

Laboratory of Reproductive Biology, Department of Animal and Environmental Hygiene,
University of Life Sciences, Akademicka 13, 20-950 Lublin,
e-mail: hanna.biswencel@up.lublin.pl

HANNA BIS-WENCEL

Glucose level in blood and urine of minks depending on body condition

Poziom glukozy we krwi i moczu nerek w zależności od kondycji ciała

Summary. The aim of this study was to assess the level of glucose in the blood and urine of minks of different shapes, over the successive stages of the production period, from breeding to weaning. On the farm of scanbrown minks, animal health studies were performed using the BCS rating system. Besides, the level of glucose in the blood and urine of females was determined. Plasma glucose concentration was determined with Cormay reagents, while in urine with test strips Medi-Test Combi 10 ® VET. The scoring system of the condition of the minks' bodies proved to be a useful and practical tool for assessing the degree of fatness in minks. The level of sugar in blood and urine were on different levels, whereas hyperglycemia with glycosuria occurred more frequently and more numerously in the lean and fatty mothers during late lactation, which indicates that this is a moment of weakness in the body's glycemic control during the reproductive cycle of minks.

Key words: minks, glucose, body condition

INTRODUCTION

Based on observations of avalanche increase in the incidence of type 2 diabetes related to modification of environmental conditions in human life, the concept of cost-efficient genotype was conjectured. He probably characterized the population of *Homo sapiens* from its inception, 2. thousands years ago. In order to maintain vital functions, genetically determined cellular metabolism system, had to develop cost-effective system in the process of evolution that could synthesize enough energy to maintain a vital function, with the small quantities of food acquired irregularly and high physical activity at the same time. As civilization advanced, people changed their lifestyles to be less active with adequate or excessive amounts of food. The same thing happened to domesticated

animals, which include the American mink *Vison vison*. This wild animal had to adapt to the cage, limiting the physical activity, but got food in quantities exceeding its expectations in return. This is especially noticeable in the perinatal period, at 2-6 weeks of lactation, and may manifest by the wet nest disease [Martino and Villar 1990], increased maternal mortality, the destruction of litters caused by mothers and even the metabolic syndrome [Clausen *et al.* 1992, Schneider and Hunter 1993].

The aim of this study was to assess the level of glucose in the blood and urine of minks with a different shape, over the next stages of the production period, from breeding to weaning.

MATERIAL AND METHODS

At the 1200 scanbrown color variety minks farm, animal health research was conducted and the level of glucose in the blood and urine of females were determined.

Plasma glucose concentration was indicated with Cormay reagents, while in urine with test strips Medi-Test Combi 10 ® VET.

Animals were fed with a balanced feed, in the December-May period: EM 1150 cal/kg (% EM from protein 52.0 from fat 36.0 from sugar 12.0), 11 May to weaning: EM-1250 cal/kg (% EM from protein 45.0 from fat 43.0 from sugar 12.0). The size of the ration was determined individually, depending on the condition of the animals. The feed was complemented with vitamin-mineral premix in doses covering the full demand for those ingredients, a preservative sodium metabisulfite and Rendox antioxidant. These preparations were added to meat and fish material stored in refrigerator. Animals had permanent access to water.

Blood samples were collected five times: in January (reproduction), April (pregnancy), May (mid-lactation), June (late lactation/weaning).

The obtained results are presented as arithmetic means (\bar{x}) and standard deviations (SD). Data analysis was performed using t-Student's test from the statistical program SPSS 12.0 PL.

RESULTS AND DISCUSSION

To evaluate the body condition of minks, the BCS scoring system developed by [Hynes *et al.* 2004] and helpful for the assessment of obesity in minks was used. Among minks under investigation, females were selected and assigned to the groups defined as BCS 1 (very thin) with a body weight of 713.6 ± 10.9 g, 2 (lean) weighing 922.3 ± 15.6 g, 3 (ideal) weighing 1121.9 ± 7.3 g and BCS 4 (severe) weighing 1315 ± 12.1 g.

Glycosuria was found in females in all examined stages of the production cycle, wherein a statistically significant differences were noticed in BCS 2 and BCS 4 females. These differences concerned the mating period in 23.2% of surveyed females, 19.6% during late pregnancy, 19.6% in mid-lactation, 10.9% in late lactation, 28.2% and 12.7% after weaning. Mean glucose values in urine varied over a wide range, from 4.76 to 11.56 mmol/l but these changes didn't bear the signs of regularity (Tab. 1).

