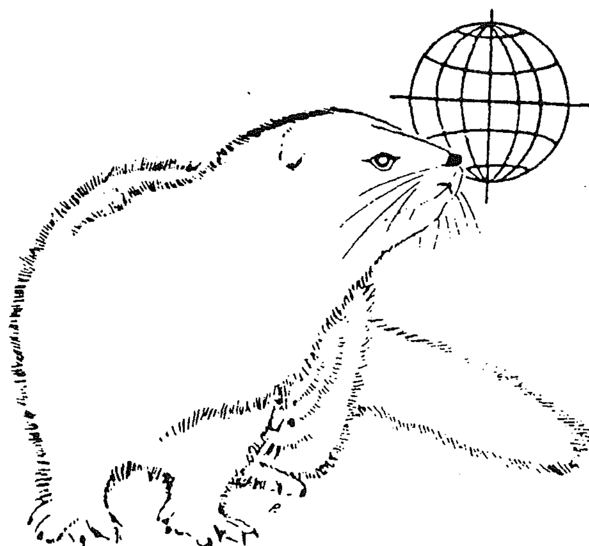

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Notes
SCIENTIFUR
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In the northern hemisphere it has been a wonderful springtime in two ways. Firstly, the actual springtime when the wonderful sun won over the Olympic winter which was one of the coldest in many years, and secondly the fantastic springtime in skin prices promising that we can now say good-bye to the longest and coldest economic winter in the history of fur industry.

Hopefully, all parties have learned from the crisis and are now better equipped to avoid future crises.

We hope that this economic spring will also influence the situation of IFASA/SCIENTIFUR positively with regard to prompt payment of the very delayed invoices now sent out to members and/or subscribers. We also hope that many people and organizations will regard SCIENTIFUR as the natural replacement for the sources of information which, because of the crisis, do not exist any more.

Although many consider a lot of the information given in SCIENTIFUR to be too scientific in relation to the information desired, it still holds a lot of practical information, and will bring its readers in contact with people and organizations involved in fur animal research and advisory services.

If organizations or larger groups of fur breeders want to test the value of SCIENTIFUR themselves, we will be pleased to arrange a 6-months subscription against payment of the actual additional costs for production and mailing of the journal. Single samples copies for information are available without any costs.

Again in 1994 we thank the Council of European Fur Breeders' Associations (CEFBA) for supporting IFASA/SCIENTIFUR so strongly that the economic basis for production and distribution of SCIENTIFUR is secured. It is still our hope eventually to have so many subscribers that we can become financially independent and maybe even find the economic power to produce a real, printed journal with good illustrations.

Under Notes in the former issue of SCIENTIFUR we advertized the updated electronic version of our INDEX. We wonder why we have received so few orders for new as well as updated indexes. IF YOU REALLY NEED TO FIND SCIENTIFIC AND TECHNICAL INFORMATION REGARDING FUR ANIMAL PRODUCTION, THERE IS ONLY ONE SOURCE, I.E.: SCIENTIFUR and the SCIENTIFUR INDEX which after updating cover the majority of all information regarding fur animals from 1960 until December 1993. Please send you order with prepayment as soon as possible.

In the next issue of SCIENTIFUR we hope to be able to start publishing a series of reports regarding results of the very comprehensive research regarding domestication of fur animals performed over many years by our colleagues at the Institute of Cytology and Genetics, Novosibirsk, Russia.

The intention is for all these results to end up in a booklet giving an updated summary of the effect of domestication etc. The main title of the series and the booklet will be: "Evolutionary-genetic and genetic-physiological aspects of fur

animal domestication". We thank all our dear colleagues in Novosibirsk for giving SCIENTIFUR the opportunity to be the channel for this very important information and draw your attention to the following letter to the editor.

We know from many direct contacts that Poland, Russia, and China are seriously interested in having the book, BEAUTIFUL FUR ANIMALS - AND THEIR COLOUR GENETICS, translated into their own languages and distributed in large quantities in the respective countries. We of course consider this SCIENTIFUR production to be a very central and unique contribution, and we sincerely hope that the economic basis for the production in the countries mentioned will be found.

Also in this issue of SCIENTIFUR you will find a relatively large number of original reports. It seems that not only is SCIENTIFUR filling the position as the leading source of information in abstracts and newsletters, but also for original scientific and technical reports our position is becoming still stronger - a position we are very proud of.

The board of IFASA will hold a meeting in the Netherlands on November 10-12, which also the representatives of the working groups will attend. If you have any comments regarding the activities of IFASA, please contact the president, Einar J. Einarsson, or other representatives of the board incl. the undersigned secretary of IFASA. Please note Einar J. Einarsson's new address, telephone and fax numbers as stated on the first page of the present and coming issues of SCIENTIFUR.

We wish all our readers and contributors a very good summer.

Best regards,

Your editor

Dear Dr. Gunnar Jørgensen,

This letter has been prompted by the information Dr. Osadchuk personally gave me. During her visit in Denmark, as she told me, she has discussed possibilities of publishing in English one of our collection of papers with you through Scientifur.

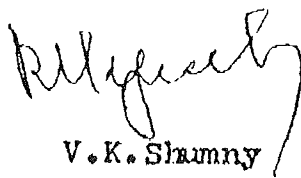
The Institute of Cytology and Genetics is looking forward to cooperation with your Institute in terms of research and publications in English of our results through your Scientifur. As you know, for fifty years experiments with domestication of fur animals have been carried out at this Institute by the late Academician D.K. Belyaev, there are continued by his closest follower Prof. Lyudmila Trut. These studies have gained recognition as priority bioscience research in Russia and, most recently, supported by International SORAS funds, receiving highest ratings by peer referees. I am writing to you because, as I now believe, the Institute will have financial possibilities to organize an English rendering of experimental results with domestication, the collection of papers is entitled "Evolutionary-genetic and genetic-physiological aspects of fur animal domestication".

Dr. Lyudmila Trut join me in my opinion that the above cited collection of papers is the only one, so far, that summarizes our results with domestication of fur animals, already reflected only partly in English, and, hence, worthy of publication in Scientifur. This collection of papers has been published in 1991 at our Institute.

The translation will be done in Novosibirsk and accompanied with new photograps and figures. The relevant material and documentary evidence are under the sole supervision of Dr. Trut who has been also awarded personally the above mentioned SORAS grants.

It will be my pleasure, if you could further establish correspondance or FAX communication concerning the above mentioned publication with Lyudmila Trut of the English version of the above mentioned collection of papers.

Yours sincerely

Director Academician 

V.K. Shumny

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Original Report

Haematological and clinical-chemical status in mink on production farms

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Summary

For three years blood samples were collected at pelting from scanblack male kits on two mink farms. Each year samples were taken from 30 animals at each farm for analysis for selected haematological and clinical-chemical variables. The results showed no clinically significant differences between farms. The variation in the variables examined was larger between years than between individuals and smaller between farms than between individuals. Variations from year to year are supposed to be caused by changes in feed composition from year to year and in natural biological variations. No clinical health problems existed on the farms during the period of investigation.

Introduction

To ensure a good production result on mink farms, one of the factors which must be fulfilled is a good health condition. From practice it is well-known that the production result is negatively affected by outbreak of contagious diseases as well as feed-related diseases. On the other hand, it is uncertain to which extent the production result is affected by subclinical changes of the health condition. By means of haematological and clinical-chemical variables it has been possible to characterize feed related diseases such as nutritional anaemia (*Helgebostad, 1968; Brandt & Mejborn, 1987*), nutritional muscular dystrophia (*Brandt & Henriksen, 1986*) and hereditary tyrosinaemia (*Christensen et al., 1986*). Based on clinical examinations in connection with well defined nutritional diseases, suggestions for an analytical profile for health surveillance on mink farms was prepared (*Brandt, 1992*). The purpose of the present investigation was to describe the basic level of haematological and clinical-chemical variables on mink farms in relation to the health condition on the farms.

Materials and methods

Farms and animals
In 1989, 1990, and 1991 blood samples were collected in connection with pelting on two private mink farms. Each year, blood samples were taken from approx. 30 scanblack male kits on each farm. The two farms used feed from the same feed kitchen.

Blood samples
In connection with pelting, the animals were anaesthetized with Na-pentobarbital (35 mg/kg body weight IP), blood samples were taken by heart puncture, and the animals were killed and weighed.

Table 1 Variables analysed and methods of analysis

Variable		Abbrevation	Method of analysis
Hematokrit		HCT	Manual on hematocrit centrifuge (Hettick)
Hemoglobin		HB	Cyanomethemoglobin method
Mean corpuscular volumen		MCV	Calculated as HCT/ERY (1991) Electronical - Linson counter 431A (1989, 1990)
Mean corpuscular hemoglobin		MCH	Calculated as HB/ERY
Erythrocytes		ERY	Electronical - Linson Counter 431A
Leucocytes		LEU	Electronical - Linson counter 501A
Thrombocytes		THR	Electronical - Linson counter 431A
Differential count of leucocyte		-	Manual, May-Grünwald-Giemsa stained blood smear
Enzymes:	Aspartate-amino-transferase Alanine-amino-transferase Creatine-Kinase	ASAT ALAT CK	Activities determined according to recommendations from Scandinavian Committee on Enzymology (Boehringer-Mannheim GmbH Diagnostica Kits)
Creatinine		CREA	Colorimetrical (Boehringer-Mannheim GmbH Diagnostica Kits)
Urea		UREA	Enzymatical (Boehringer-Mannheim GmbH Diagnostica Kits)
Total protein		PRO	Biuretmethod (Boehringer-Mannheim GmbH Diagnostica Kits)
Iron		FE	Colorimetrical (Boehringer-Mannheim GmbH Diagnostica Kits)
Labil iron binding capacity		LIBC	Colorimetrical (Boehringer-Mannheim GmbH Diagnostica Kits)
Total iron binding capacitet		TIBC	Colorimetrical (Boehringer-Mannheim GmbH Diagnostica Kits)
Proteins		-	Agarose-gel-zone-electrophoresis
Lipoproteins		-	Agarose-gel-zone-electrophoresis
Immunoglobulins		-	Rocketimmunoelectrophoresis in agarose-gel

Whole blood stabilized with K-EDTA was used for the following haematological analyses: Haematocrit, haemoglobin, erythrocytes, leucocytes, thrombocytes, differential count of leucocytes as well as mean corpuscular volume and mean corpuscular haemoglobin for erythrocytes.

Whole blood stabilized with Na-heparin was centrifuged at 3000 RPM for 15 min., separating the plasma from the blood corpuscules. The plasma was used for clinical-chemical analyses of: the activities of the enzymes ASAT, ALAT and CK, creatinine, urea, total protein, iron as well as labile and total iron binding capacity (LIBC and TIBC). The amount of immunoglobulins was determined semi-quantitatively by rocket immunoelectrophoresis. The amount of total protein and the amount of lipoproteins in Na-heparin and K-EDTA plasma, respectively, were separated and classified in different proteins by means of zone electrophoresis (*Carlström & Johansson, 1983*). Afterwards, the electrophoresis bands were quantified by scanning in a dual-wavelength flying-spot scanner (Shimadzu CS-9000). The methods of analysis are described in table 1.

Statistics

The statistical examinations were performed with programmes from SAS Institute Inc., version 6.04. Mean and standard deviations (SD) are calculated by means of standard procedures. To examine if - for the variables examined - there were differences between farms and years, the data collected were analysed with the following analysis of variance:

$$Y_{ijk} = \mu + f_i + y_j + c_{ij} + e_{ijk}, \text{ where}$$

- Y_{ijk} = value measured for farm i, year j, and individual k
- μ = mean for population
- f_i = effect of farm i (i = 1,2)
- y_j = effect of year j (j = 1989, 1990, 1991)
- c_{ij} = effect of interaction between farm i and year j
- e_{ijk} = residual variation of individual k [$\sim NID(0,\sigma^2)$]

Table 2 Hematological variables on farm 1 and 2, 1989-1991. Results are mean ± SD. P-values from analysis of varians

Variable	Year	1989		1990		1991		P-value[1]	
	Farm	1	2	1	2	1	2	farm	year
N		30	30	28	34	30	19		
HCT	%	45±9.2	47±3.3	45±3.1	45±3.2	46±3.6	47±2.6	-	-
HB	mmol/l	9.3±1.6	9.3±0.50	10.4±0.73	10.2±0.89	10.7±0.90	10.9±0.59	-	***
MCV	fl	61±3.8	61±2.5	58±2.4	58±2.9	66±1.5	66±1.4	-	***
MCH	fmol	1.21±0.11	1.14±0.06	1.29±0.08	1.26±0.07	1.54±0.04	1.55±0.04	**	***[2]
ERY	$10^{12}/l$	7.7±1.3	8.2±0.62	8.1±0.69	8.1±0.65	7.0±0.48	7.1±0.34	-	***
LEU	$10^{9}/l$	5.1±1.9	4.5±1.7	4.1±1.1	3.6±1.4	4.5±1.3	5.3±1.2	-	***[2]
THR	$10^{9}/l$	476±206	430±70	394±68	379±56	-	-	-	**
Diff. leuc. count:									
Mat. Nentroph.	%	49±11	56±9.4	48±11	53±12	51±10	48±11	*	-
Band Nentroph.	%	0.63±0.81	0.63±0.67	0.61±0.74	0.62±0.65	0.73±0.69	0.74±0.65	-	-
Eosinophils	%	5.3±3.5	4.4±2.8	3.1±2.2	3.1±3.8	5.0±3.1	4.7±2.9	-	**
Basophils	%	0.23±0.43	0.10±0.31	0.14±0.36	0.18±0.39	0.07±0.25	0.11±0.32	-	-
Lymphocytes	%	41±12	35±9.7	46±10	40±10	39±9.7	42±11	-	-
Monocytes	%	3.9±1.6	3.9±2.2	3.0±1.2	73.6±1.5	5.0±2.0	4.5±2.3	-	***

[1] -: P>0.05, *: P<0.05, **: P<0.01, ***: P<0.001

[2] Interaction between farm and year, P<0.05

Table 3 Clinical-chemical variables on farm 1 and 2, 1989-1991. Results are mean ± SD. P-values from analysis of varians

Variable	Year	1989		1990		1991		P-value[1]	
	Farm	1	2	1	2	1	2	farm	year
N		30	30	29	34	30	19		
ASAT	µkat/l	1.7±0.35	1.9±0.41	1.8±0.99	1.6±0.32	1.8±0.57	1.4±0.33	-	-[2]
ALAT	µkat/l	3.8±3.2	2.3±0.64	5.2±2.3	2.4±0.79	2.3±0.96	2.4±1.9	***	***[3]
CK	µkat/l	5.7±2.5	6.8±2.9	5.3±6.1	5.3±2.7	7.0±5.3	4.6±3.0	-	-
CREA	µmol/l	50±7.8	59±7.5	55±6.9	57±5.9	65±9.1	58±4.7	-	***[3]
UREA	mmol/l	7.5±1.4	6.1±2.6	3.6±1.2	5.1±1.8	7.2±1.8	8.5±2.8	-	***[3]
PRO	g/l	64±6.8	62±3.7	62±3.3	66±3.3	61±4.8	62±2.8	-	***[3]
FE	µmol/l	27±9.4	24±6.7	29±6.1	25±6.1	25±6.5	22±3.2	***	-
LIBC	µmol/l	19±11	23±9.0	17±7.1	28±7.0	15±8.7	17±5.8	***	***[2]
TIBC	µmol/l	47±6.9	46±5.3	46±4.9	53±5.1	40±5.1	39±5.1	*	***[3]

[1] -: P>0.05, *: P<0.05, **: P<0.01, ***: P<0.001

[2] Interaction between farm and year, P<0.01

[3] Interaction between farm and year, P<0.001

Results

The results of the haematological analyses appear in table 2. For the haematological variables very few differences were found between farms. Mean corpuscular haemoglobin was higher for farm 1 than for farm 2, and the difference was most significant in 1989. In 1989 the standard deviations for the variables are in general 2-3 times higher for farm 1 than for farm 2. The haematological variables, with the exception of haematocrit and the frequency of eosinophil leucocytes and monocytes, varied from year to year.

For the enzyme ALAT (table 3) significant differences exist between the two farms, between years and interaction between farm and year. Creatinine, urea and total protein in plasma vary significantly from year to year, whereas no differences were found between the two farms. The iron content in plasma and the iron binding capacity are different for the two farms, and the iron binding capacity varies from year to year. From table 4 it appears that the relative frequency of the various fractions of plasma proteins and lipoproteins varies from farm to farm and from year to year. The content of immunoglobulins is significantly different from year to year, whereas no difference is found between farms.

Body weight was lower on farm 1 than on farm 2 in 1989 and in 1990, whereas the opposite was the case in 1991 (table 4).
For the entire period no significant differences in body weight between farms and between years were found, whereas there is interaction between year and farm.

Table 4 Characteristics of proteins in plasma and bodyweight on farm 1 and 2, 1989-1991. Results are mean ± SD. P-values from analysis of varians

Variable	Year	1989		1990		1991		P-value[1]	
	Farm	1	2	1	2	1	2	farm	year
N		30	30	29	34	30	19		
Plasma proteins:									
Albumin	%	61±8.6	47±4.3	43±4.8	51±5.5	58±6.4	57±6.8	*	***[3]
α_1-globulin	%	10±2.6	16±3.1	17±1.9	13±2.1	11±1.6	12±1.1	**	***[3]
α_2-globulin	%	9.0±2.7	7.1±2.8	9.7±2.1	7.5±1.9	8.3±1.7	9.5±2.0	***	-[3]
ß-globulin	%	9.7±3.1	16±2.4	16±3.6	15±2.3	11±2.2	10±2.0	***	***[3]
Fibrinogen	%	7.8±2.6	10±1.9	11±1.8	9.6±2.4	8.2±2.1	8.5±2.0	-	***[3]
-globulin	%	1.7±0.83	3.5±1.3	3.4±1.5	3.1±1.2	3.5±2.1	3.6±1.9	**	**[3]
Lipoproteins:									
Albumin	%	5.0±1.5	5.1±0.69	7.5±3.3	7.1±3.2	2.7±1.9	2.2±1.5	-	***
α-lipoprotein	%	60±7.8	69±5.5	66±4.7	67±5.2	69±9.0	69±7.6	***	***[3]
Pre-ß-lipoprotein	%	1.7±3.0	1.3±1.6	3.9±3.0	1.5±1.8	1.7±1.8	0.58±2.2	***	***
ß-lipoprotein	%	21±7.2	21±3.7	19±5.0	18±5.3	20±6.8	24±6.3	-	*
Chylomicroner	%	11±5.3	3.1±4.8	1.8±1.4	4.2±2.5	5.6±7.0	3.4±2.0	***	***[3]
Immunoglobulins:									
IgA	AU/l	0.68±0.60	0.96±0.62	0.26±0.13	0.41±0.46	0.49±0.45	0.44±0.33	-	***
IgG	AU/l	0.89±0.20	0.92±0.25	0.48±0.18	0.43±0.11	0.44±0.10	0.51±0.13	-	***
IgM	AU/l	1.1±0.68	0.94±0.74	0.74±0.24	0.59±0.30	0.95±0.41	1.0±0.37	-	***
Bodyweight	g	1941±275	2075±179	1998±244	2133±283	2170±208	1990±305	-	-[2]

[1] -: P>0.05, *: P<0.05, **:P<0.01, ***:P<0.001

[2] Interaction between farm and year, P<0.01

[3] Interaction between farm and year, P<0.001

Discussion

The haematological variables show variations from year to year, whereas no significant differences were found between farms. As two farms use wet feed from the same feed kitchen, the haematological variations found are supposed to be a result of differences in feed from year to year and of climatic conditions, just like farm routines and genetic dispositions of the animals may have contributed. The higher standard deviations for the variables for farm 1 than for farm 2 in 1989 indicate that physiologically the animal group was more heterogeneous on farm 1 than on farm 2 the first year.

Creatinine and total protein in plasma vary from year to year. As no differences were found be-

tween farms, the variations found may be caused by changes in the protein content of the feed and in the nature of the protein sources used. The amount of metabolizable energy from protein was in 1989 35% and was then reduced to 30%. Plasma concentrations of urea vary from year to year. The reason for part of the variation may be that the animals had eaten at different times prior to the collection of blood samples, as the concentration of urea at feeding increases by as much as a factor 3 (*Damgaard et al., 1994*).

The enzyme ALAT is a liver enzyme, and the plasma content increases partly with increased protein metabolism and partly when liver tissue is damaged. When given a feed where the energy distribution was low from protein and high from fat, varying degrees of fatty infiltration of the liver developed in the animals. In these animals the plasma activity of ALAT was higher (6.2 μkat/l) than in normal animals (3.0 μkat/l) given a standard feed (*Damgaard et al., 1994*). In 1989 and 1990 the activity of this enzyme in plasma was 1.7 respectively 2.2 times higher for the animals on farm 1 than for the animals on farm 2. This indicates that the animals on farm 1 suffered from fatty infiltration of the liver. As the standard deviation for the variable ALAT is considerably higher on farm 1 than on farm 2, the degree of fatty infiltration of the liver differed very much for the animals examined. The occurrence of fatty liver on one farm and not on another when using the same feed must be due to differences in feeding as regards amount and feeding routine and in the animals' genetic disposition to metabolize fat.

There are differences in the concentration of plasma iron on the two farms and in the iron binding capacity which is a measure of the plasma content of the protein transferrin. The differences found are not supposed to cause differences in the welfare of the animals between farms. Differences in the relative occurrence of the individual protein fractions between farms may be caused by genetic conditions, whereas the difference from year to year on the same farm is not immediately explicable. Chylomicrons belong to the lipoproteins and transport neutral fat in the blood. The content in the blood is normally low, but increases in nonruminant animals after the intake of fatty feeds, which is supposed to be the reason for the differences found.

It is remarkable that the content of the immunoglobulins IgA, IgG and IgM is identical on the two farms within the same year, as the pressure of infection must be different on the two farms. Differences from year to year may be partly feed-related, partly due to natural biological variations, and partly due to changes in the antigen standard, as this was each year produced from a group of animals from another production farm.

To be able to prepare a health surveillance programme applicable for demonstration of clinical and subclinical diseases, it is necessary to test the programme on farms with poor production results caused by the animals' welfare. In the investigation period there were no health problems on the two farms in the growth period, and it is therefore impossible to evaluate partly whether the clinical examination programme prepared is sufficient to reveal health problems and partly if it can be reduced to comprise a smaller number of analyses.

