KRMIVA

CHANGES IN SOW COLOSTRUM NUTRIENTS IN THE FIRST 12 HOURS FROM THE BEGINNING OF FARROWING

PROMJENE HRANJIVIH TVARI U KOLOSTRUMU KRMAČE U PRVIH 12 SATI NAKON POČETKA PRASENJA

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ABSTRACT

Colostrum is the specific first diet of mammalian neonates and plays an important role in neonatal growth and development. The composition and quantity of colostrum and milk produced by sows is an important factor in successful piglet production. The aim of this study was to determine the changes in sow colostrum nutrients in the first 12 hours postpartum. The concentrations of dry matter, crude protein, fat and lactose in sow colostrum were quantified in 20 sows (Large White with various lactation numbers and various litter sizes) at 6 time points throughout first 12 hours from the beginning of farrowing. One sample of colostrum (10 mL) represented the secretion from one gland. Samples were stored at – 20 °C. Dry matter content was the highest in 2 hours after the beginning of farrowing (21.91%) and its concentration decreased during the first 12 hours to 18.74%. Crude protein concentration during the first 12 hours of lactation declined by nearly 35%. The fat concentration in colostrum gradually increased during the first 12 hours. The lowest concentration of colostrum fat (3.43%) was 2 hours from the beginning of farrowing. The lactose concentration (2.82%) was the lowest on 2 hours from beginning of farrowing and its concentration increased during the first 10 hours to 3.55%. The decrease in total protein and dry matter, and the concomitant rise in fat and lactose content, appears to signal the transition from colostrum to milk.

Key words: sow, colostrum, crude protein, fat, lactose

INTRODUCTION

Colostrum is the specific first diet of mammalian neonates and is rich in immunoglobulins, antimicrobial peptides, and growth factors (Playford et al. 2000; Salobir and Rezar 2010; Gálik et al. 2011). Colostrum and milk composition are key to survival of newborn pigs (Hartmann et al. 1984). Functional development of the mammary gland is closely synchronized with the normal process of parturition. Fifty percent of pre-weaning mortality in the U.S. swine herd occurs during the first 3 d after birth. With the additional knowledge that piglets are born with as little as 2% of body weight as fat (Seerley et al. 1981) and that reserves of stored glycogen also are limited (Boyd et al. 1978), the importance of rapid and adequate colostrum intake by the newborn pig is clear (Noblet et al. 1997). Colostrum also has the essential role in the developing piglet; most importantly, it provides passive immunity and nutrients to the piglet and permits thermoregulation.

It also stimulates gastrointestinal development, muscle protein synthesis and the development of active immunity. The production of colostrum, however, is very variable between sows and the factors affecting this variability are not well known (Farmer et al., 2006). These factors are divided into genetic and non-genetic (Trakovická et al. 2005). Klaver et al. (1981) showed, that feeding level during early lactation had no effect on quantity and composition of milk. The principal objective of this experiment

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was to examine the changes in dry matter, crude protein, fat and lactose composition of sows' colostrum from the beginning of farrowing to 12 hours.

MATERIALS AND METHODS

Twenty sows (Large White with various lactation numbers and various litter sizes) were selected from Sheep and pig farm Žirany (VPP Kolíňany, the Slovak University of Agriculture in Nitra). Sows were inseminated with semen from Large White boars and were housed with their litters in individual farrowing boxes with straw bedding. From 5th day before farrowing, sows were fed 1.3 kg per 100 kg live weight daily of a diet containing 13.88% crude protein, 3.96% fat, 3.33% crude fibre, 58.79% nitrogen-free extract and 12.0 MJ.kg^{-1} ME. Water was supplied ad libitum throughout the experiment. Parturitions were watched but observers interfered as llittle as possible in the farrowing process. The beginning of parturition was as the birth of the first piglet. Mammary secretions were collected from the right second (5 mL) and sixth (5 mL) gland – these two samples were then mixed. Colostrum samples were collected without injection of oxytocin at the time points: 2, 4, 6, 8, 10 and 12 hours from the beginning of farrowing. Samples were stored at -20°C (freezing box PDF370S, Evermed) until they were analyzed for crude protein, fat, lactose and dry matter (MilkoScan FT 120, Foss A/S). Colostrum composition data were statistically analyzed by one-way ANOVA, testing differences in average nutrient concentration of colostrum between different sampling times, were performed with Duncan-test ($P<0.05$), using a SAS Enterprise Guide 4.2 (SAS Institute Inc.).

