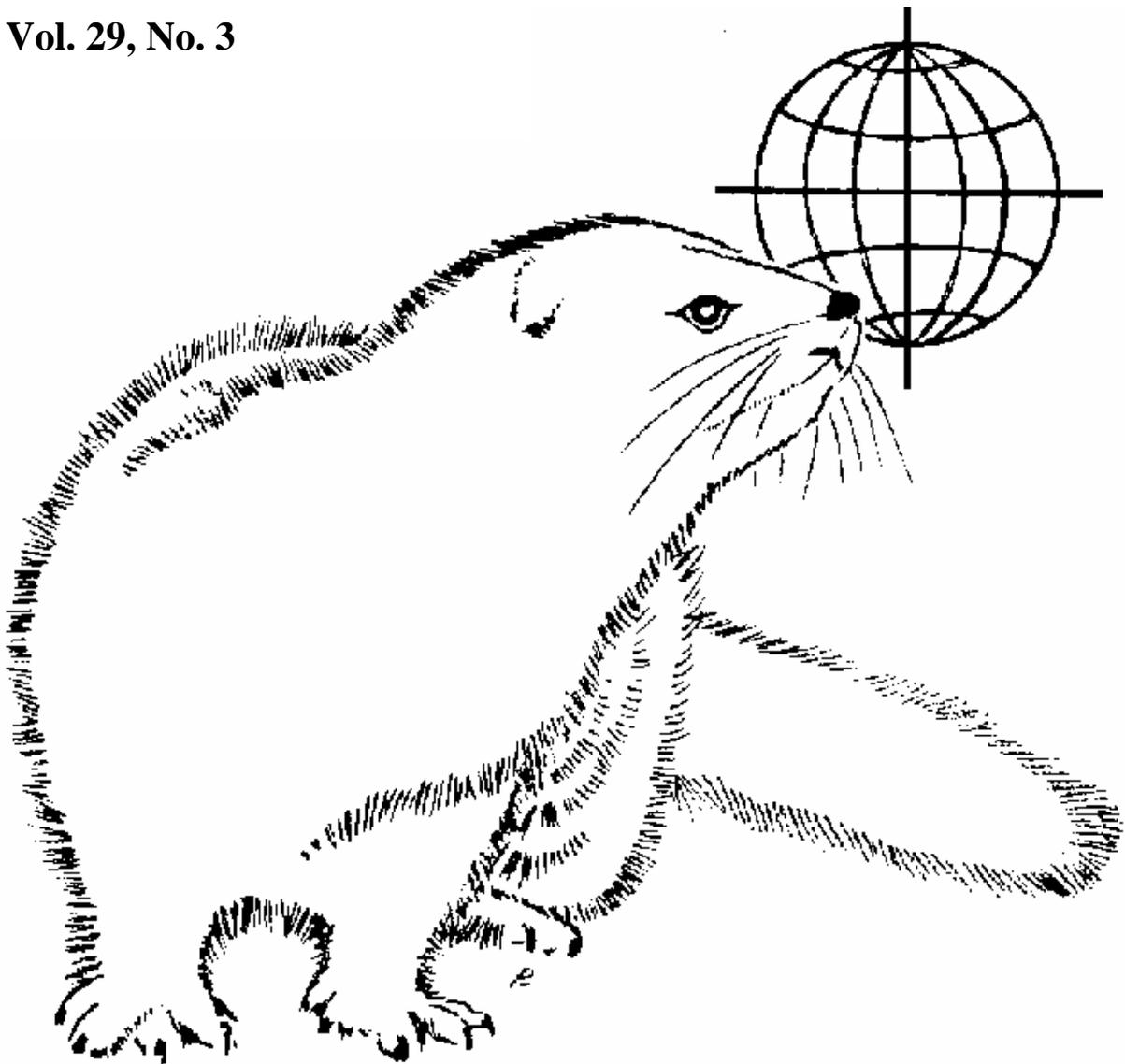


SCIENTIFUR

SCIENTIFIC INFORMATION IN FUR ANIMAL PRODUCTION

Vol. 29, No. 3



INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

SCIENTIFUR - scientific information in Fur Animal Production.

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Birthe M. Damgaard
SCIENTIFUR
P.O. Box 14
DK-8830 Tjele, Denmark

Tel: +45 89991512
Fax: +45 89991500

E-mail: Scientifur@agrsci.dk

SUBSCRIPTION 2003- : DKK 600.- per volume (year) including bank charges and postage.

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TRESURER'S ADDRESS. All correspondence regarding subscription and payment should be addressed to the Treasurer:

Steen H. Møller
IFASA
P.O. Box 14,
DK-8830 Tjele, Denmark

Tel: +45 89991346
Fax: +45 89991500

E-mail: IFASA@agrsci.dk

INDEXING: Scientific Reports and Original Reports published in **SCIENTIFUR** are indexed in common international indexes covering data regarding animal science. All titles that have been published in **SCIENTIFUR** are covered in an electronic **SCIENTIFUR INDEX**, which is updated each year. This index can be downloaded from the Webb-site: <http://www.ifasanet.org>

International Fur Animal Scientific Association (IFASA). Board of directors:

Dr. Bruce D. Murphy (president): E-mail: murphyb@MEDVET.Umontreal.CA

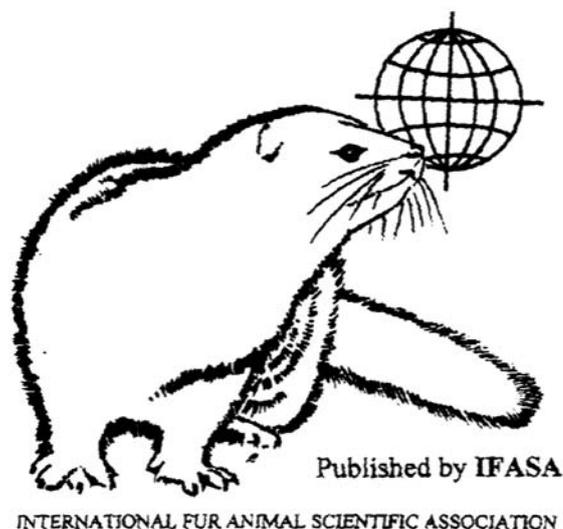
Dr. Steen H. Møller (vicepresident, treasurer): E-mail: IFASA@agrsci.dk

Dr. Ilpo Pölönen. E-mail: ilpo.polonen@stkl-fpf.fi

Ing. Wim Verhagen. E-mail: info@nfe.nl

Dr. Marian Brzozowski. E-mail: brzozowskim@delta.sggw.waw.pl

SCIENTIFUR
ISSN 0105-2403
Vol. 29, No. 3



1.	Contents	87
2.	Notes	91
3.	Symposiums, congresses etc.	93
	<u>NJF Seminar No. 377, 2005</u>	93
	Biochemical evaluations of reasons to outbreak/resistance against the diseases wet mink kits. <i>T.N. Clausen, K. Mortensen, A.D. Sørensen, J.C. Sørensen, H. Sørensen</i>	93
	A food-borne epidemic of Aleutian Disease in Danish mink farms. <i>C.M. Willadsen</i>	94
	Evaluation of oxidative stress in mink (<i>Mustela vison</i>) using the comet assay. <i>R. Garbes, K. Rouvinen-Watt</i>	94
	Economic weights for most important traits in Finnish blue fox production. <i>J. Peura, T. Serenius, I. Strandén</i>	95
	Development of an advisory concept – Reproduction and feed control from 1st December to 1st June. <i>M.U. Hansen, Vilhelm Weiss, T.M. Lassén</i>	95
	Peas as a protein source in blue fox feed. <i>N. Koskinen, J. Valaja, I. Pölönen, P. Peltonen-Sainio, T. Rekilä</i>	96
	Annual feed intake in mink kits fed individual ad libitum or restricted during the growth period. <i>S.H. Møller, V.H. Nielsen, B.K. Hansen</i>	96

