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Production Performance and Egg Quality of the Alabio Ducks (*Anas platyrhynchos* Borneo) on Different Ages of Flocks During the First-Laying Period

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Abstract:
Background: *The Alabio duck (Anas platyrhynchos Borneo) is one of the natural genetic resources that has the potential to be a superior type of laying duck in South Kalimantan. The purpose of the study was to examine egg production, duck feed conversion, and the physical quality of Alabio duck eggs at different ages during the production period of the first egg-laying period.*
Materials and Methods*: The research was conducted at the Poultry Breeding Center (BPTU) in Tanah Laut Regency, South Kalimantan. The materials used in this study were 5 flocks of female Alabio ducks (each with about 500 heads of ducks per flock) with different ages: 6 months, 9 months, 12 months, 15 months, and 18 months.*
Results*: The percentage of egg production was affected by the ages of Alabio ducks; the highest yield was at 9 months of age (87.60%) and the lowest at 18 months (47%) with an all-term first-period production average of 71.92%. The feed conversion ratio was affected by the ages of the Alabio ducks. The lowest FCR value was the 9-month age group (2.67) and the highest was the 18-month age group (4.64). The ages of the group have an effect on egg weight, egg shape index, yolk percentage, albumen percentage, percentage of eggshells, shell thickness, HU, yolk index, and albumen index, but have no real effect on yolk color.*
Conclusion *Overall, 9-month-old Alabio ducks produce the highest egg production, the lowest feed conversion, and the best egg quality in averages.*
Key Word*: Alabio duck, ages, egg production, FCR, qualities*

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I. Introduction

In many Asian nations' agricultural economies, duck production is significant. The region alone is responsible for 82.6% of the world's total production of duck meat. Asians not only participate in the production of ducks but also enjoy and consume duck meat, eggs, and other items. Despite this, there are few resources available for focused teaching to enable rural households to boost duck production[1]. Alabio ducks have a very large role in increasing the income of duck breeders in rural areas. The South Kalimantan Provincial Government continues to strive to develop and preserve Alabio ducks[2].

The Alabio duck (*Anas platyrhynchos* Borneo) is one of the natural genetic resources that has the potential to be a superior type of laying duck in South Kalimantan[3]. Alabio ducks have enormous potential to be developed both as broilers and as laying ducks[4]. Sulaiman & Rahmatullah (2011)reported that, from the aspect of productivity at the Alabio duck production center in Hulu Sungai Utara, the highest percentage of egg production is in the intensive system at 91.00%, followed by the semi-intensive system at 83.17%, and then the extensive system at 55.38%.

The productivity of grazing laying ducks is only about 26.9–41.3%, equivalent to 98–151 eggs/head/year, while the egg production rate of confined ducks can reach 55.6% (203 eggs/head/year), and it is even reported that the egg production of Mojosari-Alabio (MA) cruciferous ducks for a year reaches 69.4% (253 eggs/head/year)[5]. Meanwhile, the results of observations of the egg production rate of Alabio ducks in three farmer groups in Sungai Pandan Regency showed that Alabio ducks produced eggs of around 73.47% for three months and had good egg quality based on the variables of eggshell thickness, eggshell percentage, albumin percentage, yolk percentage, HU value, egg yolk color, protein content, and fat content[6].

Alabio ducks are traditionally recognized as ducks that have the advantage of high egg production and high quality based on egg weight, shell color, and bright yolk color, as well as being able to produce a fairly good carcass. Their taste is also preferred because of their predominance of meat and their less fishy-smelling eggs[3]. However, the problem until now has been that Alabio ducks still lack in their selection and breeding

efforts; even some observers suspect that in general, Alabio ducks experience a decline in genetic quality, both in production quantity and quality, due to an increase in inbreeding caused by mating between close relatives.

The purpose of the study was to examine egg production (% Duck day), feed conversion ratio (FCR), and the physical quality of Alabio duck eggs at different ages during the production period of the first egg-laying period (6–18 months of age).

II. Material And Methods

Study Design:CRD 5 different ages of flocks as treatments, 4 times data collection and 50 eggs each flock as replication

Study Location: The research was conducted at the Poultry Breeding Center (BPTU) in Tanah Laut Regency, South Kalimantan, Indonesia.

Study Duration: March 2022 to August2022.

Sample size: 2500 female Alabio ducks and about 500 duck eggs.

