CHANGES IN THE AVERAGE CONCENTRATION OF MINERALS IN THE COLOSTRUM OF SOWS DURING THE FIRST 48 HOURS AFTER PARTURITION

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Abstract

Colostrum has essential roles in the first hours of the piglets life. It is important for piglets due to its nutrient composition. Composition of colostrum is variable. There are differences between breeds and sows which are caused due to lactation stage, nutrition before parturition, genetics, individuality and many other factors. Colostrum is source of important nutrients like energy, immunoglobulins, fats and minerals. Minerals are important and essential for their structural functions in the body of piglets, in the regulatory functions of body fluids and in the erythropoiesis. The aim of this study was to determine changes in the concentration of minerals in the colostrum of sows during the first 48 hours after parturition. The concentration of minerals of sow colostrum was determined in 5 sows (White Improved Breed in the second litter). Minerals were analyzed with ContrAA®700 (Analytikjena, Germany). From birth of the first piglet to 48. hour, in this time period were concentrations of minerals in colostrum in these intervals: Ca from 0.44 g.kg^{-1} to 0.86 g.kg^{-1}, P: 1.30 – 1.41 g.kg^{-1}, Na: 0.73 – 1.46 g.kg^{-1}, K: 1.03 – 1.44 g.kg^{-1}, Cu: 2.93 – 4.26 mg.kg^{-1}, Fe: 1.39 – 2.06 mg.kg^{-1}, Zn: 12.84 – 21.68 mg.kg^{-1} and Mg 73.00 – 94.50 mg.kg^{-1}.

Key Words: Sow, colostrum, minerals, piglets, development

Colostrum is secreted from the udder immediately after farrowing and is a rich source of highly digestible nutrients, which are critical to the survival of the newly born piglet. Colostrum contains natural growth factors for the normal development of vital life-sustaining organs. The litter performance before weaning is mainly influenced by the sow's colostrum, milk yield and intake (King'ori, 2012). Colostrum also has essential roles for the developing piglet, most importantly, it provides passive immunity (Kanka et al. 2013) and nutrients to the piglet and permits thermoregulation. It also stimulates gastrointestinal development, muscle protein synthesis (Petrak et al., 2012) and the development of active immunity (Rolinec et al., 2012b). Colostrum synthesis is largely initiated before parturition, and thus its mineral composition may be influenced by other mineral demands on the reproducing female, primarily during late fetal growth (Mahan et al., 2009). In contrast, later milk mineral compositions are considered to be influenced largely by the postpartum feed and mineral intakes, sow body mineral status, and milk production differences rather than the effect of prepartum diets (Mahan, 2000; Mahan and Peters, 2004). Breed differences exist for ash, calcium, and phosphorus concentrations in bovine milk, but there is a dearth of information available on the effect of genetics on mineral element concentrations of porcine milk (Park et al., 1994). Colostrum mineral composition can be influenced by factors affecting the mineral needs of pregnant sows and dietary mineral supplementation and her body mineral status (Peters et al., 2010). The production of colostrum is very variable among sows and the factors affecting this variability are not well known. High colostrums yield can be achieved by reducing stress before, during and after farrowing as well as ensuring that sows have unrestricted access to fresh drinking water. Parity has a slight influence on milk yield with, a tendency for a greater production in second- and third-parity sows than in first parity or older sows (Devillers et al., 2007). Many minerals in milk and colostrum are also essential nutrients that play important roles as structural constituents (e.g., Ca, P, Mg), in the regulatory functions of body fluids (e.g., K, Na) and in the erythropoiesis (e.g., Fe, Cu) (Rolinec et al., 2010). Mineral elements are secreted into milk via diffusion and active transport processes (Park et al., 1994). Comprehensive information on the composition of the whole spectrum of essential inorganic elements in sow milk and colostrum is very limited (Park et al., 1994) and due to these facts the aim of this experiment was to determined and observed development of selected minerals in the colostrums of sows from 0. hour birth of the first piglet to 48. hour after birth of the first piglet.