To sum up, the examinations performed have shown that on the basis of haematological and clinical-chemical variables no clinically important differences were found between mink kits at pelting on the two farms. The variation for the variables examined was larger between years than between individuals and smaller between farms than between individuals. The variations from year to year are supposed to be caused by changes in feed composition from year to year and in natural biological variations. The applicability of the analytical profile prepared for health recording cannot be finally evaluated, as no clinical health problems were found on the two farms in the years in question.

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Original Report

Use of various resting platforms by group-housed blue foxes

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Abstract

The use of various types of resting platforms was studied in two arctic blue fox groups housed in large ground floor enclosures. The results showed that some resting places were favored only by one fox, but some others almost by all. The animals most frequently utilized the platforms for sleeping and least often for jumping or other short-term visits. It seems obvious that the main function of platform use is not that of an observation post alone. Wooden platforms were not preferred over ones made of wire-mesh net. Particularly a large net bunk which resembled the farm cage floor was surprisingly popular although the animals had no previous experience of net surface. No marked relationship was found between amount of use and social status of the animals.

Introduction

Farmed canids have traditionally been housed in wire-mesh cages which do not provide a place to seek shelter or hide against the variable stimuli of the farm environment. Recently, however, increasing interest has focused on alternative, improved housing conditions (*Huprecht, 1993; Korhonen & Alasuutari, 1993*). Most demands for environmentally enriched circumstances include possibilities for mark contact or for the provision of resting platforms and nest boxes. Although separate studies employing both improvements have been carried out, few actual data are available on conditions in which access to both ground contact and resting places has been simultaneously provided (*Alasuutari & Korhonen, 1992; Korhonen et al., 1991*). It might be expected that the enclosure environment as such already constitutes a considerable improvement over wire-mesh cages, thus eliminating the need for further environmental enrichment. However, if resting platforms have some other possible functions, then these would also emerge in the enclosure conditions. It has been speculated, for instance, that the use of resting places might somehow be linked with the social ranking of the animals (*Tembrock, 1957*).

The objectives of the present study were therefore to clarify (1) to what extent arctic blue foxes (*Alopex lagopus*) employ various resting places if they are freely available in large ground enclosures, and (2) to determine if social ranking within the group might influence their use.

Materials and methods

Subjects and general managements

The experiments were carried out at the Exp. Fur Farm of the University of Helsinki in Finnish Lapland (69°N, 27°E; 350 km north of the Arctic Circle). Enclosure 1 was measuring 17 m

long x 11 m wide x 2 m high, and enclosure 2 - 22 m long x 11 m wide x 2 m high. Various resting places (platforms, bunks or rooves of nest boxes) were freely available (fig. 1, tables 1-2). Adults (age over 1 year) and juveniles (<1 year) were housed together in both enclosures. All were born in enclosures and thus had no previous experience of net conditions. The animals were fed fresh-mixed fox feed ad libitum until the end of November, after which 350 g feed per animal was provided daily.

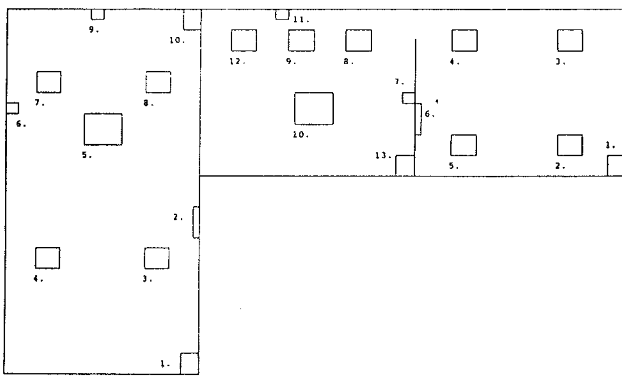

Fig. 1. Schematic presentation of the experimental enclosures studied. Left: enclosure 1, right: enclosure 2. Location of different resting places is indicated by different numbers 1-13. See also tables 1-2.

Observations

The animals were observed visually during two periods. I: Oct. 12 and Oct. 14 (Air temp. -8° and -1°C, snow depth 3 cm) and II: Jan. 20 and Jan. 24 (Air temp. -11° and -17°C, snow depth 40 cm). Observations lasted daily from 8 a.m to 8 p.m without interruption.

The social status of the animals within the enclosures was determined by scoring winners (dominant) and losers (submissive) during the observation periods. A dominance index value was calculated from the numbers of dyads in which a fox was scored as dominant or submissive (*Frafjord, 1993*). The dominance index value shows the social status of the individual, and the dominance index order thus indicates the rank order within the group. Details on the calculations and dominances are presented in the paper of Korhonen and Alasuutari (1994).

Results

Use of the various resting platforms is depicted in tables 1 and 2. In general, useage was higher during period II (809 ± 137 min) than during period I (575 ± 128 min, $p<0.01$; ANOVA). During period I (Oct), adults (280 ± 228 min) used them more ($p<0.05$) than juveniles (118 ± 15 min) within the enclosure 1, but males (78 ± 42 min) used less ($p<0.01$) than females (165 ± 51). Also in enclosure 2, adults (286 ± 31 min) used platforms significantly more ($p<0.001$) than juveniles (47 ± 48 min).

However, no differences were found between males (195 ± 160 min) and females (139 ± 177 min). During period II (Jan), the use of resting places tended to be greater by adults (281 ± 284 min) than juveniles (172 ± 73 min). In addition, females (316 ± 277 min) used them more ($p<0.05$) than males (79 ± 90 min) within enclosure 1. In enclosure 2, adult useage (216 ± 265 min) was significantly greater ($p<0.05$) than that of juveniles (91 ± 88 min). In addition, males (216 ± 265 min) used more ($p<0.05$) than females (140 ± 18 min).

Marked variations existed in the amount of use both between individuals and the various platform types ($p<0.001$; ANOVA). Some places were favored only by one fox but some others almost by all (tables 1-2). The animals did not visit inside nest boxes at all. During period I, the types preferred the most by the foxes in enclosure 1 were the net corner (locations code 1) and the wooden corner (19). Wooden flats (6,9) and the roof of nest box number 3 (7) were preferred the least. In enclosure 2, on the other hand, those most favored were the rooves of nest boxes numbered 4 and 1 (4,2) and, correspondingly, wooden flats (7,11) were the least favored. During period II, the least favored in enclosure 1 were the rooves of the nest boxes numbered 2 (4) and 3 (7). The wooden V was used the most, but also the corner and flat types were now preferred. In enclosure 2, on the other hand, several practically unused platform types were found. The most favored platforms were large net bunk and wooden V.

Table 1 Use of restingplaces (mean, min/animal/12 h) in enclosure 1 during periods I and II. Measurements (length, cm x width, cm) of places 1,2,3 and (4,7,8),5,6 (and 9) and 10 were 60 x 60, 105 x 28, 70 x 40, 107 x 118, 40 x 34 and 50 x 50, respectively. Mesh size of net was 1.25 inches. Distance from the ground without snow was 50 cm for each type. For the location of places see fig. 1. Letters a,b and c represent individual foxes. The order of these letters indicates which of these foxes used most and least the resting place in question. Number of animals for juvenile females was three (a–c), but for others two (a,b). Total daily use can be calculated by multiplying animal number with the mean use in question. For social status, see table 3.

	Adults				Juveniles					
	males		females		males		females		total	
Resting place	I	II	I	II	I	II	I	II	I	II
(1) net corner	0	15^{b}	25^{ba}	15^{a}	87^{ba}	77^{ba}	40^{acb}	2^{a}	152	109
(2) wooden V	0	0	52^{a}	111^{a}	1^{b}	82^{ab}	5^{b}	51^{bca}	58	244
(3) roof of nest box 1	2^{a}	0	0	10^{a}	5^{ba}	0	73^{acb}	50^{c}	80	60
(4) roof of nest box 2	0	0	3^{a}	0	2^{a}	0	1^{b}	0	6	0
(5) large net bunk	25^{a}	25^{a}	0	71^{a}	4^{a}	9^{ab}	5^{ba}	17^{abc}	34	122
(6) wooden flat 1	0	0	1^{b}	143^{b}	4^{a}	0	0	0	5	143
(7) roof of nest box 3	0	0	0	0	3^{ab}	0	1^{b}	0	4	0
(8) roof of nest box 4	21^{a}	7^{b}	1^{a}	6^{a}	1^{a}	0	3^{a}	0	26	13
(9) wooden flat 2	0	0	0	71^{ba}	0	55^{a}	0	0	0	126
(10) wooden corner	0	3^{b}	119^{ba}	85^{ba}	0	1^{a}	0	0	119	89
total use	48	50	201	512	107	224	128	120	484	906

Tabel 2 Use of resting places (mean, min/animal/12 h) in enclosure 2. See further fig. 1 and table 1. Number of animals was two (a,b) for males and three (a–c) for females. Total daily use can be calculated by multiplying animal number with the mean use in question.

	Adults				Juveniles					
	males		females		males		females		total	
Resting place	I	II	I	II	I	II	I	II	I	II
(1) net corner	6^{ba}	0	31^{abc}	0	3^{a}	0	3^{ab}	0	43	0
(2) roof of nest box 1	10^{ba}	0	110^{bac}	11^{acb}	0	5^{ab}	3^{bc}	4^{b}	123	20
(3) roof of nest box 2	35^{ab}	0	39^{bca}	1^{b}	3^{ba}	0	0	0	77	1
(4) roof of nest box 3	20^{b}	0	0	0	0	0	0	0	20	0
(5) roof of nest box 4	20^{ab}	1^{a}	41^{bc}	108^{bac}	74^{ab}	17^{ba}	0	5^{ab}	135	131
(6) wooden V	16^{ab}	53^{a}	9^{bac}	4^{bac}	0	5^{ba}	0	125^{ab}	25	187
(7) wooden flat 1	0	0	0	0	0	0	0	0	0	0
(8) roof of nest box 5	18^{b}	0	1^{b}	0	0	0	0	0	19	0
(9) roof of nest box 6	22^{b}	0	5^{ba}	1^{c}	0	0	7^{a}	0	34	1
(10) large net bunk	83^{ab}	305^{ba}	2^{a}	2^{a}	1^{a}	1^{a}	0	2^{b}	86	310
(11) wooden flat 2	0	43^{a}	2^{a}	0	0	0	0	0	2	43
(12) roof of nest box 7	1^{a}	0	23^{cba}	0	0	0	0	0	24	0
(13) wooden corner	77^{ab}	1^{b}	1^{c}	1^{a}	0	0	0	17^{cab}	78	19
total use	308	403	264	128	81	228	13	153	666	712

The social status of the animals changed to some extent from October to January (table 3). During the first period (Oct), juveniles were typically lowest in the rank but, during the second period, their position improved. Use of the resting platforms in enclosure 1 did not depend on the social status of the animal. In enclosure 2, on the

other hand, a very significant correlation was found between social status and use ($r=-0.85$, $p<0.01$; Spearman's rank correlation) in October. Thus, the animals that were highest in the rank order (i.e. adults), utilized the platforms the most and vice versa. In January, however, no correlation was found anymore.

The resting platforms were mostly used for sleeping, and the least for jumping (table 4). The situation was the same in both enclosures during the two observation periods. Use of resting platforms was not quite evenly distributed for each hour. In addition, some differences existed between enclosures and periods.

Table 3 Social status (1=most dominant, 10=most submissive) and use of resting places (min/12 h). Social status shows animal's position in the rank order. A=adult, J=juvenile. Letters a-c indicate the use of various resting places in tables 1-2

		Period I		Period II	
		Status	Use	Status	Use
Encl. 1:	male A-1[a]	1	96	1	50
	male A-2[b]	2	0	2	50
	female A-1[a]	3	190	9	502
	female A-2[b]	4	205	4	522
	male J-1[a]	7	77	3	298
	male J-2[b]	8	137	6	189
	female J-1[a]	5	133	7	56
	female J-2[b]	6	112	5	113
	female J-3[c]	9	139	8	191
Encl. 2:	male A-1[a]	1	286	1	236
	male A-2[b]	3	330	4	570
	female A-1[a]	2	257	7	67
	female A-2[b]	4	266	6	290
	female A-3[c]	5	269	5	27
	male J-1[a]	7	120	2	15
	male J-2[b]	8	42	3	41
	female J-1[a]	6	8	10	220
	female J-2[b]	9	25	9	190
	female J-3[c]	10	6	8	49

Table 4 Distribution of use of resting places for jumping, lying (1-10 min) and sleeping

	Period I			Period II		
	Jumping	Lying	Sleeping	Jumping	Lying	Sleeping
Enclosure 1						
Adult males	2.2	6.8	91.0	2.9	40.6	56.5
Adult females	3.4	24.4	72.2	1.8	9.0	89.2
Juvenile males	7.1	16.4	76.5	1.9	21.2	76.9
Juvenile females	11.9	16.5	71.6	3.3	45.6	51.1
Enclosure 2						
Adult males	4.8	23.8	72.0	0.4	11.0	85.0
Adult females	4.9	24.5	70.6	5.9	43.6	50.5
Juvenile males	1.9	15.6	82.5	8.2	42.0	49.8
Juvenile females	16.9	23.8	59.3	4.0	17.8	78.2

Discussion

The results show that arctic blue foxes made use of the various resting places when enclosures were equipped with them. The degree of use, however, varied during the study. In a previous experiment with two foxes, the amount of use of the nest box roof, and wooden and net platforms was 0.7, 13.4 and 16.0 % during 24 h (*Korhonen et al., 1991*). A higher amount of use for the rooves of nest boxes was observed in another enclosure experiment with 8 foxes, i.e. from 2.6 to 15.0 % (*Alasuutari & Korhonen, 1992*). These values are in rather good agreement with the present data, although some differences also exist. As already shown in previous experiments employing wire-mesh cages, useage varies between animals, experiments and also within different periods of the same experiment (*Korhonen & Niemelä, 1993; Mononen et al., 1993*). In addition to individual preference, it is often difficult to give any other explanation for the variation than that the conditions and arrangements differ one way or another between experiments. This should be kept in mind, and caution should be exercised when comparing various studies if the experimental managements are not quite the same. Furthermore, the present study revealed that the use of certain resting platforms can be either occasional or fixed which, of course, easily produces variation between different observations. In circumstances such as in the present study, where several spare resting platforms were available, the foxes did not necessarily prefer any particular one.

It has been observed that during the daytime, wild foxes would sleep or rest outside their dens on higher places such as on logs or large stones (*Tembrock, 1957*). Thus, it might be assumed that if the availability of suitable resting places is limited, then the social ranking of the foxes would resolve which of them occupy or do not occupy such places. In the present study, on the other hand, a significant correlation was found between social status and useage only during October in enclosure 2, which does not allow us to conclude that the use of resting places is dependent on social rank order. However, it should be remembered that the high number of available resting platforms might have decreased the social competition for them. More studies are needed in conditions with a limited amount of resting platforms in order to clarify the hypothesis further.

Resting platforms were used the most for sleeping, as has also been observed in wire-mesh cages (*Korhonen & Niemelä, 1993*). The amount of short-term use, on the other hand, was low. In addition, resting platforms were used by the foxes even more in January than in October, although there was 40 cm of snow at that time which means that the platforms were only 10 cm above the snow surface. These results do not necessarily support previous speculations that the main function of the resting platforms is that of an observation post alone. However, resting sites on higher places probably give foxes a significant feeling of security and, of course, provide the possibility to survey the environment. According to Underwood & Masher (1982) wild arctic foxes have an instinctive tendency to seek out high places for shelter, which might explain the preference for resting platforms observed in the present study, too.

It was interesting to note that the foxes frequently also used resting platforms made of wire-mesh net material, although they had no previous experience of such. Especially the use of a large net bunk, which resembled a conventional cage floor, was surprisingly high. Thus, it is obvious that foxes do not regard net flooring as an unpleasant surface, although animal welfare advocates are often of that opionion.

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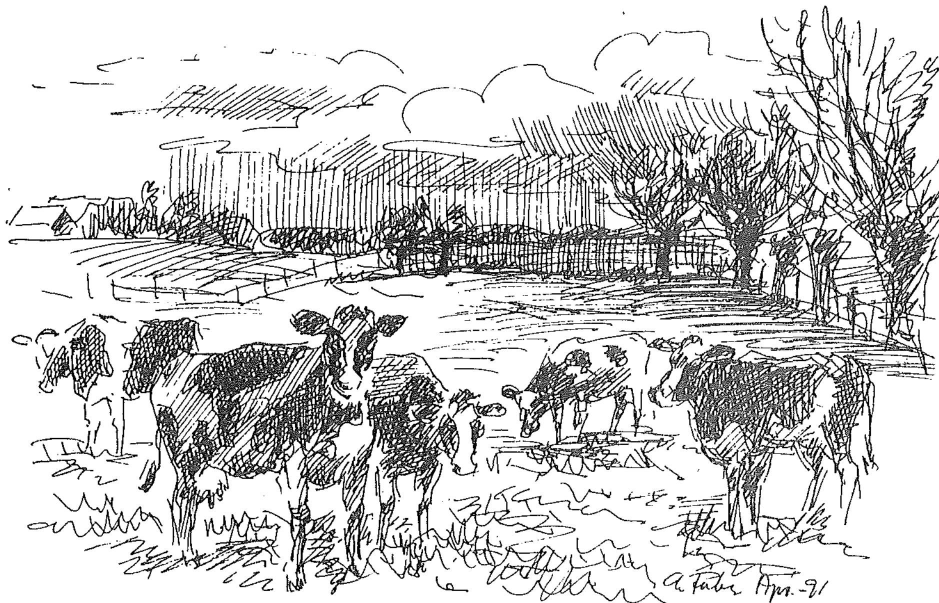


Cell proliferation during fibre growth initiation in ferret hair follicles

D.P. Saywell, A.J. Nixon

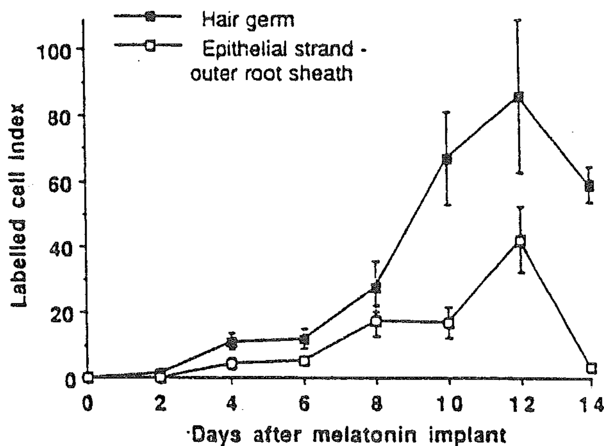


Fig. 2. Cell proliferation in epithelial tissues of the ferret hair follicle; hair germ/germinal matrix, epithelial strand/new outer root sheath. Labelled cell index is the mean of the number of BrdU labelled cells per 6 μm section relative to follicle bulb width. Vertical bars represent SEM.

The commencement and course of cell proliferation is described in proanagen hair follicles of ferrets. Initiation of autumn fur growth was synchronised in 32 animals using melatonin implants. Skin samples containing S-phase cells labelled in vivo with bromodeoxyuridine were collected from groups of four animals up until the time of development of metanagen follicles at 14 days post-implants. Cells were visualised by an indirect immunocytochemical method and counts made of proliferating cells in the hair germ, epithelial strand/outer root sheath, connective tissue sheath and dermal papilla. Telogen follicles showed no labelling in all four tissues until 4 days after melatonin implant. The largest number of proliferating cells were in the hair germ, which formed the new fibre and inner root sheath. The cell labelling index for this tissue remained high at 14 days post-implant. In other tissues, cell proliferation reached peaks during mid to late proanagen, then declined as the metanagen state was reached. These results indicate that some key signalling events controlling ferret hair growth occur between 0 and 4 days after the melatonin implant, and illustrate the separate processes of follicular regeneration and fibre growth occurring in proanagen follicles.

Proceedings of the New Zealand Society of Animal Production, Vol. 52, pp. 299-302, 1992. 3 figs., 12 refs. Authors' summary.

Early maturation of the coat in foxes

I.I. Kravtsov, G.A Kuznetsov

Data were obtained on groups of 30 silver-black male foxes housed in sheds, shaded so that the light allowance in July-Sep. would be (1) 20 lux natural light; (2) 20-40 lux natural light; (3) 40-60 lux natural light; (4) all available natural light; (5) 40 lux artificial light only for 8 h plus 20 lux for 8 h; (6) 40 lux artificial light for 8 h; (7) 40 lux artificial light for 8 h plus 60 lux for 8 h; (8) natural light only. The experiment was repeated for 3 yr. The moult was finished 11-12 days earlier in groups 1, 2, 5 and 6 than in groups 3, 4, 7 and 8; points for overall quality (pelt size and colour) were higher (94.32-113.2) and the percentage of deficient pelts was lower (2.8-14.0) for groups 1, 2, 5 and 6 than for groups 3, 4, 7 and 8 (88.2-107.0 and 3.5-25.6 resp.).

Krolikovodstvo i Zverovodstov, No. 1, pp. 9-10, 1990. 2 tables. In RUSS. CAB-abstract.

Morphological aspects on the reproductive organs in female mink (*Mustela vison*) exposed to polychlorinated biphenyls and fractions thereof

Britt-Marie Bäcklin, Anders Bergman

The gross morphology of the post-parturient uteri and the histology of the ovarian cyclic corpora were studied in two experiments in groups of ten female mink (*Mustela vison*). Groups were exposed, during the reproductive season, to the technical polychlorinated biphenyls (PCBs) Clophen A50 or Aroclor 1254, to 4 fractions prepared from the technical PCBs, to combinations of these fractions, and to a synthetic chlorobiphenyl (CB) mixture. Three fractions contained CB congeners with a different number of chlorines in *ortho*-position to the biphenyl bond, viz. two to four (2-4), one (1) and no (0)-*ortho* CB congeners, respectively,

while the fourth contained bi- and tricyclic contaminants, mainly representing polychlorinated dibenzofurans and polychlorinated naphthalenes. Fractions of congeners and contaminants were given in doses equivalent to those present in the PCB doses.

