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ORIGINAL ARTICLE

Impact of fat and selected profiles of fatty acids contained in the colostrum and milk of sows of native breeds on piglet rearing

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ABSTRACT

The aim of this study was to evaluate the effect of the level of fat and selected fatty acids found in the milk of sows on the rearing of native breed piglets. Simultaneously, in order to improve the accuracy of the performed analyses, atomic absorption spectrometry was employed in the applied analytic methodology. The experimental animal material comprised 60 sows of the indigenous White Złotnicka breed. Colostrum and milk were collected on the first and 14th days of lactation. In all, 240 samples were collected. The following parameters were determined in the course of the experiment: number and weight of piglets, body weight gains as well as deaths of piglets. A total of 1270 born piglets was subjected to investigations. The performed experiments demonstrated that, with the progress of the lactation period, the content of fat and saturated fatty acids (SFA) turned out to be statistically significant and showed a growing tendency. Fat increased by about 2% and palmitic acid (C16:0) increased most, that is by 5%. Linolic (C18:2) and linolenic (C18:3) acids revealed decreasing trends. Irrespective of the day of lactation, the level of unsaturated fatty acids (UFA) determined in sows' colostrum and milk was higher in comparison with that of SFA, and the UFA to SFA ratio ranged from 1.84% to 1.33%. Proportions of n-6 to n-3 fatty acids were determined at the level of about 1.6:1.0 in the colostrum and 1.3:10 in milk. The highest daily body weight gains were recorded in the case of piglets derived from sows with the highest fat level – 294 g, while in the case of stearic acid (C18:0), the smaller its concentration in the colostrum and milk of the experimental sows, the better body weight gains of piglets – 262 g. At the same time, stearic acid (C18:0) was found to exert a statistically significant effect on piglet mortality at the level of $P \leq 0.05$. Its highest concentration caused the highest proportion of deaths among piglets - 16.23%. The performed analysis of correlations that occurred between fat, fatty acids and traits associated with piglet rearing confirmed that linolic acid (C18:2; n-6) was highly significantly correlated with piglets' body weights (r = 0.456**) and was negatively correlated with piglets' deaths (r = –0.312). On the other hand, fat revealed correlation with body weight gains of piglets (r = 0.333*_ and a negative correlation with deaths of piglets (r = –0344*). Recapitulating, the results of the performed experiments revealed that differences in the levels of fat and fatty acids found in sows' colostrum and milk influenced results of piglet rearing. Together with the increase in the content of fat and UFA in sows' colostrum and milk, piglets were characterized by the best body weight, growth rate, as well as by small mortality.

Key words: *colostrum, fat, fatty acids, milk, native breed.*

INTRODUCTION

Colostrum and, later on, milk supply the first, most important nourishment for newly born animals. There are differences in milk chemical composition in individual species which are the result of environmental

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factors affecting them, as well as of adjustments to the requirements of progeny. The method of sows' nutrition during pregnancy, the entire lactation period as well as drying, is connected with both quality and quantity of the produced food. Numerous experiments confirmed that diet modifications of sows as well as the inclusion in their diets of different components find their reflection in milk composition (Van den Brand *et al*. 2000; Eissen *et al*. 2003; Lauridsen & Jensen 2007). These kinds of measures should be carried out very carefully in order not to overfeed sows during pregnancy causing their over-fattening which can exert a negative influence on the course of the parturition action. Excessive fattening in sows also leads to reduced appetite during lactation and hence, to decreased milk production (Van den Brand & Kemp 2006). Milk fat is made up primarily of triglycerides of fatty acids. They are characterized by a positive influence already during the fetal period and later on, contained in milk, they provide a serious source of energy and affect growth as well as functioning of individual organs (Farmer & Petit 2009; Sampels *et al*. 2011). Fatty acids fulfil building and defensive functions, protecting many body organs; in particular, they are responsible for the correct workings of the heart and blood vessels as well as of the nervous system. Consumption of essential polyunsaturated acids by piglets is very important during the first hours of their lives because they have been proven to provide immunological functions. They exert a defensive influence protecting young animals against dangerous contagious swine diseases caused by bacteria or they can have a mitigating effect on diarrhoea threatening newly born piglets and, in addition, it was proven that they can exert influence on the size of the litter (Leskanich & Noble 1999; Smits *et al*. 2011).

