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Short Communication

Effect of Egg Weight and Egg Shape Index on Hatching Performance and Eggshell Quality of White-Nest Swiftlets

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Abstract | This study aimed to evaluate the effect of egg weight and egg shape index on hatching performance and eggshell quality of white-nest swiftlets. A total of 200 white-nest swiftlet eggs were included in this study. The egg weight was classified into three groups, namely Group EW1: 1.61 - 1.80 g, Group EW2: 1.81 - 2.00 g, and Group EW3: 2.01 - 2.20 g. The egg shape index was classified into three groups, namely Group ESI1: 60.01 - 65.00%, Group ESI2: 65.01 - 70.00%, and Group ESI3: 70.01 - 75.00%. The results showed that hatching weight, eggshell weight, and thickness were improved along with the increased in the egg weight ($p < 0.05$). On the other hand, egg shape index, hatchability, and hatching yield were not significantly differed across three egg weight groups ($p > 0.05$). The egg shape index had a significant effect on the hatchability of white-nest swiftlets ($p < 0.05$). Group ESI3 had a higher hatchability as compared to ESI1 ($p < 0.05$), while ESI2 did not differ with ESI1 and ESI3 ($p > 0.05$). The egg shape index did not significantly affect egg weight, hatching weight, hatching yield, eggshell weight, and eggshell thickness ($p > 0.05$). It could be concluded that egg weight is an essential determining factor for hatching weight, eggshell weight, and thickness, while egg shape index is crucial for hatchability of white-nest swiftlets.

Keywords | Edible bird's nest, Hatchability, Hatching weight, Incubation, Shell thickness

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INTRODUCTION

Edible bird's nest is a livestock product that has high economic value because it contains valuable nutrients and beneficial health effects. Edible bird's nest contained 53.09 – 56.25% protein with 10 essential amino acids and 18 non-essential amino acids (Elfita et al., 2020). Moreover, edible bird's nest also contained 10.5% sialic acid (Cai et al., 2016). The sialic acid content of edible bird's nest was reported to have several biological effects such as anticancer, antihypertensive, immunomodulator, brain and cognition development, as well as skin whitening properties (Ling et al., 2022).

Indonesia is the largest edible bird's nest producer in the world. The edible bird's nest production in Indonesia reached about 85% of the total world production (Huang et al., 2020). The demand for Indonesian edible bird's nest continues to increase from year to year. In 2012, the exports of edible bird's nest reached about 405 tons, while in 2020 this number increased up to 1,313 tons (BPS – Statistics Indonesia, 2021). This great potential certainly needs to be supported by the development of a sustainable production system to ensure the superiority of Indonesian edible bird's nest production in the global market.

Swiftlet eggs are often taken during the harvesting process of edible bird's nest. This condition makes it impossible for swiftlet eggs to hatch naturally. Whereas the hatching of swiftlet eggs is very important to ensure the swiftlet populations in a sustainable manner. One of the efforts that can be made to overcome this problem is by utilizing artificial hatching technology (Amin et al., 2021).

Several factors that might determine the success of the hatching process include egg weight and egg shape index. Study on the effects of egg weight and egg shape index on hatching performance is widely available in commercial poultry, such as chickens, ducks, and quails (Ipek and Sozcu, 2017; Iqbal et al., 2017; Kostaman and Sopiyana, 2021). However, the available body of knowledge indicating a controversy regarding the effect of egg weight and egg shape index on hatching performance. In some studies, egg weight and egg shape index provide significant impact on hatching performance (Alasahan and Copur, 2016: Khalil et al., 2016; Ipek and Sozcu, 2017; Iqbal et al., 2017; Hegab and Hanafy, 2019). However, other studies reported negligible effect of these traits on hatching performance (Sarı et al., 2010; Onbaşılar et al., 2011; Ramaphala, 2013; Rashid et al., 2013; Kostaman and Sopiyana, 2021). Furthermore, the investigation of this topic in swiftlet is currently still very limited. Therefore, this study aimed to evaluate the effect of egg weight and egg shape index on hatching performances and eggshell quality of white-nest swiftlets.

