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Feeding Programs to Induce Molting in Japanese Quails *(Coturnix japonica)*

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ABSTRACT

The experiment was carried out in the experimental poultry house of the Research and Development Unit of Brotas of Agência Paulista de Tecnologia dos Agronegócios do Centro-Oeste, SP, Brazil. The objective of the study was to evaluate forced-molting methods and their effects on body weight, egg production, feed intake, and mortality, as well as bird performance during the second laying cycle. A total number of 400 65-week-old Japanese quails was distributed in a completely randomized experimental design into five treatments, with four replicates of 20 birds each. The following treatments were applied: **T1**= not submitted to forced molting, **T2**= 01 day of fasting + 13 days receiving 15g feed/bird/day (1F+R), **T3**= 02 days of fasting + 12 days receiving 15g feed/bird/day (2F+R), **T4**= 03 days of fasting + 11 days receiving 15g feed/bird/day (3F+R), and **T5**= 3 days of fasting and fed *ad libitum* thereafter (3F+AL). Significant differences were detected among treatments. When submitted to 3 days of fasting followed by *ad libitum* feeding, birds presented complete body weight recovery. No egg production percentage differences were detected in birds submitted to forced molting.

INTRODUCTION

Forced molting has been studies with the purpose of using layers for one additional production cycle, and management changes are the most commonly used techniques (Garcia *et al.,* 2001). The purpose this practice is to allow the bird's reproductive system to rest for a certain period in order to restore its reproductive capacity, in order to improve eggshell quality and to reduce egg losses (Ramos *et al.*, 1999).

Several methods have been studied in the last three decades, but fasting (feed and/or water withdrawal and no use of artificial lighting) seems to be the most commonly applied (Wakeling, 1977; Shippee *et al.*, 1979; Stevenson & Jackson, 198; Berry & Brake, 1985; Harms, 1991), as it is easy to apply and promotes good results.

However, although during natural molting feed intake, activity, and body weight are reduced, the method of extended feed withdrawal is considered harmful to bird welfare. Therefore, there is an increasing interest in the research of alternative methods that reduce stress and present the same economic results as the conventional method applied in forced molting (Ramos *et al.*, 1999).

The first forced molting experiments with layer quail were carried out by Cantor & Johnson (1984), who compared feed fasting with feeding the same levels of a regular diet or one containing 1.5% zinc. The authors observed high body weight loss and mortality in the molted birds, and that feed fasting and zinc addition resulted in earlier egg production cessation as compared to feed restriction. Egg production 49 days after treatment was higher for the birds fed zinc and submitted to feed restriction as compared to those submitted to fasting.

Garcia *et al.* (2001), after submitting quails to forced molting by fasting them for three days, compared the use of two different diets during the resting period: egg-production feed or ground corn for four or seven days after fasting, followed by egg-production feed. The authors observed that birds fed only the egg-production feed recovered their body weight and started laying earlier than those fed ground corn.

If proper forced molting techniques could be used in quails, the reutilization of flocks for an additional laying cycle could become an economically feasible alternative for quail egg production.

The objective of the present study was to evaluate different forced molting methods in Japanese quails, and their effects on body weight, egg production, feed intake, and mortality, with the purpose of finding less severe methods to promote forced resting that comply with the increasing global concern with animal welfare.

MATERIAL AND METHODS

The experiment was carried out in the experimental poultry house of the Research and Development Unit of Brotas of Agência Paulista de Tecnologia dos Agronegócios do Centro-Oeste, SP, Brazil.

A total number of 400 end-of-lay 65-week-old Japanese quails (*Coturnix japonica*) were used. Birds were housed in 4-m wide and 12-m long masonry poultry house. Twenty 100-cm long, 34-cm wide, and 16-cm high metal cages, with four internal divisions of 25 cm each, were used to house 20 birds per cage. Each cage compartment was equipped with a nipple drinker and a trough feeder.

Birds were distributed in a completely randomized experimental design into five treatments, with four replicates of 20 birds each. The following treatments were applied: T1 (Control) – birds not submitted to forced molting, T2 (1F+R) – birds submitted to 1 day of fasting, and thereafter fed 15g feed/bird/day for 13 days, T3 (2F+R) – birds submitted to 2 day of fasting, and thereafter fed 15g feed/bird/day for 12 days, T4 (3F+R) – birds submitted to 3 day of fasting, and thereafter fed 15g feed/bird/day for 11 days, and T5 (3F+AL) – birds submitted to 1 day of fasting, and thereafter fed *ad libitum*.