Material and Methods

Changes in minerals were observed in the colostrum of five sows of White Improved Breed (VPP s.r.o. Kolíňany, farm Žirany). Sows were in the second litter and were fed with the feed mixture for lactating sows. They were healthy and without signs of diseases. Sampling of the colostrum was performed in the following time period: in the time of the birth (0. hour) and 3, 6, 12, 18, 24 and 48 hours after birth of the first piglet. Samples were hand-milked and closed into clear and marked test-tubes. After that samples were freezed and transported to Department of Animal Nutrition and then were the samples of colostrum lyophilised (Freeze Dryer Series, ilShin Europe, Netherland). Minerals were determined on the device ContrAA®700 (Analytikjena, Germany). Values of minerals in colostrum samples were statistically analyzed by the MS Excel 2007 and the SAS system 9.1.

Results and Discusion

The mineral composition of sow's colostrum is highly individual. There is a big difference between sows in amounts of minerals in colostrum. Differences in the development of minerals concentration in colostrum are during lactation also individual and variable.

The greatest difference in development of minerals was in calcium content. In the one of sow's colostrum was difference of minerals concentration between the time of birth of the first piglet to 48 hour after that +94.97%. In the colostrum of another sow the concentration of calcium was increased from birth of the first piglet to 48 hour after that by +91.67%. The average increase in the content of calcium from birth of the first piglet was +93.67%. The sow's colostrum is known that it has low content of iron. We found that the concentration of iron was declined. From hour of birth of the first piglet to 48 hours after that in the colostrum of the one of sows the concentration of iron declined by 28.35 %. In the colostrum of another sow the amount of iron declined from hour of birth of the first piglet to 48 hour after that by 17.51 %. We found that the average concentration of iron was decreased from 0. hour - birth of the first piglet to 48. hour by -22.63%. Amounts of other minerals were changed from hour of birth to 48. hour after birth of the first piglet as follows: P -2.19%, Na +27.52%, K -6.82%, Cu -29.40%, Zn -40.77% and Mg + 20.55%.

Coffey et al. (1982) found that content of calcium in the colostrum 24 hours after birth of the first piglet was 1.52 g.kg^{-1}. In the comparison with the average concentration in colostrums of our sows 24 hours after birth of the first piglet (0.86 g.kg^{-1}) were their values of calcium content higher. The average concentration of phosphorus which they found (1.58 g.kg^{-1}) compared to our results (1.34 g.kg^{-1}) was higher. The average amount of sodium was higher in the colostrum of our sows (1.06 g.kg^{-1} vs. 0.76 g.kg^{-1}). The concentration of potassium in their research (1.62 g.kg^{-1}) compared to average concentration in colostrum of our sows was higher (1.21 g.kg^{-1}). Their results of magnesium levels (91 mg.kg^{-1}) compared to colostrums of our sows (94.50 mg.kg^{-1}) were lower. The average content of iron in colostrums of our sows was lower than their (5.4 mg.kg^{-1} vs 1.79 mg.kg^{-1}). We found that the average concentration of zinc was in our results higher (16.78 mg.kg^{-1} vs. 9.2 mg.kg^{-1}). They found the content of copper 0.26 mg.kg^{-1}. In comparison with our average values of copper in colostrums it is less (3.53 mg.kg^{-1}).

In comparison with Zeman et al. (1994) and Petrikovič et al. (2005) (1.10 g.kg^{-1}) were our average values of phosphorus higher. Peters et al. (2009) examined the average content of minerals in the colostrum of sows. They fed sows with feed with added minerals which were in organic or inorganic form and they used two different standards of minerals requirements. They found the average content of calcium in the colostrum of sows from 0.89 g.kg^{-1} to 0.96 g.kg^{-1}. Our average values of calcium were lower (0.63 g.kg^{-1}). The average content of phosphorus in the colostrum of our sows (1.35 g.kg^{-1}) was in their range of average values (from 1.30 g.kg^{-1} to 1.41 g.kg^{-1}). The average amount of sodium in colostrums (1.06 g.kg^{-1}) was close to their found interval (from 0.65 g.kg^{-1} to 1.00 g.kg^{-1}). The average amount of potassium in the sows colostrums (1.22 g.kg^{-1}) compared to their results (1.28 g.kg^{-1} to 1.32 g.kg^{-1}) were close to their found range. The average content of magnesium in the colostrum in their experiment compared to our colostrums was higher (from 100 mg.kg^{-1} to 110 mg.kg^{-1} vs. 83.50 mg.kg^{-1}). The average value of copper in our colostrums (3.64 mg.kg^{-1}) was in their found interval (from 1.36 mg.kg^{-1} to 3.70 mg.kg^{-1}). The average content of iron (1.71 mg.kg^{-1}) was in colostrums related to their results (from 1.57 mg.kg^{-1} to 2.17 mg.kg^{-1}). The average content of zinc was in colostrums (18.41 mg.kg^{-1}) near to their found range (from 14.90 mg.kg^{-1} to 18.08 mg.kg^{-1}).

