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Comparative Analysis of Egg Quality and Egg Laying Capacity of Different Quails

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ABSTRACT

A comparative analysis of egg quality and egg laying capacity of Korea quail, Beijing white quail and China yellow quail under same conditions was undertaken. Results demonstrated that egg weight, long end and egg shape index of Korean quail are significantly higher than those of Beijing white quail and China yellow quail (P<0.05). The short end, yolk height, yolk width and yolk weight of Korea quail and China white-feather quail are significantly higher than those of China yellow quail (P<0.05), the yolk index of China yellow quail is far higher than those of Korea quail and Beijing white quail (P<0.05), the protein height of Beijing white quail is greatly higher than those of ret two species (P<0.05). Based on comprehensive evaluation, the egg quality of Korea quail is better than those of other two species, egg production and laying rate of China yellow quail are significantly higher than those of Korea quail and Beijing white quail (P<0.05). The average egg weight of Korea quail is significantly higher than those of China yellow quail and Beijing white quail (P<0.05). The egg laying capacity of China yellow quail is better compared to other two species.

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Authors' Contribution
JYB conceived and designed the study and conducted the lab work. SY analyzed the data and wrote the article. YZP helped in sampling. XHW and GLL helped in analysis of data.

Key words
Quail, Egg quality, Egg laying performance, Egg shape index, Yolk index.

INTRODUCTION

Quail is the smallest birds in Galliformes and the ideal poultry with high egg laying. With small body size, big eggs, high laying rate, small fodders consumption, high growth rate, short cultivation time, low production cot and high economic benefits, quail possesses strong competition and bright development prospect. The egg white of quail eggs is particularly consistent and has extremely high biological valence, reasonable composition of essential amino-acids and rich microelements.

Quail is an excellent experimental animal and can be used in scientific experiments and studies of nutriology, histology, embryology, hemadenology, physiology, thremmatology, pharmacology and toxicology (Lin, 2006). It is an ideal animal model for biological safety evaluation. Moreover, it is a good material for genetic experiment (Song *et al*., 2001; Pang, 2001). Currently, researches on egg-laying quail mainly focus on growth and development (Pang *et al*., 2008), feather studies (Xu *et al*., 2012), slaughter performance (Li *et al*., 2015), microsatellite markers (Bai *et al*., 2016a, b; Wang *et al*., 2016) and functional genes (Bai *et al*., 2017). There are rare studies on quality of quail eggs; Bagh *et al*. (2016) analyzed the egg quality traits of Japanese quail with different plumage color. In this paper, egg quality and egg laying capacity of Korea quail, Beijing white quail and China yellow quail were compared and analyzed.

MATERIALS AND METHODS

Experimental materials

In this paper, 50 Korea quails, 50 Beijing white quails and 50 China yellow quails were cultivated in the experimental pasture. For each species, 10 quails were put in one cage, including five cages of each species. All quails were cultivated from Week 8 to Week 18. Eggs were collected at the fixed time every day. Numbers and weights were recorded. Egg quality of each species was tested every week by choosing 50 eggs.

Performance measurement

Longitudinal diameter, horizontal diameter and yolk width were measured by vernier caliper. Egg weight, egg white height, yolk height and yolk weight of quail eggs were tested by the egg quality testing system. Shell thickness of quail egg was tested by micrometer.

Analysis method

Two-way analysis of variance on egg quality of different quail species was carried out by using SPSS17.0. Species and age in weeks at egg laying were considered as the major influencing factors. Multicomple comparison was carried out by the Duncan method. The correlation analysis of egg quality was carried out by the correlation analysis module in SPSS software.

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RESULTS

Comparison of egg quality of different quail varieties

Comparative analysis results of egg quality of different quail species are shown in Table I. All egg quality properties except yolk height have significant differences among three species (P<0.05). The egg weight and long end of Korea quail are significantly higher than Beijing white quail and China yellow quail (P<0.05), egg weight and long end of Beijing white quail are far higher than compared to those of China yellow quail (P<0.05). The short end and yolk weight of Korea quail and Beijing white quail are significantly higher than those of China yellow quail (P<0.05). The Korea quail shows significantly higher egg shape index compared to Beijing white quail and China yellow quail (P<0.05). The yolk index of Korea quail and China yellow quail is far higher than that of Beijing white quail (P<0.05). Three species have significant differences in shell thickness and egg white height (P<0.05). Korea quail shows the highest shell thickness, followed by China yellow quail and Beijing white quail. Beijing white quail has the highest egg white height, followed by China yellow quail and Korea quail successively.

