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Short Communication

Correlation Analysis between Exon 4 of ESR1 Gene and Carcass Traits in Egg Quail

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Authors' Contribution
JYB conceived and designed the study and conducted the lab work. ZHD and ZHL analyzed the data and wrote the article. XNL helped in sampling. HRG helped in analysis of data.

Key words
Egg quail, Estrogen receptor gene (ESR), Correlation analysis, Carcass traits, SNP

ABSTRACT

The purpose of this study was to investigate the effect of estrogen receptor gene (ESR1) polymorphism on the carcass traits of laying quail. The polymorphism of ESR1 gene exon 4 in three laying quail populations was detected by PCR product sequencing, and the correlation between ESR1 gene and carcass traits of laying quail was analyzed. The results show that, Exon 4 of ESR1 gene among Beijing white quail, the pectora weight and pectoral muscle rate of CC genotype was significantly higher than that of CT and TT genotype(P<0.05). Among Korean quail, the body weight and carcass weight of CC genotype were significantly higher than that of CT and TT genotype(P<0.05). It was found that exon 4 of ESR1 gene was significantly associated with body weight, carcass weight, pectora weight, pectoral muscle rate of egg quail(P<0.05).

In recent years, the research of molecular marker genetic breeding is being developed, which has became an emerging technology for the breeding and improvement of quail varieties. Bai *et al*. (2016a, 2016b, 2016c, 2016d, 2017) Analyzed the polymorphism of quail population by using microsatellite markers and EST-SSR markers. Zhang *et al*. (2013) research shows that, the expression of MC1R was higher in black plumage quails than that in maroon plumage quails, whereas the expression of ASIP was higher in maroon plumage quails than that in black plumage quails Bai *et al*. (2019, 2016d). It is concluded that the black plumage colour in Japanese quails may be caused by either increased production of MC1R or decreased production of ASIP. Li *et al*. (2019) indicated that the black plumage color may be caused by increased production of MC1R and the white plumage color may be caused by increased production of ASIP in Japanese quail. Rasul *et al*. (2019) analyzed the effects of different anti stress agents on the growth and meat quality of Japanese quail. Sanches *et al*. (2019) analyzed the cashew shell technology in the diet of meat quail. ESR gene, which is also called estrogen receptor gene, is a kind of nucleic acid receptor in the family of activated transcription factors which is combined with specific hormone response DNA element. Many scholars have carried out the research work of ESR1 gene in human, pig, chicken, cattle, sheep, guinea pig, etc., but the correlation analysis between ESR1 gene and carcass traits of quail has not been reported. Therefore, in order to provide a reference for marker-assisted selection of quails, the association of exon 4 of ESR1 gene with carcass traits was analyzed by using sequencing technology technique with egg quail as experimental animals.

Materials and methods

In this experiment, egg quails were 50 China quails with yellow feathers, 50 Beijing quails with white feathers and 50 Korean quails. All egg quails were females. Blood samples (5ml each) were collected at vein in wings and stored in heparin sodium anticoagulant tubes which were then kept in a refrigerator under -20°C. DNA was extracted by poultry whole blood DNA kit and kept under -20 °C.

Primers at exon 4 of ESR1 gene were designed with references to the design of Pu (2016), The primer sequence is as follows: F:CGGGCGAATGATGAAACA, R: CCCAGTTGATCATGTGCA, Size is 301bp. Primers were synthesized by Beijing Dongguo Changsheng Biotechnology Co., Ltd. Pre-denaturation at 94°C for 4 min, then denaturation at 94°C for 40 s, annealing at 58°C for 1 min, annealing at 72°C for 20 seconds, denaturation, annealing and elongation were carried out for 35 cycles, then elongation at 72°C and finally the reaction was completed and cooled and preserved at 4°C. PCR products are directly sent to Zhengzhou Dingguo biology Co., Ltd. for sequencing.

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SPSS 17.0 statistical software was used to analyze the association between different genotypes and body size traits, and Duncan multiple comparison method was used to make multiple comparison. The final results were expressed in the form of mean value ± standard error.

Results and discussion

The results of PCR product detection for exon 4 of ESR1 gene were shown in Figure 1, and it can be seen that the detection results are all single band, and the size of exon 4 of ESR1 gene is consistent with the target fragment, which indicate that the quality of PCR amplification products is well up to standard. The PCR amplification products of all individuals of exon 4 of ESR1 gene were sequenced and the sequencing results were shown in Figure 2, it can be seen that in the Exon 4 of ESR1 gene, one SNP site is C50T, and three genotypes were detected.