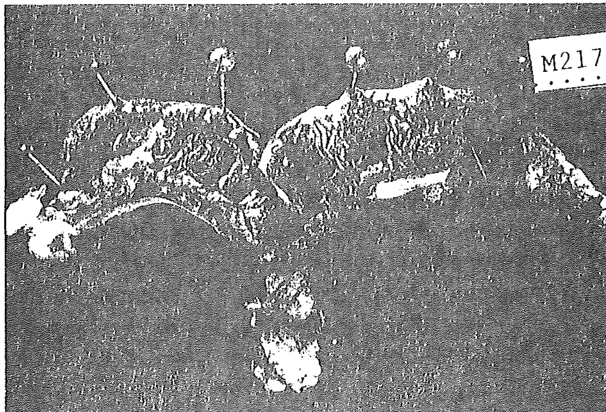


Fig. 3. Formalin-fixed uterus from a two-year-old mink, exposed to Clophen A50, Group 2, 1988, with signs of LFD and EFD. Placental sites of LFD are seen as dark cavities in a transversely folded endometrium. Photo: B. Ekberg.

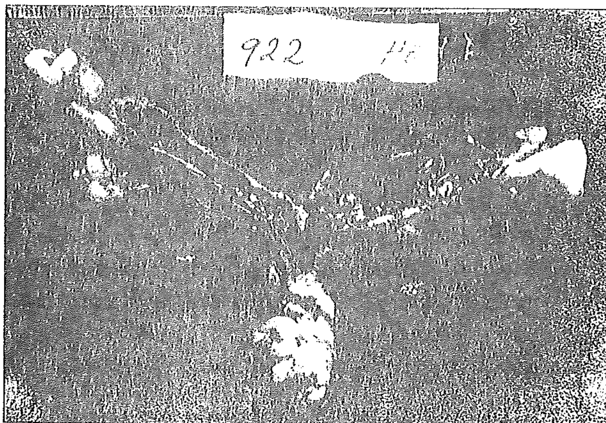


Fig. 4. Uterus and ovaries from a 1-year-old mink, exposed to Aroclor 1254, Group 9, 1989, with signs of PP states, LFD and EFD. The right uterine horn shows two widened placental sites and the left horn shows one. Associated mummified concepti are placed above the horns. The endometrium is smooth compared to fig. 3. (Ovaries are placed at each side of the corpus uteri). Phot: B.-M. Bäcklin.

Groups exposed to the commercial PCBs and to combinations of the fractions thereof showed a severe decrease in reproductive outcome with high incidences of fetal deaths. Groups exposed to single PCB fractions and to the synthetic CB mixture showed no such effect. Females in the Clophen A50 group showed a predominance of late fetal death and had ovaries containing corpora lutea, while females in the Aroclor 1254 group showed a high frequency of early fetal death and had ovaries mostly containing corpora albicantia. Effects of fetal conditions upon sex hormone interactions are discussed.

AMBIO, Vol. 21, No. 8, 1992, pp. 596-601, 1992. 2 tables, 4 figs, 36 refs. Authors' summary.

Influence of commercial polychlorinated biphenyls and fractions thereof on liver histology in female mink (*Mustela vison*)

Anders Bergman, Britt-Marie Bäcklin, Bertil Järplid, Lars Grimelius and Erik Wilander

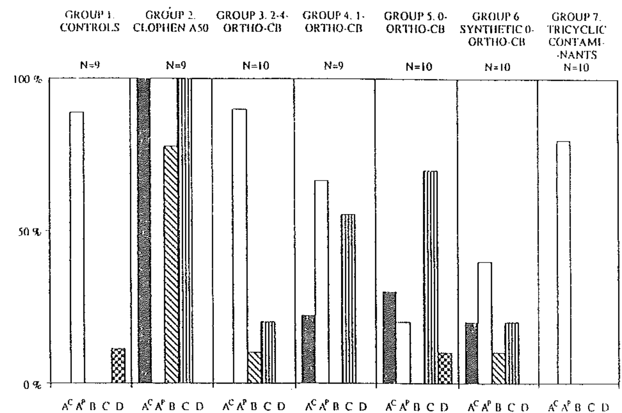


Fig. 1. Frequencies (%) of certain morphological changes in the liver (A^c-D columns), after exposure to commercial PCB (Clophen A50), different fractions thereof, and a synthetic mixture of non-*ortho* chlorinated CBs to 2-year-old female mink (1988 experiment). A^c, centrolobular and A^p, perilobular fatty changes in hepatocytes. B, hemosiderosis of Kupffer cells. C, polymorphonuclear cells. D, foci of mononuclear cells.

Effects on liver histology were studied in 13 groups of female mink after treatment, for 79-96 days during the reproductive season in 1988 and 1989, with the commercial polychlorinated biphenyls (PCBs), Clophen A50 and Aroclor 1254, to 4 fractions prepared from the commer-

cial PCBs, to combinations of these fractions, and to a synthetic chlorobiphenyl (CB) mixture.

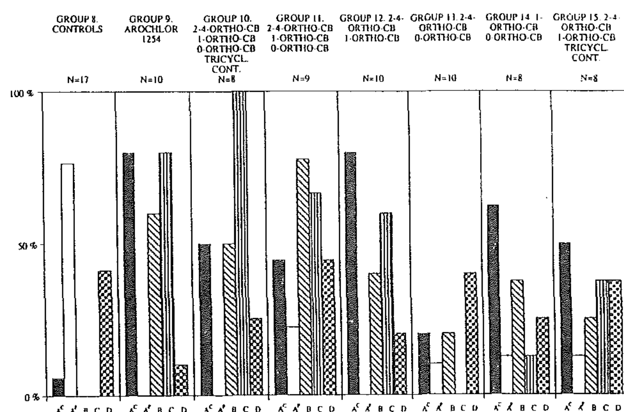


Fig. 2. Frequencies (%) of certain morphological changes in the liver (A^c-D columns), after exposure to commercial PCB (Aroclor 1254) and different combinations of fractions thereof to 1-year-old female mink (1989 experiment). A^c, centrolobular and A^p, perilobular fatty changes in hepatocytes. B, hemosiderosis of Kupffer cells. C, polymorphonuclear cells. D, foci of mononuclear cells.

Three fractions contained CB congeners with a different number of chlorines in *ortho*-position to the biphenyl bond, viz. two to four (2-4-), one (1-), and no (0-) *ortho* CB congeners, while the fourth contained bi- and tricyclic contaminants mainly representing polychlorinated dibenzofurans and polychlorinated naphthalenes. Fractions of congeners and contaminants were given in doses equivalent to those in the doses of commercial PCBs. Some histological changes, viz. fatty changes in hepatocytes, hemosiderosis of Kupffer cells, frequency of polymorphonuclear cells and of mononuclear cells, were selected and used as parameters in semiquantitative estimations of the effects on liver histology. High incidences of change were found in groups exposed to commercial PCBs and in combinations of 3 and 4 different fractions, and on exposure to a combination of 1-*ortho* and 2-4 *ortho* CBs. The least marked effect in animals related with combinations of CB fractions was found on exposure to 2-4 *ortho* and 0-*ortho* CBs. Following treatment with single CB fractions, certain effects were observed in the groups given 0-*ortho* and 1-*ortho* CBs while very slight effects on the liver were observed in the group treated with 2-4-*ortho* CBs. No effects at all were observed in the group given bi- and tricyclic contaminants. The degree of liver changes was ascribed to the combined effects of different compounds rather than to specific effects of individual compounds present in the commercial PCB products.

AMBIO, Vol. 21, No. 8, pp. 591.595, 1992. 7 figs., 32 refs. Authors' summary.

PCB and PCB methyl sulfones in mink treated with PCB and various PCB fractions

Åke Bergman, Maria Athanasiadou, Sune Bergek, Koichi Haraguchi, Sören Jensen, Eva Klasson Wehler

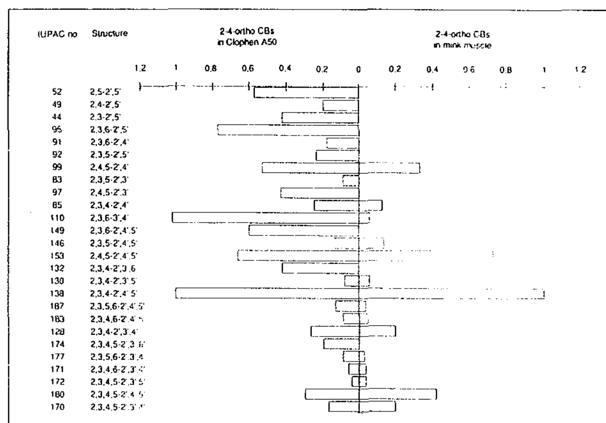


Fig. 10 Composition of Cbs present in the 2-4-*ortho* CB diet (bars to the left) given to mink Group 3 and CBs present in mink muscle after the dosing period (bars to the right). The relative amounts are related to I-138 (3.61% of the total Clophen A50 (10)). The possible content of I-163 in the I-138 peak has not been considered relevant for this presentation. Structure and IUPAC numbers are given.

The retention of individual polychlorinated biphenyls (CBs) and persistent metabolites of CBs, methylsulfonyl CBs ($MeSO_2$-CBs), was studied in mink tissue after 3 months of daily administration during pregnancy. The dose consisted of crude PCB (Clophen A50), PCB fractions and combinations of fractions containing CBs with no chlorines in the *ortho*-positions, 1 chlorine in an *ortho*-position, 2-4 chlorines in the *ortho*-po-

sitions or polychlorinated dibenzofurans (PCDF) and polychlorinated naphthalenes (PCN). The CB patterns, determined by gas chromatography, in the fractions given to the mink and in muscle, are compared for the mink groups. The concentrations of CBs and $MeSO_2$-CBs were determined in muscle from each group of minks. PCB and the CB fractions containing 2-4-ortho CBs or 1-*ortho* CBs were shown to significantly increase the body burden of these compounds in exposed minks. CBs with 5 or more chlorine atoms, and lacking vicinal hydrogens in 3,4-positions, were most efficiently retained in the mink, while CBs with chlorine atoms in 2,5-positions and unsubstituted 3,4-positions were most readily metabolized. The formation of $MeSO_2$-CBs, lipophilic metabolites of PCB, was verified and concentrations determined in mink muscle samples and in livers from 3 individual mink from 3 of the groups. In the liver samples only a few $MeSO_2$-CBs were observed, but at high concentrations. The CB/$MeSO_2$-CB ratio was shown to be slightly lower in the liver than in the muscle samples.

AMBIO, vol. 21, No. 8, pp. 570-576, 1992. 3 tables, 11 figs., 40 refs. Authors' summary.

Daytime use of various types of whole-year shelters in farmed silver foxes (*Vulpes vulpes*) and blue foxes (*Alopex lagopus*)

V. Pedersen, L.L. Jeppesen

The use of four different whole-year shelters was examined in 50 silver and 50 blue fox vixens in the autumn and winter months from November 1987 to February 1988 and from August 1988 to March 1989. Observations were not carried out during breeding. All vixens had free access to a top box with an underlying shelf, a side box and an open box. The location of the vixens was determined by the use of regularly performed scan samplings with a sampling interval of 10 min. After a short period of becoming accustomed to the shelters both species showed a preference for the shelf and the top box. Silver foxes spent most time on the shelf, whereas blue foxes spent most time in the top box. Blue foxes were observed in the shelters twice as frequently as silver foxes. When disturbed, most of the silver foxes fled from the experimenter to the opposite side of the cage; some fled into the top box. Most of the blue foxes fled into the top box when disturbed and some fled into the side box. It was suggested that these differences between species were reflecting greater general timidity in the blue fox or different behavioural strategies towards danger in the two species.

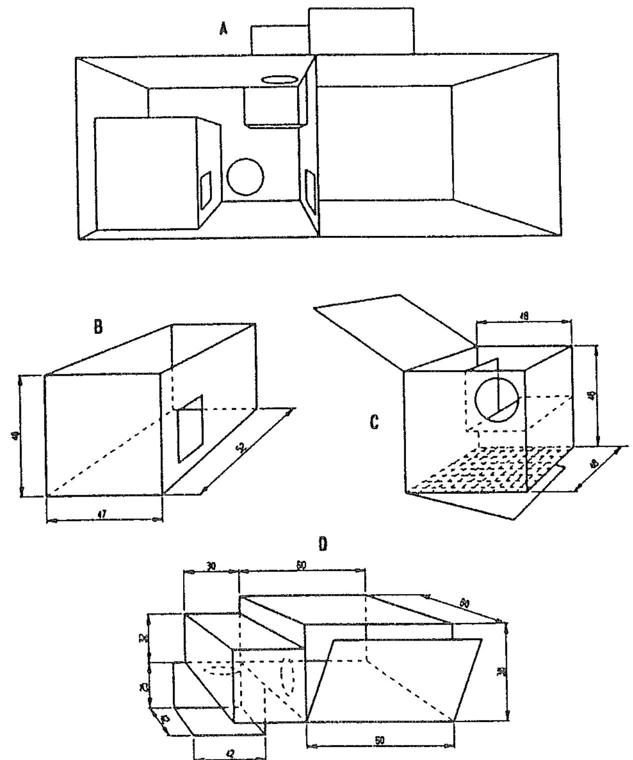


Fig. 1. Front view of a double fox cage showing the empty right-hand section and the left-hand section with the shelters (A). Beneath the fox cage the dimensions (in cm) of the open box (B), the side box (C), and the top box and shelf (D) are shown.

Applied animal behaviour Science, Vol. 36, 2/3, pp. 259-273, 1993. 6 figs., 17 refs. Authors' abstract.

An infrared thermographic study of surface temperature in relation to external thermal stress in three species of foxes: the red fox (*Vulpes vulpes*), arctic fox (*Alopex lagopus*), and kit fox (*Vulpes macrotis*)

Johan J. Klir, James E. Heath

Temperatures of different body surface regions of unrestrained adult red, arctic, and kit foxes exposed to ambient temperatures (T_a) ranging

from -25° to 33°C were measured by infrared (IR) thermography. Foxes are able to regulate heat exchange with their environment by controlling the temperature of the body surface. At T_a's well below zero, they are able to maintain all exposed surfaces above the freezing point by vasodilation and increased blood flow into these surface areas. The important thermoregulatory surfaces include the area of the face, nose, dorsal head, pinna, lower legs, and paws in red and kit foxes, and the face, nose, front of the pinna, lower legs, and paws in arctic foxes. All these thermoregulatory effective surface areas are covered with relatively short fur during all seasons. The lower legs and paws are the most effective surfaces. The surface involved in active heat loss seems to be nearly the same in all foxes. However, there are significant interspecific differences in the relative size of these surfaces, which are relatively large in kit foxes, small in arctic foxes, and intermediate in red foxes. Foxes use the nose for evaporative cooling, and it is probably a part of a brain-cooling mechanism similar to that described in dogs.

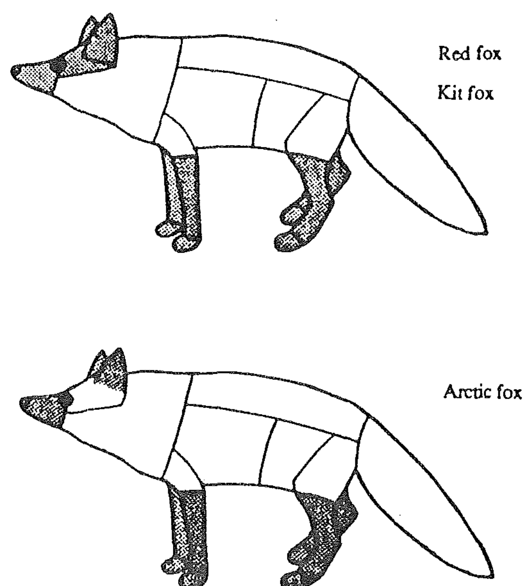


Fig. 5. The thermoregulatory effective surface areas (shaded) in the red fox (*Vulpes vulpes*), arctic fox (*Alopex lagopus*) and kit fox (*Vulpes macrotis*)

Physiological Zoology, vol. 65, No. 5, pp. 1011-1021, 1992. 1 table, 5 figs., 16 refs. Authors' abstract.

The ferret in biomedical research. A review.

Ricardo G. Fischer, Björn Klinge

Ferrets have been widely used as experimental animals in biomedical research. In periodontal research, increasing concerns about the use of dogs and monkeys as experimental animals has added to the interest in the use of the ferrets as an experimental animal. The aim of this review is to present aspects of the animals biology and husbandry, including reproduction, housing and handling, nutritional requirements, diseases and anaesthesia. Finally, the characteristics of dentition and periodontal diseases are presented.

Scandinavian Journal of laboratory Animal Science, vol. 19, No. 4, pp. 153-161, 1992. 46 refs. In ENGL, Su. SWED. Authors' summary.

The effect of repeated blood sampling on different hormonal and immunological parameters in silver fox vixens (*Vulpes vulpes*)

Randi Oppermann Moe, Morten Bakken

Evaluation of blood parameters is often an important part of animal experimentation. Unless permanent catheters are used, blood sampling entails handling the animal one or more times. This is also the case in fur animal research, where blood values have been used in a wide range of experiments. It has been shown that the presence of humans, handling and immobilization are stressors for the majority of farmed silver foxes. Repeated handling and blood sampling may influence the animals' physiological status and therefore also the parameters of interest in the experiment. The aim of the present study was to elucidate whether repeated blood sampling series can influence a range of hormonal and immunological parameters in the silver fox.

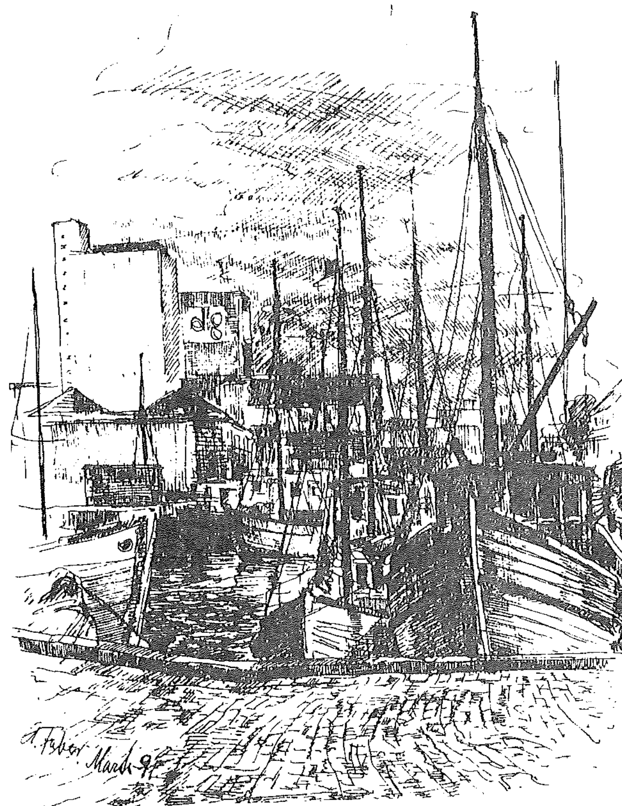
A total of 14 one-year-old silver fox vixens were divided into two groups. The animals in group 1 were blood-sampled every two weeks for a year: five samples were taken with 30-minute intervals on each occasion. Those in group 2 functioned as controls and were not sampled in that period. At the end of this period, a similar series of samples was taken from

both groups. The following parameters were then measured: eosinophilic and neutrophilic granulocytes, lymphocytes, total numbers of red and white blood cells and plasma concentrations of cortisol, prolatin and testosterone. During the experiment the animals were lifted out of their cages using neck tongs and blood was sampled from the cephalic vein on the forelimb. Each blood sample took approximately two minutes. The staff handling the animals were the same during the whole experiment.

The numbers of white blood cells, neutrophilic granulocytes and plasma concentrations of prolactin varied between groups but not within a sample series. The numbers of eosinophilic granulocytes and total red cells varied within a sample series, but significant differences were not registered between the groups. Plasma concentrations of cortisol and testosterone, together with total lymphocyte numbers, varied both between groups and within a sample series. Testosterone concentrations showed the greatest variations. Repeated blood sampling resulted in significantly lower concentrations of testosterone compared with the controls.

These results are based on relatively few animals, but suggest that repeated blood sampling over a long period can influence the values of several blood parameters. Furthermore, effects can also be demonstrated during repeated sampling over a short period.

In ENGL. Author's abstract. Code 3-4-5-F. NJF-proceedings No. 92, 1994, Oslo, Norway.



Original Report

The Polish White Neck Fox

Grazyna Jezewska[*], *Andrzej Leznicki*[**], *Wieslaw Geisler*[**], *Janusz Maciejowski*[*]
[*]*Agricultural University of Lublin, ul. Akademicka 13, 20-950 Lublin, Poland*
[**]*Fur Animal Farm, Batorowka, Poland*

Summary

A new colour mutation of fox, the white neck has been described. It appeared on one Polish farm in the early 1970's. Generally, its colour pattern is identical with that of the silver fox, the characteristic trait, however, being the white collar around the animal's neck and white spots on the face, belly and legs. The gene responsible for such a colour pattern is an allelic form of the locus "W" gene and it is lethal when homozygous.

Introduction

A new colour mutation of the fox, later named the White neck fox, first appeared at a state-run farm in Batorowka near Piotrków Trybunalski, Poland, in 1970. A couple of silver foxes gave a litter of 5 pups, one of which from the beginning of the suckling phase differed from the others with regard to its hair colour and colour patterns. Later, as a mature animal, it resembled the white face fox described earlier by Johansson (*ref. 2, 3*). However, some differences were also present, namely a broad white collar around the animal's neck which justified the name White neck (*ref. 1*).

The mutant, which turned out to be male, was used in breeding work. Over the 6 years it was used for reproduction, it successfully mated 29 females, mainly silver, but also 2 platinum and 1 white neck being its granddaughter. The colour distribution among 89 reared offspring was: 39 white neck, 48 silver and 2 platinum (*ref. 1*). The white neck fox was considered to be a new colour variety and it has been bred in Batorówka up to the present.

The authors show the characteristic traits of the white neck fox regarding its colour, reproduction results and genetical determination of its colour pattern.

Material and methods

The materials used in the research come from the fur animal farm in Batorówka, Central Poland. They include the data concerning white neck and silver foxes from the last 11 years. The following crossings were recorded at the farm: white neck female x white neck male, white neck female x silver male, silver female x white neck male and silver female x silver male. Reproduction results in females as well as weaning rates and colour segregation in offspring from parents of different colours were analyzed.

