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Teat order affects postweaning behaviour in piglets

A ordem da teta afeta o comportamento pós-desmame em leitões

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ABSTRACT

The objective of this study was to investigate if piglets that suck anterior teats differ from the others in the litter in birth weight, if they have higher growth rate during lactation, and if this affects behaviour and post-weaning weight gain, when piglets change to a solid diet. For this, the teat order of 24 litters was determined during suckling. Piglets were weaned on the 28th day of age, and 24 groups were formed, composed of one piglet that sucked on the first two pairs of teats (AT) and three piglets that sucked on the other teats (OT). Even though weight at birth did not vary according to teat order, weight gain at weaning differed between the groups (AT: 6.64, S.E. 0.20kg, OT: 5.73, S.E. 0.13kg; $P<0.001$). After weaning, AT piglets spent more time lying ($P<0.01$) and less time eating ($P<0.01$) and vocalizing ($P<0.01$), than the other piglets. Other behaviours (agonistic interaction, escape attempt and drinking) did not differ between the groups. Piglets that sucked anterior teats gained more weight until weaning, suggesting they took in more milk; this fact might have lead them to have less contact with solid food before weaning, influencing their post-weaning alimentary behaviour.

Key words: weaning, social behaviour, vocalization, feeding, stress.

RESUMO

O objetivo deste estudo foi verificar se leitões que mamam nas tetas anteriores diferem dos demais da leitegada no peso ao nascimento e tem maior taxa de crescimento durante a lactação, e se isso influencia o comportamento e ganho de peso pós-desmame, quando os leitões passam a receber dieta exclusivamente sólida. Para isso, a ordem da teta foi determinada durante a fase de amamentação em 24 leitegadas. Aos 28 dias de idade, os leitões foram desmamados e foram formados 24 grupos, compostos por um leitão que mamava nos dois primeiros pares de tetas (AT) e três leitões que mamavam nas demais tetas (OT). Embora o peso ao nascimento não tenha diferido de acordo com

a ordem da teta, o ganho de peso até o desmame diferiu entre os grupos (AT: 6,64, EP 0,20kg, OT: 5,73, EP 0,13kg; $P<0,001$). Após o desmame, AT passaram mais tempo em repouso ($P<0,01$) e menos tempo comendo ($P<0,01$) e vocalizando ($P<0,01$), quando comparado com os demais. Outros comportamentos (interação agonística, tentativa de fuga e bebendo) não diferiram entre os grupos. Os leitões que mamavam nas tetas anteriores ganharam mais peso até o desmame, o que sugere que ingeriam mais leite; isso pode ter levado a um menor contato com alimento sólido antes do desmame, por sua vez, influenciando o comportamento alimentar pós-desmame.

Palavras-chave: desmame, comportamento social, vocalização, alimentação, estresse.

INTRODUCTION

At weaning piglets are subjected simultaneously to multiple stressors, including the loss of their mother and her milk - which is their main source of nutrition - and the change of physical environment and social group (WEARY et al., 2008; HÖTZEL et al., 2011). These changes are abruptly imposed on piglets, generally between 21 and 28 days of age, which is premature in relation to the physiological and social development of the species, and hinders their adaptation to these stressors (WEARY et al., 2008). These severe social, environmental and nutritional changes related to weaning in pigs result in a low intake of food (PAJOR et al., 1991).

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Management practices that promote an increase in food consumption during the post-weaning period can contribute positively to the adaptation of piglets to the new nutritional, physical and social environment (WEARY et al., 2008). In order to reach this goal, it is essential to understand the factors that influence feeding behaviour of piglets during the post-weaning period. One of these factors is the previous experience with solid food before weaning. Within the same litter, the piglets which consume more solid food during lactation are usually the first ones to try to consume feed after weaning (SULABO et al., 2010). However, even though offering creep feed to piglets from their second week of life is a common practice, their consumption is low and too variable amongst the individuals of the same litter and amongst litters (PAJOR et al., 1991; PLUSKE et al., 2007).