The materials used in this study were 5 flocks of female Alabio ducks (each with about 500 heads, for a total of 2500 female ducks) with different ages; that is, the duck groups were producing eggs at the ages of 6 months, 9 months, 12 months, 15 months, and 18 months. Ducks were kept in the floor cage system. Feed ducks were given as needed for laying ducks each given 150 g/head/day with the following nutritional composition in Table 1. while freshwater drinks were provided *ad lib*.

Table 1. Nutrition of Feed Alabio Laying Ducks

No	Content	Unit	Requirement
1	Moisture	%	Maks. 14.0
2	Crude Protein	%	Min. 17.0
3	Crude Fat	%	Min. 3.0
4	Crude Fiber	%	Maks. 10.0
5	Ash	%	Maks. 14,0
6	Calcium (Ca)	%	2.90 – 4.25
7	Total phosphorus	%	0.55
8	Energy	Kcal/Kg	Min 2,650

Procedure Methodology

The method used in this research is CRD with 5 treatments in the form of differences in the age of the duck group, namely 6 months, 9 months, 12 months, 15 months, and 18 months. The production performance data collected and analyzed were egg production (duck-day percentage) and feed conversion ratio (FCR), collected in four replications. Meanwhile, the egg quality data analyzed was in the form of data on 50 eggs from each age group (a total of 250 eggs), including egg weight, egg shape index, yolk percentage, albumen percentage, shell percentage, shell thickness, HU, yolk color, yolk index, and albumen index.

$$\text{Duck day (\%)} = \frac{\text{Total Eggs}}{\text{Total Ducks}} \text{ x } 100$$

$$\text{FCR} = \frac{\text{Total Feed Consumption}}{\text{Total Egg Weight}}$$

Measurement of egg weight (g), egg yolk weight (g), and dry shell weight (g) was carried out using a digital scale, while albumen weight (g) was the difference between albumen weight (g) = egg weight - (yolk weight + shell weight). Egg length (mm), egg width (mm), yolk diameter (mm), and albumen diameter (mm) were measured using a digital caliper. Egg yolk color was measured using a Roche yolk color fan. The measurement method was carried out by matching the yolk color with a color on the Roche yolk color fan. Shell thickness (mm) was measured using a digital micrometer taken from the center of the egg shell. Egg shape index = egg width / egg length, yolk index = yolk height / yolk diameter, albumen index = albumen height / albumen diameter, Haugh unit (HU) was measured by measuring the height of thick albumen (thick albumen) using a digital height micrometer. The albumen height was measured at a point 10 mm away from the yolk. HU was calculated based on the Haugh Units (HU) = 100 log (H + 7.57 - 1.7 $W^{0.37}$), H is albumen height (mm), and W is egg weight (g)[7].

Statistical analysis

All data are analyzed with ANOVA, and if there is a noticeable influence, they are further tested with DMRT. The analysis was performed using the SPSS Ver. 21.0 application program (SPSS Inc., Chicago, IL, USA, 2012).

III. Results

Egg Production (%Duck-day) and Feed Conversion Ratio (CFR) in the First Period

Table 3 shows that Alabio duck egg production at different ages shows significant differences, or the age of the ducks affects the percentage of eggs produced ($P < 0.05$). The results of further tests also showed that there were noticeable differences between the age groups of Alabio ducks ($P< 0.05$). Sequential egg production from lowest to highest was in the age groups of 18 months (47.00%), 15 months (62.20%), 6 months (79.00%), 12 months (81.40%), and 9 months (79.40%).The results of observations on the percentage of egg production found differences in production depending on the age of Alabio ducks at different age flocks, as shown in Table 2 and Figure 1. The highest yield was at 9 months of age (87.60%) and the lowest at 18 months (47%) with an all-term first-period production average of 71.92%. The results of observations of egg production rates show that there is a noticeable difference, which shows that the age of ducks has a very real effect on the level of duck egg production. This is of course related to the reproductive physiology and hormonal cycle of ducks.

In general, poultry egg production will follow a curve of accelerated production starting at the age of 6 months and then slowly decreasing starting at the age of 12 months until it sharply decreases at the age of 18 months (Figure 1). Meanwhile, the feed conversion ratio indicates a real influence of Alabio duck age or production age on the feed conversion ratio value ($P<0.05$). The 9-month age group had the lowest FCR value (2.67) but did not differ markedly from 12 months (2.77), followed by 6 months (2.99), 15 months (3.48), and the 18-month age group (4.64) as the highest FCR value(Figure 1).

