PATH ANALYSIS ON WEIGHT, BODY DIMENSION AND EAR TYPE OF SAIBEI RABBITS

Wu Zhan-fu[1]*, Ma Xu-ping[1], Tian Shu-fei[1], Wu Shu-qin[1], Li Cun-xin[1], Guan Li-hui[1], Li Wen-hai[2], Wang Hai-yun[2]
(Correction by Liang Chang-ming[1])

[1]Department of Animal Science, Hebei North University, Zhangjiakou, Hebei 075000, China
[2]Rabbit Breeding Farm of Chicheng County Zhangjiakou city, China
*Corresponding author: wuzhanfu8808@126.com

ABSTRACT

Weight, body dimension and ear type were studied on 105 six-month Saibei rabbits by path analysis. The results showed that the correlation coefficients between six-month weight on one hand and body length, chest girth, ear length, ear width on another hand were respectively 0.730, 0.736, 0.465 and 0.354. Path coefficients for them were 0.526, 0.535, 0.264, -0.148. The summation of the determination coefficients was 0.849, and the error coefficient was 1-0.849 by analyzing the determination coefficients. The best multiple linear regression equation for Saibei rabbits was established

Key Words: Saibei rabbits, Weight, Path analysis, Multiple-regression.

INTRODUCTION

Saibei rabbit is a huge rabbit with fur (Wu Shu-qin *et al.*, 2005) and meat (Yang Zheng and Wu Zhan-fu, 1993) of top quality which was from crossbreed of French Buck rabbits and Belgian Flemish Giant rabbits. It is of large size, fast growing, powerful breed, great adaptability, strong disease-resistant, etc (Yang Zheng, 2001), (Yang Zheng *et al*., 1996), Saibei Rabbits have become one of the most popular rabbit varieties. Many factors can influence adult weight, which is one of main economic characters of Saibei rabbits. Many data indicated that body length, chest girth were highly related to body weight. Saibei rabbit's unique ear type is one of distinctive characters from other rabbits. As this research was part of Saibei rabbits' breeding study, the ear type was regarded as a factor which would be related to its body weight. Path analysis was used to study the relationships of body length, chest girth, ear length, ear width with 6-month weight. The best multiple linear- regression provided the theoretical basis of Saibei rabbits' breeding.

MATERIALS AND METHODS

During 2003-2004, under the same conditions, 105 six-month Saibei rabbits weight (Y), body length (x_1), chest girth (x_2), ear length (x_3), ear width (x_4) were measured in Animal Science Department Breeding Farm, Hebei North University. Path analysis (Ming Dao-xu, 2003), put forward by S. Wright, is an extension of the regression model, which is used to test the fit of the correlation matrix against two or more causal models which are being compared. By path analysis, correlation coefficients between traits were further divided into direct effect and indirect effect to make traits clearer. It is widely used in the field of animal breeding. The data were analyzed by means of SPSS software (Chen Ping-yan, 2000).

RESULTS

The basic data of Saibei rabbits are reported in Table 1. Phenotypic correlation coefficient matrix and the significant test are reported in Table 2 and Table 3.

Table 1: Analysis of Some Saibei rabbits traits

Traits	mean	Standard deviation	Coefficient of variation
Weight (kg)	4.6329	0.4752	10.26
Body length (m)	0.4837	0.0340	7.03
Chest girth (m)	0.3650	0.0223	6.11
Ear length (m)	0.1557	0.0123	7.90
Ear width (m)	0.0872	0.0075	8.60

Table 2: Phenotypic correlation coefficient matrix

Traits	Body length	Chest girth	Ear length	Ear width	Weight
Body length (x_1)	1	0.305**	0.298**	0.260**	0.730**
Chest girth (x_2)	0.305**	1	0.309**	0.278**	0.736**
Ear length (x_3),	0.298**	0.309**	1	0.820**	0.465**
Ear width (x_4)	0.260**	0.278**	0.820**	1	0.354**

Note:**Significance at the α<0.01 level; *Significance at the α<0.05 level

Table 3: Analysis of ANOVA for data

Variation source	Sum of square	Degrees of freedom	Mean Square	F
Regression	19.928	4	4.982	140.113**
Residual	3.556	100	0.036	
Total	23.484	104		

Note:**Significance at the α<0.01 level; *Significance at the α<0.05 level

From phenotypic correlation coefficient matrix, body length, chest girth, ear length, ear width had significant positive correlation with six-month weight by ANOVA analysis (P<0.01).

Path analysis

According to path analysis principle, path coefficients were as follows: p_1=0.526, p_2=0.535, p_3=0.264, p_4=-0.148 by simultaneous equations. To illustrate the relationships among traits, correlation coefficient was subdivided into direct effect and indirect effect (Table 4).

Table 4: Analysis of Direct Effect and Indirect Effect

Traits	Correlation coefficient (r_{iy})	Direct effect	Indirect effect				
			Body length	Chest girth	Ear length	Ear width	Total
Body length (x_1)	0.730**	0.526		0.163	0.079	-0.038	0.204
Chest girth (x_2)	0.736**	0.535	0.160		0.082	-0.041	0.201
Ear length (x_3),	0.465**	0.264	0.157	0.165		-0.121	0.201
Ear width (x_4)	0.354**	-0.148	0.137	0.149	0.216		0.502

Note: **Significance at the α<0.01 level; *Significance at the α<0.05 level

The conclusion was made from Table 4:

1. The correlation coefficient was 0.736 (r) between chest girth (X_2) and Saibei rabbits' weight (Y). Direct effect was 0.535 and indirect effect was 0.201. Above data showed that the coefficient degree was great and the direct effect was dominant. So the chest girth was treated as a forecast index on Saibei rabbits' weight in its selection.

