CHEMICAL SCORE OF SOW'S COLOSTRUM

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Abstract

The concentration and proportion of essential amino acids in sow's colostrum changes every hour from the start of colostrum secretion. One of the parameters describing the protein quality of sow's colostrum is the chemical score. The aim of this study was to determine the chemical score of colostrum of sows. Colostrum samples were collected every hour from birth of first piglet (h 0) till 12th hour after birth of first piglet (h 12). According to the concentration of essential amino acids (g.16 g N^{-1}) in sow's colostrum and in whole egg the chemical score (CS_{egg}) were calculated. The highest value of CS_{egg} was at 7th h (56.3%). The lowest value of CS_{egg} was at 12th h (46.1%). When CS_{egg} was calculated (whole egg was used as standard protein), in every sampling time isoleucine was the most limiting essential amino acid. During the first 12 h, protein of sow's colostrum had not reached the quality of egg protein ($CS_{egg} < 100$). Additionally, the average concentration of essential amino acids of sow's milk was used as a standard protein for calculation of chemical score ($CS_{sow's\ milk}$). The values of $CS_{sow's\ milk}$ were in interval from 80.2% (h 12) to 102.6% (h 9). When $CS_{sow's\ milk}$ was calculated (sow's milk was used as standard protein), isoleucine (h 0 and 1) and histidine (h 2, 3, 5, 6, 8, 10, 11 and 12) were the most limiting amino acids. At h 4, 7 and 9 there was no limiting essential amino acid ($CS_{sow's\ milk} > 100$). No significant ($P>0.05$) changes for CS_{egg} and $CS_{sow's\ milk}$ between colostrum samples collected at different times from the birth of the first piglet till 12th h were observed.

Key Words: Sow, colostrum, limiting essential amino acid, chemical score

Colostrum is for newborn piglets the only source of nutrients and water. Separate nutrients of colostrum as well as its constituents play essential role in growth and development of newborn piglet (Rolinec et al., 2017). Nutrient with the highest concentration in colostrum is crude protein, 0 h 15.7%, 12 h 8.8% (Klobasa et al., 1987). Proteins holds a central place in body metabolism. Amino acids are critical nutrients (Moughan, 2015). Essential amino acids are required by sucking piglets. One method for assessing protein quality is by determining a chemical score, i.e. the ratio of a gram of the limiting amino acid in a sample to the same amount of the corresponding amino acid in a reference protein (whole egg protein) multiple by 100. This formula is used for determining the quality of proteins in diets or food, as well as in feeds in animal nutrition (Pajtáš et al., 2009; Zelenka, 2006; Bell et al., 1991). Quality of sows colostrum were analysed in many researches (Hurley, 2015; Šamanc et al., 2013; Csapó et al., 1996; Jackson et al., 1995; Elliott et al., 1971), but the information about values of chemical score of sow's colostrum are missing. Therefore, the aim of this study was to calculate the chemical score of sow's colostrum.

Material and Methods

The concentration of essential amino acids (g.16 g N^{-1}) was determined in colostrum samples from twelve sows (breed Large white), housed in University sheep and pig farm in Žirany (VPP SPU s.r.o Kolíňany). Concentration of amino acids were determined using amino acid analyser AAA 400 (Ingos, Prague). Concentration of nitrogen were determined by Kjehldal method. All analyses were realised in Laboratory of Quality and Nutritive Value of Feeds at Department of Animal Nutrition (SUA in Nitra). Colostrum samples were collected every hour in time interval from birth of first piglet (h 0) till 12th hour from birth of first piglet (h12). Some of the sows (during a suckling bout initiated by the piglets) did not eject colostrum and this is the

reason, why the number of colostrum samples is not identical in every sampling period. Chemical score (CS) defined Pajtáš et al. (2009) as the percentage share of limiting essential amino acid of protein in sample and the same amino acid in standard protein (whole egg). This percentage share is calculated for all essential amino acids and as a chemical score is assigned the lowest value. This value is used for determining the quality of protein in feed. We used this formula for determining the CS_{egg} in every colostrum sample. However in pig nutrition the protein of sow's milk is considered as a standard protein. Therefore we calculated chemical score ($CS_{sow's\ milk}$), where average concentration of essential amino acids in sow's milk (g.16 g N^{-1}) was used as a standard protein. Results of determination of CS_{egg} and $CS_{sow's\ milk}$ were tested for normal distribution, which is needed for statistical analysis as published Schubertová and Candrák (2014). Gained results were statistically analyzed by one-way ANOVA, the differences between mean values of CS of colostrum collected in different times were tested with Tukey's Studentized Range (HSD) Test (SAS system 9.1, SAS Institute Inc.). $P<0.05$ was considered as significant.

