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Aspects of sexual precocity and morphometry of uterus, placenta and embryos/fetuses in Piau breed and Commercial line gilts

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ABSTRACT

In view of the importance of the genetic material of local breeds in the swine industry and the lack of information about reproductive performance of Piau females, two experiments were conducted to evaluate puberty and sexual maturity as well as the morphometry of embryos/fetuses, placenta and uterus during the first 90 days of gestation in Piau breed and Commercial line gilts. In experiment I, 37 Piau and 25 commercial line gilts were used. From the 120 days of age, detection of estrus was performed using mature boars from the first to third estrus of each gilt. Data regarding to age, body weight and estrus duration were recorded. After third estrus, females were slaughtered and ovaries were collected to determine ovulation rate. In experiment II, 36 Piau and 18 commercial line gilts were distributed into three groups according to the mating: Commercial, commercial line females *x* commercial line male; cross-mated, Piau females *x* commercial line male; and Piau, Piau females *x* Piau male. Gilts were slaughtered at 7, 15, 30, 45, 60 and 90 days of pregnancy. Piau females reached puberty and sexual maturity at the same age as commercial line females, but with lower weight; moreover, Piau group showed negative correlations of birth weight with puberty (−0.27) and sexual maturity (−0.29). Commercial gilts presented higher ovulation rate, weight and length of uterus, and length and thoracic circumference of fetuses. Nevertheless, number of fetuses was similar in all groups at 90 days of gestation suggesting that Piau females present higher survival rates of the conceptuses. The results showed differences between the genetic groups related to fetal and placental development, gestational losses, number of ovulations and uterine development. In addition, an intermediate status of fetal weight was observed in Piau/Commercial line crossbred conceptuses; thus, the selection of Piau females on reproductive traits to be mated with commercial line males would be an alternative to contribute to improvement of intramuscular fat content.

1. Introduction

In the swine industry, the main genetic groups are characterized by displaying lean meat and rapid weight gain, the result of several breeding studies. However, there are other genetic groups, such as criolla breeds, that may favorably contribute to breeding programs. Among these groups, the Piau breed presents characteristics such as rusticity, low management requirement, meat and bacon production and meat marbling [1].

Some studies have already been carried out on Piau breed,

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mainly on the conservation of breeds [1,2], candidate gene expression for intramuscular fat content [3] and ovulation rate [4], carcass traits [5,6], muscle development [7,8] and reproductive traits in males [9].

Several factors such as age, body weight, growth rate, nutrition and management can influence the manifestation of first estrus in gilts. The consideration of these factors and the physiological knowledge from the pre-pubertal stage will allow defining routine practices that favor the early entry of the litter into reproductive and productive life. Early age at puberty is also a useful feature for selecting or rejecting gilts before entering the replacement group [10].

In reproductive terms, Piau females present smaller litter size compared to commercial lineage animals, due to the lower ovulation rate [4,11] and other limiting factors such as placental development and reduced uterine capacity at all stages of gestation [12].

In pigs, regardless of genotype, the gestational period lasts 114–116 days, and is characterized by morphophysiological, metabolic and endocrine transformations, occurring both in the mother and in the concept [13] and can be influenced by factors such as genotype, litter size, season and environment [14]. During pregnancy, the sow passes through critical periods of embryonic and/or fetal losses that define litter size and are related to maternal-embryonic interaction, ovulation rate, uterine capacity, placental efficiency, and development rate of the fetus. The rate of prenatal death in pigs can reach values of 50% during the gestational period, first with embryo losses between days 12 and 15 and later between days 25 and 30 of gestation. In the fetal phase, losses occur between days 30 and 40, followed by a new loss between days 55 and 75 and near delivery [15,16].

Asynchrony of embryonic development that occurs mainly at 11–12 days of gestation can result in embryos at different stages of development, which may lead to embryonic death due to incompatibility with the uterine environment [17]. After the first 30 days of gestation, the rapid growth of fetuses promotes space limitations that can cause fetal death due to reduced uterine capacity. Thus, sows with large litters have higher rates of fetal mortality during this period [18]. After 44 days of gestation, uterine crowding can have impacts on placental development and possibly on fetal and postnatal development [18–20], although the sow placentas grow rapidly between the 20th and 60th day of gestation, which precedes the onset of accelerated fetal growth between days 75 and 90 [21,22].

