



Evaluation of Induced Molting Methods on the Livability and Reproductive System Regression of Japanese Quails (*Coturnix japonica*)

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ABSTRACT

This study aimed at evaluating the alternative method of zinc oxide and fasting to induce molt in Japanese quails. A total number of 190 48-week-old quails was used. They were at end of laying cycle, and presented low egg production. Quails molted by zinc oxide (Z) were fed a diet containing 25,000 ppm of zinc oxide, and received water *ad libitum*. Quails treated by fasting (F) received no feed and a day of water restriction. The treatment period was determined by the experimental level of body weight loss (BWL). Birds were submitted to different levels of BWL in order to analyze reproductive system regression (ovary + oviduct), and livability. The following groups were established according to their BWL: Control (untreated quails); F₂₅ (25% BWL by F); F₃₅ (35% BWL by F); Z₂₅ (25% BWL by Z), and Z₃₅ (35% BWL by Z). Z₂₅, Z₃₅, and F₃₅ presented no significant differences in reproductive system weights after molting; however, their weights were lower than F₂₅, Z₂₅, Z₃₅, and F₃₅ presented the following livability: 97.5, 72.5, and 90%. Japanese quails treated by the alternative method of zinc oxide, presenting body weight loss of 25%, showed low mortality rate, and adequate regression of the reproductive organs.

INTRODUCTION

Japanese quails (*Coturnix japonica*) derive from China and Japan, and they are the most important species in the worldwide quail production (Tobón *et al.*, 2002), having an excellent egg production performance.

During the last few years, many researches were carried out on poultry management, nutrition, and health, promoting considerable advances in poultry production. However, little is known on quail management (Souza *et al.*, 2004). Techniques designed for chickens are usually adapted to quail production. Induced molt is an example of a widely used tool in layer management programs (Berry & Brake, 1985; Hussein *et al.*, 1988; Breeding *et al.*, 1992; Tilbrook *et al.*, 1992; Hussein, 1996; Berry, 2003); however, due to lack of research involving quails, there are no results that prove the efficacy of this technique in quail production. Induced molting is used in the poultry industry to increase the reproductive lifespan of layers leading to new laying cycles (Laurentiz *et al.*, 2005). As the layers get older, their egg production and egg external quality decrease (Keshavarz, 1994; Hurwitz *et al.*; 1998). Forced molting can restore their reproductive system capacity, and promote a new laying cycle (Colvara *et al.*, 2002).

Body weight loss, feather replacement, and cessation of egg production are parameters used to determine the efficacy of molting. Albuquerque *et al.* (1999) observed that hens submitted to the most severe feather replacement presented higher post-molting production. As to body weight loss (BWL), research studies point out that BWL levels



between 25 and 30% promote better post-molting production in a second laying cycle (Baker *et al.* 1983; Hussein, 1996). However, according to Brake and Thaxton (1979), post-molting productive improvement is related to the regression and to the regeneration of the reproductive system cells. Mehner (1969), quoted by Giampauli *et al.* (2005), showed that a decrease in reproductive system activity causes regeneration of the glands of the uterine mucosa. Therefore, post-molting results are associated with organ regression levels obtained during the molting process (Ruszler, 1998). Also, the reduction in the ovary weight depends on the duration of fasting or BWL level (Berry, 2003).

Among several molting methods, fasting and zinc oxide are highlighted. Fasting is commonly used in hens (Ruzler, 1998) due to its low cost and simple use (Hussein, 1996). Due to animal stress, the inclusion of relatively high zinc concentrations in feeds has been extensively studied as a possible alternative to feed deprivation (Berry & Brake 1985; McCormick & Cunningham 1987). For a long time, zinc oxide efficiency was supposed to be promoted by its anorexic effect (McCormick & Cunningham 1987). However, zinc oxide also showed to be more efficient for egg laying cessation and post-molting production as compared to feed deprivation methods (Berry, 1984).