Results and Discussion

The quality of protein in colostrum of sows was determined with comparison to the egg protein (CS_{egg}) and additionally to the protein of sow's milk ($CS_{sow's\ milk}$). The development of CS_{egg} and $CS_{sow's\ milk}$ is shown in Tab. 1. The most limiting essential amino acid is shown in bracket. Minimal value of CS_{egg} is at h 12 and maximal value is at h 7. Compared to egg protein, in colostrum samples of all sampling times the isoleucine (Ile) was the limiting essential amino acid. Lowest value of $CS_{sow's\ milk}$ is at h 12 and maximal value is at h 9. According to $CS_{sow's\ milk}$ at 4th h, 7th h and 9th h the colostrum of sows had not limiting essential amino acid. At other sampling times the isoleucine (h 0 and 1) and histidine (His) (h 2, 3, 5, 6, 8, 10, 11 and 12) were the limiting essential amino acids. Average value of CS_{egg} and $CS_{sow's\ milk}$ for sow's colostrum from fist 12 hours of colostrum synthesis is 52.6 and 94.9 respectively. Compared values of CS_{egg} with $CS_{sow's\ milk}$ it is clear, that composition of essential amino acids is alike to sow's milk, the values are near to or over 100. Whereas the values of CS_{egg} are in interval from 46.1 to 56.3, that indicate the large shortage of essential amino acids (mainly by isoleucine) in sow's colostrum, when compared to egg protein.

The protein quality of different feeds, animal or plant products, as well as the genetic markers of milk quality and relationship between milk and health were assayed (Lorková et al., 2017; Miluchová et al., 2009; Písaříková et al., 2005; Kráčmar et al., 1999). Amino acid concentration, bud in milk of sows was examined for example by Daza et al. (2004) and Dunshea et al. (2005). If researchers took sows colostrum samples, then it was within 12 hours after farrowing (Hurley, 2015; Elliott et al., 1971). However the determination of protein quality of sow's colostrum and its development by hours is still missing. Biological value of sow's colostrum published Csapó et al. (1996), they analysed colostrum at hours 0 and then milk at 52nd hour and later. They found between h 0 and 52nd hour similar development of biological value in sow's colostrum as in our results. Only one reference was found which reported on the quality of protein in sow's colostrum. No additional data on the quality of sow's colostrum protein were found in the literature.

Conclusions

All changes in chemical score between different sampling times were nonsignificant ($P>0.05$). During the first 12 hours, according the CS_{egg} protein of sow's colostrum had not reached the quality of egg protein, the most limiting essential amino acid was isoleucine. Results of this research bring closer look on the development of protein quality of sow's colostrum, as well as on the basic values of chemical score of sows colostrum, which can be used in future research in area of sow's colostrum quality evaluation.

Table 1. *Chemical score (CS) in sow's colostrum*

Time from birth of first piglet	n	compared to egg* CS_{egg}	compared to sow's milk** $CS_{sow's\ milk}$
h 0	12	47.1 (Ile)	87.3 (Ile)
h 1	12	50.1 (Ile)	93.0 (Ile)
h 2	12	52.3 (Ile)	96.4 (His)
h 3	9	50.8 (Ile)	94.4 (His)
h 4	9	55.6 (Ile)	101.5
h 5	9	53.3 (Ile)	97.3 (His)
h 6	8	51.8 (Ile)	94.5 (His)
h 7	7	56.3 (Ile)	101.5
h 8	8	53.2 (Ile)	95.5 (His)
h 9	6	55.8 (Ile)	102.6
h 10	7	55.1 (Ile)	95.7 (His)
h 11	6	55.7 (Ile)	93.9 (His)
h 12	7	46.1 (Ile)	80.2 (His)

n number of analysed colostrum samples;
* values were calculated according to concentration of essential amino acids in the egg published by Zelenka (2006);
** values were calculated according to the average concentration of essential amino acids in sow´s milk published by Elliott et al. (1971); Csapó et al. (1996); Dourmad et al. (1998); Daza et al. (2004); and Petrikovč et al. (2005);
( ) limiting essential amino acid.

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