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Original Research

Evaluation of Some Management Procedures for Controlling Broodiness in Turkey and Muscovy Duck

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Abstract

The objective of this study was to evaluate pens switching, closing nest boxes after egg laying and nest boxes switching inside the same pen as management procedures for controlling broodiness in turkey and Muscovy duck breeders and their role in circulating prolactin. Black bronze turkey (n.= 350) and Muscovy duck (n.= 700) were randomly selected and housed on deep litter. The results showed a significant ($P \leq 0.05$) increase in egg production in turkey and Muscovy duck breeders in response to pens switching and closing nest boxes after end of egg laying. While, there was no significant ($P > 0.05$) difference in egg production in response to switching of nest boxes in turkey hens but a significant ($P \leq 0.05$) result was found in Muscovy ducks. On the other hand, there were significant ($P \leq 0.05$) decreases in circulating prolactin level and broodiness in both turkey and Muscovy duck breeders in response to pen switching, closing nest boxes after egg laying and nest boxes switching. In conclusion, application of these management procedures was associated with increased egg production while decreased expression of broodiness (incubation behaviour) and circulating prolactin in turkey hens and Muscovy ducks.

Keywords: Broodiness; Incubation behaviour; Muscovy duck; Nest box; Pen switching; Turkey

Introduction

Broodiness, or incubation behaviour, is considered as a major cause of poor egg production in turkey and duck breeder flocks. Broodiness is a condition or behavioural tendency in which laying birds have a desire to set their eggs (Squires, 2010). When birds go broody they stop laying eggs, increase its nesting activity, and assemble their physiological and behavioural resources for broodiness (Sharp, 1989). This is a favourable condition in pigeons and wild birds to produce new offspring through the natural nest incubating process in absence of artificial incubators and hatcheries. However, it is an unfavourable condition in layer and breeder flocks kept for maximum egg production (El- Halawani *et al*., 2000). In recent years, generations of genetic selection had reduced the tendency of the birds to become broody especially for egg type chickens, and greatly reduced this trait in broiler breeder hens (Jiang *et al*., 2005), but broodiness remained a considerable problem in turkey and duck breeder flocks. At the same time as, without proper management procedures, broodiness can still have a significant impact on overall egg production especially in turkeys and ducks breeder flocks (Sharp and Hocking, 2009). This is most evident in hot climates especially in tropical and subtropical areas, associated with improper nest and management conditions (Rozenboim *et al*., 2004). Many scientists had identified many of the key factors that lead to broodiness. The environmental factors that initiate incubation behaviour, the neural and endocrine stimuli, management conditions that are required for broodiness to occur, and the physio-

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logical changes that must occur in the hen to result in persistent nesting, regression of the ovary, and cessation of egg production (Book *et al*., 1991; Bedecarrats *et al*., 1997; Rozenboim *et al*., 2004; Liang *et al*., 2006; Kagya-Agyemang *et al*., 2012). Broody hens could be recognized by their behaviour and the morphological changes associated with the onset of broodiness. The broody female was spending a large proportion of her time on the nest (Roy *et al*., 2004). When approached, the hen might display aggressive behaviour. This could include hissing, back or / and neck feathers erection, as well as pecking. The hen will also struggle to remain on the nest (De Marchi *et al*., 2008). Another early sign of broodiness is the production of distinctive smelling faeces when the oviduct is everted. As broodiness developed, the oviduct becomes dryer and harder to evert, the pelvic bones move closer together compared to the first three weeks of lay, and the skin between the bones becomes inflexible (Sharp and Hocking, 2009). Broody birds often courage feathers losses from their chest and abdomen. As a consequence of this, they develop one or several patches of uncovered skin on the ventral surface (Book *et al*., 1991). These reddish, well vascularized areas of skin are usually called brood patches, which improve heat transfer to the eggs (Midtgård *et al*., 1985). Early identification of these females going broody is essential for their rapid return to egg production. Proudman (1997) stated that, effective elimination of broodiness would save the industry between \$60 and \$100 million per year. So, the most important aspect of successful broody control is prevention. Broodiness was controlled by several factors including genetics (Nestor *et al*., 1996; Romanov *et al*., 2002), neuroendocrinology (Youngren *et al*., 1991; El Halawani *et al*., 2002), hormonal (Taira and Beck, 2006), pharmacology (Reddy *et al*., 2007), environment management (Sharp, 1989). Recently, two immunological approaches have been successfully developed to inhibit broodiness and involved immunoneutralizing circulating prolactin (March *et al*., 1994; Crisóstomo *et al*., 1997; Zhang *et al*., 2013) or vasoactive intestinal peptide (El Halawani *et al*., 1995; Mobarkey *et al*., 2013). However, these methods were labour intensive, particularly since immunizations have to be repeated at frequent intervals, and were probably too expensive for practical use (Sharp and Hocking, 2009). From this apprehension, the objective of this study was to evaluate effectiveness of pen switching, closing nest boxes after egg laying and nest boxes switching as three management procedures for controlling broodiness in turkey and Muscovy duck breeders and their role in circulating prolactin.