The objective of this study was to determine which induced molting method causes better reproductive system regression and livability of Japanese quails (*Coturnix japonica*) treated with the alternative method of zinc oxide or fasting.

MATERIAL AND METHODS

The study started on March, 2006. It was performed at the Ornithological Studies Lab of the Veterinary School of the State University of Ceará, Brazil. A total number of 190 quails was used. Quails were 48 weeks old at the end of the laying cycle, and presented low egg production. Birds were individually weighed, identified, and housed in experimental cages with five birds per cage at a density of 106 birds/m². Birds were supplied with 17 hours/day of light during the experiment.

Two methods of induce molting were applied: Zinc Oxide Method (Z) or Fasting (F). Quails were submitted to different levels of body weight loss in both treatments (BWL): 0%, 25%, or 35%. Birds in group Z were supplied with water *ad libitum* and layer feed containing 25,000 ppm of zinc oxide. Birds in group F were submitted to a day of water restriction and feed deprivation until the end of treatment. Treatment

duration was relative to the achievement of desired BWL by the birds (0%, 25% or 35%), and varied from 3 days up to 5 days in both treatments.

Experimental groups

The analysis of reproductive organs regression was performed with 30 birds. These were divided into the following groups: Control (untreated quails, n=6); F₂₅ Group (25% of BWL by F, n=6); F₃₅ Group (35% of BWL by F, n=6); Z₂₅ Group (25% of BWL by Z, n=6) and Z₃₅ Group (35% of BWL by Z, n=6). Quails were euthanized, and had their reproductive organs collected. Ovary weight (g), oviduct weight (g), reproductive system weight (g), oviduct length (cm), and percentage of reproductive organs weight relative to body weight (g) were evaluated. All data of molted quails were compared to control group. After organ collection, the ovary and the oviduct were separately weighed, using an analytical scale, and oviduct length was measured.

Mortality was analyzed for each treatment in order to determine the effect of induced-molting method on livability. A total number of 160 quails was divided into the same categories as before (F₃₅, Z₂₅, Z₃₅, and Control), except for F₂₅, each comprising 40 birds.

Statistical Analysis

Data were initially submitted to the Kolmogorov-Smirnov and Shapiro-Wilk tests to confirm normality distribution, and to the Bartlett test to verify variance homogeneity among the treatments. When statistical demands for analysis of variance were complied, this analysis was carried out using GLM procedures of SAS software (1999). Test for comparison of means were selected according to the criteria established by Sampaio (2002): variables with a coefficient of variation (CV) of up to 15% had their means compared by the Student-Newman-Keuls (SNK) test, whereas those with CV higher than 15% had their means compared by the test of Duncan (comparisons involving more than four treatments) and by Student's t-test (comparison involving up to four treatments). When essential statistical demands to perform the Analysis of Variance were not met, Kruskal-Wallis non-parametrical test was used. Means were considered significantly different when $p < 0.05$, and the results were expressed as mean \pm standard deviation.

RESULTS AND DISCUSSION

Table 1 shows the regression of oviduct length,



ovary weight, oviduct weight, and reproductive system weight at different levels of body weight loss.

According to oviduct length regression results, we verified that all groups achieved significant reductions as compared to the control group, except for F_{25} . Quails treated with zinc oxide and those submitted to fasting with 35% BWL presented no significant regression differences, independent of body weight loss. As to ovary weight, all induced-molting groups presented significantly lower results than control group. However, birds belonging to groups Z_{25} , Z_{35} and F_{35} achieved regressions of 0.47g, 0.46g e 0.47g in body weight, with percentages of 92.153%, 92.337% e 92.137%, respectively, but these were not statistically different. These results are consistent with those of Berry & Brake (1985), who used the fasting method with BWL of 30 to 34%, during 16 days in commercial layers, and observed ovary weight regression of 91.18%. Quails in group F_{25} showed 81.479% of ovary weight reduction. Souza *et al.* (2006), studying fasting to induce molting in commercial layers, obtained a 78.36% regression, and considered it to be insufficient. Groups Z_{25} , Z_{35} , and F_{35} presented oviduct weight values of 1.87 g, 1.76 g, and 1.79 g, respectively, after forced molting. These groups showed the highest regressions, and were not significantly different among each other. Except for the quails submitted to the 25% BWL fasting, all results are consistent with El-Deek & Al-Harhi (2004), who, studying induced molting in hens, observed no difference in ovary weight, oviduct weight and length of hens fed 20,000 ppm zinc oxide in the feed, submitted to feed restriction, or submitted to fasting. Araújo *et al.* (2006), analyzing the ovary and

