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Genetic improvement of tilapias in China: Genetic parameters and selection responses in fillet traits of Nile tilapia (*Oreochromis niloticus*) after six generations of multi-trait selection for growth and fillet yield

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ABSTRACT

Genetic parameters and selection responses were obtained for fillet weight and fillet yield of Progift Nile tilapia (*Oreochromis niloticus*) in China after six generations of multi-trait selection for growth and fillet yield. A total of 9619 test fish representing 687 full-sib families in six generations (G_1–G_6) of Nile tilapia originating from the GIFT breed were sacrificed to record skin-on fillet weights. Some of these skin-on fillets were further processed by skinning (5971 test fish) and trimming (4633 test fish) to allow calculations of three estimates of fillet yield (based on skin-on, skinned and trimmed fillets). Recorded fillet weights were positively influenced by body weight and negatively influenced by age at recording. The heritability (h^2) of skin-on fillet weight showed large variation in magnitude between generations (range of 0.00–0.45), but was of medium magnitude (0.30) when analyzing all data combined. The h^2 of fillet yield, which varied between 0.08 and 0.30 in different generations, was relatively stable (0.17–0.23) for different estimates of fillet yield when analyzing across all generations. Including all data, the effects common to full-sibs (c^2) accounted for 8% and 1–2% of the total phenotypic variance, respectively, for skin-on fillet weight and different estimates of fillet yield. The genetic correlations between different estimates of fillet yield were all very high (0.95–0.97 when analyzing all data) showing that it is sufficient to select based on skin-on fillet yield. The genetic correlation between skin-on fillet weight and body weight at harvest was also very high (0.97), while that between fillet yield and fillet weight was of moderate magnitude (0.33). The genetic correlation between fillet yield and body weight at harvest was not significantly different from zero. Genetic trend analysis based on all data predicted accumulated selection responses of 121 g (1.87 phenotypic standard deviation units) larger skin-on fillet weight and 1.2%-units higher skin-on fillet yield after six generations of multi-trait selection. It is concluded that the ongoing program in China has resulted in considerable genetic improvement of fillet weight, and that genetic changes of fillet yield is a much slower process (0.2%-units per generation). Implications for commercial selective breeding programs are discussed.

1. Introduction

Tilapias have the potential of becoming the most important aquaculture species in the world. In 2010, the world production of farmed tilapias reached 3.2 million metric tons of which about 35% was produced in China (Fitzsimmons et al., 2011). While most of the farmed tilapias in China were hybrids produced by crossing Nile tilapia (*Oreochromis niloticus*) females and Blue tilapia (*O. aureus*) males (Li et al., 2006), this has changed in favor of pure-bred Nile tilapia due to the development of several genetically improved breeds. Chinese tilapia production is concentrated in South China (Zhao, 2011), where tilapias are mainly farmed in semi-intensive or intensive all-male, mono-culture systems.

More than 40% of the Chinese tilapia production in 2010 was exported, mainly as frozen fillets to the US market (Fitzsimmons et al., 2011). As a result, China was the main exporter, accounting for more than 70% of the total tilapia supply to this market. However, other countries in Asia and Latin-America are increasing their tilapia production both for local consumption and export to the US market. Stronger competition with other tilapia producers increases the necessity to reduce production cost and improve quality of Chinese tilapia products. In addition to improving the production systems, it is also necessary to develop genetically improved breeds of tilapia that perform well under different production systems in China and also have improved fillet traits.

Reported fillet yields of Nile tilapia show large variation (34–45%) (Gjerde et al., 2012; Nguyen et al., 2010; Rutten et al., 2005). Generally, these estimates are much lower than those of Atlantic salmon

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