



Preliminary results of chemical analysis of sow colostrum from first to ninth parity

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ABSTRACT

Chemical composition and quality of colostrum have a great influence on pigs' lifetime productivity and pre-weaning mortality. There are a different methods for determinate quality of colostrum, but some of them are not suitable for use at the farms. Method for assessing the quality of colostrum should be quick, simple and accurate. In today's intensive keeping condition pre-weaning period is the most sensitive and the highest losses of piglets are in that period of production. Quality of colostrum is the factor which has an influence on the decrease of that mortality. Research was conducted on 90 samples of colostrum collected from 33 PIC sows. Samples was collected regarding the parity (first, third and ninth) and time of the year (spring, summer and winter). The objective of this study was to examine the changes in fat, protein, lactose, dry matter (DM) and non-fat dry matter (NDF) amount in sows' milk regarding the number of parity and season as well as determining the quality of colostrum using the refractometry method.

(Keywords: sows, colostrum, chemical composition, piglets)

INTRODUCTION

The most critical period for surviving the piglets is within few hours after the farrowing. There are three different energy sources for newborn piglets, and they are glycogen, colostrum and transient milk. Fat and lactose from colostrum ensures enough energy for piglets until transient milk become available.

Colostrum is the first product of mammalian gland and it represents a key to survival of newborn piglets. It is rich with digestible nutrients since it contains functional proteins, immunoglobulins (Ig), fats, minerals and vitamins in order to ensure good health of piglets. It is secreted from the udder after farrowing. Chemical composition of colostrum is very variable and it change rapidly to the milk (Rooke & Bland, 2002). Colostrum is essential for survival of the piglets during the lactation period and also post weaning period (King'ori, 2012, Rolinec et al., 2011; Quesnel, 2011; Cabrera et al., 2010). Devillers et al. (2007) have shown the importance of colostrum during the pre-weaning period. They limited the amount of colostrum which piglets consume and which led to the increase of piglets' mortality to 82%. Colostrum contains immunoglobulins, minerals and growth factors. Immunoglobulins are important because they neutralize toxins, viruses and bacteria. They represent passive immune protection because they renew and strengthen immune functions (Gálik et al., 2011). The most important substances of colostrum are immunoglobulins since they provide passive immunity to piglets. Until now, a lot of researches regarding the concentration of immunoglobulines

content in dependence of number of parity (Inoue *et al.*, 1980; Tuchscherer *et al.*, 2006; Krakowski *et al.*, 2002) were conducted.

If piglets do not take colostrum within few hours after farrowing, the interstitial becomes impermeable to immunoglobulins. Piglets do not have fully developed immune system so they are sensitive to different kind of pathogens. If piglets do not get enough amount of colostrum they are going to be more sensitive to pathogens and hypothermia. Colostrum also provides gastrointestinal development, muscle protein synthesis and it is the strongest natural immune stimulator (Božanić, 2004). For the keeping of positive energy balance is important that piglets consume colostrum within 24 hours after farrowing. Chemical composition and amount of produced colostrum varies among the sows. Factors responsible for that variability can be divided into two groups: genetic and non-genetic (Trakovická *et al.*, 2005). Factors affecting the colostrum composition and yield are genotype, number of parity, nutrition, endocrine status and environment factors (Farmer and Quesnel, 2008). Nutrition is the factor which has the greatest influence on composition. The main role of colostrum is to supply piglets with immunoglobulins (Godden, 2008). Other components of colostrum are relaxin, IGF-2, IGF-1, leptin, prolactin and insulin (Blum and Hammon, 2000; Bartol *et al.*, 2008). Colostrum is also important for development of intestinal system, thermoregulation of piglets and it is important for immune transfer from the sow (Xu *et al.*, 2000; Le Dividich *et al.*, 2005). Research conducted by Bartol *et al.* (2008) showed that piglets fed enough amounts of colostrum had better reproductive performance later in life. High quality of colostrum is an important factor that affects the health of newborn piglets. Rolinec *et al.* (2011) investigated the change in chemical composition of colostrum within 12 hours after the farrowing. They have conducted research on 20 sows with different number of lactation and litter size. The highest content of dry matter was 2 hours after farrowing (21.91%) and its concentration was reduced within 12 hours on 18.74%. Concentration of crude protein was 13.59% and 12 hours after farrowing it was 8.85%. The lowest concentration of fat was 2 hours after farrowing (3.43%), and the highest 8 hours after farrowing (5.21%). The highest concentration of lactose was 10 hours after farrowing and it was 3.55%. The decreasing of protein content and dry matter and increasing the fat indicate the transition from colostrum to the milk. Salobir and Rezar (2009) said that there are 3.4% of lactose, 5.9% fat and 15.1% proteins in colostrum.

