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Influence of Swimming Deprivation on Behavior, Performance and some Blood Parameters of Muscovy Ducks

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ABSTRACT

This experiment was done to determine the effect of swimming deprivation on drinking behaviour, feather pecking behavior, feed consumption, weight gain, feed conversion ratio, live body weight, slaughter weight, carcass weight and dressing percentage, serum corticosterone, triiodothyronine (T3) and tetraiodothyronine (T4) of Muscovy ducks. Two groups were used; the first one is the control group fed on basal diet with free access to swimming pond, and the second fed on basal diet without access to swimming pond. The previous parameters were recorded daily or weekly during the experiment or after slaughtering for collecting blood parameters. The results explained that, there was an insignificant decrease in drinking behavior and significant increase in feather pecking. However, there was an insignificant decrease in feed consumption, live body weight, feed conversion, weight gain, dressing percentage, liver weight and serum corticosterone level. There was an insignificant decrease in T3 and T4 level and significant increase in feather pecking behaviour. It could be concluded that, swimming deprivation at the end of the fattening period of ducks had an adverse effect on some duck behaviors but it have no significant effect on improvement of performance parameters and carcass characters.

Introduction

Over the past years a considerable amount of scientific research has focused on animal welfare (Broom, 1991; Sandøe *et al*., 2003). Performance records, behavioral, physiological and clinical parameters are considered as good indicators for assessing animal welfare (Broom, 1996). As the demand for animal protein has increased, people begin to use Muscovy ducks as a source of meat. The Muscovy or Barbary duck is good for meat production.

Measures of welfare, we highlighted two as being the most important to both ducks and people: the condition of the ducks and what the animals themselves wanted. In the UK, approximately 18 million ducks (*Anas platyrhynchos*) were reared for meat. Ducks is able to cover their heads with water and spray water over their bodies with their bills, which allow ducks to submerge their bills or water troughs (which allow dabbling and head-dipping) are more commonly used bell drinkers. However, a recent review of the welfare of ducks in European husbandry systems still considered the inadequate supply of a “suitable water source” effects welfare issue for farmed Pekin ducks (British Poultry Council, 2008). The volume of air trapped in the feathers is lower, and body density is greater in species of birds that habitually dive deeper. How-

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ever, less air among the feathers would reduce insulation and increase heat loss, thus requiring deeper-diving birds have greater amounts of subcutaneous fat for insulation (Wilson, 1992).

It is widely recognized that ducks are “strongly water-oriented” and require access to water for swimming (bathing) in order to fulfill their biological needs (Appleby *et al*., 1994). When given a choice between nipple drinkers, bell drinkers, and open water troughs, Pekin ducks preferred open water troughs and were willing to work harder for access to them. Ducks worked harder for troughs over bells and bells over shallow or deep in guarded water (trough with grid on). They also illustrated that, ducks needs water to fulfill their behavioural needs (Ruis *et al*., 2003).

Leg problems in ducks in relation to water supply and found that providing ducks with access to open water reduces the incidence of toe and footpad lesions. The lack of foraging opportunities and open water for preening in intensive duck farms can cause birds to redirect their pecking at other ducks, sometimes degenerating into cannibalism. However, due to the occurrence of feather-pulling and cannibalism in all groups of ducks, including those with open water access, the authors concluded that “ducks are unsuccessful in coping with intensive housing conditions and that suffering, pain and damage are resulting from this. Ducks with deep water troughs had less feather damage due to pecking than those who only had access to bell drinkers and shallow basins which restricted their preening and foraging abilities. They also found that, providing Muscovy ducks with an outdoor run and open water greatly reduced feather pecking; only 12% of ducks showed injuries compared to 50% when ducks had neither outdoor access nor open water (Knierim *et al*., 2004).

Rodenburg *et al*. (2005) reported that ducks prefer open water to water provided in the form of nipples, that their behavioural repertoire is enhanced with open water and that body and plumage condition is also improved. The same authors found that, without access to open water, ducks can “show abnormal behavior, such as head-shaking and stereotypic feather-preening.

Although the most common system used for duck rearing worldwide is an intensive system without pool, the finding of a study done by Erisir *et al*. (2009) indicated that intensive system without pool is the best system in terms ducks welfare and growth. However, deaths in the first weeks in intensive system were considered so it may be better to restrict access to of birds to outside for the first two or three weeks of life in this system.

