

Effects of Fast and Slow Feather Genes on Early Body Weight and Feather Growth of Dahan Broiler

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Abstract: In order to explore the relationship between feather and early development of body weight in fast- and slow-feathering groups of Dahan broiler, the body weight and feather growth rate (covert, primary and tail feather) of 1-10 weeks old Dahan broilers were measured and analyzed. The results showed that there was no significant difference in body weight between fast feathering and slow feathering broilers aged 1-10 weeks; Before 4 weeks of age, the main wing feathers of fast feathered chickens were significantly longer than those of slow feathered chickens (isometric slow feathering, inverted slow feathering, unexplained slow feathering) ($P < 0.05$ or $P < 0.01$), and the difference gradually decreased with the increase of age, but there was no significant difference at the end of brooding; At the age of 10 weeks, the overlying wing feathers of the inverted and equal length slow feathered chickens were significantly longer than those of the fast feathered and unexplained slow feathered chickens ($P < 0.05$); Before 2 weeks of age, the main wing feather of fast feathered chicken was significantly longer than that of slow feathered chicken, the main wing feather of isometric slow feathered chicken was significantly longer than that of inverted slow feathered chicken and unexplained slow feathered chicken ($P < 0.05$), and the main wing feather of inverted slow feathered chicken was significantly longer than that of other three phenotypes (fast feathered, isometric slow feathered and unexplained slow feathered chicken) ($P < 0.05$ or $P < 0.01$); The tail feathers of fast feathered chicken and slow feathered chicken were significantly longer than that of slow feathered chicken at the same week of age. There was no significant difference in the length of tail feathers among the three different phenotypes of slow feathered chicken; The results showed that the growth of wing feather before 2 weeks old could be used as an auxiliary method for fast and slow feather identification of Dahan broiler.

1 INTRODUCTION

Dahan broiler is a new high-quality broiler breed bred by Sichuan Daheng Poultry Breeding Co., Ltd. and

Sichuan Academy of Animal Husbandry Science, and has passed the examination and approval of the National Livestock and Poultry Genetic Resources Committee. Dahan broiler, a new yellow feather

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broiler breed independently bred by act in China, has the characteristics of rough feeding resistance, strong disease resistance, strong adaptability, high production efficiency and good meat flavour (Peng 2019 and Jiang 2007). At present, Dahren broiler has been bred for 10 generations in succession. Its genetic structure is stable, the breeding progress of production shape and reproductive performance is obvious, and its survival rate and appearance uniformity are excellent. It is an ideal model property for genetic research (Li 2019 and Peng 2019). In poultry production, chicken feathers are a very important economic trait, which can be divided into fast feathers and slow feathers, also known as early feathers and late feathers, mainly referring to the early, late and fast growth of wing feathers and tail feathers, which can be seen within 24% hours after chicks emerge from their shells. Chicken's fast and slow feathers belong to sex-linked genetic traits. The male chicks obtained by matching fast-feathered cocks with slow-feathered hens are slow feathers, while the female chicks are fast feathers. At present, it is used to separate the male and female of newborn chicks, replacing the anal sex identification technology widely used in production. It is simple, fast and accurate, saves labor resources and labor costs, and avoids adverse reaction of anal idenstarted to lay 2-7 days earlier than slow-feathered chickens (Xie 2002). Durmus et al. found that the egg production of fastification to chickens, spreading diseases and crushing chickens. It is a modern chicken production (Song 2003).

It has been found that feather speed has certain influence on growth and development, body weight, laying performance, disease resistance, production performance and reproductive performance of chickens (Cheng 1987 and Xing 2020). Zhong Chen et al. found that the weight of fast and slow feathered chickens was significantly different among individuals (Zhong 2010). Rumin Jia et al. found that the shin of recessive white slow feather cock is longer than that of fast feather cock (Jia 2009). Jinfang Xie found that Chongren Ma chicken fast-feathered chickens -feathered hens was greater than that of slow-feathered hens (Xie 2002). Jianhua Ouyang et al. found that the laying weight of slow-feathered Wanzai Kangle Yellow Chicken was significantly greater than that of fast-feathered chickens (Ouyang 2002). In addition, some studies have found that there are some differences in viability and disease resistance between fast-feathered chickens and slow-feathered chickens. Lowe et al. found that the mortality of offspring of fast-feathered hens was higher than that of offspring of slow-feathered hens

(Lowe 1981). Dong Li et al. found that the viability of Locke fast-feathered chickens was stronger than that of Biloch slow-feathered chickens (Li 1991), and Harris et al. also observed similar results (Harris 1984).

In order to explore the relationship between feather speed and weight of Dahren broiler, the length and weight of main wing feather, covering main wing feather and tail feather of Dahren broiler at different growth days were measured and analyzed, aim to provide basis for breeding fast and slow feather strains of Dahren broiler.