The most accurate method for evaluating the content of IgG in colostrum is radial immunodiffusion (RID). Visual assessment is not precise indicator of the antibody level because fat and proteins can change visual appearance of colostrum and they do not reflect the level of antibodies. Assessing the quality of colostrum by using a hygrometer is simple for use and economically acceptable. It measures the specific weight of colostrum using floating glass. A new method for measuring the quality of colostrum is the use of refractometer. Refractometry is an optical phenomenon that is based on the diffraction of rays of light on the border of two different environments in which the light spreads at different rates (Chigerwe *et al.*, 2008). Dry matter determined in that way represents water-soluble substance and it is measured with special instrument, refractometer. The advantage of this method is in simplicity, time of measure and small amounts of samples. Preliminary research indicates that the result of the 22% Brix or more indicates good quality colostrum (Quigley *et al.*, 2013; Biemann *et al.*, 2010). Although Brix refractometer measures the amount of sugar in the sample, the result can be converted to the estimate of the total solids content of milk (Dairy News, 2010). Following is the equation developed by Penn State:

$$\text{The total dry matter} = (0.9984 \times \% \text{ Brix score}) + 2.077$$

MATERIAL AND METHODS

Collecting the samples

86 samples of colostrum from 33 sows (PIC hybrids) were collected. The samples were divided into three groups depending on the number of parity and time of the sampling. There were collected 40 samples from sows between first and third parity, 22 samples from sows between fourth and sixth parity and 24 samples from sows between seventh and ninth parity. Samples were collected during three time periods: spring, summer and winter. The first sampling was carried out during April 2013th year, the second one during the August 2013th year and the last one in the February 2014th. Samples were collected from the same gilts and sows in the group during the sampling period. Samples from the first group belong to the sows from first to the third litter (1st), samples from second group belongs to the sows from fourth to sixth litter (2nd), and last group of samples belongs to the sows from seventh to ninth litter (3rd). All animals involved in this study were kept under the same feeding and keeping conditions. From each sow there was taken 10 ml of colostrum. Colostrum was taken from only one breast.

Preparing the samples

Sample was taken to the sterile tube and after the collection was stored at the temperature of -20 °C. Frozen samples for the refractometry analysis were melted at the room temperature and blended. In the same way samples were prepared for chemical analysis.

Analysis with digital BRIX refractometer

For analysis used ATAGO PR-100 (measuring range 0–32% BRIX) device was used. After instrument calibration with distilled or deionized water the colostrum samples were measured. The duration of measurements was 1,5sec. Instrument measure the refractive index of the sample and instantly converts it to % BRIX units. Minimal amount of sample necessary for measurement is 100 µl (or cover prism in its entirety).

Chemical analysis of samples

Chemical analysis of collected samples was carried out on the MILKOSCAN FT120 (FossElectric). In this way the concentration of fat, proteins, lactose, non fat dry matter (NFM) and dry matter (DM) was determined.

RESULTS AND DISCUSSION

Table 1 show the results from analysis of colostrum samples taken from gilts and sows from first to ninth parity. The data were submitted to ANOVA and differences between groups were analyzed with Fisher's test. The results of present study do not correspond to the research of Mahan (1998) who suggested that concentrations of fat decrease with parity. Number of litter and sampling period had a significant effect on sow fat content in colostrum, but there was not found any statistically significant effect between these two factors. Chemical analysis indicated that levels of fat were the highest in the colostrum of sows from 3rd group. Moreover, there was found a statistically significant effect of sampling period on nonfat dry matter. The lowest average value was during the February while the highest was recorded during the August, with the exception of sows from 3rd group. There was not found any statistically significant effect of sampling period and number of litter at the level of protein, lactose and dry matter. *De villers et al.*

(2007) showed that parity had influence on the milk yield; during the second and third parity yield was higher in comparison to first or later parity.

