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Rearing performance of piglets from the aspect of mammary gland remodeling in sows of two genotypes

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Abstract: *Rearing performance of piglets from the aspect of mammary gland remodeling in sows of two genotypes*. The aim of the study was to determine rearing performance of piglets from the aspect of changes in some zoometric indicators of milk line during the reproductive cycle of Danhybrid and PIC crossbred sows. Data for analysis of mammary glands in the third and fourth reproductive cycles were collected from 50 multiparous sows, including 20 Danhybrid and 30 PIC. Number of teats, length of the milk line, base width of the mammary gland, and nipple length were determined. Measurements were made with a tape or caliper during three phases of the reproductive cycle: empty sow period (at mating), gestation (late pregnancy, 7 days before farrowing), and lactation (7th day of nursing). Data were collected for the number of total born piglets, number of live born and stillborn piglets, and number of piglets reared to the 21st day. The results were statistically analysed. Differences were found for base width of the mammary gland at mating ($P \leq 0.01$ in the third cycle and $P \leq 0.05$ in the fourth cycle) and length of the milk line during late pregnancy and lactation ($P \leq 0.05$ in the third cycle). During the reproductive cycle the magnitude of changes in zoometric indicators of the mammary gland was distinctly higher in PIC than Danhybrid sows, with a significantly lower number of total and live born piglets. The differences in the intensity of mammary gland remodeling in the two sow groups may be associated among others with the advancement of body development (slightly greater changes in the fourth compared to the third cycle), genetic dissimilarity (slightly greater changes in PIC compared to Danhybrid sows), better survival at birth and higher activity of piglets from the PIC compared to the Danhybrid group during the suckling period. Rearing performance of the piglets should be regarded as good, and losses were smaller in the PIC vs. Danhybrid sow group.

Key words: sows, Danhybrid, PIC, mammary gland, piglets born and reared

INTRODUCTION

One of the keys to success in pig production is the high reproductive efficiency of the sow, expressed as high prolificacy (Koketsu 2016, Mabry 2016). A prerequisite for a good result, i.e. at least 28 piglets reared per sow per year, is that the offspring make full use of sow's milk. A good growth rate of neonatal piglets and low mortality of suckling piglets are conditional on the sufficient number and quality of sow's teats and its high milk yield (Skok et al. 2007, Chalkias 2013, Rekiel et al. 2013, Sommavilla et al. 2015). Piglet growth and development as well as piglet losses also depend on anatomic location of the teats at which piglets suckle based on the social hierarchy (Skok et al. 2007). Sows of maternal breeds and lines should have at least seven pairs of active, morphologically normal mammary glands. The average heritability of the traits allows it to be improved, which is conducive to increasing

teat number and improving rearing performance of the offspring (Pumfrey et al. 1980, Borchers et al. 2002, Chalkias 2013, Ocepek et al. 2016).

The mammary gland is subject over time to anatomical and functional changes, which begin during the period of fetal growth and development, and continue in the postnatal period. Their magnitude depends on the stage of body maturation, phase of the sow's reproductive cycle, and activity of suckling piglets (Motyl et al. 2001, Procak et al. 2004, Rząsa et al. 2005, Krzymowski and Przała 2015).

The aim of the study was to determine rearing performance of piglets from the aspect of changes in some zoometric indicators of milk line during the reproductive cycle of crossbred sows of two genotypes: Danhybrid and PIC.

MATERIAL AND METHODS

Data for analysis of mammary glands in two reproductive cycles (third and fourth) were collected from 50 multiparous sows, including 20 Danhybrid and 30 PIC. Number of teats (TN), length of the milk line (LML), base width of the mammary gland (BWMG), and nipple length (NL) were determined in the experimental sows. Zoometric measurements of the mammary gland were made with a tape and caliper to within 0.1 mm during three phases of the reproductive cycle: empty sow period (at mating), gestation (late pregnancy, 7 days before farrowing), and lactation (7th day of nursing). Data were collected for the number of total born piglets, number of live born and stillborn piglets, and number of piglets reared to the 21st day.

The results were statistically analysed. Differences between the groups were determined by the Mann–Whitney U-test (IBM SPSS Statistics 24). Tables bring together the results of zoometric measurements, arithmetic means, standard deviations, and the magnitude of changes in the analysed traits.