Therefore, the objective of this study was to assess the effect of fat levels and selected fatty acids contained in sows' colostrum and milk on native breed piglet rearing. Simultaneously, in order to increase the accuracy of the performed analyses, atomic absorption spectrometry was employed in the applied analytic methodology.

MATERIALS AND METHODS

Animal material

The experimental animal material comprised 60 sows of the indigenous White Złotnicka breed. The origin of the animals was known because the Department of Pig Breeding and Production of the Poznań University of Life Sciences is in possession of the complete documentation of this breed. Pigs of White Złotnicka breeds are covered by the National Protection Program of Genetic Resources. The performed investigation comprised the period of two consecutive lactations (lactations 2 and 3). All experimental sows were kept in identical conditions fulfilling all welfare requirements. Sows were kept in individual parturition pens in the period from approximately the 10th day before parturition to the third week of lactation. The sows were fed individually twice a day with a standard mixture according to Polish Nutrient Requirements for Pigs (1993). Water was available *ad libitum*. All sows taking part in the trial were mated naturally and all progeny derived from one father, a White Złotnicka purebreed boar. Throughout the duration of the trial, mothers' milk was the only feed given to piglets, and they were not fed additionally by any concentrate.

Experimental materials

Colostrum and milk were collected on day 1 (2 h after parturition) and day 14 of lactation. Milking was performed by hand following an intramuscular oxytocin injection in amounts ranging from 2.5 to 4.0 mL (the applied quantity depended on the day of lactation and not on the weight of animals). Colostrum and milk in the amount of about 8 mL were milked from all active teats directly into test-tubes containing Milkostat conservation preparation. Next, samples were cooled to −20°C.

In all, 240 samples were collected, that is 120 colostrum samples and 120 milk samples (60 sows × two lactations × 2 days).

Within the period of 24 h after parturition, piglets were subjected to individual identification; their gender was identified and all were ear-tagged.

The following parameters were determined in the course of the experiment: number and body weight of piglets on days 1, 7, 14 and 21 of the trial; and daily growth of individual piglets in periods from days 1–7, from days 8–14 and from days 15–21, as well as mortality for the entire period of rearing, that is from day 1 to 21 of life.

The total of 1270 born piglets derived from 120 litters (60 sows × two lactations) were subjected to investigations.

Laboratory analyses of the collected colostrum and milk samples

Determination of the fat content on the first and 14th days of lactation was performed with the assistance of the Milkoscan apparatus type FT 120 manufactured by Foss Electric (Hillerød, Denmark).

Determination of selected fatty acid profiles

Profiles of selected fatty acids are presented in Table 1. Colostrum and milk samples stored at refrigerator conditions (−20°C) were brought to room temperature and were then shaken using a laboratory shaker (Vortex, Staufen im Breisgau,Germany; IKA Genius 3) with the aim was to level out the composition in their entire volume. Next, 2 mL of the material were taken from each sample and placed in centrifuge Falcon-type test-tubes. Extraction of lipophillic compounds was performed with the assistance of Folch's reagent (a mixture of chlorophorm and methanol – 2:1 v/v) using 10 mL of the mixture per each 2 mL of the sample. In order to homogenize the mixture, test-tubes containing milk with the solvent were mixed thoroughly using a shaker. Next, after the period of 24 h, samples were spun in a laboratory centrifuge (Eppendorf, Hamburg, Germany; 5430) for 5 min at 30 130 × *g*. This allowed separation of the protein sediment from the extraction mixture. The supernatant was then transferred through a filter to a glass separator where portions of distilled water were added in order to cause migration of methanol from an organic phase to aqueous phase.

The bottom phase, which was made up of chlorophorm and diluted lipids, was treated with anhydrous sodium sulphate with the aim to remove water residues and then was transferred into a round-bottomed flask.

Chlorophorm (solvent) was evaporated using an evaporator (Laborota 4000 efficient, Heidolph, Schwabach, Germany) in a water jacket at 40°C until the solvent was completely evaporated. Next, the process was continued by blowing the flask content with a neutral gas (nitrogen) until constant dry lipid fraction mass was achieved.

Extracted lipid compounds were dissolved in 3 mL *n*-hexane and transferred quantitatively into screw-capped test-tubes of dark glass which were additionally sealed using a parafilm. Samples were stored in refrigeration conditions until chromatographic analyses.