Results and discussion

The colour of the main part of a white neck fox's trunk is identical to that of a silver fox. However, the characteristic trait of a white neck is a broad white collar around the neck and a "mask" i.e. a white stripe covering the nose and partly the face, the tip of the nose being black.

Table 1. Colour segregation in the offspring of white neck and silver foxes

Number of matings	Number of litters	Total number of pups at weaning	Colour			
			White neck		Silver	
			n	%	n	%
white neck x white neck	26	87	58	66.7	29	33.3
white neck x silver	471	1976	944	47.8	1032	52.2

There are also white spots on the legs and belly. The tail is black with a white tip.

Since the width and regularity of the collar as well as of the white spots on the legs and face vary, the animals are selected for the regularity of those traits. An intensive black colour immediately after the collar, which provides a good contrast to white, is also a desirable trait.

In Batorówka white neck foxes are mated among themselves and cross-bred with silver foxes. Table 1 shows the colour segregation in the offspring obtained from such matings. White neck x white neck mating gave 66.7% of white neck pups and 33.3 silver with a phenotype segregation rate close to 2:1. The presence of silver pups in such litters points to their heterozygosity regarding colour genes. The results of silver x white neck matings, where the white neck appeared both as males and females confirm this thesis. Among the offspring coming from 471 litters 47.8% pups were white neck and 52.2% silver i.e. the phenotype split rate was close to 1:1, which was further statistically proved:

$$x^2 = 3.92 < x^2_{0.01} = 6.63$$

Table 2. Reproduction results of silver and white neck foxes in Batorówka farm

Mating type female x male	number of females	FEMALES								litter size at birth per female		litter size at weaning per female		survival rate %
		bearing		barren		miscarried		destroyed						
		n	%	n	%	n	%	n	%	total	bearing	total	bearing	
white neck x white neck	32	26	81.25	2	6.25	1	3.12	3	9.38	3.00	3.69	2.72	[illegible]	[illegible]
white neck x silver	408	316	77.45	43	10.54	6	1.47	43	10.54	4.72	4.72	3.24	4.18	[illegible]
silver x white neck	188	155	82.45	13	6.91	6	3.19	14	7.45	4.30	4.80	3.48	4.23	[illegible]
silver x silver	750	591'	78.80	56	4.50	3	0.40	100	13.30	4.31	4.81	3.40	[illegible]	[illegible]

In the examined farm white neck were also mated with platinum foxes (*ref. 1*).
Although only two litters obtained from platinum female x white neck male mating were recorded, three types of offspring were present: silver (4 animals), platinum (2) and white neck (1). The presence of silver pups in such a litter points to heterozygosity of their parents, and the simultaneous presence of silver, platinum and white neck animals suggests the allelomorphism of the colour genes responsible for all these colours.

The reproduction results in white neck and silver females from Batorówka farm are shown in table 2. Since the white neck fox is a new mutant variety, the data included in the table comprise the last 11 years. Average litter size at birth and at weaning per white neck female mated with a silver male and vice versa, as well as that regarding silver females mated with silver males are similar. Considerably different, however, are the results obtained from white neck x white neck matings. Although the number of such litters is not high (26) their average size is 25% lower.

Johansson (2) examined the reproduction in white face, platinum and silver foxes. According to that author the average litter size per female was 4.48, when silver x silver or silver x mutant (platinum or white face) were mated, whereas that of mutant x mutant was 3.56.

Johansson concluded that the lower litter size in mutants mated with mutants pointed to the lethality of homozygous forms regarding platinum and white face genes.

Fig 1. Ring neck pelts with medium to large collar. The white tip of the tail is a little different and almost like the one of the silver fox

Conclusion

The results of the colour pattern segregation in the offspring of white neck foxes mated among themselves and with silver and platinum animals point to the fact that the gene responsible for such a colour is an allelic variety of the gene from the locus "W" recognized earlier in the platinum fox (W^p). We propose to call the next gene from this series W^n (from "neck"). Unlike the platinum gene, W^n does not cause the hair colour to become lighter but it is responsible for the appearance of a white collar, a "mask" on the face, and white spots on the belly and legs.

The reproduction results obtained by the authors suggest that W^n, is also lethal when homozygous.

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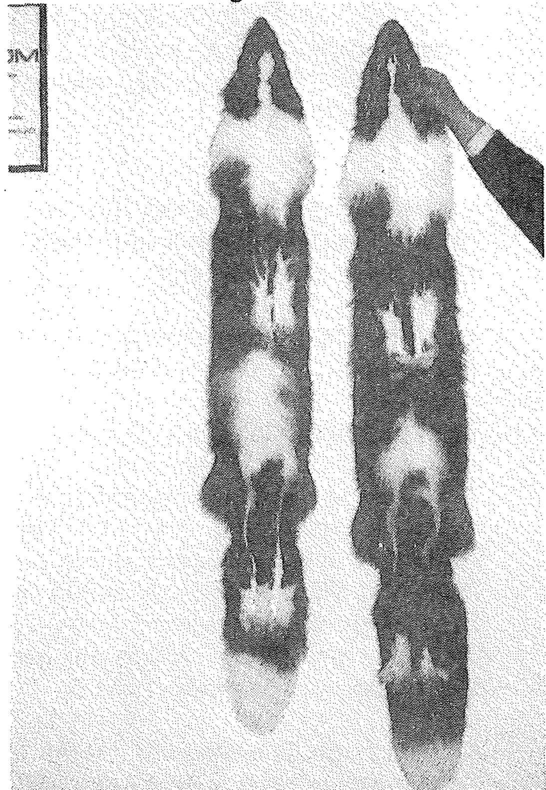
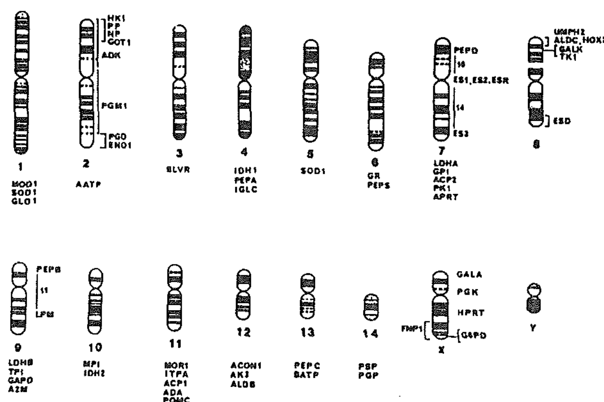


Fig. 2. The ventral side of the ring neck pelts in figure 1

American mink (*Mustela vison*) (2n = 30)

O.L. Serov, S.D. Pack

60 genes are listed, and for each, the gene symbol, the locus name, the chromosomal location and literature reference are given. The chromosomal assignment of 55 genes was done by using mink-mouse or mink-Chinese hamster somatic cell hybrids; for 30 of these, both hybrids were used. A karyotype of prophase and metaphase chromosomes stained by the G-band method is shown.



Genetic maps locus of complex genomes 4.126-4.128, 1990. 1 table, 1 fig., 19 refs. In ENGL. CAB-abstract.

On homology between the Lpm system of allotypes in American mink and the Gp system of allotypes in domestic pigs

V.I. Yermolaev, E.G. Mirtskhoulava, M.A. Savina, I.G. Gorelov, R.C. Matichashvili, O.K. Baranov

The 5α-macroglobulin allotypes αM1, αM2, αM3, αM4 and αM5 were identified in the pig. The αM1 allotype was reported as a marker of pig α-macroglobulin, the latter being homologous to α2-macroglobulins in the human and in the mink. The allotypes αM2-αM5 were specified as markers of the second isotypical variant of pig α-macroglobulins, which was homologous to mink Lpm macroglobulin (α_1M).

As seen from data obtained by the International Comparative Test ISABR 87-88, αM1 is a new allotype, while allotype αM2-αM5 correspond to four allotypes in the Gp system (*Janik et al.*). Based on these data, a conclusion was made on the homology between the Lpm system in American mink and the Gp system in the pig. Since the allotypes studied are the part of α-macroglobulins, a locus controlling them was designated the AM locus. We also find it more advantageous to apply the same name to the homologous locus in mink, instead of the Lpm used earlier. Genetic control of 5 allotypes was studied and the structure of the AM locus in pig analysed in detail. A comparative study of the organization of the above locus and the homologous locus in mink was carried out.

Genetika (Moskva), Vol. 27, No. 2, pp. 304-315, 1991. 4 tables, 3 figs., 29 refs. In RUSS, Su. ENGL. Authors' summary.

Immunogenetics of immunoglobulin in domestic mink

I.I. Fomicheva

Reduced expressivity and penetrance of allotypes H2-H4 and the regulation of allotype H6 expression by a regulatory gene concealed the linkage of mink C genes in statistical analyses. Their linkage was demonstrated by di- and polyhybrid test crosses with 3,4 and more generations.

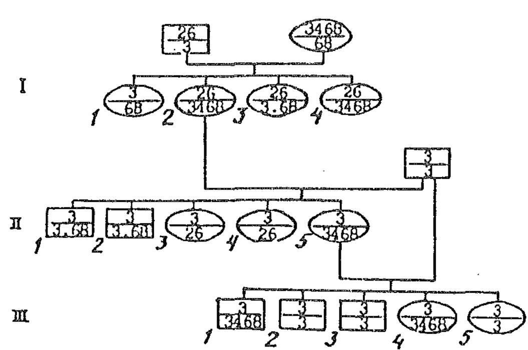


Рис. 3. Сцепленное наследование четырех Сγ-аллотипов в составе гаплотипа H3H4H6H8. Точкой обозначено отсутствие экспрессии аллотипа

Genetika (Moskva), Vol. 28, No. 8, pp. 142-152, 1992. 1 table, 6 figs., 42 refs. In RUSS, Su. ENGL. Author's summary.

Activation of expression of two mink immunoglobulin CH genes after infecting mink with the Aleutian disease virus

I.I. Fomicheva, D.K. Tsertsvadze, O.Yu. Volkova, N.A. Popova, S.I. Smirnykh, N.A. Kisteneva, K.N. Kuznetsov, V.F. Kudashev, Yu.D. Kaveshnikov

110 ranch-raised mink were injected with the Aleutian disease virus. Allotypes of constant regions of γ-heavy chains of the mink immunoglobulins secreted were analysed during 3 months.
Activation of the expression of two markers (H3 and/or H4) up to minor or to nominal level (above 200 μg/ml) was observed. No such enhancement of expression of two other allotypes (H6 and H8) was found. The results suggest that the expression of two mink immuno-globulin CH genes induced by viral infection have allotype-specific regulation.

Genetika (Moskva), Vol. 27, No. 5, pp. 895-902, 1991. 3 tables, 39 refs. In RUSS, Su. ENGL. Authors' summary.

Use of DNA fingerprinting to determine parentage in muskrats (*Ondatra zibethicus*)

L. Marinelli, F. Messier, Y. Plante

The detection of high levels of genetic variability by DNA fingerprinting probes has allowed researchers to accurately assess relatedness. Multiple-mating strategies are characteristic of the mating systems of small mammals. As such, techniques that provide an accurate indication of how individuals are related genetically is of great importance to assess the mating system of a species.

In this study, we applied the DNA fingerprinting technique to captive and wild muskrats (*Ondatra zibethicus*) to determine its usefulness for parentage analysis in wild populations. We found that DNA digested with the restriction enzyme *Hae* III and probed with Jeffreys's mini-group. In the wild population, paternity was assigned between two adult males based on diagnostic fragments and similarity of banding patterns. The likelihood that paternity could be misassigned to a full sibling was high in this free-ranging population. However, because natal dispersal in muskrats is male biased, it is unlikely that two brothers would associate with the same female.

Journal of Heredity, vol. 83, No. 5, pp. 356-360, 1992. 3 tables, 1 fig., 31 refs. Authors' summary.

Molecular cloning and characterization of ferret *Pneumocystis carinii* gp120

C.G. Haidaris, T.W. Wright, F. Gigliotti, P.J. Haidaris

Based on antibody reactivity to recombinant clones, Western blotting, indirect immunofluorescence assays, Northern blotting and Southern blotting, we demonstrate that we have cloned a portion of the gene encoding the major glycoprotein (gp120) of ferret *Pneumocystis carinii.*

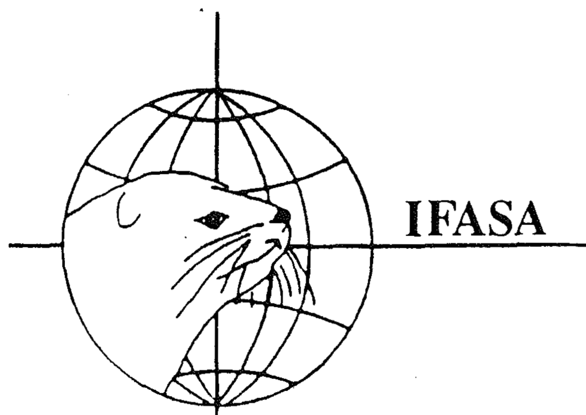
Journal of Protozoology, Vol. 38, No. 6, pp. 5S-6S, 1991. 7 refs. Authors' abstract.

Conservation of animal gene resources in the Nordic countries

K. Maijala, A. Neimann-Sörensen, S. Adalsteinsson, N. Kolstad, B. Danell, B. Gjelstad

The Nordic Working Party on animal gene banks (NAGB) has (1) mapped out conservation needs and activities, (2) mediated information about these, (3) initiated establishment of national gene banks, (4) built a Nordic information centre with data bank, (5) followed progress and applied results of research on methods for conservation, (6) distributed information on scientific and popular levels, and (7) seeked collaboration with similar activities in plants and animals.

Proceedings of the 4th World Congress on Genetics applied to Livestock Production, Edinburgh 23-27 July 1990 XIV Dairy cattle genetics and breeding, adaptation, conservation 459-462, 1990. 3 refs. authors' summary.



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Original Report

Endocrine testicular function in the male mink and blue fox and methods of its stimulation

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Russian Academy of Sciences, Pushkinskaya 11,
Petrozavodsk, 185610, Russia

Summary

Endocrine testicular function in dark-brown mink and blue fox males during the ontogenesis period (from 1 to 10 months) and in pubertal specimens 2-3 years old was assayed in various biological periods. The stimulation of the reproductive function by the use of the acoustic irritants of the "rut calls" type and the effect of chorionic gonadotropin were also studied. It was determined that the level of active androgens (testosterone + dihydrotestosterone) in mink and blue fox remained low in summer. The increase in the level of hormones took place in mink in December and in blue fox in late January. Maximum gonad function activity in mink and blue fox males was detected at the age of 10 months. Prior to rut, the testosterone level in mink was 3 times higher than in blue fox. It was observed that the period of hormone function activation in blue fox was considerably shorter than in mink. Acoustic stimulation prior to rut promoted the increase in the concentration of testosterone in the blood of blue fox in contrast to mink and the increase in reproductive qualities of both species. Injections of chorionic gonadotropin to 6 month-old blue foxes for 3 days (70 IU per animal) reliably increased the level of androgens in blood.

Introduction

Seasonal reproduction is a pronounced feature of the majority of wild animals, including the Mustelidae and Canidae families, and it is very difficult to determine the beginning and the end of the pubertal changes in reproduction function because puberty can be retarded by environmental factors. In Mustelidae the hormone function in the ontogenesis period was studied the most thoroughly in mink and polecat (*Nieschiag, Bienick, 1975; Boissin-Agasse & Boissin, 1979; Sundqvist, 1992*). The dynamics of hormone testicular ativity in the ontogenesis period in silver fox males was observed by Osadchuk (1992); M. Joffre & J. Joffre (1975), who noted that the high level of testosterone in the blood of fox cubs was altered by the significant fall in the production of androgens during the following 4 months of their lives. In spring, after the end of reproduction, the decay in the development of gonads generally begins in Mustelidae and Canidae Mails (*Ilina, 1975*). The activation of testicular gametogenous and hormone function resume in October-November in connection with the change in light that leads to the activation of the hypothalamus-hypophysis system and the increase in the secretion of prolactin and gonadotropins (*Klotshkov et al. 1982; Boissin-*

Agasse, 1983). High androgen testicular activity in pubertal mink and blue foxes during the rut period was found by many researchers (*Sundqvist et al. 1984; Tug, 1984; Smith et al. 1985*).

One of the main tasks of present-day fur farming is the increase in the efficiency of pedigree stock breeding and the improvement of reproduction qualities. Endocrine disorders are possible reasons for difficulties emerging at fur farms. To stimulate and regulate the sexual cycle, environmental factors (light, acoustic stimulators etc.) and biologically active substances (gravohormone, chorionic gonadotropin (CG), gonadotropin releasing-hormone (Gn-RH)) are used. Nevertheless, the application of exogenous preparations remains limited in fur animals up to now. It is probably connected with insufficient knowledge about hormone function and the utmost conservatism of biological functions in these animals.

Materials and methods

Our many years long observations of the endocrine function in mink and blue fox males during postnatal ontogenesis (from 1 to 10 months) and in pubertal animals in various biological periods as well as some ways of reproduction stimulation are represented in this article.

The research was performed on healthy dark-brown mink and blue fox males 1-10 months old and on mature 2-3 year-old animals in various periods of the reproductive cycle. The state of endocrine function activity was determined according to the summarized content of testosterone and dihydrotestosterone in peripheral blood serum. The hormones were analysed by the radio-immunologic method using "Beloris" sets. The obtained results were analysed with the help of the Student's t-test.

Results and discussion

Mink

The testosterone level in standard mink males 1 month-old is low and is 1.0 + 0.3 nmol/l. Slight decreases in the content of androgens was observed in 2 month-old mink while the activation of androgen function took place in 4 month-old mink (1.74 + 0.7); the activity kept increasing at the age of 5 months ($P < 0.001$) and a more than 2-fold increase in androgen level was observed in 6-7 month-old mink (4.86 + 0.9 nmol/l, $P < 0.001$).

In the period from 8 to 9 months the activity kept increasing and in 10 month-old mink the testosterone concentration became maximum in late February (7.2 + 0.9 nmol/l, $P < 0.001$ - fig. 1) compared to early ontogenesis.

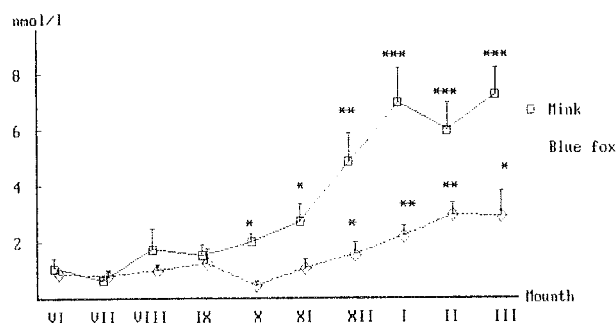

Fig. 1. Testosterone dynamics in the serum of mink and blue fox of different ages. The significance in comparison with one-month-old kits is marked by asterisks: * - $P<0.05$; ** - $P<0.01$; *** - $P<0.001$

Thus, the content of androgens in mink blood in ontogenesis increases in the process of growth and at the onset of puberty by the age of 8-9 months, i.e. by the beginning of the reproduction period. Maximum testosterone content was found to be at the age of 10 months. The data presented by Strunnikova (*Sirotkina et al., 1984*) generally coincide with the results obtained by Polyntsev (1981). But the author detected the beginning of hormone level increase at the age of 5 months interpreting the fact as an indication of the onset of mink male puberty, and the following decrease in testicular activity was explained by seasonal effect.

The foregoing data on the dynamics of the hormones level in mink males agree well with the morphologic changes in the animals' testicles at this time (*Onstad, 1967; Yurisova & Klotshkov, 1978; Mata, 1982*). Onstad observed that the number of lipid inclusions in mink Leidig cells increased since the 4th month and became maxi-

mum at the age of 7 months. After that their content decreased. In the spring months after the reproduction period the decay in gonad development began. In summer the male genitals atrophied. The mass of testicles decreased to 1 g compared to 2.5 g in the rut period, testicular canalicules faded and spermagenesis stopped. According to our data (fig. 2) the androgen concentration in pubertal mink male blood remained low in summer (0.01 + 0.26 nmol/l). From October a pronounced increase in testosterone secretion began, its content increasing by 2.9 + 0.6 nmol/l, $P < 0.05$. After that the activation of gematogenous and hormone testicular functions caused by the light change was observed, lasting to an increase in activity of the hypothalamos-hypophysis system and the increase in prolactin and gonadotropin secretion. In December-January the testosterone content in the blood increased more than 2 times (6.3 - 13.1 nmol/l). By the beginning of the rut the hormone concentration increased even more (21.7 + 4.5) High testosterone level were retained during February (27.4 + 2.9 nmol, $P < 0.001$). In March, during the active rut period, the decrease in the level of androgens (11.3 - 16.1 nmol/l) was observed though its content remained rather high. Intensive androgenous activity in mature mink during the mating period was emphasized by some authors (*Nischlag & Bienick, 1975; Sundqvist et al., 1988*).

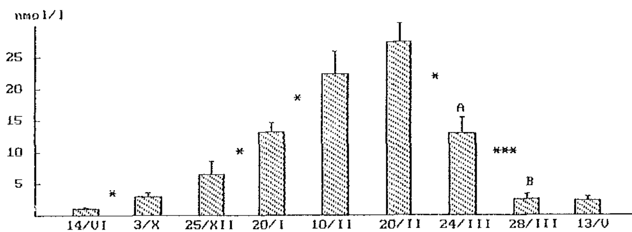

Fig. 2. Testosterone dynamics in the blood serum of adult mink during a year (A - active males; B - "infertile" males)

It was stressed in our studies that testosterone concentration in males unable to mate was lower in March than in active males and approximated the values observed in summer (2.6 + 0.7 nmol/l, $P < 0.001$ - fig. 2). These data coincide with the results presented by Tung et al (1984) that testify to the low level of LH and testosterone in black sterile mink males, but in the opinion of Sundqvist et al. (1984) surplus testosterone production at the beginning of the activation of sexual function has a negative effect on the quality of mink sperm in the period of rut. After the end of the reproduction period testicular function in mink definitely decreased. In April the level of testosterone became more than 5-fold lower than in March, the difference between the content of testosterone in "active" and sterile males blood vanished.