Stress decreases triiodothyronine (T3) and increases corticosterone concentrations and both changes known to reduce protein deposition through alterations in protein turnover in birds and other species. These effects, reduce the total muscle mass, as reflected by a decrease in body weight (Yunianto *et al*., 1997). The present experiment was done to determine the effects of swimming deprivation on drinking behaviour, feather pecking behavior, feed consumption, weight gain, feed conversion ratio, live body weight, slaughter weight, carcass weight and dressing percentage, serum corticosterone, triiodothyronine (T3) and tetraiodothyronine (T4) of Muscovy ducks.

Materials and methods

Twenty four one month old Muscovy ducklings in a completely randomized design, test with 2 groups (Two replicates per each), each replicate included six birds. The first represented the control group, where the duckling were reared under normal environmental, feeding and housing conditions. The second group was the water deprivation, where ducklings were reared as the control except denial of water bath.

Management and cleaning

Day to day management was carried out for keeping the facility clean. After daily cleaning, cleaned feeders and drinkers were dried and filled with food and water. Also, the contaminated wastes and dead birds were hygienically disposed by incineration.

Lighting

Continuous lighting program (23 hours lightning: 1 hour darkness) was used, 60 watt bulb was suspended 2.20 m at head height of the birds (Coates *et al*., 2000).

Temperature and relative humidity

The temperature was set initially at average between 85- 90 f., birds were observed if they were huddle that mean temperature too low, if they were panted or stayed away that means temperature was too high and gradually reduced by one degree a day by slightly raising the heat lamp at a rate of 3 /week (Coates *et al*., 2000).

Diet and feeding

The basal diets were formulated using Central poultry developmental organization (1999) guidelines. It contained 21% protein (starter type from 1 –6 weeks) and 23% (grower type from 6 – 8 days) with 3200 kcal/kg. Feed was offered daily and residual feed was measured weekly.

Birds' identifications

Bird identifications carried by wing band, which changed every week.

Medication and vaccination

.Medication was given to the experimented ducklings according to the design shown in Table 1.

The chicks were vaccinated in drinking water against duck cholera and duck plague.

Work items

Behavioral Observations

Behavioral observation was started from 37 days old and extended up to 70 days old using both video tape and eye observation. Duckling's behavior was observed to directly throughout the study using Scanning technique according to Fraser and Broom (1990). Three birds in each replicate were observed three times a day for three days / week as follows: At early morning (8.0: 9.0 am), at late morning (12:1 pm) and at late afternoon (4: 5 pm). So each group was observed 30 min. daily for recording the percent of ducklings performing the following behaviors. 1) Drinking behavior: obtaining water at the drinkers. 2) Feather pecking: pecking the body of other birds.

Duckling Performance

Live body weight (LBW)

Ducklings were individually weighed at the end of the experimental period (37 to 70 days of age) using Sartorius balance produced by Sartorius-Universal, Germany. Individual live body weights was totaled and divided by the number of experimented ducklings to obtain the average live body weight (LBW). All birds were weighted to the nearest 0.1gm.

Body weight gain (BWG)

The average live body weight gain was calculated every week by subtracting the individual initial live weight from the final one. Individual live Weight gains were totaled and divided by the number of experimented ducklings to obtain average live body weight gain (BWG).

Feed intake (FI)

Ducklings in each replicate were provided with a certain amount of feed every week.
The residuals were obtained at the end of the same week and the amount of feed consumed was calculated by differences. The following equation was applied to obtain the average amount of feed consumed.
Feed intake (gm/bird) = Amount of feed consumed /Number of duckling

Feed conversion (FC)

Feed conversion (feed required to produce a unit of gain) was calculated for each age interval by dividing the average feed consumption per

Table 1. Medication was given to the experimented ducklings

Name of drug	Age	Does of drug	Route of Administration
Enroflox 10%	1-3 days of age	1/2 ml/liter	Drinking water
Royal Colistin	1-3 days of age	1 g/6 liter	Drinking water
Vitamins AD_3E	3 days/ week	1 ml/liter	Drinking water
Liquid minerals	3 days/ week	1 ml/liter	Drinking water
Neoterrmycin	4-10 days of age	3 g/liter	Drinking water

duckling per week on the average body weight gain per duckling per week.