The experimental feed was based on ground corn and soybean meal, and formulated according to NRC (1994) recommendations.

The experimental period was 126 days. During the first 14 days, birds were submitted to forced molting by providing natural lighting, and fed according to the experimental treatments. Feed intake, body weight loss, egg production, and mortality were recorded during this period. The remaining 112 days were divided in four 28-day periods, during which egg weight, egg production, feed intake, and feed conversion ratio per dozen eggs were recorded. A lighting program of 17 hours of light was applied. Water was offered *ad libitum* during the entire experimental period.

Data were submitted to analysis of variance using SAS (2000) statistical package. Means were compared by the test of Tukey ($p<0.05$). The effects of treatments on body weight were analyzed using polynomial regression equations.

RESULTS AND DISCUSSION

Mean body weight in the beginning of the experiment was 166.0g, and there were no significant body weight differences within each experimental treatment (Table 1).

On the first day of the experimental period, the body weight of birds submitted to fasting – treatments 2 (1F+R), 3 (2F+R), 4 (3F+R), and 5 (3F+AL) – was significantly lower as compared to the body weight of the birds in treatment 1 (Control), which were not submitted to fasting. Body weight loss of fasted birds was, in average, of approximately 12.7% relative to their mean initial weight.

Table 1 - Mean bird weight (g) according to experimental treatments during the experimental period.

	Period (days)						
Treat.	**Initial**	**1**	**2**	**3**	**7**	**10**	**14**
1 (Control)	165.1	163.0 A	159.9 A	156.4 A	153.4 A	151.7 A	149.3 A
2 (1F+R)	168.3	147.0 B	141.3 B	143.2 B	142.9 AB	139.5 AB	135.1 AB
3 (2F+R)	161.6	140.4 B	122.7 C	123.3 C	128.9 CD	129.7 B	125.8 B
4 (3F+R)	168.1	146.7 B	128.6 C	115.4 C	122.1 D	126.2 B	125.2 B
5 (3F+AL)	167.1	145.7 B	127.8 C	117.6 C	139.2 BC	144.8 A	148.5 A
Mean	166.0	148.6	136.1	131.2	137.3	138.4	136.8
CV (%)	3.48	3.62	4.17	4.40	4.59	4.96	5.65
P	>0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Means followed by different capital letters are significantly different by the test of Tukey ($p<0.05$).

On the second and third days of the experimental period, birds in treatment 2 (1F+R) presented significantly lower ($p<0.01$) body weight as compared to those in treatment 1 (Control), which did not molt, and significantly higher ($p<0.01$) than those in treatments 3 (2F+R), 4 (3F+R), and 5 (3F+AL), which were still being submitted to fasting. On the second day of fasting, mean body weight loss of birds still submitted to fasting was 23.7% relative to their mean initial body weights.

Birds in treatments 4 (3F+R) and 5 (3F+AL), fasted for three days, lost 30.49% of their mean initial body weights.

On the seventh experimental day, birds in treatment 2 (1F+R), fasted for only one day, had similar body weight as those in treatment 1 (Control), which did not molt. Birds in treatment 5 (3F+AL), submitted to three days of fasting, had lower body weight than those in treatment 1 (Control), but similar body weight as those in treatment 2 (1F+R). Birds in treatment 3 (2F+R) and in treatment 5 (3F+AL) presented similar body weights, which were lower than those in treatment 2 (1F+R). Birds in treatment 4 (3F+R) had similar body weights as those in treatment 3 (2F+R), but lower as compared to the other treatments.

On the tenth day of the experimental treatment, treatments 1 (Control) and 5 (3F+AL) presented similar body weights, which were higher as compared to treatments 3 (2F+R) and 4 (3F+R). Treatment 2 (1F+R) results were not significantly different from the other treatments. Mean body weight was 138.4g during this period.

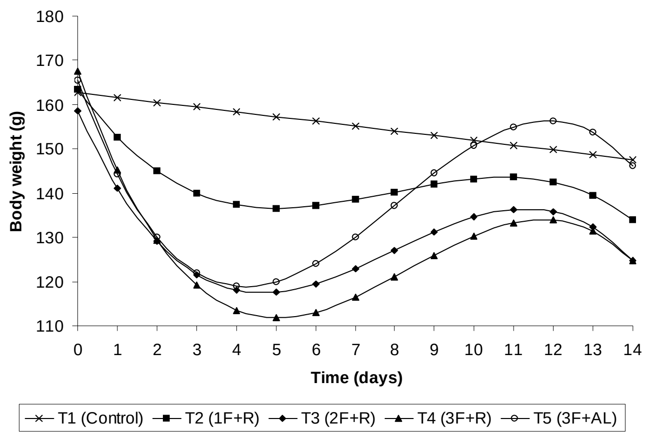
From the tenth to the last day of the experimental period, birds in treatments 1 (Control) and 5 (3F+AL) also presented similar weights, which continued to be higher than those in treatments 3 (2F+R) and 4 (3F+R), whereas birds in treatment 2 (1F+R) were not significantly different from the other treatments. Mean body weight was 136.8g during this period.

