RESPONSE OF OXYGEN SUPPLEMENTATION DURING THE HATCHING PERIOD ON HATCHING WEIGHT AND WEIGHT GAIN OF MOJOSARI DUCKS STARTER PERIOD

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ABSTRACT
This study aimed to determine the response of oxygen supplementation during penetration to hatching weight and body weight gain in Mojosari. The sample used was 300 fertile eggs of Mojosari ducks. Sampling by purposive sampling. The research method was an experiment with a completely randomized design with 3 x 2 factorial patterns and five repetitions. The first factor was Oxygen (O2) supplementation which consisted of three levels, namely without O2 supplementation (A1), O2 supplementation in incubators up to 21% (A2) levels, O2 supplementation in incubators up to 25% (A3) levels. In comparison, the second factor was the time of O2 supplementation, which consists of two variations: the first to the 2nd day and the 25th day until hatching (B1) and the 25th day until hatching (B2). Variables considered include hatch weight and weight gain. The results showed a significant ($p < 0.01$) interaction between O2 supplementation level and time. Their interactions responded to the hatching weight and weight gain of Mojosari ducks in the starter period. The highest hatching weight was in the treatment without supplementation (control), while the highest body weight gain was in the O2 supplementation treatment, up to 21% given on the first, second, and 25th day until hatching.

Keywords: Local Ducks, Oxygen, Hatching, Weight.

1. INTRODUCTION

The application of technology in hatchery management using hatching machines will contribute to poultry development, including Mojosari ducks. The application of hatching machine technology could be optimized by paying attention to factors related to the hatching process. The level of O_2 in the incubator is one factor that influences the hatching process's success (Okur et al., 2022; Okur and Eratalar, 2021).

O_2 is very important for the survival of an organism (Omar et al., 2020). Because through respiration, O_2 is used in the oxidation process by every body cell to form ATP, which is necessary for all biological activities, both growth and development of the organism's body (Fathollahipour et al., 2018; Juan et al., 2021). Previous studies have proven that the hatching process requires an oxygen level of 21% O_2 so that the embryo's growth can run well and that good and healthy growth embryos are obtained (Asson-Batres et al, 1989). The hatching time is the plateau phase in O_2 consumption, just after the pipping period or during the change from *chorioallantoic* to pulmonary respiration (Ben-Gigi et al., 2021). Thus, it is reasonable to research the response of adding O_2 in the hatching machine to the hatching weight and weight gain of Mojosari ducks.

2. RESEARCH METHODS

The research method was experimental, using a completely randomized design with a 3 x 2 factorial pattern with five repetitions. In this experiment, there were two treatment factors: (1) the first factor was O_2 supplementation in the incubator, which consisted of three variations, namely without O_2 supplementation or 0 % (A1), oxygen supplementation up to 21% (A2), and oxygen supplementation up to with a content of 25% (A3); (2) the second factor is the time of O_2 supplementation consisting of two variations, namely the first to the 2nd day and the 25th day of hatching to hatching (B1), the 25th day of hatching to hatching (B2).

Sampling (eggs) was purposive random sampling based on the following criteria:

1. Eggs came from ducks aged ± 1 – 1.5 years
2. Eggs obtained from mating ducks with a male-to-female ratio of 4 compared to 100
3. Eggs from ducks with the same rearing and feeding system
4. Eggs less than seven days old before hatching
5. Egg weight between 65 – 70 g
6. Bluish eggshell color
7. Clean egg shells
8. The eggshell texture is good or not rough and grooved
9. Oval egg shape with a ratio between width and length is 3 to 4

Observed variables in this study were hatching weight and weight gain of Mojosari ducks in the starter period (2 weeks). The data was analyzed using factorial ANOVA with the software IBM SPSS Statistics 19. The least significant difference test was used with a significant level of 0.05 and 0.01 to determine differences between treatments.

3.RESULTS AND DISCUSSION

Hatching Weight

The average and standard deviation of the ducks' hatching weight in response to the O_2 supplementation treatment given at various times of the hatching period, the results can be seen in Table 1.