Blue fox

The study of hormone function in the ontogenesis period in blue fox males was conducted at the age of 1 to 10 months. The dynamics of androgen content is shown in fig. 1. It reflects a substantial decrease in the function of androgens production in 1-3 month-old blue foxes (0.86 + 0.2 - 0.66 + 0.2 nmol/l). In 4 month-old males an increase in testosterone secretion took place (1.2 + 0.5 nmol/l). This can be interpreted as an initial indication of the onset of puberty of blue foxes. The hormone concentration was reduced in 5 month-old blue foxes, probably because of the seasonal effect. The pronounced increase in the function of gonads began at the age of 7 months and increased by the age of 9-10 months (January) reaching the level of 2.95 + 0.4 nmol/l (*Sirotkina, 1992*).

The testosterone level in the blood of mature blue fox males turned out to be low in summer, as in mink. The low values of hormone activity were retained early as well (0.53 + 0.1 nmol/l - fig. 3). From late January to early February the first increase in hormone secretion (4.3 + 0.9) was observed. Before the mating period (late February) the testosterone content kept increasing in blue fox blood and reached its peak (8.6 + 1.2 nmol/l, $P < 0.01$).

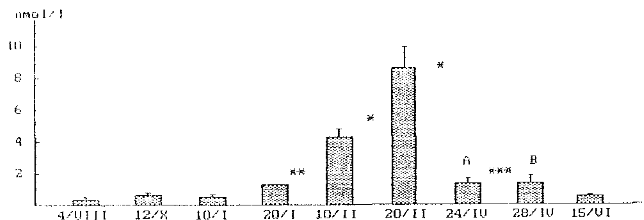

Fig. 3. Seasonal variations of serum testosterone in the adult blue fox (A - active males, B - "infertile" males)

After the mating season (April) the hormone concentration reduced markedly (1.3 + 0.3, P < 0.001). The distinction be-tween the hormone level in actively reproducing males and the sterile ones was not detected. The testosterone level did not exceed 1.3 + 0.5 nmol/l. Similar dynamics in hormone function and morphological changes were presented by Andersen (1980), and Sundqvist et al. (1984), who showed the correlation of these functions and the agreement of the obtained data. The pulse inflow of testosterone in blood with its peak concentrations occurring within 20-60 minutes is characteristic of the representatives of Canidae and the other species. The same pulse pattern is also peculiar to LH. The data were obtained in the assay on the levels of testosterone and gonadotropins in dog blood (*De Coster et al., 1979*).

Hormone function stimulation in mink and blue fox

For several years we have been conducting research on the stimulation of sexual and hormonal function in males and females of fur animals "Rut call" acoustic stimulators as well as biologically active substances - chorionic gonadotropin and prostaglandins were used. The "rut call" acoustic stimulators were recorded and played at the farm 20-25 days prior to the beginning of rut in February. The intensity of sound reached 60-80 db (*Tyutyunnik et al. 1987*). The blood of mink and blue fox was tested 10-12 and 25 days after the acoustic stimulation. The animals that were kept in a separate section, chosen according to age and reproduction qualities of the previous year, made up a reference group. After the "rut call" acoustic stimulation, an increase in the testosterone level (fig. 4) was observed in the dark-brown mink males in 10 days compared to the initial period of studies. The values were higher in test animals (27.2 + 6.5 nmol/l) than in the reference group (21.8 + 4.5). After 25 days of acoustic stimulation the testosterone level reduced in test animals and in the reference group as well, but the reduction turned out to be more pronounced in reference group males (16.1 + 4.2 nmol/l) compared to test animals (21.1 + 0.7). The first blood test was carried out in blue foxes before the reproduction period (February 10th) and the second test was performed 12 days after the acoustic stimulation (February 22nd). At the beginning of the experiment the content of testosterone in blood was equal in both groups (fig. 4), and 12 days after the acoustic stimulation a substantial difference was detected: the hormone content increase in test males was 2.5-fold higher (11.2 + 2.2 nmol/l compared to 4.4 + 1.2, P < 0.05). A certain increase in the activation of hormone function in reference group males took place, but was less pronounced than in the test group (7.4 + 1.1 compared to 4.5 + 0.96, P < 0.05).

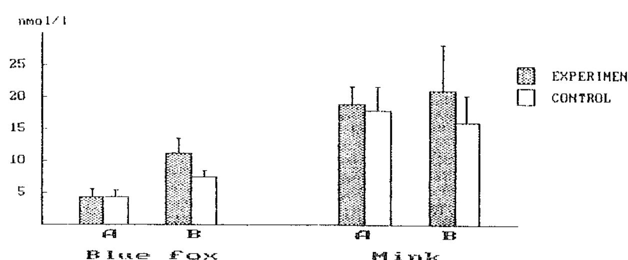

Fig. 4. The influence of acoustic irritation "rut calls" on testosterone dynamics in the blood serum of mink and blue fox (A - before acoustic irritation, B - past acoustic irritation)

Thus, the use of "rut call" before mating in blue fox males, in contrast to mink, led to an increase in the testosterone content in blood up to the values peculiar to the period of active reproduction, whereas in mink the acoustic stimulation did not cause a marked change in the androgen concentration in blood, only a tendency to the increase in the hormone activity of gonads was shown. Nevertheless, both in blue fox and mink acoustic stimulation promoted an increase in reproduction qualities such as fertility and the number of cubs per female.

In order to study the impact of the gonadotropic hormones on endocrine testicular function in the ontogenesis period, an experiment was carried out on blue foxes 5-6 months old. The males were subdivided into two groups. The hypodermic injections of CG (70 IU per animal) were made in the 1st group and 3-fold injection of CG, 70 IU each for 3 days were made in the 2nd group. The blood test on the content of sexual hormones was performed a day after CG injection in the 1st group and 3 days after the first injection in the 2nd group. The testosterone content test showed (fig. 5) that its substantial

increase took place only after the 3-fold CG injection (1.48 + 0.3 nmol/l in test group compared to 0.7 + 0.17 nmol/l in the reference group, $P < 0.05$). The androgen content did not reach the values peculiar to mature animals in the rut period.

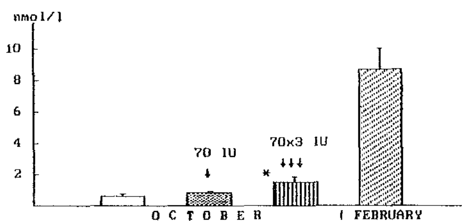

Fig. 5. The stimulation influence of gonadotropin (GC) (70 IU per animal) on endocrine testicular function of blue foxes 5-6 months old. The significance of differences in comparison with basal level is marked by asterisks: $P<0.05$.

Thus, the gonads of 5-6 month-old blue fox cubs are able to respond to the stimulating influence of gonadotropins. But even 3-fold stimulation with CG does not lead to the optimum hormone response but the use of various biologic stimulators can promote the development of reproduction control methods in fur animals. On the basis of our observations we have found out that the values of testosterone content in mink in the period of sexual quiscence and in the beginning of the rut period exceed 2-3-fold the testosterone content in blue fox. The period of the activation of hormone function is much shorter than in mink.

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Light, melatonin and reproduction in mink

L. Martinet, C. Bonnefond, D. Allain

The mink (*Mustela vison*) is reared for its fur. Periods of moulting and growth of hair are strongly correlated with those of gonadal activity. Research carried out at INRA has been oriented towards improving our knowledge of the control of the period of moulting and hair growth and of the control of reproductive cycles. Like most mammals living in temperate and cold zones, the mink shows annual cycles of reproduction, metabolism and moulting which are driven by annual variations in day length. The pineal gland (PG) is a key element in the photoperiodic control of annual cycles: 1) in mink maintained under constant day lengths the disappearance of certain cycles (growth and regression of the testis) or the appearance of circannual cycles (moulting), whose period is close to but not equal to one year, is observed; 2) in mink maintained under natural environmental cues, similar results are obtained after pinealectomy or denervation of the PG by superior cervical ganglionectomy (SCGX). The rhythmic secretion of melatonin (Mel) by the PG transduces the pholic signals received by the retina into a hormonal signal: - in the mink as in other mammals, the duration of Mel secretion is proportional to the length of the night; - during pregnancy, progesterone secretion is inhibited when the photoperiod is less than 12 h. This inhibition is absent in females in which Mel secretion has been suppressed by SCGX; - the administration of Mel to SCGX females by appropriate daily intravenous infusions reproduces the inhibitory effect of short days (such as an 11-h or longer perfusion, mimicking a night of 11 h or more) on progesterone secretion. In the mink, it is not the daily rhythm of Mel secretion which seems necessary to signal photoperiodic information but a threshold daily duration; 1) growth of the testes begins at the end of November when photoperiod is <10 h and the duration of the nocturnal Mel peak is >14 h. Transferring males to an artificial photoperiod of 8 h in July induces this growth as early as September; 2) this early regrowth is also observed in males maintained under a 16:8 hr light/-dark cycle receiving either a subcutaneous Mel implant, or a daily Mel injection in late afternoon. Resumption of testicular activity is always preceded by autumn moulting and winter fur growth which is the marketed mink product. The use of Mel implants has led one of the authors to propose a method of early induction of winter fur growth. The use of Mel, or perhaps agonists, may allow better control of the reproductive cycles in this species.

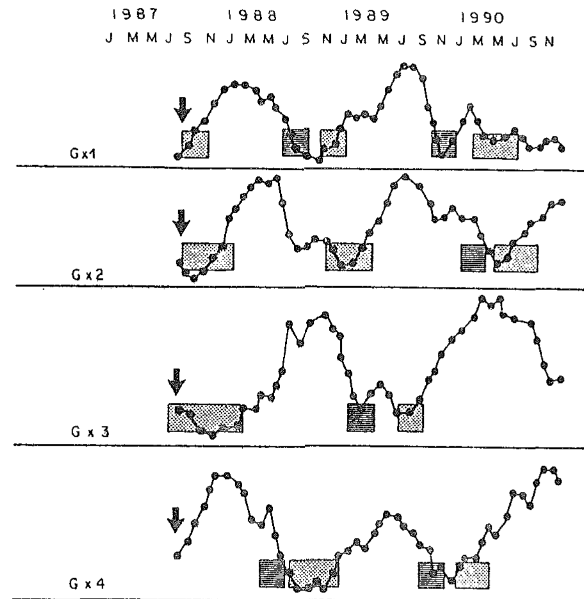


Fig. 5. Variations in plasma concentrations of prolactin and periods of moulting in the spring (line) and in the autumn (dots) in males kept under natural environmental conditions and after superior cervical ganglionectomy (SCGX)

Ann Zootech, V. 41, pp. 271-277, 1992. 7 figs., 7 refs. In FREN, Su. ENGL. Authors' summary.

The optimum time for single artificial insemination of blue fox vixens (*Alopex lagopus*) with frozen-thawed semen from silver foxes (*Vulpes vulpes*)

W. Farstad, J.A. Fougner, C.G. Torres

During the breeding season of 1991 a total of 608 blue fox vixens aged 1 to 6 years (2.3 ± 0.1 years, mean ± SEM) from 2 farms were artificially inseminated intrauterine once with frozen-thawed silver fox semen (1 ml dose containing a

total of 150 million spermatozoa). The vixens were allocated to 3 different groups according to the time of insemination. Vixens in Group 1 (n = 203), Group 2 (n = 198), and Group 3 (n = 207) were inseminated on the first, second or third day after the peak value of vaginal electrical resistance, respectively.

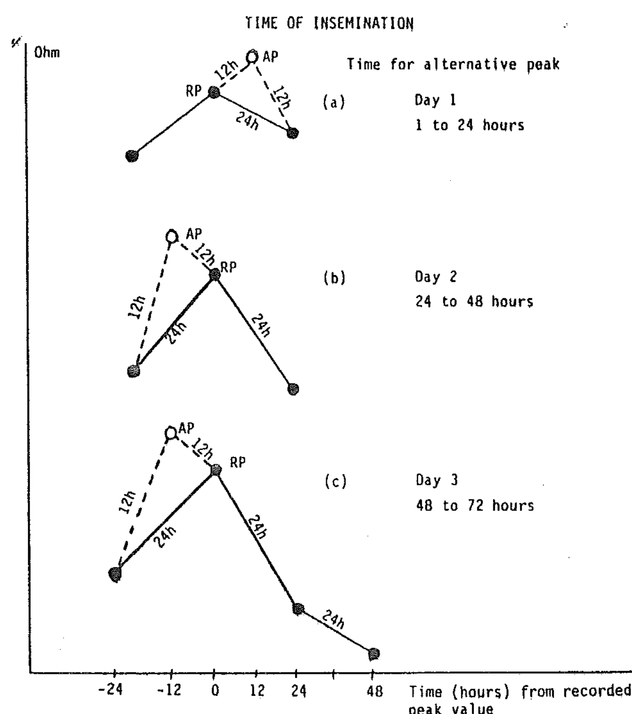


Fig. 1. Examples of curves based on measurements of vaginal electrical resistance values (in ohms). The recorded peak (RP) is the maximum ohm value actually registered by the heat detector. The alternative peak (AP) is the estimated true peak which may have occurred any time during the 24-hour period between measurements. In the figure the alternative peak is shown to have occurred 12 hours before (a) or 12 hours after (b) the recorded peak as an example. Days 1, 2 and 3 represent the time period from the true peak of the curve to insemination at 1 to 24 hours, 24 to 48 hours and 48 to 72 hours.

An overall conception rate of 75% (456 of 608) and 6.0 ± 0.1 (mean ± SEM) cubs per litter was obtained. Conception rates and mean litter sizes were significantly different between groups of vixens with respect to day of insemination (P = 0.02, Chi-square, Kruskall-Wallis Test). Vixens inseminated on the second day (Group 2) had the highest conception rate (81%) and the largest mean litter size (7.0 ± 0.2 cubs) of the three groups, while those inseminated on the third day (Group 3) had the lowest conception rate and mean litter size (70%, 5.4 ± 0.3 cubs).

Theriogenology, 38, 5, pp. 853-865, 1992. 2 tables, 1 fig., 21 refs. Authors' abstract.

Single mating of mink

V.G. Bernatskii, V.V. Pomerantsev, N.K. Mamontova

The results are summarized of 6 experiments conducted at different fur farms. In the first experiment, the yield of kits from a single mating of each female was similar whether the females were treated with chorionic gonadotropin or GnRH, or were not treated. In the 2nd and 3rd experiment, which involved mink treated with chorionic gonadotropin or GnRH, and untreated females, whelping rate was higher from 2 matings during the same estrus than from 1 mating. In the 4th experiment, the number of embryos was determined at laparotomy in 13 females that had conceived after a single mating. Litter size averaged 9.1, and ranged from 8 to 13. In the 5th experiment, whelping rate and litter size were compared in mink females mated with males having their 1st matings of the season and males that had been used for mating several times during the same season. The whelping rate and litter size were similar for matings with the 2 groups of males. In the 6th experiment, females were injected with chorionic gonadotropin on 2 or 5 Mar., mated 7-8 days later, and given a 2nd injection of chorionic gonadotropin on the day of mating or the following morning. Whelping rate was 79.38% for females injected on the day of mating vs. 69.43% for the other group.

Krolikovodstvo i Zverovodstvo, No. 1, pp 6-7, 1990. In RUSS. CAB-abstract.

Comparative semen cryopreservation in ferrets (*Mustela putorius furo*) and pregnancies after laparoscopic intrauterine insemination with frozen-thawed spermatozoa

J.G. Howard, M. Bush, C. Morton, F Morton, K. Wentzel, D.E. Wildt

A study was conducted to determine an optimum technique for semen cryopreservation and the biological competence of frozen-thawed ferret spermatozoa. Fifty-two fresh electroejaculates from 4 males were evaluated for sperm percentage motility, forward progressive motility, motility index (SMI) and acrosomal integrity. To determine the optimum temperature for maintaining sperm motility *in vitro* and the influence of glycerol on sperm motility, seminal aliquants were diluted in TEST diluent (containing either 0 or 4% glycerol) and maintained at 25° or 37°C. For cryopreservation, semen was diluted in each of 3 cryodiluents (TEST, PDV, BF5F), cooled for 30 min at 5°C and pelleted on solid CO_2 or frozen in 0-25 ml straws (20°C/min to -100°C). Following thawing, SMI and acrosomal integrity were determined. Ten females with maximum vulval swelling were given 90 i.u. human chorionic gonadotrophin and laparoscopically inseminated *in utero* with spermatozoa previously frozen using the optimum diluent and freeze-thaw method. The maintenance temperature of 25°C was superior ($P < 0.05$) to 37°C for sustaining sperm motility, and glycerol did not influence ($P > 0.05$) motility for up to 11 h of culture. After thawing, motile spermatozoa were recovered in all treatment groups, but sperm motility and normal acrosomal ratings were highest using the PDV diluent, the pelleting method and thawing at 37°C ($P > 0.05$). Seven of the 10 ferrets (70%) inseminated with spermatozoa frozen by this approach became pregnant and produced 31 kits (mean litter size 4.4; range 1-9 kits). These results illustrate the sensitivity of ferret sperm motility and acrosomal integrity to different cryopreservation conditions, and demonstrate the biological competence of frozen-thawed ferret spermatozoa.

J. Reprod. Fert. 92, pp. 109-118, 1991. 2 tables, 5 figs., 42 refs. Authors' summary.

Luteal protein secretion during preimplantation in the ferret

Jun-Ling Huang, Madison Powell, Rodney A. Mead

Ferret CL were collected on Days 5-11 of pregnancy or pseudopregnancy and incubated in McCoy's medium with radiolabeled amino acids to determine the ability of ferret CL to synthesize and secrete proteins during the preimplantation period. Products recovered from the medium were separated by one- and two-dimensional SDS-PAGE followed by fluorography and were quantified by densitometry. Selected secretory proteins were tentatively identified with specific antibodies on Western blots. Ferret CL synthesized and secreted a relatively large number of radiolabeled products. The predominant secretory proteins had molecular masses of 16, 22, 28, 32, 47, 68, and 185 kDa and were secreted at all stages of the preimplantation period. There were no qualitative changes in ferret luteal protein synthesis and secretion between Days 5-11 of pregnancy, and neither ovine prolactin (oPRL) nor dibutyryl cAMP (dcAMP) affected the pattern of protein secretion. However, oPRL (100 and 1000 ng/ml) increased incorporation of radiolabeled amino acids into luteal proteins during a 36-h incubation. The relative mobility of a 185-kDa radiolabeled product was identical to that of α_2-macroglobulin (α_2M) subunits. Antibody to human α_2M cross-reacted with a product (185 kDa) in ferret luteal extracts and culture medium, and the partially purified protein (185 kDa) inhibited trypsin activity. The major radiolabeled secretory protein (32 kDa) exhibited weak cross-reaction with antibody to a human tissue inhibitor of metalloproteinase (TIMP). This study demonstrates the wide range of proteinaceous secretory products of the ferret CL, two of which have been tentatively identified as protease inhibitors.

Biology of reproduction 48, pp. 647-654, 1993. 2 tables, 17 figs., 37 refs. Authors' summary.

Sexual dimorphism in the effects of mating on the in vitro release of LHRH from the ferret mediobasal hypothalamus

G.M. Lambert, B.S. Rubin, M.J. Baum

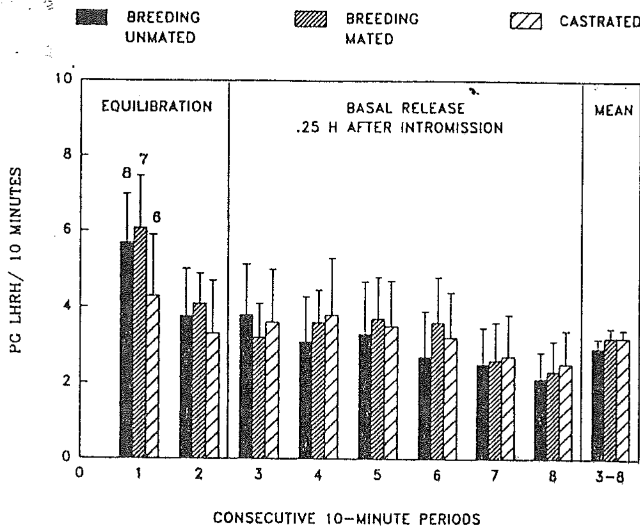


Fig. 2. Effect of achieving an intromission or castration on the in vitro release of LHRH from the MBH of male ferrets. Luteinizing hormone releasing hormone was measured in perifusion effluents collected at 10-min intervals from the MBH of groups of male ferrets (see key at top of the figure) killed at the same time as breeding males killed 0.25 h after achieving an intromission.

A sexual dimorphic pattern in the secretion of luteinizing hormone (LH) has previously been shown to occur in response to mating in an induced ovulating species, the ferret, with mating augmenting the secretion of LH in females but not in males. The aim of this study was to determine whether this dimorphic pattern in the postcoital secretion of LH reflects a dimorphic effect of mating on the neural release of luteinizing hormone releasing hormone (LHRH). The effect of mating on the in vitro release of LHRH from mediobasal hypothalami (MBH) collected from breeding male and female ferrets was studied. Luteinizing hormone releasing hormone release and content were significantly reduced in tissues from estrous females sacrificed 0.25 h after mating compared to unpaired estrous females and estrous females sacrificed 1 or 2.6 h after the mating stimulus. By contrast, the release of LHRH from MBH fragments and LHRH tissue content were equivalent in breeding males that were sacrificed 0.25 h after mating and in breeding males that were left unpaired. These data suggest that the postcoital surge of LH in the female ferret is preceded by a release of LHRH that initially depletes neuronal terminals within the MBH, whereas LHRH release, like pituitary LH secretion, is minimally affected by mating in males.

Physiology & Behavior, Vol. 52, pp. 809-813, 1992. 1 table, 3 figs., 23 refs. Authors' summary.