After the tenth experimental day, birds in treatments 2 (1F+R) and 5 (3F+AL) had recovered their body weight, which was not significantly different ($p>0.05$) from birds in treatment 1 (Control), whereas birds in treatments 3 (2F+R) and 4 (3F+R) continued to loose weight until the end of the experimental period.

Weight loss results obtained during the fasting period in the present experiment were slightly higher than those of Garcia *et al.* (2001), who observed body weight loss of 8.84% on the first day, 19.38% on the second day, and 25.64% on the third day of fasting. The higher weight loss detected in the present study was probably due to lower environmental temperatures recorded during the experimental period as compared to those recorded by Garcia *et al.* (2001). In order to maintain body heat, bird metabolic rate increased to promote thermogenesis, causing higher oxidation of body reserves.

The decomposition of treatment effects along the experimental periods using orthogonal polynomial regression showed a significant linear effect ($p<0.01$) for body weight in treatment 1 (Control) and significant cubic effects ($p<0.01$) for the other treatments.

As shown in Graph 1, birds in treatment 1 (Control) suffered a significant linear body weight loss during the experimental period, which may be explained by the reduction of the lighting period, causing reduction in feed intake, and therefore body weight loss. Body weights of birds in treatments 2 (1F+R), 3 (2F+R), 4 (3F+R), and 5 (3F+AL) presented a cubic behavior during the experimental period, with minimum values detected on 5.07, 4.66, 5.03, and 4.23 days, and maximum values on 10.74, 11.32, 11.75, and 11.9 days, respectively.



Graph 1 - Estimated body weight of birds submitted to the experimental treatments during the experimental period of 14 days.

Body weight prediction equations of birds submitted to each treatment as a function of time are:

1 (Control): $Y= 162.92 - 1.072X \; R^2 = 88.77$;

2 (1F+R): $Y= 163.419 - 12.575x + 1.826x^2 - 0.077x^3 \; R^2 = 83.71$;

3 (2F+R): $Y= 158.519 - 20.429x + 3.093x^2 - 0.129x^3 \; R^2 = 90.3$;

4 (3F+R): $Y= 167.603 - 25.876x + 3.674x^2 - 0.146x^3 \; R^2 = 96.64$;

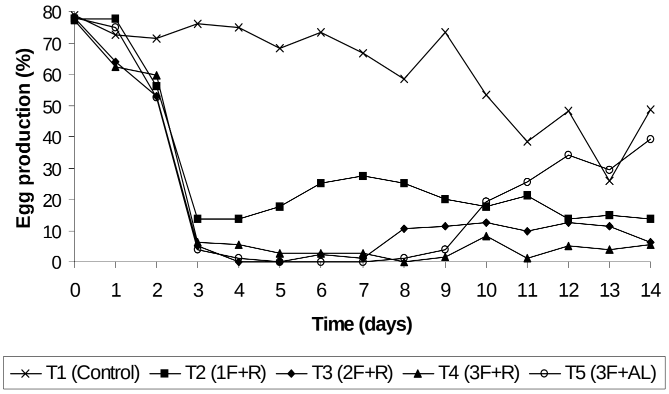
5 (3F+AL): $Y= 165.54 - 25.116x + 4.033x^2 - 0.167x^3 \; R^2 = 89.89$;

where Y is the estimated body weight and X is the period in days.

Table 2 shows egg production, feed intake, and mortality data of birds per experimental treatment during the experimental period.

Mean egg production of birds in treatment 1 (Control) was significantly higher (p<0.01) as compared to the other treatments. Treatments significantly (p<0.01) influenced feed intake, with birds in treatment 1 (Control) presenting higher feed intake relative to the remaining treatments as they were not submitted to feed restriction. Birds in treatments 2 (1F+R), 3 (2F+R), and 4 (3F+R) presented lower feed intake as a result of restricted feeding after the fasting period. Treatments did not significantly affect mortality rate. Mean mortality during molting was 1.04%, which was lower than that observed by Garcia *et al.* (2001), of 2.29%.