Different flock ages have a marked effect on feed conversion ratio (FCR); the best (lowest) FCR is obtained at 9 months of age, although it is not significantly different from feed conversion at 12 months of age. In general, with increasing lifespan, the feed-conversion of Alabio ducks increases or decreases in ration efficiency. Feed-conversion ratio (FCR) is a comparison between the amount of ration consumed and the amount of egg production produced. The higher FCR, the more inefficient the ration consumed in producing egg production, on the contrary, the lower FCR, the more efficient the ration used in producing egg production.

Table 2. Percentage of egg production (%Duckday) AlabioDucks andFeed Conversion Ratio at the age of 6, 9, 12, 15, and 18 months

Ages of Ducks (Months)	Ducks	Egg Prod (egg)	FC/d	Egg Prod (%)	SEM	FCR	SEM
6	500	397	150	79.40	$\pm1.50^{c}$	2.99	$\pm0.04^{b}$
9	500	438	150	87.60	$\pm2.48^{d}$	2.67	$\pm0.04^{a}$
12	500	407	150	81.40	$\pm2.11^{c}$	2.77	$\pm0.04^{a}$
15	500	321	150	64.20	$\pm1.69^{b}$	3.48	$\pm0.05^{c}$
18	500	235	150	47.00	$\pm2.10^{a}$	4.64	$\pm0.04^{d}$

Notes : Different superscript letters in the same column show a significant difference ($P<0.05$)

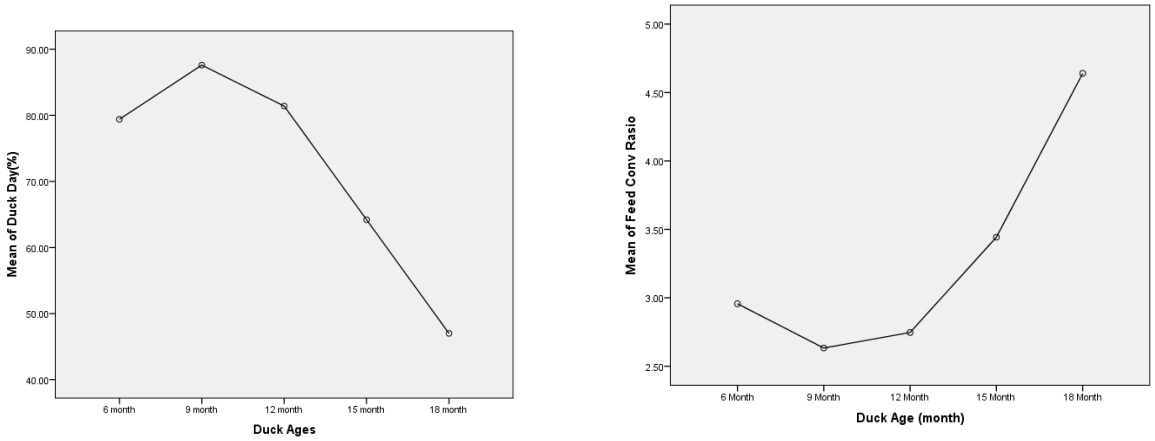

Figure 1. Egg Production (% Duck-day) and Feed Conversion Ratio (FCR) of Alabio Ducks onDifferent Ages of the Flocks

The physical quality of Alabio duck eggs

Table 3 shows that the age of the group has a noticeable effect on egg weight, egg shape index, yolk percentage, albumen percentage, and percentage of eggshells ($P < 0.05$). In general, the older the age of the Alabio ducks, the larger or heavier the eggs produced; the eggs range from 63.28 to 68.82 g, with the smallest at the age of 6 months and the largest at the age of 18 months. Meanwhile, the egg shape index is a comparison between the width of the egg and the length of the egg, and even though it shows a real influence on the age group, it does not show a much different value, which is about 0.78–0.79. In general, the older the age of the Alabio ducks, the heavier the yolk eggs or the higher the percentage produced, with the lowest percentage of eggs at 6 months of age (31.59%) and the highest at 18 months of age (37.05%). Conversely, the older the age of the Alabio ducks, the lighter the egg white or the lower the percentage of albumen produced, with the lowest percentage of albumen at 15 months of age (54.95%) and the highest at 6 months of age (67.73%). Similarly, with the percentage of shell, the older the age of ducks, the lower the percentage of weight of shell. The heaviest eggshell was at the age of 6 months (10.1%), although not significantly different from the age of 9 months (9.93%), and the shell was lowest at the age of 18 months, although it is not significantly different from the ages of 12 months and 15 months.

