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Genetic Parameter Estimation for Growth Traits in HD-K75 Pigs

Jyotishree Bayan[1], Galib Uz Zaman[1], Arundhati Phookan[1], Farzin Akhtar[2], Jitendra Saharia[3], Sourabh Sulabh[4]

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ABSTRACT

Background: The AICRP on pigs, has developed a variety of pig called HD-K75 with 75% Hampshire inheritance and 25 % indigenous inheritance through 16 generations of *inter-se* mating with concomitant selection. These pigs have been distributed among the local farmers. This study was undertaken to monitor the performance and to estimate the genetic parameters to keep the HD-K75 pigs' performance at a desirable level through proper and accurate selection.

Methods: Growth records of the progenies of 44 sires and 114 dams of HD-K75 pigs maintained over 6 years from 2012 to 2018 bred in the ICAR-All India Coordinated Research Project (AICRP) on pigs located at College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati were utilized to study the heritability of various growth traits. The heritability (h^2) estimates were obtained by the paternal half-sib correlation method using the sire component of variance and co-variance.

Result: The h^2 estimates for body weight at birth, 42 days, 1 month, 2 months, 3 months, 4 months, 6 months, 8 months and average daily gain during birth to 42 days, 42 days to 4th month, 42 days to 6th month and 42 days to 8th month of age were obtained as 0.391 ±0.110, 0.373 ± 0.116, 0.203±0.069, 0.131±0.070, 0.424±0.124, 0.904±0.224, 0.537±0.158, 0.071± 0.093, 0.198±0.067, 0.899± 0.222, 0.569±0.163 and 0.016±0.081 respectively. Moderate to high heritability estimates for body weight at various stages of growth in the present study indicated that the population under investigation possesses a good amount of additive genetic variance and these estimates may be incorporated in appropriate selection programs for genetic improvement of the herd.

Key words: Growth traits, HD-K75 pigs, Heritability estimates.

INTRODUCTION

Pig farming in India is primarily a small-scale unorganized rural activity and is an integral part of diversified agriculture, particularly in the tribal belt of the country and has been contributing to improving the nutritional security in terms of the protein requirements of the poor and socially weaker section of the society including the tribal people of India (Talukdar *et al.,* 2019). Pigs occupy a unique role among the meat-producing animals of the Eastern Himalayan hill region and are the animal of choice for meat, especially for tribal populations in Northeast India (Li *et al.*, 2022). Most households rear pigs as one of the sources of income. Crossbred pigs are superior on average to their purebred counterparts under harsh and diverse agro-climatic conditions (Sulabh *et al.,* 2017). Though there is a vast population of Indigenous pigs with unique traits in north eastern region of India, the productivity of the pigs is low due to the poor productive and reproductive performance of local pigs (Kadirvel *et al.,* 2021). The latest methods of increasing the production can involve the use of transgenesis especially based on stem cell research (Sulabh *et al.,* 2018; Kumar *et al.,* 2018). However, they are costly and will require repeated efforts to develop highly productive animals. The production of indigenous breeds of pigs can also be improved by cross-breeding and selection utilizing the effects of heterosis (Yadav *et al.,* 2018). For selection, conventional methods as well as some molecular marker-based methods like PCR-RFLP can be used (Sulabh *et al.,* 2016; Gupta *et al.,* 2016). However, the conventional method is still an easily affordable method for the selection process. The ICAR-All India Co-ordinated Project on Pigs (AICRP), AAU, Khanapara, Guwahati, Assam was established in the year 1971. It is one such project that is engaged in the overall improvement of the performance potential of pigs, especially production. The

[1]Deptartment of Animal Genetics and Breeding, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-781 022, Assam, India.
[2]Goat Research Station, Assam Agricultural University, Byrnihat-785 013, Assam, India.
[3]Department of Livestock Production and Management, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-781 022, Assam, India.
[4]Department of Animal Science, Kazi Nazrul University, Kalla, Asansol-713 340, West Bengal, India.

