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Effect of Different Housing Systems on Growth and Welfare of Pekin Ducks

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Abstract: The aim of this study was to investigate the effect of different housing systems on growth and welfare of Pekin ducks. A total of 420 (212 male, 208 female) one-day-old ducklings were used in this study. The ducklings were randomly divided into 4 treatment groups; 2 Intensive Systems (IS) (one without pool and the other with swimming pool) and 2 intensive systems with outside activity (IOS) (one with swimming pool and the other without pool). The IOS with swimming pool was found to influence the body weight at 6 weeks of age. Body weight at 6 weeks of age was lower in ducks reared in IOS with pool than those reared in IOS without pool. Feed consumption was the highest and also feed efficiency was the lowest in ducks reared in IS without pool. The differences between the groups in terms of values for immune response, H-L ratio, plasma corticosterone, cholesterol, glucose and triglyceride levels were not statistically significant. It is concluded that although, the most common system used for duck rearing worldwide is IS without pool, the findings of the present study indicate that IOS with swimming pool is the best system in terms of duck welfare and growth.

Key words: Intensive housing system, outside activity, swimming pool, duck, welfare

INTRODUCTION

Pekin ducks are reared for meat production. The weight and age for slaughtering commercial Pekin ducks are 3.0-3.2 kg and 41 day (Applegate *et al*., 1998). In general, they grow under an intensive system without swimming pool. The adoption of intensive production systems for agricultural animals has resulted in remarkable increases in productive efficiency (Mench, 1992). But these systems have had a negative impact on animal welfare. For example ducks can start to show abnormal behavior in absence of the swimming pool. The Council of Europe recommends that ducks should be able to cover their head with water and to spread water over their feathers (Anonymous, 1999).

Welfare is defined as the animal's ability to maintain normal behavior and physiological homeostasis (Mench, 1992). Animal welfare is controlled with growth, H-L ratio, plasma corticosterone level and immune response. Therefore, the aim of our study was to determine the effects of different housing systems (access an outside activity and swimming pool) on duck growth and welfare such as H-L ratio, plasma corticosterone, serum glucose, cholesterol and triglyceride levels and immune response to SRBC.

MATERIALS AND METHODS

Animals, housing systems and diets: A total of 420 (212 male, 208 female) one-day-old ducklings (Star 52-Grimaud Freres) were obtained from a commercial hatchery. The ducklings were randomly divided into four treatment groups; 2 intensive systems (IS) (one without pool (A) and the other with swimming pool (B)) and 2 intensive systems with outside activity (IOS) (one with swimming pool (C) and the other without pool (D)). Each pen area for the IS was 30 m^2 and for the IOS was 50 m^2 (20 m^2 inside area and 30 m^2 outside area). The size of each swimming pool was 1×2×0.5 m in width × length× depth, respectively (Fig. 1). Each group included 105 (53 male and 52 female) ducklings.

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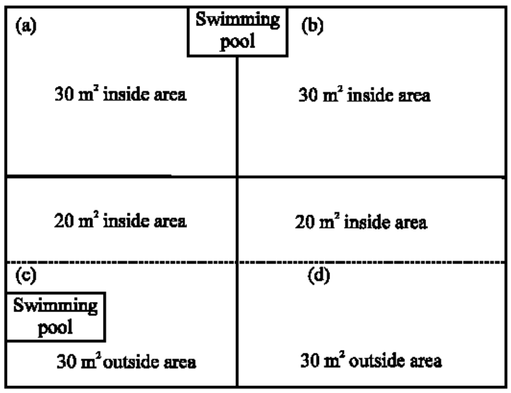

Fig. 1: Schematic drawing of pens. a): Intensive system without pool, b): Intensive system with pool, c): Intensive system with outside activity and pool, d): Intensive system with outside activity without pool)

Litter was used in inside area of all pens. Within each pen, water was provided via a bell drinker and feed via a hanging bell feeder. Feeder space was 5 cm per duck and drinker space was 2.5 cm per duck. Ducks received natural daylight during daytime and artificial light during the night. All ducks consumed *ad libitum* 2 commercial diets (first 3 weeks 22% CP, 2950 kcal kg^{-1} ME and last 3 weeks 18% CP, 3050 kcal kg^{-1} ME). All animal-use protocols were in accordance with the regulations outlined by the Ethical Committee on Laboratory Animals of the Faculty of Veterinary Medicine at the University of Ankara. The experimental period lasted for 6 weeks.