Table 3. Egg Weight and Egg Shape Index, Percentage of Yolk, Albumen and Egg Shell of AlabioDucks at the Age of 6, 9, 12, 15, and 18 Months

Age of Ducks (month)	Egg Wt (g)		E. Shape Index		Yolk (%)		Albumen (%)		Egg Shell (%)	
6	63.28	±0.56^{a}	0.78	±0.005^{a}	31.59	±0.27^{a}	67.73	±0.26^{d}	10.1	±0.07^{b}
9	64.02	±0.43^{a}	0.79	±0.005^{b}	32.43	±0.27^{a}	66.95	±0.27^{d}	9.93	±0.07^{b}
12	66.45	±0.81^{b}	0.79	±0.007^{b}	34.94	±0.40^{b}	64.49	±0.40^{c}	9.25	±0.12^{a}
15	67.06	±0.74^{b}	0.79	±0.004^{b}	35.94	±0.38^{c}	54.95	±0.39^{a}	9.1	±0.08^{a}
18	68.82	±0.52^{c}	0.78	±0.005^{a}	37.05	±0.43^{d}	62.29	±0.43^{b}	9.1	±0.22^{a}

Notes : Different superscript letters in the same column show a significant difference ($P<0.05$)

Table 4. Shell Thickness, HU, Yolk Color, Yolk Index and Albumen Index ofAlabioDuck Eggs at the Ages of 6, 9, 12, 15, and 18 Months

Ages of Ducks (Month)	Shell Thick. (mm)		HU (H Units)		Yolk Color (YCF)		Yolk Index		Alb Index	
6	0.430	±.004^{d}	83.65	±1.57^{b}	14.98	±0.02	0.43	±0.004^{c}	0.13	±0.005^{c}
9	0.397	±.003^{c}	85.62	±0.82^{b}	14.98	±0.02	0.41	±0.005^{b}	0.12	±0.003^{bc}
12	0.375	±.004^{b}	82.55	±0.99^{b}	14.98	±0.02	0.40	±0.005^{b}	0.11	±0.003^{b}
15	0.349	±.003^{a}	72.60	±1.56^{a}	14.98	±0.02	0.41	±0.006^{b}	0.09	±0.003^{a}

18	0.457	±.006^{e}	75.57	±1.15^{a}	14.9	±0.04	0.38	±0.008^{a}	0.10	±0.003^{a}

Notes : Different superscript letters in the same column show a significant difference (P<0.05)

Table 4 shows that age groups have a noticeable effect on shell thickness, Haugh Unit value, yolk index, and albumen index (P < 0.05), but no real effect on yolk color (P>0.05). Shell thickness decreased with the increase in the lifespan of ducks, which decreased from 0.430 mm at 6 months of age to 0.349 at 15 months of age but again increased to 0.457 at 18 months of age. While HU values generally decrease with increasing duck age or production period, the highest HU is at 9 months of age (85.62), and the lowest HU is at 15 months of age (72.60). Similarly, the yolk index and albumen index in general decrease in value with increasing age of ducks. Yolk index is highest at 6 months old (0.43) and lowest at 18 months old (0.38). The albumen index is highest at 6 months of age (0.13) and lowest at 9 months of age (0.09).

IV. Discussion

Solihat *et al.* (2003) stated that egg production in ducks is influenced by feed, genetics, and the speed of genital ripening. Similarly, different levels of stress between individuals can affect egg production levels. The above is in accordance with the opinion [9]that the level of duck stress has an impact on egg production. The factors that determine egg production are genetics, nutrition, production age, cage type, maintenance system (extensive, semi-intensive, and intensive), and temperature[10].

The productivity rate of confined laying ducks is higher than that of grazed ducks because the quality of feed given is better. The egg production of Mojosari and Alabio cross ducks, known as MA ducks, reached 69.4%, or 253 eggs, for 365 days with good feed quality [5]. Meanwhile, Sulaiman & Basransyah (2022)reported that the egg production of Alabio ducks by giving 20% of duck weeds in the ration reached 47% with a feed conversion of about three at the age of 7-month-old ducks.