Materials and methods

Animal housing and management

Black bronze turkey (n.= 350) and Muscovy duck (n.= 700) were randomly selected and housed on deep litter system inside two different buildings at El-Wafaa farm, Ismailia, Egypt. Each building contained number of separate pens, each one used for housing of 50 turkey hen (small pen) or 100 Muscovy duck (large pen). Wood shaving was used as a bedding material (8-12 cm depth) upon concrete floor. The stocking density was set three birds /M^2 and sex ratio was one male/ 5 females. Each four turkey hens and Muscovy ducks were provided with a nest box bedded with wheat straw. All birds were exposed to a 14-h photoperiod and 10-h dark. The light intensity was around 50 lx for all birds. They were fed on a standard turkey and duck breeders diet provided for ad libitum intake and had free access to water. A hen was considered to be broody (incubating) if it was sitting in the nest box or at any other site of the pen at least three times out of the three daily inspections (08.00, 12.00, 16.00 h) during three consecutive days.

Experimental design

The experiment was started at week 12 of egg production in turkey hens and week 18 in Muscovy ducks and extended for 12 week. Egg production and broody birds were estimated daily for each group.

Experiment I: pen switching

Black bronze turkey (n. = 150) and Muscovy duck (n.=300) were randomly selected and sub divided into three groups, A, B, and C. They were reared on three separate pens, I, II, and III respectively. Group A was moved to the pen of group B and group B was moved to the pen of group A weekly through the doors between pen I and II. At the same time, group C still in its pen (III) without any changes.

Experiment II: closing nest boxes after egg laying

Black bronze turkey (n =100) and Muscovy duck (n= 200) were randomly selected and subdivided into two groups. Regarding to group one, the nest boxes were remained open all over the entire period of the experiment and all birds had free access to their nest boxes. While in group two, the nest boxes were closed daily from 16.00 till 5.00 h.

Experiment III: nest boxes switching

Black bronze turkey (n = 100) and Muscovy duck (n= 200) were randomly selected and sub divided into two groups. In the group one, the nest boxes were fixed in its position for 12 weeks. On the other hand, in the group two, the nest boxes were randomly rearranged inside the same pen weekly.

Blood sample

At the end of the experiment, three ml blood sample were aspirated from the wing vein of turkey hens and Muscovy ducks and transferred to heparinized vacuum tubes without delay. Plasma was separated by centrifugation 3000 rpm for 10 m and stored at -20 ^{o}Ċ till assayed for prolactin hormone using radioimmunoassay (Campbell *et al*., 1981).

Statistical analysis

Data were tested for distribution normality and homogeneity using statistical package Minitab software version 16. Data were reported as means and standard errors of the mean (SE). The differences in parameters between groups were compared with Student-t test. The significance level was set at $P \leq 0.05$.