Corresponding Author: Galib Uz Zaman, Deptartment of Animal Genetics and Breeding, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-781 022, Assam, India. Email: gzaman60@gmail.com

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AICRP on pigs, AAU, Khanapara has developed a variety of pig called HD-K75 with 75% Hampshire inheritance and 25 % indigenous inheritance (75% H and 25% I) through 16 generations of *inter-se* mating with concomitant selection and the same was released as a new variety during October 2016. It is one of the popular varieties of pig among the farmers not only in Assam but also in the northeastern region for their growth and prolificacy under the prevalent managemental conditions. The HD-K75 piglets produced at AICRP on pig, Khanapara centre are distributed among the farmers of the region. However, it is necessary to monitor the performance of the HD-K75 pig variety from time to time and also to estimate the genetic parameters to keep their performance at a desirable level and for proper and accurate selection for optimum production and genetic improvement of the herd.

MATERIALS AND METHODS

The present study on the estimation of heritability of various growth traits at different ages and daily body weight gain of HD-K75 pigs was carried out in the Department of Animal Genetics and Breeding, College of Veterinary Science, AAU, Khanapara, Guwahati (2018-2021). The records pertaining to progenies of 44 sires and 114 dams maintained over 6 years from 2012 to 2018 bred in the ICAR-All India Coordinated Research Project (AICRP) on pigs, AAU, Khanapara, Guwahati, were utilized for the current study. The growth traits included in the study were body weight at birth, 42 days, 1 month, 2 months, 3 months, 4 months, 6 months, 8 monthsand average daily body weight gain during birth to 42 days, 42 days to 4th month, 42 days to 6th month and 42 days to 8th month of age. The average daily gains (ADG) at different periods of growth were calculated as per Brody (1945) and expressed in grams.

$$\text{Daily body weight gain (g)} = \frac{W_2 - W_1}{t_2 - t_1}$$

Where

W_2 and W_1 are the final and initial body weights of the animals for corresponding time units at t_2 and t_1 respectively.

The heritability for various growth traits in HD-K75 pigs was estimated by the paternal half-sib correlation method using sire components of variance and covariance as per the method given by Becker (1975). For this analysis, the data of only those animals whose sires had three or more progenies were considered for all the traits.

The model used for heritability estimation using sire components of variance and covariance is as follows:

$$Y_{ij} = \mu + S_i + e_{ij}$$

Where,

Y_{ij}= Observed value of jth individual born to ith sire.

μ = Overall population mean.

S_i = Effect due to ith sire.

e_{ij}= Random error component assumed to be distributed normally and independently with mean zero and constant variance (0, δ^2e).

The standard errors (SE) of heritability estimates were calculated as per the method described by Swiger *et al*. (1964).

RESULTS AND DISCUSSION

The heritability estimates for body weight at birth and weaning in HD-K75 pigs were estimated as 0.391±0.110 and 0.203±0.069 respectively (Table 1). In the present investigation, the heritability estimates for body weight at 1 month, 2 months, 3 months, 4 months, 6 months and 8 months of age in HD-K75 pigs were obtained as 0.373± 0.116, 0.131±0.070, 0.424±0.12, 0.904±0.224, 0.537± 0.158 and 0.071±0.093 (Table 1) respectively.

In the present investigation in HD-K75 pigs, the heritability estimates for daily body weight gain during the pre-weaning period of growth *i.e.* birth to 42 days were estimated as 0.198±0.067 (Table 2). The heritability estimates for daily body weight gain during the post-weaning period of growth *viz*. 42 days to 4th month of age, 42 days to 6th month of age and 42 days to 8th month of age in HD-K75 pigs were observed as 0.899±0.222, 0.569± 0.163 and 0.016±0.081 (Table 2) respectively.

