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# Study of fertility, fetal survival and prolificacy in relation to social rank in multiparous Iberian sows

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**Abstract.** The causes of the low prolificacy of the Iberian pig are unknown, and embryo mortality has not been characterized in this breed, for which breeding and gestation are usually managed in groups, thus resulting in stress related to social hierarchy that could affect its reproductive efficiency. Therefore, the objective of this study was to determine the influence of social rank on fertility, embryo mortality and prolificacy in the Iberian pig. Multiparous Iberian sows ( $n=39$ ) were weaned at  $35\pm3$  postpartum days and then were bred in 4 corrals using 4 boars during  $\approx 40$  days. Social rank of sows (R1=dominant; R2=intermediate; R3=subordinate) was determined during feeding, using the 4 corrals up to  $\approx 90$  days post-weaning and then a single, larger corral. Sows were scanned by ultrasonography at 20-30, 35-45 and 50-60 post-coitum days. Body weight was similar among ranks. Conception rate at first estrus was lower for R3. Fetal survival after 40 days of gestation was greater for R2 than for R1 and R3. However, R3 sows tended to farrow more live piglets and to yield heavier piglets at weaning.

**Keywords.** Iberian pig – Behavior – Litter size – Embryo mortality – Ultrasonography.

## ***Etude de la fertilité, survie embryonnaire et prolificité en fonction de la hiérarchie sociale chez les truies multipares de porc Ibérique***

**Résumé.** Les causes de la faible prolificité du porc Ibérique ne sont pas connues, et la mortalité embryonnaire n'a pas été caractérisée pour cette race, chez laquelle on a l'habitude de manipuler ensemble la mise à la reproduction et la gestation, résultant en un stress dérivé de la hiérarchie sociale qui pourrait diminuer son efficacité reproductive. L'objectif de cette étude était d'identifier l'influence du rang social sur la fertilité, la mortalité embryonnaire et la prolificité chez le porc Ibérique. Des truies Ibériques multipares ( $n=39$ ) ont été sevrées à  $35\pm3$  jours post-partum, et elles ont été placées dans 4 enclos différents avec 4 verrats pendant 40 jours. Le rang des femelles (R1=dominantes; R2=intermédiaires; R3=subordonnées) a été déterminé pendant la distribution de la nourriture, en utilisant les 4 enclos jusqu'à  $\approx 90$  jours après le sevrage, et un enclos plus grand ensuite. Les truies ont été échographiées à 20-30, 35-45 et 50-60 jours post-coïtaux. Le poids corporel était similaire entre rangs. Le taux de conception à la première chaleur était inférieur pour R3. La survie fœtale postérieure à 40 jours de gestation était plus élevée pour R2 que pour R1 et R3. Cependant, les R3 tendirent à mettre bas plus de porcelets vivants et à les sevrer plus lourds.

**Mots-clés.** Porc ibérique – Conduite – Prolificité – Mortalité embryonnaire – Ecographie.

## **I – Introduction**

Many studies have been published reporting productive data related to reproduction in the Iberian pig, but the information about the reproductive physiology of the Iberian female is very scarce, probably due to the limited geographic distribution of this breed. In fact, the ovulatory, uterine and fetal components related to litter size in this breed are still unknown. However, this information is really needed for this breed, which is known by its low prolificacy in comparison with the main European breeds (Dobao *et al.*, 1988; Vázquez *et al.*, 1994). In the Iberian pig, the mean litter size is seldom greater than 7, and it increases with parity up to a maximum mean of 9.5 from the 5<sup>th</sup> to the 8<sup>th</sup> farrowing (Vázquez *et al.*, 1994). Besides, the new European regulations on animal welfare make group housing of female pigs during gestation mandatory, which poses many questions about the influence of stress on reproduction in this and other

