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Discovery of SNP in exon 14 of the *ADD1* gene and its association with fatness traits in four meat-type duck populations (Brief Report)

Detektion von SNP im Exon 14 des *ADD1* Gens und seine Assoziation mit Fettmerkmalen bei vier Mastenten-Populationen (Brief Report)

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Background

Fatness traits are important economically traits in meat producing animals including duck (WU *et al.* 2008a, b). In human, the *α-Adducin* (*ADD1*) gene polymorphism was associated with blood pressure and other subsequent negative effects related to obesity, cardiovascular and renal failure. In fact, there was some relationship between obesity and hypertension. Thus the *ADD1* gene is a candidate gene for fatness traits and the study aims to invest the relationship between the polymorphism of the *ADD1* gene and fatness and growth traits.

Procedures

The chicken *ADD1* gene sequence (NM_001079730.1) was used for primer design (GSP1-F, 5′-AAA GGA GGA AGG GAG ATG-3′ and GSP1-R, 5′-GGA CTT TCC TG GAG ATT C-3′) and SNP discovery. PCR program: 4 min at 95 °C, 33 cycles of 30 s at 95 °C, 30 s at 54 °C and 30 s at 72 °C and final extension at 72 °C for 10 min. PCR reactions were carried out in total volumes of 15 µL with 40 ng of genomic DNA, 0.5 pmol of each primer, 1.5 µL 10×buffer, 1.5 mM $MgCl_2$, 0.25 mM dNTPs and 1.5 U *Taq* DNA polymerase.

The population we used for SNP identification in *ADD1* exon 14 were Z2 (maternal line), Z4 (paternal line), hybrid lines of Peking duck and selected Cherry Valley duck (in total 377 individuals). All birds were raised in floor pens and fed commercial corn-soybean diets that met NRC requirements, and were slaughtered at 8 weeks of age. Carcass weight, eviscerated weight, breast muscle weight, leg muscular, abdominal fat weight (AFW), subcutaneous fat plus skin weight (SFW) and intramuscular fat (IMF) were measured. Three PCR fragments from different SSCP patterns in different populations were subcloned into T-vectors (*TianGen*) and sequenced. Sequencing reactions were performed using BigDye Terminator chemistry and resolved on an *ABI PRISM 3730* DNA sequencer. Association analyses between the SNPs and traits in 377 ducks were performed using *SPSS13.0* with the following model:

$$Y=\mu+G+L+G\cdot L+e \quad (1)$$

where Y is the dependent variable (analysed traits), μ is overall mean, G is the genotype of *ADD1* exon 14 (GG, AA and GA), L is the duck population, $G\cdot L$ is the interaction between genotype and duck population (it is a fixed effect) and e is the random error.

Results

The amplified fragment of exon 14 was approximately 166 bp in size and exhibited polymorphism in different individuals and populations. Three band patters could be identified for exon 14 of the *ADD1* gene, which were the products of two alleles (G and A).

But the alteration of exon 14 (G2193A of NM_001079730.1) was synonymous and did not result in an amino acid change. Association analysis revealed that the homozygous (GG) birds had significant higher SFW than homozygous (AA) in Z2. The homozygous (GG) birds had significant higher carcass weight than the heterozygote (GA) in Z4. The homozygous (GG) birds had significant lower IMF than homozygous (AA) in Cherry Valley duck. The homozygous (GG) birds had significant higher leg muscular weight than homozygous (AA) and the homozygous (GG) birds had lower percentage of AFW than heterozygote (GA) and homozygous (AA) in Hybrid Peking duck. Though the frequency of genotype AA was quite low in the populations and there was no consistent association of *ADD1* across all populations the study promotes *ADD1* as a candidate gene for growth and fatness traits.

Table 1
Table Least square analysis between exon-14 of *ADD1* gene and fatness traits in ducks
Analyse zwischen Exon 14 SNP von ADD1 und Fettmerkmalen bei Enten

Population	Traits	Genotype		
		GG	AA	GA
Peking duck Z2	SFW, g	598.0±12.7 [a] (n=37)	535.5±38.6 [b] (n=4)	562.8±10.6 [a b] (n=53)
Peking duck Z4	carcass weight, g	2795.3±43.8 [a] (n=31)	2746.2±67.62 [a b] (n=13)	2678.5±34.1 [b] (n=51)
Cherry Valley duck	intramuscular fat, %	3.94±0.15 [b] (n=28)	4.53±0.20 [a] (n=16)	4.13±0.11 [a b] (n=54)
Hybrid Peking duck	leg muscular weight, g	124.1±2.3 [a] (n=51)	104.7±9.5 [b] (n=3)	123.9±2.8 [a] (n=36)
	percentage of AFW, %	4.31±0.13 [b] (n=51)	5.45±0.53 [a] (n=3)	4.76±0.15 [a b] (n=36)

a,b denoted significant difference ($P<0.05$)

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