RESPONSE OF JAPANESE QUAIL TO DIFFERENT FORCE-RESTING PROCEDURES: 1- PERFORMANCE PROFILES OF QUAILS FORCE RESTED BY EXCESSIVE DIETARY Zn AND/OR DIETARY Ca DEFICIENCY AND SEVERE QUANTITIVE FEED RESTRICTION REGIMEN

By

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Abstract: *The present experiments were carried out at the Poultry Research Farm belonging to Department of Poultry Production, Faculty of Agriculture, Kafr El-Sheikh, Tanta University.*

The aim of this work was to investigate the different responses of Japanese quails to different methods of inducing forced rest. The methods applied to force resting included qualitative and quantitative dietary procedures. To achieve these goals, two separate experiments were carried out on Japanese quails at the end of their egg laying season (32-week of age and about 33% rate of laying).

In the first experiment, treatments groups were:

Treatment 1: (HZn-HCa): birds have been offered diet containing high zinc level (20000 ppm zinc) as zinc sulfate heptahydrate ($ZnSo_4.7H_2O$) and high calcium level (3.79%) for 28 days.

Treatment 2: (HZn-LCa): birds have been offered diet containing high zinc level (20000 ppm zinc) and low calcium level (0.23%) for 28 days.

Treatment 3: (LZn-HCa): birds have been offered diet containing low zinc level (2800 ppm zinc) and high calcium level (3.79%) for 28 days.

Treatment 4: (LZn-LCa): birds have been offered diet containing low zinc level (2800 ppm zinc) and low calcium level (0.23%) for 28 days.

Treatment 5: (LCa): birds have been offered diet containing low calcium level (0.23%) only without any zinc added, for 28 days.

Treatment 6: (control): birds have been offered diet containing the requirements of zinc (45 ppm) and calcium (2.57%), (control group).

In the second experiment, forced rest was induced using the fasting regimen described by Yashimura et al. (1997). Feed and water were withdrawn for three days, then birds were provided with water beginning on day 4 treatment and thereafter. Gradual feeding was started 4 days after the cessation of egg lay.

Two groups were used, the first group was subjected to the fasing treatment while the other served as control.

The main results obtained could be summarized as follows:

Experiment 1: Live body weight was significantly decreased in groups fed diet supplemented with high zinc and/or low calcium content.

- *The lowest body weight were records observed in groups given the highest Zn level (20000 ppm) regardless to dietary Ca level.*
- *After a two-week recovery period a compensatory growth was obtained and no significant differences among groups could be revealed.*
- *Adding Zn to the basal diet at the level of 20000 ppm severely reduced the amount of feed consumed, while the effect of the lower level of dietary Zn (2800 ppm) appeared by the end of the second week of treatment*
- *Birds of HZn-LCa group showed significantly the least value of feed consumption among all groups throughout the four treatment weeks.*
- *Treatments including the lower level of Zn was not very effective to force the birds to rest, especially when it was accompained by the high level of Ca (group 3, LZn-HCa).*
- *Using the low Zn level together with the low Ca level (group 4, LZn-LCa) resulted in a more adverse effect on egg laying than using solely.*

- *After returning to the normal basal diet, a gradual increase in egg laying rate was observed in the different forced rest groups.*

- *During 8th week of the recovery period, rate of lay in the first and second groups reached about 535% & 525% of the records achieved by control hens, respectively.*

- *Egg weight was significantly decreased in response to forced rest treatment and the effect was mainly due to their effect on egg shell.*

- *Fertility and hatchability records of eggs collected from the different experimental groups during the last week of the recovery period showed that high dietary Zn treatments, regardless to the Ca level caused significant improvement of both traits.*

Results of Experiment 2 showed that the quantitative feed restriction regimen applied to induce the forced rest seemed to be more effective than those used in experiment 1.

In conclusion, birds responded in both experiments nearly in the same, but in case of the fasting method, the response was quicker and more potent. Moreover, birds started the second cycle about 3 weeks earlier and showed better persistency of egg production.

INTRODUCTION

Induced moulting or forced rest of commercial layers has been used extensively as a management tool for extending flock performance. Farms use the single-cycle (non-moulted) house over a ten year period, whereas only 5.7 flocks would be required for a typical two-cycle (one-moult) flock system (Bell, 2003).

The most common procedure of forced moult is based on a short period of feed withdrawal, which results in cessation of production, involution of the reproductive tract, and loss of primary feathers (Brake, 1993 and Park *et al.*, 2004).

Other methods of forced moult include the feeding of low-calcium (Gilbert and Blair, 1975 and Gilbert *et al.*,1981) low-sodium (Begin and Jonson, 1976 and Nesbeth *et al.*, 1976) or high-zinc (Shippee *et al.*, 1979 and Breeding *et al.*, 1992) diets.

Many studies, mostly on chickens and turkeys, were concerned with comparing the efficiency of these methods. Brake (1993), however, concluded that the only alternative to the techniques based on feed withdrawal is feeding a high-zinc diet which. According to McCormick and Cunningham (1987), owes its efficacy to the inhibition of feed intake.

Diets deficient in calcium have been successfully used to induce moulting in SCWL hens (Gilbert *et al.*, 1981 and Waddington *et al.*, 1985). At extremely low concentrations of calcium in the diet (0.5 g/kg), there is almost a complete cessation of egg production (Gilbert, 1973; Gilbert and Blair, 1975). Central mechanisms involving the pituitary operate at such low calcium concentrations. Because hens would normally stop laying on such diets can be forced to continue laying if given gonadotrophins (Taylor *et al.*, 1962).

The various technique of induced moulting have been reported to result in higher egg production, heavier egg weight, better feed efficiency, less mortality, and improvement in egg quality parameters such as albumen height, shell thickness and specific gravity as reviewed by Park *et al.* (2004). This general increase in reproductive performance results from rejuvenation effect which may be associated with an increased tissue sensitivity or efficiency and reorganization of metabolic processes (Brake *et al.,* 1979). In addition, the loss of adipose tissue may be associated with the overall increase in performance (Brake *et al.*, 1979). The decrease in body weight of hens due to either feed withdrawal or loss of appetite is directly related to decreased muscle, adipose tissue, liver, and the involution of reproductive organs (Berry and Brake, 1985).

To our knowledge, very few studies investigated the effect of force-moulting on Japanese quails. Therefore, the present experiments were mainly designed to study the response of quails at the end of their first laying cycle to some of the conventional force-moulting techniques.