MATERIALS AND METHODS

Hatching Eggs

A total of 200 white-nest swiftlet eggs were obtained from Sukorejo, Pasuruan, Indonesia. The site was located between 7.69°S latitude and 112.73°E longitude, with the altitude of 179.78 m above mean sea level. Swiftlet eggs are collected during the harvesting process of edible bird's nest. The egg weight was determined by using digital balance (Habsari et al., 2018) and then classified into three groups, namely Group EW1: 1.61 - 1.80 g (n = 67), Group EW2: 1.81 - 2.00 g (n = 82), and Group EW3: 2.01 - 2.20 g (n = 51). The egg shape index was determined by using Vernier caliper (Andri et al., 2018) and then classified into three groups, namely Group ESI1: 60.01 - 65.00% (n = 91), Group ESI2: 65.01 - 70.00% (n = 63), and Group ESI3: 70.01 - 75.00% (n = 46).

The swiftlet eggs were then incubated in a programmable incubator at 34°C and 80% of relative humidity. The incubation was performed for 25 days. The hatching swiftlet were weighed directly after hatch. Hatching yield was calculated by hatching weight / egg weight x 100% (Mesquita et al., 2021). The eggshell were weighed by using a digital balance (Edi et al., 2018) and shell thickness was measured by using a micrometer (Andri et al., 2016). All experimental procedures was undertaken in accordance to the institutional animal care of the Faculty of Animal Science, Universitas Brawijaya.

Data Analysis

Data of hatching performances were tested using one-way analysis of variance with General Linear Model (GLM) procedures in IBM SPSS Statistics 22. When differences were significant, means were separated using Duncan's Multiple Range tests at the 0.05 level of significance.

RESULTS AND DISCUSSION

The descriptive data of egg weight, egg shape index, hatchability, hatching weight, hatching yield, eggshell weight, and eggshell thickness of white-nest swiftlets in this study is shown in Table 1. The results of this current study is almost similar to that reported by Amin et al. (2021), who found that the range of egg weight and hatching weight of white-nest swiftlets were 1.72 – 2.12 g and 1.37-1.42 g, respectively. Reichel et al. (2007) observed that the egg weight and hatching weight of swiftlet were 1.37 g (range 0.8 – 1.6 g) and 1.11 g (range 1.0 – 1.2 g). In another study by Tarburton (2003), the egg weight of swiftlet was ranged between 1.87 and 2.10 g, while hatching weight was ranged between 1.35 – 1.52 g. The hatchability of swiftlets under natural condition in the cave was 77% (Tarburton, 2003), while in the man-made swiftlets house was 100% (Amin et al., 2021).

The results showed that the egg weight groups had a different mean egg weight ($p < 0.05$), with the following order EW1 < EW2 < EW3 (Table 2). The egg weight significantly affects hatching weight, shell weight, and shell thickness ($p < 0.05$). Hatching weight was improved along with the increased in the egg weight ($p < 0.05$). Group EW3 had a higher eggshell weight and thickness as compared to Group EW1 ($p < 0.05$). Hatching performances of commercial poultry such as chickens, ducks, and quails were used to compare and elaborate the current findings because the study on swiftlets is currently very limited. In line with this study, Hegab and Hanafy (2019) also found that the heavier egg weight resulted in the heavier hatching weight. Abudabos et al. (2017) also reported that the hatching weight was increased along with the increased in the egg weight. In a study by Ipek and Sozcu (2017), heavy eggs also significantly produce higher hatching weight as compared to the light eggs. Iqbal et al. (2017) also noted that the large egg weight could improve the hatching weight. The higher egg weight indicating the higher egg contents (yolk and albumen) (Ipek and Sozcu, 2017; Hegab and Hanafy, 2019; Nowaczewski et al., 2022). The egg contents will be used as nutrient sources for embryo

Table 1: Descriptive data of hatching performance of white-nest swiftlets

Items	N	Mean ± SE	Range (Min – Max)
Egg weight (g)	200	1.88 ± 0.01	1.61 – 2.20
Egg shape index (%)	200	65.94 ± 0.27	60.01 – 75.00
Hatchability (%)	200	86.00 ± 2.46	0 – 100
Hatching weight (g)	172	1.51 ± 0.01	1.13 – 1.86
Hatching yield (%)	172	80.35 ± 0.34	58.80 – 93.25
Eggshell weight (g)	172	0.108 ± 0.001	0.070 – 0.200
Eggshell thickness (mm)	172	0.589 ± 0.002	0.460 – 0.690

