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Comparisons of Egg Quality Traits, Egg Weight Loss and Hatching Results between Chinese and Mamut Geese Eggs Reared under the Countryside Conditions

Research Article

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ABSTRACT

This study was carried out in order to comparisons of egg quality traits, egg weight loss and hatching results between Chinese and Mamut geese eggs reared under the countryside conditions in Kütahya province. For use in the experiments, eggs have taken from both Mamut and Chinese geese 38-44 weeks old. Animals reared extensive conditions (free-range production system) and were been not any special care or feeding has been applied in addition to the care and feeding in the rearing conditions. Male-female ratio was usually respectively 1/2-4, 1/3-5 in mamut and chinese geese. Laying period of both genotypies is early January, the eggs used in the research were obtained after 4 weeks from the first spawning time. The average egg yield of the flock were 35-40 eggs for each genotypes. Eggs were stored 12-16 ˚C temperature, 70-75% humidity under environment conditions 5-7 days until are put into the incubator. At the end of the research, Mamut geese egg quality criteria of egg weight (g), yolk color value, albumen index (%), eggshell thickness (mm), eggshell weight (g), haugh unit (%), eggshell ratio (%) (P<0,01), shape index (%), yolk index (%) (P<0.01) compare to Chinese geese eggs were found significant as statistical. Same way, Mamut geese egg weight loss (P<0.01) and hatching results of fertility (%), hatching chick weight. (g) (P<0.01), hatching performance (%) (P<0.05) compare to Chinese geese eggs were determined statistical values important. Taken together these results; Mamut geese eggs' can be said egg quality traits, egg weight loss, and hatching results statistically significant compare to Chinese geese eggs.

KEY WORDS Chinese goose, egg quality, egg weight loss, hatching results, Mamut goose.

INTRODUCTION

Poultry breeding is one of the most popular animal husbandry activities in Turkey as well as all over the world. Poultry breeding, such as especially layer hen and broiler, quail, goose, duck and turkey, is carried out in almost all regions. While extensive poultry farming consisting of a few chickens, geese, turkeys and ducks for domestic consumption is common in rural areas, new ones are increasing day by day to enterprises engaged in industrial production under intensive conditions. In Turkey, in the poultry sector are constituted hen about 99% of production (66% broiler, layer hen 33%), while the 1% of it geese, ducks, turkeys and other poultry are constituted too (TAGEM, 2018). Many factors are effective in staying goose breeding at such low levels in our country. The consumption of products obtained from geese was been limited to only the regions where they are grown. This situation shows that geese can not sufficiently introduced to consumers. In addition, our goose production has not reached the desired levels, as scientific studies on poultry breeding are mostly focused on chicken meat and eggs (Aral and Aydın, 2007; Akın and

Çelen 2020a). Geese are included in the Anser genus of the Anatidae family and were among the first poultry animals to be domesticated. The historical process of goose breeding BC. It dates back to 3000s and the studies made point to Egypt. Domesticated geese; it is possible to divide it into two parts as European origin geese and Asian origin geese. Of these, European origin, from wild Greylag geese (Anser anser), if Asian origin it is thought to have been rooted from wild Swan geese (anser cygnoides) (Pingel, 2011; Buckland and Guy, 2002). The majority of goose breeding in the world is made up of Asian countries with cold climates (more than 95%), and 99% of the production in the Asian continent also takes place in China (FAO, 2020).

In Turkey, goose breeding is carried out dominated cold climatic conditions regions, such as Northeast Anatolia, Central Anatolia and in the inner parts of Aegean regions (Akın and Çelen, 2020a; Tilki and İnal, 2004). Traditional breeding methods are applied in our regions where goose breeding is carried out. Extensive breeding method, consisting of 10-15 goose enough to meet the domestic family consumption, has been adopted. In this method, the chicks are grazed on the pasture until about 1 month before the slaughter phase after reaching the age of 1 month, and besides, they are fed with grain feeds consisting of wheat, barley, corn, and also fed bread and leftovers (Boz *et al.* 2017a; Boz *et al*. 2017b). In recent years, we see that farms have become widespread consisting of more than 500 geese on average in semi-intensive and intensive conditions, as well as extensive production according to the news in both local and national press.