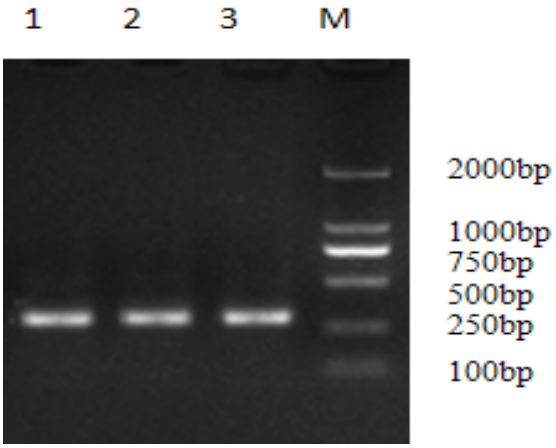

Fig. 1. Detection of PCR products of exon 4 of ESR1 gene. Note: m is DL2000 marker, 1 is Chinese Yellow quail, 2 is Beijing white quail, 3 is Korean quail.

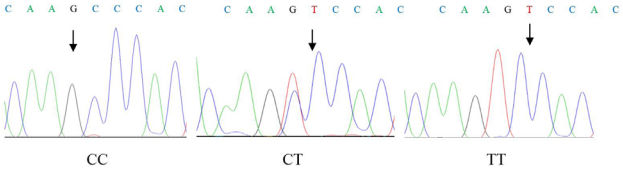

Fig. 2. Detection of SNP locus in exon 4 of ESR1 gene.

Three genotypes, CC, CT and TT, were detected in exon 4 of ESR1 gene in three quail populations, the frequency of CC genotype of ESR1 gene exon 4 was 0.273, 0.667, 0.106, and that of CT genotype was 0.318, 0.235, 0.277 and that of TT genotype was 0.409, 0.098, 0.617, respectively. The frequencies of exon 4 of ESR1 gene of T allele in China yellow quail and Korean quail were the highest (0.568, 0.755, respectively), the frequencies of exon 4 of ESR1 gene of C allele in Beijing white quail was as high as 0.784. This finding was similar to the results of Pu (2016).

The results of correlation between ESR1 exon 4 and carcass traits of quail are shown in Table I. It can be seen that Exon 4 of ESR1 gene had no significant effect on the slaughter traits of China yellow quail ($P>0.05$). Among Beijing white quail, the pectora weight and pectoral muscle rate of CC genotype was significantly higher than that of CT and TT genotype ($P<0.05$), and this rate had no significantly effects on other slaughter traits ($P>0.05$). Among Korean quail, the body weight and carcass weight of CC genotype were significantly higher than that of CT and TT genotype ($P<0.05$), and this had no significant effect on other slaughter trait ($P>0.05$). It was found that exon 4 of ESR1 gene was significantly associated with body weight, carcass weight, pectora weight, pectoral muscle rate of egg quail ($P<0.05$). Liu *et al.* (2017) indicated in their studies that Large White pigs of AB and BB genotypes of ESR gene produced superior total litter size and total living piglets than pigs of AA genotypes, although the differences were not statistically significant. They found that multiparous sows of BB genotypes had their total litter size and healthy piglets even 0.12 heads and 0.07 heads more respectively than that of AA genotypes, with the differences not statistically significant. Tan (2015) detected 4 SNPs in the first Exon of ESR gene in Jiaxing black pigs, but the HH genotype in A7188G locus was the only one that had litter size and total living piglets of greater than those by JJ genotype, in addition to its produced dead fetus and, in case of living piglet, the birth weight more than that by JJ genotype. As to the rest of the traits, no significant difference was observed among the various genotypes. Liu (2016) suggested that there was notable divergence in the total litter size, number of living piglets and birth weight between Jinhua sows of GG genotype and GA genotype of ESR gene. Wu (2013) carried out researche with female line of Shaobo Chicken and then found some polymorphisms at the 5' lateral of ESR gene, and the egg yields of 43 weeks by pigs of EE and EF genotypes both were higher than that by FF genotypes. As demonstrated in this study, exon 4 of ESR1 gene went significantly correlated with the body weight, carcass weight, pectora weight, pectoral muscle rate of egg quails.

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Table I. Correlation analysis between ESR1 gene exon 4 and carcass traits of laying quail.