In rearing systems that allow the sow to regulate suckling frequency, either by natural (HÖTZEL et al., 2004) or artificial (WEARY et al., 2002) means, there is a decrease in suckling frequency associated with a higher frequency of feeding right after weaning. This suggests that feed intake and feeding behaviour after weaning are inversely related to piglets' milk intake during lactation (WEARY et al., 2008). The anterior teats of sows produce more milk than the posterior teats (SKOK et al., 2007) and piglets that suckle anterior teats gain more weight during lactation (PEDERSEN et al., 2011). Since the intake of solid food is low until around the 28th day of age (PAJOR et al., 1991; PLUSKE et al., 2007), it can be concluded that the greater weight gain at weaning in piglets that suck on anterior teats is due to the fact that these piglets drink more milk. PLUSKE et al. (2007) suggested that piglets that suck from anterior teats would be less motivated to seek other sources of food, ignoring the solid diet.

Besides low food intake, during the first days after weaning, piglets show an increase in the frequency of behaviours that indicate a stress response, amongst them agonistic and abnormal behaviours, vocalization and agitation (HÖTZEL et al., 2011). It has also been suggested that hunger and damage to the gastrointestinal tract resulting from the low intake of food might add to the other weaning stressors, exacerbating the stress response (FRASER et al., 1998). The objective of this study was to verify if the piglets that suck anterior teats differ from the others in the litter in terms of birth weight and have the highest growth rate during lactation, and if it affects behaviour and post-weaning weight gain, when piglets intake only a solid diet.

MATERIAL AND METHODS

Twenty-four litters, with 8.6 ± 2.5 (mean \pm SE) piglets/litter, from multiparous F1 sows (Landrace \times Large White) cross-bred with MS60 (Duroc \times Large White \times Pietran) were used. A week before expected parturition the sows were moved to a lactation unit where they were housed in individual standard farrowing crates (2.2 \times 0.6m), within a pen of 2.2 \times 1.87m with a plastic slatted floor. There was a creep area of 0.4 \times 0.6m in the pen, with concrete walls and solid wooden floor covered with shavings. Creep area temperature was provided by radiant heat lamp. Both sows and piglets had free access to water from nipple drinkers in the pen. The sows were offered *ad libitum* access in a semiautomatic feeder to a concentrated diet of 3300kcal ME kg⁻¹ and 17.11% of crude protein. The piglets were offered *ad libitum* access to a concentrated diet containing 3500kcal ME kg⁻¹ and 16% of crude protein, from 2 weeks of age, in a manual feeder placed on the ground. Both the maternity and the farrowing pen had natural ventilation.

In order to determine the teat order, five daily suckling events were observed between the 10th and the 15th day after birth (25 suckling events were observed). In the beginning of each day, piglets were identified by numbers on their dorsal using a non-toxic marker pen, proper for this. The piglets that suckled only at the two pair of cranial teats were classified as "anterior teats" (AT) and the ones that suckled other teats were classified as "other teats" (OT). Cross fostering was made on the day of birth, when necessary, between litters born at the same day and no rejection was observed. All piglets were weighed at birth and at weaning; the piglets used to assess the post-weaning behaviour were also weighed on the morning of the fifth day after weaning.

Weaning was carried out when the piglets were on average 28.2 ± 0.3 days old. Twenty-four groups of four piglets were formed from different litters, homogeneous in weight, sex and age, and containing one AT and three OT piglets. They were placed in a 0.8 \times 1m pen with a nipple drinker and a manual feeder.