In Turkey; the breeding of domestic geese consisting of black, gray, white and pied varieties is common in familial holdings consisting of a few geese herds. These geese tend to brood and are preferred as they do not require an hatcher for goose breeding. As the production capacity of the enterprises increases, they are started production under semi-intensive or intensive conditions. For this reason, goose breeds that do not have a tendency to brood, can reach high egg and meat yield in a short time and have a high tolerance level against adverse environmental conditions are in more demand by producers. In recent years, due to the high level of efficiency Chinese, Linda, Embden, Mamut geese, etc. It has been reported to breed in goose farms set founded with the support of various grants and loans in Turkey (Akın and Çelen, 2020b).

Mamut geese developed in Denmark as a Linda and tolouse hybrid are preferred by goose breeders in Russia, Belarus and Ukraine due to their superior yield performance. It is stated that the live weight of adult Mamut geese can reach 11-13 kg in males and 9-10 kg in females (Akın *et al*. 2020c). They are known as important commercial genotypes that do not tend to brood, can yield an average of 50 eggs and have a high post-hatching survival rate around 85% (Akın *et al*. 2020c). It is demanded by many breeders in our country due to stated their superior properties (Akın *et al*. 2020c).

These geese, whose homeland is China, brown and gray/white varieties are available. It is characteristic with its hilly on their heads and is one of the remarkable breeds in this respect. In these geese whose are mild breeds, weight are average 4.5-5.5 kg in adult males, 3.5-4.5 kg females. The biggest feature of the chinese geese is high egg production (50-60 eggs in one spawning period). In general, the egg weight is 120 g on average, and it is relatively low compared to other goose eggs is lighter (Saatçi *et al*. 2021).

Depending on the climatic conditions and the genotypes are grown in our country, the spawning period in geese generally lasts between December-April and in the Aegean region until the end of November-May (Akın and Çelen, 2020b).

During the specified periods, eggs are stored under suitable conditions (70-75% humidity and 12-16 ˚C) and natural or artificial incubation method is applied according to the hatching characteristics of the grown genotype. Eggs to be incubated must be free from various defects and deformities (dirty, cracked, too large-too small, sharp-blunt, etc.). At the same time, the quality characteristics (shell thickness, shape index, etc.) of the eggs to be used in incubation should be at the levels reported in previous studies.

With this research, it was aimed comparisons of egg quality traits, egg weight loss and hatching results between Chinese and Mamut geese eggs reared under the countryside conditions in Kütahya province.

MATERIALS AND METHODS

Feed rations

After the chicks are one month old, in addition to pasture grazing, goose feed provided by the commercial company, and also they were fed with such as bread, food scraps etc. The same feed was used for both geese genotypes and it was obtained from a private commercial company that sells geese feed. The ingredients and chemical analyses of the diets fed used in this study are given in Table 1.

Animals

The egg material of the research was procured from Taş goose farm, which is engaged in goose breeding in Büyüksaka Village, Central District of Kütahya Province. For use in the experiments, eggs have taken from both Mamut and Chinese geese 38-44 weeks old. Animals reared extensive conditions (free-range production system) and were been not any special care or feeding has been applied in addition to the care and feeding in the rearing conditions.

Table 1 Ingredients and chemical analyses of the diets

Feed materials	**g kg^{-1} as fed**
Barley	220
Maize	564
Cotton meal	100
Soybean meal	50
Calcium carbonate	10
Meat-bone meal	50
Vitamin*	2,5
Mineral**	1
Salt	2.5
Total	1000
Metabolizable energy (kcal/kg)	2965
Crude protein (g kg^{-1} as fed)	151

* Each kg of vitamin mix. contains: vitamin A: 15000000 mg; vitamin D_3: 3000000 mg and vitamin E: 3000 mg.
** Each kg mineral mix. contains: Mn: 60.000 mg; Fe: 60.000 mg; Zn: 50.000 mg; Cu: 15.000 mg; Co: 250 mg; I: 850 mg and Se: 500 mg.

Male-female ratio was usually respectively 1/2-4, 1/3-5 in mamut and Chinese geese. Laying period of both genotypies is early January, the eggs used in the research were obtained after 4 weeks from the first spawning time. The average egg yield of the flock were 35-40 eggs for each genotypes.

