COMPARATIVE STUDY ON COLOSTRUM PRODUCTION AND COLOSTRUM COMPOSITION IN ALENTEJANO SWINE BREED AND LWxLR SOWS – PRELIMINARY RESULTS

Charneca, R.[1]; Tirapicos Nunes, J.[1] and Le Dividich, J.[2]

[1]Universidade de Évora – Departamento de Medicina Veterinária -ICAM – Instituto de Ciências Agrárias Mediterrânicas - Apartado 94 – 7002-554 Évora

[2]INRA, UMR-SENAH – Unité Mixte de Recherches – Systèmes d'Elevage, Nutrition Animale et Humaine - 35590 St- Gilles, France

SUMMARY- This study aimed at comparing the colostrum composition and production of Alentejano Swine Breed (AL) to modern sows (LW x LR) (LL). Ten sows from each genotype were used. All farrowings were attended. Colostrum samples were collected at birth of the first piglet and at regular intervals during 36 h after the onset of farrowing. One sample of milk was also collected at d 15 of lactation. Piglets were weighed at birth and at 24 h of age. AL sows had lower gestation length ($p < 0.001$) and litter size ($p < 0.05$). Piglets from AL sow were lighter at birth ($p < 0.001$), gained less weight ($p < 0.001$) and consumed less colostrum ($p < 0.001$) than LL piglets between birth and 24 h of age. AL sows produced less colostrum ($p < 0.001$) than LL sows. Within each genotype colostrum consumption of piglets was dependent on birth weight ($p < 0.001$). Production of colostrum was dependent on litter weight (piglets born alive) at birth but not on litter size. Mortality rate between birth and weaning averaged 24.3% for AL piglets and 14.3% for the LL piglets, with most of losses occurring within 3 days after birth. In both genotypes, piglets dying before weaning were lighter at birth and consumed less colostrum than survivors. Further studies are required to determine the respective role of birth weight and colostrum consumption in post-natal mortality and to determine the immune quality of colostrum.

Key words: alentejano swine breed, colostrum, piglets, mortality

INTRODUCTION

The Alentejano swine breed is known to be less prolific while piglets mortality between birth and weaning is higher when compared to improved genotypes raised under intensive systems (Charneca, 2001). Colostrum is essential for piglet survival and growth, providing the piglets with immunoglobulin and energy during the first hours following birth (Le Dividich *et al*. 2005). Colostrum production of the sow and consumption of the piglets estimated indirectly from the change in piglets body weight between birth and 24h are very variable (Le Dividich *et al*., 2004; Devillers *et al*., 2005). The colostrum composition changes very rapidly towards that of milk during the first 24-36 hours post-partum (Klobasa *et al*., 1987).

Colostrum intake in piglets depends on both the ability of the sows to produce colostrum and on that of the piglets to extract the colostrum from the mammary glands which is influenced by the piglet body weight and piglet vitality (Devillers *et al*., 2007). However there is little scientific data on the composition or on both the production of the sow and consumption of the piglet from Alentejano swine. In this study we report preliminary results on colostrum composition, production of the sows and consumption of the piglets when AL sows are compared to modern sow raised under the same farrowing and nursing environmental conditions.

MATERIAL AND METHODS

The experiment was carried out in the Experimental Centre of Mitra – University of Évora – Portugal.

Animals: Ten Alentejano breed sows (AL) and 10 Large-White x Landrace (LL) sows and their litters were used. The Alentejano sows were mated by AL boars whereas Large-White x Landrace (LL) sows were mated by a Large-White boar. Average parity was 3.2 ± 0.8 and 3.6 ± 0.8 for Al and LL sows, respectively.

Housing. The LL sows were always kept in indoor swine facilities. During gestation they were raised in groups (3-4 sows per group) on solid concrete floor. AL sows were raised as were LL sows during the first month of gestation. After ultrasonic confirmation of gestation they were moved to an outdoor park (4.5 ha of total area), where they had access to floorless arks. Seven days before the expected farrowing date, all sows were moved to the farrowing house and placed in individual conventional farrowing crates with concrete slatted floor in the sows' area and plastic floor in the piglets areas. Piglets were provided with local heating consisting of one infra-red lamp (175W) suspended above the creep area. Piglets were weaned at 28 days. In all facilities and parks, sows had free access to water from low-pressure nipple-drinkers.