Comparative analysis of egg laying performance of different quail varieties

Comparative analysis results of egg laying capacities among three quail species are shown in Table II. Egg production and laying rate of China yellow quails are significantly higher than those of Korea quails and Beijing white quails (P<0.05). Egg production and laying rate of Korea quail are far higher than those of Beijing white quail (P<0.05). The feed-gain ratio of Beijing white quail is significantly higher than those of China yellow quail and Korea quail (P<0.05). Not significant differences of feed-gain ratio between China yellow quail and Korea quail are discovered (P>0.05). However, all three species have same variation trends in term of weekly egg production, average egg weight, laying rate and feed-gain ratio.

Correlation of egg quality and egg laying performance of quail

Table III shows that egg weight has an extremely significant negative correlation with yolk index (P<0.01), but has extremely significantly positive correlations with other egg quality properties (P<0.01). Correlation coefficients of egg weight with short end, yolk weight and long end are the highest, reaching 0.869, 0.795 and 0.794, respectively. Yolk height has extremely significant positive correlation with yolk index, showing a correlation coefficient of 0.864. Moreover, the yolk index is significantly negatively correlated with other egg quality properties. It can be seen from Table IV that egg production has an extremely significant positive correlation with laying rate, showing a correlation coefficient of 0.996.

Table I.- Comparison of egg quality of different quail varieties.

Egg quality	Beijing white quail	China yellow quail	Korea quail
Egg weight/g	10.90±0.04^{b}	10.73±0.04^{c}	11.24±0.04^{a}
Long end/mm	32.15±0.07^{b}	31.84±0.06^{c}	32.71±0.07^{a}
Short end/mm	25.23±0.04^{a}	25.05±0.04^{b}	25.33±0.03^{a}
Egg shape index	1.27±0.003^{b}	1.27±0.002^{b}	1.29±0.002^{a}
Yolk height/mm	8.44±0.04^{a}	8.38±0.03^{a}	8.37±0.04^{a}
Yolk width/mm	24.64±0.07^{a}	23.96±0.06^{b}	24.49±0.06^{a}
Yolk index	0.34±0.002^{b}	0.35±0.002^{a}	0.34±0.002^{b}
Yolk weight/ g	3.50±0.02^{a}	3.34±0.01^{b}	3.54±0.02^{a}
Shell thickness/mm	0.16±0.001^{c}	0.18±0.001^{b}	0.18±0.001^{a}
Egg white height/mm	1.86±0.02^{a}	1.72±0.02^{b}	1.65±0.02^{c}

The difference between the lowercase letters is significant (P<0.05), and the same alphabet is not significant (P>0.05).

Table II.- Comparative analysis of egg laying performance of different quail varieties.

Egg laying performance	Beijing white quail	China yellow quail	Korea quail
Egg production/number/week	3.6.68±0.23^{c}	5.91±0.18^{a}	4.75±0.18^{b}
Laying rate	52.70±3.23^{c}	85.65±2.23^{a}	68.57±2.35^{b}
Feed-gain ratio	6.45±1.55^{a}	3.08±0.14^{b}	3.84±0.27^{b}
Average egg weight/g	10.81±0.09^{b}	10.57±0.10^{c}	11.23±0.05^{a}

The difference between the lowercase letters is significant (P<0.05), and the same alphabet is not significant (P>0.05).

Table III.- Correlation coefficient between egg quality of quail.

Egg quality	Egg weight	Long end	Short end	Egg shape index	Yolk height	Yolk width	Yolk index	Yolk weight	Shell thickness
Long end	0.794**	1							
Short end	0.869**	0.485**	1						
Egg shape index	0.198**	0.730**	-0.242**	1					
Yolk height	0.244**	0.113**	0.223**	-0.049	1				
Yolk width	0.551**	0.490**	0.505**	0.148**	-0.129**	1			
Yolk index	-0.087**	-0.158**	-0.079**	-0.113**	0.864**	-0.606**	1		
Yolk weight	0.795**	0.658**	0.699**	0.180**	0.169**	0.689**	-0.214**	1	
Shell thickness	0.107**	0.048	0.044	0.016	-0.009	-0.067*	0.027	-0.017	1
Egg white height	0.183**	0.042	0.208**	-0.117**	0.385**	-0.04	0.329**	0.029	-0.083**

**, correlation coefficient is very significant (P<0.01); *, correlation coefficient is significant (P<0.05), and the other correlation coefficient is not significant (P>0.05).