The effect of ad libitum and restricted feeding on feed intake curves and feed efficiency curves in mink. <i>V.H. Nielsen, S.H. Møller, B.K. Hansen, P. Berg</i>	97
Effects of restricted feed intake on neonatal mortality in blue fox (<i>Alopex lagopus</i>). <i>G. Sanson, Ø. Ahlstrøm</i>	97
Oligosaccharides, bioactive proteins and peptides in mink colostrums; structures, analytical techniques and bioavailability. <i>J. Elnif, P.R. Hansen, K. Mortensen, L. Paaajanen, A.D. Sørensen, J.C. Sørensen, S. Sørensen, H. Sørensen</i>	97
Energy metabolism of mink kits during the early postnatal period. <i>S. Harjunpää, K. Rouvinen-Watt, H.T. Korhonen</i>	98
Effect of dried sugar beet pulp on eating time and mean transit time in energy restricted mink (<i>Mustela vison</i>) females. <i>C. Hejlesen, H.N. Laerke</i>	98
Individual feeding of mink, a powerful tool for evaluating the influence of feed intake on mink health. <i>H. Baekgaard, M. Sønnderup</i>	99
Metabolism of D- and L-methionine in mink (<i>Mustela vison</i>). <i>J. Elnif, N. E. Hansen</i>	99
Effect of body weight on reproductive success in blue fox. <i>G. Sanson, Ø. Ahlstrøm</i>	99
Does high energy allowance during implantation increase litter size in mink? <i>S.H. Møller, I.C. Klaas</i>	100
Stereotyped behaviour and welfare. <i>L.L. Jeppesen</i>	100
Daytime scannings reliably reflect 24-h group differences of stereotypy in mink. <i>P.M. Svendsen, S.W. Hansen, L.L. Jeppesen</i>	101
Stereotyped behaviour can be reduced by breeding. <i>B.K. Hansen, L.L. Jeppesen, P.M. Svendsen, P. Berg</i>	101
Hall housing in blue foxes: alternative or not? <i>H.T. Korhonen, L. Jauhiainen, T. Rekilä, T. Kivinen</i>	101
Effect of cage environment on the welfare and productivity of mink. <i>S.W. Hansen, J. Malmkvist</i>	102
Do fibres in mink feed affect the feeding motivation? A preliminary study. <i>S.W. Hansen, T.N. Clausen, B.M. Damgaard</i>	102
Fasting of mink kits fed different feed rations and its effect on liver fat content, plasma metabolites and enzymes. <i>T.N. Clausen, P. Sandbøl</i>	103
Collection and storage of urine in N – balance trials with mink. <i>S. Lisbjerg</i>	103
Effect of acids in feed on pH in mink urine. <i>S. Lisbjerg</i>	103
An objective method to determine fur-priming in mink (<i>Mustela vison</i>) – provisional results. <i>M. Fredberg, B.K. Hansen, P.V. Rasmussen</i>	104
Group housed mink – effect on welfare and production. <i>H. Lindberg, E. Aldén, L. Lidfors</i>	104

Protein digestion determined by protein hydrolysis catalysed by mink proteases compared to data produced by use of proteases from other monogastric animals. <i>K. Mortensen, A.D. Sørensen, J.C. Sørensen, H. Sørensen</i>	105
Profiles and functions of lipids, especially LC-PUFA in mink tissues and organs as function of essential lipids in the diets. <i>C. Bjerregaard, T.N. Calusen, A.D. Sørensen, J.C. Sørensen, H. Sørensen</i>	105
Pedigree analysis of Finnish blue fox population. <i>I. Strandén, J. Peura</i>	106

Notes from the Group of Editors

This issue of *Scientifur*, which is the third issue of Volume 29, contains the abstracts of NJF Seminar no. 377, held in Uppsala, 5-7 October 2005.

For future issues of *Scientifur*, we invite our readers to submit proceedings, articles for reviewing, short communications, abstracts and letters on fur animal production.

On behalf of the
Group of Editors

Birthe Damgaard

Nordic Association
of Agricultural Scientists

NJF Seminar no. 377

NJF's Subsection for Fur Animals

Uppsala, Sweden
5-7 October 2005



Nordisk Tidsskrift for Landbruksvidenskab

Health

Biochemical evaluations of reasons to outbreak/resistance against the diseases wet mink kits

T.N. Clausen, K. Mortensen, A.D. Sørensen, J.C. Sørensen, H. Sørensen

The disease wet mink kits, sticky or greasy kits, are a serious problem for the mink production in Denmark and other countries with corresponding climates. The affected kits develop a greasy sticky surface on the skin at the neck and tail area and in

addition, often diarrhoea and invariably a mewing, distressed behaviour, which at severe cases result in death as the final outcome. The reasons to the disease have been the subject for a great number of investigations directed at the effects from microorganisms, bacteria, virus, management, feed and immunology of the animals and/or environmental factors. No one of these areas seems to give the solution or answer to what could be the reasons to outbreak or resistance against the disease. In the present project focus is directed at biochemical or molecular based possibilities for lack of sufficient resistance of the sensitive mink kit against bacterial and/or virus attack. Possible targets

for attack on the mink kits can be in the air or lung system, e.g. related to the prostaglandin system, or it can be in the air or lung system, e.g. related to the prostaglandin system, or it can be through the digestive system with relation to components in the milk/colostrums.

The study is based on opportunities for investigations of the various actual biomolecules using new gentle and advanced analytical techniques as supercritical fluid techniques (SFT) and accelerated solvent extraction (ASE). Using these methods which have been adapted to extraction of the relatively small amounts of available colostrums/milk dry matter, the lipids including membrane lipids can be extracted without denaturation of proteins and carbohydrate moieties, which then are released from e.g. milk micelles or membrane structures. Following extraction and group separations, analyses of individual biomolecules are performed with use of new advanced and traditional biochemical and natural product chemistry methods as FPLC, FC, IsoPrime, IEF, SDS-PAGE, microtip systems, HPCE, MECC, SFC, EFLC-ELSD and spectroscopy.

Comparison of results obtained with analyses of milk/colostrum samples from mink with and without wet mink kits, has shown, that lactoferrin in the milk/colostrum from mink with wet kits have defects with respect to binding ferri ions. The relevance of this with respect to the importance of Fenton reactions and active oxygen species as bacterostatic compounds is investigated and evaluated in the present work. The results obtained show, that lactoferrin is present in colostrums/milk from mink with wet kits, and at concentrations as found for mink milk/colostrums from mink without wet kits. The lactoferrin in mink milk/colostrums from mink with wet kits has however, a weak insufficient binding of ferri ions, which may result in limited resistance of the mink kits against the bacteria/virus causing the disease under some environmental conditions.