2. The correlation coefficient was 0.730 (r) between body length (X_1) and Saibei rabbits' weight (Y). Direct effect was 0.526 and indirect effect was 0.204. The data showed that body length was also a forecast index on weight in its selection.

3. The correlation coefficient was 0.465 (r) between ear length (x_3) and Saibei rabbits' weight (Y).

Direct effect was 0.264 and indirect effect was 0.201. The data showed that ear length was also a forecast index on weight in its selection.

4. The correlation coefficient was 0.354 (r) between ear width (X_4) and Saibei rabbits' weight (Y). Direct effect was –0.148 and indirect effect was 0.502. It was shown that the correlation coefficient between ear width and Saibei rabbits' weight effected indirectly through chest girth (X_2), body length (X_1) and ear length (x_3) on its weight.

The results of path analysis indicated how the independent variables influenced the dependent variable indirectly and directly, and explained the reason of correlation between characters. Wrong conclusion and wrong selection could arise if based on phenotype correlation only.

Calculation of decision coefficients and establishment of a preliminary regression equation

Determination coefficients of any independent variable's and two independent variables' interaction to Saibei rabbits' weight (Y) were as follows:
$d_{y,x1}$=0.277, $d_{y,x2}$=0.286, $d_{y,x3}$=0.070, $d_{y,x4}$=0.022, $d_{y,x1,x2}$=0.172, $d_{y,x1,x3}$=0.083, $d_{y,x1,x4}$=-0.040, $d_{y,x2,x3}$=0.087, $d_{y,x2,x4}$=-0.044, $d_{y,x3,x4}$=-0.064

According to the path analysis principle, the sum of determination coefficients added by the determination coefficient of error is 1. The sum of determination coefficients was: $\sum d=0.849$. And the determination coefficient of error was 1- $\sum d$=0.151. The regression equation was:
$\hat{y}=7.345x_1+11.416x_2+10.228x_3-9.325x_4-3.865$

The regression correlation of the equation was significant by means of t test ($P<0.05$). The regression equation remained much more effective ($\sum d=0.849$).

Deletion of less significant character

When the multiple linear regression relation by means of significant test was significant ($P<0.05$), the significant test must be carried out to each partial regression coefficients, so it can be judged the significance of each independent variable and delete the less significant independent variables to establish more simplified optimum linear regression equation. Among path coefficients, p_4 is the smallest, though significant and it can be deleted because the result of t test was not extremely significant (P=0.032). Path coefficients were calculated again: p_1=0.524, p_2=0.532, p_3=0.145. Though p_3 was the smallest, it cannot be deleted because the result of t test was extremely significant (P=0.001).

Calculation of determination coefficient again and establishment of optimum linear regression equation

$d_{y,x1}$=0.274, $d_{y,x2}$=0.0283, $d_{y,x3}$=0.021, $d_{y,x1,x2}$=0.170, $d_{y,x1,x3}$=0.045, $d_{y,x2,x3}$=0.048

The sum of determination coefficient was $\sum d=0.841$. The difference was small between the sum of determination coefficient before deleting p_4 and that after deleting it. The deletion of p_4 had no distinct effect on the regression equation accuracy. The optimum linear regression equation was:
$\hat{y}=7.321x_1+11.341x_2+53594x_3-3.918$.

The regression correlation of the regression equation was extremely significant ($P<0.01$). The more simplified regression equation remained much more effective ($\sum d=0.841$).

DISCUSSION

1. From the results of path analysis and correlation analysis, the correlation coefficients between characters indicated that there was a positive correlation between body length, chest girth, ear length, and ear width and 6-month weight. The correlation coefficients between chest girth, body length, ear length, ear width and 6-month weight was 0.736, 0.730, 0.465 and 0.354 respectively.

2. Considering the unique Saibei rabbits' ear type, body length, chest girth, ear length, ear width were selected and carried out by path analysis with 6-month weight. These traits were used to evaluate the body weight of Saibei rabbits. The sum of determination coefficient was 0.849, which indicated the major factors influencing Saibei rabbits' 6-month weight were found. The regression equation consisting of these characters had higher reliability.

3. Ear width was deleted during path coefficient calculation because it had indirect effect on weight, and the direct effect was negative (-0.148).

4. The regression equation indicated the correlation of body length, chest girth, ear length, ear width and weight, and applied theory direction for three strains of Saibei rabbits' breeding.

5. The determination coefficient decreased from 0.849 to 0.841which had no influence on regression equation accuracy degree, but made calculation process simplified.

6. The optimum regression equation had higher accuracy because the sample size is large. This equation had wider application scope and greater practical value.

REFERENCES

Chen Ping-yan 2000. SPSS Software Applied Programming. *Beijing. People's Military Medical Press, 153-159.*

Ming Dao-xu 2003. Biometry and Experimental Design (the 3rd edition). *Beijing. China Agricultural Press, 102-210.*

Wu Shu-qin, Sun Jie-feng, Ma Xu-ping 2005. Primary report on wool quality of Saibei rabbit. *Chinese Journal of Rabbit Farming, 2, 23-25.*

Yang Zheng, Wu Zhan-Fu, Wu Fu-Chang 1996. The Primary Estimation Heritabilities of Several Main Characters in Saibei Rabbits. *In: F. Lebas. Proc. 6th World Rabbit Congress, Toulouse, France, 389-391.*

Yang Zheng, Wu Zhan-fu 1993. The Macroscopic Features and the Growth Law of Saibei Rabbits. *Chinese Journal of Rabbit Farming, 3, 37-38.*

Yang Zheng 2001. Technology of Raising Saibei Rabbits. Beijing. *China Agricultural Press.*