The average feed conversion ratio (FCR) during the study was 2.41–2.67, with an overall average of 2.51 (Table 5). The performance of the laying ducks in the present study was similar to the finding of Ketaren & Prasetyo (2001), who reported that the FCR of a crossbred duck between Mojosari and Alabio (MA) at 22 to 42 weeks of age was 2.88. While studying the feeding effect of diets containing different forms of duckweed for local ducks on their productive performance and egg quality or egg yolk pigmentation, the FCR was quite high, ranging from 5.31 to 7.65 [13].The smaller the conversion rate indicates that the feed used is more efficient, and vice versa[14].

In general, Alabio duck eggs are very popular, especially with the people of South Kalimantan, who value duck eggs more than chicken eggs. Alabio duck eggs are classified as *Tambak* (referring to the area where duck eggs are produced, TambakSirang Village, Banjar Regency) and *Pantai* (referring to the area where duck eggs are produced, Pantai Hambawang District, HST) duck eggs, distinguished by the size and degree of the yolk, where Tambak duck eggs are larger in size and have a more reddish yellow yolk[3].

Table 2 above shows that the average egg weight is 63–68 g and that the age of the ducks has a noticeable effect on the weight of the eggs. The older the female ducks get, the more they gain weight from their eggs. These results are in accordance with those reported by Sulaiman & Rahmatullah (2011), namely 63.80-66.38 g,, also that the egg weights of Bali Ducks and Alabio Ducks are relatively the same, where the egg weight of Alabio Ducks is 65.74 g, which is the normal weight of duck eggs, which is 60–70 g per egg. This is in accordance withThe National Standarization Agency (2008), egg weight is divided into 3 classes, namely large eggs weighing more than 60 g/egg, medium i.e. eggs weighing 50-60 grams/egg, and small i.e. eggs weighing less than 50 g/egg. Egg weight is significantly influenced by the hen's age, and it rises as the hen gets older[17]. Factors that affect egg weight, length, and width are the environment, the age of the hens, egg composition, and the egg-laying period [18].

The data from the research conducted showed that the average egg shape index of Alabio ducks was 0.78–0.79, which indicates a normal egg shape index. Okatama *et al.* (2018)stated that the egg shape index was obtained from the comparison of egg width and egg length with an index of 0.70–0.79, which was the normal range of the egg shape index. The length and width of an egg that determine the egg shape index are affected by genetics, the hen's age, feed, and season[18]. The egg will have a more rounded shape the higher the index, whereas the egg will have a more oval shape the lower the index.

In general, the yolk weight is 31.59–37.05% of the egg weight, and the albumen weight is generally 22.72 g (34.39% of the egg weight). This result is in accordance with Ismoyowati & Purwantini (2013),where

the yolk weight is 23,549 g and the albumen weight is 33.53 g. The yolk is formed for 10–12 days before the hen lays her eggs. The yolk weight ranges from 30–33% of the total egg weight [20]. The difference in egg white weight is due to differences in the ability of each duck to synthesize egg white [15]. The amount of egg white synthesis and secretion varies depending on the amount of egg white synthesis in each bird [22]. While the means of the yolk index and albumen index are 0.41 and 0.11, respectively, and there is a significant difference between ages, The yolk formation process produces different egg yolk weights depending on the genetic ability of each individual bird and nutrient consumption. In previous research Sulaiman & Rahmatullah(2011)found that the value of yolk index = 0.38 and albumen index = 0.13, similarly[23]found that yolk index = 0.37-.0.8 and albumen index = 0.10-0.11. Yolk index, value 0.35-0.42, and albumen index, value 0.050-0.174, are indicators of egg freshness (internal quality of eggs); the lower the index value, the lower the quality value of eggs; the index value is both influenced by temperature and storage time[24][10].