Feeding. During gestation, the LL sows were fed twice a day with ~3 Kg of commercial diet containing (per Kg diet) 3200 Kcal DE, 160g CP and 7g lysine. AL sows were fed twice a day ~2.0Kg of the same commercial diet during the first month of gestation. In the outdoor pasture park they received the same amount and type of feed, but given once a day. Care was taken to spread the feed in the field. In the farrowing day no feed was provided to the sows and thereafter the lactation diet containing (per kg diet) 3300 Kcal DE, 170g CP and 10.5g lysine was gradually increased until *ad libitum.* Individual feed intake was not determined. However, during gestation sows were grouped on the basis of body weight and age in order to reduce competition and hence to avoid large differences in feed intake. Piglets had access to a creep feed containing (per Kg diet) 3400 Kcal DE, 190g CP and 12.4g lysine, starting on d14 of lactation. Piglets were weaned at 28 d of age.

Farrowing surveillance and samples collection. All farrowing were supervised but none was induced. Soon after birth, piglets had their umbilical cord cut at about 10-12cm from the navel after which they were identified (ear tag) roughly dried, weighed and returned to the sow. These operations were performed very quickly, usually within 2 min of birth. At 24 hours after birth, piglets were re-weighed. Piglets dying during the nursing period were weighed and approximate death time recorded. Colostrum consumption of the piglets between birth and 24 h of age was estimated according to the prediction equation of Devillers *et al.* (2004).
Colostrum (50-100ml) was collected from at birth of the first piglet and at 3, 6, 12, 24 and 36 hours after the birth of the first piglet, immediately filtrated on gauze and stored at -20ºC until they were analyzed. Milk samples were also collected at d15 of lactation. Sows were intramuscularly administered oxytocin (20 IU) to induce colostrum and milk release from 3 h onwards. Colostrum or milk letdown typically occurred 3 to 4 min later.

Analytical procedures. Dry matter (DM) of colostra and milk was determined after drying at 102ºC until constant weight. Crude protein (CP) was determined according to Dumas method (CP= N x 6.38) using a LECO FP-528 Nitrogen/Protein Determinator. Total lipids (LIP) content was determined according to Gerber method (AOAC, 1990) and lactose was determined using a commercial kit Boehringer Mannheim ® Lactose/D-Galactose (ref. 0176303).

Statistical analysis. All data were analysed using the NCSS (2001) software. Sows reproductive and productive traits data were analysed using the general linear model (GLM) procedure with the one-way analysis of variance (ANOVA) using genotype as fixed effect. Litter weight gain and colostrum production of the sow, were also analysed by covariance using litter size and litter weight (live born piglets) as covariates. Colostrum and milk data were analyzed using a split-plot ANOVA with genotype as the main effect and sampling time as a repeated measure. Tukey-Kramer test was used to separate means. Newborn piglets' weights, weight gain from birth to 24h of age, colostrum intake and data were analysed using the general linear model (GLM) procedure with the one-way analysis of variance (ANOVA) using genotype as fixed effect. Colostrum intake (g/Kg BW) was also analysed by covariance using litter size as covariate. Finally all piglets data were analysed using the general linear model (GLM) procedure with the one-way analysis of variance (ANOVA) using piglets status at weaning (survivor or dead) as fixed effect.

RESULTS AND DISCUSSION

Reproduction performance is presented in tables 1 and 2, respectively.

Table 1. Effects of genotype on reproduction performance (means±sem)

	AL (n=10)	LL (n=10)	SL
Gestation length (days)	110.7 ± 0.4	115.2 ± 0.4	p < 0.001
Litter size (n)			
Total born	8.6 ± 0.86	11.7 ± 0.86	p < 0.05
Born alive	8.2 ± 0.76	11.2 ± 0.76	p < 0.05
Farrowing length (min)	134 ± 21	173 ± 21	ns

AL – alentejano breed; LL – Large-White x Landrace; SL – significance level; ns – no significant

There were marked effects of genotype on reproduction performance. As previously reported by Nunes (1993) the AL sows had shorter gestation length than the LL sows. Also prolificacy was lower than in LL sows. However prolificacy of AL sows is in the range of those reported by Marques (2002) and Charneca (2001). Mortality rate between birth and weaning averaged 24.3% for the AL piglets that was higher than the 14.3% found in LL piglets. In both genotypes most of the losses occurred within 3 days after farrowing (85% and 75% for AL and LL piglets, respectively). These observations agree well with those reported by Marques (2002) and Le Dividich and Rooke (2006).