Experiment 1: **Determination egg quality traits**
Egg material of the experiment was obtained from geese aged 38-44 weeks. Eggs were stored 12-16 ˚C temperature, 70-75% humidity under environment conditions 5-7 days until are put into the incubator. Eggs belonging to each genotype were consisted of 30 eggs as 10 × 3, and thus a total of 60 eggs were used to determine the egg quality criteria of the experiment. The analysis of the egg quality criteria of the study was carried out in the student laboratories of Usak University Faculty of Agriculture. In determining the internal and external quality criteria of the eggs used in the research; egg weight, egg width-length, eggshell weight, eggshell thickness (sharp-equatorial-blunt), yolk color scale (roche yolk color range, 1-16), albumen and yolk height, albumen and yolk diameter were measured. First, the external quality criteria of the eggs were determined, then the eggs were broken and waited for 10 minutes in order to make the correct measurement, then the internal quality criteria were determined. The following formulas were used to determine the shape index (SIN) (1), yolk index (YIN) (2), albumen index (AIN) (3), Haugh unit (HU) (4) (Sharp and Powel, 1930; Heiman and Carver, 1936; Haugh, 1937; Reddy *et al.* 1979). Electronic scale with 0.1 g sensitivity were used to determine the weight of the eggs. Digital calipers were used for egg inside quality characteristics, albumen length, albumen diameter, yolk diameter and yolk height, while a tripod micrometer (1/100 mm sensitive) was used to determine the height of albumen and yolk. Micrometer was used to determine eggshell thickness.

By breaking the eggs, the shell membranes of the samples taken from the sharp, blunt and equatorial parts of the egg were also removed and the eggshell thickness was determined. The indices and the Haugh unit were calculated with the equations below.

(1) SIN= (Ewi (mm)/El (mm)) × 100
(2) YIN= Yh (mm)/Yd (mm)) × 100
(3) AIN= (Ah (mm) / (Al (mm)+Ad (mm)/2)) × 100
(4) HU= 100 log (Ah (mm)+7.57–1.7 Ewe (g)$^{0.37}$)

Where:
SIN: shape index
Ewi: egg width.
El: egg length.
YIN: yolk index.
Yh: yolk height.
Yd: yolk diameter.
AIN: albumen index.
Ah: albumen height.
Al: albumen length.
Ad: albumen diameter.
HU: Haugh unit.
Ewe: egg weight.

Experiment 2: **Determination egg weight loss and hatching results**
Experimental groups to determine egg loss weight and hatching results; eggs belonging to Chinese and Mamut geese randomly selected from the farm were divided into 3 replications according to the random parceling method. Eggs belonging to each genotype consisted of 105 eggs as 35 × 3, and thus a total of 210 eggs were used to determine the egg loss weight as individual each eggs and hatching results of the experiment. The analysis of the hatching results of the study was carried out in the student laboratories of Usak University Faculty of Agriculture.

The eggs used in the study were weighed and determined egg weights before they were placed in the incubator. The incubator is set at 37.7 ˚C temperature and 55% humidity.

No interferences were applied to the incubator and eggs in the first week of incubation. As of the 8th day of incubation, the cooling process was carried out at certain intervals; 8-14 day, 5 min. cooling and water spraying, 15-21 day, 15 min. cooling and water spraying, 22-28 day, 25 min. It was applied by cooling and water spraying (Boz, 2015). The hatcher values are set to have a temperature of 37.5 ˚C and a humidity of 75%. On the 29th day of incubation, the eggs were weighed again and the weight loss of the eggs was determined and the transfer process was carried out.

At the end of the incubation, the weights of newly hatched chicks first were determined, then the eggs that did not have any chicks were broken; Fertilezed-unfertilized eggs, under-shell mortality, early-mid-late period mortalities were detected. Using the results found; fertility, hatching performance, hatchability, the number of newly hatched chicks, hatching chick weight, early-mid-late period mortalities, external pip ratio values were determined (Elibol, 2009). The following formulas were used to determine the hatching results (Elibol, 2009).

Formulas:

(1) FE= (NFE) / (NEH) × 100
(2) HA= (NHC) / (NEH) × 100
(3) HP= (NHC) / (NFE) × 100
(4) EPM= (NEPM) / (NFE) × 100
(5) MPM= (NMPM) / (NFE) × 100
(6) LPM= (NLPM) / (NFE) × 100
(7) EPR= (NPPM) / (NFE) × 100

Where:
FE: fertility.
NFE: number of fertilized eggs at hatch.
NEH: number of eggs at hatch.
HA: hatchability.
NHC: number of hatching chicks.
HP: hatching power.
EPM: early-period mortalities.
NEPM: number of early-period mortalities chicks.
MPM: middle-period mortalities.
NMPM: number of middle-period mortalities chicks.
LPM: late-period mortalities.
NLPM: number of late-period mortalities chicks.
EPR: external pip ratio.
NPPM: number of external pip mortalities chicks.