MATERIALS AND METHODS

Two experiments were carried out to investigate the response of Japanese quails at the age of 32 wk to force rest via fasting technique or feeding birds on high dietary zinc, low dietary calcium or different combinations between the two nutrients. Number of birds and the experimental design of the first experiment are presented in Table 1, while those of the second experiment are shown in Table 2.

Experimental Procedure:

Three hundred and twenty seven (109 males and 218 females) 32-week-old Japanese quails at the end of their production curve were used in the present study. Birds were individually weighed and caged in an open sided building (each cage contained one male and two females) for two weeks before beginning of the experimental period. The ambient temperature was about (21 C^o), and was recorded daily during treatment period. A daily photo period of 17 hr was used. In all treatments birds were fed *ad-libitum* on a commercial layer diet. Basal diet was formulated to meet the nutrients requirements of Japanese Quail birds according to N.R.C. 1994, (20.08% CP and 2907 Kcal ME/Kg diet), (Table 3).

Characteristics Investigated:

All birds in each treatment were examined daily, in order to detect any abnormalities in gait or behavior. Live body weight, feed consumption percentage of egg production, egg weight, shell thickness, shell weight percentage (at the end of the treatment period and the peak of production), fertility and hatchability rates were recorded.

Statistical Analysis:

Data were statistically analyzed using the general linear models procedure "GLM" of the SAS program (1985). Differences between treatment means were tested using Duncan's Multiple Range test (Duncan, 1955).

RESULTS

Live Body Weight:

Results presented in Table (4) show live body weight changes during treatments (1-28 day) and after forced rest treatments (29-84 day) in experiment 1. By the end of the first week differences among groups were clear in quails of the first and second groups, which received the highest dietary Zn (20000 ppm), showed the lowest body weight records and significantly differed from the control group ($P < 0.01$). Reduction in body weight in the other treated groups was slight and insignificant. As birds continued to consume the experimental diets, variations among groups became more clear and the lowest body weight records were observed in groups received the highest Zn level (20000 ppm) regardless to dietary of Ca level. At the end of the experimental period (4th week) live body weight of birds in the first group decreased to about 78.4% of its initial value, while the second group it reached about 74% and both were significantly ($P<0.01$) less than the other four groups. Adding Zn at lower level (2800 ppm), whatever the level of Ca was seemed to be less effective in reducing bird body weight, since it reached about 93% and 91.5% of its initial records in the third and fourth groups, respectively.

Using the low dietary Ca level as the only tool of forced rest (group 5) showed no significant effect on either body weight significantly differ from the control group and did not change throughout the experimental period.

As soon as birds returned to the normal basal diet, a gradual increase in live body weight was observed in the first four weeks (Zn-treated groups). After a two-week-recovery period, a compensatory growth was obtained and no significant differences among groups could be revealed. Meanwhile those of HZn-HCa groups restored their initial body weight latter by the end of the third week of recovery.

Results of the second experiment (Table 6) showed that the use of fasting technique to induce forced rest was more effective than those of experiment one with regard to reducing birds live body weight. On the seventh day of treatment birds lost about 38.4 % of their initial body weight. By the third week birds restored their initial body weight, and up to the end of the experiment (9 weeks) body weight records of the treated group significantly exceeded those of control group.

Feed Consumption:

Results concerning feed consumption during the four-week-experimental period in experiment one and the following 8-week-recovery period are shown in Table (5).

It is clearly shown that adding Zn to the basal diet at the level of 20000 ppm severely significantly reduced ($P<0.01$) the amount of feed consumed.

The effect of the lower level of dietary Zn appeared by the end of the second week of treatment. At this time, birds of HZn-HCa, HZn-LCa, LZn-HCa and LZn-LCa groups consumed about 63.6%, 40.1%, 85.6% and 84.2% of that for birds fed on basal diet, respectively.

No detectable changes in feed consumption due to the low dietary Ca level (group 5) could be observed. However, when this low dietary Ca level was accompanied by the highest Zn level added, a synergistic effect was noted. At the end of the four-week-treatment period, average daily feed consumption records in the five treatment groups as percentage of that for birds receiving the basal diet were 42.2%, 29.2%, 73.3%, 69.84 and 94.31% for HZn-HCa, HZn-LCa, LZn-HCa, LZn-LCa and Lca, respectively.

On returning to the basal diet, birds of those groups increased their feed consumption significantly and even exceeded the records of control group in several weeks.

In the second experiment, the principle of this method was a quantitative feed restriction regimen in which birds were allowed food gradually from day 8 to day 11, but *ad-libitum* on day 12 and thenceforth. Therefor, it was naturally to find that feed consumption during the first two weeks of treatment decreased sharply due to treatment (Table 7). However, a significant increase in the amount of feed consumed was observed during the following three weeks. This coincided with the fast compensatory growth obtained during this period.

Egg Production:

Results regarding the effects of the different methods applied for inducing forced rest on egg production are shown in Table (8). As birds of the experiments were taken from the flock at the end of laying season, the average laying rate in the different groups ranged between 34% and 37%.

It is clearly seen that birds in all groups responded to the different methods applied since the first week of treatment with varying degrees. The most pronounced effect was that obtained in groups given the highest level of zinc (group 1 and 2). Through the first week of treatment, average egg production percentage in the first group (HZn-HCa) decreased to about 59.5% of its initial value. When the high level of dietary Zn (20000 ppm) was accompanied by the lowest calcium level (0.23%) (group 2, HZn-LCa), reduction in egg production was more severe and the rate of lay in this group did not exceed 38% of its initial value. It is interesting to mention that egg laying ceased completely on the 9th day of treatment in the first group and two days earlier (the seventh day) in the second group. Results obtained also proved that treatments including the lower level of Zn was not very effective to force the birds to rest, especially when it was accompanied by the high level of Ca (group 3). Birds of this group needed a longer period to respond. The first significant reduction in egg production of this group was observed after two weeks of treatments where it reached about 71% of its initial value. During the third and fourth week of treatment, the rate of lay in this group decreased to about 43.6% and 41.9% of its initial value, respectively, but never stopped completely. Using the low Zn level together with the low Ca level (group 4, LZn-LCa) resulted in a more adverse effect on egg laying than using each of them separately. Rate of lay in this group decreased significantly to about 50% of its initial value by the second week of treatment. Corresponding values during the third and fourth weeks were 34.4% and 17.0% consequently.