RESULTS AND DISCUSSION

There were no differences in the number of teats between Danhybrid and PIC sows ($P > 0.05$) (Table 1), but the number of piglets born and reared to 21st day was lower in PIC than in Danhybrid sows ($P \leq 0.01$). Differences were observed between the sow groups in the base width of the mammary gland during the empty sow period (third cycle, $P \leq 0.01$, fourth cycle, $P \leq 0.05$). There were significant differences in length of the milk line in the sows from the compared genetic groups during gestation and lactation ($P \leq 0.05$), which were observed in the third cycle, but not in the fourth cycle ($P > 0.05$) – Tables 1 and 2. During gestation and lactation, PIC compared to Danhybrid sows had longer milk line by 3.18 and 3.67 cm (third cycle) and 1.61 and 2.32 cm (fourth cycle), respectively. The extent of changes in the analysed zoometric indicators of the mammary gland during gestation compared to the empty sow period, and during lactation vs. gestation and the empty sow period was progressive (Tables 3 and 4), which is supported in the literature (Rząsa et al. 2005). Changes in PIC compared to Danhybrid sows, expressed in percentage points, were markedly higher for WMG and NL measurements during

TABLE 1. Mammary gland characteristics of the multiparous sows of two genotypes in the third reproductive cycle

Traits	Danhybrid, $n = 20$		PIC, $n = 30$		P
	$\bar{x}$	*SE*	$\bar{x}$	*SE*	
TN	14.5	0.761	14.6	0.932	0.599
Empty sow period					
LML (cm)	66.30	4.707	66.27	6.871	0.655
BWMG (cm)	10.12	1.732	8.12	1.601	0.001
NL (cm)	1.97	0.385	1.78	0.380	0.135
Late pregnancy					
LML (cm)	70.55	4.049	73.73	6.368	0.039
BWMG (cm)	11.83	1.823	10.77	2.298	0.088
NL (cm)	2.20	0.287	2.31	0.289	0.172
Lactation period					
LML (cm)	76.63	3.594	80.30	6.733	0.020
BWMG (cm)	13.03	1.950	12.67	2.591	0.749
NL (cm)	2.63	0.299	2.73	0.315	0.252

TN – teat number; LML – length of milk line; BWMG – base width of the mammary gland; NL – nipple length.

TABLE 2. Mammary gland characteristics of the multiparous sows of two genotypes in the fourth reproductive cycle

Traits	Danhybrid, $n = 20$		PIC, $n = 30$		P
	$\bar{x}$	*SE*	$\bar{x}$	*SE*	
Empty sow period					
LML (cm)	66.79	4.492	66.07	6.359	0.626
BWMG (cm)	9.46	1.763	8.16	1.382	0.012
NL (cm)	1.72	0.274	1.73	0.352	0.798
Late pregnancy					
LML (cm)	71.82	4.134	73.43	5.788	0.285
BWMG (cm)	11.52	1.705	10.50	2.077	0.058
NL (cm)	2.17	0.354	2.25	0.291	0.318
Lactation period					
LML (cm)	78.53	3.893	80.85	6.236	0.120
BWMG (cm)	13.51	1.425	12.60	2.603	0.350
NL (cm)	2.57	0.315	2.71	0.302	0.164

LML – length of milk line; BWMG – base width of the mammary gland; NL – nipple length.

TABLE 3. Changes in zoometric indicators of the mammary gland of sows in the third reproductive cycle

Period/traits	Danhybrid	PIC
Late pregnancy vs. empty sow period		
Change in LML (cm/%)	4.25 / 6.41	7.46 / 11.26
Change in WMG (cm/%)	1.71 / 16.90	2.65 / 32.64
Change in NL (cm/%)	0.23 / 11.68	0.53 / 29.78
Lactation period vs. late pregnancy		
Change in LML (cm/%)	6.08 / 8.62	6.57 / 8.91
Change in WMG (cm/%)	1.2 / 10.14	1.9 / 17.64
Change in NL (cm/%)	0.43 / 19.55	0.42 / 18.18
Lactation period vs. empty sow period		
Change in LML (cm/%)	10.33 / 15.58	14.03 / 21.17
Change in WMG (cm/%)	2.91 / 28.75	4.55 / 56.03
Change in NL (cm/%)	0.66 / 33.50	0.95 / 53.37

Explanation as in Table 2. WMG – width of the mammary gland.