Proceedings from NJF – Seminar No. 377, 4 pp, Authors' abstract.

A food-borne epidemic of Aleutian Disease in Danish mink farms

C.M. Willadsen

In connection with routine blood examination for Aleutian disease (AD) in June 2002 a few reactors were detected in samples submitted from 20 farms located in a region which for several years had been virtually free of AD. All reactor-farms obtained feed from the same feed kitchen. Subsequently, it was decided to test all the breeding stock of all farms served by the feed kitchen (319 farms) and the breeding stock of 44 mink farms located in the same region, but supplied with feed from other feed kitchens (control farms). Up to the end of October reactors had been detected in 233 (73 %) of the farms served by the feed kitchen. The overall reactor rate among breeding animals was 0.75 pct for farms with reactors. A single reactor had been detected in one control farm. Further investigations indicated that feed contaminated with AD virus had been produced by the feed kitchen on one day during the second half of May 2002. AD-virus was detected by Polymerase-Chain-Reaction (PCR) technique in all of 12 reactors collected from eight different farms. Sequencing of the PCR products showed a high degree of similarity between the isolates, thereby indicating that the virus originated from a single source. In order to control the epidemic, depopulation was eventually carried out in 158 reactor-farms, while the remaining farms with reactors adopted a "test-and-slaughter" policy. AD reoccurred in one farm following depopulation. Out of 295 mink farms remaining operative on September 1. 2005 all but 10 farms were registered as AD-free.

Proceedings from NJF – Seminar No. 377, 4 pp, 1 table. Author's abstract.

Evaluation of oxidative stress in mink (*Mustela vison*) using the comet assay

R. Garbes, K. Rouvinen-Watt

Nursing sickness is the most prevalent cause of mortality in adult mink (*Mustela vison*) females.

Hyperglycemia, as a result of acquired insulin resistance, may be a method of onset and causes increased levels of oxidative stress. Oxidative damage to intracellular structures, including DNA, may lead to altered cellular function, whereas insulin mediates DNA repair under short-term hyperglycemic conditions. The objective of the present study was to examine the ability of the comet assay to detect oxidative stress induced damage to DNA via hydrogen peroxide and to examine the effect of glucose with and without insulin on levels of DNA damage in mink leucocytes *in vitro*. A dose dependent increase in oxidative damage was observed with increasing levels of hydrogen peroxide from 0 to 1000 μ M. There was a significant increase in the amount of oxidative damage at levels of 10 mM glucose and above with the highest mean total comet score occurring at 30 mM which was higher than 0 mM ($P=0.008$), 10 mM ($P=0.010$) and 15 mM ($P=0.066$). With the addition of 10 nM insulin, at glucose concentrations of 6 mM and above, there was a decrease in the amount of oxidative damage. This was observed at 15 mM ($P=0.041$) and 30 mM ($P=0.077$) suggesting that insulin has a greater effect on levels of oxidative damage at highly hyperglycemic conditions. Further research is necessary to examine the suitability of this test for measuring oxidative stress in the nursing mink female *in vivo*.

Proceedings from NJF – Seminar No. 377, 11 pp, 3 figs, 23 refs. Authors' abstract.

Breeding, genetics and reproduction

Economic weights for most important traits in Finnish blue fox production

J. Peura, T. Serenius, I. Strandén

Finnish blue fox breeding concentrates to improve fur quality, pelt size and fertility. Genetic evaluation has three trait groups: litter size at three weeks after whelping, grading traits of live animals, and skin character traits. Farmer can make a ranking list of animals, which is calculated using one of two alternative trait combinations for total merit index: litter size and grading traits, or litter size and pelt character traits. Economically the most valued trait

of blue fox has been the pelt size (Lohi 2005). However, no studies have been made about economic values and economic weights in Finnish blue fox breeding. Therefore, the objective of this study was to estimate economic values and weights for the most important traits (pelt size, pelt quality, pelt colour clarity and litter size) in Finnish blue fox production.

Proceedings from NJF – Seminar No. 377, 7 pp, 6 figs, 4 tables, 6 refs.

Development of an advisory concept – Reproduction and feed control from 1st December to 1st June

M.U. Hansen, Vilhelm Weiss, T.M. Lassén

In 2003 and 2004, the customers of a feed kitchen in the middle of Jutland had problems with many lost litters in the first couple of days after birth and many barren females on the farm. In January 2005, the advisory service engaged in a co-operation with the feed kitchen to study and describe the problems and hopefully find a solution.

The problems throughout Denmark were identified by a questionnaire in 2004 where Danish farmers were asked to provide information on how many animals they had on their farm, how many litters they had lost and the number of barren females on their farm. In 2004, app. 50 % of all the farmers in Denmark completed the questionnaire. There were 3.2 % lost litters and 9.2 % barren females on the farms which participated in the survey. The problem centred on one colour type on the farm, but it was not the same colour type on all farms. If we focus on the customers from the feed kitchen with severe problems, there were 6.1 % lost litters and 14.1 % barren females, which is not considered normal.

In co-operation with the Danish Fur Breeders' Research Centre the factors which may cause the problem were discussed on a brainstorming meeting. The factors discussed were divided into nutrition and feed quality, and management-related factors.

Nutrition and feed quality factors	Management-related factors
Biogenic amines	Body condition of males and females
Toxins (fungus and bacteria)	Nest box (size and type)
Hormones in raw materials	Farm size
Vitamins (quality and storage of premix)	Water system
Amino acids	Use of insecticides
Water quality	Flushing
Feed quality (microbiology and chemical)	Weight at birth
Viruses	Feeding intensity
	Infertile males
	Length of pregnancy
	Use of artificial light

Material was also collected from farms with a high percentage of lost litters, in the form of dead kits and females which had lost their litters. The animals were examined on Danish Institute for Food and Veterinary Research to see if there were any histological or pathological explanations to the problem. The results of these studies are not yet available and therefore not presented in this paper. However, the studies did not show any signs of infectious diseases as the cause of the problem.

Proceedings from NJF – Seminar No. 377, 4 pp, 1 fig, 5 refs.

Nutrition

Peas as a protein source in blue fox feed

N. Koskinen, J. Valaja, I. Pölönen, P. Peltonen-Sainio, T. Rekilä

The pea crop in Europe provides the animal feed industry with a raw material rich in protein for pigs and poultry. The EU, as well as Finland, has a major deficit of raw materials rich in protein. Two-thirds of EU requirements are imported, and this includes large amounts of soya meal for animal feed, and of common beans (*Phaseolus vulgaris*), chickpeas and lentils for human consumption.

The nutritional value of grain legume seeds is important both for human food and for animal feed.

