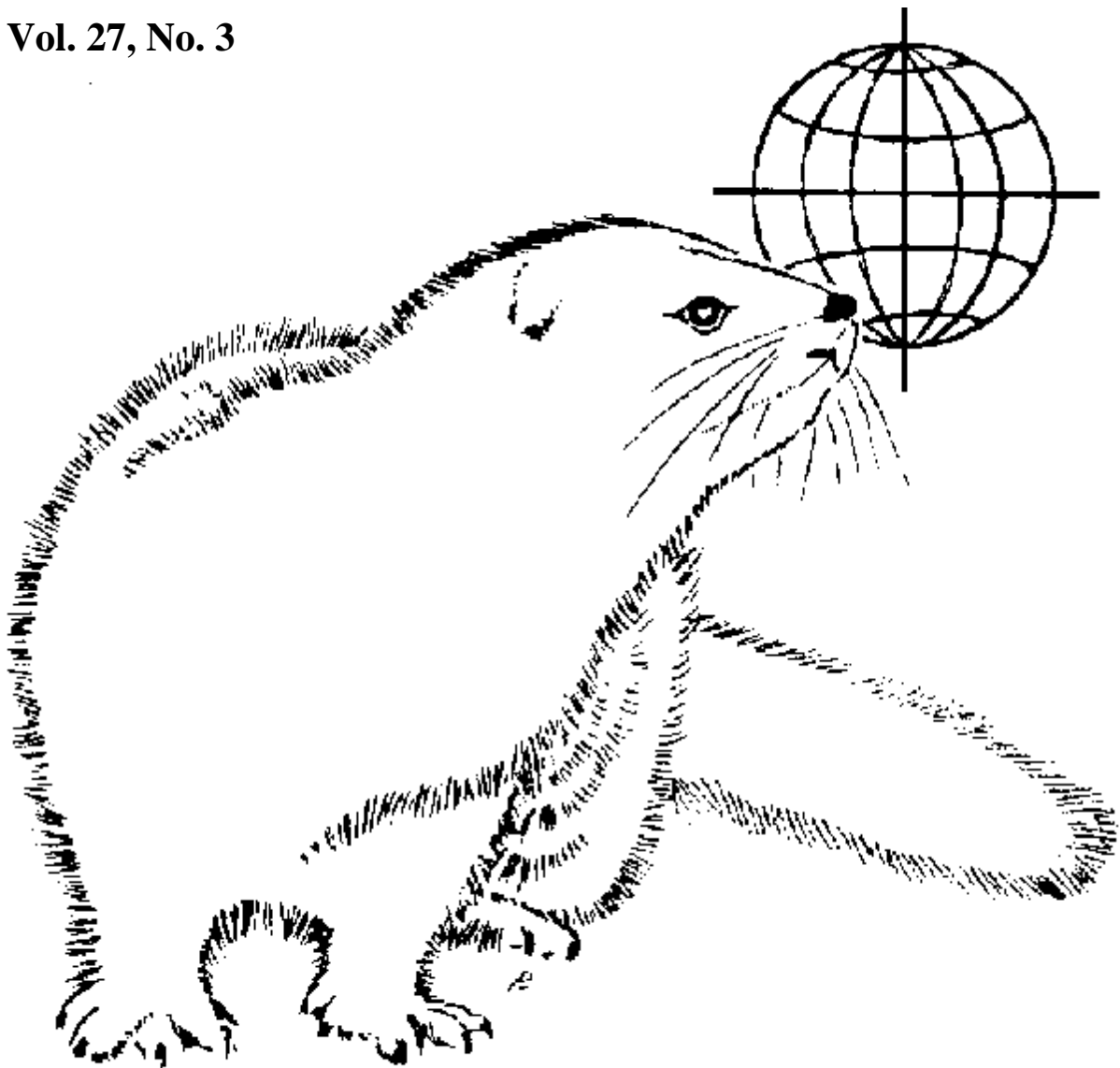


# SCIENTIFUR

SCIENTIFIC INFORMATION IN FUR ANIMAL PRODUCTION

Vol. 27, No. 3



INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

## **SCIENTIFUR - scientific information in Fur Animal Production.**

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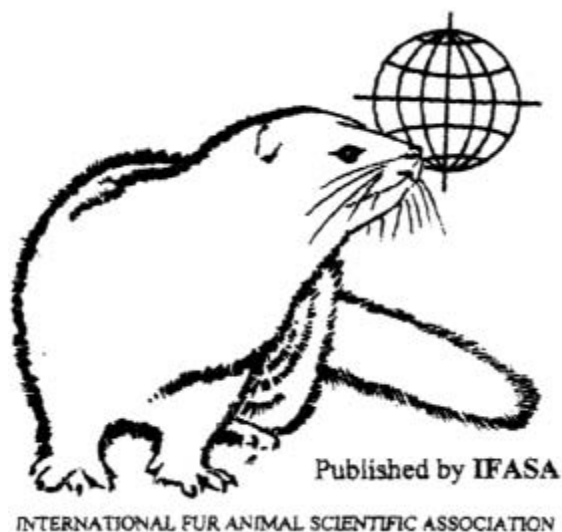
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## Notes from the Group of Editors

This version of *Scientifur* is the third issue of volume 27. The issue contains a number of interesting abstracts from the Annual Report, 2003, of the Danish Fur Breeders' Research Center.

The fourth issue of *Scientifur* containing only reviewed articles is expected to appear shortly.

As always, we invite our readers to submit proceedings from congresses and seminars with relation to fur animal production. We also invite you to submit short communications, abstracts and letters on fur animal production, and in particular we ask you to send us articles for reviewing.

On behalf of the  
Group of Editors

Birthe Damgaard



## Reports on: Behaviour

### Cortisol and corticoid metabolites in mink faeces

*J. Malmkvist, R. Palme, S.W. Hansen, B.M. Damgaard*

Activation of the HPA axis, including increased concentrations of cortisol, is used as an indicator of stress in mink. We measured cortisol and three types of cortisol metabolites in faeces collected during three days from 24 male mink, half of which had been injected with ACTH at the beginning of the experiment. The concentration of 11.17-dioxoandrostan was significantly higher in faeces from the ACTH treated mink, whereas the level of cortisol was low in faeces from both groups of mink. Analysis of cortisol metabolites in faeces is a potential method for evaluating stress in mink.

