

Table 3. Average kit weights at the age of 28 and 42 days. (SD in parenthesis). Different letters indicate significant difference between groups. NS=non significant.

Feed group	Mean body weight, g			
	Age 28 days		Age 42 days	
	Males	Females	Males	Females
AD LIB	166 (37) a	150 (35) a	269 (75)	253 (64)
RESTR	154 (35) b	138 (35) b	259 (69)	239 (65)
P value	0.0009	0.004	NS	NS (p=0.1)

Female body weight, g

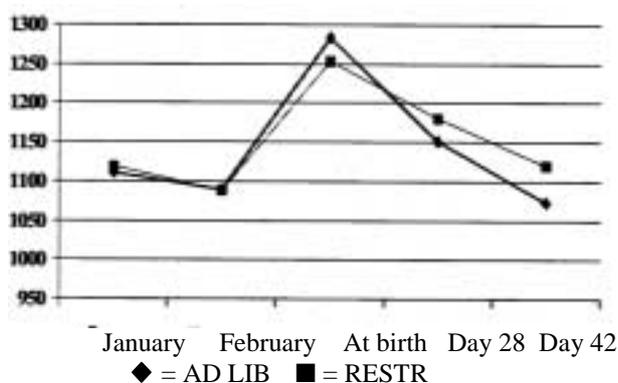


Fig. 3. Females fed *ad libitum* or restrictive: average body weights in the winter and during lactation 2000.

It was concluded that the feed intensity of the females in the gestation period was important for the milk production in the lactation period.

Annual Report 2000, 51-54. 4 tables, 2 figs., 4 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

Addition of phosphoric acid or ammonium chloride to mink feed in June. Influence on urine pH and body growth.

T.N. Clausen

Urine pH and body growth were investigated in mink kits in a 17 days period from weaning June 13 to June 30. Four groups of each 10 litters of wild type mink kits borne May 1 were used. 0,2 % phosphoric acid (75%) was added daily to the feed in group PSYRE, 0,35 % ammonium chloride was added daily to the feed in group AMMDGL, 0,35 % ammonium chloride was added three days a week to the feed in group AMM3 and one group served as control (KONT).

A daily addition of 0,35 % ammonium chloride in the period June 13 to June 30 gave a non-significant reduction in the kit body growth. 0,35 % ammonium chloride in the feed reduced the urinary pH to around 6.0. On the days where there was no ammonium chloride in the feed of group AMM3, the urine pH was on the same level as in the KONT group. 0,2 % phosphoric acid did not lower the urinary pH compared to the control group.

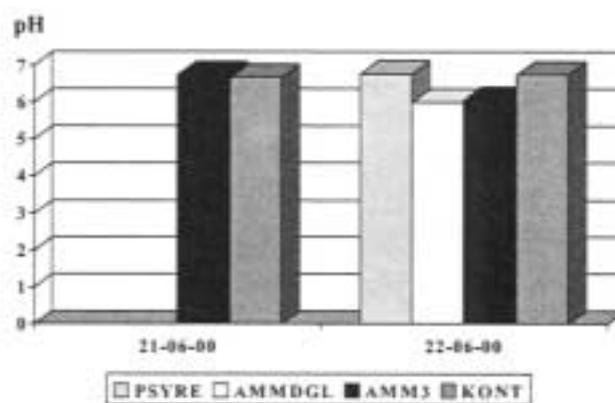


Fig. 1. Urine pH of mink kits fed plane control feed (KONT), or control feed with 0.2% phosphoric acid (PSYRE), or 0.35% ammonium chloride each day (AMMDGL) or 0.35% ammonium chloride 3 days a week (AMM3). At day 21/06 only groups KONT and AMM3 were sampled. Ammonium chloride was not added to the feed of group AMM3 on June 21.

Annual Report 2000, 55-57. 3 tables, 1 fig., 8 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

Shelf life of sulphuric acid- and Ensilox-preserved fish silage.

T.N. Clausen, C. Hejlesen

The shelf life of sulphuric acid and Ensilox-preserved fish silage were investigated. The silage were produced in May from the same fish lot, and the products were analysed regularly until mid-October.