Table 2. Effects of genotype on litter weight, litter gain (birth-24h) and colostrum production of the sows (means±sem)

	AL (n=10)	LL (n=10)	SL
Non adjusted data			
Live born litter weight (g)	9087 ± 839	14893 ± 839	p < 0.001
Litter weight gain 0-24h (g)	533 ± 189	1263 ± 189	p = 0.014
Colostrum Production (g)*	1946 ± 282	3627 ± 282	p < 0.001
Adjusted for live born litter size			
Live born litter weight (g)	10388 ± 526	13574 ± 526	p < 0.001
Litter weight gain 0-24h (g)**	490 ± 193	1306 ± 193	p < 0.05
Colostrum production (g)*	2100 ± 279	3474 ± 279	p < 0.01
Adjusted for live born litter weight			
Litter weight at 24 hours (g)**	12615 ± 192	13142 ± 192	ns
Litter weight gain 0-24h (g)**	634 ± 192	1161 ± 192	ns
Colostrum Production (g)*	2472 ± 245	3102 ± 245	ns

* Calculated by summing individual consumptions of littermates. ** all piglets, survivors or dead
AL – alentejano breed; LL – Large-White x Landrace; SL – significance level; ns – no significant

Litter weight gain within the first 24 hours is a good marker for colostrum production of the sows (Le Dividich *et al*., 2004). It was higher (p = 0.014) in LL than in Al sows suggesting that LL sows are better producers of colostrum. Further, as mentioned by Le Dividich *et al*. (2004) this litter weight gain is very variable, with a CV % approximating 63% in both genotypes.

As expected from the above, colostrum production is higher (p < 0.001) in the LL genotype. Covariant analysis indicates that colostrum production of the sows is dependent on the weight of the litter at birth, but not on the litter size. It could be hypothesised that heavy piglets at birth are also more vigorous and hence more able to extract colostrum from the udder as suggested by Van der Steen and de Groot (1992). The fact that litter weight gain was independent of litter size agrees with the previous findings of Devillers *et al.* (2005). It follows that, within a litter, the colostrum available per piglet decreases with the increase in litter size, which could explain, at least partly, the positive relationship usually reported between litter size and mortality.

The effects of genotype on colostrum and milk composition are presented in table 3. The effects of genotype, time and the interactive effects between genotype and time are also presented. For clarity mean standard errors are not presented.

Table 3. Effects of genotype and time on the composition of colostrum and milk.

		COLOSTRUM						MILK	EFFECTS		
	G	0h	3h	6h	12h	24h	36h	15d	G	T	GxT
Dry Matter (%)	AL	27.3^{a}	27.5^{a}	26.0^{a}	21.1^{b}	20.4^{b}	21.0^{b}	19.0^{b}	ns	***	*
	LL	24.9^{a}	24.4^{a}	23.7^{ab}	22.8^{ab}	19.9^{b}	21.0^{ab}	19.8^{b}			
Crude Protein (%)	AL	17.9^{a}	16.7^{a}	15.0^{a}	10.3^{b}	8.1^{bc}	7.9^{bc}	5.0^{c}	ns	***	ns
	LL	16.6^{a}	15.3^{ab}	13.4^{bc}	10.6^{c}	7.1^{d}	7.0^{d}	4.8^{d}			
Total Lipids (%)	AL	5.4^{a}	6.3^{ab}	6.6^{ab}	6.1^{ab}	7.3^{ab}	8.3^{bc}	8.5^{c}	ns	***	ns
	LL	4.6^{a}	5.4^{ac}	6.8^{abc}	7.8^{b}	7.7^{bc}	9.1^{b}	9.0^{b}			
Lactose (%)	AL	3.0^{a}	-	3.3^{a}	3.4^{a}	5.9^{b}	4.1^{c}	5.4^{b}	ns	***	ns
	LL	2.8^{a}	-	3.5^{a}	3.8^{a}	5.3^{b}	3.9^{a}	5.6^{b}			

G – Genotype; AL – Alentejano sows; LL – LW x LR sows; T, time. *; p < 0.05; ***; p < 0.001; ns – not significant. Within a line means with different letters indicate significant differences (p < 0.05)

Changes in colostrum composition over the first 36h are shown in table 3. There was no significant effect of genotype on colostrum or milk composition. Dry matter, lactose, fat and protein concentrations remained practically unchanged for 6h after the birth of the first piglet. Thereafter, there was a gradual decrease in protein content and a gradual increase in fat and lactose. Overally, the composition of colostrum over the first 36 hours after the onset of parturition was largely similar to those reported previously (Klobasa *et al*., 1987; Le Dividich *et al*., 2004).