Parameters: Ducks were weighed and feed consumption was determined weekly. Mortality was recorded daily during the experiment.

At 5 weeks of age, 5 male and 5 female ducks were randomly selected from each pen and injected with 0.1 mL of 0.25% suspension of sheep erythrocytes (SRBC) in 0.9% saline. Circulating anti-SRBC antibody titers were determined by the microhemagglutination technique from samples taken at 5 days after the immunization. All titers were expressed as the $\log_2$ of the reciprocal of the serum dilution.

At 6 weeks of age, another 5 male and 5 female ducks were randomly selected from each pen and bled from the brachial vein. Blood samples were taken in two tubes, one contained EDTA for estimating plasma corticosterone levels and the H-L ratio and the other had no anticoagulant for estimating cholesterol, glucose and triglyceride levels.

Plasma was frozen (-20°C) until analyzed for corticosterone determination. Plasma corticosterone levels were measured using the kits Active Rat Corticosterone EIA DSL-10-81100 for IDS double antibody EIA technique, with a Bio-Tek ELX800 gamma counter. Blood samples were smeared on to a glass slide for the determination of the H-L ratio. After drying, the smears were stained with May-Grünwald-Giemsa stain. The total leukocyte count includes heterophils, lymphocytes, monocytes, basophils and eosinophils. One hundred leucocytes were counted, once on each slide, using a light microscope at ×1000 magnification. The H-L ratios were determined by dividing the number of heterophils by the number of lymphocytes.

Serum cholesterol, glucose and triglyceride levels were determined using a Olympus AU600 auto analyzer and its accompanying commercial kits.

Statistical analysis: Mean body weight, feed consumption and feed efficiency were calculated on a pen basis, whereas blood samples, H-L ratio and immune response were calculated using 10 birds in each pen. Body weight, blood parameters, H-L ratio and immune response of ducks in the pens were analyzed using ANOVA with the general linear model procedure of SPSS (2001) (SPSS Inc, Chicago, IL, USA). Mortality at 6 weeks of age was evaluated using the chi-square test (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Initial body weight was not different among the groups. Outside activity and swimming pool were found to influence the body weight at 6 weeks of age. In total, the main final body weight of ducks reared in pens with pool was found 2363 g, whereas it was 2270 g in those reared in pens without pool. Final body weight of ducks was higher in IOS (2343 g) than IS (2290 g) and was higher in IOS with pool. In the IS, swimming pool had a negative effect on final body weight of ducks (Table 1).

The differences between the groups in terms of the values for H-L ratio, plasma corticosterone level and immune response were not statistically significant. In the IOS with swimming pool, H-L ratio and plasma corticosterone level were lower and immune response was higher than that without swimming pool. However, in the IS without swimming pool, H-L ratio and plasma corticosterone level were lower and immune response was higher than the IS with swimming pool (Table 1 and 2).

Serum cholesterol, glucose and triglyceride levels were not affected by different housing systems. Serum cholesterol, glucose and triglyceride levels were

Table 1: Effects of housing systems on body weight, H-L ratio and immune response at 6 week of age (Mean±SEM)