Heritability estimatesfor body weight at birth

The heritability estimates for body weight at birth in HD-K75 pigs were estimated as 0.391±0.110 (Table 1). The heritability estimates at birth obtained in the present study were in agreement with the observations of Mukhopadhyay (1989) in T×D crosses (0.3±0.04), Nath (1993) in ½ H x ½ I crossbreds (0.39±0.20) and Kalita *et al*. (2006) in Hampshire and Indigenous crossbreds (0.35±0.09). On the contrary, the heritability estimates at birth obtained in the present study were higher than those obtained in the studies of Sukhdeo *et al*. (1981) in Large White and their halfbreds (0.16±0.10), Deka (1999) in ½ H × ½ I *inter se*and¾ H × ¼ I *inter se* pigs, (0.234±0.123 and 0.199± 0.105) and Singh *et al*. (2000) in Landrace pigs (0.19± 0.08). On the other hand, Kalita (1995) in ½ H × ½ I crossbreds (0.519±0.56) and Kumar (1999) in Landrace × Desi crossbreds (0.47±0.31) recorded higher heritability estimates at birth in comparison to the estimates obtained in the present study. The study indicated that moderately higher additive genetic variance is available for improvement of the HD-K75 pig population.

Heritability estimatesfor body weight at weaning

In the present investigation in HD-K75 pigs, the heritability estimates at weaning were recorded as 0.203±0.069 (Table 1). The heritability estimates obtained by Milojic and Petrovic (1983) in Landrace pigs (0.23) was in agreement with the estimates of the present investigation. Nath (1993) observed higher heritability estimates than the values of the present study in ½ H × ½ I and in ¾ H × ¼ I crossbreds (0.60±0.12 and 0.70±0.19). Kalita (1995) in ½ H × ½ I *inter se* pigs, ¾ H × ¼ I crossbreds and in ¾ H × ¼ I *inter se* pigs (0.31±0.51, 0.80±0.72 and 0.71±0.42), Kalita *et al*. (2006) in Hampshire crossbreds (0.334±0.118) and Chakurkar *et al*.

(2021) in 75% LWY × 25% Indigenous Agonda Goan crossbred pigs observed higher heritability estimates (0.45) than the values of the present study. Contrary to the present findings, Chauhan *et al*. (1994) in indigenous pigs (0.009±0.047) and Kumar (1999) in Landrace, Desi and their crossbreds (0.03±0.12, 0.18±0.24) reported comparatively lower estimates of heritability.

Heritability estimates for body weight at 1 month

The heritability estimates for body weight at 1 month of age in HD-K75 pigs in the present investigation were obtained as 0.373±0.116 (Table 1). The heritability estimates obtained in the present study are in good agreement with the values obtained by Deka (1999) in ½ H × ½ I crosses and ¾ H × ¼ I *inter se* pigs (0.375±0.150, 0.329±0.132). Comparatively lower estimates of heritability were reported by Kalita (1995) in ½ H × ½ I and ¾ H × ¼ I pigs (0.075± 0.232, 0.20±0.15) and Singh *et al*. (2000) in Landrace pigs (0.27±0.10). However, Kumar (1999) in Landrace × Indigenous crossbreds (0.47±0.37) and Phookan (2008) in ½ H × ½ I and ¾ H × ¼ I *inter se* pigs (0.538±0.161, 0.529 ±0.135) observed higher heritability estimates of body weight at 1 month of age than those obtained in the present study.

Heritability estimatesfor body weight at 2 months

In the present study, the estimates of heritability for body weight at 2 months of age in HD-K75 pigs were obtained as 0.131±0.070 (Table 1). Similar values of heritability of body weight at 2 months of age were also recorded by Singh *et al.* (1986) in Desi pigs (0.19±0.27) and Deka (1999) in ¾ H × ¼ I *inter se* pigs (0.126±0.091). Higher heritability estimates of body weight at 2 months of age compared to the present finding were Kalita *et al*. (2006) in various crosses of Hampshire and Indigenous pigs (0.334 ± 0.118) and Phookan (2008) in halfbred *inter se* pigs and graded *inter se* pigs (0.501±0.132, 0.701±0.250).