Statistical analysis

Data were analyzed by conducting student's independent samples t-tests using SPSS version 20.0 for all comparisons between pairs of groups (SPSS, 2011). The percentage values were transformed to arcsines before statistical evaluation and $P < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

When Mamut geese eggs compare to Chinese geese eggs in regards to egg quality criteria egg weight (g), yolk color value, albumen index (%), eggshell thickness (mm), eggshell weight (g), Haugh unit (%) eggshell ratio (%) ($P<0.01$), shape index (%), yolk index (%) ($P<0.01$) there were found significant. Internal and external quality characteristics of Chinese and Mamut geese eggs statistical results are shown in Table 2.

Same way, Mamut geese egg weight loss ($P<0.01$) and hatching results of fertility (%), newly hatched chick weight (g) ($P<0.01$), hatching performance (%) ($P<0.05$) compare to Chinese geese eggs were determined statistical values important. Egg weight loss and hatching results of Chinese and Mamut geese eggs statistical results are shown in Table 3.

In studies on egg weight of geese, it has been stated that although the egg weight varies from genotype to genotype, the average egg weight is between 130-205 g and eggs between these values can be considered as hatching eggs (Selçuk *et al*. 1983; Puchajda *et al*. 1989; Puchajda *et al*. 1998). In a study in which the egg production of domestic geese in Kars was determined, it was reported that egg weight ranged between 155 and 168 g (Önk, 2009). Again, in a different study conducted in this city, it was stated that the average egg weight was 144.2-172.3 g, and the general average determined at the end of the study was around 154.9 g (Tilki and İnal, 2004). Average egg weight in White Italian × Cuban cross breed geese has been reported as 153 g (Mazanowski and Bernacki, 2006). In our study, the egg weights of Chinese and Mamut geese were found to be 140.70 ± 5.439 g and 153.72 ± 6.641 g, respectively, and Chinese goose egg weight was observed lighter than previous studies, but shown similarity with others studies on the domestic goose in Turkey (Arroyo, 1990; Tilki and İnal, 2004; Karabulut, 2021).

The lighter egg weight, it can be explained with geese are bred different regions and they have got difference olds. Since the eggs we used in our study were obtained from Chinese and Mamut geese, which were in the spawning period for the first time, they partially fell behind the values specified in other researches

Shape index is found nearly values both in two genotypies to other researches. In general, shape index values in geese were determined at 65.78%, 66.27% and 68.50% levels in previous studies (Saatçi *et al*. 2002; Tilki and İnal, 2004; Mazanowski and Bernacki, 2006).

Table 2 Internal and external quality characteristics of Chinese and Mamut geese eggs

Egg properties	Genotypes		P-value*
	Chinese goose	Mamut goose	
Egg weight (g)	140.70±5.439	153.72±6.641	0.001
Yolk color value	9.50±0.973	11.16±0.912	0.001
Shape index (%)	65.23±0.955	67.59±3.842	0.002
Yolk index (%)	36.14±1.975	37.83±2.165	0.002
Albumen index (%)	7.97±0.482	9.30±1.276	0.001
Eggshell thickness (mm)	0.58±0.012	0.60±0.011	0.001
Eggshell weight (g)	19.75±1.584	22.84±2.170	0.001
Haugh unit (%)	85.79±4.121	93.53±2.335	0.001
Eggshell ratio (%)	14.01±0.652	14.83±0.855	0.001

* ($P<0.05$).

Table 3 Egg weight loss and hatching results of Chinese and Mamut geese

Hatch properties	Genotypes		P-value*
	Chinese goose	Mamut goose	
Egg weight loss %	10.18±0.126	11.21±0.154	0.001
Fertility (%)	87.62±0.952	96.19±0.952	0.003
Hatchability (%)	60.00±1.649	71.42±3.299	0.036
Hatching power (%)	67.42±2.008	74.27±3.476	0.224
Hatching chick weight (g)	89.08±0.834	97.17±0.659	0.001
Early period mortality (%)	6.52±1.863	3.95±0.965	0.288
Middle period mortality (%)	3.27±0.053	4.96±1.011	0.288
Late period mortality (%)	14.12±1.011	10.90±1.044	0.091
External pip ratio (%)	8.67±1.003	5.92±1.672	0.230

* ($P<0.05$).

