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Principal Component Analysis on Egg Quality Characteristics of Native Duck Breeds in China

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Abstract: In this study, results showed that study six indexes were synthesized two composite indexes by Principal Component Analysis (PCA) on egg quality characteristics of Chinese native duck breeds, the first 2 principal components accounted for 65.320% of total variation using principal component analysis. It represented the information of the original indicators.

Key words: Principal component analysis, egg quality characteristics, duck, indexes, variation

INTRODUCTION

China has a very rich genetic diversity of native poultry breeds. Domestic ducks (*Anas platyrhynchos domestica*) play a key role in the animal husbandry and agricultural economic sectors of China. There are numerous unique duck Chinese breeds and a few developing domestic breeds according to the 2012 systematic field investigation (He *et al.*, 2008). A total of 32 genetically diverse native Chinese duck breeds have been reported. Several factors can affect duck egg traits, including duck age, environment, genetics, nutrition and production cycle. It's well known that duck egg weight increase with duck age, reaching a plateau by the end of the laying cycle, poultry deposited proportionately more yolk into poultry eggs with increasing poultry production age (Onbasilar *et al.*, 2011). In order to study the influence factors of duck egg quality characteristics of native duck breeds in China, this study adopts the method of Principal Component Analysis (PCA) to get the key factors. It's a key problem to use the method of Principal Component Analysis (PCA) which is essential prerequisite to calculate the fuzzy measure (Cao *et al.*, 2012).

MATERIALS AND METHODS

Data: In this study, collected data consisted of 32 recorded native Chinses duck breeds from Animal Genetic Resources in China Poultry (China National Commission of Animal Genetic Resources, 2012). The investigated 32 duck breeds included Beijing duck, Gaoyou duck, Shaoxing duck, Chaohu duck, Jingding duck, Liancheng White duck, Putian Black duck, Shan Partridge duck, Chinese Muscovy duck, Duyu duck, Ji'an Red duck, Weishan Partridge duck, Wendeng Black duck, Huainan Partridge duck, Enshi Partridge duck, Jingjiang duck, Mianyang Partridge duck, Youxian Partridge duck, Liuwu duck, Guangxi Small Partridge duck, Jingxi Large Partridge duck, Longsheng Cui duck, Rongshui Xiang duck, Mawang duck, Jianchang duck, Sichuan Partridge duck, Sansui duck, Xingyi duck, Jianshui Brown duck, Yunnan Partridge duck, Hanzhong Partridge duck and Brown tsaiya. The recorded egg quality characteristics were egg weight, egg shape index, the intensity of the shell, shell thickness, haugh unit and the ratio of egg yolk. Statistical analysis were performed using the Software Package SPSS20.0 for Windows.

Principal Component Analysis (PCA): To study the effects of egg quality characteristics of indigenous duck breeds in China, datas were analyzed using the following statistical analysis method of Principal Component Analysis (PCA).

Principal Component Analysis (PCA) aims to composite information contained in a group of n observed variables by seeking a new group of orthogonal variables named PC which is calculated from the intrinsic of the correlation matrix (Macciotta *et al.*, 2010). The objective of Principal Component Analysis (PCA) is the reduction of the original variables into a limited number of hidden latent variables that are extracted to explain correlation among the observed variables, in addition to explain why the variables are correlated with each other (Pundir *et al.*, 2011; Sadek *et al.*, 2006). PC are extracted in a descending order of the corresponding eigenvalue that measures the contribution value of original variables explained by each PC (Macciotta *et al.*, 2010). The objective of Principal Component Analysis (PCA) is to explain the maximum portion of the variance present in the original group of variables with a minimum number of synthesize variables (Chester and Wrigley, 2008).

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Table 1: Mean and standard deviation of variants for Chinese native dcuk breeds

Traits	Egg weight	Egg shape index	The intensity of the shell	Shell thickness	Haugh unit	The ratio of egg yolk
Mean±SD	70.84±7.82	1.38±0.12	4.08±1.22	0.36±0.07	79.28±7.15	33.43±3.13

Table 2: Correlation coefficients between 6 variables of Chinese native dcuk breeds

Traits	Egg weight	Egg shape index	The intensity of the shell	Shell thickness	Haugh unit	The ratio of egg yolk
Egg weight	1.000					
Egg shape index	-0.189	1.000				
The intensity of the shell	0.063	0.613	1.000			
Shell thickness	0.123	0.811	0.566	1.000		
Haugh unit	-0.297	0.280	0.171	0.063	1.000	
The ratio of egg yolk	0.159	-0.211	0.104	-0.094	-0.275	1.000

Table 3: Total variance explained

	Component initial eigen values loading			Extraction quadratic sum		
Components	Total	Var. (%)	Cumulative (%)	Total	Var. (%)	Cumulative (%)
1	2.429	40.491	40.491	2.429	40.491	40.491
2	1.490	24.829	65.320	1.490	24.829	65.320
3	0.884	14.738	80.057	-	-	-
4	0.693	11.550	91.607	-	-	-
5	0.386	6.427	98.034	-	-	-
6	0.118	1.966	100.000	-	-	-

RESULTS

The results of mean and standard deviation of variants for Chinese native duck breeds are showed in Table 1 and 2, showed that the correlation coefficients between six variables of Chinese native dcuk breeds. The total variance explained and component initial eigen values loading by principal component analysis, eigen values and variation explained in Table 3. There were two factors extracted with eigen values >1 and accounted for 65.32% of total variance. In the present study, the first factor accounted for 40.491% of the variation out of the total of 6 original statistical value traits.

It was represented by significant positive high loading of egg weight (x_1), egg shape index (x_2), the intensity of the shell (x_3), shell thickness (x_4), haugh unit (x_5) and the ratio of egg yolk (x_6). y_1 and y_2 are new principal component, then the first principal component and the second principal component, as follows:

$$y_1 = -0.122x_1+0.942x_2+0.768x_3+0.860x_4+0.383x_5-0.227x_6$$

$$y_2 = 0.714x_1-0.024x_2+0.312x_3+0.298x_4-0.645x_5+0.614x_6$$

The correlation coefficient (absolute value), the greater the principal component of the greater the representative of the variable. The correlation coefficient (absolute value) egg shape index (x_2), shell thickness (x_4), the intensity of the shell (x_3) were 0.942, 0.860, 0.768, respectively.

DISCUSSION

In this study, there were two factors extracted with eigen values >1 and accounted for 65.320% of total variance. In the present study, the first factor accounted for 40.491% of the variation out of the total of 6 original statistical value traits. It was represented by significant positive high loading of egg weight, egg shape index, the intensity of the shell, shell thickness, Haugh unit, the ratio of egg yolk.

CONCLUSION

In the present study six indexes were synthesized two composite indexes by Principal Component Analysis (PCA), the cumulative contribution rate of 2 eigen values accounted for over 65.320% of total variation basically, it represented the information of the original indicators.

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