Behavioural observations were made by direct observation made from two observers – previously calibrated to ensure reliability of results – during the whole lactation and post-weaning periods. The behaviours observed were: lying (standing-up, inactive, lying or asleep), eating (mouth in contact with the feed), drinking (mouth in contact with the drinker nipple), agonistic interactions (harming or

being harmed by another animal, biting, pushing another animal aggressively or in retaliation to an aggressive attack), escape attempt (attempting against the pen grades, placing the front paws on the cage or jumping towards the pen edges, trying to escape) and vocalization (grunting or whining. This behaviour could be observed associated with the others). Scans were made every 2 minutes, between the first and fourth day post-weaning (day 1 = weaning day). On the first day, the observations were made from 11:00 to 15:00, immediately after weaning. On the rest of the days, the observations occurred from 7:00 to 11:00, resulting in 120 observations / group / day. Daily frequencies for the statistical analysis were used.

For the statistical analysis, piglets' body weights were corrected to 28. Only the piglets that were used in post-weaning behaviour observation (24 groups of 4 piglets) were used to calculate weight and weight gain between weaning and five days after it, also making the weight correction to 33 days of age.

The teat order influence (AT vs. OT) on birth weight, at weaning day, on the fifth day post-weaning and the weight gain between those periods were accessed using the MIXED procedure of SAS (version 9.1 Inst. Inc., Cary, NC). The statistical model included teat order, sex and order*sex interactions as fixed and pen (order*sex) as random effects. The association between sex and teat order variables was accessed through the frequency test Cochran-Mantel-Haenszel.

Behaviour frequencies (eating, drinking, lying, agonistic interactions, escape attempt and vocalization) were turned into square root + 1 and analysed using the MIXED of SAS (9.1 version Inst. Inc., Cary, NC), but original values were used for the presentation of results. Teat order, day and order* day as fixed effects, pen (teat order) as random

effects, and day as repeated measure were included in the model. The command LSMEANS was used for means separation and significance was set at $P \leq 0.05$. Pearson's correlation established possible association among some behaviour.

RESULTS

There was no difference in birth weight between the AT and OT piglets. Nevertheless, AT piglets ended up heavier than OT piglets at weaning, and five days after weaning (Table 1). There was no sex effect on the piglets on birth weight, or on weight gain (Table 1). There was, however, an association between the teat order and the sex of piglets ($P=0.04$), where 70% of the AT piglets were male.

Weight gain was greater in AT piglets than in OT piglets between birth and weaning, but not in the period between weaning and the fifth day after weaning. There was a positive correlation between birth weight and weight at weaning ($r=0.53$; $P<0.0001$).

Teat order had an effect on the behaviour of piglets. In the first days after weaning, AT piglets spent less time eating ($P<0.01$) and vocalizing ($P<0.01$) and more time lying ($P<0.01$) than OT piglets. The frequency of behaviours also changed over time. From the third day onwards, there was a significant reduction ($P<0.001$) in agonistic interactions, escape attempts and vocalizations and, on the fourth day, teat order effects were not observed (Figure 1).

Some behaviours of the AT piglets group showed significant correlations amongst them. On day one, there was a negative correlation between escape attempts and lying behaviour ($r=-0.54$; $P<0.01$). On day two, there were negative correlations between lying and escape attempt behaviours ($r=-0.76$; $P<0.002$), eating and drinking behaviours ($r=0.56$; $P<0.004$), and between vocalizing and escape attempt

Table 1 - Piglets' performance by teat order (TA= anterior teats and OT= other teats) and by sex.

	-----Teat order-----		-----Sex-----		SEM	-----P Value-----	
	AT	OT	Female	Male		Order	Sex
N. of piglets at birth	72	135	85	122			
Weight at birth (kg)	1.79	1.69	1.72	1.76	0.08	0.16	0.59
Weight at 28 days (kg)	8.64 ^a	7.53 ^b	8.03	8.13	0.35	0.002	0.78
WG until 28 days (kg)	6.64 ^a	5.73 ^b	6.12	6.21	0.29	0.002	0.76
N. of piglets after weaning	24	69	43	50			
Weight at 33 days (kg)	8.65 ^x	7.52 ^y	8.00	8.15	0.59	0.06	0.80
WG until 33 days (kg)	7.04 ^a	5.77 ^b	6.39	6.42	0.56	0.03	0.95
WG between 28-33 d (kg)	0.67	0.51	0.52	0.68	0.27	0.57	0.55