Statistically significant differences between BCS 4 and BCS 2 were recorded in the breeding period, late lactation and weaning ($p \leq 0.05$ and $p \leq 0.01$) and during pregnancy ($p \leq 0.05$). In early lactation, these differences were not statistically significant. The comparison within BCS 2 and BCS 4 groups showed no statistically significant differences between early lactation and weaning only. All other periods differed significantly at $p \leq 0.05$ and $p \leq 0.01$. Body weight of the examined animals within a BCS groups, did not differ significantly between minks with glycosuria and minks with normal glucose level in urine. The highest percentage of females with glycosuria was recorded in the BCS 4 group – 38.6%, BCS 2 – 30.4%. Females from both weight groups showed hyperglycemia in late lactation, average of 7.11 ± 0.5 mmol/l, which was accompanied by glycosuria – average level of 7.4 ± 0.3 mmol/l, while the week after weaning the glucose concentration in urine was at an average of $5.8 \pm$ mmol/l.

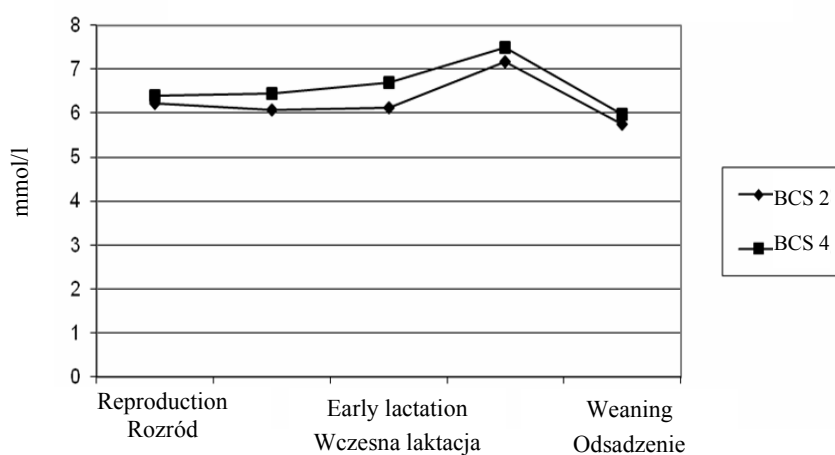


Figure 1. Mean values of serum glucose in minks
Rycina 1. Średnie wartości stężenia glukozy w surowicy norek

Wamberg *et al.* [1992] report 5.7 ± 0.18 mmol/l, as the notional value of glucose in urine. In their studies, the average glucose levels obtained for minks in this productive period were 5.3 ± 0.3 mmol/l. This indicates that the hyperglycemia observed in minks, may be a transition associated with lactation and a reversible condition. The influenced factor may be the resulting from poorly balanced dietary intake anomalies elimination, and discontinuation of litters. The glycosuria presence in all of the production cycle periods indicates interindividual differences, and shows that an inability to regulate glucose blood levels may precede the effect of glycosuria in minks [Wamberg *et al.* 1992].

Serum glucose level in minks with BCS 4 was located in the range from 5.93 to 7.49 mmol/l. In this weight group statistically significant differences were recorded in comparison of late pregnancy and lactation, and late lactation with weaning (at $p \leq 0.05$ and $p \leq 0.01$), as well as between early lactation and late lactation and early lactation and weaning (at $p \leq 0.05$). In the BCS 2 group of females, statistically significant differences were recorded between reproduction and late lactation, reproduction and weaning, and pregnancy and late lactation $p \leq 0.05$. Differences between BCS 2 and BCS 4 were statistically significant at $p \leq 0.05$, only during early lactation.