*Annual Report 2003, 7-15, 2 figs, 1 table, 61 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### Behaviour and production parameters as an indication of welfare in female breeding mink during different social housing conditions from weaning to pelting time

*V. Pedersen*

There is a trend developing to keep the breeding female together with one male kit after weaning and until pelting time. It is not documented how widespread this "routine" is and until now it has not been examined how this "routine" affects the breeding female with regard to her welfare. A pilot study was set up with the aim to examine some few parameters directly or indirectly linked to welfare of the breeding female when kept with one or two male kits until pelting. In the end of June, 192 breeding females were distributed into 4 groups. The females had between 6-10 kits and had given birth within the same week in April/May. The litters were then between 7-8 weeks old at weaning time. Group 1 females were housed singly, group 2 females were housed with 2 male kits from another litter, but of the same age as her own kits, group 3 females were housed with one male kit from another litter and of the same age as her own kits, and group 4 females were housed with one of her own sons. All animals were moved from their home cage and re-housed in

another shed in similar sized cages measuring 90x30x45 cm with one nest box. Scan sampling observations of behaviour and position in the cage were performed 30 times, divided over 6 days (2 at start, 2 in the middle and 2 at the end of the study) with 5 samplings per day with 30 minute intervals. After being killed the mink was marked, and individually measured for skin size from the snout to tail root. Bites on the leather side was counted for different regions: belly, back of the neck, back, hips and tail. After being processed the skins were checked and registered for fur damages on the same regions as above.