Table IV.- Correlation coefficient of egg laying performance of quail.

Egg laying performance	Egg production	Laying rate	Feed-gain ratio	Avg. egg weight
Egg production	1			
Laying rate	0.996**	1		
Feed-gain ratio	-0.540**	-.546**	1	
Avg. egg weight	0.200*	0.164	-0.379**	1

**, correlation coefficient is very significant (P<0.01); *, correlation coefficient is significant (P<0.05), and the other correlation coefficient is not significant (P>0.05).

DISCUSSION

With respect to studies of quail egg quality, Wang *et al*. (2017) reported that the egg white height and Haugh unit of quails which are fed by basic diet with bacillus coagulants are significantly higher than the control group (P<0.01). Nuernisha *et al*. (2013) demonstrated that egg weight and egg shape index of quail can influence the hatching rate of fertile eggs significantly (P<0.01). Guo *et al*. (2003) argued that yolk index of quail eggs after fresh storage of refrigeration processing differ significantly with that of the control group (P<0.01). Egg weight is an important index to evaluate egg laying capacity and nutrient contents. It is sensitive to body weight of hens, age in days at egg laying, temperature in shank and fodder nutrients. In this paper, there are significant differences in egg weights among three quail species (P<0.05). Specifically, Korea quail shows the highest egg weight, Beijing white quail has moderate egg weight, and China yellow quail has the smallest egg weight. However, egg weight can only cause a slight impact on fertility rate of hatching egg, but it can influence the hatching rate of fertile eggs significantly (P<0.05) (Li *et al*., 2006). The egg shape index is positively correlated with the hatching rate (Nuernisha *et al*., 2013). In this paper, there's significant difference among three quail species in term of egg weight. The egg shape index of Korea quail is significantly higher than those of Beijing white quail and China yellow quail (P<0.05). In this experiment, these opinions have been proved in the hatching process. This is because the hatching rate of Korea quail in the hatching process is higher than rest two species, which might be related with egg shape index of Korea quail.

Yolk weight attracts more attentions of egg white processers. The higher the proportion of yolk is, the better the flavor and the richer the nutrients will be. In this paper, the yolk weight of Korea quail is significantly higher than that of China yellow quail (P<0.05). Although the tested value of yolk weight of Korea quail is slightly higher than that of Beijing white quail, not significant difference is observed (P>0.05). Consumers prefer to measure freshness of eggs by consistence of egg white. Consistence of egg white is one major index to evaluate egg white quality and is the main influencing factors of proteins. In this paper, egg white height of Beijing white quail is significantly higher than other two quail species. Shell thickness and strength are main indexes to measure shell quality. Shell thickness plays an important role in protecting integrity of eggs during egg collection, package, transportation and hatching. Wang *et al*. (2018) reported that among external egg qualities, shell thickness and shell proportion can influence the respiration intensity of eggs mostly. In this paper, significant differences of shell thickness are observed among three species (P<0.05), specifically, Korea quail has the highest shell thickness, followed by China yellow quail and Beijing white quail successively.

These changes of egg laying properties conform to research conclusions of Hu (2013). Korea quail has the highest average egg weight (11.232g). The average egg weights of Beijing white quail and China yellow quail

are significantly lower (P<0.05), valuing 10.819g and 10.570g, respectively. For laying rate, the peak laying rate of China yellow quail can reach over 90%. The laying rate of Beijing white quail is low, which is caused by the late egg laying. For average egg laying properties at Week 8~18, the laying rate and egg production of Beijing white quail are significantly lower than those of rest two species. The feed-gain ratio is negatively correlated with egg production, laying rate and average egg weight. Cao *et al*. (2010) reported that the yolk index of quail eggs has an extremely significant negative correlation with storage time.

CONCLUSION

In brief, Korea quail has big and weight eggs with thick shells, which is convenient for transportation. China yellow quail has small and light eggs with moderate shell thickness. Beijing white quail has moderate egg size and thin shell against transportation. Therefore, Korea quail is superior to rest two species with respect to egg qualities. Since China yellow quail has significantly higher egg production and laying rate compared to Korea quail and Beijing white quail, it is better than other two species in term of egg laying capacity.

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Statement of conflict of interest

Authors have declared no conflict of interest.

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