Determination of methyl esters of fatty acids

The extracted milk fats were dissolved in *n*-hexane and subjected to methylation in an alkaline environment.

In selected fatty acids, the content of methyl esters was analyzed using for this purpose gas chromatography coupled with mass detection.

Methylation of hydrolyzed fats

One millilter of *n*-hexane and 200 μL of potassium hydroxide in methanol (concentration 0.2 mol/L) were added to the extracted fat (concentration 0.2 mol/L). The solution was subjected to intense mixing and then was put aside for the period of 1 min. Next, about 0.5 g of unhydrous $NaHSO_4$ was added to the mixture and it was mixed again. When sulphate was observed to precipitate, 100 μL of liquid was collected to the vial of the sample feeder of the gas chromatographer and then diluted with 1000 μL of hexane. The mixed solution was then subjected to chromatographic analysis.

Chromatographic analysis

The determination of methyl esters of fatty acids was performed in a gas chramatograph (Varian 450 with a Varian TQ 320 mass detector; Varian, Middelburg, Netherlands). Ester separation was conducted at constant helium flow (1 mL/min) using a SupelcoWax 10 (Macherey-Nagel GmbH and Co. KG, Düren, Germany) (30 m × 0.32 × 0.25) column.

Furnace temperature program: 60°C (1 min); up to 210°C with increments of 15°C/min and then 210°C for 15 min. The total duration time of the analysis was 26 min. The temperature of the injection port was 210°C.

Electron ionisation (EI) was employed in the mass spectrometer. The analysis was carried out in the total ion current (TIC) mode for purposes of quality identification of selected methyl esters and in the single ion monitoring (SIM) mode for quantitative determinations. Quantitative assays were conducted by comparing the area of the separated peaks of the examined esters of acids with the curves plotted as a result of measurements of dependences of pattern concentration on peak areas (external standard).

Table 2 presents data concerning mass values of the selected ions from individual acids.

Each quantitative evaluation was preceded by a qualitative verification.

Statistical analysis

All the obtained data were processed statistically employing the SAS ver. 8.11 statistical package (SAS Institute Inc., Cary, NC, USA) using the following methods: normal distribution test (UNIVARIATE) and multifactorial analysis of variance using for this purpose PROC GLM LSM. Calculation results were presented in the form of least squares measurements (LSM) and standard errors (SE). For discrete random variables, probit transformation was applied, which makes transformations from discrete random variables to continuous random variables possible.

In order to verify the effect of milk fat and fatty acids contained in colostrum and milk of sows on piglet body weight, daily growth of piglets and mortality, the whole body of the material was divided in such a way that the values for milk fat and fatty acids (without separation into colostrum and milk) were arranged from the lowest to the highest and then classified into one of three levels: low (values from the

Table 1 Selected profiles of fatty acids determined in colostrum and milk

Common name		Formula	No. of samples subjected to analyses
Saturated fatty acids (SFA)	Myristic	C14:0	240
	Palmitic	C16:0	240
	Stearic	C18:0	240
Unsaturated fatty acids (UFA)	Oleic	C18:1	240
	Linoleic	C18:2	240
	Linolenic	C18:3	240

Table 2 Data concerning mass values of selected ions from individual fatty acids

Name of the fatty acid ester	Retention time (min)	Sought ion (SIM)	Curve	Determination coefficient
MyristicMe	9.43	242	Linear	0.966
PalmiticMe	10.81	270	Linear	0.968
StearicMe	12.25	298	Linear	0.966
OleicMe	12.44	180	Linear	0.983
LinoleicMe	12.89	294	Square	0.993
LinolenicMe	13.57	292	Square	0.987

Me, methyl ester.

first quartile, inclusive); moderate (values contained between the first and the third quartile); and high (values above the third quartile, inclusive). This division was used in order to illustrate the non-linear impacts the presence of which at the level of statistical significance close to 0.1 was observed in many cases in the course of initial calculations. Quartile values were determined with the assistance of the SAS-UNIVARIATE procedure. (Table 3)

Pearson's phenotype correlation coefficients were assessed between piglet body weight, daily body weight gains, deaths of piglets and fat and individual fatty acids found in sows' colostrum and milk.