	Housing systems	Initial body weight (g)	Body weight at 6 week of age (g)	H-L ratio	Immune response
IOS	P	42±0.33	2450±25	0.50±0.05	5.30±0.21
	WP	42±0.33	2237±25	0.66±0.05	4.40±0.21
IS	P	42±0.33	2276±25	0.62±0.05	4.50±0.21
	WP	42±0.33	2304±25	0.55±0.05	4.90±0.21
Total	P	42±0.23	2363±18	0.56±0.03	4.90±0.15
	WP	42±0.23	2270±18	0.61±0.03	4.65±0.15
IOS	Total	42±0.23	2343±18	0.58±0.03	4.85±0.15
IS	Total	42±0.23	2290±17	0.59±0.03	4.70±0.15
		Two way ANOVA (p)			
IOS-IS		0.601	0.032	0.836	0.480
P-WP		0.289	0.000	0.311	0.242
IOS-IS X P-WP		0.186	0.000	0.018	0.004

IS: Intensive System, IOS: Intensive system with outside activity, P: Swimming Pool, WP: Without swimming Pool

Table 2: Effects of housing systems on plasma corticosterone level, serum glucose, cholesterol and triglyceride levels (Mean±SEM)

	Housing systems	Serum cholesterol (mg dL^{-1})	Serum glucose (mg dL^{-1})	Serum triglyceride (mg dL^{-1})	Plasma corticosterone (ng mL^{-1})
IOS	P	173±5.8	167±5.6	91±5.2	258±22
	WP	163±5.8	154±5.6	77±5.2	295±22
IS	P	162±5.8	162±5.6	82±5.2	276±22
	WP	170±5.8	165±5.6	86±5.2	224±22
Total	P	168±4.1	165±4.0	86±3.7	267±15
	WP	167±4.1	160±4.0	82±3.7	260±15
IOS	Total	168±4.1	161±4.0	84±3.7	277±15
IS	Total	166±4.1	164±4.0	84±3.7	250±15
		Two way ANOVA (p)			
IOS-IS		0.738	0.538	0.955	0.222
P-WP		0.871	0.358	0.384	0.726
IOS-IS X P-WP		0.127	0.137	0.080	0.045

IS: Intensive System, IOS: Intensive system with outside activity, P: Swimming Pool, WP: Without swimming Pool

determined as 168, 165, 86 mg dL^{-1} in pens with pool, as 167, 160, 82 mg dL^{-1} in pens without pool, as 168, 161, 84 mg dL^{-1} in IOS and as 166, 164, 84 mg dL^{-1} in IS, respectively (Table 2).

Feed consumption (Fig. 2) was the highest and also feed efficiency (Fig. 3) was the lowest in ducks reared in IS without swimming pool. In the IOS with pool enhanced the feed efficiency.

Mortality was higher in IOS in total, but the difference was not statistically significant (Fig. 4).

The highest body weight of ducks was found in IOS at 6 weeks of age. This may be due to more space and outside activity provided in IOS. In total, the main final body weight of ducks reared in pens with pool was found 2363 g, whereas, it was 2270 g in those reared in pens without pool. As expected, swimming pool enhanced the body weight because it is suitable for natural life of ducks. Farhat and Chavez (2000) reported that body weight of Pekin ducks at the 6th week was 3023 g which was higher than the findings of the present study. Sex and genotype differences may be responsible for this. Final body weight of ducks was higher in IOS with pool as it was similar to the natural life. In the IS, swimming pool had a negative effect on final body weight of ducks because it deteriorated environmental conditions of inside area such as ventilation, ammonia concentration, litter and temperature.

In the present study was found that the highest feed consumption and the lowest feed efficiency were in IS without swimming pool. Similarly, some researchers reported that feed efficiency was improved by providing more space for the movement of birds (Michel and Huonnic, 2003; Tauson *et al.*, 1999). In the current study, IOS with pool enhanced the feed efficiency.

The increased mortality in IOS in total may be due to much lower environmental temperatures outside at night caused to many deaths which suggest that the IOS is not suitable for ducklings in first weeks of life.