RESULTS AND DISCUSSION

The most critical period for survival of neonatal pigs is during farrowing and the first few days of life. Pigs are born with very little available fat stores and poor gluconeogenic capacity and must consume sufficient amounts of colostrum during the first 24 hours of life to keep positive energy balance (Curtis et al. 1966; Milon et al. 1983). The results are presented in Table 1. Colostrum had a high concentration of dry matter including proteins and a low concentration of fat and lactose. The transition from colostrum to milk is marked by a decline in crude protein with a simultaneous increase in fat and lactose. Data in Table 1 show that sows colostrum on second hour from the beginning of farrowing contained 21.91% dry matter, 13.59% crude protein, 3.43% fat and 2.82% lactose.

Crude protein concentration during the first 6 hours of lactation declined by nearly 20% and during the first 12 hours by nearly 35%. Concentration of crude protein decreased from 2 to 12 hours from the beginning of farrowing. This pattern is similar to that found by Klobasa et al. (1987), Jackson et al.

Table 1 Concentration of crude protein, fat, lactose and dry matter in sows´ colostrum in the first 12 hours

Tablica 1. Koncentracija sirovih bjelančevina, masti, laktoze i suhe tvari u kolostrumu krmače u prvih 12 sati

Hour from beginning of farrowing – Sati od početka prasenja	Crude protein – Sirove bjelančevine, %		Fat – Mast, %		Lactose – Laktoza, %		Dry matter – Suha tvar, %	
	Average Mean	Standard Deviation	Average Mean	Standard Deviation	Average Mean	Standard Deviation	Average Mean	Standard Deviation
2. hour – 2. sat	13.59 ± 1.31		3.43 ± 1.06		2.82 ± 0.24		21.91 ± 2.26	
4. hour – 4. sat	11.31 ± 2.04		4.01 ± 1.14*		3.08 ± 0.54*		20.23 ± 2.41	
6. hour – 6. sat	10.58 ± 1.45*		3.75 ± 1.11*		3.07 ± 0.54*		19.47 ± 2.91	
8. hour – 8. sat	9.76 ± 1.41*		5.21 ± 1.38		3.14 ± 0.20*		19.78 ± 2.40	
10. hour – 10. sat	9.54 ± 1.66*		3.67 ± 0.90*		3.55 ± 0.92		18.34 ± 2.76	
12. hour – 12. sat	8.85 ± 1.25		4.95 ± 1.96*		3.39 ± 0.60*		18.74 ± 2.22	

*P<0,05

(1995), Rolinec et al. (2009). Colostrum is characterized by a sharp drop (about 50%) in crude protein concentration during the first 48 h (Klobasa et al. 1987). 60% of sows showed a drop in colostral crude protein greater than 50% within 24 h *post partum* and the mean overall decrease for all sows was 52% (Devillers et al. 2007). In the crude protein concentration significant ($P<0.05$) differences were between the average meansat the time of sampling at 6., 8. and 10. hours. Colostrum fat concentrations were relatively low and not constant (Table 1.). Milk fat percentage values were in agreement with average milk fat values reported by Klobasa et al. (1987) and Čanakyová et al. (2009). The fat content in colostrum on day 1 of lactation of Meishan gilts was 10.9% and in the Yorkshire gilts 6.6% (Zou et al. 1992). Averette et al. (1999) reported that, milk fat concentration of sows was elevated by supplemental fat regardless of whether they were induced or farrowed naturally, whereas dietary fat had no effect on naturally farrowing gilts and tended to reduce milk fat percentage in induced gilts. In the fat concentration there were significant ($P<0.05$) differences between the average means at the time of sampling at 4., 6., 10. and 12. hours. Average lactose concentrations (Table 1.) in samples collected from 2 to 12 h of the lactation were from 2.82% to 3.39%. The lactose concentration slowly increased during the first 12 h of the lactation. Devillers et al. (2007) reported that, least proportional representation nutrient in sows colostrum was lactose. The concentration of lactose in the second hour of lactation was 3.04% and 3.26% respectively (Jackson et al. 1995). Klobasa et al. (1987); Jackson et al. (1995) and Rolinec et al. (2008) evaluated lactose concentration in sows colostrum at 6. h from 3.16% to 3.40% and at 12. h from 3.16% to 4.1%. In the lactose concentration there were significant ($P<0.05$) differences between the average means at the time of sampling at 4., 6., 8. and 12. hours. Dry matter was the highest at the beginning of farrowing (Table 1.) and its concentration decreased approximately 11% during the first 6 hours from the beginning of farrowing and approximately 14% during the first 12 h from the beginning of farrowing. This decrease in the percentage of dry matter in colostrum is attributed to a high decrease in the percentage of crude protein. Klobasa et al. (1987) evaluated dry matter concentration in sows colostrum at 6 h 22.7% and at 12 h 18.4%. In the dry matter concentration there were no significant ($P>0.05$) differences between the average means.

