

CHANGES IN THE AVERAGE CONCENTRATION OF AMINO ACIDS IN SOW'S COLOSTRUM

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Abstract

The concentrations of amino acids in sow's colostrum were determined. Colostrum samples were milked by hand from 6 Large white sows. First colostrum sample were milked immediately after birth of first piglet, next samples were milked every hour for 12 hours. After lyophilisation, mineralized samples of colostrum were analyzed for amino-acids concentration. At the time of birth of first piglet leucine ($54.97 \pm 6.66 \text{g.kg}^{-1}$ of DM – dry matter) and lysine ($43.32 \pm 5.09 \text{g.kg}^{-1}$ of DM) were the essential amino acids with the highest content. The nonessential amino acids with the highest content in colostrum sample at the time of birth of first piglet were glutamic acid ($85.80 \pm 9.66 \text{g.kg}^{-1}$ of DM) and proline ($57.62 \pm 6.41 \text{g.kg}^{-1}$ of DM). During first hour from birth of first piglets the content of all amino acids increased in average by 6.71% (minimum 2.12% cysteine, maximum 10.44% valine). Than up to 12th hour after birth of first piglet the content of all amino acids decreased in average by -17.08% (minimum -11.48% proline, maximum -23.94% cysteine). At the 12th hour after birth of first piglet the essential amino acids with the highest content were leucine ($46.19 \pm 13.06 \text{g.kg}^{-1}$ of DM) and lysine ($37.72 \pm 11.18 \text{g.kg}^{-1}$ of DM) and the nonessential amino acids with the highest content were glutamic acid ($75.77 \pm 18.36 \text{g.kg}^{-1}$ of DM) and proline ($51.00 \pm 10.43 \text{g.kg}^{-1}$ of DM). In all sampling periods, methionine has the lowest concentration (time of birth of first piglet $11.45 \pm 0.43 \text{g.kg}^{-1}$ of DM; 12th hour after birth of first piglet $10.04 \pm 1.90 \text{g.kg}^{-1}$ of DM). These results confirm, that changes of amino acids in sow's colostrum during first 12 hours of lactation are marked. We could say, that piglets born in different time after birth of first piglet ingest colostrum with different content and proportion of amino acids.

Key words: sow, colostrum, amino acids

First milk from mammary gland of mammalian female is colostrum. It is produced in time near to beginning of farrowing and in first days of lactation. Colostrum is the first nutrition for mammalian and is irreplaceable feed mainly for farm animals (Gálik et al., 2011; Šamanc et al., 2013). Chemical composition and quality of colostrum have a great influence on pigs' lifetime productivity and pre-weaning mortality. 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 (Budimir et al., 2014). Changes of quality and quantity of colostrum and milk are affected by many factors (Miluchová et al., 2014; Trakovická et al., 2013; Ševčík et al., 2011) Colostrum is complex biological system, wherein colostrum-components are presented in different proportion. Colostrum from different mammalian was assayed (Kráčmar, 2003) as well as it was assayed for different nutrients or properties (Farmer, 2015; Kielland et al., 2015; Hanušovský, 2014; Rolinec et al., 2012). There are a lot of studies describing concentration of amino acids in sow's colostrum and milk. Dunshea et al. (2005) determined concentration of amino acids at mid and late stage of lactation; Dourmad et al. (1998) at 3, 7, 15 and 22 day of

lactation; Daza et al. (2004) at 5, 12, 19 and 26 day of lactation; Elliott et al. (1971) obtained only one sample of colostrum within 12 hours after farrowing; and Csapó et al. (1996) determined amino acids concentration in sows colostrum at 0, 8-14, 20-28, 44-52, 68-76 hours after parturition. However, information about development and concentration of amino acids in colostrum of sows during first 12 hours after beginning of farrowing are missing. Exactly first hours of piglet life are the most important for survival. The aim of this study was to analyzed the development of amino acids concentration in sows colostrum during first 12 hours after birth of first piglet.