The shelf life of Ensilox-preserved fish silage seemed to be lower than that of sulphuric acid-preserved fish silage. It is suggested that Ensilox-preserved fish silage should be used within 3 months after production.

Annual Report 2000, 59-60. 5 tables, 1 ref. Danish Fur Breeders Research Center, Holstebro, Denmark.

Sulphuric acid- and Ensilox-preserved fish silage for mink in the growing-furring period

T.N. Clausen, C. Hejlesen

A study was done on sulphuric acid- and Ensilox-preserved fish silage for mink in the growing-furring period 1999.

Nine groups, each consisting of 81 wild type male mink kits and 81 wild type female mink kits, were used. In the growing-furring period the kits were fed 4, 8, 12, 16 or 20 % fish silage preserved with sulphuric acid or 4, 8, 12 or 16 % fish silage preserved with Ensilox (based on formic acid).

The results showed that mink kits fed up to 16 % Ensilox-preserved fish silage in the growing-furring period attain the same skin size and quality as mink kits fed up to 20 % sulphuric acid-preserved fish silage. However, there was a tendency towards reduced skin quality when we used 16 % Ensilox-preserved silage in the feed. The blood percent was lower in the groups fed Ensilox-silage compared to the groups fed sulphuric acid silage, and there was a reduction in the blood percent with increasing amount of silage in the feed (Fig. 2).

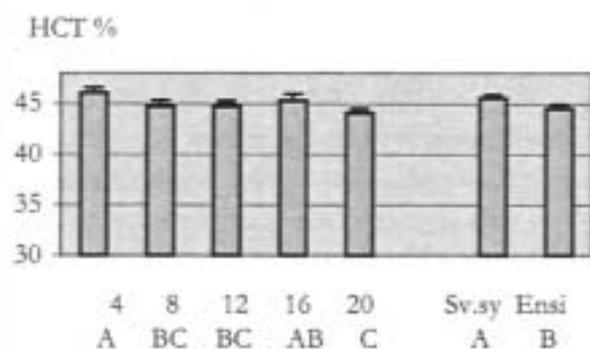


Fig. 2. The mean blood percent of mink (and SE) in relation to the amount of silage (4-20 % of silage in feed), or the type of silage (Sv.sy = sulphuric acid silage, Ensi = Ensilox silage) in feed. Different letters indicate significant differences between groups.

Annual Report 2000, 61-65. 6 tables, 2 figs., 4 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

Rape lecithin+ for mink in the growing-furring period.

T.N. Clausen, C. Hejlesen

Rape lecithin+ (R+) is a new commercial product based on phospholipids and fatty acids extracted from rape- and sunflower oil. The product has a high content of gamma-tocopherol and choline, and should be able to replace the addition of these in the vitamin premix. Six groups, each of 81 male and 81 female mink kits were fed in the growing-furring period with the addition of around 8,5 % fat. Fat was added as R+, soybean oil (SOY), lard (SV), 2/3 SOY & 1/3 SV, 1/2 R+ & 1/2 SV, or 1/2 R+ & 1/2 SOY. Rape lecithin+ alone or in combination with soybean oil or lard, reduced body weight and skin size, and can not be recommended for mink kits in the amounts used in this investigation.

Annual Report 2000, 67-71. 7 tables, 5 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

Toasted soya beans for mink in the growing – furring period.

C. Hejlesen, T.N. Clausen

Toasted soybean is an attractive source of protein as price is not influenced by demand for mink feed. Trypsin inhibitors (anti nutritional factors, ANF) in soy beans is markedly eliminated by heat treatment (toasting), but moreover soy beans contain oligo-saccharides and other ANF, which limits the use of it in mink feed. Experiments, where the fish content was varied strongly, indicated that toasted soybeans ought not to comprise more than 4-8% of the feed in the growth period. In this experiment 7 groups of 81 male- and 81 female scanbrown mink were allotted up to 9% toasted soybeans in feed containing three levels of fish-offal and industrial fish (12.5, 17.5 and 22.5% fish) and constant level of these (17.5%).

It is concluded, that more than 3% toasted soybean had a depressive effect on weight gain until late September, on weight at pelting in November and on skin length. Fur quality was not affected significantly, but the wool density was significantly reduced when 9% toasted soybeans was fed.

