DYNAMICS OF GLUCOSE IN POSTNATAL ONTOGENESIS IN CALVES IN ASSOCIATION WITH AGE AND FEED

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Abstract. Forty eight calves of different age were used for the experimental research. Animals were divided into seven groups depending on their age and diet starting from the first day of life to four months of age, and two years old adult cows. The level of glucose in blood was determined at 6 o'clock before their morning feed, as well as 30 min., 60 min. and 90 min. after feeding. It was found that the level of glucose in blood affected either by the age or the type of feed as the time after feed. In neonate calves just after birth the level of glucose in blood is very low. Five to six hours after colostrums intake, the level of glucose increases radically. In older calves that are not fed on whole milk or milk replacer any more, the level of glucose in blood in significantly lower in comparison with animals in the period of milk diet ($P<0,05$).

Keywords: calves, postnatal ontogenesis, glucose.

GLIUKOZĖS KIEKIO DINAMIKA VERŠELIŲ KRAUJYJE, ATSIŽVELGIANT Į JŲ AMŽIŲ IR ŠĖRIMO YPATUMUS

Santrauka. Straipsnio tikslas ištirti gliukozės kiekio pokyčius įvairaus amžiaus ir nevienodai šeriamų veršelių kraujyje. Keturiasdešimt aštuoni įvairaus amžiaus veršeliai buvo suskirstyti į septynias grupes, atsižvelgiant į jų amžių ir racioną. Kraujas tyrimams imtas 6 val. prieš rytinį šėrimą, taip pat 30 min., 60 min. ir 90 min. po šėrimo. Nustatyta, kad gliukozės kiekis kraujyje priklauso ir nuo gyvulio amžiaus, ir nuo šėrimo tipo, ir nuo laiko, praėjusio po šėrimo. Ką tik atsivestų veršelių kraujyje gliukozės būna labai mažai. Jos gerokai padaugėja praėjus 5 val. ar 6 val. po pirmojo žindymo. Vyresnių veršelių, kurie negauna nenugriebto pieno ar jo pakaitalų, kraujyje gliukozės yra daug mažiau negu pienu girdomų veršelių kraujyje ($p<0,05$).

Raktažodžiai: veršeliai, pogimdyminė ontogenezė, gliukozė.

Introduction. It is known, that the level of glucose in blood changes according to the feed and age (Rosenberger, 1979, Rupp et al., 1998).

During the period of colostrum and milk diet in young ruminants milk carbohydrates are broken down into monosacharides and absorbed in the abomasum into blood, therefore, the glucose level in blood in calves during this period in comparatively the highest (Donkin, Armentano, 1994; Kegley et al., 1997; Tollec et al., 1998).

Starting to feed the rough forage and concentrated mixed feed, about 10-20% of the consumed nutrients are digested in the fore stomach where a little part of carbohydrates is involved into fermentation processes and in the production of volatile fatty acids (Donkin, Armentano, 1994; Tollec et al., 1998), so glucose level in blood starts to lower in older calves (Rupp et al., 1998; Holtenius. et al., 2000).

Investigating morphofunctional development of the digestive system and adaptation processes in the postnatal ontogenesis in calves, it was determined, that the level of glucose in blood is one of the values that shows evidence that the neonate is overcoming the first critical phase in its life and is adapting to in dependent intake of feed (Brūveris et al., 2000). However, this study and literature data (Bouda, 1983; Rollin, 1986; Tancin, Pjescak, 1992; Donkin, Armentano, 1994; Holtenius et al., 2000) show that the glucose levels in blood in calves after birth at different age can vary in a comparatively wide range. Therefore, the aim of this study was to determine the dynamics of glucose level in blood in calves from birth to ruminant status in association with feeding and diet.

Material and methods. Forty eight calves of different age were used for the experimental research. The following groups of animals were formed depending on their age and diet:

- Newborn calves prior and after colostrums intake;
- Calves in the first week of postnatal ontogenesis, i.c., in the period of colostrums diet;
- One-month- old calves, in the period of whole milk diet;
- Two- months-old calves, fed on:
  - milk replacer,
  - whole milk.
- Three-month-old calves, in the transition period to the rough forage, fed on:
  - milk replacer and starter feed,
  - whole milk and starter feed.
- Animals at the age of four months, fed only on rough forage and the concentrated mixed feed.
- Matured two years old ruminants.

It should be mentioned that for calves, starting from the age of two weeks, there was free access to water and hay ad libitum. Two-there months old calves were fed in a different way: one group received milk replacer that contained at least 20% milk protein and 14% milk sugars, but another group (5 animals) received whole milk.

The glucose level in blood was determined by Prerision QID complete blood glucose monitoring system,

made in the USA, immediately after blood sampling from *v. jugularis externa*. Blood was sampled in calves prior to feeding, as well as 30 min., 60 min. and 90 min. after feed intake.