Results

Experiment I: pen switching

A significant ($P \leq 0.05$) increase in egg production was observed in group A and B compared to group C (Table I). At the same time, the results showed a significant ($P \leq 0.05$) decrease in number of broody birds and prolactin level in group A and B compared to group C in both turkey hens and Muscovy ducks (Table 1,4) in response to switch the pens with each other inside the same building.

Experiment II: Closing nest boxes after egg laying

The results in table II reflected a significant ($P \leq 0.05$) increase in egg production in both turkey hens and Muscovy ducks in group two (closed nest boxes) compared to group one (opened nest boxes). For both turkey hens and Muscovy ducks, there was a significant ($P \leq 0.05$) decrease in the number of broody birds and plasma prolactin level in group two compared to group one (Table 2, 4).

Experiment III: nest boxes switching

Switching of the nest boxes inside the same pen

Table I. Effect of pens switching with each other inside the same building on egg production and broody birds in turkey hens (n.=150) and Muscovy duck (n.=300).

pen	Group	Turkey		Ducks	
		Egg production Mean ± SE	Broody birds Mean ± SE	Egg production Mean ± SE	Broody birds Mean ± SE
I	A	15.570 ±1.51	6.290 ± 0.61	48.860 ± 1.03	17.00 ± 0.93
II	B	17.000 ±1.45	7.143 ± 1.10	48.570 ± 1.73	16.143 ± 0.99
I	B	15.428 ± 1.36	3.428 ± 0.75	49.143 ± 1.42	6.28 ± 0.47
II	A	17.143 ± 0.88	2.428 ± 0.65	49.714 ± 1.66	6.714 ± 0.57
Mean		16.285^{a}	4.821^{b}	49.071^{c}	11.534^{d}
III	C	16.75 ± 1.172	5.143 ± 0.64	50.714 ± 1.02	15.857 ± 1.02
III	C	8.71 ± 0.420	9.71 ± 0.61	39.000 ± 1.77	24.28 ± 0.78
Mean		12.730^{a}	7.426^{b}	44.857^{c}	20.068^{d}

Means at the same column having the same superscript are significantly different at $P \leq 0.05$

Table 2. Effect of closing the nest boxes after end of egg laying on egg production and broody birds in turkey hens (n.=100) and Muscovy duck (n.=200).

	Nest boxes	Turkey Mean ± SE	Duck Mean ± SE
Egg production	Opened	16.70 ± 0.748	52.20 ± 0.374
	Closed	19.30 ± 1.208	56.4 ± 0.812
	P-value	0.011	0.021
Broody birds	Opened	9.00 ± 0.547	3.60 ± 0.509
	Closed	3.00 ± 0.548	1.40 ± 0.245
	P-value	0.008	0.018

Table 3. Effect of switching of nest boxes inside the same pen on egg production and broody birds in turkey hens (n.=100) and Muscovy duck (n.=200).

	Turkey			Duck		
Nest boxes	Fixed Mean ± SE	Switched Mean ± SE	P- value	Fixed Mean ± SE	Switched Mean ± SE	P- value
Egg production	18.22 ± 0.99	18.64 ± 0.49	0.193	47.30 ± 1.72	51.62 ±1.03	0.043
Broody birds	4.65 ± 0.83	2.57 ± 0.37	0.042	4.10 ± 0.21	0.97 ± 0.05	0.006

caused a significant ($P \leq 0.05$) increase in egg production in Muscovy ducks, while there was no significant ($P > 0.05$) difference in turkey hens egg production (Table 3). On the other hand, there was a significant ($P \leq 0.05$) decrease in the number of broody birds and plasma prolactin level in both turkey hens and Muscovy ducks as a response to nest boxes switching inside the same pen (Table 3, 4).