Weight gain, g

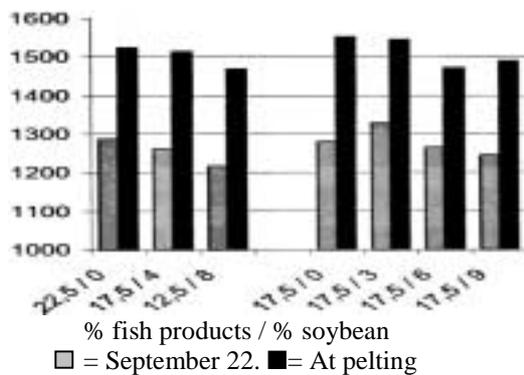


Fig. 1. Body growth in grams from weaning to September 22 and to pelting. Reduced growth with increasing amount of toasted soybean. No significant differences.

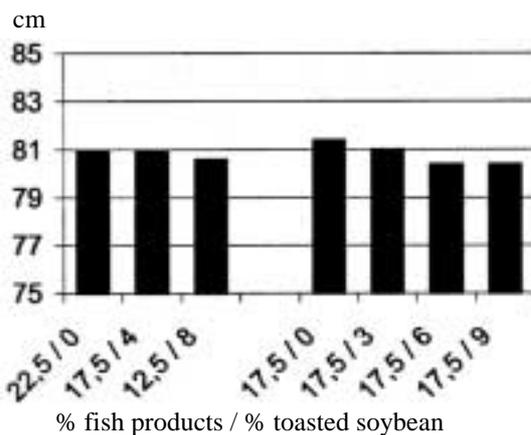


Fig. 2. Skin size in cm. Indication of reduced skin length with increasing % of toasted soybean in the feed.

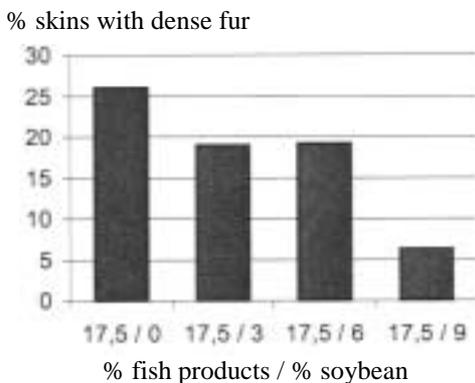


Fig. 3. Significantly fewer skins with dense fur when 9% soybean was used in the feed. ($p < 0.004$).

Annual Report 2000, 73-76. 2 tables, 3 figs., 3 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

Phase feeding of mink in the growing - furring period

C. Hejlesen, T.N. Clausen

A reduced protein content from 29 to 24% of the ME in the growth period feed from mid September has in several investigations not influenced skin length or fur quality. In these investigations fat energy has substituted energy from protein. In this experiment energy from protein was substituted by energy from either fat or carbohydrate starting at three different dates in the growing-furring period. In conclusion, substituting energy from protein either with energy from fat or carbohydrate had no effect on weight gain, skin length or fur quality.

Annual Report 2000, 77-80. 5 tables, 7 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

Analytical and calculated EFLC separation of intact oils / lipids (triacylglycerols) as methods for evaluation of oil / fat quality

S. Buskov, K. Mortensen, H. Sørensen

Enhanced Fluid Liquid Chromatography (EFLC) based on acetonitrile:2-propanol:CO₂ as eluent is described for direct analysis of intact triacylglycerols in different vegetable and animal oils. The EFLC method, like HPLC and SFC, is suitable for qualitative analyses for these oils and gives an overall good separation of the individual triacylglycerols with additional sub-separation in groups defined by carbon number (CN), number of double bonds (DB) and equivalent carbon number (ECN). A linear correlation between $\log k'$ and CN, and also between $\log k'$ and ECN is found which enables prediction of the retention times of individual triacylglycerols with good accuracy. Predicted and determined capacity factors for combinations of triacylglycerols from palmitic acid (P), stearic acid (S), oleic acid (O), linoleic acid (L), linolenic acid (Ln) and erucic acid (E) are reported using a correction constant, g_i , which depends on the type of unsaturated fatty acid.