Results and discussion. The obtained results that show the dynamics of glucose level in blood in calves from birth to ruminant status are given in Table 1.

Table 1. **The glucose level in blood of calves in postnatal ontogenesis in association with diet.**

Exp. groups	15 min. before feeding		30 min. after feeding		60 min. after feeding		90 min. after feeding	
	Mean	St.error	Mean	St.error	Mean	St.error	Mean	St.error
1 day old	1,68	0,9	2,36	0,7	3,82	0,4	3,16	0,4
7 day old	3,78	0,71	5,2	0,3	5,9	0,3	6,2	0,37
1 month old	4,76	0,62	5,1	0,21	6,7	0,36	6,3	0,23
2 month old *	4,29	0,6	4,9	0,4	5,7	0,32	5,25	0,36
2 month old **	3,76	0,51	5,1	0,31	6,4	0,29	6,3	0,29
3 month old *	5,2	0,4	6,23	0,46	6,2	0,42	5,7	0,22
3 month old **	3,83	0,3	6,3	0,5	6,2	0,36	6	0,2
4 month old *	3,6	0,4	3,7	0,31	3,6	0,27	3,6	0,21
4 month old **	4,3	0,2	4,4	0,4	4,3	0,31	4,2	0,4
2-3 year old	2,7	0,35	2,6	0,24	2,4	0,26	2,8	0,13

* - Groups of calves whom of a 2-months-hold feeding whole milk and another food depending on age.
** - Groups of calves whom of a 2-months-hold feeding milk replacer and another food depending on age.

It should be stressed that a calf is born with very low glucose level in blood – 1,68 +/- 0,19 mmol/l. Other scientists also have stressed the low glucose level in blood (Kurz, Willet, 1991; Tancin, Pjescak, 1992). However, there are data in literature that give significantly higher amount of glucose in blood in new-born calves prior to the first feed intake – 4,1-4,3 mmol/l (Bouda, 1983; Angelov et al., 1996) and even 6,6 mmol/l (Wei, Mao, 1993). These differences (in absolute figures) could be connected with the breed peculiarities of animals, climatic conditions, peculiarities of nutrition of pregnant cows and other circumstances that affect the glucose level in blood in new-born calves.

The data obtained show that 30 minutes after the first intake of colostrum the glucose level in the blood is slightly increased, but an hour after feeding it was already doubled in comparison with hat at birth (Tab. 1). One and a half hour after colostrum intake, the level of glucose showed tendency to lower a little, still it remained higher than that at birth of the animal (Fig. 1).

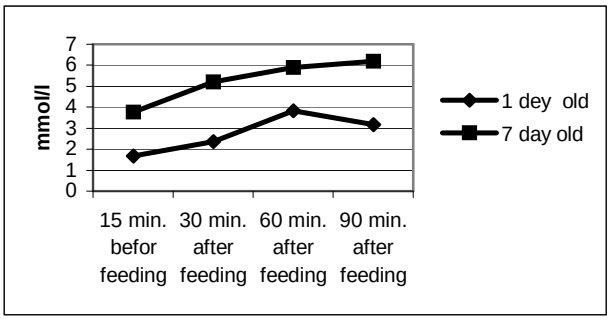

Figure 1. **Dynamics of glucose in the blood of calves on the first day of life and at the age of seven days in association with nutrition.**

It should be pointed out that this dynamics of biochemical values consist with dynamics of morphofunctional condition of the liver hepatocytes in calves in the first hours of postnatal life. The previous investigations show evidence that even two and six hours after colostrum feeding, the glycogen amount in hepatocytes in calves is remarkably decreased in comparison with that in 9-month-old (Grote, 1992; Brūveris et al., 2000). It is understandable because the new organism needs a rapid increase of energy during parturition and the first period of postnatal life, i.e., glucose, which is stored in the liver as glycogen. In calves at the age of seven days, the level of glucose in blood, already in the morning before feeding, was two times higher than that on the first day of life (Tab. 1, Fig. 1). To some extent, it is associated with the fact, that in the first colostrum milk sugar in comparatively less (2,7%) than, for example, on the third day of milking when milk sugar in colostrum is already 4,7% (Fovler, 1998).

The dynamics of glucose level, 30, 60 and 90 minutes after colostrums feeding, showed a stable tendency of increase (Fig.1). The glucose level reached its maximum 1,5 hours after colostrum intake. This positive glucose dynamic (together with changes of other blood biochemical values) indicates that adaptation processes in postnatal ontogenesis in the new-born animal are successful. This also shows evidence that colostrums intake as soon as possible after birth facilitates a more rapid overcome of hepatocytolytic syndrome in calves (Grote, 1992; Brūveris et al., 2000).