2 MATERIALS AND METHODS

2.1 Experimental Animals

We selected 240 healthy 1-day-old Dahren broilers, with half male and half female (30 males and 30 females of each genotype, such as fast feather, equal length slow feather, inverted long slow feather and unexposed slow feather), and provided by Sichuan Daheng Poultry Breeding Co., Ltd.. The experiment was conducted in Sichuan Daheng Poultry Breeding Co., Ltd. from March to June, 2021. Cage feeding, free feeding and drinking water, illumination and immunization were all conducted according to routine feeding management procedures..

2.2 Feather Length and Weight Measurement Method

The feather length and weight of each test chicken group were measured every 1 week until the 10th week. The first main wing feather, the fourth main wing feather and the longest tail feather (10 in each group) of the left wing of chickens were uniformly measured with vernier caliper. Weigh the weight of chickens in each test group with an electronic scale, 30 chickens in each group, and take the average value

3 MAIN WING FEATHER

3.1 Growth and Development of Main Wing Feather

It can be seen from Figure 1 that the main wing feather length of Dahren broilers gradually increases before 6 weeks of age, and increases slowly after 6 weeks of age. The main wing feather length of fast-feathering chickens is significantly longer than that of

three slow-feathering chickens (equal-length, inverted-length and non-emergence) at the age of 1-3 weeks ($P < 0.05$), and that of equal-length slow-feathering chickens is significantly longer than that of non-emergence and inverted-length slow-feathering chickens ($P < 0.05$). This difference gradually decreases with the increase of age, but the difference at the end of brooding is not significant. At the age of 9-10 weeks, the length of main wing feather of inverted long slow-feathered chicken was significantly longer than that of other three feather types ($P < 0.05$).

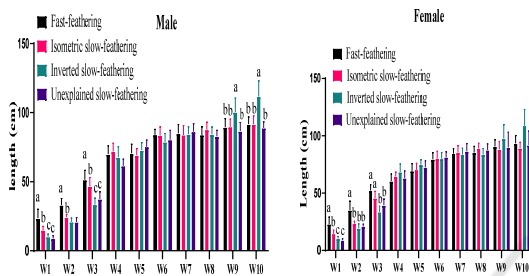


Figure 1: This caption has one line so it is centered.

3.2 Growth and Development of Cover Main Wing Feather

It can be seen from fig. 2 that the cover main wing feathers of Dahan broilers gradually grow before 6 weeks of age, and the length of the cover main wing feathers does not increase after 6 weeks of age. At the age of 1-3 weeks, the length of the cover main wing feather of fast-feathering chickens was significantly longer than that of three slow-feathering chickens ($P < 0.01$). With the increase of age, there was no significant difference in the length of cover main wing feather between fast and slow feathering chickens.

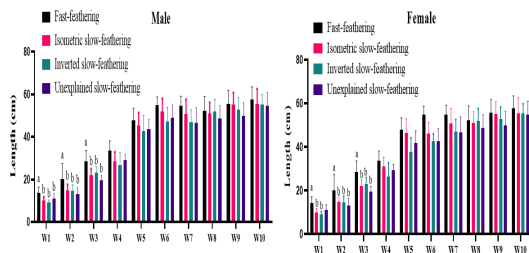


Figure 2: Feather length of cover main wings of chickens with different feather types.

3.3 Tail Feather Growth and Development

It can be seen from Figure 3 that fast-feathering chickens have grown tail feathers at the age of 1 week, while slow-feathering chickens only grow tail feathers at the age of 2 weeks. At the same age, the tail feather length of fast-feathering chickens is significantly longer than that of slow-feathering chickens ($P < 0.05$), and this trend is more significant before 4 weeks of age. With the increase of age, this difference gradually decreases.

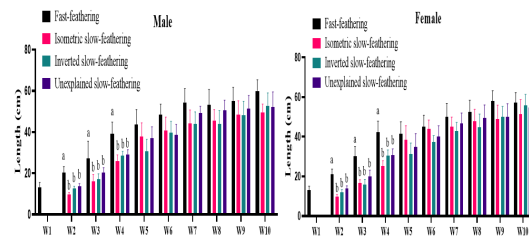


Figure 3: Tail feather length of different feather types.

3.4 Weight Development

It can be seen from fig. 4 that the weight of Dahan broilers gradually increases with the increase of the age of 1-10 weeks; Moreover, there is no significant difference in weight between different feather chickens, and this trend is similar between male and female hens.

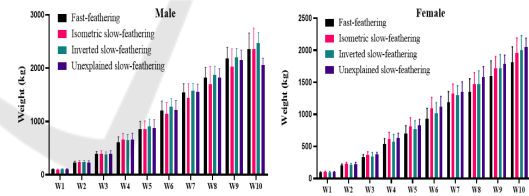


Figure 4: Weight of chickens with different feather types.