In the statistical models used in the analysis, apart from the analyzed principal effects, also other impacts were taken into consideration:

- season of sample collection (autumn, winter, spring, summer),
- milking of colostrum and milk (determined hourly),
- sex of piglets (young boars, gilts) and
- number of piglets participating in the experiment.

RESULTS

It is evident from the research results in Table 4 that content levels of fat and fatty acids in the colostrum and milk of experimental sows varied. Together with the passage of lactation time, fat and saturated fatty acid (SFA) concentrations turned out to be statistically significant and showed a growing tendency. Fat content increased by about 2%, while that of palmitic acid (C16:0) by nearly 5%. A reverse situation was observed in the case of two unsaturated fatty acids (UFA) where both linolic (C18:2) and linolenic (C18:3) acids showed a declining trend. The above differences turned out to be statistically significant.

Table 3 Division of fats and fatty acids into levels depending on their content in sows' colostrum and milk

Components found in colostrum and milk		Levels of component concentration in sows' colostrum and milk		
		I (low) $n = 80$	II (moderate) $n = 80$	III (high) $n = 80$
Milk fat		≤ 5.15	> 5.16–6.79 <	≥ 6.80
Saturated fatty acids (SFA)	Myristic – (C14:0)	≤ 3.50	> 3.51–4.57 <	≥ 4.58
	Palmitic – (C16:0)	≤ 24.56	> 24.57–27.05 <	≥ 27.06
	Stearic – (C18:0)	≤ 7.92	> 7.93–9.84 <	≥ 9.85
Unsaturated fatty acids (UFA)	Oleic – (C18:1)	≤ 22.85	> 22.86–28.10 <	≥ 28.11
	Linoleic – (C18:2) n-6	≤ 19.99	> 20.00–23.77 <	≥ 23.78
	Linolenic – (C18:3) n-3	≤ 12.86	> 12.87–16.56 <	≥ 16.57
SFA		≤ 37.60	> 37.61–40.81 <	≥ 40.82
UFA		≤ 59.17	> 59.18–62.39 <	≥ 62.40

Table 4 Content of fat and fatty acids in colostrum and milk (%) (lactations I and II)

Constituents found in colostrum and milk		Day of lactation	LSM	SE	Significance of impact
Milk fat		1	5.23	0.23	**
		14	7.19	0.22	
Saturated fatty acids (SFA)	C14:0	1	2.97	0.21	**
		14	5.20	0.23	
	C16:0	1	23.59	1.67	*
		14	28.54	1.60	
	C18:0	1	8.74	0.43	**NS**
		14	9.32	0.40	
Unsaturated fatty acids (UFA)	C18:1	1	20.99	2.43	**NS**
		14	25.81	2.32	
	C18:2; n-6	1	26.85	1.82	**
		14	17.87	1.71	
	C18:3; n-3	1	16.86	1.13	*
		14	13.25	1.16	
SFA		1	35.30	1.88	**
		14	43.06	1.80	
UFA		1	64.70	1.78	**
		14	56.93	1.90	
UFA/SFA		1	1.84	0.25	**
		14	1.33	0.09	
n-6/n-3		1	1.58	0.04	*
		14	1.32	0.03	

*Impact statistically significant at the level of $P \leq 0.05$. **Impact statistically highly significant at the level of $P \leq 0.01$. NS, impact statistically non-significant.

Table 5 Impact of fat and fatty acids on piglet body weight

Constituents found in colostrum and milk		Significance of impact	Statistical indices	Mean piglet body weight for entire rearing period at different levels of component content (kg)		
				Level I	Level II	Level III
Milk fat		**	LSM	1.79 **A**	2.45 **A**	4.08 **B**
			SE	0.30	0.29	0.27
Saturated fatty acids (SFA)	C14:0	**	LSM	3.45 **A**	3.25 **A**	1.84 **B**
			SE	0.33	0.34	0.32
	C16:0	**	LSM	4.33 **A**	3.21**B**	1.42 **C**
			SE	0.30	0.23	0.25
	C18:0	**NS**	LSM	2.93	2.96	2.63
			SE	0.37	0.35	0.40
Unsaturated fatty acids (UFA)	C18:1	**	LSM	1.48 **A**	2.75 **B**	4.04 **C**
			SE	0.35	0.25	0,30
	C18:2; n-6	**	LSM	1.43 **A**	2.60 **B**	4.26 **C**
			SE	0.26	0.24	0,29
	C18:3; n-3	**	LSM	1.45 **A**	2.52 **B**	4.15 **C**
			SE	0.23	0.25	0.30
SFA		**	LSM	4.02 **A**	3.19 **A**	1.72 **B**
			SE	0.39	0.26	0.30
UFA		**	LSM	1.73 **A**	3.19 **B**	4.03 **B**
			SE	0.22	0.26	0.39