Table 1

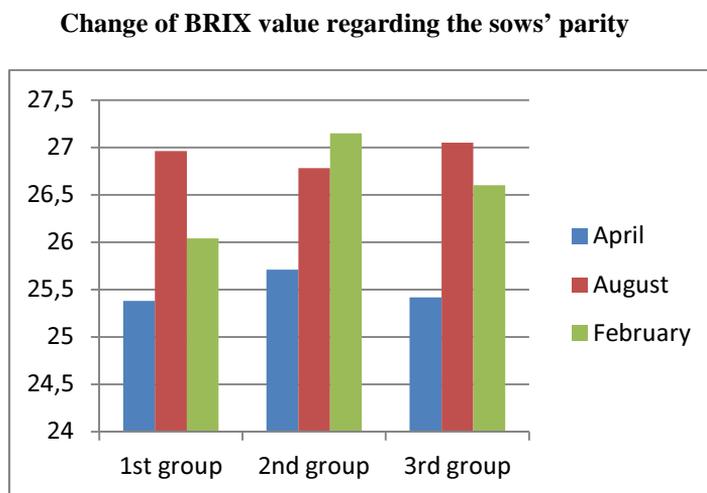
Chemical composition of sows colostrum regarding the number of parity and time of sampling

Number of parity	Time of sampling	n	Fat (%)	Proteins (%)	Lactose (%)	Nonfat dry matter (%)	Dry matter (%)
1.-3.	April	15	5,43±0,83 ^{ABC}	16.41±1.79	2.52±0.27	18.70±1.42 ^{BC}	52.75±6.02
	August	12	4,47±1,03 ^D	15.88±1.27	2.63±0.23	20.13±1.17 ^A	54.28±4.31
	February	13	5,32±0,82 ^{BC}	15.59±1.39	2.49±0.29	19.63±1.25 ^{AB}	52.94±4.57
4.-6.	April	8	5,34±0,71 ^{ABC}	16.04±2.09	2.61±0.38	18.46±1.62 ^{BC}	51.20±6.42
	August	8	4,85±0,48 ^{CD}	15.95±1.27	2.59±0.25	20.11±1.28 ^A	54.43±4.41
	February	6	5,66±0,55 ^{ABC}	15.09±1.23	2.45±0.31	19.02±1.14 ^{AB} C	50.80±4.84
7.-9.	April	10	6,05±0,81 ^A	15.55±1.34	2.65±0.21	17.98±1.17 ^C	49.99±4.95
	August	8	6,00±0,81 ^{AB}	15.36±2.52	2.67±0.51	19.51±2.37 ^{AB}	52.26±9.22
	February	6	5,76±0,97 ^{AB}	15.99±1.59	2.56±0.39	20.08±1.37 ^A	54.57±5.39
	P value number of parity		<0,001	0,705	0,605	0,651	0,666
	P value time of sampling		<0,05	0,614	0,316	<0,001	0,287
	P value interaction		0,234	0,705	0,964	0,551	0,638

A,B,C,D: different capital letters in the same column differ by Fisher's test (P>0.001)

BRIX value measurement of sow colostrum samples from the 1st group was in the range of 25.38% during the April to the 26.96% during the August. Average values of 1st group were 25.38% (April), 26.96% (August) and 26.04% (February). Average values of colostrum samples from 2nd group were 25.71% (April), 26.78% (August) and 27.15% (February). Average values were 25.42% (April), 27.05% (August) and 26.6 (February). Our results correspond to the results of *Deelen et al., 2014, Quigley et al., 2013, Biemann et al. 2010.*

Figure 1



CONCLUSIONS

Colostrum is a factor which affects the health of piglets and determines a complete production cycle and therefore the determination of its quality is of great importance. The paper presents the preliminary results of chemical composition of sows' colostrum, regarding the sows parity and seasonality, measured with standard chemical tests and BRIX refractometer. Considering that the amount of dry matter corresponds to the concentration of immunoglobuline G we would like to compare the BRIX refractometer method with laboratory measuring of chemical composition. Measuring the chemical composition of colostrum using this method could help the producer to replace bad quality colostrum and minimize the losses during production cycle.

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