Material and Methods

Colostrum samples used for determination of amino acids concentration were gained from six Large white sows. Colostrum samples were milked per hand during suckling (without oxytocin injection) at these sampling times: 0 = immediately after birth of first piglet, next samples were milked every hour from birth of first piglet till 12th hour after birth of first piglet. From each sow we had together 13 colostrum samples. Each sample consist from colostrum mix of 3 to 4 glands. Colostrum samples were freeze dried,

homogenized and analyzed for amino acids concentration using amino acid analyzer AAA 400 (Ingos, Prague). Colostrum samples for determination of amino acids were first hydrolysed by the acidic and oxidative hydrolysis. Then were analysed by HPLC with post column ninhydrine derivatisation (AAA 400). Dry matter (DM) content of the colostrum samples were determined after pre drying (freeze drying) and then by oven drying at 103°C for 4 hours. Determination of DM and amino acids concentration in colostrum samples were realised at the Laboratory of Quality and Nutritive Value of Feeds (Slovak University of Agriculture in Nitra). Sows used in this experiment were housed at the University farm. Ltd. Kolíňany, farm Žirany. The experimental sows has farrowed before this experiment 2.33 times in average. One week before parturition and during lactation sows were fed with a commercial lactation feed. Sows were housed in individual farrowing crates. The results were statistically analyzed by one-way ANOVA, the differences in average mean of amino acid concentration between different sampling times were tested with Turkey's Studentized Range (HSD) Test (SAS system 9.1, SAS Institute Inc.).

Results and Discussion

Concentration of amino acids in sow's colostrum is expressed in 100% dry matter (DM) of colostrum. Table 1 shows development of colostrum dry matter at times of colostrum milking.

The development of amino acids concentration in sow's colostrum during first 12 hours after birth of first piglet is shown in Table 2. The average total content of the 17 considered amino acids of sow's colostrum at birth of first piglet was 583.64 g.kg⁻¹ of DM. During the first hour after birth of first piglet increased total content of amino acids to 624.00 g.kg⁻¹ of DM and later decreased to 489.62 g.kg⁻¹ of DM (12th hour after birth of first piglet). Similar with increase of total amino acids of colostrum during first hour after birth of first piglet, in the same time, concentration of all the considered amino acids increased. At the time of birth of first piglet leucine and lysine were the essential amino acids and glutamic acid and proline were the nonessential amino acids with the highest content. At the 12th hour after birth of first piglet the essential amino acids with the highest content were leucine and lysine and the nonessential amino acids with the highest content were glutamic acid and proline. In all sampling periods, methionine has the lowest concentration from all considered amino acids. Comparing the values found at 1st to 12th hour after birth of first piglet with those found at time of birth of first piglet (= 100%), we came to the following conclusions: From 1st to 4th hour were concentrations of almost all amino acids higher that they were at time of birth of first piglet (except cysteine). At 6th hour after birth of first piglet almost all amino acids of sow's colostrum had lower concentration than they