^{ab}Indicates the significant differences ($P<0.05$) in the lines. ^{xy}Indicates a tendency to differences ($P<0.10$) in the lines. WG = average weight gain in this time.

behaviours ($r=0.76$; $P<0.001$). On days three and four, there was a negative correlation between eating and lying behaviours (day 3: $r=-0.53$; $P<0.007$ and day 4: $r=-0.71$; $P<0.007$).

DISCUSSION

Birth weight of the piglets did not influence the establishment of the teat order. While some studies report that larger piglets establish themselves on anterior teats (FRASER & JONES, 1975), other studies support the current results (PLUSKE et al., 2007; SKOK et al., 2007). Some explanations about the preference for anterior teats are that the piglets that choose these teats are attracted by the vocalization of the sow, even before checking the quantity of milk available (JEPPERSEN, 1982), or that choice or discovery of a certain teat occurs randomly; after that, the setting of a fixed order would occur because piglets which defend the first teat it has established it after birth (SCHEEL et al., 1977).

The finding of a positive correlation between birth weight and weaning weight is consistent with studies that show that birth weight is the major determinant of weight gain until weaning (LITTEN et al., 2003; BÉRARD et al., 2010). However, between birth and weaning, the piglets that suckled anterior teats gained more weight than the other piglets, confirming results from other studies (FRASER & JONES, 1975; PLUSKE et al., 2007; SKOK et al., 2007; PEDERSEN et al., 2011). This can be attributed to a greater milk intake after birth in piglets that suckle anterior teats, as it has been shown that the anterior mammary glands of the sow tend to produce more milk than the posterior ones (BARBER et al., 1955; SKOK et al., 2007), and there is a correlation between milk intake and growth of piglets until the third week of nursing (BARBER et al., 1955). In contrast, it is unlikely that the greater weight gain of AT piglets is due to differences in feed intake, as this is very low in suckling piglets during their first weeks of life. For example, PLUSKE et al. (1995) estimated that feed intake of suckling piglets contributes to between 1.2 and 17% of the daily energy intake between 21 and 35 days of age. During suckling feed intake is on average below 20g on 21 days-old suckling piglets (PAJOR et al., 1991), and below 80g on 28 days-old piglets (PLUSKE et al., 2007).