Studies have noted that the H-L ratio is affected by stressors and it could be used as an indicator of stress in birds (Gross and Siegel, 1983; Maxwell, 1993). Mench (1992) reported that the physiological responses generally used as indices of welfare are those associated with activation of the hypothalamic-pituitary-adrenal axis and the sympathetic-medullary-adrenal axis, the so called stress responses. These include elevated heart rate, increased secretion of corticosterone and catecholamine, immune suppression, changes in levels of reproductive

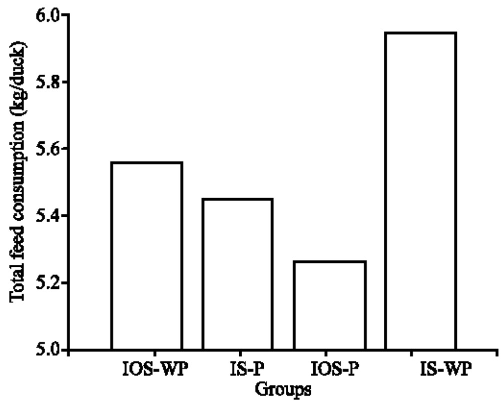

Fig. 2: Effects of housing systems on feed consumption during the experiment. (IS: Intensive System, IOS: Intensive System with outside activity, P: Swimming Pool, WP: Without swimming Pool)

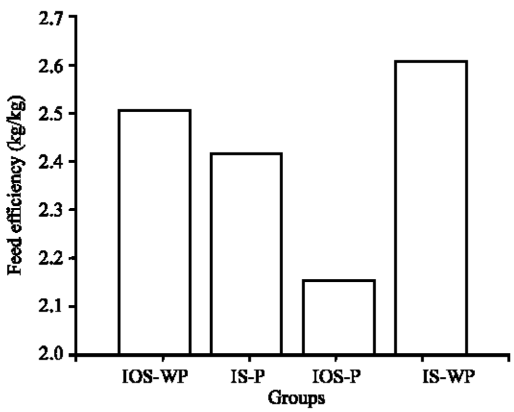

Fig. 3: Effects of housing system on total feed efficiency. (IS: Intensive system. IOS: Intensive System with outside activity, P: Swimming Pool, WP: Without swimming Pool)

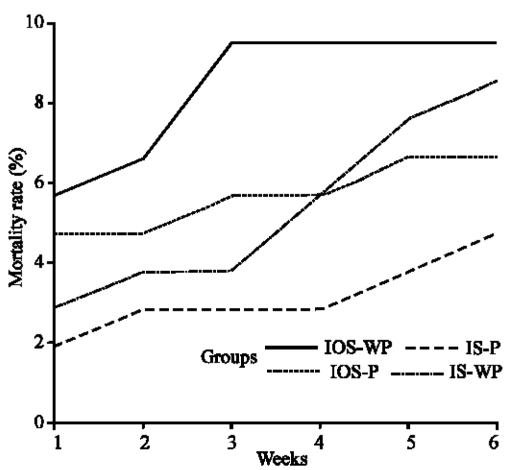

Fig. 4: Effects of housing systems on mortality rate during the experiment. (IS: Intensive System, IOS: Intensive system with outside activity, P: Swimming Pool, WP: Without swimming Pool)

and growth hormones and neurochemical changes. Related to this knowledge, in stress conditions H-L ratio and plasma corticosterone level were increased and immune response to SRBC was decreased of birds. In this study, in the IOS with swimming pool, H-L ratio and plasma corticosterone level were lower and immune response was higher than that without swimming pool. However in the IS without swimming pool, H-L ratio and plasma corticosterone level were lower and immune response was higher than the IS with swimming pool. These results indicate that IOS with swimming pool decreases stress in ducks, while IS with swimming pool is not suitable for duck rearing.

Serum cholesterol, glucose and triglyceride levels were not affected by different housing systems. In similar to our findings, Farhat and Chavez (2000) reported that plasma cholesterol and glucose levels were 174 and 188 mg dL^{-1}, respectively.

CONCLUSION

It is concluded that although, the most common system used for duck rearing worldwide is IS without pool, the findings of the present study indicate that IOS with swimming pool is the best system in terms of duck welfare and growth. However, when deaths in the first weeks in IOS were considered, it may be plausible to restrict access of birds to outside for first two or three weeks of life in this system.

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