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Effects of Underfeeding on Semen Quality of Rhode Island Cocks

¹M. Kabir, ²O.O. Oni, ¹G.N. Akpa, ²I.A. Adeyinka and ²P.I. Rekwot
¹Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria
²National Animal Production Research Institute, Shika-Zaria, Nigeria

Abstract: Fifty Rhode Island chickens were randomly assigned to five treatments with ten cocks in each treatment. Group I cocks (full fed control) received 140 g of a 16% CP growers ration per cock per day. Cocks in Group II, III, IV and V received 98, 70, 42 and 28 g of the same ration per cock per day, representing 70, 50, 30 and 20% of Group I intake, respectively. The feeding trials lasted for 8 weeks during which one ejaculate per day was collected from each cock using the massage technique. The ejaculated semen samples were subjected to both physical and biochemical evaluations. Results showed that cocks that were severely underfed (i.e., Groups IV and V) took significantly longer time ($p < 0.01$) to ejaculate. In addition, ejaculation failures were encountered more frequently with the severely underfed cocks than in cocks that were moderately underfed (i.e., Groups II and III). There were however, no significant differences in most of the biochemical parameters between cocks I all the treatment groups. Ejaculate volume, progressive sperm motility and sperm concentration were significantly depressed ($p < 0.01$) in the severely underfed cocks than in the moderately underfed cocks. Thus, this study revealed that providing Rhode Island red and white cocks with one-half to three-quarter (i.e., 50-70%) of their normal daily ration would neither undermine their semen producing ability nor affect their semen quality adversely.

Key words: Rhode Island cocks, semen quality, feed restriction

INTRODUCTION

Feed has been implicated by some workers (Hocking and Bernard, 1997) as one of the factors known to affect semen production and quality in the male bird. Studies by Boone and Hughes (1969) showed that starvation of cocks for six days led to a marked reduction in semen production, but the condition was reversed after 14 days of resumption to normal feeding. With intensive production and improved feeding, Nwosu (1979) reported a remarkable improvement in the reproductive traits of local chickens. This therefore shows that adequate nutritional environment is essential to maintain the breeding flock in good reproductive condition. Pana *et al.* (2000) reported that Cornish broiler cocks whose daily feed consumption was limited to 130 g produced ejaculates whose concentration did not differ significantly from their full-fed counterparts. According to Ezekwe *et al.* (2003) the effects of underfeeding on semen quality traits appeared to be more severe on the physical rather than biochemical characteristics, which implies that the spermatogenic functions of the testes are more responsive to underfeeding than the secretory activities of the reproductive tract.

Dietary crude protein and food intake were reported to affect semen production of broiler breeder males (Hocking and Bernard, 1997). Moderate underfeeding was reported to affect semen production and semen quality attributes of local cocks whereas volume, motility and concentration were significantly depressed by severe underfeeding (Ezekwe *et al.* 2003). It is of interest to evolve a feeding programme for breeding birds that will reduce the high cost of feeding under intensive production system without inflicting serious damage to their reproductive functions.

Thus, the sole objective of this research was to evaluate the effect of under feeding on the semen production and quality of Rhode Island red and white chickens.

MATERIALS AND METHODS

The study was conducted at the poultry breeding unit of the National Animal Production Research Institute Shika, Zaria. Shika is geographically situated between latitude 11°12' N and longitude 7°33' E at an altitude of 640 M above sea level (Akpa *et al.*, 2002). It is located 22 km northwest of Zaria City and is vegetationally in the

northern guinea savannah zone of Nigeria. The Shika climate is characterized by a well defined dry and wet seasons. The dry season lasts from mid-October to April and consists of a period of low relative humidity with strong, cold and dry northeast harmattan winds.

A total of fifty Rhode Island cocks aged between 28-32 weeks old and ranging in body weight from 1.562 ± 0.224 to 1.839 ± 0.325 kg were used. Cocks were housed in individual wire cages and fed growers ration containing 16% CP and 2737 Kcal ME kg^{-1} . Prior to the commencement of the work, a one-week pre-experimental trial was observed during which the average daily feed intake of the cocks was found to be 140 g/cock/day. This was considered necessary in order to calculate the quantity of feed required for the different levels of underfeeding the cocks would be exposed to. In addition, the pre-experimental period also allowed the birds to be trained how to ejaculate and emit semen once every morning, by the massage technique described by Hafez (1990). Thereafter, the cocks were randomly assigned to five treatment groups of ten cocks per treatment as follows:

- Group I 140 g/bird/day: (100% full-fed control)
- Group II 98 g/bird/day: (70% of group I intake; i.e., mild feeding)
- Group III 70 g/bird/day: (50% of group I intake; i.e., moderate underfeeding)
- Group IV 42 g/bird/day: (30% of group I intake; i.e., severe underfeeding)
- Group V 28 g /bird/day: (20% of group I intake; i.e., very severe underfeeding)

The entire daily ration was fed to every cock once at 0900 h, while clean drinking water was provided *ad libitum*. The feeding programme lasted for eight weeks during which each cock was ejaculated every morning. Ejaculation time for each cock was recorded using a stop watch. The ejaculates were then subjected to both physical evaluation and biochemical analysis. The physical evaluation involved determination of semen volume, semen progressive motility and sperm concentration as described by Lake (1966). The biochemical analysis involved determination of the electrolyte concentrations of the pooled weekly semen samples for cocks in each treatment group, which was stored frozen until required for analysis. The atomic absorption spectrophotometry of Quinn *et al.* (1966) was used for the analysis. The mean weekly body weight changes of the cocks were recorded to monitor body weight changes during the experimental period. One-way analysis of variance was used to test for the significance

of treatment means while Duncan's Multiple Range Test (DMRT) was used for the separation of significant treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Table 1 shows the mean weekly body weight changes of cocks in the five treatment groups. Cocks in Groups I-III recorded slight weight increase during the experimental period while members of Groups IV-V progressively lost weight within the same period. Non-significant difference was observed in the body weight changes of cocks in Groups II and III, while highly significant decrease in the body weights of cocks I Groups IV and V ($p < 0.01$) was obtained. However, cocks in Group III were significantly lighter ($p < 0.05$) than cocks in Group I. It can be deduced from these results that reducing the daily feed consumption of Rhode Island cocks by 50% would not have adverse effect on their body weights.