The seeds of most grain legumes have a balanced composition of protein, starch and fibre and provide valuable sources of both protein and energy for humans and animals. The use of heat processed or extruded peas in the growth period has been studied especially in mink feed (Bjergegaard et al. 1995, Clausen and Therkildsen 1995, Ahlstrøm and Skrede 2003). In Finland pea is rarely used in blue fox or mink feed during growing-furring period. The aim of this research project was to develop use of pea in fur animal feed in Finland. Therefore the effects of dietary peas on growth, food consumption, skin properties and diet digestibility of growing-furring blue foxes were studied.

Proceedings from NJF – Seminar No. 377, 4 pp, 1 fig, 4 tables, 3 refs.

Annual feed intake in mink kits fed individual *ad libitum* or restricted during the growth period

S.H. Møller, V.H. Nielsen, B.K. Hansen

Most farmed mink in Denmark are fed close to the average *ad libitum* intake during the growth period, based on feed leftovers at farm, shed or row level. Variation in voluntary feed intake between male + female pairs is ignored apart from the distribution of feed leftovers to cages without feed left over from the day before. Technological development has facilitated individual feeding and thus the possibility for true *ad libitum* feeding of mink. The variation in voluntary feed intake, weight gain and feed efficiency was studied in male + female pairs of Scanbrown mink kits during 15 weeks from 12 weeks of age in July to 26 weeks of age in November in 2003 and 2004. The feed intake in the dams selected as breeders in November 2003 was followed during the winter, mating, gestation, and lactation. It is concluded that individual *ad libitum* feeding increases the feed consumption, weight gain and feed efficiency compared to the usual farm feeding practice. Selection for body weight under both individual *ad libitum* feeding and general restricted feeding increases the feed efficiency by the same magnitude, mainly by increasing the weight gain or reducing the feed consumption, respectively. Despite differences in body weight and litter size, the feed consumption during the growth

season was not significantly correlated to the feed consumption during the winter or lactation periods.

Proceedings from NJF – Seminar No. 377, 4 pp, 1 fig, 2 tables, 3 refs. Authors' abstract.

The effect of *ad libitum* and restricted feeding on feed intake curves and feed efficiency curves in mink

V.H. Nielsen, S.H. Møller, B.K. Hansen, P. Berg

Feed intake and feed efficiency were studied in lines of mink on farm feeding (FF), *ad libitum* feeding (AL) and restricted feeding (RF). The results show that feed intake curves and weight gain modeled as a function of cumulated feed intake can be described by a fourth degree polynomial specific to line. Significant differences were found among the lines for feed intake ($P < 0.0001$) and feed efficiency ($P < 0.0001$). Feed intake and feed efficiency were largest in the AL-line and smallest in the RF-line. The results suggest that the feeding strategies provide the basis for a differentiated response to selection for high November weight on *ad libitum* and restricted feeding.

Proceedings from NJF – Seminar No. 377, 11 pp, 4 figs, 1 table, 7 refs. Authors' abstract.

Effects of restricted feed intake on neonatal mortality in blue fox (*Alopex lagopus*)

G. Sanson, Ø. Ahlstrøm

The study aimed revealing effects of restricted feeding of the blue fox mother one week prior to expected birth on neonatal cub mortality. Restricted feeding has been shown to be beneficial for the appetite after birth. On the other hand, as fetuses grow substantially the last days before birth, energy intake in this period may be crucial for the viability of the cub. The study showed that restricted feed intake, 30-50 % (100 g/d) of the requirement resulted in significantly lower body weight at birth and at three days of age. At seven days of the body weights were equal for the restricted group at the control given free access of feed (450 g/d). Total cub loss the first week after birth was 16.4% and

21.8% in the groups with free and restricted feeding respectively ($P > 0.05$).

Littersize and body weights of cubs on day 1, 3 and 7

N=35	Control	Restricted	Pooled SEM	P-value
Litter size				
Day 1	10.5	10.5	0.5	n.s
Day 3	9.1	9.1	0.6	n.s
Day 7	8.7	8.3	0.8	n.s
Body weights				
Day 1	77.3	70.9	1.0	0.01
Day 3	97.9	89.8	1.3	0.01
Day 7	140.9	139.6	2.4	n.s.

Totally 368 cubs were born and 70 died before seven days of age. The results of the autopsies showed that the most frequent death cause was low birth weight, dehydration and bite wounds, besides eight cubs of which death cause could not be identified. Autopsies were carried out in 39 cubs of which 26 from the restricted group and 13 from the control.

The study showed that feed restrictions in blue fox the last week before parturition should be done with caution to ensure viability of the newborn. The autopsies of neonates revealed that an important death cause is low birth weights resulting in weak cubs. Generally death causes and mortality rates appeared to be similar to those reported in dogs and cats.

Proceedings from NJF – Seminar No. 377, 9 pp, 4 tables, 7 refs. Authors' abstract.

Oligosaccharides, bioactive proteins and peptides in mink colostrums; structures, analytical techniques and bioavailability

J. Elnif, P.R. Hansen, K. Mortensen, L. Paajanen, A.D. Sørensen, J.C. Sørensen, S. Sørensen, H. Sørensen

Oligosaccharides are ubiquitous components of all living cells, where they occur as covalently bound parts of membrane associated lipids and proteins. Oligosaccharides are, in addition, widely distributed in nature as glycosides of various low molecular weight compounds, and as unbound oligosaccharides in plants and milk, especially colostrum.

Oligosaccharides are found associated to proteins as either proteoglycans or glycoproteins. The proteoglycans are a class of proteins, with as much as 95% carbohydrate by weight, consisting of glycosaminoglycan chains based on repeating disaccharide units.

Glycoproteins contain, as do glycolipids in membranes, one or more covalently bound saccharides or oligosaccharides lacking a serial repeat unit as in the proteoglycans. The amount of carbohydrate by weight in glycoproteins is highly variable, with about 4 % in immunoglobulins, about 20 % in ovomucoid, 60 & in glycoproteins of red blood cell membranes, 70 % in human ovarian cyst glycoprotein and about 80 % in gastric glycoproteins. The oligosaccharide units in glycoproteins usually contain only a few monosaccharide units, maximally 12-15.

The structures of oligosaccharides forming part of glycoproteins have only been completely elucidated for a limited number of glycoproteins, as e.g. some of those determining the blood antigen system.

In addition to being decisive for the specificity of blood antigen systems/blood types, the carbohydrate parts of glycoproteins are determinants for various important biological functions of these molecules.

Another interesting observation which calls for special attention is the occurrence in colostrum of not only high concentration of immunoglobulins, but also a great number of oligosaccharides with structural similarities to the glycoside structures seen for the carbohydrates in various glycolipids and glycoproteins.

Proceedings from NJF – Seminar No. 377, 12 refs.

Energy metabolism of mink kits during the early postnatal period

S. Harjunpää, K. Rouvinen-Watt, H.T. Korhonen

The metabolic rate in the mink is greater than in a normal-shaped mammal of a same body weight. In neonates, the main means of heat production is by

non-shivering thermogenesis (NST). The objectives of this study were to measure the mink kits' energy metabolism (EM) in cold and the capacity for NST during the early postnatal period. The basal resting EM of 1-day-, 29-day- and 43-day-old kits was 37.19 ± 69.14 Jg-1h-1, 42.61 ± 22.51 Jg-1h-1 and 29.75 ± 11.66 Jg-1h-1 at +25°C, respectively. Cold increased EM by 86% at day 1 and by 92% at day 43. Locomotor activity doubled the EM at 57-day-old mink. Induced NST increased the EM by over four-fold at 15 days, by nearly 25% at 22 days and by 51% at 57 days of age. NST was notably suppressed during 36-43 days of age. Non-shivering thermogenesis by brown adipose tissue is likely to play an important role in the early survival of mink kits.