The results showed that being together with a partner increased the amount of positive behaviours such as grooming and play, but it also increased the amount of fights and being pursued. The number of animals stereotyping were reduced in groups with one male kit, and highest in the group with singly housed females. In the group with 2 male kits, the amount of stereotypies was high as well as fights and being pursued, the number of bites on the leather side on both male and female skins was significantly higher as well as the occurrence and severity of fur damages. It was concluded that this group composition had a great negative impact on the females welfare and should therefore strictly be avoided. The question about keeping the female with one male was not as straightforward regarding the females welfare. On one hand she experienced play and grooming through the company of the male (i.e. more natural behaviour), but she also had to fight and defend herself causing some fur damages and some bites seen on her leather side (pain and frustration?). However being housed singly, caused a higher occurrence of stereotyped behaviour and less variation in behaviour with no play and only a small amount of ego-grooming (boredom?). Before the "routine" with housing females with one male kit is becoming more widespread, it is recommended that a large scale study is initiated to examine the females physiological stress levels combined with more detailed behaviour observations. In such a study the long term effects should be examined as well, in order to get knowledge on how breeding females, kept with a male kit, perform and thrive in the following breeding season. Until we have the results of such a study, keeping breeding females with a male kit after weaning until pelting should be "the exception", not "the rule".

*Annual Report 2003, 17-26, 6 figs, 5 tables, 6 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### **Fibres in mink feed in the winter period. Influence on behaviour and reproduction**

*S.W. Hansen, T.N. Clausen, J. Malmkvist, B.M. Damgaard, C. Hejlesen*

Three groups of female mink were fed a wet diet with different content of fibres. The energy content was 199, 178 and 163 kcal/100g to group LF (low fibre), MF (med. fibre), and HF (high fibre), respectively. Each of the three groups received the same amount of energy per mink per day, and consequently group HF received most grams of food per day. The three groups were fed the experimental feed from January 1 to February 24. The time spent without eating and the behaviour of the mink were observed. All the mink were weighed on January 2 and February 13, and 20 young females from each of the groups were weighed regularly through the experimental period. From February 25 until day 42 in the lactation period, all mink was feed the same feed.

On January 13-14, 80% of the mink in LF had no food left after 6 hours. The comparable time was 10 and 12 hours in MF and HF. About 30-40% percent of the old females performed stereotypies already before the start of the experiment, whereas less than 10% of the young females did. After two weeks on the experimental feed, the percentage of stereotyping young and old females in group LF increased, whereas the percentage of stereotyping animals in the two other groups remained unchanged. Immediately before the flushing period the percentage of stereotyping females was 40-50% for all groups and there was no difference between young and old females. On April 1, when all mink were fed ad libitum, the level of stereotyping young females was back to normal (less than 10%) and also the number of stereotyping old females was reduced.

There was no significant difference between groups in number of live kits per fertile female or number of kits at 42 days of age. However there was an insignificant tendency to fewer barren young females in group LF compared to group MF and HF.

It was concluded, that high fibre feed reduced the time spent without eating and the occurrence of stereotypies in mink. However, feeding mink high fibre feed during the winter period had no negative effect on the number of kits per fertile female.

*Annual Report 2003, 27-34, 6 figs, 5 tables, 29 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### **Project welfare in practice**

*L.L. Jeppesen, T. Simonsen, V. Pedersen*

Project welfare in practice was started following discussions during 2001 between the Danish Fur Breeders association (DP) and the Society for the Protection of Animals in Denmark (DB). The project is supervised by both organisations. The purpose of the project is a large scale testing under farm conditions of some initiatives supposed to improve welfare. These were: (1) selection for confidence, (2) weight loss from December and until the beginning of flushing aimed at 10%, (3) mated dams placed in every second cage before delivery, (4) removing dams from litter when kits are 8 weeks old and separating the litter into male-female pairs 1-2 weeks later, (5) furnishing cages with permanently fixes shelves or tunnels below the roof and with detached occupational objects to manipulate. Experimental and control sections with and without, respectively, the above mentioned initiatives were established on two farms in the spring 2002. Both the fixed furniture and the detached occupational material were frequently used. Female kits preferred the shelf as a lying area more than the tunnel. Male kits used the shelf and the tunnel to the same extent, but the coat on their belly was warn when they used the tunnel. The shelf can be recommended as a permanent furnishing of the mink cage, however, the placement and the final design remains to be worked out. Wire mesh rolls and plastic tubes and ropes had the most permanent occupational effect. Rope gave rise to problems with the pumps of the mucking out equipment at both farms. A wire mesh roll or a plastic tube can, based on the present knowledge, be recommended as an occupational object. However, continued control is necessary to ensure that the objects do not give rise to practical problems. In the experimental group dams were calmer in the last weeks of the lactation period as compared to control dams. In the weeks



prior to weaning the frequency of stereotypies increased and a few kit killings were observed in the experimental group just prior to the late weaning. This shows that some dams are ready to be separated from their kits earlier than at 8 weeks kit age. In conclusion the initiatives, which were tried out in the experimental group, resulted in better welfare measured by less fear and stereotypy in both dams and kits.

