similar conditions. When low semen volumes were obtained, only one or two hens were inseminated. The cocks were pre-ejaculated two days prior to the collection and insemination periods. Eggs from inseminated hens were collected for five day periods, beginning with the second day after insemination. These eggs were incubated in Jamesway (model 252B) incubators, and fertility was examined by candling the eggs on the 18th day of incubation. The percentages of fertile eggs were calculated based on the total eggs set. Eggs which appeared infertile were broken out and examined macroscopically for early embryonic development. On the 21st day of incubation, all unhatched eggs were broken out and examined macroscopically for the presence of any embryonic development abnormalities. Percent hatchability was determined by the number of chicks hatched divided by the total number of eggs set.

Packed red cell volumes (haematocrit) were determined soon after collection by utilizing capillary tubes (1.4mm x 75 mm) filled with blood and sealed at one end with potter's green clay. The tubes were centrifuged for 10 minutes in a microcapillary centrifuge (International Equipment Company). The amount of blood cell accumulated at the base of the capillary tubes was measured by a Phillips-

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Drucker microhaematocrit reader (model L-550, Astoria, Oregon) and expressed as the percent cell in the blood. The testosterone was measured using radioimmunoassay (Akanbi, 1984).

At the end of the experiment, the cocks were slaughtered and both testes from each cock were removed, weighed and expressed as grams per 100 grams of body weight. The volume of water displaced by these testes was

Multiple Range Test. Where there were significant differences among the treatment means, a t-test was either to compare the significances between the controls and the tested rations, or to compare the differences between the 50 and 100 percent CSM (Snedecor and Cochran, 1968).

TABLE: 1. COMPOSITION OF EXPERIMENTAL DIETS

Ingredients	Treatments					
	1	2	3	4	5	6
	(%)	(%)	(%)	(%)	(%)	(%)
Corn, yellow	84.02	81.52	81.52	78.32	65.82	75.31
Soybean meal (47.5% C.P.)	5.68	6.30	-	16.00	9.25	-
Cottonseed Meal (41% C.P.)	-	6.30	12.60	-	9.25	19.06
Meat meal with bone meal (50% C.P.)	5.00	-	-	-	-	-
Dehyd. alfalfa meal (17% C.P.)	2.50	2.50	2.50	2.50	2.50	2.50
Deflourinated phosphate	1.25	1.53	1.53	1.53	1.53	1.53
Limestone flour	.50	.90	.90	.90	.90	.90
Salt (iodized)	.40	.30	.30	.30	.30	.25
Trace mineral mix-65 ¹	.03	.03	.03	.03	.03	.03
Vitamin premix 1-75 ²	.12	.12	.12	.12	.12	.12
L - lysine (50%)	.50	.50	.50	.30	.30	.30
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analyses:						
Protein (%)	13.00	13.00	13.00	15.00	15.00	15.00
Energy (kcal/kg ME)	3150.00	3072.00	3106.00	3115.00	3042.00	2986.00
Methionine + Cystine (%)	0.46	0.45	0.47	0.53	0.53	0.50
Lysine (%)	0.78	0.65	0.73	0.82	0.75	0.63

¹ Trace mineral mix provides per kg ration: Mn, 50 mg; Fe, 2 mg; Cu, 0.2 mg; Zn, 27.5 mg; Co, 0.2 mg.

² Vitamin premix provides per kg ration: Vit A, 3300 IU; Vit D-3, 1100 ICU; riboflavin, 3.3 mg; d- pantothenic acid, 5.5 mg; niacin, 22.0 mg; choline, 190.0 mg; Vit B-12, 5.5 mcg; Vit.1, 1 IU; Vit K, 0.55 mg; folic acid, 0.22 mg; ethoxyquin, 0.06 g.

also measured. This was done by dropping both testes in a measuring cylinder that has a specific volume of water and the initial volume of water was subtracted from the new volume.

The statistical analyses for the first twelve months were performed using regression analysis, and the Lack of Fit determinations were used to test for parallelism of the slopes. The data collected from 13 to 24 months of the experimental period were analyzed by completely randomized design, and the treatments means were compared by Duncan's

RESULTS AND DISCUSSION

The performance data for each parameter measured for each 24 28-day were not presented here because no significant differences were observed among the treatments. In some parameters, where there were significant differences among treatments; the significance by period was not consistent. This inconsistency may be environmental, since the experiment was carried out in two seasons (summer and winter). This inconsistency may

TABLE 2. OVERALL MEAN VALUES FOR REPRODUCTIVE AND PERFORMANCE CHARACTERISTICS OF SCWL ROOSTERS FED FOR 24 28-DAY PERIODS ON CORN-SOYBEAN AND CORN - SOYBEAN - COTTONSEED RATIONS