Heritability estimates for body weight at 3 months

The heritability estimates for body weight at 3 months of age in HD-K75 pigs in the present investigation were obtained as 0.424±0.124 (Table 1). The present findings agree with the observations of Sukhdeo *et al*. (1992) in Landrace pigs (0.41±0.31) and Kalita (1995) in indigenous pigs (0.49±0.19). Higher estimates than the present finding were observed by Nath (1993) in ½ H × ½ I crossbreds and ¾ H × ¼ I crossbreds (0.78±0.56, 0.51±0.32), Kalita (1995) in ½ H × ½ I *inter se* pigs and ¾ H x ¼ I *inter se* pigs (0.58± 0.22, 0.92±0.44) and Singh *et al*. (2000) in Landrace pigs (0.64±0.16). Lower estimates than the present finding were observed by Deka (1999) in ½ H × ½ I *inter se* pigs and ¾ H × ¼ I *inter se* pigs (0.387±0.156, 0.375±0.142) and Ferdoci (2003) in Saddleback and Hampshire crossbreds (0.252 ±0.103).

Table 1: Heritability estimates with standard errors for body weights at different ages in HD-K75 pigs.

Body weight	$h^2_S \pm$ SE
At birth	0.391±0.110
At 1st month	0.373±0.116
At weaning	0.203±0.069
At 2nd month	0.131±0.070
At 3rd month	0.424±0.124
At 4th month	0.904±0.224
At 6th month	0.537±0.158
At 8th month	0. 071±0.093

Heritability estimatesfor body weight at 4 months

The heritability estimates for body weight at 4 months of age in HD-K75 pigs in the present study were obtained as 0.904±0.224 (Table 1). Comparable estimates of heritability were reported by various authors *viz*. Nath (1993) and Shylla and Bardoloi (1993) in indigenous pigs (0.82±0.06, 0.822 ±0.060) and Singh *et al*. (2000) in Landrace pigs (0.85± 0.19). Lower values of heritability in comparison to the present findings were reported by Kalita (1995) in ½ H × ½ I *inter se* pigs, ¾ H × ¼ I pigs and in ¾ H × ¼ I *inter se* pigs (0.42±0.57, 0.77±0.11, 0.43±0.49), Deka (1999) in ½ H × ½ I *inter se* pigs and ¾ H × ¼ I *inter se* pigs (0.473±0.173, 0.534±0.170) and Ferdoci (2003) in Saddleback and Hampshire crossbreds (0.484±0.173).

Heritability estimatesfor body weight at 6 months

In the present study, the heritability estimates for body weight at 6 months of age in HD-K75 pigs were found to be 0.537 ±0.158 (Table 1). The present estimates of heritability for body weight at 6 months of age are in agreement with the findings of Kalita (1995) in ½ H × ½ I pigs (0.50±0.39), Deka (1999) in ½ H × ½ I *inter se* pigs (0.586±0.193) and Ferdoci (2003) in Saddleback and Hampshire crossbreds (0.529±0.190). However, Chauhan *et al*. (1993) and Singh *et al*. (2000) in Landrace pigs (0.65±0.38, 0.63±0.16) observed higher estimates of heritability. On the other hand, Shylla and Bardoloi (1993) in indigenous pigs (0.459± 0.037), Nath (1993) in ½ H × ½ I pigs (0.24±0.04), Kalita (1995) in ½ H × ½ I *inter se* pigs (0.46±0.29), Bardoloi and Sharma (1997) in Landrace pigs (0.38±0.19) and Deka (1999) in ¾ H × ¼ I *inter se* pigs (0.395±0.148) obtained lower heritability estimates than the present findings.

Heritability estimatesfor body weight at 8 months

The estimates of heritability for body weight at 8 months of age in HD-K75 pigs in the present study were obtained as 0.071±0.093 (Table 1). Comparable estimates were reported by Deka (1999) in ¾ H × ¼ I *inter se* pigs (0.098± 0.092). Higher estimates of heritability for body weight at 8 months were recorded by Shylla and Bardoloi (1993) and Chauhan *et al*. (1994) in indigenous pigs (0.721±0.025, 0.26±0.13), Bardoloi and Sharma (1997) in Landrace pigs (0.79 ±0.27), Nath (1993) in ½ H × ½ I crossbreds and ¾ H ×¼ I crossbreds (0.47 ± 0.19, 0.42 ± 0.09) and Kalita (1995) in ½ H × ½ I crossbreds, ½ H × ½ I *inter se* pigs and ¾ H × ¼ I *inter se* pigs (0.52±0.35, 0.57±0.23, 0.41±0.26).