After returning to the normal basal diet, a gradual increase in egg laying was observed in the different forced rest groups. Results of egg production during a recovery period of 8 weeks proved that the high dietary Zn applied was the most effective tool. Quails of the first and second groups (HZn-HCa, HZn-LCa) did not return to egg laying before 15 and 17 days, respectively. Since the fifth week of the recovery period, the rate of egg laying exceeded 87% in the first group and 80% in the second group. During the 8th week of the recovery period, rate of lay in the first group reached about 535% of the records achieved by control hens which were kept on the basal diet through the all experiment. In this respect the corresponding value for the second group was about 525%.

It was observed that the low Zn level applied in the present study (2800 ppm) was less effective as a tool of induced force rest in quails regardless to the level of Ca applied with it. During the recovery period, egg production in group 3 (LZn-HCa)and 4 (LZn-LCa) increased gradually. Although, in several cases it was significantly higher than that for control group, it did not exceed 37%for the third group and 48% for the fourth group.

Results concerning egg production as influenced by the fasting regimen applied are presented in Table (9). It was observed that treated birds stopped egg laying completely by the 5th day of treatment. After returning to the normal feeding regimen, the first egg was laid on day 15. Thenceforth, a gradual increase in rate of laying was observed. Since the fifth week and afterwards, egg production records in the treated groups significantly surpassed those of control group. During the last four weeks of the experimental period, egg production percentage in the treated group reached about 294 %, 314 %, 330 % and 360 % of control records, respectively.

Egg Weight and Shell Quality:

Results obtained revealed that egg weight significantly decreased in response to forced rest treatment (Table 10). The decrease was greatest in the second group which received the high level of Zn with the lowest level of Ca. When the level of Ca was increased in the presence of the high Zn level (first group) average egg weight improved and significantly exceeded that of the second group suggesting an antagonistic relationship between the two elements with respect to egg formation. Results also indicated that using either the high or the low levels of Ca together with the low Zn level (group 3 and 4, respectively) significantly decreased average egg weight. If this result is compared with that of group five where the use of low Ca level only did not affect egg weight, it could be concluded that using Zn even at the level 2800 ppm negatively affected egg weight.

Regarding the results of egg shell weight, data obtained nearly followed those of egg weight suggesting that the effect of treatments on egg weight was mainly due to their effect on egg shell. In the first group, in spite of the high dietary Ca egg shell weight and thickness were significantly less than those for control group ($P < 0.01$). The situation became worst when the same level of Zn was accompanied by the low dietary Ca level, the second group (HZn-LCa), where the least records were obtained.

It seems that the use of the high Ca level in case of the low Zn level (group 3) to some extent could alleviate the negative effect of Zn on egg shell quality. This conclusion is supported with the results of shell quality in group 4 which were significantly less than their corresponding records in group 3. Moreover, the low dietary Ca level *per se* (group 5) did not significantly affect egg shell quality except in shell thickness.

After 8 weeks of feeding birds on normal diet, egg quality markedly improved. Average egg weight increased in the first and second groups and even exceeded that of the control and other three treatment groups which did not differ from each other. The same trend was observed for the absolute egg shell weight, but when it was expressed as percentage of egg weight, differences among groups were insignificant. As for shell thickness, it improved in the first and second groups while the other groups did not differ from control with no specific trend.

Results presented in Table (11) clearly show that by the end of the fasting period in experiment 2 the few eggs produced were quite small and having a markedly thin shell. Returning to the normal feeding regimen, a significant increase in egg weight and shell quality was obtained.

Fertility and Hatchability:

Results presented in Table (12) show fertility and hatchability records of eggs collected from different experimental groups during the last week of the recovery period in experiment 1. It's clearly observed that high dietary Zn treatments, regardless to the level of Ca (groups 1and 2) caused significant improvement of both traits. The other treatments did not significantly differ from the record of control.

Results obtained proved that birds forced to rest by the quantitative feed restriction regimen applied in the present study (experiment 2) produced not only greater egg number but also showed better fertility and hatchability percentage (Table 13).

Results obtained in the first experiment showed that the differences in mortality records between treated and control groups were insignificant during or after the treatment period, where, the maximum mortality percentage was 5.13% (in group 1, HZn-HCa).

Mortality records in the second experiment revealed that only two birds died as a result of the fasting regimen applied (3.03 %).

DISCUSSION

Live Body Weight:

Result of the present study revealed that all procedures applied to induce a pause in egg production in Japanese Quails resulted in a substantial loss in body weight. Body weight loss after four weeks of feeding birds HZn-HCa and HZn-LCa diets reached 21.6% and 25.9%, respectively. The corresponding values for LZn-HCa and LZn-LCa groups were 6.91% and 8.6% consequently, meanwhile undetectable changes were observed with LCa diet. On the other hand fasting regimen applied caused a sharp decrease in live body weight of about 38.4% within only seven days. These results are in harmony with those reported previously by Nevalainen, (1969); Berry and Brake, 1985; Cunningham and McCormick, 1985; Barron *et al.*, 1999 and Alodan and Mashaly, 1999.

According to Cunningham and McCormick (1985), White Leghorn layers fed zinc oxide at 20000 ppm lost only 16.4% of their initial body weight compared to a 30.6% weight loss in a feed removal group. Similarly, Palafox and Elodie (1980) reported body weight reductions of 15.9% for pullets fed 20 mg/g Zn oxide for 5 days.

Hussien *et al.* (1988) demonstrated that feeding 15000 ppm Zn to Japanese Quail hens depressed growth and feed intake. According to Brake *et al.*, (1981), an approximate 30% body weight loss is necessary for inducing a force rest in chicken.

Moreover, Baker *et al.* (1983) reported that body weight loss of 27-31% resulted in optimum post-molt performances when the molt was induced by various fasting and photoperiod manipulations. If these levels are representative of optimum body weight losses for molted birds then the LZn and LCa procedures employed here in our studies resulted less than optimum weight loss.

According to Nevalainen (1969), feeding White Leghorn hens a calcium-deficient diet (0.13% Ca) did not significantly affect birds body weight.

It seems that the response of birds to the fasting regimen depends greatly on the duration of treatment. Koelkebeck *et al.,* (1992) found that body weight loss varied according to the length of fasting treatment where hens subjected to 4, 7, or 14-day fast lost 18, 24 and 34% of their body weight.

It has been suggested that approximately 36% of the reduction in body weight of high zinc treated birds could be accounted for the reduced weight of the reproductive organs. The remaining loss was attributed to decreased lean muscle mass, utilization of adipose fat, and reduction of ingesta during the period of high Zn feeding (Williams *et al.*, 1989).