Role of ovarian steroids in development of uterine binding sites for prolactin in the ferret

Jack Rose, Jun-Ling Huang, Rodney A. Mead

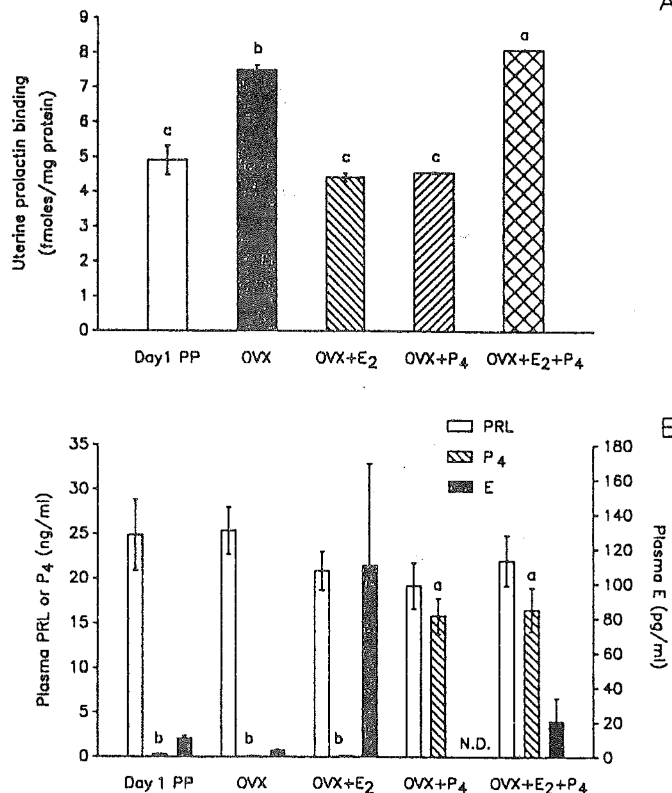


Fig. 5. A) concentrations of uterine PRL binding sites in Day 1 pseudopregnant (PP) and ovariectomized (OVX) ferrets treated with and without estradiol (E_2) and progesterone (P_4); B) plasma PRL, P_4, and E_2 concentrations in the same animals. In both graphs, means with different letters are significantly different ($P < 0.05$).

The objectives of this study were to investigate 1) the presence of specific prolactin (PRL) binding sites in the ferret uterus, 2) the uterine location of ^{125}I-labeled ovine PRL (oPRL) binding sites, 3) changes in uterine PRL binding sites during pseudo-pregnancy, and 4) regulation of PRL binding sites by ovarian steroids. Binding was determined through use of ^{125}I-oPRL and 300-800 μg of protein from the 50,000 x *g* particulate fraction. Optimal binding occurred within 6 h at 25°C. Scatchard analysis of saturation data revealed a single set of high-affinity ($K_d = 4.99 \times 10^{-11} \pm 0.88$ M), low-capacity (22.76 ± 1.62 fmol/mg) binding sites.

Analysis of hormonal specificity revealed that ovine growth hormone (oGH) cross-reacted with oPRL for the uterine binding sites, displacing 38% of the bound ligand. However, no inhibition of ^{125}I-oPRL binding occurred in the presence of a 500-fold excess of bovine thyroid-stimulating hormone (bTSH), ovine LH (oLH), or ovine FSH (oFSH), suggesting hormonal specificity of the binding sites that are located in the luminal and glandular epithelium. Prolactin binding to ferret uterine membranes increased during the first half of pseudopregnancy, plateaued between Days 21 and 28, and then declined. The concentration of PRL binding sites in uteri of ferrets on Day 1 of pseudopregnancy was 4.91 ± 0.42 fmol/mg of protein. Ovariectomy increased PRL binding (7.51 ± 0.12 fmol/mk), whereas ovariectomy and treatment with either estradiol (4.42 ± 0.12 fmol/mg) or progesterone (4.57 ± 0.03 fmol/mg) reduced the concentration of PRL binding sites to levels not significantly different from that on Day 1 of pseudopregnancy. Ovariectomized ferrets treated with estradiol and progesterone exhibited the highest concentration of PRL binding sites (8.09 ± 0.02 fmol/mg). These data suggest that ovarian steroids have a role in the development of uterine PRL binding sites, but the mechanism by which these steroids interact to enchance PRL binding is unknown.

Biology of reproduction 48, pp. 1266-1273, 1993, 1 table, 5 figs., 40 refs. Authors' abstract.

Maternal infanticide and periparturient behaviour in farmed silver foxes *Vulpes vulpes*

Bjarne O. Braastad, Morten Bakken

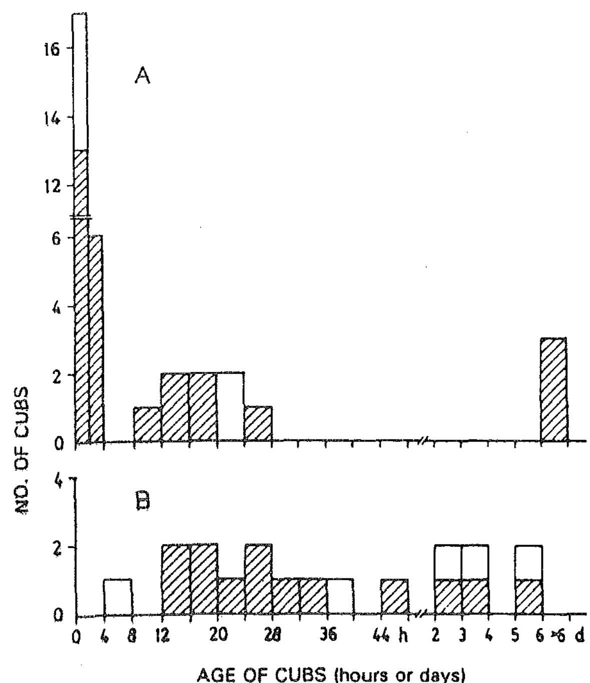


Fig. 1. Age distribution at time of observed death in cubs by cub-killing vixens. Hatched columns: cubs killed by mother, Open columns: cubs dying from other causes or as a result of obscure cub-killing. (a) Primiparous vixens; (b) multiparous vixens. The first 4-h period is divided into two periods of 2 h.

This study aimed at describing and searching for causes of infanticide by farmed silver-fox vixens. Reproduction and periparturient behaviour were studied in 21 litters of primiparous and 18 litters of multiparous vixens by video-recording inside the breeding box. Of 54 dead cubs, 41 had been bitten and probably killed. The probability that a cub with a primiparous mother would be killed was 37%. Seventeen vixens were categorized as infanticidal. Primiparous vixens killed cubs shortly after birth, whereas multiparous ones showed normal maternal behaviour

during parturition and killed later. Cubs were not killed more often during working hours. A longitudinal study including nine cub-killers showed that they usually repeated such behaviour in subsequent years. Half of the infanticidal vixens bit off the tails of their offspring prior to killing them. Dead cubs were treated as prey, often buried under wool tangles and later eaten, whatever the cause of death.

A quantitative analysis of behaviour was made by instantaneous sampling of 19 vixens (12 infanticidal). Cub-killing vixens and vixens which reproduced normally, in general, showed quite similar time-budgets of behaviour. Cub-killers also groomed cubs as frequently as non-killers, but stood more often when grooming, and showed more self-grooming and less resting inside the box during the first day post-partum. Environmental disturbances or social pathology were considered unlikely to be significant causes of cub-killing on the farm. Although several similarities were found with infanticide in other farm animals, infanticidal vixens did not show severe behavioural abnormalities.

Applied Animal Behaviour Science, 36, pp. 347-361, 1993. 4 tables, 1 fig., 35 refs. Authors' abstract.

The effect of domestication on mink

D.V. Klochkov, O.V. Trapezov

The onset of sexual maturity was studied in female mink, aged 7 months at the start of the experiment, from populations selected for domestication (tameness) or for aggression. Oestrus occurred earlier in domesticated than in aggressive mink. By Jan., the percentage of mink that had exhibited oestrus was 84 and 54.9 in the 2 groups resp. Domesticated mink had a higher number of early-stage maturing and atretic follicles than aggressive mink, but there was no difference in the number of mature follicles. Mink of both groups were subjeced to a light regime that simulated the early onset of autumn. The results indicated that aggressive mink were more sensitive than domesticated mink to photoperiodic stimulation of ovarian follicular development.

Krolikovodstov i Zverovodstvo, No. 41, pp. 10-11, 1992. In RUSS. CAB-abstract.

Effects of whelping date, date of last breeding and different mating sequences on number of mink kits born alive

R.L. Park

Over 75,000 litter records obtained from seven different mink ranches were analyzed as to the effects of whelping date and last breeding date on number of live kits born. Seven mating sequences were also considered. Smaller litter sizes were observed in the last part of the whelping season for females mated only once or twice on consecutive days. However, these reductions were not correlated with later mating dates in the breeding season.

Proceedings of the 4th World Congress on Genetics applied to Livestock production, Edinburgh 23-27 July, 1990 XV Beef cattle, sheep and pig genetics and breeding, fibre, fur and meat quality 195-198, 1990. 4 tables, 9 refs. Author's summary.

Effects of PCB and different fractions of PCB on the reproduction of mink (*Mustela vison*)

J.E. Kihlström, M. Olsson, S. Jensen, Å. Johansson, J. Ahlbom, Å. Bergman

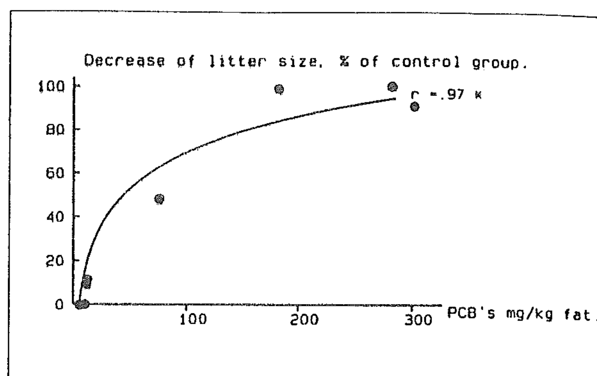


Fig. 6. Decrease of litter size, expressed as % of the corresponding control value, plotted against the mean concentration of PCBs found in mink dams given various amounts of PCB in feed. The log line correlation is calculated on basis of log transformed data for PCB concentration.

Reproductive outcome of 160 female mink (*Mustela vison*) of Standard Breed given daily doses of commercial PCB or fractions of it was studi-

ed. Exposure began in February and ended 5 days after parturition or expected parturition in mid-May. Fractions of PCB studied were (i) chlorinated biphenyls (CBs) with 2 or more chlorine atoms in the *ortho*-postitions to the biphenyl bond; (ii) CBs with only one chlorine atom in *ortho*-position; (iii) CBs without chlorine atoms in *ortho*-position; (iv) the bi- and tricyclic contaminants found in technical PCB.

Finally, a mixture of synthesized CBs without chlorine atoms in *ortho* positions was studied. Exposure to PCB, 2 mg Clophen A50 per or 1.64 mg Aroclor 1254 per day per individual decreased the number of live whelps born as well as the litter size without decreasing the implantation rate. The frequency of interrupted pregnancies increased, as did relative live weights. These results confirm earlier observations. The same results were obtained when the animals were given combinations of two or more CB fractions. When given single CB fractions separately, no significant such effects occurred. However, exposure to the single fraction containing the bi- and tricyclic contaminants-polychlorinated naphthalenes (PCN) and polychlorinated dibenzofurans (PCDF)- produced a significantly higher number of live whelps and increased survival rate. In general, the discrepancy in concentrations of total PCB in extracable fat in the various groups normally corresponded to the discrepancy of total doses given.

AMBIO, Vol. 21, No. 8, pp. 563-569, 1992, 3 tables, 6 figs., 39 refs. Authors' summary.

Biochemical blood parameters in pregnant mink fed PCB and fractions of PCB

L.-E. Edqvist, A. Madej, M. Forsberg

Biochemical parameters in blood and urine of pregnant mink fed commercial PCB, CB fractions and mixtures of the latter were examined. Mink were fed PCB fractions starting about 35 days before mating and continuing for 50 days thereafter. In 1990, mink were exposed to PCB for 53-69 days and were sacrificed 10, 17 and 26 days after mating. Blood samples were obtained at the time of sacrifice. No significant alterations were registered for the urinary parameters. Animals fed commercial PCB, but not fractions of CBs, all had elevated alanine aminotransferase (S-ALAT) ($p < 0.05$). Mink fed commercial PCB, individual or combined CB fractions had lowered ($p < 0.05$) alkaline phosphatase (S-ALP). Lowered ($p < 0.05$) serum bile acids (S-BA) were recorded in animals fed commercial PCB or 2-4-*ortho* + 1-*ortho* + 0-*ortho* and 2-4-*ortho* + 0-*ortho*.

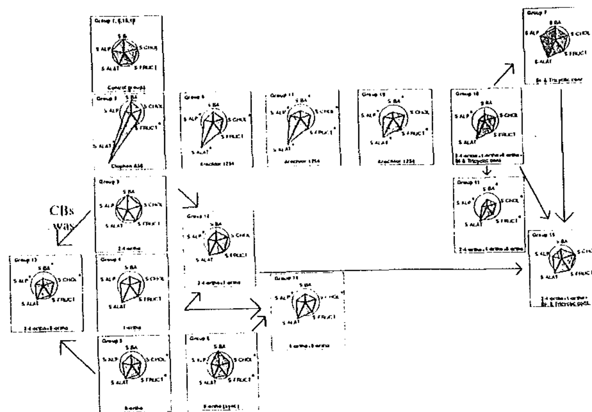


Fig. 4. Vector diagrams for S-ALAT; S-ALP; S-bile acids (S-BA); S-cholesterol (S-CHOL) and S-fructosamine (S-FRUCT) for the different groups of mink. The group mean values for the different control animals (top left) were arbitrarily assigned to be 100%. The diagrams for the experimental groups represent percentage change for each of the parameters in relation to the respective control group.* denotes values which are significantly different ($p < 0.05$) from the corresponding control animals.

The presence of bi- and tricyclic contaminants counteracted some of the observed biochemical changes, in particular decreases in S-fructosamine and in S-cholesterol. This protective effect and the lack of reponse in animals fed the contaminants could be attributed to induction of catalytic enzymes. Patterns of S-ALAT, S-ALP, S-BA, S-cholesterol and S-fructosamine for animals fed 2-4-*ortho* resembled the pattern for the control groups, whereas the combination of 2-4-*ortho* + 0-*ortho* CBs resulted in a pattern which was similar to that in animals fed commerical PCB. Significant differences from control animals were more frequent in animals given 0-*ortho* than 1-*ortho* CBs. The patterns of biochemical changes for groups of animals fed

0-*ortho* CBs alone or in combination with other CBs best reproduced the pattern of the animals fed commercial PCB. The biochemical changes observed indicate that feeding of PCB or fractions of CBs causes a disturbance in hepatocytes.

AMBIO, Vol. 21, No. 8, pp. 577-581, 1992. 1 table, 4 figs., 35 refs. Authors' summary.

Induction of cytochrome P-450-dependent enzyme activities in female mink (*Mustela vison*) and their kits by technical PCB preparations and fractions thereof

Björn Brunström

Clophen A50 (2 mg daily during the reproduction season) enhanced ethoxyresorufin *O*- deethylase (EROD) activities 2- to 3-fold in female mink (*Mustela vison*). Four fractions were prepared from the technical preparation: non-*ortho*-chlorinated chlorobiphenyls (0-*ortho*-CBs), mono-*ortho*-chlorinated CBs (1-*ortho*-CBs), CBs having 2 to 4 *ortho* chlorines 82-4-*ortho*-CBs), and bi- and tricyclic impurities.

The fractions containing 0- or 1-*ortho*-cBs induced EROD 2- to 3-fold in adults and strongly enhanced EROD (about 30-fold) in kits of treated females.

In a second study, Aroclor 1254 and each of three mixtures of the four fractions prepared from Aroclor 1254 (the fractions containing 1- or 2-4-*ortho*-CBs, the fractions containing 0- or 1-*ortho*-CBs, and all four fractions) all enhanced AHH about 2-fold in adults.

The results of the two studies indicate that EROD and AHH were maximally induced in adults by the 0- as well as the 1-*ortho*-CBs and that mink kits are more responsive than adults to P-450-inducers.

In a third study, enzyme activities were measured in Aroclor 1254-treated, fed daily and starting one month before mating, and control females at 10, 17, and 26 days after mating.

The PCB-treatment enhanced enzyme activities 1.6 to 2.7 times, an induction similar to that found 5 days after whelping in the two other studies.

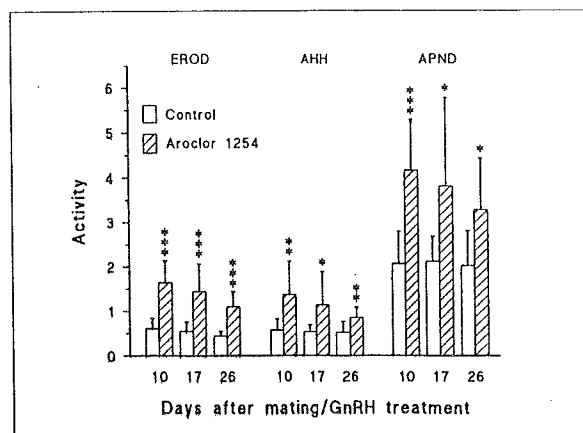
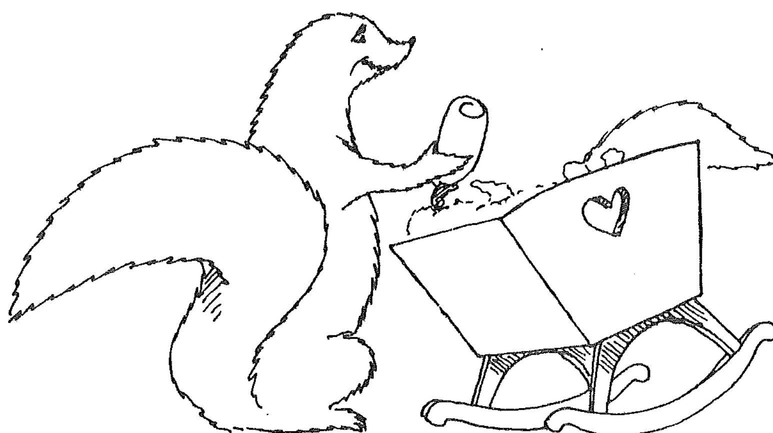


Fig. 3. Hepatic EROD, AHH, and APND activities in Aroclor 1254-exposed female mink at 10, 17, and 26 days after mating/treatment with gonadotropin-releasing hormone (gnRH) in the 1990 study. No discrimination was made between mated females and those treated with GnRH. EROD activities are expressed as nmol resorufin · (mg microsomal protein)$^{-1}$ · min^{-1}, AHh activities as units · (mg microsomal protein)$^{-1}$, and APND activities as nmol formaldehyde · (mg microsomal protein)$^{-1}$ · min^{-1}. Data are presented as means ± SD of 9-10 liver samples for each treatment. Significance levels used were: *=P < 0.05; **=P < 0.01, and ***=P < 0.001.

AMBIO, vol. 21, No. 8, pp. 585-587, 1992. 3 figs., 18 refs. Author's summary.



Original Report

An investigation into feeding carnivorous fur bearing farm animals in Estonia

Rein Mee

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In Estonia raising of farm bred fur bearing animals was introduced later than in the Nordic countries. In 1936, however, all the major fur bearing animals were kept on Estonian farms e.g. silver fox, blue fox, mink and nutria. Soon after World War II, fur farming was restored. During the years 1960-65 the farming was further expanded while several large-scale farms were established. Besides silver and blue fox, mink and nutria, the polecat, raccoon dog and chinchilla have been raised in Estonia.

A survey over the pelt production of fur bearing farm animals is presented in table 1.

Table 1. Number of fur bearing animals raised for breeding and pelt production

Species	Years		
	1980	1985	1990
Silver fox	26143	32073	33132
Blue fox	88940	96354	90199
Mink	327305	246652	222003
Nutria	2348	11314	2340

During the last decade extension of fur farming has lead to difficulties in supplying the fur bearing animals with feed. Therefore, along with breeding and keeping problems those of feeding have also been placed in the forefront, in particular the problems related to the usage of biopreparations, enzymes and pelleted feeds in raising the effectiveness of feed uptake.

In Estonia J. Reinpal, Ph.D., has studied the effect of enzyme preparations maltavamorin GIOx and lysozyme G3x used as feed additives 0.4 g maltavamorin a day added to the ration of blue foxes improved the following qualities: number of pups, live mass and survival of pups, quality of pelts. A somewhat weaker, but still a positive effect was achieved by using the lysozyme preparation as a feed additive for blue foxes.

The feeding trials carried out with mink by K. Ulst, Ph.D., during five years showed that the 0.3 g daily addition of the enzyme preparation lysozyme G3x to the feed of mink increased the fecundity of female mink, the live mass of kits at weaning as well as the pelt quality. The preparation produced a positive effect on the animals within several generations.

The author of the present paper has been studying the effect of drylot feeding on the fecundity and pelt quality of mink and silver foxes since 1986.

The feeding trials were carried out during the following different physiological periods of reproduction of female mink and female foxes: premating, mating, gestation and lactation. Feeding trials with young animals were carried on during their raising until pelting.

The series of trials was started with female mink on the E. Vilde Collective Farm of the former Rakvere District, and with female silver foxes on the Hulja State Farm in 1986. In the course of the trials 50% digestible protein of the ration was covered by dry feed pellets while the rest of the feed consisted of traditional raw slaughterhouse offal. The composition of the feed pellets was as follows: 40% blood-and-bone meal with malt sprouts, 25% barley meal, 10% grass meal, 25% milk powder, and 1000 g dry feed contained 23.2 g digestible proteins, 2.4 g fat and 26.6 g carbohydrates. The pellets contained 23 g digestible protein per 100 kcal metabolizable energy. Replacing up to 50% raw slaughterhouse offal by pellets on the basis of digestible protein produced a positive effect on the fecundity of female mink and silver foxes as well as on the body mass of their pups and kits at weaning.

After weaning the feeding trials were carried on until the animals were pelted. In the course of the trial 50% digestible protein of raw feeds in the feeding rations for young mink and silver foxes was replaced by the digestible protein of pelleted feeds. It became evident from the results that before pelting the body mass of the young animals of the test group was statistically unplausibly lower than of the control group. The animals of the test and control groups were pelted, and their pelts primarily treated and evaluated regarding quality and price on the basis of the price-list valid in the USSR in 1986. The price of the primarily treated fur of the mink of the test group was 48.67 roubles while that of the control group were 114.10 and 111.20 roubles, respectively. The higher price of the mink furs of the control group was mainly due to the larger pelts of these animals. The hair quality, however, was better in the test group.