*Impact statistically significant at the level of $P \leq 0.05$. **Impact statistically highly significant at the level of $P \leq 0.01$. Means designated with different capital letters (**A**,**B,C**) differ statistically at the level of $P \leq 0.01$. The whole rearing period of piglets comprises the time from farrowing to the 21st day of lactation. NS, impact statistically non-significant.

Irrespective of the day of lactation, the level of UFA) determined in sows' colostrum and milk was higher in comparison with that of SFA, and the UFA to SFA ratio ranged from 1.84% to 1.33%. Proportions of n-6 to n-3 fatty acids in the milk fat of our studies were determined at the level of about 1.6:1.0 in colostrum and 1.3:1.0 in milk.

Table 5 analyzes the impact of fat and fatty acids depending on their content in the colostrum and milk on piglet body weights. It is evident that the heaviest piglets derived from sows characterized by the highest concentration (level III) of fat, oleic acid (C18:1), linolic acid (C18:2) and linolenic acid (C18:3). These differences turned out to be statistically highly significant at the level of $P \leq 0.01$. A reverse dependence was obtained in the case of myristic (C14:0) and palmitic (C16:0) acids. This time, together with the increase of their concentrations in the colostrum and milk of sows, piglets' body weight decreased. Bearing in mind the above remarks, it can be concluded that acids exerted an antagonistic influence on piglets' body weight. Analyzing the impact of milk fat and fatty acids on piglets' daily growth (Table 6), a statistically significant influence of fat and stearic acid (C18:0) was observed. The highest daily growths were recorded in the case of piglets derived from sows with the highest fat level (level III) – 294 g, while in the case of stearic acid (C18:0), the smaller its concentration (level I) in the colostrum and milk of the experimental sows, the better body weight gains of piglets – 262 g. At the same time, stearic acid (C18:0) was found to exert a statistically significant effect on piglet mortality during the entire period of rearing (Table 7). When its level was highest (III), mortality of piglets amounted to 16.23%.

In order to verify more precisely interrelationships occurring between the sows' colostrum and fat and traits associated with piglet rearing, Pearson's phenotype correlation coefficients were calculated. The performed correlation analysis confirmed that linolic acid (C18:2; n-6) was highly significantly associated with piglets' body weights (r = 0.456**; Fig. 1) and was negatively correlated with piglets' mortality (r = −0.312*; Fig. 3). On the other hand, fat revealed correlation with daily growth of piglets (r = 0.333*; Fig 2) and a negative correlation with mortality of piglets (r = −0344*; Fig. 3).

DISCUSSION

In contrast to the milk of ruminant animals, such as cows, sheep, goats, buffalos and others, milk produced by sows is not used to manufacture different food articles. Nevertheless, reasons for conducting investigations remain the same – increasing yields and improving the health value of the produced food (Szumacher-Strabel 2010). Colostrum and milk composition of sows undergoes many changes as a result of a variety of factors affecting it either directly or indirectly (Skrzypczak *et al*. 2012). In their experiments carried out on the native Iberian swine breed Aguinaga *et al*. (2011) showed that the fat content in the colostrum and milk of sows had a non-linear nature and its highest level was achieved on the fifth day of lactation. Also Liotta *et al*. (2007), during their

