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Effects of Elevated Oxygen Concentrations During Plateau and Pipping Stages of Incubation on Hatching Results and Some Supply Organ Weights in Pheasant (*Phasianus colchicus*) Hatching Eggs at High Altitude

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Abstract: This study deals with the effects of extra oxygen supplementation in high altitude (1700 m) on hatching traits in pheasant (*Phasianus colchicus*) eggs during the last 4 days of incubation. The hatching eggs were obtained from a 44 weeks old Pheasant flock. All eggs were distributed randomly into one incubator and incubated for 37.6°C and 58% RH 21 days using uniform conditions. At the start of 22nd day of incubation, the eggs were randomly distributed to two experimental hatching cabinets. The temperature and RH were changed as 37.2°C and 90-92%, in both cabinets for the last 4 days of incubation. During the last 4 days of incubation, two oxygen concentrations were added to the cabinets as 19 and 23%, separately. Fertile Hatchability (FH), Internal (IP), External (EP) pipping mortalities and Late Mortalities (LM) of embryos and some supply organ weights of chicks were recorded. The 23% oxygen treatment significantly reduced EP and LM mortalities compared to control group. Increasing oxygen level at this altitude has improved the FH in 23% oxygen treatment group compared to that resulting from 19% oxygen. At hatch, lower liver weights were obtained from 23% oxygen treatment group compared to control group. These findings revealed that fertile hatchability can be improved if oxygen levels elevated at high altitudes during plateau stage of incubation in Pheasant eggs.

Key words: Pheasant, plateau stage, incubation, oxygen concentration, altitude, eggs, group

INTRODUCTION

The hatchability of fertile chicken eggs laid and incubated at sea level is well over 90%. However, metabolic rate and hatchability are impaired if eggs laid at low altitude are incubated at high altitude (Visschedijk, 1980; Giussani *et al*., 2007). High altitudes have been shown to be detrimental to hatchability (Moreng, 1983; Christensen and Bagley, 1984). The impairment is caused by the reduced barometric pressure at altitude, which not only decreases the effective oxygen tension but also increases the effective eggshell conductance. Oxygen (O_2) and Carbon Dioxide (CO_2) exchanges may influence embryonic development, hatchability and pipping (Tullett, 1990; Decuypere *et al*., 2001; Tona *et al*., 2005). Theoretically, the hatchability at any terrestrial altitude would be normalized if the embryonic gas exchange were restored to the sea level values (Visschedijk, 1991).

There are a number of studies focusing on the effects oxygen supplementation to incubator environment and their effects on the broiler incubation results, blood parameters growth, fattening performance of broiler (Wineland, 1996; Christensen *et al*., 1993, 2002, 2003). However, there has been no research on the effect of extra oxygen supplementation of pheasant (*Phasianus colchicus*) eggs during the last 4 days of incubation. Therefore, the objective of this study was to investigate the incubation properties of pheasant (*Phasianus colchicus*) eggs and chick organ weights incubated at 23% oxygen concentrations during the last 5 days of incubation.

MATERIALS AND METHODS

About 840 eggs from Phesant breeders at weeks 44 ages. Two laboratory (Cimuka) incubatory cabinets were used in the experiment. Each Incubator Cabinet (IC) contained four incubator trays with a capacity for 140 eggs each. Incubator trays were the experimental units. Digital thermostats connected to microprocessors

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with temperature sensitivity of ±0.1°C controlled the wet and dry bulb temperatures. Digital thermometers were used in each cabinet to verify set point temperatures. Initially all eggs were distributed randomly into one experimental incubator and were incubated for 21 days under uniform conditions (dry bulb temperature 37.6±0.5°C and 58% RH). There were 2 hatching cabinets were used in the study. At the completion of the 21st day of incubation, the temperature and RH were kept as 37.2°C and 90-92%, in both cabinets in order to provide the same environmental conditions for the last 4 days of incubation.

However, $2O_2$ concentrations were the study. The concentrations were 19% (control) and 23% of the atmosphere within the cabinets. Each fractional concentration at sea level corresponded to O_2 partial pressures of 144 and 175 mm Hg, respectively. Concentrations were measured with a digital oxygen-meter and flow rates from O_2, storage tanks were adjusted to maintain the desired oxygen level.

At the completion of 25th day of incubation, unhatched eggs were examined macroscopically to determine Late Embryo Mortality (LEM), External Pipping (EP) and Internal Pipping (IP). Fertile Hatchability (FH) was also calculated. Five chicks were selected randomly from each incubator at 25th day of incubation. At hatch, the chicks were weighed (nearest 0.01 mg) and decapitated. The heart, liver, pancreas and Yolk Sac with Yolk material (YSwY) (their weights based on percentage of whole body mass) were dissected, trimmed, blotted and weighed to the nearest 0.01 mg on an analytical balance. All external vessels were trimmed from the heart using surgical scissors prior to weighing. Chick weights without yolk (nearest 0.01 mg) were recorded.