Proceedings from NJF – Seminar No. 377, 11 pp, 3 figs, 28 refs. Authors' abstract.

Effect of dried sugar beet pulp on eating time and mean transit time in energy restricted mink (*Mustela vison*) females

C. Hejlesen, H.N. Laerke

Three similar diets, except for the content of the fibrous dried sugar beet offal, (LF: 0%, MF: 2.5% and HF: 5.0%) were allotted to 3 groups of female mink from of January 6th to March 7th 2005. Energy allotment was restricted individually resulting in a weight loss of 20% of there weight mid November. The time the females spend eating the restricted quantity of energy was measured 8 times and the mean transit time (MTT) and the time of first appearance (TFA) of a marker (plastic pearls) was measured 5 times.

Addition of 2.5% dried sugar beet offal reduced the time the females spend eating the restricted quantity of energy by 0.7 hour, whereas addition of 5% increased it by 1.5 hours. Addition of 2.5% and 5.0% dried sugar beet offal to the feed decreased both TFA and MTT. TFA and MTT were lowest at a 5.0% inclusion of dried sugar beet offal.

Proceedings from NJF – Seminar No. 377, 8 pp, 5 figs, 2 tables, 19 refs. Authors' abstract.

Individual feeding of mink, a powerful tool for evaluating the influence of feed intake on mink health

H. Baekgaard, M. Sponderup

In Denmark a new feeding system is available for farm practice, called individual feeding with a PDA. This new system gives us the opportunity to register the allocated feed amount on the individual animal or cage all year around.

A project was initiated between Danish fur Breeders Research Centre and the Danish agricultural advisory centre| Fur animals to gather data from five farms during the pregnancy and suckling period. The goal for the joined project is to study whether there is a relationship between the amounts of feed allocated in pregnancy and suckling period and findings of "sticky" kits, nursing sickness or the length of the lactation period.

In this manuscript we give a description of the research and show some data that give an example of the new opportunities we have for studying the individual animal instead of a group of animals. We found that the heaviest females in November got more feed allocated in average in both April and May compared to the lighter females. Females with litters of more than 8 kits got in average allocated 25 % more feed in May than females with litters of 1-5 kits.

Proceedings from NJF – Seminar No. 377, 7 pp, 2 figs, 2 tables, 1 ref. Authors' abstract.

Metabolism of D- and L-methionine in mink (*Mustela vison*)

J. Elnif, N. E. Hansen

In order to minimize the protein content in the mink feed supplementation of free individual essential amino acids is often needed. In the nature all amino acids are found as the stereo isomeric L-form but when synthesizing commercially the amino acids equal amounts of the D- and L-forms are normally produced.

Methionine is the first limiting amino acid for mink in several stages of the production cycle, especially

when growing new fur (Glem-Hansen, 1982) and hence is the amino acid most often added to mink feed. Many species, however, has a lower utilization of the synthetic D-form of methionine compared to the L-form (e.g. humans D-Met, 30%). For other species e.g. the fox there seems, however, to be no difference in the metabolism of the two stereometric forms of methionine (Dahlman, 2003).

Six one year old female mink (Scanglow) were randomly selected from the research farm at the university and individually placed in metabolic cages in the balance stable (15-17 °C). The animals were fed ad libitum of a experimental diet. The ratio between the stable isotop ¹³C and ¹²C in the expired CO₂ was measured after the animals had ingested feed added either isotop marked D- or L-methionine. Moreover a possible methionine sparing effect of adding a methionine hydroxy analog, Alimet, was studied.

It is concluded that the adult female mink fed equal amounts of either free D-methionine or free L-methionine has a strong preference for utilizing the L-form, in that less than 30% of the D-form was oxidized in this experiment compared to the L-form. Addition of the methionine hydroxy analog, Alimet, to the feed seemed to have no effect on the oxidation of any of the isoforms of methionine, although caution to this last conclusion should be made due to limited numbers of animals involved. Moreover it seems that free amino acids added to the feed are metabolized much quicker than amino acids arising from the proteins in the feed.

Proceedings from NJF – Seminar No. 377, 5 pp, 2 figs, 1 table, 5 refs. Authors' abstract.

Effect of body weight on reproductive success in blue fox

G. Sanson, Ø. Ahlstrøm

The field study aimed at examining the effects of body weight on reproductive traits in blue fox vixens. Two farms contributed with 100 vixens each in the study. The farms had expected differences in body weights. The distributions between primiparous and multiparous vixens were 78 and 22 for farm A, and 28 and 72 for farm B respectively. The average bodyweights at mid February were

8.35±0.10 for farm A and 6.56±0.11 for farm B respectively. The large difference in bodyweights and age distribution between the farms may have contributed to major differences in whelping results. Farm B (889) gave birth to almost twice as many puppies as did farm A (494). At weaning the numbers were 674 and 378 respectively. These differences represent substantial economic consequences for the fox farming industry. It's expensive to fatten a fox, and it's even more expensive to get a very poor production result. In conclusion, the effects of bodyweights on reproduction traits were not "clear-cut", but high bodyweight in mid February seemed to affect heat development negatively, as well as medical status of the udders, and the total numbers of puppies weaned.

Proceedings from NJF – Seminar No. 377, Authors' abstract.

Does high energy allowance during implantation increase litter size in mink?

S.H. Møller, I.C. Klaas

Based on the assumption that mink fed ad libitum during the implantation period will implant a high proportion of the blastocytes present and thereby give birth to large litters, the energy allowance during the implantation period of female mink has been increased to much more than the need of approx. 200 kcal/female/day in many Danish mink farms. This assumption is contradicted by the few experiments performed on the subject. High energy allowance during implantation often leads to low energy allowance in the latter part of gestation, and thereby increase the risk of pre-weaning diarrhoea in the kits. Data from 5 years (1994-1998) and 135 private mink farms on the feeding strategy in the winter, mating and gestation periods at farm level, the number of females and reproduction in Brown, Black and Other colour types was made available from a large Danish feed plant. The litter size in different colour types were analysed, using a mixed linear model including the difference in kcal/female/day between the Flushing and Conditioning period, between the Implantation and Prenatal period as well as herd size, colour type and year. The analysis showed a significant increase in litter size of 0.36 kits per 100 g difference in feed

allowance between the Flushing and Conditioning period ($P < 0.0001$) and with increasing herd size ($P < 0.05$). The difference in energy allowance between the Implantation and Prenatal periods had no significant effect on litter size ($P = 0.39$). Furthermore, the litter size differed significantly between colour types ($P < 0.0001$) and between years ($P < 0.05$).

Proceedings from NJF – Seminar No. 377, Authors' abstract.