breeds. Stress occurring close to ovulation can delay or inhibit it in farm animals (Dobson and Smith, 1995), and a low welfare level may decrease prolificacy in pigs (Robert, 1992). In addition, the social rank of group-housed female pigs, which is attained by stressful, aggressive interactions, affects reproductive efficiency and results in lower fertility and prolificacy in lower-rank females (Hoy *et al.*, 2009). Therefore, stress arising from hierarchical interactions among females must be considered in modern pig production, and more specially in the case of the Iberian pig, which being an old breed might be more sensitive to social rank related mechanisms for population regulation, as it is known to happen in many wild mammals. Moreover, the usually extensive management of Iberian females may exacerbate these hierarchical interactions. Thus, the objective of the present study was to determine the effect of social rank of group-housed Iberian sows on fertility, fetal survival and prolificacy.

## II – Materials and methods

Multiparous Iberian sows ( $n = 39$ ) were used in this study, which was conducted at the research farm of the agricultural Research Center of Extremadura (Southwestern Spain). Sows were weaned at  $35 \pm 3$  postpartum days (as usual for this breed) in 4 consecutive weaning lots, one lot every 7 days in June-July. After weaning, sows were housed in 4 outdoor corrals of  $\approx 80 \times 20$  m with an Iberian boar in each. Systematic observations (8-10 AM and 5-6 PM) for estrous activity and estrous-related behavioral, hierarchical interactions were done during the first 8 days post-weaning. The mating period lasted for  $\approx 40$  days. Sows were weighed at the end of the mating period and remained in these 4 corrals for  $\approx 50$  more days after boar withdrawal. Then, at  $\approx 90$  days post-weaning, sows were joined in a large paddock until  $\approx 7$  days before farrowing, which took place in indoor farrowing crates, where the dams remained until the ensuing weaning. The social rank of the sows was evaluated by performing *food competition tests* (Andersen *et al.*, 1999), which were performed in the 4 corrals, weekly during the mating period and every 2 weeks afterwards. Dorsal marking with paint spray aided to easily identify the individual animals. After boar withdrawal, and to improve rank evaluation, a greater range of rank scores was obtained by re-grouping the sows according to their previous rank. All the partial scores from each sow were used to obtain the overall rank: dominant (R1), intermediate (R2) or subordinate (R3).

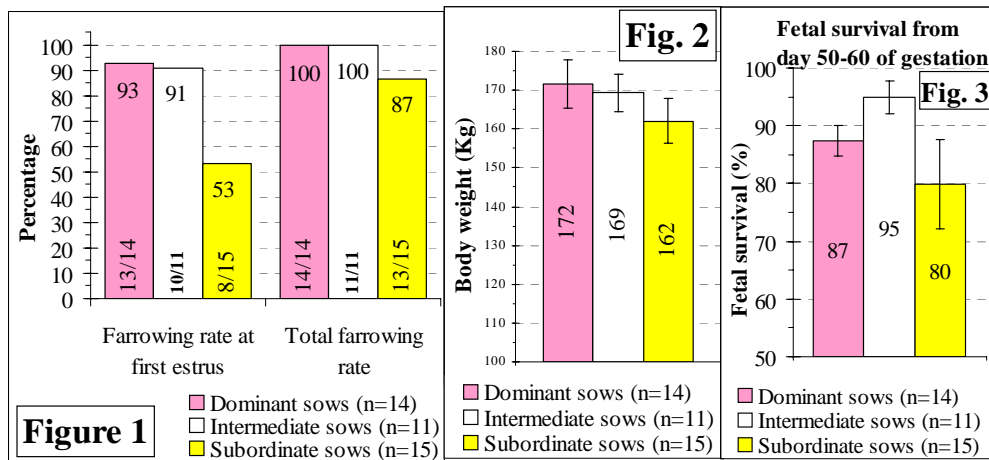
Transabdominal ultrasound scanning was performed to diagnose pregnancy and to attempt the counting of conceptuses (embryonary vesicles or placental cavities of feto-placental units). Sows were scanned on 3 days, namely on post-coitum days 20-30, 35-45 and 50-60. A scanning crate, specially designed for this study, was used to restrain the animals while feeding, thus easing precise scanning and minimizing stress, which could alter the reproductive results. An Aloka-SD500 ultrasound scanner and 2 types of deep penetrating, 3.5 MHz ultrasound probes were used, one convex and narrow (4 cm) and another linear and long (17-cm transducer head). To count conceptuses, both uterine horns were scanned with the convex probe in the usual way, and then the long linear probe was used to check for accuracy of the spatial distribution of cavities. The digital images were stored and re-played in slow motion. Percentage continuous variables were arcsin-transformed before statistical analysis.