*Annual Report 2003, 35-44, 8 figs, 4 tables. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### **Reports on: Breeding and reproduction**

#### **Mink selected to produce on a low protein content in the feed. Status for lactation period 2002, growing period 2002 and lactation period 2003**

*T. Clausen, C. Hejlesen, P. Sandbøl*

After pelting 2002 we started an investigation on the possibility of breeding mink with a good fur quality when the content of protein in the feed was low, without negative consequences for reproduction and growth. In the breeding period 2002 the control group gave birth to more kits than the investigation group, but due to a high number of greasy kits in that group, many kits died during the reproduction period. There was no difference between groups in the kit weight day 42.

In the growing furring period 2002 the pelt length and fur quality were lower in the investigation group than in the control group, but the animals chosen for the following breeding period had the same size and quality.

In the breeding period 2003 there was borne more kits in the control group than in the investigation group. Female kit body weight day 42 was higher in the investigation group than in the control group.

*Annual Report 2003, 45-48, 1 fig, 8 tables. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### **Reports on: Nutrition and feeding**

#### **Fibre as a satiety factor in mink feed**

*C. Hejlesen, P. Sandbøl*

Prior to a large scale experiment on the research farm it was investigated if barley hulls and barley straws could prolonge the time a mink spent eating a restricted quantity of energy. Three groups of 5 males each were fed either a control diet, a diet including barley hulls or a diet including chopped barley straw.

Inclusion of barley straw had a aversive effect. After a habituation period the inclusion of barley hulls prolonged the time the animals spent eating the restricted quantity of feed.

*Annual Report 2003, 49-51, 2 tables, 6 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

#### **Growth and development of mink as function of different plant or fish oils included in feed used during the gestation and nursing period**

*C. Bjerregaard, T.N. Clausen, T.M. Lassen, K. Mortensen, H. Sørensen, J.C. Sørensen, S. Sørensen*

Lipids of different types have been investigated for effect on growth and development of mink (*Mustella vison* Scrb). Trials have been performed with commercial/traditional oil-mill produced soybean oil, sunflower oil, rapeseed oil, coldpressed rapeseed oil and two different types of commercial fish-or herring oils. These six types of oils have been used in a traditional mink feed through the gestation and nursing period, with the different oils as the only variable in the feed used to the different groups of mink in the trials.

Analyses of the oils, the feed, mink milk and tissue biopsy fat samples have been performed with traditional methods of lipid analyses including supercritical fluid techniques (SFT) and gas liquid chromatography (GLC). In addition to SFT used to selective extractions (SFE), SFT was also used to chromatographic analyses (SFC, EFLC-ELSD) of individual intact triacylglycerols (TAG's). GLC was used to determination of amount and type of fatty acids (FA) in the lipids. The applied oils showed a

variation in content of essential unsaturated fatty acids (long chain polyunsaturated acids; LCPUFA) from 0.1 to 24.7 % of total FA for n-3 FA, and a variation from 2.6 to 68.8 % of total FA for n-6 FA. These differences give a variation in the ratios between n-3 and n-6 FA for the applied oils from less than 0.1 to 7.5.

The differences in chemical composition of the oils were also clearly reflected in profiles of the lipids found in mink milk and fat-biopsy samples from the mink kids. The obtained results showed, that the different types of oils gave clearly differences in growth and development of the mink. The best results were obtained with coldpressed rapeseed oil, which differed from the traditional oil-mill produced oil by a marked higher content of carotenoids and other phenolic antioxidants. The two types of fish oils showed an appreciable degradation of the native lipids, especially for one of these oils. The feed containing these two fish oils resulted in suboptimal growth and development of the mink.