Feed Consumption:

One of the marked results of the present experiments was the reduction of feed intake following feeding birds high Zn diets. The effect was more pronounced when the high dietary Zn was accompanied by the low Ca level (HZn-LCa). This agrees with Shippee *et al.,* 1979; Palafox and Elodie, 1980; McCormick and Cunningham (1984, 1987); Williams *et al.,* 1989; and Breeding *et al.,* 1992.

According to Palafox and Elodie, 1980, hens fed 20000 ppm Zn consumed diet during the first 2 days of the study but "hardly ate the feed" from 3 to 5 days of the experiment.

Our results also indicated that using low dietary Ca to induce forced rest showed no effect on amount of feed consumed. This disagrees with the results obtained by Gilbert *et al.,* 1981 who used different levels of dietary Ca (ranging between 36.8-0.48 g/kg) in feeding laying hens aging 84 wk for 11wk. They claimed that the quantity of feed eaten was linked to dietary concentration of Ca.

Egg Production:

Regarding the effect of different methods applied to force quails to rest on subsequent egg production, it was observed that through the first week of treatment, average egg production percentage in the first group (HZn-HCa) decreased to about 59.5% of its initial value. Moreover, in this group egg laying ceased completely on the 9th day of treatment (Shippee et al., 1979; Bessei and Lantzsch, 1980; Cunningham and McCormick, 985 and Johnson and Brake, 1992).

When high level of dietary Zn (20000 ppm) was accompanied by low calcium level (0.23%) (Group 2, HZn-LCa), reduction in egg production was more severe and the rate of lay in this group did not exceed 38% of its initial value. Hens of this group stopped to lay two days earlier than those of the first group (on day 7). After returning to the normal basal diet, the first egg was laid on day 17 in HZn-HCa group and on day 20 in HZn-LCa group. This may be explained by the antagonism between high level of zinc and calcium.

Birds fed LCa diet (group5) showed decreased egg production during treatment period but did not stop laying completely. This is in contrast with the results of previous workers who claimed that when hens are given a Ca-deficient diet they normally stop laying after 10-14 days (Taylor *et al.*, 1962). Similar observations were also reported by Taylor, (1965) and Nevalainen, (1969). It seems that in our present study quail hens were able to produce eggs even under the low dietary Ca applied and that this level (0.23%) was not low enough to cause complete cessation of egg production.

This is in accordance with the suggestions of Verheyen *et al.,* (1983) who reported that calcium deficient hens had a less pronounced reduction of total progesterone concentrations and showed a greater variability: some hens ceased egg production but others continued egg laying at a reduced rate. Verheyen *et al.*, (1987) added that, since a low-Ca diet does not affect plasma oestradiol concentrations in laying hens, the normal oestrogen functions such as growth and maturation of ovarian follicles are maintained.

In the second experiment, the fasting regimen (feed and water withdrawal) resulted in cessation of egg laying by the fifth day of treatment. Meanwhile, the first egg of the second cycle was laid on day 15 after returning to the normal dietary regimen.

This agrees with Ross and Herrick, (1981), who reported that egg production ceased completely within 7 days after feed was withdrawn from S.C.W. Leghorn hens.

Many authors suggested that performance of hens during the second laying cycle is related to the rate of body weight loss during forced rest treatment. According to Baker *et al.,* (1983), the optimum weight loss value for improved post-molt performance seems to be 27 to 31% on a flock average; this value insures total regression in the greatest number of hens yet-still allows early return to lay.

According to Sturkie (1976), the egg yolk contains approximately 49% water and egg albumin contains 88% water, so under fasting condition there could be considerable water conservation associated with a cessation of egg production alone.

Many authors reported that fasting laying hens causes an immediate atrophy of the maturing ovarian follicles followed by interruption of egg production (Smith *et al.*, 1957; Brake *et al.,* 1979 and Verheyen *et al.*, 1987). Follicular atrophy is followed by a sharp decrease in plasma progesterone which is mainly produced by the granulosa cells of the 3 largest follicles (Etches, 1984; Wells *et al.,* 1985).

When hens are fasted, LH levels are reported to be lower than those of fed hens (Tanabe *et al.,* 1981; Etches, 1984). The major factor contributing to the reproductive dormancy seen in starved rats has been reported to be reduced plasma LH (Walker and Frawley, 1977). It has also been reported that starvation causes follicular atresia in the hen, probably due to the decrease of gonadotropin secretion from the pituitary, and that starvation may reduce pituitary gonadotroph sensitivity to LH-releasing hormone in the hen (Tanabe *et al.,* 1981). Generally, this has been the accepted mechanism by which fasting causes hens to go out of production, i.e., the blockage has been hypothesized to be at the hypothalamic pituitary level.

Verheyen *et al.,* (1987) reported that hens fasted or given a high-zinc diet, had low plasma progesterone concentration. Because elevated plasma LH should induce steroidogenesis, i.e., increased progesterone levels, the blockade in zinc-fed hens may occur at any site from follicular LH receptors to intracellular transfer of the signal.

Egg Quality:

Egg weight and egg shell quality proved to be negatively affected by high dietary zinc level applied and also by calcium deficient diets. Using the high calcium level together with high zinc level seemed to alleviate the negative effect of the high zinc level.

It was generally observed that adding zinc to the diets even at the level of 2800 ppm negatively affected egg weight and egg shell quality. The effect was worst under the low calcium level. Using the high calcium level could alleviate the negative effect of zinc and markedly improved egg weight and shell quality. In this respect, the low level of calcium alone did not affect egg weight or egg shell quality.

Similarly, Hussien *et al.,* (1988) found that a high level of dietary Zn (1.5%) showed negative effect on egg production and egg shell breaking strength of quails. Authors attributed this negative effect due to the sharp decrease in feed consumption, thereby decreasing the level of Ca intake.

On the other hand, our results are in contrast with those reported by McCormick and Cunningham (1984) who found that egg quality variables, breaking strength, and weight were not significantly affected by high dietary Zn.

Results of the second experiment proved that egg weight and egg shell quality deteriorated due to fasting. We suggest that the main cause of this deterioration could be the severe lack of nutrients due to food and water withdrawal.

During the second cycle of laying a marked improvement in egg weight and egg shell quality was observed. Similar results were obtained by Lee (1982); Berry and Brake (1991) and AL-Batshan *et al.* (1994).