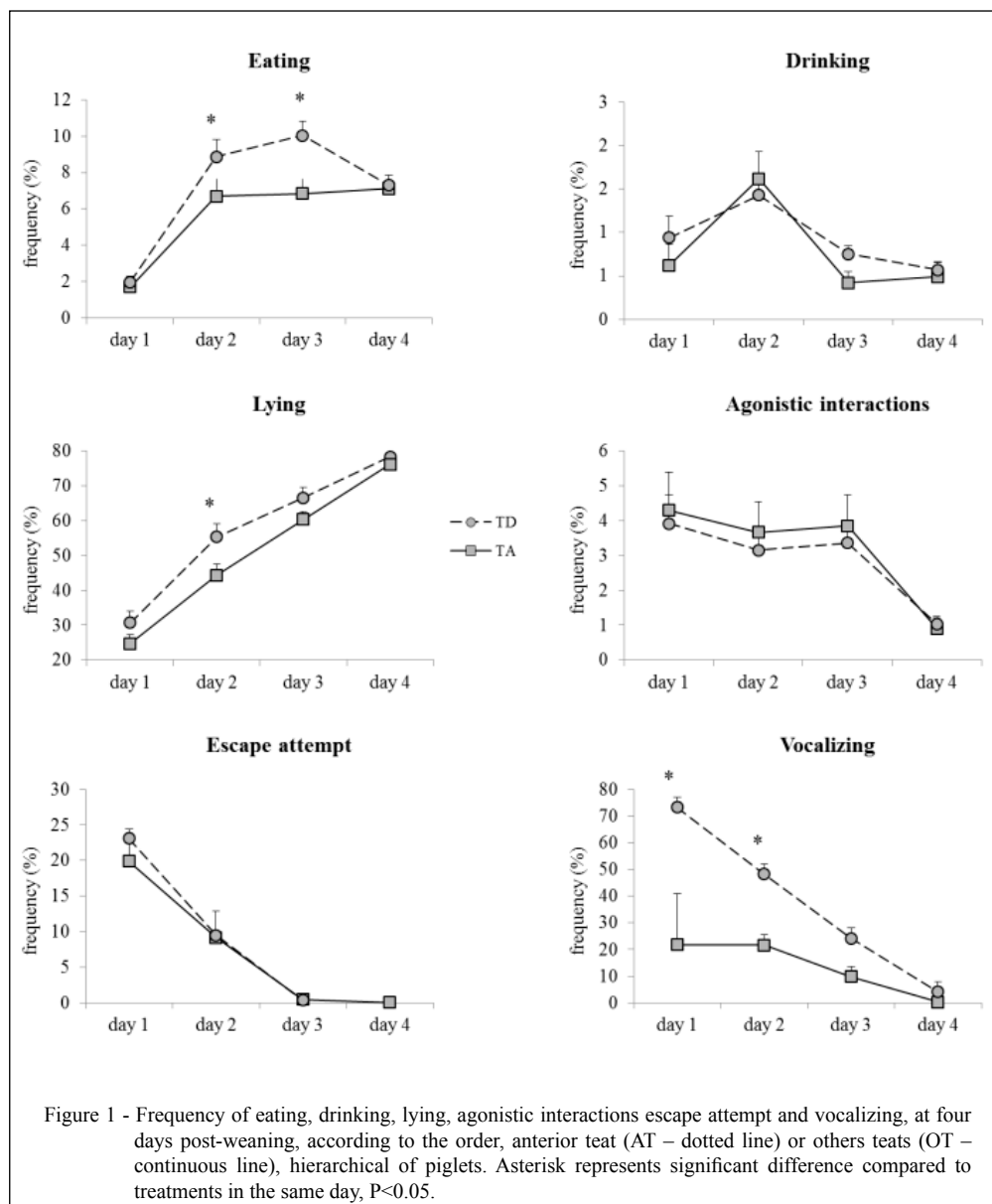
The behavioural response of piglets immediately after weaning, which was characterized by low feed intake and an increase in activity - represented mainly by escape attempts and less time lying, and an increase in vocalizations - is in

accordance with previous studies that concluded that many factors of weaning management underlie the behavioural response to weaning, such as changes in the physical and social environment (HÖTZEL et al., 2011), age at weaning (HÖTZEL et al., 2010) and quality of handling (SOMMAVILLA et al., 2011). Complementing this information, the present study demonstrates that intrinsic factors of individual piglets, associated to teat order, influence this response.

AT piglets showed a lower frequency of eating behaviour than OT piglets during the first days after weaning, as suggested by previous studies (PLUSKE et al., 2007). Some studies that artificially manipulated the contact between the sow and the piglets during the suckling period found a negative association between the frequency of milk intake and the intake of solid food (WEARY et al., 2002; KULLER et al., 2007). According to WEARY et al. (2008), these studies suggest that, regardless of the cause, the low intake of milk stimulates piglets to supply their energetic demand by taking solid food; at weaning, piglets that had more experience with solid feeding are more prepared to explore and consume solid feed than piglets that only suckled. This relation can explain the lower frequency of contact with solid food right after weaning in AT piglets.