Ethology and welfare

Stereotyped behaviour and welfare

L.L. Jeppesen

In mink, stereotyped behaviour is a popular target for public concern. From an ethical point of view, caging that allows of development of normal movements and locomotion should be preferred. However, from a scientific point of view there is no clear-cut relationship between stereotyped behaviour and animal welfare.

Although several universal theories have tried to explain the causes and functions of stereotypies, including the relationship to welfare, they have not succeeded in covering just most of the known cases of stereotypy. Seeking to understand the basis of stereotypy in single cases may be more rewarding. For instance, the relationship between high level of stereotypy and good reproduction may be explained without invoking coping or other general explanations, just by the fact that stereotyping animals are prone to be more active and slimmer than non-stereotyping animals, and for that reason to reproduce better.

The majority of publications on stereotypy links development of stereotypy with inferior environments and bad welfare. However, they also show that the performance of stereotypy (within a certain environment) seems to improve the welfare of the performing individual.

It is possible to reduce the development of stereotypy in mink by breeding. If the breeding results in animals that are unable to express bad

experiences induced by poor environments, then the breeding strategy will lead to poorer welfare. If, on the other hand, breeding results in animals that are better adapted to their environment and for that reason develops less stereotypy, then better welfare is inferred.

In an ongoing selection experiment in mink, preliminary results show that the level of cortisol derivatives in faeces is significantly lower in the low stereotypy selection line, indicating that breeding against stereotypy is a feasible way of improving welfare.

Proceedings from NJF – Seminar No. 377, 4 pp, 1 fig, 1 table, 8 refs. Author's abstract.

Daytime scannings reliably reflect 24-h group differences of stereotypy in mink

P.M. Svendsen, S.W. Hansen, L.L. Jeppesen

The present study aimed to examine whether different observation schedules result in the same inter-individual or inter-group differences in stereotypy performance. Mink from two breeding lines (F4) were used, a high stereotyping line (HSL; N=140) and a low stereotyping line (LSL; N=132). The animals were scanned using direct observations from 06.00 to 18.00 during normal and postponed feeding time. The analysis of the direct observations was focused on the HSL. Based on the direct observations 24 animals were selected for 24h video recordings (12 high stereotyping animals, HS and 12 low stereotyping animals, LS). The results of the direct observation, with and without postponed feeding correlated positively. The difference between the high and low stereotyping mink groups was maintained for morning, midday, afternoon direct observations and for daytime 24h video observations. In this experiment it seems that the daytime period in which mink are scanned, in fact gives an accurate picture of the individual differences (in the HS animals) and group differences in the 24h performance of stereotypy.

Proceedings from NJF – Seminar No. 377, 12 pp, 1 fig, 2 tables, 15 refs. Authors' abstract.

Stereotyped behaviour can be reduced by breeding

B.K. Hansen, L.L. Jeppesen, P.M. Svendsen, P. Berg

This study tests the presence of genetic variation in stereotyped behaviour and its possible relation to production traits. A total of 1480 adult females from two selection lines (High and Low frequency of stereotyped behaviour) were observed for stereotyped behaviour, body weight and litter size. Stereotyped behaviour was related to adult bodyweight, litter size and lost of kits during the lactation period. Moderate levels of additive genetic variance were detected for frequency of stereotyped behaviour ($h^2_{\pm s.e} = 0.30 \pm 0.05$) and pregnancy length ($h^2_{\pm s.e} = 0.21 \pm 0.03$). Low levels of additive genetic variance was detected for litter size 2-3 days after birth ($h^2_{\pm s.e} = 0.08 \pm 0.03$), at 2-3 weeks after birth ($h^2_{\pm s.e} = 0.07 \pm 0.03$), for percentage of lost kits from birth to 2-3 weeks after birth ($h^2_{\pm s.e} = 0.09 \pm 0.04$). A divergent genetic trend is illustrated from the two selection lines. Furthermore, there were negative genetic (-0.26) and negative phenotypic (-0.37) correlation between frequency of stereotyped behaviour and adult female body weight. A positive, but not significant genetic correlation was found between stereotyped behaviour and litter size at birth (0.41) or at 2-3 weeks after birth (0.35). A negative significant genetic (-0.52, -0.54) and phenotypic (-0.14, -0.17) correlation was found between adult body weight and litter size at birth and 2-3 weeks after birth. The genetic variation detected in this study suggests that it is possible to reduce stereotyped behaviour by breeding.

Proceedings from NJF – Seminar No. 377, 10 pp, 1 fig, 3 tables, 36 refs. Authors' abstract.

Hall housing in blue foxes: alternative or not?

H.T. Korhonen, L. Jauhiainen, T. Rekilä, T. Kivinen

The results showed that the temperature was 2-3 °C higher in the hall than in the shed and that relative humidity was 2-4% lower in hall than in the shed. The NH₃ concentration ranged from 0 to 9.5 ppm in the hall but was less than 1 ppm in the shed. The dust concentration ranged from 1 to 2.9 mg/m³ in the shed and from 0.9 to 3.2 mg/m³ in the hall.

Wind speed was from 0.2 to 0.4 m/s in the shed and from 0.09 to 0.26 m/s in the hall. Inseminations were begun in the hall 10 days later than in shed. This was a result of the different light conditions existing in these two environments. Increasing light intensity from late March onwards triggered mating and cause the vixens to become in heat during a narrow time period in the hall. In the shed, however, due decline in light from April onwards, inseminations became slower and less vixens were mated than in the hall. Sense-based impressions revealed that investigators experienced higher levels of smell and dust in the hall than in the shed but less draught. The final body weights were of the same order of magnitude in both study groups. Body length, however, tended to be longer ($P=0.06$) in animals kept in the hall than in the shed. In August, the cortisol:creatinine ratio was higher ($P=0.02$) in hall than in the shed. The next samplings in October and February reveal no significant differences. Nor were there any differences in blood screen (haemoglobin, haematocrit, white blood cells, red blood cells) between the groups. Walking tests revealed that both sexes spent more of their time on platform in the shed compared to the hall. This was because the platforms provided better opportunities to view the environment in the shed. No substantial differences were found in motivation to eat at the presence of man (feeding test) or in exploration of a novel object (ball test). The response to capture was similar in both housing environments (capture test). Purity of fur was poorer ($P=0.001$) in the hall than in the shed. Furthermore, a slight tendency ($P=0.08$) was revealed for fur quality to be poorer in the hall compared to the shed. Matings started 10 days later in the hall, but the number of successfully inseminated vixens was higher (46 of 50) in hall than in the shed (38 of 50). At whelping, the litter size was greater ($P=0.05$) in hall than in the shed. At weaning, however, no differences were found.

Proceedings from NJF – Seminar No. 377, 7 pp, 5 refs. Authors' abstract.

Effect of cage environment on the welfare and productivity of mink – a review

S.W. Hansen, J. Malmkvist

When a new Danish order concerning mink production enters into force, group-housing of mink

is expected to be legalised. Therefore, a summing up of the latest research concerning the welfare of mink kept in groups and enrichment of conventional production cages seems relevant - in particular because much of the established knowledge was not available when the first recommendations regarding group-housing of mink were introduced.