TABLE 4. Changes in zoometric indicators of the mammary gland of sows in the fourth reproductive cycle

Period/traits	Danhybrid	PIC
Late pregnancy vs. empty sow period		
Change in LML (cm/%)	5.03 / 7.53	7.36 / 11.14
Change in WMG (cm/%)	2.06 / 21.78	2.34 / 28.68
Change in NL (cm/%)	0.45 / 26.16	0.52 / 30.06
Lactation period vs. late pregnancy		
Change in LML (cm/%)	6.71 / 9.34	7.42 / 10.10
Change in WMG (cm/%)	1.99 / 17.27	2.10 / 20.00
Change in NL (cm/%)	0.4 / 18.43	0.46 /20.44
Lactation period vs. empty sow period		
Change in LML (cm/%)	11.74 / 17.58	14.78 / 22.37
Change in WMG (cm/%)	4.05 / 42.81	4.44 / 54.41
Change in NL (cm/%)	0.85 / 49.42	0.98 / 56.65

Explanation as in Tables 2 and 3.

gestation and lactation compared to the empty sow period; this concerned the third and fourth cycles. A strong development of the mammary gland occurs during lactation and reflects the milk yield of individual glands, the enlargement of which is dependent on the activity of suckling piglets (Hurley 2001, Procak et al. 2004). Rząsa et al. (2005), who investigated the mammary gland in Polish Large White and Polish Landrace crosses, concluded that enlargement of the mammary gland was small during the first five days of lactation, and changed by 36% on 21st day of lactation. Suckled mammary glands compared to unsuckled teats expand more rapidly during the first and second lactation. The productivity of mammary glands can be influenced by their suckling in the previous lacta-

tion. According to Farmer et al. (2012), the glands that were not suckled in the previous lactation produce less milk than suckled ones. Procak et al. (2004), who analysed morphometric measurements of mammary glands, concluded that unsuckled glands in the first lactation, may reach their physiological capacity in the next lactation, on the first day after farrowing. However, their width on 1st and 21st days after farrowing was smaller than the width of the glands suckled in the previous lactation. The width of the mammary glands, which were not suckled by the piglets, decreased by 50% three weeks after farrowing, regardless of size of the litter reared by the sow. In our study, LML, BWMG and NL values in the three phases of the reproductive cycle (mating, gestation, lactation) were compared in the third and fourth cycle, in both genetic groups (Danhybrid and PIC). The stabilization of LML in multiparous third and fourth parity sows may indicate that the Danhybrid and PIC sows have completed their body development.

Danhybrid sows gave birth to 2.03 (parity 3) and 2.19 (parity 4) more piglets per litter compared to PIC sows (Tables 5 and 6). The number of piglets born alive by Danhybrid sows was also higher than in PIC sows, by 1.73 and 2.03 piglets in parity 3 and 4, respectively, with highly significant differences ($P \leq 0.01$). In relation to the average calculated for all the sows under analysis, the number of piglets reared to 21st day from Danhybrid sows was higher by an average of 10.6% (parity 3) and 10.5% (parity 4), and that from PIC sows lower by an average of 7.0% (parity 3) and 6.7% (parity 4), respectively. The number of piglets reared to 21st day per Danhybrid

TABLE 5. Number of piglets born and reared (head) (parity 3)

Number of piglets (head)	Danhybrid		PIC		*P*
	$\bar{x}$	*SE*	$\bar{x}$	*SE*	
Total	15.00	2.176	12.97	2.008	0.002
Live born	14.20	2.397	12.47	2.129	0.007
Stillborn	0.80	1.196	0.50	0.682	0.442
Total losses	0.80	1.056	1.20	1.400	0.294
Reared to day 21	13.40	1.903	11.27	2.303	0.001

TABLE 6. Number of piglets born and reared (head) (parity 4)

Number of piglets (head)	Danhybrid		PIC		*P*
	$\bar{x}$	*SE*	$\bar{x}$	*SE*	
Total	15.26	1.522	13.07	2.033	0.001
Live born	14.63	1.606	12.60	1.993	0.001
Stillborn	0.63	0.955	0.47	0.629	0.656
Total losses	0.84	0.958	1.03	1.066	0.450
Reared to day 21	13.74	1.327	11.60	1.868	0.001

sow per litter was higher by an average of 2.13 and 2.14 (parities 3 and 4) compared to PIC sows, and the differences were significant at $P \leq 0.01$ (Tables 5 and 6). Slightly better reproductive results were observed for sows of both genotypes in parity 4 compared to parity 3. This shows that the genetic potential for reproductive traits became more evident in older than in younger sows.