Discussion

In commercial turkey and duck breeder flocks, birds are showing signs of broodiness 3-7 weeks after the onset of lay (Goldsmith and Williams, 1980; El- Halawani *et al*. 1995), so broodiness control should begin in the second week of egg production. Starting too early can affect the achievement of a good peak, and starting too late will result in some birds that are already broody. Broodiness was controlled by several factors. Fortunately, the environment and improper nest and management conditions can be significant providers to broodiness and, as a result, can also be manipulated to discourage this condition (Sharp, 1989). From the obtained results, it was found a decrease in broody birds after switching the pen of group A with that of group B. In case of group C, there was a reduction in egg production and increase in broody birds. It may be related to the increase in visual and tactile stimuli from nest and eggs which act as predisposing factors for increasing prolactin secretion which was responsible for broodiness initiation and cessation of egg production (Burke and Dennison, 1980; Goldsmith and Williams, 1980; Lea and Sharp, 1989). On the other hand, switching of pens of birds inside the same house induced changes in the routine of birds and forcing them in different surroundings. So, the birds lost its tendency to sit on the nest and consequently in term decreased prolactin hormone and broodiness (Richard-Yris *et al*., 1998). These records were nearly to what observed by Goldsmith *et al*. (1984) who mentioned removal of stimuli provided by the nest and the eggs during incubation induced a significant drop in prolactin levels and expression of broodiness. These findings indicated that, switching of pens of birds inside the same house was an effective method for prevention of broodiness in turkey hens and Muscovy ducks. In turkey hens and Muscovy ducks, egg production was increased and broody birds were decreased when the nest boxes were closed after egg laying. These findings could be attributed to decrease in prolactin hormone concentrations in response to closing of nest boxes after egg laying (Squires,

Table 4. Effect of pen switching inside the same building, closing the nest boxes after end of laying, and nest boxes switching inside the same pen on plasma Prolactine hormone (ng / ml) in turkey hens (n.=48) and Muscovy duck (n.=90).

Experiment		Turkey Mean ± SE	Duck Mean ± SE
Switching of pens inside the same building	Fixed pen	22.960 ± 0.236	25.370 ± 0.493
	Switched pens	20.137 ± 0.214	16.450 ± 0.769
	P- value	0.001	0.019
Close the nest box after end of laying	Opened nest	24.933 ± 0.698	25.053 ± 0.709
	Closed nest	18.063 ± 0.595	16.357 ± 0.731
	P- value	0.002	0.001
Switching of nest boxes inside the same pen	Fixed nest	23.477 ± 0.611	25.140 ± 1.140
	Switched nest	19.540 ± 0.625	17.530 ± 0.900
	P- value	0.081	0.022

2010) and removal of tactile and visual stimuli of nest and / or eggs which provided by the free access to nest box (Goldsmith *et al*., 1984). These findings were in agreement with other studies and several researchers as Lea and Sharp (1989) and Richard-Yris *et al*. (1998). So, nest boxes should be closed after egg laying to decrease expression of broodiness. From the obtained results of this work, it was found that, there was a minor effect of switching and rearranging nest boxes inside the pen on egg production in turkey hens but there was a decline in the number of broody hens. In contrast, there was an increase in egg production and decrease in the number of broody birds in Muscovy ducks. It might be due to decrease circulatory prolactin hormone (Bedecarrats *et al*., 1997) and removal of tactile and visual stimuli of nest and eggs provided by fixed nest boxes (Goldsmith *et al*., 1984). The obtained results agreed with those obtained by Book *et al*. (1991); Tong *et al*. (1997) and Squires (2010) who found that, the arrangement or appearance of nest boxes should be changed regularly to prevent the birds from becoming attached to a familiar nest site. These findings reflected that, changing the arrangement of nest boxes inside the same pen reduced expression of broodiness and improved egg production in turkey hens and Muscovy ducks.

Conclusion

The most important aspect of successful broody control was prevention. Early identification of broody females was essential, or a reduction in egg production may be expected for the rest of the laying cycle. It is important that broody prevention is carried out every day. A sudden drop in egg production after peak lay can be an indication that a broody problem has developed. It is of interest to point out that, application of pen switching, closing nest boxes after egg laying and nest boxes switching were associated with increased egg production while decreased expression of broodiness and circulating prolactin in turkey hens and Muscovy ducks.

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