Dietary Treatments	Fertility (%)	Hatchability (%)	Body Weight (kg)	Feed Consumption (g/day)	Semen Volume (cc)	Concentration (sperm 10/ml)	Spermatozoa (%)	Days of Incubation 18	Dead Embryo 21	Chicks Pipped (%)
Control-13%	89.9	67.1	2.45	92.3	0.40	5.36	10.07	4.50	3.37	3.42
50% CSM	84.4	66.9	2.57	93.4	0.42	4.67	8.20	5.53	6.13	4.52
100% CSM	87.2	7.05	2.44	97.3	0.51	5.00	8.88	5.69	6.29	4.34
Control - 15%	86.4	70.1	2.46	95.6	0.44	4.90	8.66	5.23	6.15	4.78
50% CSM	85.9	70.2	2.46	97.8	0.39	4.90	8.82	3.83	4.79	5.56
100% CSM	83.2	67.2	2.50	105.2	0.41	4.85	8.63	4.89	5.48	5.26
SD	2.33	1.76	0.05	4.58	0.04	0.23	0.63	0.70	1.13	0.75

Means are not significantly ($P > 0.05$) different.

TABLE 3. MEAN VALUES HAEMATOCRIT, TESTICULAR WEIGHT, VOLUME OF WATER DISPLACED OF TESTES, TESTOSTERONE, AND MORTALITY FROM SCWL ROOSTERS FED FOR 24 28-DAY PERIODS WITH SOYBEAN AND CORN-SOYBEAN COTTONSEED MEAL RATIONS

Dietary Treatments	Haematocrit Periods 13 (%)	24 .	Testes Weight (g/100g BW)	Water Displacement of Testes (ml)	Testosterone (ng/ml)	Mortality NO. dead/ no start)
Control-13%	41.3	44.4	48.7	1.12	0.54	5 (12)
50% CSM	40.5	43.5	46.3	1.08	0.87	1 (12)
100% CSM	41.1	43.2	46.6	1.45	0.44	2 (12)
Control -15%	40.7	42.8	43.7	1.10	0.73	1 (12)
50% CSM	41.6	42.7	42.0	1.03	1.37	3 (12)
100% CSM	40.5	41.8	44.5	1.27	1.01	2 (12)
SD	0.45	0.87	2.38	0.16	0.34	1.50

Means are not significantly ($P > 0.05$) different.

also be due to management factors which cannot be controlled, but most likely, not treatment effects. The mean for fertility, hatchability, body weight, daily feed consumption, semen volume, semen concentration, spermatocrit, dead embryos at 18 and 21 days of incubation and percent chicks pipped were not significantly ($P > 0.05$) different among the treatments. The mean for haematocrit at 1, 13 and 24 28-day periods, testosterone concentrations and mortality of the roosters were not significantly different among the treatments (Table 3).

28-day periods indicated that the performance of roosters fed 13 percent crude protein diet either with the protein from 100 percent SBM, or 50 percent mixture of SMB:CSM, or 100 percent CSM was equal to those of cocks fed 15 percent crude protein diets with similar vegetable protein sources. These diets must have met the protein requirements of the cocks. Arscott and Parker (1963) mentioned that feeding cocks with diets containing crude protein levels ranging from 6.0 to 16.0 percent did not affect their fertilizing capability. The energy levels in this experimental diet (Table 1) exceeded the metabolizable energy (2553, 2068 and 1584 kcal of ME/kg) in the diets fed to adult Single Comb White Leghorn cocks which was reported by Parker and Arscott (1964); therefore, we would not expect any detrimental effects on the reproductive capacity of the cocks.

Roberson (1970) found that when glandless cottonseed meal replaced 100 percent of the soybean meal in layer rations, no differences were observed. Since gossypol is primarily stored in the gland of the seed, the glandless would contain gilded or no gossypol.

The cottonseed meal used in this experiment is the solvent extracted commercial type. This meal contained less than 0.04 percent free gossypol as stated by the commercial supplier of the meal. With the daily feed consumption of the rooster in this experiment ranging from 92.3 to 105.2 grams per rooster per day (Table 2), the maximum daily gossypol consumption was only 42.1 mg

per cock per day, which is considerably less than reported in the earlier experiment (Akanbi, 1984).

The replacement of all the soybean meal with commercial cottonseed meal as the source of protein in raw 13 and 15 percent crude protein cocks' feed did not affect the reproductive traits of cocks. The examination of the reproductive capability of cocks fed raw cottonseed meal should be of great interest.

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