The results obtained by Berry and Brake, 1991 demonstrated that induced molting, whether by fast or zinc methods, significantly increased the amount of calbindin (calcium binding protein-$D_{28}K$) present in the egg shell gland and duodenum of aging hens. They added that egg shell quality, as measured by egg shell density and weight on the 10^{th} egg, paralleled the increase in shell gland and duodenal calbindin.

Fertility and Hatchability:

During the second cycle of laying, birds produced eggs that were characterized by higher fertility and hatchability. The improvement obtained in fertility may be related to a higher sexual efficiency of males and a better semen quality, meanwhile the improvement in hatchability could be associated, to some extent, with the significant improvement obtained with shell quality.

Table (1): Experimental design (experiment 1).

Experimental group	Abbreviation	Birds Number		Zinc Level (ppm)	Calcium Level (%)
		Males	Females		
1	HZn-HCa	13	26	20000	3.79
2	HZn-LCa	13	26	20000	0.23
3	LZn-HCa	13	26	2800	3.79
4	LZn-LCa	13	26	2800	0.23
5	LCa	13	26	-	0.23
6	Control*	12	24	45	2.57

Recommended levels according to NRC (1994).
* Control = Requirements from calcium and zinc.

Table (2): Experimental design and number of birds in each group (experiment 2).

Day	**Treatment group**	**Control group**
1	No water and no feed	*Ad-libitum* of feed and water.
2	No water and no feed	
3	No water and no feed	
4	No feed only	
5	No feed only	
6	No feed only	
7	No feed only	
8	25% feed	
9	50% feed	
10	75% feed	
11	100% feed	
12	*Ad-libitum*	
No. of birds :		
Males	22	10
Females	44	20
Abbreviations	**Fast.**	**Cont.**

Table (3): Composition and calculated analysis of the basel diet.

Ingredients:	
Yellow corn, %	65.1
Soybean meal, 44%	14.20
Glotein, %	5.00
Layer concentrate 50%	10.20
Bone meal	2.00
Limestone, %	3.30
Salt, %	0.10
Vitamin mixture, %	0.05
Trace mineral mixture, %	0.05
Total	100
Calculated analysis:	
Crude protein, %	20.08
ME kcal/kg	2907
Calcium	2.57

Table (4): Least square means ± S.E for weekly body weight (g) during and after forced rest (experiment1).

Experimental group	During the treatments (1-28 day)				
	w0	**w1**	**w2**	**w3**	**w4**
HZn-HCa	204.33 ± 2.24	186.60 ± 4.13 [b]	178.50±4.06 [c]	172.92±4.41 [cd]	160.19 ± 3.96 [c]
HZn-LCa	202.40 ± 2.24	170.77 ± 4.13 [b]	165.71±4.12 [c]	162.21±4.37 [d]	150.0 ± 4.14 [c]
LZn-HCa	196.35 ± 2.24	194.81 ± 4.13 [a]	188.50±3.89 [b]	184.97±3.85 [b]	182.71 ± 3.55 [b]
LZn-LCa	199.62 ± 2.24	191.94 ± 4.19 [a]	183.36±4.09 [b]	181.56±4.05 [bc]	182.58 ± 3.67 [b]
LCa	198.08 ± 2.24	199.06 ± 4.13 [a]	198.75±4.02 [a]	200.15±3.95 [ab]	197.33 ± 3.55 [ab]
Control	198.85 ± 2.24	200.42 ± 4.30 [a]	197.71±4.03 [a]	200.83±3.95 [a]	198.23 ± 3.55 [a]
Significance	**N.S**	**	**	***	***

Experimental group	After returning to the normal basal diet (29- 84 day)							
	w5	**w6**	**w7**	**w8**	**w9**	**w10**	**w11**	**w12**
HZn-HCa	177.13±5.47 [bc]	192.88±5.65	206.19±5.48	202.25±5.35	201.31±4.99	203.13±4.94	198.06±4.89	200.88±4.70
HZn-LCa	176.07±6.01 [c]	198.21±6.21	207.14±6.02	203.66±5.88	201.25±5.48	199.82±5.43	203.75±5.38	204.11±5.17
LZn-HCa	189.46±4.24 [ab]	194.51±4.39	196.88±4.26	196.88±4.16	199.33±3.88	198.44±3.84	201.61±3.80	203.44±3.66
LZn-LCa	194.18 ± 4.75 [a]	198.21 ± 4.88	195.96±4.74	199.61±4.62	197.68±4.31	203.54±4.27	201.43±4.23	205.57±4.06
LCa	198.78±4.45 [ab]	197.47±4.60	197.53±4.47	198.30±4.36	199.23±4.07	203.55±4.03	205.0±3.99	202.81±3.83
Control	199.29 ± 4.44 [a]	199.82±4.59	200.36±4.45	201.96±4.34	205.36±4.05	202.32±4.01	204.82±3.97	204.18±3.82
Significance	**	N.S	N.S	N.S	N.S	N.S	N.S	N.S

N.S = non-significant. * = Significant at 5% of probability. ** = Significant at 1% of probability. *** = Significant at 0.1% of probability.

Table (5): Least square means ± S.E for weekly feed intake (g/bird/day) during and after forced rest (experiment1).

Experimental group	During the treatments (1-28 day)				
	W0	W1	W2	W3	W4
HZn-HCa	34.03 ± 0.39	30.15 ± 0.17^{b}	21.94 ± 0.20^{c}	15.62 ± 0.16^{c}	14.67 ± 0.15^{c}
HZn-LCa	33.63 ± 0.39	27.22 ± 0.17^{b}	13.85 ± 0.20^{d}	10.42 ± 0.16^{d}	10.17 ± 0.15^{d}
LZn-HCa	33.72 ± 0.39	32.62 ± 0.17^{a}	29.52 ± 0.20^{b}	27.11 ± 0.16^{b}	25.50 ± 0.15^{b}
LZn-LCa	33.33 ± 0.39	33.10 ± 0.17^{a}	29.05 ± 0.20^{b}	25.95 ± 0.16^{b}	24.29 ± 0.15^{b}
LCa	33.54 ± 0.39	33.81± 0.17^{a}	34.21 ± 0.20^{a}	33.95± 0.16^{a}	32.80 ± 0.15^{a}
Control	33.95 ± 0.41	33.48 ± 0.18^{a}	34.50 ± 0.21^{a}	34.98 ± 0.17^{a}	34.78 ± 0.16^{a}
Significance	N.S	***	***	***	***