Shape index is found to be 65.23 ± 0.955%, 67.59 ± 3.842% respectively both in two genotypes, it is observed nearly values to other researches. Likewise albumen index (7.97±0.482%, 9.30±1.276%) and yolk index (36.14±1.975%, 37.83±2.165%) were observed similarity to other studies (Saatçi *et al*. 2002; Tilki and İnal, 2004). Again, the Haugh unit value 89.19% was determined in the same study, and that value was shown similarity our study for in Chinese goose 85.79 ± 4.121%, but it differed with Mamut goose 93.53 ± 2.335% (Saatçi *et al*. 2002).

It was announced the shell thickness of geese reared in Turkey was 0.520 mm (Tilki and İnal, 2004). The shell thickness of geese is considerably higher than that of other poultry (chicken 0.31-0.36 mm, turkey, 0.394 mm, quail, 0.16-0.23 mm) (Poyraz, 1989; Rahn and Paganelli, 1989; Soliman *et al*. 1994; Erişir *et al*. 1999; Şenköylü, 2001; Akın and Çelen, 2020d).

Shell thickness value has a significant effect on the gas exchange and material transition of the egg (Saatçi *et al.* 2002). As a matter of fact, it is not desirable for hatching eggs to be too thick or too thin for this reason. The fact that the shell thickness we determined for both genotypes in our study is higher than the specified value (0.58±0.012-0.60±0.011) may be due to the genotype difference or the excess calcium amount in the feed used by the breeder. In many previous studies, the shell weight of goose eggs was stated as 18.4-20.1 g, 20.37 g.

While the values of 19.75 ± 1.584 g in the Chinese goose we found in our study are found consistent with previous studies, and it was higher 22.84 ± 2.170 g in the Mamut. Shell rates were reported as 11.9-13.30% in domestic geese and 12.20% in White Italian × Cuban hybrid geese in previous studies. In our study, these values were found to be 14.01 ± 0.652% in Chinese goose and 14.83 ± 0.855% in Mamut goose (Saatçi *et al*. 2002; Tilki and İnal, 2004; Mazanowski and Bernacki, 2006). Differences in values found in studies; it may be caused by measurement errors, investigated genotypes be different, or different feeding conditions.

The yolk color value of the egg is not important in choosing the eggs to be incubated. As a result of the researches, it has been revealed that consumers generally prefer eggs when the yolk color value is around 10 (Gürbüz *et al.* 2003). As a matter of fact, the yolk color value was found close to the values specified in both also genotypes in our study (for Chinese goose, 9.50±0.973 for Mamut goose, 11.16±0.973). Shell rates were reported as 11.9-13.30% in domestic geese and 12.20% in White Italian × Cuban hybrid geese in previous studies. In our study, these values were found to be 14.80% in Chinese goose and 14.67% in Mamut goose (Saatçi *et al*. 2002; Tilki and İnal, 2004; Mazanowski and Bernacki, 2006). Many factors are effective in the difference the internal and external quality criteria of eggs from research to research.

Among these factors, the origin of the animal raised, age, feeding conditions, environmental interactions, etc. regardable (Arroyo, 1990; Tilki and İnal, 2004; Karabulut, 2021).

In this research, both genotypies 87.62 ± 0.952%, 96.19 ± 0.952% fertility respectively has been found and when compared to the other researches (72%, 71.7%, 60%, 62.97%, 71.43%, 72.37%, 76.74%, 61-72%, 42.54%, 47.25%) the results were occured higher (Faruga *et al.* 1999; Rosinski, 2002; Tilki and İnal, 2004; Saatçi *et al.* 2005; Peşmen and Yönetken, 2020). It has been stated that the hatchability, which is 75% on average in geese, can be realized at lower values if optimum conditions are not provided during the artificial incubation process (Tilki and İnal, 2004). Hatchability is determined both genotypes as 60.00 ± 1.649%, 71.42 ± 3.299 respectively for Chinese and Mamut geese were higher than many research values (%58, 9.38%, and 29.73%, 43.96%) stated (Arslan and Saatçi, 2003; Boz, 2015; Peşmen and Yönetken, 2020), but These results were lower some researches (81% to 90.25%) (Ramos *et al.* 1989; Golze, 1991; Toth, 1991).