## III – Results and discussion

The farrowing rate (Fig. 1) resulting from the first post-weaning estrus was smaller ( $p < 0.05$ ) for R3 sows (only 53%) than for R1 and R2. The total farrowing rate (including that resulting from repeating estruses) was 100% except for R3 sows, from which 1 did not conceive and another lost its pregnancy after day 58 post-coitum. These results suggest that the reproductive problems related to social rank and the possibly related stress occurred mainly for the lowest rank females, while the intermediate sows, interestingly, performed as well as the dominant animals. A possible explanation may be that R1 sows only could keep their attention on chasing

the lowest rank females. It must also be noticed that social rank did not significantly depend on body weight ( $p>0.1$ ; Fig. 2). This suggests that social hierarchy might be mainly based on psychological, behavioral factors related to aggressiveness instead of body strength related factors. Therefore, managerial decisions about female group arrangements should not be based only on body size.

Counting conceptuses was very difficult between 20 and 40 days of gestation because of the contorted placental cavities found. However, with the methodology applied, it was feasible to count them during the 3<sup>rd</sup> scanning (day 50-60 of gestation) in a repeatable way, because of their more regular shapes. Nevertheless, a slight overestimation was difficult to avoid because of the tight, crowded arrangement of large placentae at this stage, which frequently made fetuses and cavities show up twice. The presence of mummies further hampered image interpretation due to their blurry placental content. However, the overestimation of conceptus count (excluding a 12-fetus pregnancy lost) vs total born number (born alive + stillborn + mummies) was not significant ( $10.3\pm0.4$  vs  $9.7\pm0.4$ ;  $p>0.1$ ), and their correlation was acceptably high ( $r=0.74$ ;  $R^2=0.54$ ; data not shown). Pig conceptuses can be reabsorbed only until day 35-40 of gestation, but most of the mummies formed during early pregnancy (before day 50) are too small to be detected at farrowing (Van der Lende & Van Rens, 2003). The fetal survival rate (Fig. 3) from the 3<sup>rd</sup> scanning with respect to the number of piglets born (either alive or stillborn, thus excluding the mummified fetuses) was higher ( $p<0.05$ ) for R2 than for R1 and R3.



**Figs 1-3. Fertility, body weight and fetal survival depending on social rank.**

Moreover, R1 and R3 had 5 and 2 litters with mummies, respectively (13 mummies in total), and R3 totally lost a 12-fetus pregnancy after that scanning, but no mummies were found in R2 litters. Only these data, regardless the echographic study above described, yields also a greater fetal survival rate for R2 vs R1 and R3 ( $100\pm0\%$  vs  $94\pm2\%$  and  $90\pm7\%$ , respectively;  $p<0.05$ ; data not shown). This greater fetal survival of R2, again, suggests that R2 females had less stress, maybe because the R1 and R3 groups were more involved in aggressive or defensive behaviors. In contrast, the number of conceptuses present at the 3<sup>rd</sup> scanning was similar ( $p>0.1$ ) for the 3 ranks (Fig. 4), which is consistent with other studies (Van Wettere *et al.*, 2008) showing no effect of hierarchical fighting related to re-grouping during early gestation on embryo survival.