Carcass traits

At the ends of the growing period (70 days old), 5 birds from each treatment were taken randomly. Birds were individually weighed to the nearest gram and slaughtered by severing the carotid artery and jugular veins. After four minutes of bleeding, each bird was dipped in a water bath for two minutes and feathers were removed by hand. After the removal of the head, carcasses were manually eviscerated to determine some carcass traits including dressing % (eviscerated carcass without head, neck and legs) and giblets % (gizzard, liver, spleen, proventriculus and heart). Cold carcass weights were calculated after they were kept at 4°C for 18h. Dressing % was calculated as follows:-
Dressing % = Eviscerated carcass weight + giblets (heart, empty gizzard and liver) weight x 100

Live body weight at slaughter

Heart, empty gizzard, spleen, proventriculus and liver weights were expressed as relative weight proportionate to pre-slaughter live body weight.

Blood parameters

Blood parameters were estimated in the lab of microbiology, department of microbiology and immunity, faculty of medicine, Assiut University.
At 70 days old, 5 birds were randomly taken from each treatment, weighed and slaughtered. During the bird-sanguinary blood samples were collected as follows: Three ml of blood from each bird were collected in a centrifuge tube without anticoagulant to determine the chemical blood parameters and hormones. The tubes were kept at the room temperature for 30 minutes, then they were stored at a refrigerator for 60-90 minutes and then centrifuged at 3000 r.p.m for 10 minutes and the separated serum was transferred to another Epindoorf`s tube using a micropipette. The sera were kept at – 20ºC, until analysis using a commercial kit according to the procedure outlined by the manufacturer.

Triiodothyronine (T3)

Serum triiodothyronine (T3) was assayed by a solid phase enzyme immunoassay using Bio Tina GmbH Total T3 commercial ELISA kits.(Code#Bio-ET3/96;Bio-ET3/4) manufactured by Bio Tina GmbH, Bugweg 53, 58119 Hagen, Germany.

Thyroxin (T4)

Serum Thyroxin (T4) was assayed by a solid phase enzyme immunoassay using Bio Tina GmbH Total T4 commercial ELISA kits. (Code#Bio-ET3/96; Bio-ET3/ 48) manufactured by Bio Tina GmbH, Bugweg 53, 58119 Hagen, Germany.

Serum corticosterone analysis

Serum corticosterone was determined by Assay Max corticosterone ELISA kits (obtained from ASSAYPRO, Cataloge number (EC3001-1).

Statistical analysis

The results in both experiments were expressed as the mean ± SE. Differences between group means was assessed by a one-way analysis of variance (ANOVA) and post-hoc Duncan test using SPSS 11.0 (SPSS, 2011) statistical software (SPSS Inc, Chicago, Illinois, USA).

Results

Behavioral observation

The data tabulated in Table 2, showed the effect of swimming deprivation on drinking and feather pecking behavior. Analysis of variance of these results illustrated that, there was an insignificant de-

Table 2. Effect of Swimming deprivation on drinking and feather pecking behaviour (% of birds / 10 min) of Muscovy ducks

Behavioural Pattern / Group	Panting and drinking behavior	
	Drinking behavior	Feather Pecking
Control	14.91 ± 1.75	2.78 ± 0.42
Swimming deprivation	14.73 ± 1.78	7.99 ± 0.99*

Table 3. Effect of swimming deprivation on body weight (gm) at slaughtering time of Muscovy ducks

Groups / Bird	Control	Swimming deprivation
Overall mean	5490 ± 256	5349 ± 277.2

Table 4. Effect of swimming deprivation on feed intake, body weight gain (gm) and feed conversion rate of Muscovy ducks.

Parameters / Age of bird	Feed intake (gm)		Body weight gain (gm)		Feed conversion rate (kg intake/ gm gain)	
	Control	Swimming deprivation	Control	Swimming deprivation	Control	Swimming deprivation
Overall mean	1817±0.69	1689 ± 0.127	606± 0.12	541±0.17	2.99 ±0.7	3.12±0.74

Table 5. Effect of Swimming deprivation on Eviscerated weight (gm) and Dressing % of Muscovy Ducks

Carcass traits / Groups	Eviscerated weight and dressing %	
	Eviscerated weight (gm)	Dressing (%)
Control	4707 ± 150.4	90.90 ± 1.9
Swimming deprivation	4583 ± 116.4	90.76 ± 2.3