Considering the importance of the genetic material of local breeds, the need to indicate specific management for each racial type, and the lack of information about reproductive performance of Piau females, two experiments were conducted. First, we evaluated the events of puberty and sexual maturity of Piau and Commercial lineage females. Additionally, we evaluated the morphological changes of embryos/fetuses, placenta and uterus during the first 90 days of gestation and their relation with embryo and fetal losses in commercial gilts and Piau gilts mated with commercial line males (cross-mated) or Piau males.

2. Material and methods

2.1. Local and ethics

The experiments were carried out in the Pig Breeding Farm of the Department of Animal Science of the Universidade Federal de Viçosa (GMS/UFV). The farm is located at an altitude of 660 m, 20°45′16.3″ South and 42°52′57.02″ West, in Viçosa, Minas Gerais, Brazil. The studies were approved by the Ethics Committee for the Use of Animals - CEUA/UFV, proc. n° 12/2013 and n° 13/2013.

2.2. Animals and experimental design

2.2.1. Experiment I

Thirty seven Piau breed and 25 commercial lineage (Talent®, Topigs Norsvin) gilts were used; they were selected on weaning phase (from 120 days of age). Posterior to weaning phase, the gilts were housed in collective bays of five animals and fed with soy/corn-based growth ration according to nutritional management of GMS/UFV and *ad libitum* water supply.

From 120 days of age until the manifestation of third estrus, gilts were exposed for 5–10 min to a sexually mature male twice daily (06:00 and 18:00). Two commercial males 11 months old were used. The standing reflex was considered as the physiological sign of estrus.

Puberty was registered when the gilts, for the first time, demonstrated external sign of estrus by standing reflex. Females that demonstrated estrus cyclically (every 21 days on average) three times in a row were considered sexually mature.

In each estrus, data about body weight and estrus duration were registered. After third estrus, females were slaughtered and the ovaries were collected to determine the ovulation rate from the number of corpora lutea.

2.2.2. Experiment II

We used only nulliparous females for this study, 36 Piau breed and 18 Commercial line (Talent®, Topigs Norsvin), 8–9 months old at the first artificial insemination.

Females were distributed into three groups according to the mating used in the artificial insemination: Commercial (n = 18), commercial line females inseminated with semen of commercial line male; cross-mated (n = 18), Piau females inseminated with semen of commercial line male; Piau (n = 18), Piau females inseminated with Piau semen.

Each group was subdivided into six subgroups (3 animals each) according to gestational age: seven, 15, 30, 45, 60 and 90 days after artificial insemination. These ages were classified as embryonic phase (seven, 15 and 30 d) and fetal phase (45, 60 and 90 d), based on events of prenatal mortality, uterus growth, embryos and fetuses' growth and placentation [15,16].

The females were housed in collective bays of five animals and fed during the gestational period with ration for gestation phase and *ad libitum* water supply.

2.3. Artificial insemination

At the third estrus, the females of experiment II were inseminated 12 and 24 h after the onset of estrus. The females were inseminated with semen from a male of commercial line (commercial and cross-mated groups) and a Piau male (Piau group) that belong to the same herd, with proven reproductive efficiency (andrological examination and reproductive history).

The inseminating doses were prepared with a volume of 100 mL (BTS® + semen), concentration of 3×10^9 sperm/dose and stored at 15 °C for up to 72 h. Artificial insemination was performed by deep intracervical deposition of the semen [23].

2.4. Slaughter and morphological analyses

Females were slaughtered at the pre-determined time (seven, 15, 30, 45, 60 and 90 days) after the artificial insemination. After slaughter, the ovaries were collected and the corpora lutea (CL) were counted to determine ovulation rate. The uterus was weighed and then a longitudinal incision was made on the antimesometrial border to expose the embryos/fetuses. At all stages of gestation, the embryos/fetuses were counted to determine conception rate (1)