Dissertation

Päivi Soppela presented her PhD-thesis "Fats as indicators of physiological constraints in newborn and young reindeer (*Rangifer tarandus tarandus* L.)" for public discussion at the Faculty of Science, University of Oulu on June 22nd, 2000.

Päivi Soppela was born and raised in Kemijärvi, in northern Finland. She got her M.Sc. degree in biology from the University of Oulu in 1984. Thereafter she worked in various projects at the Finnish Game and Fisheries Research Institute's reindeer research in Rovaniemi during 1985–91. Here, and at the University of Oulu she started her studies in temperature regulation and fat metabolism of reindeer. During 1992 she had a research visit at the Rowett Research Institute in Aberdeen, Scotland. Soppela works as scientist at the Arctic Centre, University of Lapland, Rovaniemi, Finland (since 1994).

Her PhD-thesis is based on the following papers:

I Soppela, P., Sormunen, R., Saarela, S., Huttunen, P. & Nieminen, M. 1992. The localization, morphology, and respiratory capacity of "brown" adipose tissue in newborn reindeer. – *Comp. Biochem. Physiol.* 101A: 281–293.

II Soppela, P., Nieminen, M., Saarela, S., Keith, J. S., Morrison, J. N., MacFarlane, F. & Trayhurn, P. 1991. Brown-fat specific mitochondrial uncoupling protein in adipose tissues of newborn reindeer. – *Am. J. Physiol.* 260: R1229–1234.

III Soppela, P. & Nieminen, M. 1998. Polyunsaturated fatty acids in serum lipids of reindeer during the close postnatal period. – *J. Comp. Physiol.* B 168: 581–590.

IV Soppela, P., Heiskari, U., Nieminen, M., Salminen, I., Sankari, S. & Kindahl, H. 2000. The effect og a prolonged undernutrition on serum lipid ans fatty acid composition of reindeer calves during winter and spring. – *Acta Physiol. Scand.* 168: 337–350.

V Soppela, P. & Nieminen, M. 2000. The effect of wintertime undernutrition on the fatty acid composition of leg bone marrow fats in reindeer (*Rangifer tarandus tarandus* L.). – *Comp. Biochem. Physiol.* B, in press.

Summary: The objective of the thesis was to examine the significance of thermogenic brown adipose tissue (BAT) for the survival of newborn reindeer in the cold during the critical perinatal period. The other main objective was to study the effect of wintertime undernutrition on the fatty acid composition of blood serum and bone marrow lipids in yearling reindeer. A particular attention was paid on the proportions of unsaturated and polyunsaturated fatty acids (PUFAs) and their feasibility as indicators of nutrirional status.

The tesults showed that most of the adipose tissues in newborn reindeer were active BAT. The tissue had specific locations, specialized cell morphological structure, high aerobic capacity and it contained tissue-specific, rate-limiting factor for thermogenesis, uncoupling protein (UCP1). BAT contained relatively little PUFAs but they were most readily mobilized fatty acids of this tissue. Newborn reindeer had very low proportions of principal PUFAs in their serum lipids but they were effectively retented from the milk lipids. BAT was most active during the first days of life but its aerobic capaciry declined during rhe first month of life while UCP1 disappeared and the tissue adopted the characteristics of white adipose tissue.

The effects of wintertime undernutrition on tissue lipids was studied in captive calves fed restricted ratios of lichens during winter and spring. In early wintet serum lipid levels of the calves were high, and serum contained high proportions of linoleic and other PUFAs. Lichen diet induced significant reductions in body weighs and levels of serum lipids and PUFAs. Serum PUFAs decreased also in the calves fed high-quality feed but less than in the lichen group. The growth of the feed group started early in spring which obviously increased their lipid requirements. Plasma leptin and insulin levels decteased in parallel with body weight which implies that these factors may contribute regulation of body weight.

The bone matrow fats in freely grazing reindeer in autumn had high proportions of unsaturated fatty acids, such as oleic acid. The proportions of oleic acid and principal PUFAs were significantly decreased in starved reindeer during winter.

In conclusion, active BAT is the most important adipose tissue in the newborn reindeer, and it is likely to have a major significance on the thermoregulatory heat production and survival of reindeer in the cold. The changes in the specific PUFAs of serum and bone marrow lipids reflect the changes in the nutritional status and suggest that these fatty acids are preferentially utilized during wintertime undernutrition. Reindeer are well adapted to redused nuttitional value and availability of feed duting winter, and loss of body weight is part of their seasonal survival strategy.

Thesis is available on Internet-address:
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