Data on piglets' birth weight, weight gain from birth to 24h of age and colostrum consumption of AL and LL piglets are presented in table 4.

Table 4. Piglets' birth weight, weight gain and colostrum intake (means ± sem)

	AL	LL	SL
Birth weight (BW) (g)	1106 ± 27 (n=82)	1330 ± 23 (n=112)	p < 0.001
Weight gain (birth-24h) (g)	65 ± 10 (n=82)	113 ± 9 (n=112)	p < 0.001
Colostrum intake (g)	266 ± 14 (n=73)	336 ± 12 (n=108)	p < 0.001

n, number of piglets; AL, alentejano breed piglets; LL, crossbreed piglets; SL, significance level

At birth AL piglets were lighter (p < 0.001) than LL piglets. Also their weight gain and colostrum intake in the first 24h were inferior (p < 0.001) than those observed in LL piglets. This effect of birth weight on weight gain from birth to 24h and colostrum consumption is in agreement with the findings of Le Dividich *et al*. (2004) and Devillers *et al.* (2005).

Lower colostrum intake in Al piglets can be related both to the lower ability of AL sows to produce colostrum and the lower birth weight of the piglets (Le Dividich *et al*. 2004). However, when expressed per Kg birth weight there was no significant effect of genotype on colostrum consumption of the piglets. In both genotypes, the birth weight is positively and significantly correlated with the weight gain (r^2=0.53, p < 0.001) and colostrum consumption during the first day of life (r^2 = 0.59, p < 0.001).

When expressed in g / Kg birth weight, the relations remain significant for weight gain ($r^2 = 0.43$, $p < 0.001$) and colostrum consumption ($r^2 = 0.18$, $p < 0.05$), in accordance with the observations of Le Dividich *et al*. (2004) and Devillers *et al.* (2005).

Characteristics of piglets dying after birth are shown in table 5.

Table 5. Characteristics of piglets dying after birth compared to those of survivors. (means ± sem).

	AL PIGLETS		SL
	dead	**survivors**	
Number of piglets	20	62	
Birth weight (BW) (g)	982 ± 42	1146 ± 24	p < 0.001
Age of death (days)	2.2 ± 0.6	-	-
Weight gain (birth-24h) (g)	0 ± 14	86 ± 8	p < 0.001
Body weight at death, g	1022 ± 73	-	
	LL PIGLETS		
	dead	**survivors**	
Number of piglets	16	96	
Birth weight (BW) (g)	1013 ± 62	1383 ± 25	p < 0.001
Age of death (days)	3.2 ± 0.9	-	-
Weight gain (birth-24h) (g)	15 ± 24	129 ±10	p < 0.001
Body weight at death, g	1014 ± 80	-	

SL, significance level

In both genotypes, piglets dying during the nursing period have in common to be lighter ($p < 0.001$) at birth and to gain much less weight ($p < 0.001$) during the first 24 h than survivors. Estimation of colostrum consumption of these piglets is not, however, possible because many of them died before 24 h of age. However, their body weight gain from birth to 24 h of age or to death time suggest that these piglets have consumed much less colostrum and (or) milk than survivors. It could be hypothesised that survival of these piglets is doubly impaired by a low birth weight and a lower colostrum and (or) milk consumption which both reduce the vigour of these piglets and their ability to compete at the udder. However, a larger data set is required to determine the respective role of birth weight and colostrum consumption on post-natal mortality.

CONCLUSIONS

Data of this study indicate colostrum and milk composition of Alentejano and modern sows is similar whereas AL sows produce less colostrum. In both genotypes, production of colostrum is dependent on the weight of the litter but not on the litter size, while within each genotype, consumption of colostrum is dependent on the piglet birth weight. In both genotypes, piglets that died before weaning were lighter at birth and had consumed less colostrum or (and) milk than survivors. Further studies are necessary to determine the effects of genotype on the immune quality of colostrum.

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