had at time of birth of first piglet (except isoleucine and glutamic acid). Amino acids expressed as a proportion of lysine (lysine=100) at time of birth of first piglet: lysine 100.0, methionine 26.4, threonine 76.5, leucine 126.9, isoleucine 44.7, histidine 35.7, arginine 74.6, valine 78.1, phenylalanine 58.0, tyrosine 59.8, glycine 44.6, alanine 58.1, serine 86.6, proline 133.0, cysteine 35.5, aspartic acid 111.1, glutamic acid 198.1. At 6th hour from birth of first piglet the proportion of amino acids expressed of lysine was: lysine 100.0, methionine 26.3, threonine 76.1, leucine 128.7, isoleucine 45.9, histidine 35.8, arginine 73.9, valine 79.7, phenylalanine 57.7, tyrosine 59.3, glycine 44.4, alanine 57.4, serine 85.9, proline 136.0, cysteine 33.3, aspartic acid 111.8, glutamic acid 205.2. At the 12th hour after birth of first piglet proportion of amino acids expressed of lysine was: lysine 100.0, methionine 26.6, threonine 69.4, leucine 122.5, isoleucine 45.0, histidine 32.7, arginine 74.1, valine 73.0, phenylalanine 53.5, tyrosine 54.4, glycine 41.8, alanine 53.4, serine 78.4, proline 135.2, cysteine 30.8, aspartic acid 106.1, glutamic acid 200.9. In the time from birth of first piglet till 12th hour after birth of first piglet the concentration of all amino acids in sows colostrum decreased: lysine by -12.9%, methionine by -12.3%, threonine by -20.9%, leucine by -16.0%, isoleucine by -12.2%, histidine by -20.3%, arginine by -13.4%, valine by -18.5%, phenylalanine by -19.6%, tyrosine by -20.7%, glycine by -18.4%, alanine by -20.0%, serine by -21.1%, proline by -11.5%, cysteine by -23.9%, aspartic acid by -16.8%, glutamic acid by -11.7%. However, this decrease of all amino acids was not significant ($P>0.05$), except decrease of phenylalanine between 1st to 10th hour after birth of first piglet ($P<0.05$). Sows reproductive performance is determined by number of weaned piglets (Nevrkla et al., 2014) and therefore is correct nutrition of piglets very important. As it was mentioned above, authors researched sows colostrum and milk determined amino acid content in different times of lactation with following results. Csapó et al. (1996) published decrease of amino acids during change of colostrum to milk. Elliott et al. (1971) in their experiment with different content of protein in sow's diet found generally greater amino acid content in defatted colostrum than in defatted milk. Similar Dunshea et al. (2005) found higher content of amino acids at mid stage of sow's lactation than at late stage of lactation. This statements confirm effect of lactation stage on concentration of amino acids in sow's milk. Based on our results, we can say, that generally in colostrum the content of amino acids is during first 4 hours after birth of first piglet higher than it was at time of birth of first piglet and then after 6th hour the content of amino acids decreased. These changed the proportion of amino acids in sows colostrum expressed as a proportion of lysine content. We could say, that piglets born in different time after birth of first piglet ingest colostrum with different content and proportion of amino acids.

Table 1. Dry matter (DM) content of sow's colostrum during sampling period (%)

	Hour from birth of first piglet												
	0 ⁺	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th	11 th	12 th
DM*	21.5	22.0	22.5	22.6	21.8	20.6	20.5	22.1	20.0	21.0	19.7	19.7	18.1
	±1.9	±2.6	±2.3	±2.0	±2.0	±1.8	±2.2	±2.8	±2.7	±2.9	±2.2	±2.7	±3.3

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Table 2. Effect of time from beginning of farrowing on colostrum amino acids concentration (g.kg⁻¹ of DM)