Carcass traits	Beijing white quail			Chinese yellow quail			Korean quail		
	CC	CT	TT	CC	CT	TT	CC	CT	TT
Weight(g)	139.195± 2.347^{a}	133.167± 3.621^{a}	135.500± 2.513^{a}	136.457± 3.412^{a}	134.527± 4.275^{a}	144.408± 2.156^{a}	160.240± 3.562^{a}	144.400± 4.051^{b}	143.525± 3.626^{b}
Slaughter weight(g)	133.450± 2.315^{a}	127.789± 3.023^{a}	129.500± 2.672^{a}	130.929± 3.165^{a}	129.464± 4.023^{a}	139.408± 2.512^{a}	156.860± 3.512^{a}	140.811± 4.451^{b}	139.544± 3.497^{b}
Eviscerated weight(g)	84.725± 1.324^{a}	80.356± 2.583^{a}	85.400± 2.401^{a}	87.814± 1.634^{a}	86.591± 3.142^{a}	93.400± 1.946^{a}	99.860± 2.832^{a}	91.000± 3.801^{a}	92.713± 3.740^{a}
Heart weight(g)	1.020± 0.052^{a}	0.978± 0.0632^{a}	1.200± 0.0542^{a}	1.071± 0.097^{a}	1.109± 0.068^{a}	1.125± 0.048^{a}	1.180± 0.124^{a}	1.122± 0.046^{a}	1.006± 0.037^{a}
Liver weight(g)	3.930± 0.153^{a}	3.933± 0.183^{a}	4.300± 0.152^{a}	3.700± 0.393^{a}	3.500± 0.283^{a}	3.883± 0.214^{a}	5.380± 0.629^{a}	5.800± 1.452^{a}	4.138± 0.137^{a}
Pectora weight (total)(g)	28.860± 0.732^{a}	25.122± 0.934^{b}	26.000± 0.823^{b}	26.886± 1.235^{a}	26.427± 1.423^{a}	29.425± 0.965^{a}	30.340± 1.839^{a}	28.533± 1.976^{a}	29.425± 1.216^{a}
Leg muscle weight (single)(g)	7.195± 0.148^{a}	7.178± 0.381^{a}	7.800± 0.210^{a}	7.314± 0.371^{a}	7.445± 0.324^{a}	7.667± 0.221^{a}	8.020± 0.174^{a}	7.578± 0.321^{a}	7.519± 0.292^{a}
Slaughter rate(%)	95.863± 0.135^{a}	95.955± 0.159^{a}	95.572± 0.145^{a}	95.966± 0.176^{a}	96.203± 0.183^{a}	96.515± 0.214^{a}	97.884± 0.103^{a}	97.510± 0.299^{a}	97.233± 0.140^{a}
Eviscerating percentage(%)	60.933± 0.591^{a}	60.403± 1.404^{a}	63.026± 0.743^{a}	64.502± 1.265^{a}	64.432± 1.084^{a}	64.768± 1.217^{a}	62.369± 1.707^{a}	63.010± 1.826^{a}	64.356± 1.177^{a}
Heart rate(%)	1.211± 0.063^{a}	1.217± 0.068^{a}	1.405± 0.061^{a}	1.217± 0.100^{a}	1.285± 0.064^{a}	1.207± 0.049^{a}	1.176± 0.100^{a}	1.243± 0.054^{a}	1.103± 0.047^{a}
Liver rate(%)	4.659± 0.188^{a}	4.936± 0.269^{a}	5.035± 0.192^{a}	4.232± 0.463^{a}	4.029± 0.262^{a}	4.172± 0.265^{a}	5.379± 0.562^{a}	6.740± 0.324^{a}	4.575± 0.244^{a}
Pectoral muscle rate (total)(%)	34.013± 0.550^{a}	31.276± 0.647^{b}	30.445± 0.598^{b}	30.654± 1.382^{a}	30.429± 0.819^{a}	31.481± 0.714^{a}	30.475± 1.998^{a}	31.080± 1.001^{a}	31.812± 0.624^{a}
Leg muscle ratio (single)(%)	16.991± 0.251^{a}	17.858± 0.630^{a}	18.267± 0.432^{a}	16.647± 0.709^{a}	17.179± 0.419^{a}	16.417± 0.322^{a}	16.133± 0.699^{a}	16.682± 0.365^{a}	16.253± 0.204^{a}

Statement of conflict of interest

The authors have declared no conflict of intesest.

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