The number of born alive + stillborn was similar among ranks (R1:  $9.1 \pm 0.6$ ; R2:  $9.9 \pm 0.1$ ; R3:  $9.3 \pm 0.6$ ;  $p > 0.1$ , data not shown). However, R3 sows tended to have more born alive and less stillborn piglets ( $p < 0.1$ ; Fig. 4). Perhaps lower rank females are less stressable during parturition and, thus, have a lower incidence of hypoxic stillborn piglets. This good maternal trait could be consistent with less aggressive females, perhaps partially explaining the origin of their rank. Piglet weight at weaning tended ( $p < 0.1$ ) to be smaller for R3 vs R2 litters (Fig. 5). Coefficients of within-litter variation for growth traits were very similar among ranks (Fig. 5). At weaning, piglet survival and litter weight were also similar among ranks (Figs 4 and 6;  $p > 0.1$ ).

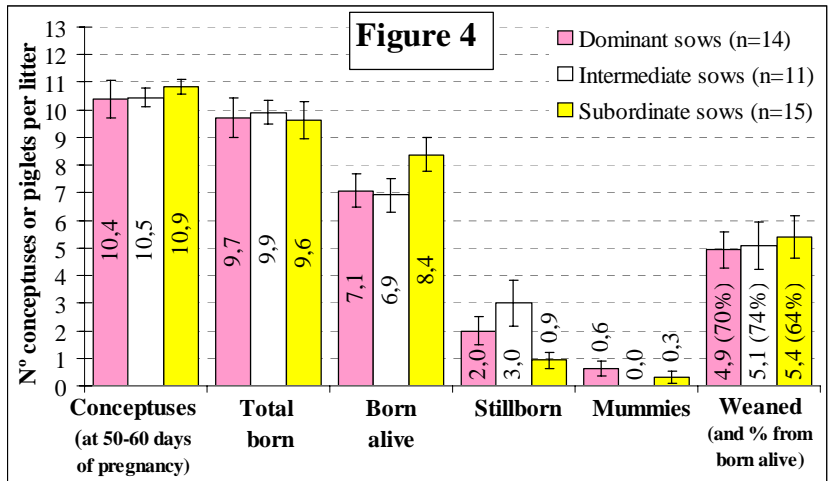
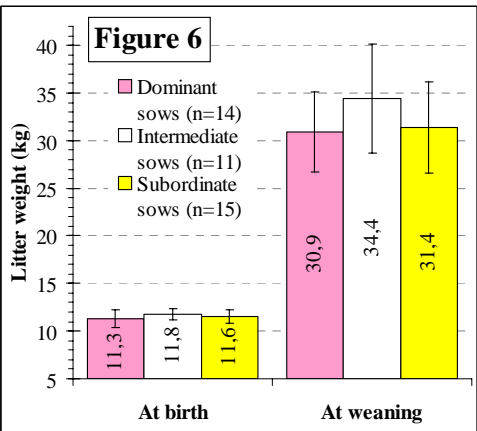
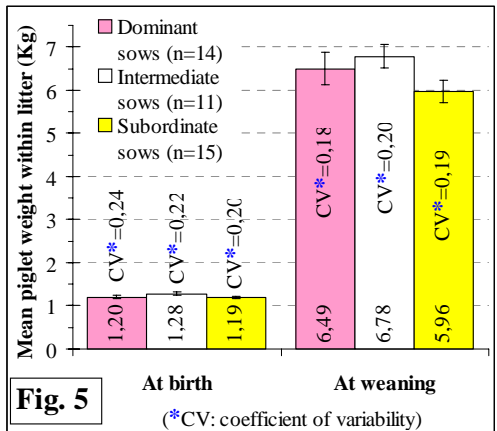


Fig. 4. Litter size. Due to conception failure and pregnancy loss,  $n=14-13$  for Subordinate sows.



Figs 5-6. Piglet and litter weight at birth and weaning. Subord.:  $n=13$  due to missed farrowings.

Having greater litters, this may imply that R3 females had good maternal traits. In conclusion, social rank affected reproductive traits mainly in R3 sows, as expected, but, surprisingly, R2 females were less affected than the dominant, R1 sows. In contrast, R3 sows may have

superior maternal traits. Finally, social rank is not only based in body weight, which may be an issue to be considered when re-grouping females.

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