The sows of the two compared genotypes showed differences in their reproductive potential. This is supported in the literature on the subject, which shows that sow fertility depends on breed (Blicharski and Snopkiewicz 2016). The number of piglets born dead by the more fertile Danhybrid sows compared to PIC sows was higher in parities 3 and 4 by 0.3 and 0.17, respectively. This is consisted with the findings of Wallgren (2013), who reported that improvement of reproductive traits and consistent improvement of the basic reproductive indicator, i.e. number of piglets born per litter, is accompanied by an increased number of stillborn piglets. Comparison of piglet production results in Sweden (2013 vs. 2003) showed increases in prolificacy (by 2 piglets weaned per sow per year), number of total born piglets (by 1.72) and stillbirths (by 0.31) (Wallgren 2013). Stillbirths affect 48.3% of all litters and range from 5.2 to 7.5% (Pedersen et al. 2010). The improvements in sow fertility and the associated increase in stillbirths are influenced not only by breeding work and crossbreeding. Stillbirths of piglets are also affected by other factors including the sow's fat reserves, intrauterine growth restriction, birth order and the interval between each piglet being born, reproductive cycle, hypoxia, neonatal weight and sex (Vanderhaege et al. 2010, Baxter et al. 2012, Rutherford et al. 2013). In our study, piglet losses during the maternal rearing period were moderate and higher for PIC compared to Danhybrid sows (parity 3: 9.62 vs. 5.63%, parity 4: 7.94 vs. 6.08%). Data reported by Wallgren (2013) show that preweaning piglet mortality in Sweden was 14.3% in 2003 and 18.3% in 2013. These results are similar to the European Union average of 14–17% (Pedersen et al. 2010).

CONCLUSIONS

During the reproductive cycle, the magnitude of changes in zoometric indicators of the mammary gland was distinctly higher in PIC compared to Danhybrid sows, with a significantly lower number of total and live born piglets. The differences in the intensity of mammary gland remodeling in the two sow groups may be associated among others with the advancement of body development (slightly greater changes in the fourth compared to the third cycle), genetic dissimilarity (slightly greater changes in PIC compared to Danhybrid sows), better survival at birth and higher activity of piglets from the PIC compared to the Danhybrid group during the suckling period.

Rearing performance of the piglets should be regarded as good, and losses were smaller in the PIC vs. Danhybrid sow group.

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Streszczenie: *Wyniki odchowu prosiąt w aspekcie przebudowy gruczołu mlekowego loch dwóch genotypów*. Celem badań było określenie wyników odchowu prosiąt w aspekcie zmian wybranych wskaźników zoometrycznych listwy mlecznej w cyklu reprodukcyjnym u loch hybrydowych Danhybrid i PIC. Dane do analizy pozyskano od 50 loch wieloródek, w tym 20 Danhybrid i 30 PIC, wykonując ocenę gruczołu sutkowego w trzecim i czwartym cyklu reprodukcyjnym. Określono liczbę sutków (TN) oraz długość listwy mlecznej (LML), szerokość podstawy gruczołu mlekowego (BWMG) i długość brodawki sutka (NL). Pomiary wykonano taśmą lub suwmiarką w trzech fazach cyklu reprodukcyjnego: luźności (przy kryciu), prośności (ciąża wysoka, 7 dni przed porodem) oraz laktacji (7. dzień karmienia prosiąt). Zgromadzono dane dotyczące liczby prosiąt urodzonych ogółem, urodzonych żywo i martwo oraz odchowanych do 21. dnia. Wyniki opracowano statystycznie. Stwierdzono różnice w BWMG przy kryciu ($P \leq 0{,}01$ w cyklu 3 i $P \leq \leq 0{,}05$ w cyklu 4) oraz w LML w okresie wysokiej ciąży i w laktacji ($P \leq 0{,}05$ w cyklu 3). W cyklu reprodukcyjnym poziom zmian wskaźników zoometrycznych gruczołu mlekowego był wyraźnie większy u loch PIC w porównaniu do Danhybrid, przy istotnie mniejszej liczbie prosiąt urodzonych ogółem i urodzonych żywo. Zróżnicowana intensywność przebudowy gruczołu mlekowego dwóch grup loch może być związana m.in. z zaawansowaniem rozwoju somatycznego (zmiany nieco większe w cyklu 4 względem cyklu 3) oraz odmiennością genetyczną (nieco większe zmiany u loch PIC w porównaniu z Danhybrid), oraz z lepszą żywotnością noworodków i większą aktywnością prosiąt z grupy PIC w porównaniu z Danhybrid w okresie ssania. Wyniki odchowu prosiąt można uznać za dobre, straty były mniejsze w grupie loch PIC względem wyników Danhybrid.

Słowa kluczowe: lochy, Danhybrid, PIC, gruczoł mlekowy, prosięta urodzone i odchowane

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