Experimental group	After returning to the normal basal diet (29- 84 day)							
	W5	W6	W7	W8	W9	W10	W11	W12
HZn-HCa	28.10 ± 0.30^{b}	33.00 ± 0.33^{a}	34.19 ± 0.26^{a}	34.50 ± 0.30^{a}	35.08 ± 0.35^{a}	35.00± 0.86^{ab}	35.83 ± 0.77^{a}	36.25 ± 0.73^{a}
HZn-LCa	23.33 ± 0.30^{c}	30.48 ± 0.33^{b}	34.76 ± 0.26^{a}	33.80 ± 0.30^{a}	35.41 ± 0.35^{a}	35.83± 0.86^{a}	34.58 ± 0.77^{a}	35.42 ± 0.73^{a}
LZn-HCa	29.80 ± 0.23^{b}	32.35 ± 0.25^{b}	34.17 ± 0.19^{a}	34.66 ± 0.23^{a}	33.33 ± 0.26^{b}	33.33± 0.65^{bc}	32.62 ± 0.58^{b}	33.33 ± 0.55^{b}
LZn-LCa	26.43 ± 0.27^{b}	32.48 ± 0.29^{b}	33.71 ± 0.23^{b}	33.91 ± 0.27^{b}	32.58 ± 0.31^{b}	32.33± 0.77^{cd}	31.67± 0.69^{bc}	33.33 ± 0.66^{b}
LCa	32.15 ± 0.24^{a}	33.00 ± 0.27^{a}	33.33 ± 0.21^{b}	33.70 ± 0.24^{b}	31.46 ± 0.29^{c}	31.94± 0.70^{cd}	32.50 ± 0.63^{b}	32.22 ± 0.60^{b}
Control	34.32 ± 0.23^{a}	34.25 ± 0.25^{a}	32.41 ± 0.19^{b}	34.00 ± 0.22^{a}	33.10 ± 0.26^{b}	30.95± 0.65^{d}	30.00 ± 0.58^{c}	31.67 v 0.55^{b}
Significance	***	***	N.S	N.S	***	***	***	***

N.S = non-significant. *** = Significant at 0.1% of probability.

Table (6): Least square means±S.E for weekly body weight (g). (experiment 2).

Week	Experimental group		Significance level
	Fasting group	Control group	
0 (initial)	190.28 ± 1.12 C	190.25 ±1.50 C	N.S
1	117.22 ± 1.21 b E	185.0 ± 1.62 a C	***
2	152.16 ± 0.94 b D	192.25 ± 1.26 a B	***
3	197.16 ± 0.86 a C	192.75 ± 1.15 b B	*
4	215.28 ± 0.87 a B	195.0 ± 1.17 b AB	***
5	210.49 ± 0.95 a B	192.50 ± 1.27 b B	***
6	212.78 ±0.94 a B	200.13 ± 1.26 b A	**
7	217.92 ± 1.08 a AB	197.0 ± 1.45 b AB	***
8	219.58 ±0.99 a A	202.13 ± 1.34 b A	***
9	222.78 ± 0.96 a A	200.63 ± 1.29 b A	***

N.S = non-significant. * = Significant at 5 % of probability.
** = Significant at 1 % of probability. *** = Significant at 0.1 % of probability.
a, b = within rows A,… E = within columns

Table (7): Least square means ± S.E for weekly feed intake (g/bird/day). (experiment 2).

Week	Experimental group		Significance level
	Fasting group	Control group	
0 (initial)	32.69 ± 0.11 D	33.00 ± 0.16	N.S
1	0.00 b G	31.90 ± 0.08 a	***
2	25.26 ± 0.09 b F	32.14 ± 0.13 a	***
3	36.03 ± 0.13 a A	33.02 ± 0.16 b	***
4	35.01 ± 0.09 a B	32.88 ± 0.13 b	***
5	34.10 ± 0.10 a CD	32.11 ± 0.13 b	***
6	33.12 ± 0.11 CD	32.10 ± 0.15	N.S
7	32.75 ± 0.30 CD	33.00 ± 0.41	N.S
8	33.57 ± 0.11 C	32.86 ± 0.14	N.S
9	32.00 ± 0.63 E	32.11 ± 0.84	N.S

N.S = non-significant. *** = Significant at 0.1 % of probability.
a, b = within rows A,… E = within columns

Table (8): Least square means ± S.E for weekly egg production (%) during and after forced rest (experiment 1).

Experimental group	During the treatments (1-28 day)				
	W0	**W1**	**W2**	**W3**	**W4**
HZn-HCa	34.16 ± 2.61	20.33 ± 2.52 [cd]	5.49 ± 1.99 [d]	0.00 [c]	0.00 [c]
HZn-LCa	36.26 ± 2.61	13.74 ± 2.52 [d]	0.00 [d]	0.00 [c]	0.00 [c]
LZn-HCa	34.07 ± 2.61	32.42 ± 2.52 [ab]	24.18 ± 1.99 [b]	14.84 ± 1.88 [b]	14.29 ± 2.06 [b]
LZn-LCa	35.17 ± 2.61	28.57 ± 2.52 [b]	17.58 ± 1.99 [c]	12.09 ± 1.88 [b]	6.04 ± 2.06 [c]
LCa	36.81± 2.61	26.92 ± 2.52 [bc]	18.68 ± 1.99 [c]	16.48 ± 1.88 [b]	17.58 ± 2.06 [b]
Control	35.71 ± 2.72	36.91 ± 2.61 [a]	34.53 ± 2.07 [a]	29.76 ± 1.96 [a]	28.57 ± 2.15 [a]
Significance	N.S	***	***	***	***