We found that the concentration of ash in the colostrums of our sows was rising. The difference between 0. hour birth of the first piglet to 48. hour after that was +17.24%. Results are almost identical with Klobasa et al. (1987) 0.63% and Aguinaga et al. (2011) 0.72%. Hughes and Hart (1935) found at Farrowing the concentration of ash 0.61% and Zerobin (1987) 5 hours after farrowing 0.71% and 20 hours after farrowing 0.77%.

The concentration of dry matter in the colostrums was declining. The difference between 0. hour birth of the first piglet to 48. hour after that was -22.40%. Le Dividich et al. (1994) reported that during parturition was the concentration of dry matter 23.4 % and 24 hours after parturition was 22.0%. Csapo et al. (1996) and Klobasa et al. (1987) found the content of dry matter 24 – 30% at the start of farrowing. Klobasa et al. (1987) claims that 6 hours after start of farrowing was the content of dry matter 22.70% and 12 hours after that 18.4%. Rolinec et al. (2011, 2012a) says that at the time of birth of the first piglet was dry matter 23.43%, 3 hours later 23.23%, 6 hours later 19.47% and 12 hours from birth of the first piglet 18.74%. Coffey et al. (1982) found 24 hours after birth of the first piglet the content of dry matter 21.10%.

Table 1. Development of minerals concentration in sow's colostrum (g.kg^{-1} dry matter)

Hours from birth of the first piglet	**Ca**	**P**	**Na**	**K**
0	0.44±0.09	1.37±0.17	1.14±0.46	1.11±0.35
3	0.44±0.04	1.30±0.06	1.41±0.69	1.03±0.21
6	0.57±0.00	1.36±0.10	0.88±0.02	1.34±0.23
12	0.64±0.04	1.32±0.08	0.74±0.13	1.44±0.03
18	0.66±0.02	1.41±0.08	0.73±0.07	1.36±0.13
24	0.81±0.06	1.34±0.06	1.06±0.22	1.21±0.28
48	0.86±0.19	1.34±0.27	1.46±0.68	1.04±0.42
Average content for 48 hours	0.63±0.15	1.35±0.03	1.06±0.28	1.22±0.15

Table 2. Development of minerals concentration in sow's colostrum (mg.kg^{-1} dry matter)

Hours from birth of the first piglet	Cu	Fe	Zn	Mg
0	4.15±0.31	2.06±0.12	21.68±1.17	73.00±0.00
3	3.78±0.21	1.96±0.28	20.28±0.37	75.50±4.50
6	4.26±0.56	1.60±0.11	21.30±2.11	78.50±5.50
12	3.44±0.30	1.60±0.03	17.16±1.24	89.00±5.00
18	3.36±0.73	1.39±0.13	18.82±5.35	86.00±2.00
24	3.53±1.05	1.79±0.51	16.78±4.37	94.50±8.50
48	2.93±0.12	1.59±0.20	12.84±0.62	88.00±16.00
Average content for 48 hours	3.64±0.43	1.71±0.22	18.41±2.88	83.50±7.34

Figure 1. Development of ash concentration is sow's colostrum (%)