n: number of samples, SE: standard error, Min: Minimum, Max: Maximum

Table 2: Effect of egg weight on hatching performance of white-nest swiftlets

Items	Group EW1 (1.61-1.80 g, n = 67)	Group EW2 (1.81-2.00 g, n = 82)	Group EW3 (2.01-2.20 g, n = 51)
Egg weight (g)	1.70 ± 0.01[a]	1.90 ± 0.01[b]	2.10 ± 0.01[c]
Shape index (%)	66.72 ± 0.16	66.88 ± 0.16	67.30 ± 0.18
Hatchability (%)	87.40 ± 4.37	87.36 ± 4.29	89.03 ± 4.92
Hatching weight (g)	1.38 ± 0.01[a]	1.53 ± 0.01[b]	1.66 ± 0.01[c]
Hatching yield (%)	81.06 ± 0.59	80.58 ± 0.58	79.15 ± 0.66
Eggshell weight (g)	0.102 ± 0.002[a]	0.110 ± 0.002[b]	0.114 ± 0.003[b]
Eggshell thickness (mm)	0.580 ± 0.004[a]	0.587 ± 0.004[ab]	0.598 ± 0.005[b]

n: number of samples

[a-c] Different superscripts within a row indicate a significant difference ($p < 0.05$)

Table 3: Effect of egg shape index on hatching performance of white-nest swiftlets

Items	Group ESI1 (60.01-65.00%, n = 91)	Group ESI2 (65.01-70.00%, n = 63)	Group ESI3 (70.01-75.00%, n = 46)
Egg weight (g)	1.90 ± 0.01	1.90 ± 0.01	1.90 ± 0.01
Egg shape index (%)	62.51 ± 0.14[a]	67.00 ± 0.16[b]	71.40 ± 0.19[c]
Hatchability (%)	79.42 ± 3.89[a]	90.90 ± 4.48[ab]	93.47 ± 5.14[b]
Hatching weight (g)	1.51 ± 0.01	1.52 ± 0.01	1.54 ± 0.01
Hatching yield (%)	79.55 ± 0.56	80.12 ± 0.60	81.11 ± 0.68
Eggshell weight (g)	0.110 ± 0.002	0.109 ± 0.002	0.107 ± 0.003
Eggshell thickness (mm)	0.593 ± 0.004	0.585 ± 0.004	0.588 ± 0.005

n: number of samples

[a-c] Different superscripts within a row indicate a significant difference ($p < 0.05$)

development during incubation. Thus, more available nutrient sources in the heavy eggs will resulted in the improvement of hatching weight. Additionally, previous reports also showed that the eggshell weight and eggshell thickness were proportional to the egg weight, in which the higher egg weight resulted in a heavier (Hegab and Hanafy, 2019) and thicker eggshell (Hristakieva et al., 2017).

On the other hand, the egg shape index, hatchability, and hatching yield were not significantly differed across three egg weight groups ($p > 0.05$, Table 2). Similar to this finding, Hristakieva et al. (2017) also reported that the egg weight was not correlated with the egg shape index and hatching yield. In Onbaşılar et al. (2011) study, it was also found that the egg weight did not influence hatchability. It could be stated that the egg weight is not a principle predictor for the hatchability of white-nest swiftlets eggs.

Table 3 shows that the egg shape index groups had a different mean egg shape index ($p < 0.05$), with the following order ESI1 < ESI2 < ESI3. The egg shape index had a significant effect on the hatchability of white-nest swiftlets. Group ESI3 had a higher hatchability as compared to ESI1 ($p < 0.05$), while ESI2 did not differ with ESI1 and ESI3 ($p > 0.05$). In a study by Gutiérrez et al. (2021), it was also reported that egg shape index significantly affect hatchability. Similarly, Alasahan and Copur (2016) also noted that egg shape index affected hatchability. King'ori (2012) suggested that hatchability is highly associated with egg shape index because axial position of embryo will be changed during advance stage of embryonic development. In a study by Jabbar et al. (2018) deviation of egg shape index from the normal shape led to the higher embryonic malposition, malformation, and dead in shell, thus reducing hatching performance. It could be stated that the egg shape index close to the standard form is the most suitable condition for hatchability of white-nest swiftlets.

The egg shape index did not significantly affect egg weight, hatching weight, hatching yield, eggshell weight, and eggshell thickness ($p > 0.05$, Table 3). In accordance with this study, Duman et al. (2016) also reported that egg shape index did not influence egg weight, eggshell weight, and eggshell thickness. Alasahan and Copur (2016) also found that egg shape index had no significant effect on hatching weight.

CONCLUSION

According to the results of current study, it could be concluded that the egg weight has a positive effect on hatching weight and eggshell quality. While egg shape index more likely influence the hatchability of white-nest swiftlet.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

NOVELTY STATEMENT

This study reports for the first time effects of egg weight and egg shape index on hatching performance and eggshell quality of white-nest swiftlets.

AUTHORS CONTRIBUTION

All authors equally contributed and approved the manuscript.

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