*Annual Report 2003, 53-66, 11 figs, 4 tables, 21 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

#### **Fatty acid profiles of mink milk and tissues of kits as a function of different n-6:n-3 fatty acids ratios in the diet**

*T.N. Clausen, M.U. Hansen, T.M. Lassén, K. Mortensen, H. Sørensen, J.C. Sørensen, A.H. Tauson*

Fatty acid composition of lipids in mink milk and tissues of mink kits have been determined as a function of different ratios between n-6 and n-3 fatty acids in the feed for pregnant and lactating mink. The experiment comprised 5 groups of each 25 scanbrown female mink. The 5 groups were fed diets with different ratios between n-6 and omeg-3 fatty acids. This was achieved by substituting sunflower oil and rapeseed oil with fish oil. The ratios between the n-6 and n-3 fatty acids in the 5 groups were: 12.4:1; 5.0:1; 1.8:1; 0.9:1 and 0.3:1.

From the groups with n-6:n-3 ratios of 12.4:1; 5.0:1 and 0.3:1 five females were milked twice on days 2 and 28 of the lactation. Kits from each of the litters were killed as newborn and 28 days post partum. Adipose tissue from these kits were sampled. Fat

from all samples was extracted with supercritical fluid extraction (SFE). The fatty acid composition was analyzed by gas chromatography.

The fatty acid composition of the feed showed a decreasing amount of linoleic acid and an increasing amount of DHA and EPA when the amount of fish oil was increasing. The fatty acid composition of milk showed the same pattern, which indicates that the fatty acid profile of the milk is very dependent of the fatty acid profile of the diet. The fatty acid composition of the adipose tissue was similar to the fatty acid composition in the milk. There was a higher proportion of EPA and DHA as well as a lower content of linoleic acid in the adipose tissue of the kits from females fed a diet with an n-6:n-3 ratio of 0.3:1 than from those fed a ratio of 12.4:1.

*Annual Report 2003, 67-74, 8 figs, 6 tables, 18 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

#### **Protein content in feed for mink females and kits**

*T. Clausen, C. Hejlesen, P. Sandbøl*

The requirement of protein to mink dams and kits in the early growing period was investigated. In the investigation we used 6 groups each consisting of 130 scanglow mink dams. The dams in groups 1 – 5 were fed with 30 percent of the metabolisable energy (ME) from protein in the period December to February 24, whereas group 6 received this feed until April 20. In the gestation period we used 45 percent of ME from protein in groups 1 - 5. From April 20 and until the kits were 56 days of age, they were feed 50 (group 1), 45 (group 5 and 6), 40 (group 2) and 30 (group 3) percent of ME from protein. In the group 4 we feed 30 percent until May 28 and then raised the level to 40 percent of ME.

The results showed that 30 percent of ME from protein was enough in the lactation period until the kits starts to eat, thereafter the protein content should be increased to fulfil the needs of the kits in the first part of the growing period. 40 percent of ME from protein was enough in the whole lactation period and the early growth. The disappointing results from kits feed 45 percent of ME from protein could not be explained.

*Annual Report 2003, 75-79, 1 fig, 7 tables, 4 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### **Blood meal to mink kits in the growing – furring period**

*T. Clausen, C. Hejlesen*

There are different blood products on the market for mink feed. The amount of blood products with a low protein digestibility is increasing, due to increased demands on sterilisation of the blood. In the growing furring period 2002 we made some investigations on two different blood products Blossol (protein digestibility 90) and blood meal (protein digestibility 64). We used 4 groups each consisting of 120 male and 120 female scandbrown mink kits. Blossol was used in three groups with 2, 4 or 6 percent, and blood meal was used in one group with 6 percent.

The increase in body weight from start of the investigation till September was reduced with increasing Blossol in the feed and 6 percent blood meal had the lowest body weight increase. The total body weight gain from start to pelting showed the same tendency, and the resulting skin length was highest in the group feed 2 percent Blossol, significantly shorter in groups feed 4 and 6 percent Blossol and shortest in the group feed 6 percent blood meal. The balance between the essential amino acids Ile/Leu and Arg/Lys varied between groups. This could possibly be an explanation to the reduction in body weight gain in the Blossol groups. However it cannot explain the very low production results in the group feed blood meal.

These results show that under these circumstances we can only use small amounts of blood products in the feed for mink.