Graph 2 presents egg production per treatment during the experimental period.



Graph 2 - Egg production according to treatment during the experimental period.

As shown in Graph 2, in the beginning of the experiment, egg production was approximately 80%.

Birds in treatment 1 (Control) reduced egg production during the 14 experimental days, reaching levels of approximately 55% on day 14, which was caused by the short lighting period. Birds in treatment 2 (1F+R) did not show complete cessation of egg production, which remained in levels of 15 to 30% during the 14 experimental days. Birds in treatment 3 (2F+R) stopped producing eggs on the fourth experimental day, and resumed production on the eighth day, at a level of approximately 10%. Birds in treatment 4 (3F+R) decreased egg production to less than 5% after experimental day 8. Birds in treatment 5 (3F+AL) completely stopped to produce eggs on the fifth day of molting, and resumed producing eggs on day 9. On the last molting day (day 14), egg production reached 45%. Treatment 5 presented the highest productivity as compared to the other treatments that submitted birds to forced molting.

Garcia *et al.* (2001), using feed fasting to cause forced molting in quails, observed that egg production was reduced from 65.70% in the lay period to 27.14% on the first day of fasting, to 27.04% on the second day, and to values close to zero on the third day.

Table 3 shows egg weight, egg production, average daily feed intake, and feed conversion ratio per dozen eggs values of Japanese quails during the second laying cycle, after being submitted to forced molting.

Table 3 - Egg weight (EW, g), egg production (EP, %), average daily feed intake (FI, g), and feed conversion ratio per dozen eggs (FCR/dz) of Japanese quails submitted to forced molting.

Treatments	EW (g)	EP (%)	FI (g)	FCR/dz
1 (Control)	10.59ab	69.96b	21.80ab	0.39ab
2 (1F+R)	10.41b	77.14a	21.71ab	0.35b
3 (2F+R)	10.53b	72.84ab	21.18b	0.36b
4 (3F+R)	10.66ab	73.42ab	22.98a	0.39ab
5 (3F+AL)	10.86a	70.76ab	22.69a	0.41a
Probability	P<0.01	P<0.05	P<0.01	P<0.01
CV(%)	4.21	12.22	7.72	17.90

Means followed by different letters in the same column are significantly different by the test of Tukey (p<0.05)

Treatments significantly influenced the measured performance parameters.

Egg weight of birds in treatment 5 (3F+AL) was higher as compared to treatments 2 (1F+R) and 3 (2F+R), and were not different from treatments 1 (Control) and 4 (3F+R).

Table 2 - Egg production (EP, %), average daily feed intake (FI, g), and mortality (Mort, %) as a function of treatments during the experimental period.

Parameters	Treatments						
	1 (Control)	2 (1F+R)	3 (2F+R)	4 (3F+R)	5 (3F+AL)	CV (%)	Prob.
EP (%)	60.70a	25.53b	14.28b	12.03b	20.35b	25.01	P<0.01
FI (g)	20.02a	13.57c	12.42c	11.35c	17.00b	7.72	P<0.01
Mort. (%)	0.97	0.71	1.41	1.29	0.84	48.43	P>0.05

Means followed by different letters are significantly different by the test of Tukey (p<0.05)

The highest egg production was obtained in treatment 2 (1F+R), and the lowest in treatment 1 (Control), whereas the other treatments presented no differences as compared those treatments. The highest productivity was obtained in treatment 2 (1F+R), which may be explained by the use of the egg-production feed immediately after fasting, allowing rapid recovery of body weight and development of the reproductive tract, and therefore these birds were able to resume egg production earlier. These results are consistent with those obtained by Garcia *et al.* (2001).

The highest feed intakes were recorded in treatments 4 (3F+R) and 5 (3F+AL) as compared to treatment 3 (2F+R), but were not different from treatments 1 (Control) and 2 (1F+R). This may be explained by the fact the birds in treatments 4 (3F+R) and 5 (3F+AL) were submitted to longer fasting periods.

Treatment 5 (3F+AL) resulted in the worst feed conversion ratio per dozen eggs as compared to treatments 2 (1F+R) and 3 (2F+R), whereas the remaining treatments were not significantly different. The worst feed conversion ratio in treatment 5 (3F+AL) was possibly caused by the low egg production and the high feed intake observed in these birds.

CONCLUSIONS

Based on the results obtained in the present study, we can conclude that providing *ad libitum* feeding after fasting allows rapid recovery of body weight and productivity, as well as longer laying persistence. In addition, two days of fasting are sufficient to cause complete cessation of egg production.

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