Experimental group	After returning to the normal basal diet (29- 84 day)							
	W5 (1)	**W6 (2)**	**W7 (3)**	**W8 (4)**	**W9 (5)**	**W10 (6)**	**W11 (7)**	**w12 (8)**
HZn-HCa	0.00 [c]	0.00 [b]	7.14 ± 9.78 [bc]	41.07±7.73 [ab]	87.50 ± 5.41 [a]	91.07 ± 5.43 [a]	87.50 ± 3.58 [a]	92.86 ± 4.21 [a]
HZn-LCa	0.00 [c]	0.00 [b]	3.57 ± 9.78 [c]	50.00± 7.73 [a]	80.36 ± 5.41 [a]	85.71 ± 5.43 [a]	89.29 ± 3.58 [a]	91.07± 4.21 [a]
LZn-HCa	15.31±4.29 [abc]	20.41± 5.32 a	31.63± 7.39 [ab]	34.69± 5.84 [ab]	35.71 ± 4.09 [bc]	34.69± 4.11 [bc]	36.75 ± 2.71 [b]	33.67 ± 3.18 [b]
LZn-LCa	7.14 ± 5.08 [bc]	31.43± 6.29 [a]	42.86 ± 8.75 [a]	47.14 ± 6.91 [a]	40.00 ± 4.84 [b]	38.57 ± 4.86 [b]	37.14 ± 3.20 [b]	37.14 ± 3.77 [b]
LCa	21.43± 4.64 [ab]	23.81± 5.75 [a]	34.52 ± 7.98 [a]	29.76± 6.31 [ab]	26.19 ± 4.42 [bc]	27.38± 4.44 [bc]	27.38 ± 2.92 [c]	29.76 ± 3.44 [b]
Control	26.53 ± 4.29 [a]	26.53± 5.32 [a]	29.59±7.39 [abc]	20.41 ± 5.84 [b]	21.43 ± 4.09 [c]	20.41± 4.11 [c]	15.31 ± 2.71[d]	17.35 ± 3.18 [c]
Significance	***	***	**	*	***	***	***	***

N.S = non-significant. * = Significant at 5% of probability. ** = Significant at 1% of probability. ***= Significant at 0.1% of probability

Table (9): Least square means ± S.E for weekly egg production (%). (experiment 2)

Week	Experimental group			Significance level
	Fasting group		Control group	
0 (initial)	31.17 ± 1.89	E	30.00 ± 2.82	N.S
1	9.13 ± 1.33 b	F	32.14 ± 1.78 a	***
2	0.00 b	G	32.14 ± 1.13 a	***
3	0.00 b	G	28.57 ± 1.98 a	***
4	5.16 ± 1.94 b	F	29.29 ± 2.60 a	**
5	36.11 ± 2.59 a	D	24.29 ± 3.47 b	***
6	71.43 ± 2.05 a	C	24.29 ± 2.75 b	***
7	82.94 ± 2.25 a	AB	26.43 ± 3.02 b	***
8	80.16 ± 2.08 a	B	24.29 ± 2.78 b	***
9	85.32 ± 2.22 a	A	23.57 ± 2.97 b	***

N.S = non-significant. ** = Significant at 1% of probability.
*** = Significant at 0.1% of probability.
a, b = within rows A,… E = within columns

Table (10): Least square means ± S.E for egg weight, shell weight, shell percentage and shell thickness. (experiment 1)

Experimental group	During forced rest treatment			
	Egg weight (g)	Shell weight (g)	Shell percentage (%)	Shell thickness (mm)
HZn-HCa	9.24 cd	0.57 cd	6.19 cd	0.168 c
HZn-LCa	8.55 e	0.49 d	5.79 d	0.145 d
LZn-HCa	9.40 bc	0.69 b	7.39 ab	0.200 a
LZn-LCa	9.00 d	0.61 c	6.81 bc	0.179 cb
LCa	9.69 ab	0.75 ab	7.74 ab	0.185 b
Control	9.95 a	0.80 a	8.05 a	0.205 a
S.E	0.12	0.03	0.34	0.004
Significance	***	***	***	***

Treatment	At the peak of recovery			
	Egg weight (g)	Shell weight (g)	Shell percentage (%)	Shell thickness (mm)
HZn-HCa	11.33 a	0.95 ab	8.40	0.220 a
HZn-LCa	11.00 a	0.98 a	8.92	0.210 ab
LZn-HCa	10.41 b	0.85 c	8.17	0.198 bc
LZn-LCa	10.07 b	0.80 c	7.95	0.204 bc
LCa	10.20 b	0.87 cb	8.56	0.195 c
Control	10.08 b	0.81 c	8.04	0.200 bc
S.E	0.15 b	0.03	0.29	0.004
Significance	***	***	N.S	**

N.S = non-significant. ** = Significant at 1 % of probability.

Table (11): Least square means ± S.E for egg weight, shell weight, shell percentage and shell thickness. (experiment 2)

Experimental group	During forced rest treatment			
	Egg weight (g)	Shell weight (g)	Shell percentage (%)	Shell thickness (mm)
Fast.	8.66 [b]	0.44 [b]	5.15 [b]	0.139 [b]
Cont.	10.67 [a]	0.89 [a]	8.35 [a]	0.172 [a]
S.E.	0.14	0.02	0.26	0.003
Significance	***	***	***	***

Experimental group	At the peak of the recovery			
	Egg weight (g)	Shell weight (g)	Shell percentage (%)	Shell thickness (mm)
Fast.	12.04 [a]	1.08 [a]	8.97 [a]	0.200 [a]
Cont.	10.70 [b]	0.87 [b]	8.13 [b]	0.185 [b]
S.E.	0.08	0.03	0.21	0.002
Significance	***	***	*	**

* = Significant at 5% of probability. ** = Significant at 1% of probability
*** = Significant at 0.1% of probability.

Table (12): Least square means ± S.E for fertility and hatchability after forced rest (experiment 1).

Experimental group	Egg Number	Fertility %	Hatchability %
HZn-HCa	105	93.33 ±1.34 [a]	90.78 ± 3.63 [a]
HZn-LCa	96	94.79 ± 1.34 [a]	91.22 ± 3.63 [a]
LZn-HCa	90	83.33 ±1.34 [b]	74.59 ± 3.63 [b]
LZn-LCa	75	82.67 ± 1.34 [b]	77.30 ± 3.63 [b]
LCa	87	85.06 ± 1.34 [b]	72.83 ± 3.63 [b]
Control	72	84.72 ± 1.34 [b]	76.98 ±3.63 [b]
Significance		***	***

*** = Significant at 0.1% of probability. a, b = within columns

Table (13): Least square means ± S.E for fertility and hatchability (experiment 2).

Experimental group	Egg number	Fertility (%)	Hatchability (%)
Fast.	115	90.48 [a]	83.58 [a]
Cont.	68	85.28 [b]	65.46 [b]
S.E.		1.37	1.01
Significance		*	***

* = Significant at 5% of probability. *** = Significant at 0.1% of probability.
a, b = within columns

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الملخص العربى

إستجابة السمان اليابانى للطرق المختلفة للراحة الاجبارية . 1- الكفاءة الانتاجية للسمان اليابانى تحت ظروف الراحة الاجبارية بواسطة زيادة الزنك فى العليقة أو انخفاض الكالسيوم فى العليقة وعن طريق تقديم نظام غذائى محدد

محمد مصطفى الحباك ، صبرية بدوى ابو السعود ، سعد زغلول الدمراوى
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اجريت هذه التجارب بمزرعة الدواجن التابعة لقسم انتاج الدواجن بكلية الزراعة بكفرالشيخ – جامعة طنطا واستهدفت هذه التجارب دراسة مدى امكانية دفع طيور السمان اليابانى الى الراحة الاجبارية فى نهاية موسم انتاج البيض كوسيلة لادخاله فى دورة انتاج جديدة يمكن من خلالها مضاعفة الحياة الانتاجية للقطيع ولتحقيق هذا الهدف تم دراسة طريقتين مختلفتان لاحداث الراحة الاجبارية للطيور.