Table 6 Impact of fat and fatty acids on growth of piglets

Constituents found in colostrum and milk		Significance of impact	Statistical indices	Mean daily growth of piglets for entire rearing period at different levels of constituent content (g)		
				Level I	Level II	Level III
Milk fat		*	LSM	229.0 **a**	239.0	294.0 **b**
			SE	14.0	16.0	37.0
Saturated fatty acids (SFA)	C14:0	**NS**	LSM	245.0	244.0	219.0
			SE	13.0	19.0	14.0
	C16:0	**NS**	LSM	255.0	235.0	225.0
			SE	11.0	22.0	32.0
	C18:0	*	LSM	262.0 **a**	232.0	219.0 **b**
			SE	17.0	16.0	14.0
Unsaturated fatty acids (UFA)	C18:1	**NS**	LSM	236.0	238.0	244.0
			SE	15.0	12.0	39.0
	C18:2; n-6	**NS**	LSM	219.0	252.0	259.0
			SE	32.0	15.0	14.0
	C18:3; n-3	**NS**	LSM	228.0	237.0	261.0
			SE	24.0	15.0	14.0
SFA		**NS**	LSM	275.0	247.0	223.0
			SE	54.0	27.0	34.0
UFA		**NS**	LSM	242.0	244.0	274.0
			SE	50.0	17.0	13.0

*Impact statistically significant at the level of $P \leq 0.05$. **Impact statistically highly significant at the level of $P \leq 0.01$. Means designated with different small letters (**a**, **b**) differ statistically at the level of $P \leq 0.05$. The whole rearing period of piglets comprises the time from farrowing to the 21st day of lactation. NS, impact statistically non-significant.

Table 7 Impact of fat and fatty acids on mortality of piglets

Components found in colostrum and milk		Significance of impact	Statistical indices	Mean piglet mortality in the entire rearing period at different levels of component content (%)		
				Level I	Level II	Level III
Milk fat		**NS**	LSM	20.05	11.33	4.44
			SE	10.50	4.50	3.85
Saturated fatty acids (SFA)	C14:0	**NS**	LSM	3.87	5.24	11.34
			SE	1.15	2.10	3.90
	C16:0	**NS**	LSM	7.23	8.22	9.33
			SE	3.50	2.65	4.14
	C18:0	*	LSM	5.32	3.73 **a**	16.32 **b**
			SE	3.81	1.20	4.20
Unsaturated fatty acids (UFA)	C18:1	**NS**	LSM	13.9	8.24	3.89
			SE	1.17	4.13	1.05
	C18:2; n-6	**NS**	LSM	11.70	5.10	0
			SE	6.2	4.20	0
	C18:3; n-3	**NS**	LSM	12.60	7.20	4.40
			SE	3.82	3.20	2.50
SFA		**NS**	LSM	3.36	6.70	9.50
			SE	2.27	1.75	3.32
UFA		**NS**	LSM	6.90	4.50	2.90
			SE	4.35	2.90	1.70

*Impact statistically significant at the level of $P \leq 0.05$. **Impact statistically highly significant at the level of $P \leq 0.01$. Means designated with different small letters (**a**, **b**) differ statistically at the level of $P \leq 0.05$. The whole rearing period of piglets comprises the time from farrowing to the 21st day of lactation. NS, impact statistically non-significant.

initial investigations on a native Italian Nero Siciliano swine breed reported that the level of fat in the colostrum and milk of sows varied and reached the highest percentage value of 8.68 in the first period of lactation. Experiments carried out by Beyga and Rekiel (2009) on hybrids of commercial breeds (Polish Large White × Polish Landrace) in which they investigated fat content in sows' milk showed that the level of fat increased together with the progress of lactation reaching the value of 6.4%. In our experiments, significant differences were recorded between levels of fat and fatty acids contained in the colostrum and milk of native breed sows. It was demonstrated that there were more UFA than SFA in sows' colostrum and milk;