The shell thickness varied with age; Sulaiman & Rahmatullah (2011)found a shell thickness of 0.347–0.365 mm, and Sulaiman*et al.* (2022)) reported that the shell thickness was 0.382 mm (0.374–0.390), whileIsmoyowati & Purwantini (2013)found a shell thickness of 0.429 mm. Leach & Gross in Whittow (2000)described that the eggshell layer calcification is divided into three layers: the mammillary layer, the palisade layer, and the crystal surface layer. Differences in eggshell thickness in poultry are influenced by genetics, feed, age, and environmental temperature. Adult hens can only store a certain amount of calcium in the egg shell, and this amount is also influenced by genetics and the age of the bird [27].

The HU value is one of the criteria for determining the quality of the inner egg by measuring the height of egg albumin and egg weight. A high HU value indicates that the viscosity of the albumin is getting more intense. Albumin contains ovomucin, which plays a role in the binding of water to form an albumin gel so that albumin can be viscous. Albumin is even thicker if the ovomucin mesh is in large quantities and strong, so that the viscosity of the albumin becomes high. The higher the HU value, the higher the ovomucin, and the better the interior quality of the egg. The results of this study show that Alabio ducks have a good HU, and these results are emphasized by the opinion [28]that the HU value of newly issued eggs is worth 100, while the eggs with the best quality value are above 72, and rotten eggs are worth below 50.

The Haugh Unit in this study is about 72.60–85.62, generally lower than that obtained bySulaiman & Rahmatullah (2011)as well as in Alabio ducks, which is between 75.08–77.55 and reported by Ismoyowati & Purwantini (2013);the HU value of Alabio ducks is 78.06. HU is the freshness value of an egg, generally influenced by the length of storage and the egg storage environment. Haugh Unit (HU) is the quality of egg white (albumen), which is measured based on the height of the egg white and egg weight [29]. HU is a measurement method that can describe the quality of eggs as a whole [24]. The HU value is highly dependent on the freshness of the egg; the freshness of the egg can be seen from the height of the egg white. Albumen height and Haugh units decrease with storage time, and this decrease occurs more quickly at higher temperatures[10].

The results of the yolk color measurements in this study received a score of 14.90, almost 15. This value is the highest listed on the egg yolk color fan measuring instrument. The yolk score obtained in the study can explain why the yolk color of Alabio ducks has the highest value on the measuring instrument used. These differences are thought to be closely related to age and environmental factors, especially diet. Eggs are one of the poultry farming products that have complete nutritional content and are easy to digest. They contain animal protein sources in addition to meat, fish, and milk. In general, eggs consist of three main components: the eggshell (11% of the egg weight), albumen (57% of the egg weight), and yolk (32% of the egg weight)[30].

The yolk color of Alabio duck eggs, which is bright yellow leading to orange, is a yolk color that is appreciated by consumers. Yolk color in general is 14.97, while reported by Ismoyowati & Purwantini, (2013),the yolk color is 14.88, and is higher than what is founded which is in the range of 10.24–12.54. The color of the yolk in general is largely determined by the feed, which is rich in carotene and other pigments. Giving duckweed can increase yolk color in Alabio ducks (Sulaiman & Basransyah, 2022). Although consumer perception of egg yolk color is generally linked to geographical location, culture, and traditions, it is true that consumers in most parts of the world prefer deeply hued yolks. Yolk color in laying hens is primarily determined by the content and profile of pigmenting carotenoids present in their feed and can be easily adapted via feed ingredients [31].

Tuiskula-Haavisto *et al*. (2002)reported that the characteristics of egg production are influenced by genetics, which affects the age at first laying eggs, egg weight, and the number of eggs contained on the Z chromosome [32]. According to Roberts (2004), many factors affect the external quality of eggs (egg size, shell

weight, and shell thickness) and the internal quality of eggs (yolk color, albumen quality): strain, age, nutrition, consumption, disease, molting, stress, storage time, and also water quality.

V. Conclusion

Based on the results and discussion, it can be concluded that: The percentage of egg production was affected by the ages of Alabio ducks; the highest yield was at 9 months of age (87.60%) and the lowest at 18 months (47%), with an all-term first-period production average of 71.92%. The feed conversion ratio was affected by the ages of the Alabio ducks. The lowest FCR value was the 9-month age group (2.67) and the highest was the 18-month age group (4.64). The ages of the group have an effect on egg weight, egg shape index, yolk percentage, albumen percentage, percentage of eggshells, shell thickness, HU, yolk index, and albumen index, but have no real effect on yolk color. Overall, 9-month-old Alabio ducks produce the highest egg production, the lowest feed conversion, and the best egg quality in averages.

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