Table 2 shows the average ejaculation time and other semen quality traits of the Rhode Island cocks. A total of 348 semen samples were collected over the eight-week experimental period. Ejaculation failures were encountered more in the severely underfed cocks (Groups IV and V) than in cocks in Groups I, II and III. Similarly, the severely underfed cocks were slower ($p < 0.01$) to respond to manipulation for ejaculation. Generally, ejaculation time increased as the level of underfeeding increased.

Semen quality traits of cocks in Group I and II did not differ significantly. Boone *et al.* (1967) reported that reducing either total feed or calorie intake to 15% resulted in loss of body weight and very poor quality semen and decreased fertility. The cation concentrations (electrolytes) of the semen of cocks in all the treatment groups lie within the range reported for normal cock semen (Lake *et al.*, 1958). The semen of cocks in Groups I-III did not differ significantly in their biochemical constituents. This implies that the secretory ability of structures responsible for contributing the biochemical constituents of semen were not adversely affected when the feed intake of the cocks was reduced by half (i.e., 50%).

The physical quality traits began to fall as the level of underfeeding increased from 70 to 50%, but this trend was unobserved in the biochemical constituents. The explanation to this was that the spermatogenic functions of the testis can be said to be more responsive to underfeeding than the secretory activity of the reproductive tract. This supports the findings of Davies *et al.* (1957) that underfeeding diminishes the ability of the gonads to respond to gonadotropin stimulation.

Table 1: Mean weekly body weight (kg) of Rhode Island cocks Levels of feed restriction

| Weeks | Levels of feed restriction (%) | | | | |
|-------|--------------------------------|-------------|-------------|-------------|-------------|
| | 100 | 70 | 50 | 30 | 20 |
| 1 | 1.562±0.224 | 1.231±0.201 | 1.147±0.201 | 1.133±0.200 | 1.146±0.178 |
| 2 | 1.586±0.355 | 1.347±0.211 | 1.219±0.209 | 1.116±0.213 | 1.213±0.190 |
| 3 | 1.471±0.211 | 1.402±0.238 | 1.237±0.216 | 1.068±0.188 | 1.108±0.151 |
| 4 | 1.569±0.277 | 1.484±0.255 | 1.270±0.239 | 1.040±0.165 | 0.937±0.125 |
| 5 | 1.634±0.302 | 1.531±0.282 | 1.322±0.234 | 0.978±0.111 | 0.900±0.107 |
| 6 | 1.735±0.338 | 1.577±0.293 | 1.400±0.243 | 0.915±0.108 | 0.884±0.139 |
| 7 | 1.773±0.333 | 1.604±0.304 | 1.437±0.251 | 0.872±0.114 | 0.852±0.120 |
| 8 | 1.839±0.325 | 1.628±0.325 | 1.518±0.252 | 0.904±0.129 | 0.855±0.131 |

Table 2: Average ejaculation time, semen traits and semen cation concentrations of Rhode Island cocks exposed to restricted feed consumption

| Traits | Levels of feed restriction (%) | | | | |
|--|--------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| | 100 | 70 | 50 | 40 | 20 |
| Number of ejaculates | 81 | 74 | 68 | 65 | 60 |
| Time (sec) of ejaculation | 5.29±0.34 ^{***} | 5.38±0.39 ^c | 7.15±0.42 ^b | 9.31±0.4 ^b | 12.18±0.38 ^a |
| Semen volume (mL) | 0.43±0.13 ^a | 0.38±0.08 ^b | 0.32±0.06 ^b | 0.25±0.03 ^c | 0.18±0.01 ^d |
| Semen motility (%) | 73.83±0.24 ^a | 68.29±0.20 ^b | 62.53±0.28 ^b | 57.38±0.30 ^c | 50.51±0.26 ^d |
| Sperm conc. ($\times 10^9$ mL ⁻¹) | 1.97±0.44 ^a | 1.48±0.35 ^b | 1.17±0.29 ^b | 0.87±0.16 ^c | 0.63±0.12 ^c |
| Calcium (mg 100 mL ⁻¹) | 6.38±0.74 ^b | 7.97±0.52 ^a | 6.56±0.64 ^b | 5.73±0.41 ^c | 6.77±0.49 |
| Sodium (mg 100 mL ⁻¹) | 382.46±59.27 ^a | 328.82±44.60 ^b | 274.15±37.25 ^c | 238.33±29.32 ^d | 184.08±52.71 ^e |
| Magnesium (mg 100 mL ⁻¹) | 6.98±0.83 ^a | 6.35±0.55 ^a | 5.87±0.47 ^b | 4.61±0.43 ^c | 4.31±0.29 ^c |
| Potassium (mg 100 mL ⁻¹) | 60.38±8.74 ^a | 55.92±7.52 ^a | 46.56±5.64 ^b | 31.73±6.41 ^c | 38.29±4.88 ^{bc} |

**Means in the same row with different superscripts are significantly different (p<0.01)

In conclusion therefore, it can be said that moderate underfeeding (i.e., reducing the daily feed intake by 30 to 50%) was found not to adversely affect semen production and semen quality attributes of Rhode Island cocks. Instead, a substantial saving in terms of cost of feeding would be achieved by the farmer.

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