Table 1. The values of serum and urine glucose in minks BCS2 and BCS4 groups ($\bar{x} \pm SD$)
 Tabela 1. Wartości glukozy w surowicy i moczu nerek grup BCS2 i BCS4 ($\bar{x} \pm SD$)

Glucose Glukoza	Reproduction Rozród		Pregnancy Cięża		Early lactation Wczesna laktacja		Late lactation Późna laktacja		Weaning Odsadzenie	
	BCS2	BCS4	BCS2	BCS4	BCS2	BCS4	BCS2	BCS4	BCS2	BCS4
Serum glucose (mmol/l) Glukoza w surowicy	6.23 ± 0.73	6.40 ± 1.32	6.08 ± 0.77	6.45 ± 0.71	6.13 ± 1.28 ^a	6.69 ± 0.99 ^b	7.16 ± 1.46	7.49 ± 0.99	5.76 ± 0.19	5.96 ± 0.47
Glucose in urine (mmol/l) Glukoza w moczu	10.25 ± 2.85 ^{Aa}	11.77 ± 3.71 ^{Bb}	4.76 ± 0.94 ^a	5.12 ± 0.87 ^b	5.63 ± 0.53	5.96 ± 0.55	6.98 ± 0.86 ^{Aa}	7.41 ± 0.78 ^{Bb}	5.52 ± 0.26 ^{Aa}	5.86 ± 0.23 ^{Bb}

A, B, C – average marked in large letters differ significantly at $p \leq 0.01$; a, b, c – indicated by small letters at $p \leq 0.05$;

A, B, C – średnie oznaczone dużymi literami różnią się istotnie przy $p \leq 0.01$; a, b, c – oznaczone małymi literami przy $p \leq 0.05$;

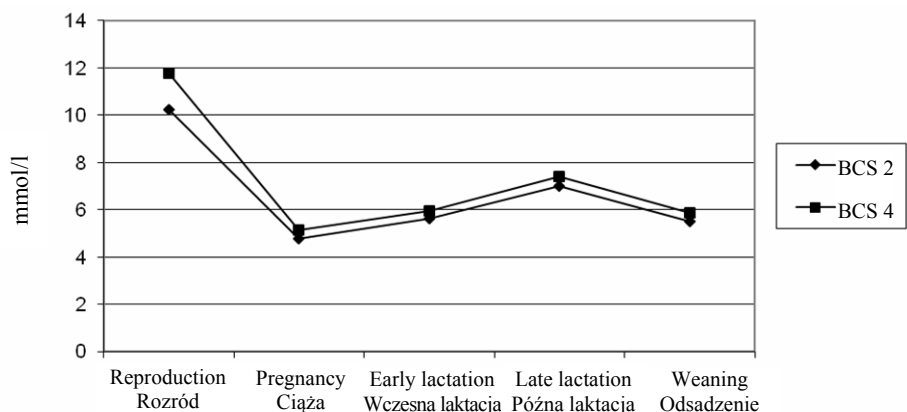


Figure 2. Mean values of glucose in the urine of minks
Rycina 2. Średnie wartości stężenia glukozy w moczu norek

[Wamberg *et al.* 1992] observed significant differences in blood glucose levels of females from the group with BCS 2 during late lactation, in which blood sugar levels exceeded the reference value and amounted to 7.16 mmol/l compared to other weight groups. Studies [Faryna *et al.* 2001] confirmed that both excess and lack of body fat in lactating minks, can cause accumulation of fat in glucose metabolizing cells, causing insulin resistance and interruption of the peripheral glucose economy. Studies [Faryna *et al.* 2001, Fink and Borsting 2002] have shown that obesity in minks is characterized by higher fat storage in fat cells. This means that they do not fulfill their protective role in relation to the daily servings of fatty acids supplied to the body in relation to other body tissues such as skeletal muscle, liver cells, pancreatic β cells. The accumulation of fat, leads to impaired sugar metabolism. Also been observed [Bis-Wencel 2006] that the level of non-esterified fats, the stimulators of hepatic glucose production, increases with age, which manifests as overweight or obesity.