The data from the experiment were subjected to a one-way ANOVA using a randomized complete block design with the Statistical Analysis System-ANOVA procedure. For statistical analyses, all percentage data were transformed using arc sine transformations and microbial counts were transformed to log10 prior to statistical analysis (Minitab, 1998).

RESULTS AND DISCUSSION

The pattern of cell growth and metabolism of the chick embryo can be manipulated by changing the oxygen availability late in incubation (Richards *et al*., 1991). During the last part of incubation period the demand of oxygen exceeds oxygen diffusion capacity of the eggs shell pore system and chorioallantoic membrane (Rahn, 1981). Increasing oxygen concentrations from 19-23% at high altitude improved fertile hatchability ($p<0.05$) in Pheasant eggs (Table 1). The improvements due to supplemented oxygen were 18.13% in the treatment group. The oxygen treatment had no significant effect on IP deaths in either the oxygenated or the nonoxygenated incubator. Embryonic mortality (LM) during 22-23 days of incubation ($p<0.05$) and EP deaths were reduced ($p<0.01$) by oxygenation.

The embryonic mortalities occurred before 22nd of incubation were not evaluated due to study design. These results agrees with that of Bagley *et al*. (1988) who stated that an oxygen partial pressure of 109 torr depressed hatchability, compared to that resulting from partial pressure of 131 torr in Turkey eggs and Celen *et al*. (2009) who stated that oxygen supplementation to the incubator at high altitude (1700 m) improves fertile hatchability. The hatchability at any terrestrial altitude is theoretically normalized if the gas exchange is restored to sea level values (Visschedijk, 1991). The main reasons of the higher FH in oxygenated group were lower embryonic deaths including in LM and EP deaths.

These results for pheasant eggs agrees with Christensen and Bagley (1988) who stated that the embryos in dense gas environment are better prepared metabolically to cope with the rigors of pipping and hatching than are embryos in a tenuous gas environment (Wilson, 1993; Mauldin and Buhr, 1991) who stated that oxygen deficiency at high altitude is one of the main reason for late embryonic mortalities.

The effect of oxygen supplementation in Phesant eggs on some supply organ weights are shown in Table 2. No significant differences were found between groups for chick weight, chick weight without yolk, percent heart and yolk weights. This result agree with Celen *et al*. (2009) who observed that no significant differences were found for chick body weight at hatch when added oxygen at high altitude whereas disagree with that of Christensen *et al*. (2004) who stated that increasing oxygen concentrations of oxygen in the incubators increased body weight and yolk utilization in Turkey chicks.

Supply organs were defined as heart, liver, intestine (Christensen *et al*., 2002) and pancreas, gallbladder (North and Bell, 1990). The percent liver weight was higher in control group ($p<0.05$) whereas percent pancreas weight were heavier in 23% oxygen rather than that of control group ($p<0.05$). This result disagrees with that of Van Golde *et al*. (1998) who stated that increase in oxygen avaibility produces an increase embryonic and organ mass not only late in incubation period but also halfway the incubation period when O_2 availability is not limited under normal incubation conditions.

Table 1: Percentage hatchability and embryonic deaths in pheasant (*Phasianus colchicus*) eggs at high altitude with supplemented oxygen or non-supplemented during the plateau stage in oxygen consumption

Oxygen supplement	IP	EP	OEM†	LM	FH
O_2	1.75±1.01	0.89±0.09	15.92±1.74	7.94±0.80	73.49±3.28
Control	0.00±0.00	3.71±0.06	17.61±0.97	18.53±1.54	60.16±2.41
P	NS	*	NS	**	*

†OEM: Embryonic Mortalities before 19 days of incubation; **p<0.01, *p<0.05, NS: Non Significant

Table 2: Organ weights of chicks at pull time in pheasant (*Phasianus colchicus*) eggs at high altitude with supplemented oxygen or nonsupplemented during the plateau stage in oxygen consumption

Oxygen supplement	Chick weight (g)	Without yolk (g)	Liver (%)	Heart (%)	Pancreas (%)	Yolk sac (%)
O_2	21.80±0.19	19.89±0.50	2.41±0.10	0.84±0.02	0.12±0.01	8.16±0.85
Control	21.68±0.24	20.90±0.90	3.03±0.25	0.88±0.04	0.10±0.01	9.98±0.68
P	NS	NS	*	NS	*	NS

*p<0.05; NS: Non Significant

Results of this study suggest that hatchery managers at high altitudes may improve hatchability by improve hatchability in Phesant eggs like other poultry species.

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