Table 6. Effect of Swimming deprivation on liver weight (gm) of Muscovy Ducks

Carcass parameter / Bird	Edible Giblets	
	Liver	
	Control	Swimming deprivation
Overall mean	97.88 ± 2.68	94.36 ± 3.4

Table 7. Effect of water deprivation on serum tri-iodothyronine (T3) and thyroxin (T4) (nmol/ L) and corticosterone level (ng/ ml)

	T3 (nmol/L)		T4 (nmol/L)		T3 T4		Corticosterone (ng/ ml)	
	Control	Swimming deprivation	Control	Swimming deprivation	Control	Swimming deprivation	Control	Swimming deprivation
Overall mean	1.88 ± 0.19	1.82± 0.17	23.36 ± 0.28	23.32 ± 0.28	0.080± 0.008	0.078± 0.007	10.12 ± 0.2	10.46 ± 0.26*

P<0.05

crease of drinking behavior and significant increase in feather pecking behaviour in the swimming deprivation group compared with the control group.

Performance characters

Feed intake, Body weights and Body weight gain

Tables 3 and 4, cleared that, there was an insignificant decrease of feed intake, average final body weights and average body weight gain as a result of these swimming deprivations.

Carcass characters

Tables 5 and 6, illustrated that, there was an insignificant decrease in Eviscerated weight, dressing Percentage and liver weight percentage in the force feeding group compared with the control one.

Effect of swimming deprivation on serum hormones

Table 7, cleared that, there was an insignificant decrease in serum T3 and serum T4 and T3/T4 in swimming deprivation in comparison with the control one. However, there was a significant increase in serum corticosterone level of the swimming deprivation group compared with the control group.

Discussion

Central poultry development organization (1999) and Juliet Gellatley *et al*. (2006) reported that, though duck is a water fowl and very fond of water, water for swimming is not essential at any stage of duck rearing. However, water in drinkers should be sufficiently deep to allow the immersion of their heads and not themselves. On the contrary, a reverse opinion was for Ruis *et al*. (2003); Benda *et al*. (2004) and Rodenburg *et al*. (2005). This finding may be related to using of drinking troughs which had the same effect of swimming pool in allowing ducks to drink and splash their body and legs in water (Juliet Gellatley *et al*., 2006).

Feather pecking associated with stress. Knierim *et al*. (2004) found that feather pecking was positively correlated with the plasma concentration of corticosterone. Moreover, this finding could be attributed to the denial of water, which opens the way to abnormal or stereotyped behavior (Juliet Gellatley *et al*., 2006). Also the lack of foraging opportunities and swimming water for preening in intensive duck redirects the birds for pecking at other ducks. Furthermore, there were few signs of frustration in ducks reared without bathing water. They exhibited increased head stretching and other behaviours (mostly directing attention to adjacent pens) that leads to an increase in feather pecking. (Appleby *et al*., 1994; Council of Europe, 1999; Ruis *et al*., 2003; Knierim *et al*., 2004).

Furthermore, the body weight, body weight gain, feed intake and feed conversion ratio could be explained as result of rearing of ducks under swimming deprivation for only 5 weeks, which did not result in stress so that the body weight and body weight gain and feed intake and feed conversion were insignificantly increased in the current study.

Moreover, these results of carcass traits may be related to the insignificant effect of the swimming pool deprivation on body weight, and the body weight gain which resulted in an insignificant effect on performance and carcass characteristics of Muscovy ducks. (Council of Europe, 2006).

In concerning hormones, These results were in agreement with that of Williamson *et al*. (1985); Sturkie (1986); Geraert *et al*. (1996); Rodenburg *et al*. (2005); Decuypere and Buyse (2005) and Gharib *et al*. (2005) and may be attributed to a reduction in food intake as well as the increased adrenocortical activity (Williamson *et al*., 1985). In stress condition, plasma corticosterone level was increased and immune response was decreased in birds. In Pekin duck with one day old rearing on intensive system without swimming pool, plasma corticosterone level was lower and immune response was higher than that without swimming pool (Erisir *et al*., 2009). However, the present study was carried out using one month old Muscovy ducks without an intensive system of rearing.

Conclusion

This study examined the behavioral, productive and neuroendocrine responses of Muscovy Ducks to deprivation of swimming pool. This experiment indicated that deprivation of swimming pool had no effect on the ducks behavior (except feather pecking), performance, carcass characteristics and blood parameters of the experimental duckling. Therefore, the swimming pool is not essential at any stage of duck rearing.

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