Group-housing makes it possible to increase the number of animals and thus improve profitability. At the same time, the individual mink may benefit from more space, provided that the actual liberty of action is not restrained by the other mink in the cage. Furthermore, a large cage makes it possible to increase complexity, which is an advantage with regard to the welfare of the animals, e.g. several studies have demonstrated group-housing results in a reduction of tail chewing/tail sucking. However, the mink is a solitary animal, and consequently increased aggression is a documented problem in mink kept in groups. Furthermore, group-housing makes it more difficult for the farmer to monitor the welfare of the individual mink in that it becomes difficult to observe the appetite and the consistency of faeces of the individual animal. Recent studies have demonstrated that it is possible to reduce the level of fur chewing/fur sucking, stereotypic behaviour and physiological stress in mink kept in conventional production cages by enrichment of the cages. At the same time, it is concluded that the cage environment is more important to the welfare of mink than is the size of the cage.

Proceedings from NJF – Seminar No. 377, 8 pp, 42 refs. Authors' abstract.

Posters

Do fibres in mink feed affect the feeding motivation? A preliminary study

S.W. Hansen, T.N. Clausen, B.M. Damgaard

During the winter, the energy content of the feed and the amount of feed allocated are reduced resulting in increased activity and stereotypic behaviour in mink (Damgaard et al., 2004). The possibilities of slimming the breeding females to have them react positively to flushing without provoking stereotypic behaviour have been studied

by increasing the content of fibres (barley husks) in the mink feed (Hansen et al., 2004). The results demonstrated that a high energy content reduced the time without feed and the occurrence of stereotypic behaviour. However, a similar study, in which citrus pectin residues or tryptophan was used as roughage in the feed, demonstrated that the time without feed was reduced whereas the occurrence of stereotypic behaviour was not (Clausen, et al., 2005). A possible explanation for this could be that the two products tasted so badly that though the mink were not satisfied they preferred not to eat. Therefore, in a study using beet residues as roughage, the 'tastability' of the feed was assessed while at the same time the eating patterns of the mink were tested using operant conditioning techniques.

The following hypotheses were tested:

1. Mink distinguish between three types of feed, i.e. there is a difference in the elasticity (the slope) and/or the intensity (intercept) of the demand functions (DF).
2. Mink compensate for a low energy content in the feed by increasing the number of rewards, i.e. slopes of the demand functions (DF) run parallel, but the intensity of the demand function for low energy feed is significantly higher than the demand function for high energy feed.

Furthermore, we studied if the number of rewards per meal, the number of meals and the duration of the meals differed between the various beet feeds tested.

Proceedings from NJF – Seminar No. 377, 3 pp, 5 refs.

Fasting of mink kits fed different feed rations and its effect on liver fat content, plasma metabolites and enzymes

T.N. Clausen, P. Sandbøl

At pelting, we investigated the effect of fasting time and/or different feed rations on the liver fat infiltration, the plasma concentration of different metabolites and enzymes. Fasted vs. fed mink kits reduced the relative liver weight and increased the liver fat percent. Mink fed a low protein diet and fasted for 48 hours, developed a fat infiltration in the liver faster than mink fed a high protein diet. Responses in plasma metabolites and enzymes are

discussed. The change in metabolism depends on the time of fasting and also seems to depend on the prior feeding history.

Proceedings from NJF – Seminar No. 377, 5 pp, 6 tables, 15 refs. Authors' abstract.

Collection and storage of urine in N – balance trials with mink

S. Lisbjerg

In N-balance trials with mink urine is collected in bottles containing sulphuric acid to prevent evaporation of volatile N. Furthermore the voided urine is collected daily and stored frozen until analysis. Experiments were conducted to evaluate if daily collection and storage at frost is necessary. N and pH in urine were measured as an effect of storage temperature, –time and addition of sulphuric acid.

The results showed that the urinary N percent was unaffected by time, temperature and addition of sulphuric acid when stored in 3-4 days. Without sulphuric acid the urinary pH increased from 7.2 after one day to 9.5 after 3 days.

It is concluded that performing N-balance trial with mink in a 4 days long collections period does not require a daily collection of urine. It is however recommended to add sulphuric acid in the urine collection bottles.

Proceedings from NJF – Seminar No. 377, 2 pp, 3 tables. Author's abstract.

Effect of acids in feed on pH in mink urine

S. Lisbjerg

5 acids/acidifiers were screened for the effect on urine-pH in mink mails. Adipic Acid, Succinic Acid, Glutaric Acid, Benzoic Acid and Potassium disulfate were tested at 3 different levels. Ammoniumchlorid (0,35%) served as a positive control. Succinic Acid, Glutaric Acid, Potassium disulfate and Ammoniumchlorid had a negative effect on feed intake with increasing inclusion. This corresponds with earlier observations on Ammoniumchlorid. When correcting for feed

intake, Adipic Acid showed the best effect on lowering urine-pH, resulting in a pH below the critical level for development of urinary stones (Struvit stones).

Proceedings from NJF – Seminar No. 377, 3 pp, 5 tables, 6 refs. Author's abstract.

An objective method to determine fur-priming in mink (*Mustela vison*) – provisional results

M. Fredberg, B.K. Hansen, P.V. Rasmussen

In mink production it is important to be able to determine when the winter fur is mature and the mink can be pelted. Today it is only possible for the farmer to use subjective methods to determine when the fur of the mink is mature. Therefore we aimed at developing an objective method to determine fur priming in mink.

We used a portable spectrophotometer to measure fur and skin colour of the skin of 20 brown male mink once a week in the period from September 13th (week 38) to November 8th (week 46). Fur and skin colour were assessed on the neck and loin around the backbone. After pelting the colour on the skin side of the fur was visually graded in the neck and loin region. Based on the visual grading the pelt was classified as mature or not. Comparisons were made between measurements from the spectrophotometer on live mink and visual grading of the skin side after pelting.

Lightness of the skin seems to be a good parameter to mirror the pelage cycle of the mink. The skin is light in the beginning and in the end and dark in the middle of the pelage cycle. The average skin lightness of the loin ranked in intervals from (32 - 57), (30 - 47) and (48 - 59) in week 38, 40 and 46, respectively. Skin lightness decreased from week 38 to 40 and increased from week 40 to 46, which is in accordance to the change in skin colour during the pelage cycle, due to the amount of growing hair, in which pigment is produced. In the first few weeks the variations between animals were high and it tended to decrease subsequently – indicating a higher variation in the beginning of the winter pelage cycle. Comparing curves of skin lightness on the neck and loin showed that pelage cycle tend to be delayed in the neck compared to the loin, which

is in accordance with the development of the winter coat that progress from tail to head. The three mink with the lowest skin lightness at the loin in week 46 were visually determined not to be mature and mink with the highest lightness in week 46 were visually determined to be mature, which indicate a positive correlation between spectrophotometric colouration and visual grading. Provisional results indicate that a spectrophotometer is an objective and applicable method to measure fur priming in mink.

Proceedings from NJF – Seminar No. 377, 1 p. Authors' abstract.

Group housed mink – effect on welfare and production

H. Lindberg, E. Aldén, L. Lidfors

When new regulations for housing of farmed mink in Sweden have been up for discussion group housing has been one of the many alternatives. Mostly because it would increase the individual space and perhaps function as a social enrichment. Unfortunately it can also increase aggression which can lead to increased stress, injury and pelt damage which leads to negative effects on welfare and production. In this study we wanted to investigate the effects of group housing on welfare and production measured as body mass, pelt damage and economy.