Table 2: Heritability estimates with standard errors for body weight gain at different periods of growth in HD-K75 pigs.

Daily Body weight gain	$h^2_S \pm$ SE
Birth to 42 days	0.198±0.067
42 days to 4th month	0.899±0.222
42 days to 6th month	0.569±0.163
42 days to 8th month	0.016±0.081

Heritability estimatesfor daily body weight gain

The heritability (h^2) estimates for daily body weight gains at different periods of growth *viz*. birth to 42 days, 42 days to 4th month, 42 days to 6th month and 42 days to 8th month of ages in HD-K75 pigs were estimated from paternal half-sib correlation method using sire components of variance and co-variance and depicted in Table 2.

In the present investigation in HD-K75 pigs, the heritability estimates for daily body weight gain during the pre-weaning period of growth *i.e.* birth to 42 days was estimated as 0.198±0.067. The present finding agrees with the heritability estimates for daily body weight gain during the pre-weaning period recorded by Goswami and Raina (1981) in Landrace pigs (0.189±0.082), Park *et al*. (1987) in Hampshire and Landrace crosses (0.18±0.16), Kalita (1995) in ¾ H × ¼ I pigs (0.17 ± 0.77) and Khatun (2018) in T×D pigs. On the contrary, higher heritability estimates were obtained by Nath (1993) in various Indigenous, halfbred and graded pigs (0.224±0.022, 0.353±0.031, 0.377± 0.082), Kalita (1995) in Indigenous pigs, ½ H ½ I pigs, ½ H ½ I *inter se* pigs and ¾ H × ¼ I*inter se* pigs (0.40 ± 0.16, 0.52±0.57, 0.34±0.52, 0.74±0.43) and Ferdoci (2003) in Saddleback × Indigenous crosses. However, Roychoudhury and Bhatia (1980), in Landrace pigs (0.06±0.09) and Pandey *et al*. (1996) in LWY pigs obtained relatively lower heritability estimates for daily body weight gain during the pre-weaning period.

The heritability estimates for daily body weight gain during the post-weaning period of growth *viz*. 42 days to 4th month of age in HD-K75 pigs was observed as 0.899± 0.222 (Table 2). Relatively lower estimates of heritability during the period from 42 days to the 4th month were recorded by Khatun (2018) in ¾ H × ¼ I pigs and T×D pigs and Ferdoci (2003) in Hampshire x Saddleback crosses. The heritability estimates for daily body weight gain for the period from 42 days to 6th month of age was 0.569±0.163. Comparable estimates of heritability for daily body weight gain during 42 days to the 6th month of age were reported by Nath (1993) in ¾ H × ¼ I pigs (0.565±0.058) and Kalita (1995) in ¾ H × ¼ I *inter se* pigs (0.49±0.29). On the other hand, in ½ H × ½ I and indigenous pigs, Nath (1993) and Kalita (1995) reported lower estimates of heritability (0.339 ±0.039, 0.34±0.36) respectively. The heritability estimates for average daily body weight gain for the period from 42 days to 8th month of age was 0.016±0.081. In ¾ H × ¼ I pigs. In ¾ H × ¼ I pigs and Khatun (2018) obtained similar observations while in TxD pigs, the estimate was higher.

CONCLUSION

The heritability estimates for body weight at various stages of growth differed from each other. Moreover, these estimates also differed from the reports of different researchers conducted in different periods and different populations owing to environmental variations and variations in the genetic build-up. In addition to this, the variations might also be due to different methods of heritability estimation utilized by various authors.

From the results of the present study on HD-K75 pigs maintained at ICAR-AICRP on Pigs, AAU, Khanapara, it can be concluded that the moderate to high heritability estimates for body weight at various stages of growth in the present study indicated that the population under the investigation possess a good amount of additive genetic variance and these estimates may be incorporated in appropriate selection program for genetic improvement of the herd in terms of growth traits at various stages using adequate methods of selection.

Conflict of interest

The authors declare that they have no conflict of interest.

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