Amino acid ^a	Hour from birth of first piglet												
	0 ⁺	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th	11 th	12 th
Lysine	43.32 ±5.09	46.66 ±2.80	45.75 ±3.03	45.35 ±2.79	45.48 ±3.15	44.15 ±5.52	42.32 ±7.36	44.23 ±7.08	38.80 ±7.83	40.37 ±7.22	38.23 ±9.68	36.71 ±10.98	37.72 ±11.18
Methionine	11.45 ±0.43	12.06 ±0.77	11.95 ±0.80	12.15 ±0.26	11.71 ±0.84	11.83 ±0.97	11.14 ±1.51	10.94 ±1.20	10.10 ±1.12	10.75 ±1.07	9.95 ±1.50	9.94 ±2.19	10.04 ±1.90
Threonine	33.14 ±5.45	35.84 ±2.91	35.08 ±2.87	34.51 ±1.57	34.53 ±2.85	33.98 ±2.97	32.23 ±5.85	33.13 ±2.61	28.63 ±6.34	29.93 ±2.48	27.63 ±7.29	25.99 ±7.42	26.20 ±9.15
Leucine	54.97 ±6.66	58.94 ±4.70	57.81 ±3.68	57.63 ±3.16	57.33 ±4.00	57.14 ±5.58	54.47 ±8.84	55.43 ±6.65	49.03 ±8.81	51.23 ±5.83	48.00 ±10.64	46.01 ±11.83	46.19 ±13.06
Isoleucine	19.35 ±1.70	21.31 ±1.16	20.80 ±1.35	20.49 ±1.67	20.69 ±1.38	20.57 ±2.31	19.45 ±3.10	20.10 ±3.00	17.89 ±3.12	18.61 ±3.02	17.51 ±3.68	16.95 ±4.07	16.99 ±4.38
Histidine	15.48 ±2.37	16.39 ±0.87	16.00 ±0.87	16.04 ±0.98	15.90 ±1.61	15.79 ±1.83	15.16 ±2.90	15.52 ±1.49	13.57 ±2.65	14.35 ±1.38	13.27 ±3.12	12.44 ±3.19	12.33 ±3.60
Arginine	32.30 ±5.14	35.15 ±3.62	34.47 ±3.40	33.87 ±2.95	34.02 ±2.41	33.17 ±3.81	31.27 ±5.24	32.81 ±5.26	28.80 ±5.80	29.50 ±5.09	28.41 ±7.00	26.51 ±7.20	27.96 ±8.39
Valine	33.82 ±4.66	37.35 ±2.98	36.42 ±2.85	35.58 ±2.29	36.02 ±2.54	35.82 ±3.14	33.72 ±5.62	34.76 ±4.02	30.31 ±6.13	31.49 ±3.44	29.58 ±7.37	27.94 ±7.99	27.55 ±8.50
Phenylalanine	25.11 ±3.21	26.49 ^A ±1.76	25.71 ±1.57	25.66 ±1.21	25.60 ±2.01	25.37 ±2.28	24.40 ±4.29	24.86 ±1.96	21.73 ±4.39	22.85 ±1.76	19.16 ^B ±4.99	20.16 ±5.05	20.19 ±6.28
Tyrosine	25.89 ±3.80	27.39 ±1.51	26.87 ±1.36	26.49 ±0.94	26.49 ±2.00	26.32 ±2.27	25.11 ±4.59	25.95 ±2.31	22.51 ±4.77	23.60 ±1.87	21.94 ±5.49	20.42 ±5.28	20.53 ±6.84
Glycine	19.31 ±3.19	20.50 ±1.93	20.15 ±1.75	19.80 ±0.88	19.89 ±1.53	19.64 ±1.20	18.80 ±2.94	19.41 ±1.59	17.04 ±3.19	17.27 ±1.07	16.52 ±3.83	15.48 ±3.67	15.75 ±4.87
Alanine	25.17 ±3.50	26.62 ±2.13	26.03 ±1.90	25.86 ±1.31	25.77 ±2.12	25.45 ±2.37	24.29 ±4.16	25.04 ±2.47	21.08 ±4.30	22.70 ±2.27	21.16 ±5.23	19.91 ±5.47	20.14 ±6.37
Serine	37.50 ±5.83	39.85 ±3.04	39.16 ±2.68	38.88 ±1.39	38.55 ±2.89	38.14 ±3.38	36.37 ±6.38	37.14 ±2.44	32.45 ±6.71	34.03 ±2.60	31.31 ±7.94	29.55 ±8.11	29.59 ±9.77
Proline	57.62 ±6.41	61.00 ±4.61	60.62 ±3.86	60.50 ±4.04	60.93 ±2.97	60.42 ±6.31	57.58 ±7.72	59.89 ±8.41	54.47 ±7.89	55.96 ±8.92	53.38 ±11.18	50.48 ±11.01	51.00 ±10.43
Cysteine	15.30 ±2.10	15.62 ±1.38	15.24 ±1.74	15.33 ±0.99	15.08 ±1.58	15.00 ±1.16	14.10 ±2.52	14.30 ±1.25	12.55 ±2.74	12.83 ±0.98	12.20 ±3.27	11.35 ±3.53	11.64 ±3.88
Aspartic acid	48.12 ±5.84	50.78 ±3.44	50.22 ±3.29	49.75 ±2.23	49.74 ±3.60	49.56 ±4.85	47.30 ±7.60	48.22 ±4.30	42.89 ±8.06	44.75 ±5.39	40.89 ±9.59	39.30 ±9.90	40.01 ±11.87
Glutamic acid	85.80 ±9.66	92.05 ±5.38	91.00 ±5.63	91.21 ±6.95	91.26 ±8.29	90.51 ±9.80	86.85 ±13.21	87.24 ±8.80	79.01 ±11.73	82.00 ±10.09	76.72 ±15.20	75.59 ±17.29	75.77 ±18.36

* Concentration of amino acid is expressed as mean of six colostrum samples ± standard deviation; ^ATime of birth of first piglet; Within rows, means with different superscript are significantly different (P<0.05).