Hatching power was observed in both genotypes as 68.49 ± 2.008 %, 74.27 ± 3.476 respectively for Chinese and Mamut geese were higher than geese bred in Kars and Aksaray provinces (24.73% and 10.6%, respectively) and but it was determined also higher (58-63%) than the hatching power average of three genotypes in Poland (Arslan and Saatçi, 2003; Kırmızıbayrak *et al.* 2016; Karabulut *et al.* 2017), but it was found lower to the hatching power for Armutlu, Başkuyu, Tatlıcak, INRA geese and for Afyonkarahisar local geese (76.74, 80.56, 80%, 84.91%, 80.55%) (Tilki and İnal, 2004; Peşmen and Yönetken, 2020). Differences in hatching power values are mainly due to hatching errors or conditions, as well as storage conditions. The differences in cooling, water spraying, temperature, humidity, and turning processes are effective during incubation (Akman and Yıldırım, 1995).

Hatching chick weight is determined both genotypes as 89.08 ± 0.834 g, 97.17 ± 0.659 g respectively for Chinese and Mamut geese and It was similar to many research values (Arslan and Saatçi, 2003; Kırmızıbayrak *et al.* 2016). Geese have a huge variations in EPM (0.0-8.9%) at hatching by different researchers have been put forward (Faruga *et al.* 1999; Tilki and İnal, 2004). It was not observed significantly between the two genotypes as statistical in EPM (6.52±1.863 and 3.95±0.965), MPM (3.27±0.053 and 4.96±1.011), LPM (14.12±1.011 and 10.90±1.044), and EPR (8.67±1.003 and 5.91±1.672) values (P>0.05). These results were shown similarity to the embryonic mortalities values such as EPM, MPM, LPM, and EPR stated in previous studies respectively (EPM; 3.7-6.2-8.0%, 6.58-3.45-7.55-8.93%, 7.92-0.85%), (MPM; 1.8-7.7-9.1%, 0.83-0.78%), (LPM; 6.2-8.6-9.4%, 2.63-6.90-3.77-0.00%, 7.71-5.06%), (EPR; 0.00-6.90-1.89-5.36%) (Bednarczyk and Rosinski, 1999; Tilki and İnal, 2004; Boz, 2015).

When we evaluate the findings of our study, which we conducted to comparisons of egg quality traits, egg weight loss, and hatching results between Chinese and Mamut geese eggs, in point of with the previous studies;

- Since the eggs of geese in the first laying period were used in our study, the egg weights were partially lighter than the values stated in previous studies.
- For the reasons explained; the length, width, eggshell weight, etc. of the eggs examined external quality criteria could be found to lower the values than in previous research. Therefore, it is thought that the eggs to be taken from both genotypes in the later spawning periods will be heavier and the egg length, width and eggshell weight used in determining the external quality criteria will be higher.
- Among the internal quality criteria of eggs, values such as yolk index, albumen index, yolk color value, Haugh unit were found close to those stated in previous studies.
- While fertility, hatchability, and hatching power values were found higher than many studies values, hatching chick weight and other hatching results such as EPM, MPM, LPM, and EPR were observed similarity to previous studies.

CONCLUSION

Chinese and Mamut geese have been started preferred in Turkey as in countries such as Russia and Ukraine in commercial goose breeding due to their superior performance, especially egg and meat yield. These geese can reach the marketable stage in a short time due to their high egg and meat yield performances. They have become one of the indispensable genotypes of commercial goose breeding in recent years due to their superior characteristics such as their suitability for artificial incubation and their high survival rate after hatching. Many goose breeders prefer Chinese geese for their eggs (it lay an average of 50 eggs), and Mamut geese for their meat yield (it can be reached 11-13 kg live weight) in Kütahya, Afyon, and Uşak provinces in the Aegean region. As a result of our study, it was observed that the egg weight loss, hatching results, and egg quality criteria of Chinese and Mamut geese raised in Kütahya were in line with the values in previous studies. As a result of our research, it has been concluded that future studies are needed to demonstrate the yield performance of Chinese and Mamut geese.

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