Table 1. Average Hatching Weight (Gram) in Response to O_2 Supplementation Treatment Given at Various Times and Hatching Periods

Supplementation time	No Supplementation (A1)	Levels of O_2 supplementation	
		21% (A2)	25% (A3)
Day 1, 2, 25 until hatching (B1)	$46.30^{c} \pm 0.81$	$42.32^{b} \pm 1,14$	$40.63^{a} \pm 1.11$
Day 25 until hatching (B2)	$45.95^{c} \pm 0.83$	$44.63^{b} \pm 1.39$	$41.78^{a} \pm 0.52$

Information :

$^{a, b, c}$ The means of different superscripts in the same row were significantly different ($p < 0.01$)

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Table 1 showed O_2 supplementation gave different responses ($p < 0.01$) to hatching weight. The 21 % O_2 supplementation (treatment A1) and the 25 % O_2 supplementation (A2 treatment) reduced hatchling weight by 5.72% and 10.65% compared to the control (without oxygen supplementation). It was suspected that there were differences in the response in the prenatal period and the pipping period to O_2 supplementation. In the ducks' prenatal period (day 1 to day 22 of hatching), the available nutrition sources were still relatively abundant, so the response was to stimulate growth. In contrast, there were relatively few nutrition sources in the pipping period (day 23 to before hatching). It was suspected that O_2 supplementation caused stress, resulting in many glycogenolysis events (Gonzales-Rivas et al., 2019). So, the hatching weight of O_2supplementation at 21% levels (A2 treatment) was lower by 5.72 % (43.48 grams vs. 46.12 grams), and the results of O_2 supplementation up to 25% levels were 10.65% lower (41.21 grams vs. 46.12 grams) compared to control (without O_2 supplementation).

O_2 supplementation time gave a different response ($p < 0.01$) to hatching weight. Hatching weight in treatment B2 (time of O_2 supplementation 25th day until hatching) was 2.41% higher (44.12 gram vs. 43.08 gram) compared to treatment B1 (time of O_2 supplementation day 1 and 2 and the 25th day until hatching). It was due to stress factors (changes in respiration rate from low to high or high to low) caused by the time of oxygen supplementation.

This stress was thought to cause inhibition of thyroid hormone secretion (Abo-Al-Ela et al., 2021). Meanwhile, the role of thyroid hormones (thyroxine and triiodothyronine) increases the use of oxygen in the tissues, thereby affecting the growth and development of the embryo, which also results in its hatching weight (Forhead & Fowden, 2014). Suppose the synthesis of thyroid hormone is inhibited, resulting in glycogenolysis (Gonzales-Rivas et al., 2019) so that the embryo weight is lower, which results in lower hatching weight. In that case, another possibility is that this stress causes most of the energy to be used for basic life so that the energy for growth is reduced (Harris, 2015). However, because treatment B2 received a rather stable treatment than B1, the hatching weight in treatment B2 (25th day of O_2 supplementation) was higher than that of B1 treatment (1st, second, and 25th day to hatch of O_2 supplementation).

There was an interaction ($p < 0.05$) between O_2 supplementation and O_2 supplementation time on hatching weight. It means that level and time of O_2 supplementation did not stand alone in influencing hatching weight, but there was an interaction between them. The hatching weight in the non-supplementation group (A1B1 and A1B2) had the highest weight hatching of around 45 to 46 grams due to the more stable treatment than the other treatments. It was argued that the development of avian embryos requires low O_2 levels at the beginning of development and requires O_2 with higher levels during the organogenesis and morphogenesis phases (Fathollahipour et al., 2019).

Weight Gain

The average and standard deviation of the ducks' weight gain in response to the O_2 supplementation treatment given at various times of the hatching period, the results can be seen in Table 2.