Our results obtained show that glucose amount in blood continues to rise till one month of age in calves. In the morning prior to feeding it's reached the highest level "on an empty stomach" 4,76 mmol/l in the experimental animals during the milk-feeding period (Tab. 1). After whole milk intake, the glucose level in blood was still increasing and reached its maximum 6,7 mmol/l 60 minutes after eating.

We share those authors' opinion that biologically complete calf nutrition in the first weeks of postnatal life

facilitates the process of faster and better adaptation of the digestive system and the body itself (G.Angelov et al., 1996; J.Longenbach et al., 1997; R.Zabelsky et al., 1999). The glucose dynamics in blood in calves at the age of two months in association with feeding and diet is presented in Figure 2. It shows that in the morning the glucose level in blood was a little higher in those animals that receipted milk replacer instead of whole milk. However, the results of changes of glucose values 30, 60 and 90 minutes after feeding whole milk or milk replacer show that higher glucose level in blood during all the time of examination was in calves that were fed on whole milk. Taking into account the fact that milk sugar content was higher in milk replacer (14%) than in whole milk (5%) (M.Fovler, 1998), it makes consider that milk replacer at the same time raises also insulin level in blood, so amount of glucose in these animals is raised comparatively less (Strudzinski. et al., 1989; Gostettleter, 1993).

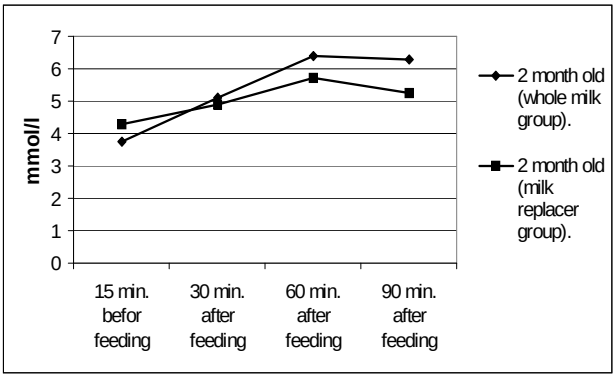

Figure 2. **Dynamics of glucose in blood in 2-month-old calves fed on whole milk or milk replacer.**

Calves of three months of age that were fed on milk replacer and a special concentrated mixed feed for calves, had the highest glucose level in blood all ever observed in experimental animals before feeding (Tab 1). The dynamics of glucose level in these animals after intake of certain feed in presented in Figure 3. Maximum glucose values were reached 30 minutes after feeding (6,2 – 6,3 mmol/l) and they remained at about the same level 1,5 hours after eating either whole milk or milk replacer. The results show that starting to transfer to the rough forage, the glucose level in blood in general is comparatively high. As regards the dynamics of 4-months-old calves, it means animals that are fed neither milk nor milk replacer; the glucose level in blood in general becomes lower, within the range of 3,6-4,6 mmol/l (Tab. 1). A little higher glucose level in blood was found in those ages of two and three month's animals that were fed on whole milk.

Conclusions:

1. The glucose level in the blood in calves depends on age, diet and time when it is fed.
2. The lowest glucose level in new-born calves is on the first day of life. It is doubled after an hour of feeding; therefore, it is of great importance for the calf to receive colostrum as soon as possible after birth.

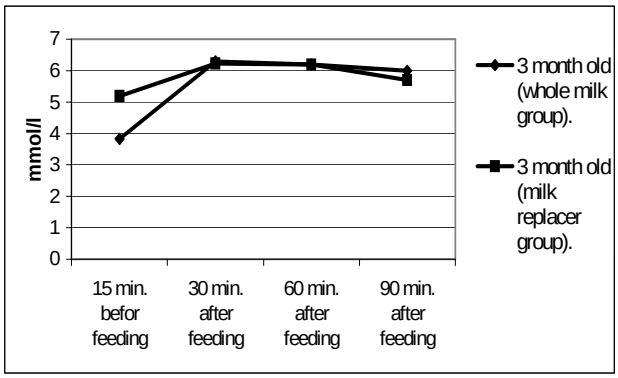

Figure 3. **Dynamics of glucose in blood in 3-month-old calves fed on whole milk or milk replacer.**

3. The highest glucose level in the blood of calves is during the transfer period to rough forage in the morning prior to feed intake and after it when animals receive either whole milk or milk replacer, or rough forage and the concentrated mixed feed.
4. Whole milk (in comparison with milk replacer) facilitates to maintain a little higher glucose level is blood in 2-3 months old calves than in those of 4 months old ones.
5. Feeding calves only on rough forage and the concentrated mixed feed, the glucose level in blood becomes more stable, it does not change with feeding and time after that.

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