Older females have larger litters, and thus higher demand for milk production, which in turn is carried by the hepatic gluconeogenesis. It seems legitimate to undertake research focusing on finding ways to reduce the adverse consequences of a broad-based stress, resulting from inadequate dietary supplementation with polyunsaturated n-3 fats, lack of movement and consequently females fatness, which exacerbates the animal body weight selection, lack of monitoring for female hyperglycemia and glycosuria. It is an active process that can be observed in the early stage, and therefore the possibility of early diagnosis results in reducing maternal mortality, especially in the 4–6 weeks of lactation and young minks of 1–5 weeks. The few studies on the body condition of minks depending on the biochemical blood parameters volatility (including glucose) and the experiments on other animal species, including representatives of the *Mustelidae* family, suggest that the mechanism of glucose homeostasis of the lactating female rely on insulin resistance with hyperglycemia as the main feature. In animals with marked insulin resistance the ability to stimulate translocation of GLUT-4, insulin-dependent

blood glucose transporter is impaired, which comes to the binding of glucose by peripheral muscle and fat cells. Similarly, as the main pathologies of diabetes in cats and dogs is peripheral insulin resistance, incomplete production of insulin and increased glucose production in the liver, which manifests as obesity [Khayat *et al.* 2002, Møller 2004].

CONCLUSIONS

The body condition scoring system of minks proved to be useful and practical tool for assessing the degree of fatness in mink. The level of sugar in the blood and urine is a factor varying between individuals, depending both on the genetic background and nutrition as well as farming practices of the specific farm. Our research shows that hyperglycemia with glycosuria frequently and numerously occurred in mothers during late lactation, suggesting that this is a moment of weakness in the body's glycemic control during the reproductive cycle of minks.

REFERENCES

- Bis-Wencel H., 2006. Wpływ diety na wybrane wskaźniki rozrodu norek. *Acta Sci Pol. Med. Vet.* 5, 103–110.
- Clausen T.N., Olsen C.R., Hanes O., Wamberg S., 1992. Nursing Sickness in the lactating mink (*Mustela vison*) I. Epidemiological and pathological observations. *Can. J. Vet. Res.* 56, 89–94.
- Hynes A.M., Rouvinen-Watt K., Armstrong D., 2004. Body condition and glycemic control in mink females during reproduction and lactation. *Proc. VIII Int. Sci. Cong. Fur Anim. Prod. The Netherlands*, 15–18 September 2004. *Scientifur* 28(3), 79–86.
- Fink R., Borsting C.F., 2002. Quantitative glucose metabolism in lactating mink (*Mustela vison*) – effects of dietary levels of protein, fat and carbohydrates. *Act. Agric. Scand., Sect. A. Anim. Sci.*, 52, 34–42.
- Frayn K.N., 2001. Adipose tissue and the insulin resistance syndrome. *Proc. Nutr. Soc.* 60, 375–380.
- Khayat Z.A., Patel N., Klip. A., 2002. Exercise and insulin stimulated muscle glucose transport: Distinct mechanism of regulation. *Can. J. Appl. Physiol.* 27, 129–151.
- Martino P.E., Villar J.A., 1990. A survey on perinatal mortality in young mink. *Vet. Res. Comm.*, 14, 199–205.
- Møller S.H., 2004. Management of health in mink. A HACCP plan for energy allowance during winter and gestation in order to control sticky kits. *VIII International Scientific Congress in Fur Animal Production. The Netherlands*, 15–18 September 2004.
- Schneider R.S., Hunter D.B., 1993. A survey of the causes of mortality in adult mink, with emphasis on the lactation period. *Can. Vet. J.*, vol. 34, 103–108.

Streszczenie. Celem pracy była ocena poziomu glukozy we krwi i moczu norek o różnej kondycji w kolejnych etapach okresu produkcyjnego, tj. od rozrodu do odsadzenia. Na fermie norek odmiany barwnej scanbrown przeprowadzono badania kondycji zwierząt przy użyciu systemu oceny

BCS oraz oznaczono poziom glukozy we krwi i w moczu samic. Stężenie glukozy w surowicy oznaczono za pomocą odczynników firmy Cormay, natomiast w moczu za pomocą pasków testowych Medi-Test Combi 10® VET. System oceny punktowej stanu ciała nerek okazał się użytecznym i praktycznym narzędziem do oceny stopnia otluszczenia u nerek. Poziom cukru we krwi i moczu kształtował się na zróżnicowanych poziomach, przy czym hiperglikemia wraz z cukromoczem częściej i liczniej występowały u matek chudych i otluszczonych, w okresie późnej laktacji, co wskazuje, że jest to moment osłabienia kontroli glikemicznej organizmu w czasie cyklu reprodukcyjnego nerek.

Słowa kluczowe: norki, glukoza, kondycja ciała