*Annual Report 2003, 81-84, 1 fig, 6 tables, 4 refs. Danish Fur Breeders Research Center, Holstebro, Denmark*

### **Poultry offal to mink in the growth period combined with meat and bone meal and swine pulp in the furring period**

*T. Clausen, C. Hejlesen*

In the growing period 2002 we investigated the use of poultry offal in mink feed, further we investigated combinations of poultry offal, meat and bone meal and swine pulp in the period September to pelting. We used nine groups each consisting of 125 Scanblack male and 125 female mink kits. From July 10 to September we used 30, 40 or 50 percent poultry offal in the feed. Thereafter we used, either 30, 40 or 50 percent poultry offal alone, or in combinations with 3 percent meat and bone meal and 6% swine pulp, or 6 percent meat and bone meal and 9% swine pulp. The results showed that we can use 30, 40 or 50 percent poultry offal in the feed for mink kits in the whole period from July to pelting, without any consequences for the size of the skins but the skin quality was reduced with increasing poultry offal. If we further used meat and bone meal and swine pulp from September 6 until pelting, there was no consequences for skin size up to 40 percent poultry offal in combinations with 6 percent meat and bone meal and 9% swine pulp. We could also use up to 50 percent poultry offal in combinations with 3 percent meat and bone meal and 6% swine pulp. Though the skin quality was reduced with increasing meat and bone meal and swine pulp.

*Annual Report 2003, 85-89, 7 tables, 5 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### **Amino acid profiles in the growing and the furring period of mink (*Mustela vison*)**

*P. Sandbøl, T.N. Clausen, C. Hejlesen*

The optimal amino acid profile of an ideal protein changes with the demand for different manifestations of life (gain, maintenance, reproduction and lactation). Whole body amino acid profiles have been shown to be a good basis for the determination of the amino acid profile of the ideal protein. An attempt was made to produce three feeds for the growing and respectively the furring period of mink (*Mustela vison*) based on the amino acid profiles of the present norm for mink (Mn), cat (Kn)

and respectively mink milk (Mm) and the whole body composition of mink (Mk). This resulted in 3 different amino acids profiles for each of the two periods, although not quite as intended. The feeds were fed to 3 groups of 50 full sibling male mink kits each (Scanbrown), during the growing period and accordingly during the furring period.

In the growing period we did not achieve the planned profiles, as the amino acid content of the slaughter offal used, deviated considerably from the table values. There was a higher content of the amino acids cystine and threonin in the group Kn than in the groups Mm and Mn. Group Kn had a significantly ( $p < 0,003$ ) higher gain (1027 g) than the groups Mm og Mn (922 g respectively 946 g) in the period from July to September 4th. From September 4th and to the 26th - standard feed kitchen feed was used. In this period the groups Mm and Mn compensated for this difference by a significantly ( $p < 0,0001$ ) better weight gain than group Kn. There was no difference between the groups with regards to skin length and fur quality.

In the furring period the groups Mk and Kn had significantly better ( $p < 0,005$ ) live weight gain (626 g and 660 g) from September to pelting as compare to group Mn (544 g) and significantly ( $p < 0,02$ ) longer pelts (Mk, 87.5 cm; Kn, 87.3 cm) as compared to Mn (86.3 cm). There was no significant differences with regards to fur quality, colour, silkyness or wool quality. Group Mk had significantly ( $p < 0,003$ ) less red furs.

The results indicated that an amino acid profile different from the present norm may give equal or better performance results. Further, that the requirement for methionine per se in the furring period is not above 0.31 g digestible/MJ and that 22 % of the metabolizable energy from protein could be sufficient in the furring period.

*Annual Report 2003, 91-96, 8 tables, 10 refs. Danish Fur Breeders Research Center, Holstebro, Denmark*

### **Methionin and other methyl donors to mink in the furring period**

*T. Clausen, P. Sandbøl, C. Hejlesen*

A preliminary investigation on the possibility of replacing some of the methionin in the minkfeed with Methionin Hydroxy Analog (MHA) or betain was performed. We used tree groups each consisting of 120 male and 120 female scanbrown mink kits. Until September 6 a standard feed kitchen diet was feed. The trial feed was based on a basal feed containing 29 percent of metabolizable energy from protein, but a level of methionin 20 percent below the norm. To this feed we added dl-methionin (MET), MHA (MHA) or betain (BET).