In total 120 Scan Brown juvenile mink were housed in groups of 12, six females and six males, in large cages (80 x 195 x 40 cm) or in pairs, male and female, in standard cages (80 x 40 x 30 cm) from weaning in July until pelting in November 2004. Large cages were equipped with wood- and wire net shelves (20 x 25 cm), plastic cylinders (30 x 16 cm), wire net cylinders (30 x 13 cm) and plastic ropes (40 cm). All mink were weighed, pelted and scanned for fur damage. Pelt damage was categorized according to a 1-3 scale where 3 was the most severe damage.

In total 78% of group housed females, 76% of group housed males, 48% of pair housed females and 3% of pair housed males had some type of pelt damage. Damaged skins were categorized by severity of damage in 3 categories where 1 was light damage and 3 was more severe damage (Fig. 1 and 2). In group housed mink there were more severe pelt

damage compared to pair housed mink, especially amongst females (Fig. 1 and 2). Which resulted in a lower fur quality in group housed individuals, especially amongst females. In total 20 males had some degree of wet belly, 18 were group housed males and 4 were pair housed males. Although the quality decreased on the group housed skins the mean price on auction only differed 2.3% between group housed mink and pair housed mink. Pair housed males showed a tendency to have a higher body mass than group housed males ($p=0.07$, t-test, $n=28$). The group housed males, however showed a larger individual variation in body mass (min 1877 gram and max 4180 gram). No difference in body mass between pair housed and group housed females were found (NS. t-test, $n=28$).

Proceedings from NJF – Seminar No. 377, 2 pp, 2 figs. Authors' abstract.

Protein digestion determined by protein hydrolysis catalysed by mink proteases compared to data produced by use of proteases from other monogastric animals

K. Mortensen, A.D. Sørensen, J.C. Sørensen, H. Sørensen

The digestive tract of mink (*Mustela vison* Schreb) is relatively short and so is the transit time for mink feed during digestion compared to that of other monogastric animals. Active hydrolases in the gastrointestinal tract are for all animals key factors for utilisation of the feed including proteins. The present work is focused on activities of mink trypsin (EC 3.4.21.4), chymotrypsin (EC 3.4.21.1) and inhibitors for these enzymes. The catalytic power of the enzyme and intestinal peptidases determine their efficiency in relation to opportunities for efficient protein utilisation, and it is properties that are reflected in kinetic parameters. It is found that trypsin and chymotrypsin have a strong and nearly irreversible binding to protein type inhibitors of animal, egg and plant origin, with a binding in a one to one molecular ratio. The results obtained show also, that mink trypsin and chymotrypsin are composed of isoforms, with molecular weights of 22-30 kD and a trypsin group with $pHi < 6$ and one with $pHi > 11$. The activity of mink trypsin is much higher than found for porcine and rat trypsin; for most isoforms ca. 10 times higher. Knowledge to

the properties of mink trypsin and chymotrypsin compared to that of other animals are useful in relation to evaluation of protein digestibility obtained by use of other animals or their enzymes in in vivo and in vitro trials.

Proceedings from NJF – Seminar No. 377, 15 pp, 5 figs, 2 tables, 27 refs. Authors' abstract.

Profiles and functions of lipids, especially LC-PUFA in mink tissues and organs as function of essential lipids in the diets

C. Bjerregaard, T.N. Calusen, A.D. Sørensen, J.C. Sørensen, H. Sørensen

Lipids in the brain and lungs of mink kit (*Mustela vison* Schreb) have been investigated as part of a more comprehensive study of the quality of lipids in relation to mink feed and its influence on growth and development of mink. Focus has been placed on the significance of lipids for membrane structures and metabolism. Lipid analyses of mink feed, tissues, milk and internal organs of the animals have been performed by gas chromatography (GLC) to characterise the profile of fatty acids (FA). Supercritical Fluid Techniques (SFT; as extraction, SFE and as chromatography, SFC, EFLC-ELSD) have been used for the studies of intact lipids in feed and in tissues, organs and milk of the animals. The brain and lung tissues have a dry matter (DM) content of approximately 21% dominated by protein and lipids, which accounts for 45-49% of the DM and 40-42% of the DM, respectively in the brain and for the lungs corresponding figures of protein and lipid content are 60-65% of the DM and 30-35% of the DM, respectively. The brain tissues of mink kits do not contain intact triacylglycerols (TAG). However, FA are present in complex lipids as phospholipids and glycolipids, which also seems to be the case for lung tissues. Very small amounts of TAG were present in the lungs of newborn kits whereas appreciable amounts of TAG were present in lungs from one month old mink kits. In addition, lungs and especially brain tissues of the mink kits revealed a very high content of cholesterol. The brain and lung lipids seem, thus, to consist primarily of membrane lipids with special significance for their structure and function and they seem to play a minor role in metabolic processes for energy production. The energy needed in the brain is

mainly produced from glucose and under special circumstances also from ketone bodies. The lipid metabolism of the brain include enzyme catalysed processes as FA chain elongation (elongases) and formation of double bonds in FA (desaturases). The FA transported to or formed in the brain result, thus, in the mandatory long chain polyunsaturated fatty acids (LC-PUFA). In this connection, the content of unsaturated FA in the feed seems to be significant as is a correct ratio between n-6 and n-3 PUFA and therefore also the formation of 20:4 (n-6) (AA; arachidonic acid), 20:5 (n-3) (EPA; eicosapentaenoic acid) and 22:6 (n-3) (DHA; docosahexaenoic acid). These LC-PUFA's are regarded as essential for normal development of the brain, of visual function, and for optimal development of newborn kits. An other special and very important information obtained with the present study, is the detection of quantitatively dominating amounts of cholesterol in the brain tissue. Thus, knowing that the blood-brain barrier prevent transport of cholesterol from blood to brain, this strongly indicates that the dominating biosynthesis of cholesterol in the brain takes place with an assumed origin in ketone bodies, which are transferred from blood to brain. The amphiphilic compounds in lung membranes seems to undergo a continuously metabolism and secretion. It is also assumed, that the production of these membrane molecules is relatively low until just before birth, which make the newborn kits more sensitive to disturbtion of the lung function. In connection with the lungs, special interests are devoted to prostaglandins (PG) and the role of PG in processes of inflammation and allergic responses.

Proceedings from NJF – Seminar No. 377, 15 pp, 8 figs, 3 tables, 20 refs. Authors' abstract.

Pedigree analysis of Finnish blue fox population

I. Strandén, J. Peura

Animal breeding aims to change selected target traits. It is well known that an efficient breeding programme tends to increase inbreeding. Increased inbreeding has shown to affect negatively litter size in blue fox (Nordrum, 1994, Wierzbinski et al., 2004).

In this study we looked at trends in average inbreeding coefficient and coefficient of relationship in the Finnish blue fox population, and estimated effective population size.

Proceedings from NJF – Seminar No. 377, 3 pp, 3 figs, 1 table, 3 refs.

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