التجربة الاولى : كانت العاملات فيها كالاتى:

المجموعة الاولى : قدم للطيور عليقة تحتوى على مستوى مرتفع من الزنك مع مستوى مرتفع من الكالسيوم (20000 جزء فى المليون كبريتات زنك ، 3.79 % كالسيوم).

المجموعة الثانية: قدم للطيور عليقة تحتوى على مستوى مرتفع من الزنك مع مستوى منخفض من الكالسيوم (20000 جزء فى المليون كبريتات زنك ، 0.23 % كالسيوم).

المجموعة الثالثة: قدم للطيور عليقة تحتوى على مستوى منخفض من الزنك مع مستوى مرتفع من الكالسيوم (2800 جزء فى المليون كبريتات زنك ، 3.79 % كالسيوم).

المجموعة الرابعة: قدم للطيور عليقة تحتوى على مستوى منخفض من الزنك مع مستوى منخفض من الكالسيوم (2800 جزء فى المليون كبريتات زنك ، 0.23 % كالسيوم).

المجموعة الخامسة: قدم للطيور عليقة تحتوى على مستوى منخفض من الكالسيوم بدون اضافة الزنك (0.23% كالسيوم).

المجموعة السادسة (مجموعة مقارنة) : قدم للطيور عليقة تحتوى على الاحتياجات الاساسية من الزنك والكالسيوم (45 جزء فى المليون زنك ، 2.57% كالسيوم) .

التجربة الثانية : تناولت دراسة مدة كفاءة نظام التصويم كطريقة لاحداث الراحة الاجبارية فى طيور السمان حيث قسمت الطيور الى مجموعتين :

المجموعة الاولى : تعرضت فيها الطيور الى منع الماء لمدة ثلاثة ايام ولمنع الغذاء لمدة سبعة ايام.

المجموعة الثانية كانت مجموعة مقارنة

ويمكن تلخيص اهم النتائج المتحصل عليها فى النقاط التالية:

التجربة الاولى:

- سببت معاملات الراحة الاجبارية انخفاضا معنويا فى وزن الجسم ، وكان التاثير اشد ما يمكن فى المجموعات التى اعطيت المستوى العالى من الزنك
- لم يكن لاستخدام المستوى المنخفض من الكالسيوم منفردا كأداة لاحداث الراحة الاجبارية تاثيرا معنويا على وزن الجسم
- بعد اسبوعين من انتهاء المعاملات والعودة الى التغذية الطبيعية حدث نوع من النمو التعويضى فى المجموعات المعاملة.
- ادى استخدام المستوى العالى من الزنك (20000 جزء فى المليون) الى انخفاض شديد فى كمية الغذاء الماكول منذ الاسبوع الاول من العاملة ، بينما ظهر هذا التاثير متاخرا مع نهاية الاسبوع الثانى عند استخدام المستوى المنخفض من الزنك (2800 جزء فى المليون)
- لم يكن لاستخدام الكالسيوم منفردا تاثيرا معنوى على كمية الغذاء الماكول الا انه عندما صاحب هذا المستوى العالى من الزنك حدث تاثيرا متعاضدا بين العنصرين.
- عند العودة للعليقة الاساسية زادت شهية الطيور للغذاء ازداد معدل استهلاكها ربما كمحاولة لتعويض ما فاتها حتى انها فاقت فى كثير من الاحيان المجموعة المقارنة معنويا.
- توقف وضع البيض تمام فى المجموعة الاولى (20000 جزء فى المليون زنك ، 3.79% كالسيوم) عند اليوم التاسع من المعاملة وكان قد توقف قبل ذلك بيومين فى المجموعة الثانية 20000(جزء فى المليون زنك ، 0.23% كالسيوم).
- لم يسبب المستوى المنخفض من الزنك التوقف الكامل عند وضع البيض خاصة اذا ما كان هذا المستوى مصحوبا بالمستوى المنخفض من الكالسيوم الا انه سبب انخفاضا حادا فى انتاج البيض.
- مع العودة الى العليقة الطبيعية حدثت زيادة تدريجية فى معدل وضع البيض فى المجاميع المعاملة ، لدرجة انه مع نهاية الاسبوع الثامن من فترة ما بعد المعاملة وصل الانتاج فى المجموعتان الاولى والثانية اكثر من خمسة اضعاف قيمته فى المجموعة المقارنة.
- ادت معاملات الراحة الاجبارية الى انخفاض معنوى فى متوسط وزن البيضة اثناء المعاملة وكان السبب الاساسى بنسبة كبيرة هو انخفاض وزن القشرة.
- عند تحضين بيض الطيور التى سبق وتعرضت لمعاملات الراحة الاجبارية اشارت النتائج الى تحسن صفات الخصوبة والفقس معنويا عن المجموعة المقارنة.

التجربة الثانية : يمكن القول بصفة عامة بناء على نتائج هذه التجربة ان استخدام نظام التصويم المتبع فى هذه الطريقة كان اكثر فعالية كاداة لاحداث الراحة الاجبارية فى طيور السمان عن الطريقة المتبعة فى التجربة الاولى.

ويمكن القول بايجاز ان استجابة الطيور للطريقتين اتخذت نفس المسالك الا انها اختلفت فى مدى شدة التاثيرات المختلفة فكانت فى حالة نظام التصويم اسرع حدوثا واشد فعالية وعلاوة على ذلك نجد ان الطيور فى حالة اتباع نظام التصويم بدأت الدورة الانتاجية الثانية مبكرة بحوالى ثلاثة اسابيع عن الطريقة الاولى وكانت اكثر مثابرة على الانتاج خلال هذه الدورة ، لذلك فعلى ضوء نتائج تجارب الدراسة الحالية يمكن ان نوصى باستخدام نظام التصويم كأداة فعالة لاحداث الراحة الاجبارية فى طيور السمان لادخاله فى دوره انتاجية ثانية.