the oviduct on different days post-molting, concluded that reproductive system biometrics was not different in layers submitted to fasting or to the method of 20,000 ppm zinc oxide dietary inclusion. Quails molting by fasting at 25% BWL did not present satisfactory reduction of oviduct length, ovary weight, oviduct weight, and reproductive system weight parameters. This may be explained by the insufficient time for the regression of the reproductive system. Brake (1993) found that uterine lipids of commercial layers initiate their mobilization process only after the ninth day of treatment or when the bird reaches 25% body weight loss. Berry (2003) observed that, using the fasting method, commercial layers with 25% BWL were able to achieve complete ovary regression. Our experiment showed that this finding is valid only for zinc oxide-treated birds. Fasting method was not able to achieve full regression of the reproductive organs of quails.

Table 2 shows reproductive organ weights relative to body weight obtained by different Body Weight Loss levels. It can be seen that the lowest reproductive system weights were obtained by the Z_{25} ; Z_{35} e F_{35} groups, with respective results of 2.34g, 2.22g, and 2.59g, but with no significant difference. Birds from group F_{25} presented higher reproductive system weights ($p < 0.05$) as compared to the other induced-molting groups, with 52.528% reduction of its initial weight. Garcia *et al.* (2001), using a three-day fasting, obtained 25.64% BWL with 31.67% reduction in reproductive system weight. Lavor (2004) submitted Japanese quails with different body weights to a four-day feeding with 20,000 ppm zinc oxide feed, and found reproductive system reductions varying from 53.66%

Table 1 - Regression of oviduct length, ovary weight, oviduct weight, and reproductive system weight at different levels of Body Weight Loss.

Treatment	Oviduct length		Ovary weight		Oviduct weight	
	(cm)	Regression(%)	(g)	Regression(%)	(g)	Regression(%)
Control	27,27 ± 3,00 ^a	0	5,62 ± 0,96 ^a	0	7,06 ± 1,25 ^a	0
Z_{25}	17,80 ± 3,23 ^c	34,73	0,47 ± 0,14 ^c	92,15	1,87 ± 0,64 ^c	73,53
F_{25}	25,20 ± 4,83 ^{ab}	7,58	1,11 ± 0,60 ^b	81,48	3,51 ± 1,25 ^b	50,31
Z_{35}	19,00 ± 3,42 ^c	30,33	0,46 ± 0,06 ^c	92,34	1,76 ± 0,33 ^c	75,00
F_{35}	22,08 ± 2,99 ^{bc}	19,01	0,47 ± 0,08 ^c	92,14	1,79 ± 1,07 ^c	74,69

Different letters in the same column indicate significant difference ($p < 0.05$).

Table 2 - Reproductive tract weight based on body weight obtained from different Body Weight Loss levels.

Treatment	Initial Body weight (g)	Reproductive tract weight (g)	(%) Reproductive tract based on body weigh	(%) Reproductive tract regression
Control	150,17	12,68 ± 1,24 ^a	8,44 ± 0,62 ^a	-
Z_{25}	153,17	2,34 ± 0,71 ^c	2,04 ± 0,54 ^c	71,84
F_{25}	155,17	4,61 ± 1,75 ^b	4,01 ± 1,44 ^b	52,53
Z_{35}	142,83	2,22 ± 0,36 ^c	2,38 ± 0,47 ^c	75,88
F_{35}	137,50	2,59 ± 0,85 ^c	2,51 ± 1,21 ^c	70,30

Different letters in the same column indicate significant difference ($p < 0.05$).



to 66.2%. The other treatments achieved reproductive system regression over 70.302%.