Replacing some of the methionin with beatin or MHA had no negative consequences for pelt length. There was an increase in fur quality by replacing some of the methionin with betain. The BET group had the same pelt length and better fur quality than the MET group. This could indicate that the requirement of methionin for fur growth is fulfilled at 0,13 g digestible methionin / 100 kcal, if there is a sufficient amount of methyl groups / cystin in the feed.

*Annual Report 2003, 97-100, 5 tables, 8 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### **Digestibility of different sources of starch**

*C. Hejlesen, P. Sandbøl*

The increasing environmental restrictions can make it necessary to reduce the dietary protein content. Hence, the focus on carbohydrates increases. In an experiment we focused on the glycemic index and starch digestibility in 7 different starch sources. We were not successful in determining the glycemic index, and the method used for analysis of starch content was insufficiently accurate.

Among the tested starch sources, different digestibility of crude carbohydrate was measured. But it is not revealed whether this was caused by processing and storage or different contents of NSP or amylose and amylopectine composition of the starches.

*Annual Report 2003, 101-104, 1 fig, 2 tables, 6 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

**Reduced protein and amino acid profiles in the growing/furring period of mink (*Mustela vison*). Influence on health, growth and fur quality**

*P. Sandbøl, T.N. Clausen, C. Hejlesen*

6 groups of Scanbrown mink each 120 males and 120 females were given feed with different protein levels and amino acid profiles from July to pelting. The control group (K29) fulfilled the norm for amino acids using typical raw materials. One group with 25 % of ME from protein (F25, ) fulfilled the norm for amino acids (after addition of methionin). From the F25 feed, two feeds containing respectively 29 % (F29) and 33 % (F33) of ME from protein were produced, with the same amino acid balance. To the same feed (F25) a mix of non-essential amino acids (gly - glu) were added up to a content of 29 % of ME from protein (F25+4). One group (F29S) were fed as F25+4 from July to September and thereafter as F29 until pelting.

The groups K29, F25, F29 and F25+4 had significant better weight gain ( $p < 0,0008$ ) from July to September 4th, compared to the groups F33 and F29S. Group F29S were fed the same feed as F25+4 in this period and the observed difference can not be explained on basis of the treatments. From September 4th to the 26th the other groups compensated for the difference in weight gain. Live weight gain from September 26th to pelting was significant better in group K29 ( $P < 0,0001$ ) in comparison with the other groups. This difference was so marked, that it resulted in a significantly higher gain from July to pelting in group K29 ( $p < 0,0001$ ). Possible reasons for this difference are discussed.

Group K29 had significant ( $p < 0,0001$ ) longer pelts than the other groups. For the groups F25, F29 and F33 group F29 had significant ( $p < 0,0001$ ) longer pelts than group F33 and group F25 was intermediate to these two groups.

Group F29S had significantly ( $p < 0,002$ ) lower pelt quality than the other groups. K29 had significantly ( $p < 0,0006$ ) lighter pelts than the other groups. Group F33 had significantly more silky pelts in

comparison with the groups F25, F29, F29S and F25+4 and more pelts with heavy wool.

*Annual Report 2003, 105-110, 1 fig, 7 tables, 4 refs. Danish Fur Breeders Research Center, Holstebro, Denmark*

**Reports on: Physiology and analytical techniques**

**Amino acid imbalance in mink feed in the growing period – Influence on the liver**

*P. Sandbøl, T.N. Clausen, C. Hejlesen, J.B. Andersen, B.M. Damgaard*

Two trials have been carried out, to clarify the consequences of varying the essential amino acid (EAS) to total amino acid (TAS) ratio in mink feed during the growing furring period. The focus of the present paper will be the preliminary interpretation of the results of the analysis carried out on the livers of a representative number of the pelted animals.

Significant differences ( $p < 0.05$ ) were found between treatments in the hepato somatic index (HSI). No significant differences were found for glycogen. When expressed per gram of tissue, there was a significant ( $p < 0.05$ ) difference between treatments of DNA, free fatty acids (FFA), and triacylglycerol (TAG). When expressed per mg of DNA, there was a significant difference ( $p < 0.05$ ) between treatments of protein and glucose.

The results are discussed in relation to their validity, their relevance in relation to the enzymatic capacity of the mink liver and to general performance results.