In 1989 the series of trials was carried on before mating as well as during the periods of mating and pregnancy. According to the principle of analogues the animals under test were divided into 4 groups, 15 female animals in each (a test group and a control group both in 2 replications). 50 per cent of the digestible protein of raw slaughterhouse offal in their feed ration was replaced by pelleted feeds. The composition of the pelleted feed was identical to that of the trials carried out in 1986. The results of the trials showed that partial (up to 50%) replacing of raw slaughterhouse offal by feed pellets on the basis of digestible protein in the feed rations for female silver foxes did not have a negative effect on their fecundity.

As the trials carried out so far were quite successful, they were continued, adding besides pellets the biopreparations to the ration of silver foxes.

From January up to June 1991, until the weaning of the silver fox pups, the feeding trial with female silver foxes was carried out on a farm for fur bearing animals of the Hulja State Farm. There were 80 females both in the test group as well as the control group and they were fed as presented below.

The female foxes of the test group were partially fed with pellets. The composition of feed pellets used in the trial was as follows: 30% pea meal, 30% dried skimmed milk, 30% mixed feed meal and 10% grass meal. There was 35.6 g digestible protein per 100 g pellets. The female silver foxes of the control group were fed the usual feed without any special supplements.

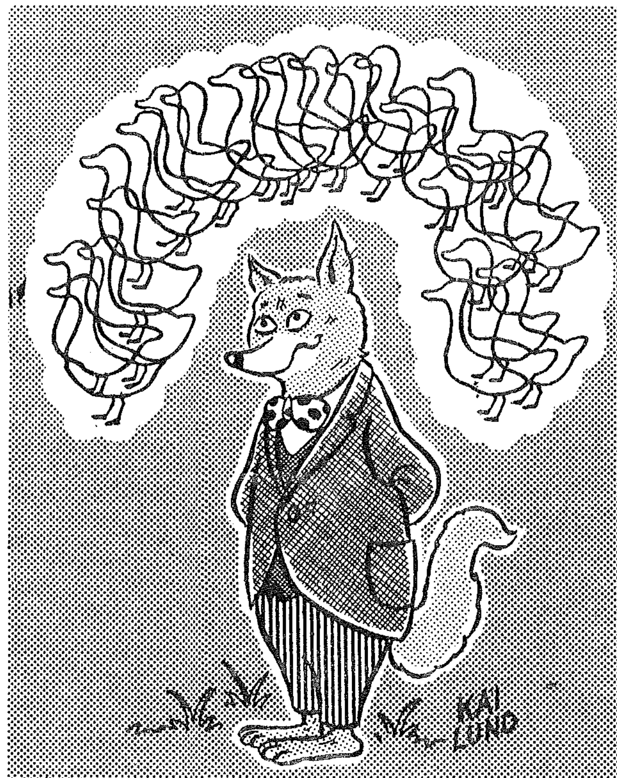
The trials showed that the pellets could be used as a substitute for raw feed for female silver foxes. The female silver foxes who were given pellets to the extent of 50% instead of raw feed had more pups than those of the control group.

There occured one abortion in the test group and two abortions in the control group, respectively. 4.12 pups per female were born in the test group and 4.11 in the control group. The body mass at weaning was 2.07 kg in the test group and 1.94 kg in the control group. Consequently, the pellets can succesfully be used in feeding female silver foxes.

In 1991 the effect of biopreparation ABP-3 (acidophilous bacteria mass enriched by maltavamorine GIOx) on fecundity of silver foxes and growth of pups was studied by the author as well. The ABP-3 contained active strains of lactobacterium acidophilum. When multiplying in the digestive tract, acidophilous bacteria metabolize several products of digestion, especially glucose and other sugars, which are the constituents of feed. Acidophilous bacteria have antagonistic qualities as to several microorganismus, e.g. saprophytes, E. coli and Salmonella. The acidophilous bacteria themselves produce lactic acid, which reduces the saprophytic and fermentation processes in the digestive tract and stimulates the activity of the digestive glands.

30 g of the preparation ABP-3 were added to the daily feed ration of 80 female silver foxes of the test group. The female silver foxes of the test group had 4.15 pups per female, while those of the control group had 4.11. Consequently, the utilization of the biopreparation ABP-3 was useful in every respect. By the beginning of the weaning period 94.6% of the pups in the test group and 93.8% of those in the control group survived, their body mass being 2.07 and 1.94 kg, respectively. Considering the value of the fur of the silver foxes, the bigger body mass of the pups of the test groups is of importance. Thus the utilization of bioactive substances has shown promising results.

To sum up, it can be mentioned that the production of high-quality furs has become more complicated due to the shortage of appropiate feeds. Certain solutions have been found, e.g. replacing the traditional animal protein feeds by new ones. New feeds, acidophilous bacteria mass, feed yeasts and enzymes have been used. Utilization of dry feeds in the form of full ration pellets is considered to the most promising means to partially replace the traditional feeds. Following the experience of the Nordic Countries, the centralized manufacture of feeds for fur bearing animals can be arranged in Estonia as well.



treated than in the control group. The exact mechanism by which alterations in the secretion of cortisol could influence the observed high incidence of fetal resorption in PCB fed mink is not known. Furthermore, the results indicate ovary/corpus luteum to be the most probable source of U-oestrone sulfate in the pregnant mink.

AMBIO, Vol. 21, No. 8, pp. 582-585, 1992. 4 figs., 35 refs. Authors' summary.

ß-carotene, retinol and retinyl ester concentrations in serum and selected tissues of ferrets fed ß-carotene

J.D. Ribaya-Mercado, J.G. Fox, W.D. Rosenblad, M.C. Blanco, R.M. Russell

The concentrations of ß-carotene, retinol and retinyl esters in serum and selected tissues of ferrets fed diets supplemented with ß-carotene (80 µg/g wet diet) for 3 wk were determined. The initial concentration of serum ß-carotene was 0.011 ± 0.006 µmol/L (mean ± SEM); at the end of the experimental period it was 5.75 ± 1.60 µmol/L.

No significant differences in serum retinol and total retinyl esters were observed between ß-carotene-fed and control ferrets that had been fed an unsupplemented diet. The predominant retinyl esters in serum were retinyl stearate (53%) and retinyl palmitate (35%). Of the tissues analyzed after ß-carotene feeding, the liver contained the highest concentration of ß-carotene (78.8 ± 18.8 nmol/g). Other tissues that contained ß-carotene in amounts ranging from 17 to 20 nmol/g were adrenals, small intestine, stomach and colon; lesser amounts (6.9 nmol/g) were found in kidneys. Amounts ranging from 1.2 to 2.3 nmol/g were found in muscle, bladder, adipose tissue, lungs and skin; only 0.37 and 0.34 nmol/g were present in brain and eyes, respectively. Thus, like humans, ferrets have the capacity to absorb intact ß-carotene and to store this compound in tissues, especially the liver. However, compared witt humans, ferrets have elevated concentrations of retinyl esters in serum, liver and other tissues.

J. Nutr. 122, pp. 1898-1903, 1992. 2 tables, 25 refs. Authors' abstract.

Serum carotenoids and retinoids in ferrets fed canthaxanthin

G. Tang, G.G. Dolnikowski, M.C. Blanco, J.G. Fox, R.M. Russell

A high-performance liquid chromatographic method has been developed to analyze canthaxanthin (CX) with other carotenoids and retinoids in serum. Serum (100 µL) was extracted first with chloroform/methanol and then with hexane, using retinyl acetate and ß-carotene as the internal standards. The residue of the extract was resuspended into ethanol and injected onto an 8.3 x 0.46 cm 3-µm ODS column. The gradient system consisted of two solvents of acetonitrile/tetrahydrofuran/water with different ratios. The carotenoids and retinoids were measured at 450 nm and 340 nm, respectively. CX was detected in the serum of the ferrets fed CX (79% all-trans and 21% cis-isomer, 50 mg/kg body weight by average for 1 month), but was not detected in the control group. The existence of CX in the serum was confirmed by its UV/-visible absorption spectrum and by its negative chemical ionization/mass spectrum with an M-ion at m/z 564. The serum level of all-trans CX in the exprimental ferrets was 33.34 ± 3.33 nmol/L (n=13) and that of cis CX was 72.48 ± 7.64 nmol/L (n=13). There was no difference between the CX-fed group and the control group in the serum levels of retinol, retinyl esters, lutein, cryptoxanthin, or ß-carotene. Retinyl esters in ferret serum represent 93% of total vitamin A level, which is more than 10 times higher than the vitamin A level in human blood. High retinyl esters level in the circulation of the ferret is a general phenomenon in carnivores.

J. Nutr. Biochem., Vol. 4, pp. 58-63, 1993. 2 tables, 3 figs., 30 refs. Authors' abstract.

Growth, body composition and fur quality of farmed mink and polecats on brewers' mash and basal diets

H. Korhonen, M. Harri

The experiments were undertaken to evaluate growth, chemical body composition, and fur quality of growing, farmed mink (*Mustela vison*) and polecats (*Mustela putorius*). In both species,

weight gain for animals in control, 10% mash and fasting groups were of the same order of magnitude. However, animals on 20% mash feeding showed retarded weight gain. Chemical body composition of carcasses did not differ significantly between various feeding test groups. Differences between species were mainly non-significant. No marked differences in fur quality parameters between the experimental groups were observed. It is concluded that brewers' mash can be used mixed (concentration of 10% or lower) in fresh mink and polecat feed.

J. Anim. Physiol. a. Anim. Nutr. 59, pp. 107-112, 1988. 5 tables, 15 refs. Authors' summary.

Feeding nutria

K.S. Kul'ko

Feeding of nutria is discussed. In summer, nutria are fed on a diet containing various types of grass and legumes including clover, lucerne, pea, vetch, stems of sunflower oil plants and of maize, twigs of trees, and shrubs. During summer the daily diet of an adult nutria contains 400-600 g green feeds, 140-150 g grain mixture, 100-200 g tree twigs and bushes and 1.4-1.6 g NaCl. In winter, the suggested daily diet includes 30-40 g hay, 300-400 g feed beet and carrots, 140-150 g grain mixture, 2 g CaCO3, 1.5-1.7 g NaCl. Feeding is twice daily. Pregnant nutria are given additional feed; towards the end of pregnancy the energy content of the diet is reduced by decreasing the amount of concentrates. During the 1st and 2nd months of lactation the daily allowance of feed is increased 1.5-2- to 3-fold, respectively. Feeding during these periods of lactation should be to appetite. The diet of nutria should also contain animal protein sources, such as milk, fish meal and meat-and-bone meal.

Krolikovodstvo i Zverovodstvo, No. 6, pp. 36-37, 1991. 1 table. In RUSS. CAB-abstract.

Complete pelleted diets for muskrats

S.A. Klochkova, R.Z. Zarinov

Studies on the use of a complete pelleted feed for rabbits in the feeding of young and lactating muskrats (*Ondatra zibethicus*) are reported. The pellets containing 50% mixed feed, 40% grass meal, 5% fish meal, 4.5% fodder yeast, and 0.5% sodium chloride. The mixed feed had 30% grass meal, 19% ground oats and barley, 15% wheat bran, 13% oil cake and meal, 2% fish meal, 1% hydrolised yeast, 0.5% NaCl and 0.5% bone meal. Crude protein in the pellets was 18.3%, fats 3.0%, fibre 16.2%, ash 5.6% and energy 4.5% kcal/g. Digestibility coefficients were: DM 68.5%, gross energy 68.4%, crude protein 67.2%, fats 79.8%, crude fibre 41.7%, nitrogen-free extract 80.8%, ash 48.3%, calcium 36.4% and phosphorus 27.9%. Mean daily gain of young muskrats fed on pellets throughout the year was 3.2 g. The pellets can be used without supplements for muskrats kept in heated conditions during autumn and winter until the beginning of the reproductive season. For muskrats in sheds pellets should be supplemented with sugar-rich feeds during the cold season. During pregnancy and lactation supplements of grain, carrots, beets, fresh grass and young willow shoots should be used.

Krolikovodstvo i Zverovodstvo, No. 6, pp. 5-6, 1990. 2 tables. In RUSS. CAB-abstract.

Rates of heat and water loss in female mink (*Mustela vison*) measured by direct calorimetry

Søren Wamberg

The energy expenditure (EE) of adult female mink was studied by continuous 24-hr measurement of rates of total heat loss (THL) in a controlled environment using a 24 m³ calorimeter allowing separate on-line determinatio of sensi-

Heat and water loss in female mink

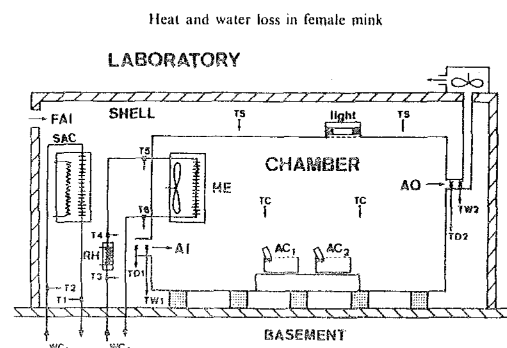


Fig. 1. Schematic diagram of the heat-sink calorimeter showing the airflow circuit and temperature controlling units. SHELL, shell space; CHAMBER, inner chamber of calorimeter; FAI, fresh air inlet; AI, chamber air inlet; AO, chamber air outlet; SAC, shell space air conditioning unit; HE, heat exchanger; RH, reference heater; WC_1 and WC_2, water cooling units; TS, thermometers in shell space; TC, thermometers in chamber; T_{1-6}, thermometers in water circuits; TD_1 and TD_2, dry bulb thermometers; TW_1 and TW_2, wet bulb thermometers. AC_1 and AC_2, transparent Macrolon® animal cages.

tive (SHL) and evaporative (EHL) heat loss within the range of 20-200 W (72-720 kJ/hr). In four adult female mink (scanblack colour mutant), studied in transparent cages and given free access to feline food pellets and water, the mean 24-hr energy expenditure (=THL) under controlled experimental conditions was 8.9 W/kg (range: 5.5-13.1 W/kg) at 18°C and 5.8 W/kg (range: 4.3-9.5 W/kg) at 24°C.

The results are in agreement with the data reported in the literature on the metabolic rate of adult farm-raised mink, calculated from rates of oxygen uptake under controlled experimental conditions, and with the energy requirement for maintenance, 586 kJ/kg/day (6.8 W/kg) recommended by the NRC. Under the experimental conditions of the present study the mean rate of total evaporative water loss (TEWL) amounted to 3.7 g/kg/hr at 18°C and 5.5 g/kg/hr at 24°C.

The contributions of SHL and EHL to 24-hr THL in female mink were inversely related and markedly dependent on chamber temperature. When corrected for evaporated urinary and faecal water, SHL and EHL amounted to 76 and 24% of THL at 18°C, but at 24°C the corresponding values were 41 and 59%. The mean rate of insensible water loss, calculated as total evaporative water loss minus faecal and urinary water evaporated from the bedding material, amounted to about 84-90% of TEWL or 3.1 g/kg/hr at 18°C and 5.0 g/kg/hr at 24°C. The increase of EE in response to ambient temperatures below the thermoneutral zone ("metabolic coefficient") calculated from the difference between the minimum values for the EE at 18 and 24°C amounted to 0.20 W/°C/kg.

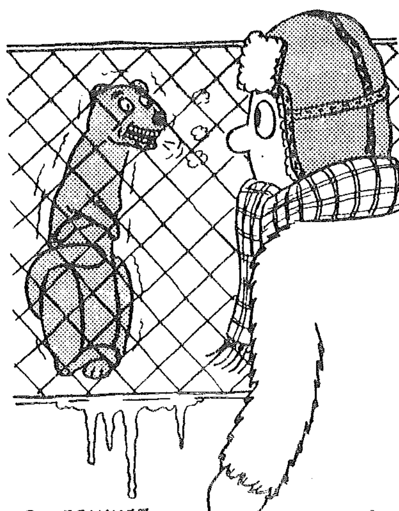
Comp. Biochem. Physiol. Vol. 107A, No. 3, pp. 451-458, 1994. Author's abstract.

Table 5. Literature data on mass-specific energy metabolism in adult mink (*M. vison*)

Authors	N^a	Sex	Metabolic rate (kJ/day/kg body wt)	Metabolic rate (watts/kg body wt)	Method	Temperature[b] (°C)	Comments
Hodson and Smith (1945)	6/—	—	874	10.1	Digestion trials	T_a	Maintenance
Perel'dik and Titova (1950)	—/—	m	627	7.3	Respirometry		BMR
Farrell and Wood (1968a)	11/3	f	352	4.1	Respirometry	25	BMR
Farrell and Wood (1968b)	18/5	f	844–1078	8.9–12.5	Digestion trials	T_a	Maintenance
Iversen (1972)	5/—	—	354	4.1	Respirometry	Tz	BMR
Harper *et al.* (1978)	—/31	m	619	7.2	Body balance regression	T_a	Maintenance
Chwalibog *et al.* (1980)	33/8	m	492	5.7	24-hr respirometry	20	Maintenance
Korhonen *et al.* (1983)	5/1	m	416	4.8	Respirometry	21–22	RMR
Wang *et al.* (1988)	—/—	f	276[c]	3.2[c]	Respirometry	22	RMR
Tauson *et al.* (1992)	6/6	f	581[c]	6.7[c]	24-hr respirometry	20	Maintenance
This study (experiment 1)	1/4	f	768	8.9	24-hr direct calorimetry	18	Maintenance
This study (experiment 2)	1/4	f	501	5.8	24-hr direct calorimetry	24	Maintenance

[a] N = number of determinations/number of animals.
[b] T_a = ambient temperature; Tz = thermoneutral zone.
[c] Values are kJ or W/animal/day (body weight not stated).

Søren Wamberg



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Original Report

Correlation between deoxyribonuclease activity in mink serum and resistance to Aleutian disease

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Summary

A significant and persistent increase in deoxyribonuclease (DNase) activity in serum from standard mink relatively resistant to infection with DNA-containing Aleutian disease virus (ADV) after inoculation with the virus was observed. There was an insignificant brief increase in DNase activity in serum from Sapphire mink susceptible to ADV infection and subsequent death. There were no changes in ribonuclease (RNase) activity in the mink serum after inoculation with the ADV.

Anti-ADV antibodies titre was higher in the serum from Sapphire mink susceptible to ADV than in standard mink resistant to it.

It is suggested that induction of DNase activity is a preferable mechanism providing resistance to ADV in mink.

A high titre of antibodies in Sapphire mink may contribute to the severity of the disease and to high lethality due to the damaging effect of the immunocomplexes deposited in kidneys and other organs.

Introduction

Aleutian disease of mink is caused by the persistent DNA-containing Aleutian disease virus (ADV) and is responsible for serious economic losses in mink farms. The salient features of this lethal disease are extreme hypergammaglobulunemia and plasmacytosis. Although ADV infected mink develop high titres of antibodies to the virus, they fail to neutralize the virus and prevent the disease (*Lodmell et al., 1976; Aasted, 1985*). Different lesions are produced by circulating immunocomplexes such as glomerulonephritis, arthritis and uveitis described in ADV affected mink (*Henson et al., 1967; Porter et al., 1973; Hadlow, 1982*). Similar lesions are observed in other morbid conditions, particularly in severe autoimmune diseases of man such as systemic lupus erythematosus. It is known that standard mink (genotype A/A) are relatively resistant to ADV, while Sapphire mink (genotype a/a) are highly susceptible to the viral infections (Aasted, 1985). Humans and animals possess not only immune defense in a form of antibodies induced by viral antigens, but they have also other humoral antiviral protective barriers formed, for instance, by interferons.

There are data which allow us to regard endogenous nucleases as antiviral protective means of this kind (*Liu et al., 1964; Maksimovich et al., 1974; Glukhov et al., 1976*). For instance, ribonuclease (RNase) activity is induced in human and animal blood in response to tick-borne encephalitis virus infection. It has been demonstrated that a low level of RNase activity correlates with the severe course of viral encephalitis and meningoencephalitis, and the high level of its activity in serum with its mild course (*Glukhov et al., 1976; Sichko, 1985*).
A number of studies have shown that exogenous deoxyribonuclease (DNase) has a protective antiviral effect; it inhibits reproduction of DNA viruses (*Trukhachov et al., 1967*) and is efficient in the treatment of a number of diseases caused by these viruses (*Colain et al., 1970; Gutorov et al., 1976; Demin et al., 1983*). With all this in mind, it appeared worthwhile to examine the relations between induced activities of nucleases in serum and severity of disease caused by ADV in mink.

Material and methods

The strain P-1 of ADV (Institute of Veterinary preparation, Moscow, Russia) was used for studies of experimental Aleutian disease in mink. The i.p. administered dose of the AV was $5 \cdot 10^7$ LD_{50}. Blood was taken from the tail vein before infection and at fixed time points several days after it to study DNase and RNase activities and antiviral antibody titres.

To determine the antibody titres we used the viral diagnosticum prepared by the Tobolsk bioplant (Russia). High molecular weight spleen DNA and *E. coli* tRNA (Oline Plant of chemical reagents, Latvia) were used as substrates for measuring DNase and RNase activities. The titre of antiviral antibodies was determined by direct immune electrophoresis (*Cho & Ingram, 1972, 1974*). Measurements of DNase and RNase activities were based on increase in absorption at 260 nm of the acid soluble fraction obtained after enzyme hydrolysis of high molecular weight DNA or tRNA, respectively, by serum nucleases at 37°C as described (*Elliott et al., 1968*).

The data were tested by Student's t-test for statistical significance.

Results and discussion

The time course for changes in DNase activity in serum from ADV infected mink
The basal level of DNase activity in serum from ADV-susceptible Sapphire mink was 2-3 fold higher than in standard mink. Three days after infection with the virus the activity of DNase in Sapphire mink first increases very slightly, then falls sharply so that its level by day 30 is 2-3 fold lower than the basal (fig. 1).