Table 3 shows egg production during treatment up to the post-molting production.

All quails submitted to molting showed a cessation in egg production. Quails of groups Z₂₅ and Z₃₅ presented total cessation of egg production only on the fourth day of treatment, while birds of the F₃₅ group stopped laying on the third day of molting. The new productive cycle (egg production higher than 5%) was observed on the tenth day of post-molting treatment in all groups. Biggs *et al.* (2004) used induced molting in layer hens through fasting, and six days were needed for egg production to cease. Bar *et al.* (2003), studying several molting programs, found that 25,000 ppm zinc oxide feed caused a faster egg laying cessation. The faster cessation of quail egg production as compared to commercial layers is probably explained by the quail's fast metabolism, which was verified by Blem (1978). Our study showed that quails submitted to fasting methods completely stopped laying one day earlier than birds treated with zinc oxide.

Figure 1 shows quail livability from the beginning of induced molting until beginning of productive period. In the Control, Z₂₅ and F₃₅ groups, there were no significant differences in livability during the analyzed period, with respective values of 100%, 97.5%, and 90% of live birds, which means 0%, 2.5%, and 10% mortality. In the Z₃₅ group, induced molting resulted in significant differences in livability ($p < 0.05$) as compared to the other groups, with a percentage of 72.5%. Zamprônio *et al.* (1996), using the fasting method in quails, obtained 23.24% and 25.44% mortality on the third and sixth molting day, respectively. Garcia *et al.* (2001) observed mortality rates of 2.04% and 4.60% on the second and third day of molting also using the same technique in quails. Silva *et al.* (2003), utilizing virginiamycin in layer feeds before fasting, found a 1% mortality rate. According to Buxadé (2000), mortality occurring during induced molting in commercial layers varies from 1 to 1.5%, which means that the result that was most consistent with this study was that of group Z₂₅. The other groups presented higher mortality rates.

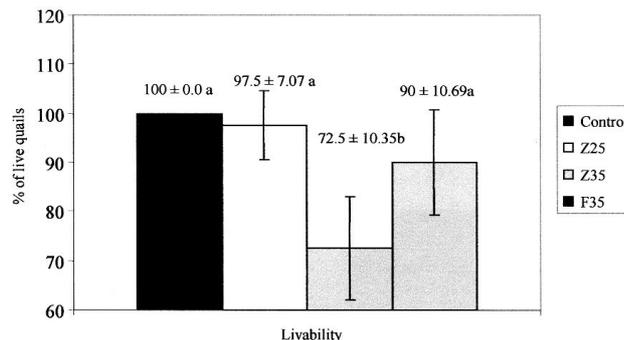


Figure 1 - Livability of quails submitted to different Body Weight Loss levels during induced molting

CONCLUSION

Japanese quails submitted to 25% body weight loss through the alternative method of zinc oxide presented satisfactory regression of the reproductive organs, as well as a low mortality.

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Table 3 - Egg production (%) during treatment until onset of the new laying cycle.

Method	*Production	Days since beginning of treatment									
		1	2	3	4	5	6	7	8	9	10
Control	62,5	57,5	62,5	50	55	50	52,5	50	57,5	62,5	60
Z ₂₅	60	57,5	2,5	2,5	0	0	0	0	0	0	5,26
Z ₃₅	60	57,5	2,5	2,56	0	0	0	0	2,94	0	10,34
F ₃₅	62,5	60	5,40	0	0	0	0	0	0	3,03	8,33

* Egg production before forced molting treatments.



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