4 DISCUSSIONS

4.1 Growth Differences of Main Wing Feather, Covered Main Wing Feather and Tail Feather of Dahan Quality Broilers

Chicken feather growth is controlled by both growth environment and genes. On the one hand, external factors such as nutrition, growth environment, stress response and drug property have great influence on the growth and development of chicken feathers. On

the other hand, fast and slow feather genes regulate feather growth and play a decisive role (Jia 2009). Fast and slow feather genes are a pair of companion genes that control feather growth speed, which are located on Z chromosome and control the growth and development of main wing feather, main wing feather, tail feather and other parts of chicken feathers (Song 2003 and Zhong 2010). According to the relative length of main wing feather and covered main wing feather, chickens can be divided into four different feather types: fast feather, slow feather without emergence, slow feather with equal length and slow feather without emergence (Cheng 1987). In production, combining the laws between fast and slow feather genes and the corresponding phenotypic traits, a self-distinguishing male and female mating line was established, which improved the efficiency and benefit of poultry breeding. During the growth and development of chickens of different feather types, the growth status and feather speed of their feathers are different, which usually decreases with the increase of chicken age (Rong 2010). In this experiment, the main wing feathers and the main wing feathers of Dahan broilers increased with age, which collectively showed that their feathers grew faster in the early growth stage and gradually decreased in the middle and late growth stages, which was consistent with the research results of Xiaohui Liu and others on Bashang long-tailed chickens. At 1-3 weeks of age, the main wing feathers and the main wing feathers of fast-feathering chickens of Dahan broilers were significantly longer than those of slow-feathering chickens, and the differences gradually decreased with the increase of age. There are many similar research results. The research results of Chenglin Zhong et al. show that the main wing feather length of fast-feathered yellow-feathered chickens in Sichuan mountainous area is significantly longer than that of slow-feathered chickens before 4 weeks of age (Zhong 2018). The research of Xiaohui Liu et al. shows that the main wing feather and covering wing feather of fast-feathered Bashang long-tailed chickens are significantly longer than that of slow-feathered chickens before 2 weeks of age, and the differences are gradually reduced with the increase of age (Liu 2014). The results of this experiment showed that the growth and development of tail feathers of Dahan broilers also followed a certain rule. Fast-feathered chickens had grown tail feathers at the age of 1 week, while slow-feathered chickens began to grow tail feathers at the age of 2 weeks. The tail feathers of fast-feathered chickens were significantly longer than those of slow-feathered chickens at the same age,

which was similar to the research results of Ting Rong et al. and Xiaohui Liu et al. (Rong 2010 and Liu 2014). Previous studies have shown that the growth and development of chicken tail feather is late, and the growth and development of chicken tail feather is very obvious in about 2 weeks, with a length of about 3 cm. There is a difference in tail feather development between fast feather and slow feather, which undoubtedly provides the possibility for feather type identification. It also shows that the length of tail feather can also be a new reference and basis for act to distinguish male from female, and the identification time is best controlled at 1-4 weeks old.

4.2 Relationship between Fast and Slow Feather Speed and Body Weight of Dahan Broilers

The fast and slow feather genes can not only control the growth and development of chicken feathers, but also have a certain influence on the early growth speed and weight of chicken. Chenglin Zhong et al. found that the weight of slow-feathered chickens in yellow feather system of Sichuan mountainous black-bone chickens was significantly larger than that of fast-feathered chickens (Zhong 2018). Lechao Zhang et al. found that the slow feather line of Taihang chicken grew faster than the fast feather line (Zhang 2017). The research of Ning et al. also verified this point, that is, the weight of slow-feathering white-shelled hens in both sexual maturity and adult weight was significantly higher than that of fast-feathering hens (Ning 2005). However, there are some studies that show the opposite. Kumar et al. studied Desi, Bailaihang and Luodao Red Chicken (RIR), which showed that fast-feathering chickens were all heavier than slow-feathering chickens (Kumar 1975). In addition, Guilong Yan et al. made use of Roman commodity to replace laying hens, Haixia Han et al. made use of Laiwu Black Chicken, Zuanshou Liu et al. made use of Xingza 288 Chicken Breed, Xiangpin Qiu et al. made use of dual-purpose C-line Chicken Breed, and Zhong Chen et al. made use of Huangshi local chicken Breed, all of which showed that fast-feathered chickens were heavier than slow-feathered chickens (Han 2009, Liu 1983, Cheng 1987 and Chen 2010). The results of this study showed that the weight of Dahan broilers increased with age, but there was no significant difference in weight between fast and slow breeds, which was consistent with the research results of Hayson RIR chickens, Yan Xiong on Lingnan yellow chickens, and Xiaohui Liu on Bashang long-tailed chickens (Hays 1932, Xiong 1995 and Liu 2014). This shows that the feather speed

of different poultry groups has different effects on weight development and cannot be generalized. The fast and slow feather genes have different effects on the growth of chickens or young poultry in different experiments, which may be mainly related to varieties, strains, genders, experimental conditions, feeding methods, heat preservation measures and other factors.

5 CONCLUSIONS

In this experiment, the feeding density of different groups of chickens was not adjusted in time in the later period, which may have certain influence on the test results, but on the whole, there was no significant difference in weight development between fast and slow feather strains of Dahan broilers. The appearance time and relative length of tail feather can effectively judge fast and slow feather individuals of Dahan broilers, which is helpful to improve the accuracy of phenotypic selection when establishing fast and slow feather pure lines of Dahan broilers.

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