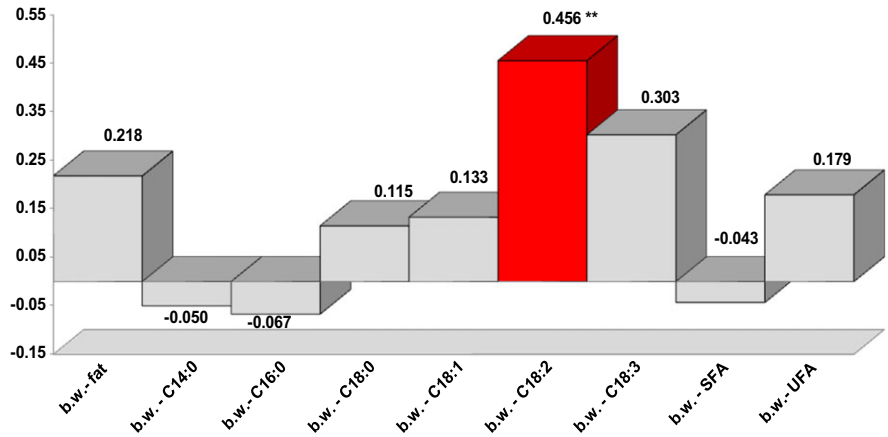

Figure 1 Correlation coefficients between body weight of piglets and percentage fat and fatty acids content. b.w. – body weight of piglets; fat. – fat; C14:0 – myristic acid; C16:0 – palmitic acid; C18:0 – stearic acid; C18;1 – oleic acid; C18:2 – linoleic acid; C18:3 – linolenic acid; SFA – saturated fatty acids; UFA – unsaturated fatty acids.

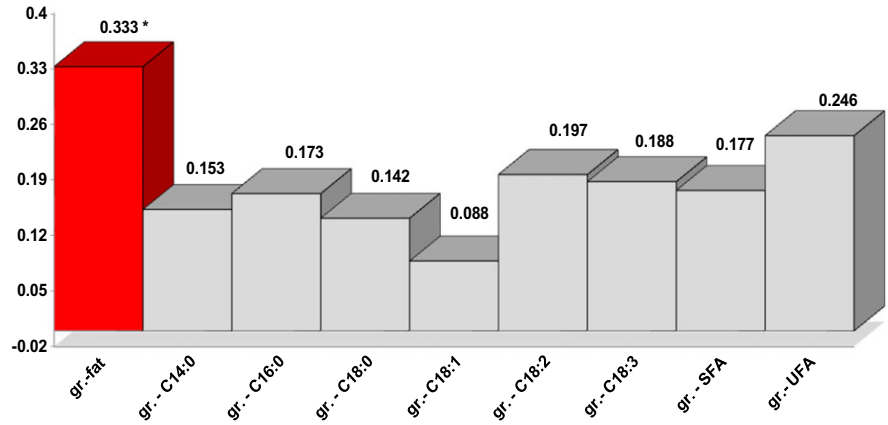

Figure 2 Correlation coefficients between daily growth of piglets and percentage fat and fatty acids content. gr. – daily growth of piglets; fat. – fat; C14:0 – myristic acid; C16:0 – palmitic acid; C18:0 – stearic acid; C18;1 – oleic acid; C18:2 – linoleic acid; C18:3 – linolenic acid; SFA – saturated fatty acids; UFA – unsaturated fatty acids.

in colostrum the level of UFA was determined at 65%, while in milk at 57%. Also Mazur and Stasiak (2006) reported similar results in their studies on sows. They observed that in the case of the control group, even though the animals did not obtain diets supplemented with crude fat, the proportion of UFA was higher. Quantitative relations of UFA to SFA exert a decisive impact on lipid digestibility as well as on the improvement in health conditions, productivity and welfare of pigs (Stahly *et al*. 1980; Rossi *et al*. 2010). In their studies, Beyga and Rekiel (2009) proved that proportions of UFA in colostrum was higher than those of SFA reaching 49%, while in milk the situation was found reversed in favour of SFA. To illustrate the variability in proportions of UFA to SFA, studies by Strzałkowska *et al*. (2009) carried out on goat and sheep milk can be quoted in which a higher proportion of SFA was recorded.

The content of milk nutrients can undergo variations as a result of modifications in the way of feeding. In our own investigations, experimental diets did not contain any feed additives, that is diets were not modified in any way which could affect the results regarding sows' colostrum and milk composition. In recent years, a growing interest has been observed in conjugated linolic acid (CLA) (C18:2), which has a number of specific characters advantageous for health, including antioxidant, anticarcinogenic and antiarteriosclerotic properties, as well as traits stimulating immunological reactions (Brandebourg & Hu 2005; Nałęcz-Tarwacka *et al*. 2009).