We found the impact of sampling time on the fat and crude protein concentration. For the fat and dry matter concentration the effect was insignificant (Table 2.). Jackson et al. (1995) found, that concentrations of fat, protein and lactose in colostrum and milk changed over time ($P<0.01$). Fat and lactose percentage in the colostrum of sows increased from 0 to 12 hours. Concentration of crude protein and dry matter decreased from 0 to 12 hours.

CONCLUSIONS

The principal objective of this study was to examine the changes in crude protein, fat, lactose and dry matter concentrations in sows colostrum during first 12 hours from the beginning of farrowing. In colostrum, levels of dry matter and crude protein were high while those of fat and lactose were comparatively low. We detected in sows colostrum 13.59% (2. hours) crude protein decreasing at 12.hours to 8.85%, 21.91% (2. hours) dry matter decreasing at 12. hours to 18.74%, 3.43% (2. hours) fat increasing at 12.hours to 4.95%, 2.82% (2. hours) lactose with increasing at 12. hours to 3.39%. We found the impact of sampling time on the fat and crude pro-

Table 2 Analysis of variance of the nutrient content of colostrum, depending on the time of sampling

Tablica 2. Analiza varijance sadržaja hranjivih tvari u kolostrumu ovisno o vremenu uzimanja uzorka

Nutrient – Hranjiva tvar	F Value	Pr > F	R-Square
Crude protein – Sir. bjelančevine	10.57	<.0001	0.524
Fat - Mast	2.76	0.0287	0.223
Lactose - Laktoza	1.76	0.1382	0.155
Dry matter – Suha tvar	0.67	0.6499	0.065

tein content. For the fat and dry matter content the effect was insignificant. Results from this study indicate that sows colostrum is subject to considerable changes in the early hours from the beginning of farrowing.

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SAŽETAK

Kolostrum je specifična prva hrana novorođenih sisavaca te igra važnu ulogu u njihovu rastu i razvoju. Sastav i količina kolostruma i mlijeka, što ih proizvodi krmača, važan su čimbenik za uspješnu proizvodnju praščića. Cilj ovog rada bio je odrediti promjene hranjivih tvari u kolostrumu krmače u prvih 12 sati postpartum. Koncentracije suhe tvari, sirovih bjelančevina, masti i laktoze u kolostrumu krmače izmjereni su u 20 krmača (Large White različitog broja laktacija i različitih veličina legla) 6 puta u tijeku prvih 12 sati od početka prasenja. Jedan uzorak kolostruma (10 ml) predstavljao je sekreciju jedne žlijezde. Uzorci su spremljeni na -20 C. Sadržaj suhe tvari bio je najviši 2 sata nakon početka prasenja (21.91%) a njezina koncentracija se smanjila kroz 12 sati na 18.74%. Koncentracija sirovih bjelančevina za vrijeme prvih 12 sati laktacije pala je za gotovo 35%. Koncentracija masti u kolostrumu postepeno je rasla za vrijeme prvih 12 sati. Najniže koncentracije masti u kolostrumu (3.43%) bile su 2 sata nakon početka prasenja. Koncentracija laktoze (2.82%) bila je najniža 2 sata nakon početka prasenja i ona se povećala u prvih 10 sati na 3.55%. Pad ukupnih bjelančevina i suhe tvari te istovremeno povećanje sadržaja masti izgleda da upozoravaju na prijelaz iz kolostruma u mlijeko.

Ključne riječi: krmača, kolostrum, sirove bjelančevine, mast, laktoza