Understanding the factors that influence ingestive behaviour after weaning is vital to propose solutions that allow avoiding or minimizing the problems resulting from low energetic intake during this period (PLUSKE et al., 1995; WEARY et al., 2008). The significant increase in the frequency of feeding on days three and four after weaning was negatively correlated with the lying frequency, therefore, it is more likely that these two types of behaviour express the motivation of early weaned piglets for exploring the new environment (HÖTZEL et al., 2011). Thus, these results suggest that the variation in the frequency of ingestive behaviours and in the intake of post-weaning food amongst piglets from the same litter (PAJOR et al., 1991) can be related to the individual differences in motivation to explore. The absence of any correlation between feeding and the stress related behaviours suggests that stress is not the main cause of the delay in the onset of solid feeding. In fact, several studies suggest that the low food intake of weaned piglets is related to other factors, such as psychomotor maturation, inexperience with chewing and little previous contact with solid food (WEARY et al., 2008).

Some authors have interpreted the increase in the vocalization frequency after weaning as a manifestation of the motivation of piglets to re-



establish the contact with their mother (WEARY et al., 2008). Piglets that suckled on posterior teats vocalized more than the larger piglets, which suckled anterior teats. MASON et al. (2003) found similar and suggested that the vocalization pattern of smaller piglets, from posterior teats reflects a greater stress due to maternal separation in these piglets than on those that suckled anterior teats. The longest time spent lying and the lower frequency of vocalizations on the first day after weaning observed in AT piglets suggests an adaptive strategy focused on coping the social stress caused by the separation from their

mother (HENNESSY et al., 2009) and in reducing the energy waste (DANTZER, 2004). As discussed in HÖTZEL et al. (2011), the energy expenditure involved during the typical response to weaning of piglets weaned in commercial systems can hinder the adaptation of piglets. It can affect the metabolism and facilitate the development of infections commonly observed during the period after weaning (PLUSKE et al., 1995). This strategy to save energy can also explain the lower frequency of vocalization in AT piglets, once this kind of behaviour involves energy expenditure (WEARY & FRASER, 1995). In

contrast, OT piglets, which had lower caloric reserves to maintain their homeostasis, were possibly more motivated to look for food or a heat source to replace their mother, which might have stimulated them to start taking solid food earlier.

Some correlations between the frequencies of different behaviours in AT piglets can help explain individual differences in weaning response. For example, escape and vocalization behaviours in the same individual showed a high positive correlation. On one hand, both behaviours are of negative valence and high excitement; thus, the correlation between the expression of these two behaviours reinforces their validity as post-weaning stress indicators. On the other hand, the absence of a correlation between the frequency of vocalizations, agonistic and escape behaviours suggest that the increase of aggressiveness observed immediately after weaning is more related to the establishment of a social order, as proposed by JARVIS et al. (2008), than to an unspecific stress response. Corroborating this hypothesis, AT and OT piglets groups did not differ on the frequency of agonistic behaviours. This suggests that teat order does not necessarily reflect the social hierarchy after weaning, in accordance with previous studies that concluded that the social hierarchy after weaning is related to the weight at the moment of the formation of the group, and not to the teat order (SCHEEL et al., 1977).

CONCLUSION

Birth weight did not influence the establishment of the teat order, but had a clear influence on the growth of piglets during the suckling period. Suckling anterior teats influenced post-weaning behaviour of the piglets, most notably by reducing the frequency of feeding behaviour and vocalizations and increasing the frequency of resting behaviour. These behaviours may explain, at least partially, the variation reported in several studies on the post-weaning behaviour amongst piglets from the same litter. This effect may be mediated by a greater milk intake of piglets that suck on anterior teats, which allows them to adopt an energy saving strategy to cope with the stressors associated with weaning.

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ETHICS COMMITTEE AND BIOSAFETY

All procedures involving animals were approved by the Ethics Committee for Animal Use (CEUA) of the Universidade Federal de Santa Catarina (PP 400/2009).

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