Annual Report 2000, 81-94. 3 tables, 11 figs., 18 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

Investigation of dry matter content in mink milk

C. Bjerregaard, T.N. Clausen, K. Mortensen, H. Sørensen, S. Sørensen

Determination of individual constituents in mink milk is generally expressed in % of dry matter (DM) in the milk. The interval of DM content reported for mink milk has, however, varied considerable in different investigations, leading to a need for further evaluation of these differences. In the present study, the DM content in mink milk obtained from 4 different lactating years (1997, 1998, 1999, 2000) has been determined by lyophilisation. Moreover, selected samples were reanalysed by a standardised AOAC method (Air oven method). The results obtained revealed only minor differences in DM level determined by the two methods tested. Mink milk has been shown to have a considerably higher content of DM compared to the DM content in milk from other animals. The variation in DM content was marked both between different animals, and during the lactating period for individual animals. The now obtained results have been compared and discussed in relation to data from earlier studies on DM in mink milk.

% DM

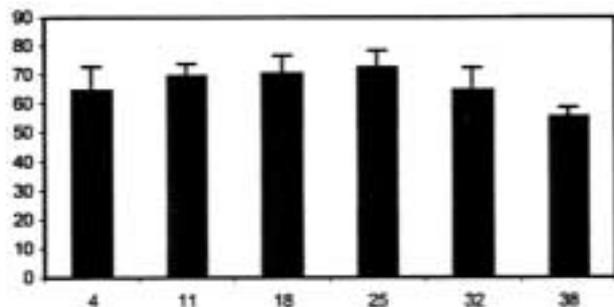


Fig. 1. Variation of dry matter content in mink milk from day 4 to day 38 in lactation. Each bar is a mean of 10 females. Standard deviation marked on the top.

Annual Report 2000, 95-98. 2 figs., 9 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

New methods of analysis for characterization of lipids in mink feed and studies of lipid metabolism.

C. Bjerregaard, S. Buskov, K. Mortensen, H. Sørensen, J.C. Sørensen, S. Sørensen

Lipids, vegetable oils and animal fat are quantitatively dominated by triacylglycerols, but this group of lipids comprises also appreciable amounts of amphiphilic compounds, especially phospholipids, as well as nutritional important groups of compounds as fat-soluble vitamins, phytosterols, and antioxidants. Considering the quantitatively dominating part that lipids form of most of the traditionally used mink feed, it is obvious that efficient methods of analyses for determination of individual intact lipids are of outmost importance. Such methods are wanted for correct information on the lipid quality, potential risk of rancidity, content of native intact lipids, triacylglycerols and phospholipids. Methods based on Supercritical Fluid Techniques (SFT) give opportunities for quantitative and selective extraction of triacylglycerols by Supercritical Fluid Extraction (SFE) followed by extraction of amphiphilic lipids (phospholipids) by use of SFE with modifier. With Supercritical Fluid Chromatography (SFC) individual intact triacylglycerols are well separated and give a supplement to traditionally used gas chromatographic (GC) analyses of fatty acid methyl esters (FAME), which are transformation products of triacylglycerols. The new and recently obtained improved techniques for lipid analyses are Enhanced Fluid Liquid Chromatography (EFLC) supplied with Evaporative Light Scattering Detection (ELSD). This new method of analysis allows determination of individual intact lipids (triacylglycerols) with prediction of the type of fatty acids in the compounds, and the technique is relatively simple to perform. The potential value of this technique is shown by the results included and discussed in this work, and it gives the basis for studies of lipid metabolism, which is a poorly investigated area of the mink research.

Annual Report 2000, 99-105. 1 table, 9 figs., 9 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

Reports on: Hair and skin

Fibroblast stem cells from mink grown *in vitro* cell cultures – a smart and cheap tool for skin research and testing of feed additives.

B. Riis

This study shows that it is possible to grow mink skin fibroblasts in primary culture. It was also found that the primary culture could be serially passaged thus establishing a stable subculture population designated MiS-1. It was shown that MiS-1 could be

stored at -196°C , thawed and further propagated. Capillary zone electrophoresis (CZE) analysis showed that samples from skin of very young mink kits and the MiS-1 essentially contained the same proteins. This shows that the skin fibroblast cells are valid models for mink skin research. Furthermore, testing of various substances (i.e. hormones, feed additives etc.) can be performed on such a skin model thus saving time and money.