In their studies on sows, Peng *et al*. (2010) and Cordero *et al*. (2011) used a diet supplemented with CLA. They claim that milk composition itself underwent only a slight change. However, supplementation with CLA increased the content of SFA in the colostrum and milk, while the content of monounsaturated fatty acids (MUFA) declined. Krogh *et al*. (2012) observed that the addition of CLA to feed reduced colostrum and milk productivity. Many researchers

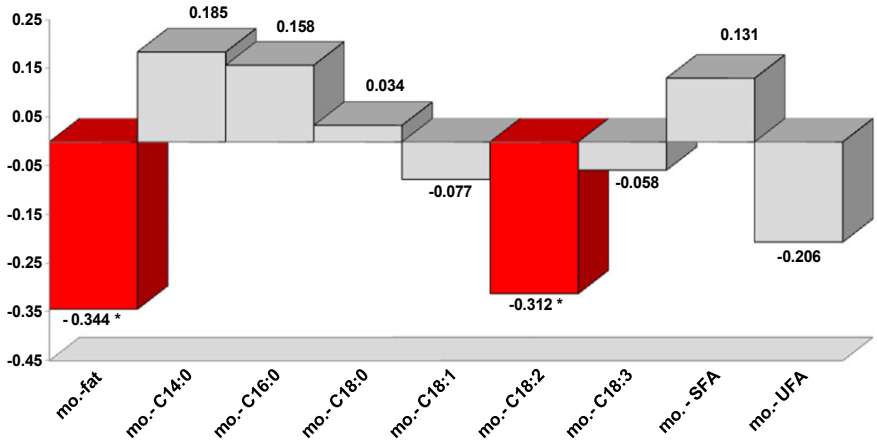

Figure 3 Correlation coefficients between mortality of piglets and percentage fat and fatty acids content. mo. – mortality of piglets; fat. – fat; C14:0 – myristic acid; C16:0 – palmitic acid; C18:0 – stearic acid; C18;1 – oleic acid; C18:2 – linoleic acid; C18:3 – linolenic acid; SFA – saturated fatty acids; UFA – unsaturated fatty acids.

emphasize in their reports that the content of milk fatty acids is strongly associated with the quality of fat introduced into the feed (Tilton *et al.* 1999; Gulati *et al.* 2002; Cattaneo *et al.* 2006). The performed analyses of our own research results corroborated the paramount importance of fat and fatty acids on piglet rearing. The results of these studies confirm conclusions of Buczyński *et al.* (2008) that sows with fat content exceeding 7% rear piglets of higher body weight and of greater daily growth. These relationships were also corroborated by Szyndler-Nędza *et al.* (2013) who showed that the level of fat in sows' milk is important in the first week of life of piglets. Linolic (n-6) and linolenic (n-3) acids fulfil a number of biological functions in animal organisms. Among others, they determine the structure of cell membranes, they constitute a source of tissue hormones, the so called eicosanoids (that is why they are often referred to as vitamin F) and regulate insulin secretion. Proportions of n-6 and n-3 fatty acids in cows' milk fat are optimal and, on average, amount to approximately 3.5:1 (Cichosz & Czeczot 2011). The ratio of n-6 and n-3 fatty acids in sows' milk in our study was lower.

Pearson's correlation performed in our investigations confirmed the influence of linolic acid C18:2 (n-6) on body weights and mortality of piglets. Experiments carried out by Traczykowski (2006) also indicated that polyunsaturated fatty acids from n-6 and n-3 groups exerted a significantly advantageous influence on the postnatal growth and development of piglets, on their mortality and growth. Innis (2000) as well as Brandebourg and Hu (2005) reported a distinct impact of omega-3 fatty acids (α-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)) on sows' reproductive functions as demonstrated by a greater number of active egg cells, higher embryo and fetus survivability, as well as by a better quality of secreted colostrum. Bazinet *et al.* (2003) add that the above acids favor better health.

Recapitulating, it can be concluded on the basis of the obtained research results that different levels of fats and fatty acids contained in sows' milk and colostrum affected rearing results of the experimental piglets. Together with the increase of fat and UFA content in the colostrum and milk of the native breed of sows, their piglets were characterized by the best body weights, growth rate, as well as lower mortality. Bearing in mind the fact that the population of sows participating in the trial revealed huge variability with respect of fat and fatty acid concentrations in the colostrum and milk – as evidenced by their division into three levels – it might be suggested that the observed variability could be used as a selection indicator for sows. Although the importance of fat in piglets' lives was demonstrated many times and prosalubrious properties of fatty acids (especially of UFA) are widely accepted, nevertheless, their impact on piglets' rearing has not been sufficiently elucidated. In particular, insufficient attention is paid to native pig breeds and it must be remembered that their proper rearing is key for their survival.

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