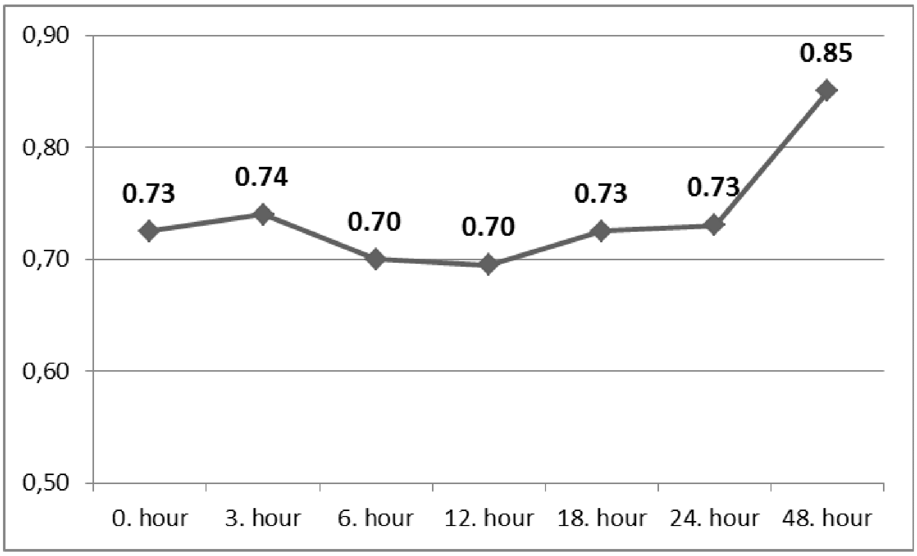
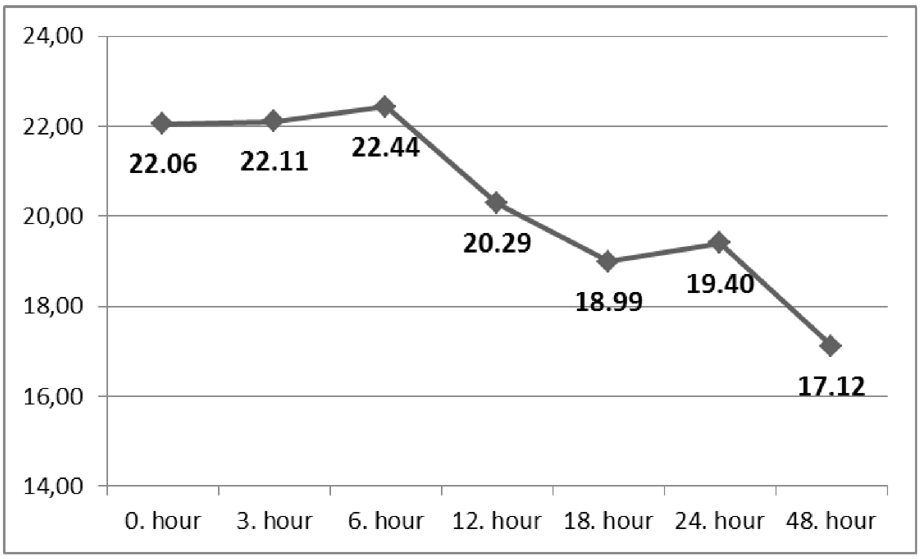


Figure 2. Development of dry matter in sow's colostrum (%)



Conclusion

The aim of this experiment was to examine the changes in selected minerals concentration in sow's colostrum during the first 48 hours after birth of the first piglet. We found that the mineral composition of sow's colostrum is highly individual and there is a big difference between sows in amounts of minerals in colostrum. Differences in the development of minerals concentration are during lactation also individual and variable. The greatest difference in the development of minerals was in calcium content. The sow's colostrum is known that it has low content of iron. We found that the concentration of iron was declined. The average increase in the content of calcium from birth of the first piglet to 48 hours after that was +93.67% and the average concentration of iron was decreased from hour of birth of the first piglet to 48. hour after birth of the first piglet by -22.63%. Amounts of another minerals were changed from hour of birth to 48. hour after birth of the first piglet as follows: P -2.19%, Na +27.52%, K -6.82%, Cu -29.40%, Zn -40.77% and Mg +20.55%.

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