Annual Report 2000, 107-111. 3 figs., 3 refs. Danish Fur Breeders Research Center, Holstebro, Denmark.

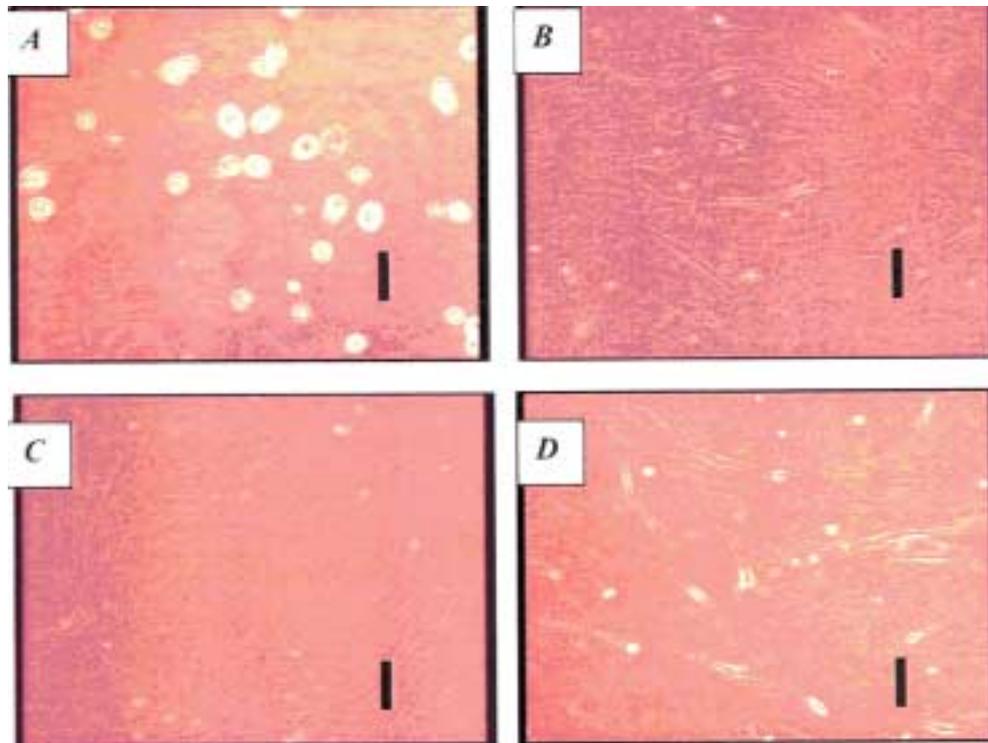


Fig. 1. Mink skin fibroblasts, MiS-1, in culture, (100 x). A new culture, B after 24 hours, C after 48 hours, D after 6 weeks. The dark scale at lower right corner = 0.1 mm.

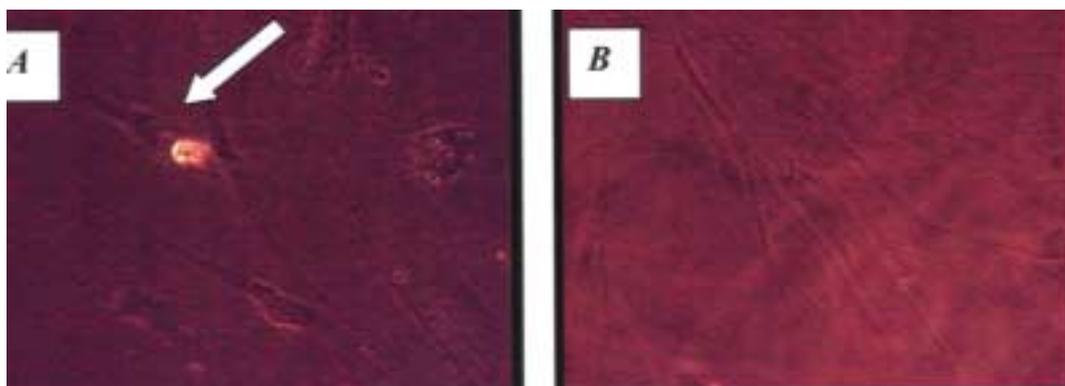


Fig. 2. Mink skin fibroblasts, MiS-1, (300 x). A: A dividing cell (arrow), B: Slim characteristic of fibroblasts.

