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Genetic determination of individual birth weight, litter weight and litter size in Mukota pigs

M. Chimonyo [a], K. Dzama [b,*], E. Bhebhe [c]

[a] *Department of Livestock and Pasture Science, Faculty of Science and Agriculture, University of Fort Hare, P. Bag X1314, Alice 5700, South Africa*
[b] *Department of Animal Sciences, Stellenbosch University, P. Bag X1, Matieland 7602, South Africa*
[c] *Department of Paraclinical Veterinary Studies, University of Zimbabwe, P. O. Box MP 167, Mount Pleasant, Harare, Zimbabwe*

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Abstract

Genetic parameters for individual birth weight (IBWT), total number of pigs born (NBT), number of pigs born alive (NBA), number of pigs born dead (NBD) and litter weight at birth (LBWT) were estimated using 1961 Mukota pigs kept at the University of Zimbabwe Farm, Harare, Zimbabwe. Variance components were estimated for IBWT based on a direct-maternal genetic effects model. The genetic relationships among NBT, NBA, NBD and LBWT were assessed using a multi-trait direct effects model. For LBWT, the direct, maternal and common environmental litter proportions on the phenotypic variance were 0.090, 0.033 and 0.009, respectively. After adjustment of IBWT for NBA, phenotypic fractions were 0.091, 0.034 and 0.011 for direct, maternal and litter effects. The correlation between the direct and maternal genetic effects of IBWT was −0.354 and −0.295, with and without adjustment for NBT. Heritabilities for NBT, NBA, NBD and LBWT were 0.020, 0.030, 0.088 and 0.196, respectively. Differences in the maternal heritability and the heritability for LBWT, a trait of the dam, are different due to accumulation of observations per litter. Maternal genetic effects are, therefore, of less importance than in highly selected European breeds.

Keywords: Heritability; Maternal effects; Birth weight; Litter size; Mukota pigs

1. Introduction

Mukota pigs have been demonstrated to show adaptation traits to survive under tropical low input smallholder production conditions. For example, they are much more able to utilise agricultural by-products (Kanengoni et al., 2002, 2004) and are less susceptible to parasites (Zanga et al., 2003) than exotic pigs.

* Corresponding author. Tel.: +27 72 9012026.
E-mail addresses: mchimonyo@ufh.ac.za (M. Chimonyo), kdzama@sun.ac.za (K. Dzama), ebhebhe@vet.uz.ac.zw (E. Bhebhe).

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Currently, there are no formal genetic improvement programmes for Mukota pigs in Zimbabwe. Genetic improvement of pigs leads to efficient pork production. It is imperative that genetic parameters for reproductive traits in Mukota pigs have to be available to design effective selection and genetic improvement programmes.

To date, selection for sow productivity in the Large White and Landrace has concentrated on litter size at birth (Mungate et al., 1999; Bolet et al., 2001; Holl and Robison, 2003). Litter traits of economic importance include litter weight at birth (LBWT), total number of pigs born per litter (NBT), number of pigs born alive (NBA), average birth weight and number of pigs born dead (NBD). These traits are cumulative and do not refer to individual pigs. It has been repeatedly shown that the economics of sow productivity are also influenced by individual birth weight. Low birth weight results in higher mortality at birth as well as during the nursing period (Roehe, 1999; Milligan et al., 2002). Low birth weight also reduces postnatal growth (De Passille et al., 1993; Klemcke et al., 1993). Genetic analyses of individual birth weight are rare because of the additional labour, time and costs involved. Accurate estimates of the variance and covariance components for Mukota pigs have to be available to produce reliable predictions of breeding values of animals, particularly if genetic correlations exist between weight at birth and growth performance of pigs. The objectives of this study were, therefore, to:

1. Estimate direct and maternal additive genetic parameters for individual birth weight (IBWT);
2. Determine the effect of adjusting the weight of piglets at birth to the total number of pigs born per litter (NBT) and number of pigs born alive in a litter (NBA); and
3. Estimate genetic parameters for cumulative litter traits (LBWT, NBT, NBA and NBD) in Mukota pigs.

2. Materials and methods

2.1. Description of study site

Mukota pigs were kept at the University of Zimbabwe Farm (UZF), Harare, Zimbabwe. The altitude is approximately 1300 m above sea level. The area is situated at 18°N and 30°E and annual rainfall averages 800 mm.

2.2. Pig population structure

Two unrelated Mukota boars and 16 Mukota gilts were bought from Mutoko Communal Area, nearly 250 km to the north east of Harare in October 1997. The pigs were bought to develop a satellite population on-station at the University of Zimbabwe Farm. This was prompted by the significant decline in the population of the Mukota pigs and indiscriminate crossbreeding practised in the communal areas. The pigs that were selected for the current study showed typical characteristics of the Mukota pigs, as previously described by Holness (1972). Briefly, Mukota pigs have erect ears, a stocky body and are predominantly black in colour. The number of teats for the gilts ranged from 12 to 16. For pedigree information, the farmers were asked whether any form of crossbreeding had occurred and could recall the parentage of the pigs up to the fifth generation. No selection based on performance was practised.

Another four Mukota sows were bought, in 1998, from Mvuma, which lies about 300 km to the south of Harare. This was meant to increase diversity and broaden the genetic base in the herd. In July 1999, three more Mukota boars and five gilts were obtained from Mount Darwin district, about 200 km to the north of Harare. Four Mukota boars were also selected from the herd and were mated to gilts produced from sows that had been bought from other farms to reduce inbreeding. The study population was, thus, generated from 16 grand dams and five grand sires. Thirty-nine dams and four boars were the sires generated from the base population. Therefore, a total of 9 and 55 breeding males and females, respectively, were used in the current study. Sows were culled after the eighth parity, with an average of 6.5 parities per sow.

Mating was done in a way that reduced inbreeding. Mating was done in a way that reduced inbreeding. Animals with a relationship coefficient of above 5% were not mated to each other. All matings were through natural service. Gilt replacements were selected on a within-litter basis, with no more than a gilt being selected from the same litter. The gilts selected for breeding had above average daily gains and having at