It is concluded, that usage of liver parameters requires a standardised procedure for euthanasia and liver sampling, more so for some parameters (glycogen and possibly FFA) than for others. That the HSI must be interpreted with caution. Excess of amino acids may cause swelling of the hepatocytes and possibly alter the amount of hepatic enzymes and thereby the total gluconeogenic capacity of the mink liver. The mink has a high gluconeogenic capacity, seen as an increased glucose content per hepatocyte with an increased excess/imbalance of amino acids. Liver parameters may be helpful in explaining performance results such as weight gain and pelt quality.

*Annual Report 2003, 111-118, 4 figs, 3 tables, 33 refs. Danish Fur Breeders Research Center, DK-7500, Holstebro, Denmark.*

### **Investigation in organ size in big mink**

*T. Clausen*

For three consecutive years, 1999 to 2001, we investigated the organ size of light and heavy male mink kits, in a breeding group selected for body size. The kits were weighed and measured, the organs were taken out and weighed. The relative weight of the organs compared to the body size, metabolic body size ( $\text{kg}^{0.75}$ ), pelted body size and pelted body length were calculated.

When selecting mink for heavy body size in November, the kits get a little longer but they especially get fatter. The total body weight of the mink had a greater influence on the size of the pelt than the length of the body. The length of the bones in the legs, follow the body length, but the weight of the bones follow the metabolic body weight. Selecting fat animals increased organ size compared to body length, but compared to total body weight the lean mink has the heaviest organ weights. Compared to metabolic body weight there was no difference between heavy and light mink in the weight of the organs, except for length of the intestine. There was a significant difference between years due to the fact that the animals in both groups got heavier.

*Annual Report 2003, 119-122, 4 figs, 1 table, 3 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### **Conversion factors for estimation of amino acid digestibility from the digestibility of crude protein**

*C. Hejlesen*

Data from 63 digestibility trials (8 of vegetable- and 55 animal origin, consisting of respectively 4 and 29 ingredients in the Råvaretabel) were used to calculate formulas for estimation of the apparent digestibility of the amino acids (ADAA) as a function of apparent digestibility of crude protein (ADP).

There was a correlation between ADP and ADAA for 10 amino acids regard less of the ingredient type. For the remaining 8 amino acids the correlation were influenced by ingredient type. The correlation between ADP and ADAA for some amino acids in some ingredients did not fit into the general correlation.

The presented formulas should only be used to estimate the apparent digestibility of amino acids, until results from digestibility trials is available.

*Annual Report 2003, 123-128, 2 figs, 1 table, 2 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

### **Development of analytical methods for characterisation of starch**

*C. Bjerregaard, C. Christiansen, K. Mortensen, H. Sørensen*

Development of analytical methods for characterisation of starch in mink feed and faeces have comprised a colorimetric method and a method based on an enzymatic degradation of starch in combination with HPCE analysis of the obtained products. The colorimetric method showed good correlation between colour response and increasing concentration of starch ( $r^2$  close to 1). The method was thus applicable for quantitative determination of starch, provided knowledge to the origin of starch. Information of structural variation of the starch fractions was obtained by the enzymatic method, based on a heat resistant  $\alpha$ -amylase Termamyl and isoamylase, prior to HPCE analyses of oligosaccharides released. Results obtained showed considerable variation with respect to peak pattern in electropherograms, indicating structural differences in the amylopectin fraction.

*Annual Report 2003, 129-140, 11 figs, 6 tables, 18 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.*

**Reports on: Health****Detection and sequence analysis of Danish and Swedish strains of mink astrovirus**

*C. Mittelholzer, L. Englund, K.-O. Hedlund, H.-H. Dietz, U. Hellman, G. Czifra, L. Svensson*

The sequences of mink astroviruses collected from 11 farms in Denmark and Sweden were analysed and found to be homologous with one another but different from those of other astroviruses. A species-specific reverse transcriptase-PCR for mink astrovirus was established and shown to be suitable for detection of the virus in clinical samples.

In contrast, further attempts are needed to produce and characterize a recombinant mink astrovirus capsid protein which is inevitable for development of serological methods or experimental vaccines in order to control the infection.

*Annual Report 2003, 141-148, 3 figs, 10 refs.  
Danish Fur Breeders Research Center, Holstebro,  
Denmark.*