Relationship between pelt colour in brown mink characterised with traditional methods and with colour measurements

P.V. Rasmussen, P. Berg

In mink production the shade of a certain coat colour can be controlled or modified by selection. In praxis, this is based on traditional, visual methods, meaning that differences between grades are relative. The question is whether absolute colour measurements applied to live animals and their pelts can complete the visual grading and the genetic knowledge based on it. We used visual and colorimetric methods separately to describe the fur colour of brown mink from a selection experiment (live animals and stretched, dried pelts). This paper presents correlations between visual colour intensity, clarity, and colorimetric lightness, red, yellow, and chroma (saturation). The results show that it is possible to characterise the colour of both sexes of live brown mink and the pelts with objective and nondestructive methods. Further, visual and colorimetric variables are correlated with each other to different degrees.

Table 3. Correlation of colorimetric L*, a*, b* and C* between live animals (A) and skins (S). Males (N = 206) over, and females (N = 184) under the diagonal.

	L* (A)	a* (A)	b* (A)	C* (A)	L* (S)	a* (S)	b* (S)	C* (S)
L* (A)		0.34	0.48	0.45	0.32	0.20	0.23	0.23
a* (A)	0.31		0.92	0.96	0.51	0.63	0.59	0.60
b* (A)	0.50	0.89		1.00	0.51	0.50	0.51	0.52
C* (A)	0.46	0.94	0.99		0.52	0.54	0.54	0.55
C* (A)	0.36	0.58	0.54	0.56		0.60	0.72	0.70
a* (S)	0.19	0.65	0.54	0.58	0.57		0.94	0.97
a* (S)	0.25	0.62	0.57	0.59	0.71	0.92		1.00
C* (S)	0.24	0.64	0.57	0.60	0.69	0.95	1.00	

Table 4. Correlation between visual grading of colour and clarity and colorimetric variables L*, a*, b* and C* on live animals. Males (N = 237) over, and females (N = 256) under the diagonal. ns = non significant, p \geq 0.05.

	Colour	Clarity	L*	a*	b*	C*
Colour		-0.15	-0.17	-0.37	-0.36	-0.37
Clarity	-0.19		-0.07ns	0.60	0.41	0.46
L*	-0.21	0.03 ns		0.27	0.43	0.40
a*	-0.40	0.63	0.26		0.92	0.96
b*	-0.42	0.45	0.44	0.90		0.99
C*	-0.42	0.51	0.40	0.94	0.99	

Annual Report 2000, 113-116. 5 tables, 6 refs.
Danish Fur Breeders Research Center, Holstebro,
Denmark.

Reports on: Pathology & Diseases

Pre-weaning diarrhoea and exanthema in mink kits in Sweden and Denmark - A case control study of possible causative agents and contributing factors.

L. Englund, H.-H. Dietz., M. Chriél, K.-O. Hedlund

Pre-weaning diarrhoea and exanthema ("greasy kits") is frequently observed in farmed mink kits. Previous studies have often suggested that this is a multifactorial disease complex but histopathological studies have also suggested an underlying viral infection. In this study intestines and intestinal contents from 180 mink kits, in affected and non affected farms, were examined by electron microscopy and histopathology. Epidemiological data were also collected. Preliminary results indicate that there may be a correlation between the presence of, as yet unidentified, virus and the occurrence of "greasy kits" in the 18 Swedish and Danish mink farms included in the study. More detailed studies of the observed virus-like particles are currently made in co-operation with experts on the identification of small enteric viruses in humans. Efforts are also made to try and isolate the observed viruses in different cell cultures, bearing in mind that *in vitro* growth of such viruses is often difficult before suitable media and cell lines are identified. Some of the human enteric viruses cannot be cultured at all, others will multiply only in particular cell lines. Nevertheless, virus culture is the preferred way to identify virus and to develop test methods which allow epidemiological studies on a larger scale. Should propagation in culture prove impossible, direct sequencing of the viral genomes will be applied.

Annual Report 2000, 117. Danish Fur Breeders
Research Center, Holstebro, Denmark.