Table 2. Average Weight Gain (gram) in Response to Treatment of O_2 Supplementation Given at Various Times of Hatching Period

Supplementation time	No Supplementation (A1)	Levels of OXYGEN supplementation	
		21% (A2)	25% (A3)
Day 1, 2, 25 until hatching (B1)	$159.99^{a} \pm 6.52$	$196.36^{c} \pm 6.52$	$176.21^{b} \pm 5.42$
Day 25 until hatching (B2)	$159.51^{b} \pm 1.23$	$169.75^{c} \pm 9.89$	$130.56^{a} \pm 9.40$

Information :

$^{a, b, c}$ The means of different superscripts in the same row were significantly different (p <0.01

Table 2, O_2 supplementation gave a different response ($p < 0.01$) to the weight gain of the Mojosari ducks. The weight gain resulting from O_2 supplementation up to a level of 21% (A2) was 14.59% higher (183.06 grams vs 159.75 grams) compared to no supplementation (treatment A1) and 19.08% higher (183 .06% vs 153.38%) compared to O_2 supplementation up to 25% (treatment A3). It was due to the supplementation of O_2 up to optimum levels (21%) given during embryonic development so that the ducklings were trained to carry out rapid respiration and, after hatching, were also thought to be able to carry out rapid or optimal respiration so that their body weight gain was higher than with another treatment. This situation could be seen from the DOD supplementation results in up to 21% compared to the control, which looked more active and agile, and the growth of the fur was good, dry and smooth. It was also supported by the opinion of Simon and Keith (2008) that ducklings resulting from optimum O_2 supplementation had better activity, as 21 % O_2 in the atmosphere. In addition, ducklings resulting from supplementation had better heart and liver growth than those without supplementation (Christenson & Donaldson, 1991), so their metabolic processes were better, resulting in better weight gain after hatching. Conversely, if the O_2 given exceeds the optimal requirement, it will disrupt the embryo's growth (Bast et al., 1991) so that its growth (during the embryo and after hatching) cannot reach optimal.

O_2 supplementation time gave a different response ($p < 0.01$) to the ducks' weight gain. Body weight gain in treatment B1 (time of O_2 supplementation on the 1^{st} and 2^{nd} day and 25^{th} day until hatching) was 15.82% higher (177.52 grams vs 153.27 grams) compared to treatment B2 (time of O_2 supplementation 25^{th} day until hatching). This situation was caused by the B1 treatment of ducklings during embryonic development on the first and second days they received O_2 supplementation; with the O_2 supplementation, it was suspected that duck embryo development would be optimal (especially the entoderm layer) so that when the ducks hatch, these ducks had a better digestive tract system. It caused better feed efficiency so that the weight gain of these ducks was higher than the group of ducks hatched without supplementation. It was supported by the opinion of Li et al. (2019) that on the first and second day of hatching, the initial stages of embryo growth and development were the development of the ectoderm and entoderm layers and the formation of the mesoderm layer. The ectoderm would later develop to form the nervous system, the eyes, feathers, beak, claws (nails), and skin. Mesoderm would develop into bones, skeletal muscles, reproductive system, and excretory system, while the entoderm would develop into respiratory, secretory, and digestive tract organs.

There was an interaction ($p < 0.05$) between O_2 supplementation levels and on ducks' weight gain. The highest duck weight gain (196.36 grams) was in the A2B1 treatment (the O_2 supplementation group with up to 21% levels was given on the 1st, 2nd, and 25th day until hatching) because: (1) the ducks during embryonic development, it received oxygen supplementation up to 21% on days 1, 2 so that it experiences better growth, especially at the beginning of embryonic development, namely days 1 and 2 (Metcalfe et al., 1981)

4. CONCLUSION

There was an interaction between levels and time O_2 supplementation gave different responses to hatching weight and body weight gain of Mojosari ducks in the starter period, with the highest average hatching weight (46.12 ± 0.80 gram) in the treatment without O_2 supplementation (control) while the highest average weight gain (196.36 ± 12.63 grams) was in the treatment that received O_2 supplementation up to 21% levels given on day 1, 2nd and 25th to hatch (A2B1). It is recommended to supplement oxygen up to 21% in the machine given on the 1st, second, and 25th days until hatching to obtain good weight gain for ducks during the starter period.

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