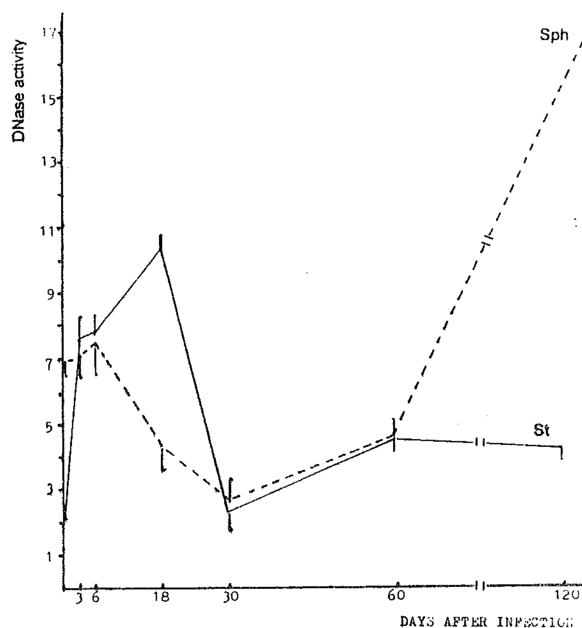

Fig. 1. DNase activity in serum of standard and Sapphire mink after infection with ADV

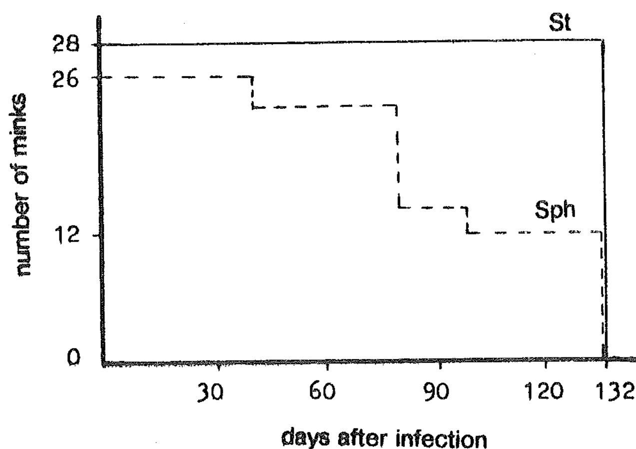

Fig. 2. Longevity of standard and Sapphire mink after infection with ADV. Standard mink were sacrificed 132 days after ADV infection

Sixty days after the infection the number of dead Sapphire mink starts to increase and continues to rise steadily to the end of the experiment (fig. 2).

In figs. 1, 2 and 3: continuous line - standard mink (St), discontinuous - Sapphire mink (Sph). Each point correspons to the number of mink in fig. 2.

Seventy-five days after ADV-inoculation DNase activity in serum of Sapphire mink drastically increases and this is associated with an increase in disease severity apparently as a consequence of tissue necrosis (figs. 1 and 2).

The pattern is quite different in ADV-resistant standard mink: DNase activity is markedly increased as early as 3 days after the infection, when exceeding five-fold the basal level; it increased further up to day 18 and fell to the basal level on day 30 (fig. 1). Thirty days after ADV infection DNase activity remains near the basal level.

It is noteworthy that RNase activity in serum of Sapphire and standard mink remain unaltered.

Time course of changes in antiviral antibodies titres in ADV-infected mink

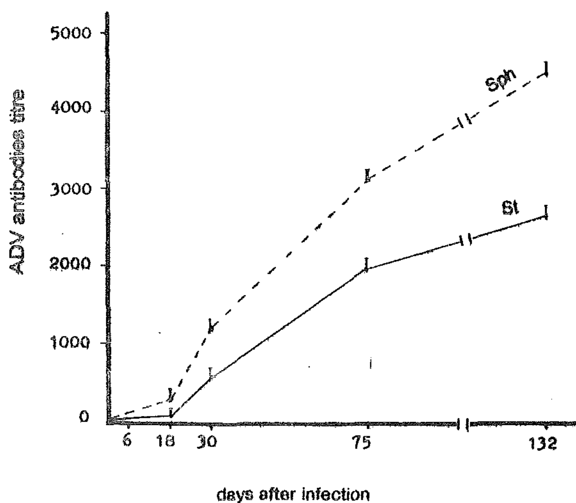

Fig. 3. Antiviral antibody titres in standard and Sapphire mink after inoculation with ADV

As shown in fig. 3, the level of antiviral antibodies sharply increases in standard and Sapphire mink after infection with ADV, reaching a level exceeding 1:1000 and 1:2000, respectively, 120-132 days after the infection. Antiviral antibody titres increase more rapidly and reach higher levels in Sapphire than in standard mink.

Sapphire mink started to die 30-40 days after the infection and on day 132 only 46% remained alive, whereas most of the standard mink were alive (fig. 2).

The present data agree with those in the literature demonstrating the direct relation between the level of antiviral antibodies to ADV and the degree of severity of Aleutian disease (*Lodmell et al., 1981; Aasted, 1985; Fomicheva et al., 1991*).

It is also noteworthy that enhanced synthesis of antiviral antibodies starts 30 days after infection with ADV, while the increase in DNase activity (when such occurs) starts much earlier (figs. 1 and 3).

From comparison of the time course of changes in the immune response and the increase in DNase activity in standard mink after infection with ADV, it may be suggested that DNase activity is a factor contributing to relative resistance of mink to Aleutian disease. Resistance of mink to Aleutian disease correlates with DNase activity and it does not depend on the antiviral antibody titre in mink. Furthermore, the higher level of antiviral antibodies in sapphire compared to standard mink seems to be an additional factor contributing to the severity of the Aleutian disease and high lethality due to the enhanced formation of immunocomplexes.

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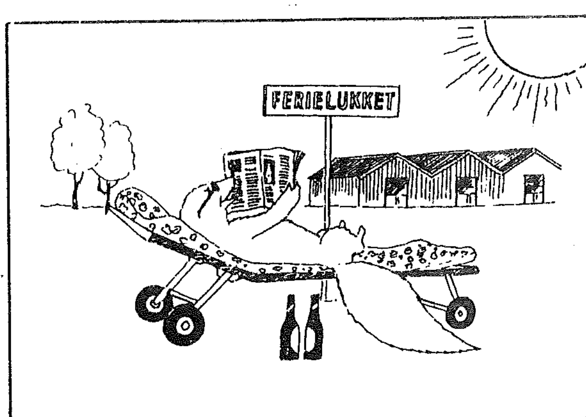


Comparison of promoter activity in Aleutian mink disease parvovirus, minute virus of mice, and canine parvovirus: possible role of weak promoters in the pathogenesis of Aleutian mink disease parvovirus infection

J. Christensen, T. Storgaard, B. Viuff, B. Aasted, S. Alexandersen

Aleutian mink disease parvovirus (ADV) infection causes both acute and chronic disease in mink, and we have previously shown that it is the level of viral gene expression that determines the disease pattern.

To study the gene regulation of ADV, we have cloned the P3 ADV and P36 ADV promoters in front of a reporter gene, the chloramphenicol acetyltransferase (CAT) gene, and analyzed these constructs by transient transfection in a feline kidney cell line and mouse NIH 3T3 cells.

The genes for ADV structural proteins (VP1 and VP2) and the nonstructural proteins (NS-1, NS-2, and NS-3) were cloned into a eukaryotic expression vector, and their functions in regulation of the P3 ADV and P36 ADV promoters were examined in cotransfection experiments. The ADV NS-1 protein was able to transactivate the P36 ADV promoter and, to a lesser degree, the P3 ADV promoter. Constitutive activities of the P3 ADV and P36 ADV promoters were weaker than those of the corresponding promoters from the prototypic parvovirus minute virus of mice (MVM) and canine parvovirus (CPV). Also, the level of transactivation of the P36 ADV promoter was much lower than those of the corresponding P38 MVM and P38 CPV promoters transactivated with MVM NS-1. Moreover, the ADV NS-1 gene product could transactivate the P38 MVM promoter to higher levels than it could transactivate the P36 ADV promoter, while the P36 ADV promoter could be transactivated by MVM NS-1 and ADV NS-1 to similar levels.

Taken together, these data indicated that *cis*-acting sequences in the P36 ADV promoter play a major role in determining the low level of transactivation observed. The P3 ADV and P4 MVM promoters could be transactivated to some de-gree by their respective NS-1 gene products. However, in contrast to the situation for the late promoters, switching NS-1 proteins between the two viruses was not possible. This finding may indicate a different mechanism of transactivation of the early promoters (P3 ADV and P4 MVM) compared with the late (P36 ADV and P38 MVM) promoters.

In summary, the constitutive levels of expression from the ADV promoters are weaker than the levels from the corresponding promoters of MVM and CPV. Moreover, the level of NS-1-mediated transactivation of the late ADV promoter is impaired compared with the level of transactivation of the late promoters of MVM and CPV. Altogether, the results may indicate that the ability of ADV to cause persistent infection in vivo, at least in part, is linked to the weak constitutive and transactivated activities of the ADV promoters.

Journal of Virology, Vol. 67, No. 4, pp. 1877-1886, 1993. 10 figs., 70 refs. Authors' summary.

Expression of Aleutian mink disease parvovirus proteins in a baculovirus vector system

J. Christensen, T. Storgaard, B. Bloch, S. Alexandersen, B. Aasted

We have previously published a detailed transcription map of Aleutian mink disease parvovirus (ADV) and proposed a model for the translation of the two virion structural proteins (VP1 and VP2) and three nonstructural proteins (NS-1, NS-2, and NS-3) (*S. Alexandersen, M.E. Bloom, and S. Perryman, J. Virol. 62:3684-3994, 1988*).

To verify and further characterize this model, we cloned the predicted open reading frames for NS-1, NS-2, NS-3, VP1-VP2, and VP2 alone into a recombinant baculovirus and expressed them in Sf9 insect cells. Expression of VP1-VP2 or VP2 alone in cDNA and in the genomic form was achieved. The expresed proteins had molecular weights similar to those of the corresponding proteins of wild-type ADV-G, although the ratio of VP1 to VP2 was altered. The recombinant baculovirus-expressed ADV VP1 and

VP2 showed nuclear localization in Sf9 cells and were able to form particles indistinquishable, by electron microscopy, from wild-type virus.

The large nonstructural protein, NS-1, showed predominantly nuclear localization in Sf9 cells when analyzed by immunofluorescence and had a molecular weight similar to that of wild-type ADV NS-1. Moreover, expression of NS-1 in Sf9 cells caused a change in morphology of the cells and resulted in 10-times-lower titers of recombinant baculovirus during infection, suggesting a cytostatic or cytotoxic action of this protein. The smaller NS-2 gene product seems to be located in the cytoplasm. When analyzed by Western immunoblotting, NS-2 comigrated with an approximately 16-kDa band seen in lysates of ADV-infected feline kidney cells.

The putative NS-3 gene product exhibited a diffuse distribution in Sf9 cells and had a molecular weight of approximately 10,000. All of the expressed ADV-encoded proteins were recognized by sera from ADV-infected mink. Thus, expression of ADV cDNAs allowed assignment of the different mRNAs to the viral proteins observed during ADV infection in cell culture and supported our previously proposed ADV transcriptional and translational scheme. Moreover, the production of structural proteins from a full-length NS-2 mRNA may add to the repertoire of parvovirus gene expression.

Journal of Virology, Vol. 67, No. 1, pp. 229-238, 1993. 7 figs., 35 refs. Authors' summary.

Topographical analysis of the G virion of Aleutian mink disease parvovirus with monoclonal antibodies

D.L. Barnard, F.B. Johnson

The topography of the Aleutian mink disease parvovirus (ADV) G virion was analyzed with monoclonal antibodies and polyclonal antiserum. There was homology between the two major structural proteins as others have previously reported.

Trypsin treatment of the virion with subsequent immunoblotting revealed that VP2 represents the main peptide on the exterior of virion and that VP1 is probably embedded within the capsid. Additional analyses of the trypsin-treated virions showed that VP2 is responsible for binding complement and that it also represents the structural part of the virion that binds to cellular receptors.

A third protein, p34, was detected that might represent a third structural polypeptide because of its many unique epitopes relative to the other peptides detected.

Arch Virol 127, pp. 271-289, 1992. 6 tables, 3 figs., 41 refs. Authors' summary.

Aleutian mink disease parvovirus infection of mink peritoneal macrophages and human macrophage cell lines

H. Kanno, J.B. Wolfinbarger, M.E. Bloom

Aleutian mink diseases parvovirus (ADV) mRNAs are found in macrophages in lymph nodes and peritoneal exudate cells from ADV-infected mink. Therefore, we developed an in vitro infection system for ADV by using primary cultures of mink macrophages or macrophage cell lines. In peritoneal macrophage cultures from adult mink, virulent ADV-Utah I strain showed nuclear expression of viral antigens with fluorescein isothiocyanate-labeled ADV-infected mink serum, but delineation of specific viral proteins could not be confirmed by immunoblot analysis.

Amplification of ADV DNA and production of replicative-form DNA were observed in mink macrophages by Southern blot analysis; however, virus could not be serially propagated. The human macrophage cell line U937 exhibited clear nuclear expression of viral antigens after infection with ADV-Utah I but not with tissue culture-adapted ADV-G. In U937 cells, ADV-Utah I produced mRNA, replicative-form DNA, virion DNA, and structural and nonstructural proteins; however, virus could not be serially passaged nor could [^{3}H]thymidine-labeled virions be observed by density gradient analysis.
These findings indicated that ADV-Utah I infection in U937 cells was not fully permissive

and that there is another restricted step between gene amplification and/or viral protein expression and production of infectious virions. Treatment with the macrophage activator phorbol 12-myristate 13-acetate after absorption of virus reduced the frequency of ADV-positive U937 cells but clearly increased that of human macrophage line THP-1 cells. These results suggested that ADV replication may depend on conditions influenced by the differentiation state of macrophages. U937 cells may be useful as an in vitro model system for the analysis of the immune disorder caused by ADV infection of macrophages.

Journal of Virology, Vol. 67, No. 4, pp. 2075-2082, 1993. 2 tables, 7 figs., 48 refs. Authors' summary.

Aleutian disease in domestic ferrets: diagnostic findings and survey results

D. de B. Welchman, M. Oxenham, S.H. Done

Aleutian disease was diagnosed as the cause of posterior ataxia and paresis in domestic ferrets. Six serologically positive animals (four clinically affected and two unaffected) were investigated in detail and seven other clinically affected ferrets were also identified. The diagnostic findings included hyper-gammaglobulinaemia, histological lesions in the central nervous system and parvovirus-like particles in mesenteric lymph nodes. A wider serological survey of 446 animals owned by members of a ferret club revealed an incidence of 8.5 per cent seropositive animals.

Veterinary Record 132, pp. 479-484, 1993. 5 tables, 7, figs., 20 refs. Authors' summary.

Mesangioproliferative glomerulonephritis in mink with encephalitozoonosis

Z.-y. Zhou, K. Nordstoga

Renal specimens from 6 mink with encephalitozoonosis were studied by light and electron microscopy and immunohistochemistry. The glomeruli of affected kidneys had a mesangioproliferative glomerulonephritis which was characterized by an increase in mesangial cells and matrix in most glomeruli. Some glomeruli were partially or completely sclerosed.

There were protein or granular casts in the cortical and medullary tubules. Interstitial nephritis, vasculitis and tubular cysts were found. Electron microscopy demonstrated extensive matrix and increased cellularty in the mesangial areas. Glomeruli showed segmentally thickened or wrinkled capillary basement membranes. Electron dense deposits were found in the glomerular basement membranes and mesangium. Peroxidase-anti-peroxidase immunohistochemistry demonstrated that IgC and IgM positive material was present as granular deposits in the glomerular basement membrane and occasionally in the mesangium.

Acta vet. scand. 34, pp. 69-76, 1993. 10 figs., 30 refs. Authors' summary.

Lactic acid bacteria for mink. Colonization and persistence of *Enterococcus faecium* Cernelle 68 in the digestive tract of mink

K. Pedersen, M. Jørgensen

A method was developed to follow a lactic acid bacterial strain, Enterococcus faecium Cernille 68, with respect to adhesion, multiplication, colonization, and persistence in the digestive tract of mink. Also the spread of the strain in the cage was examine. When adding 5 x 10^9 c.f.u. of a rifampicin resistant mutant per kg feed, high viable counts were registered throughout the digestive tract, apart from the oesophagus. Counts were increasing in the aboral direction, suggesting some multiplication in the intestine. It was possible to detect the strain in the intestinal tract 4 days after discontinuation of administration. Neither culture nor scanning electron microscopy gave evidence to suggest that *E. faecium* Cernille 68 adhered to the mucosa. The spread of the *E. faecium* strain was observed in the environment. Counts of *E. coli*, lactobacilli, staphylococci, and clostridia were low, and none of these bacteria were constant findings.

Acta vet. scand, 33, pp. 95-103, 1992. 3 tables, 3 figs., 23 refs. Authors' summary.

Investigation of the spreading of Enterococcus faecium Cernelle 68 from female mink to sucking kits

M. Jørgensen, K. Pedersen

In order to investigate the transfer of the lactic acid bacterial strain *Enterococcus faecium* Cernelle 68, nine mink females were fed a rifampicin resistant strain of the bacterium during a 25 day period, 5 x 10^9 c.f.u. per kg feed, while another nine females were kept as a control group. All 18 females had kits. One litter from each group was given 10^7 c.f.u. of *E. faecium* Cernelle 68 per kit. Kits were killed for bacteriological examination and scanning electron microscopy of the digestive tract. Furthermore, fecal samples from females and kits together with samples of nest material were collected for bacteriological examination.

The intestinal microflora of the kits was sparse. In nest material and in a fecal sample from a female in the test group high numbers of *E. faecium* Cernelle 68 were found. However, the *E. faecium* strain was not transferred to the kits. Kits inoculated with *E. faecium* Cernelle 68 excreted the strain within 15 hours - 2 days. No permanent colonization occurred.

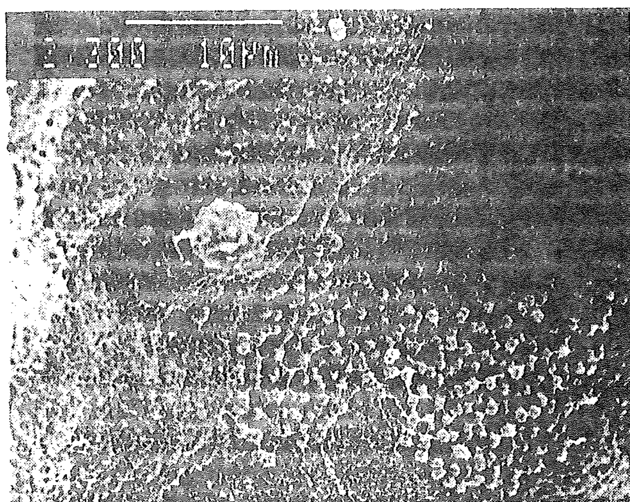


Fig. Scanning electron microscope view from the small intestine of a mink kit. Cocci are seen adhering to the mucous membrane. The bacteria are attached to each other and to the mucous membrane by unknown fibri structures. Enlargement and length units are shown.

Simultaneously, it was investigated in a challenge study, if *E. faecium* Cernelle 68 was able to prevent outbreak of diarrhoea in kits. Three females were given the rifampicin resistant *E. faecium* strain while 3 untreated females served as control group. From each group one litter was challenged with 10^8 c.f.u. of a pathogenic *Staphylococcus intermedius* strain per kit, and a second litter from each group with a pathogenic *Escherichia coli* strain. A third pair of litters were given an *Aerococcus viridans* strain. All three strains were previously isolated from outbreaks of "sticky kits" but probably only the *S. intermedius* and *E. coli* strains were causal organisms.

The kits challenged with the *S. intermedius* or the *E. coli* strain developed diarrhoea in both control and test groups, while the two litters given the *A. viridans* strain did not.

In the digestive tract of all kits examined from both control and test group a *Lactococcus lactis subsp. diacethylactis* was cultured in large numbers. By scanning electron microscopy this strain was shown to associate with the mucosa in the jejunum.

Dansk Veterinærtidskrift 75, 1, pp. 9-13, 1992. 1 table, 1 fig., 10 refs. In DANH, Su. ENGL. Authors' summary.

Role of gastric pH in isolation of *Helicobacter mustelae* from the feces of ferrets

J.G. Fox, M.C. Blanco, L. Yan, B. Shames, D. Polidoro, F.E. Dewhirst, B.J. Paster

Background: *Helicobacter mustelae* colonize the gastric mucosa of ferrets and causes persistent chronic gastritis. Methods: Hypochlorhydria, as measured by gastric pH probe, was induced by administering oral omeprazole, a proton pump inhibitor of the parietal cell, to adult ferrets in two separate experiments. Feces of ferrets were cultured for *H. mustelae* before, during, and after omeprazole therapy. Results: *H. mustelae* was isolated in 23 of 55 (41.8%) sequential fecal samples collected during omeprazole therapy. The same ferrets with acidic gastric pH had *H. mustelae* isolated in 6 of 62 (9.75) of the fecal cultures ($p < 0.01$). A DNA species-specific *H.*

mustelae probe confirmed the presence of the organism in both the stomach and feces of all 5 ferrets. In 4 of 5 ferrets restriction enzyme patterns of the gastric *H. mustelae* were identical to those of the fecal *H. mustelae* strains. Conclusions: Hypochlorhydria promotes fecal transmission of a gastric *Helicobacter* organism. The *H. mustelae*-colonized ferret provides an ideal model to study the epidemiology and pathogenesis of *Helicobacter pylori*-induced gastritis.

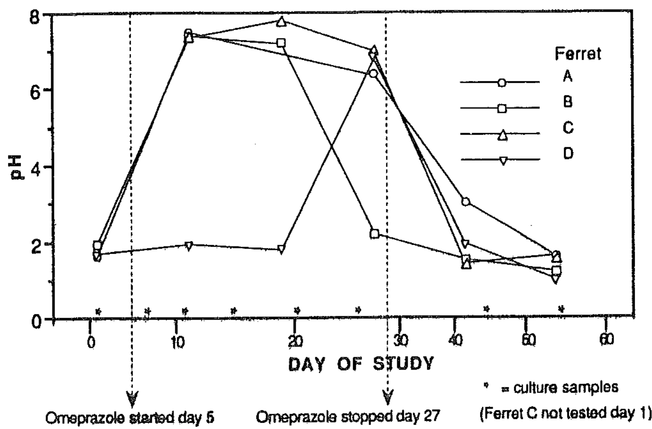


Fig. 2. Experiment 1: gastric pH in ferrets on omeprazole therapy. Ferrets before and after omeprazole therapy.

Gastroenterology 104, pp. 86-92, 1993. 2 tables, 3 figs., 33 refs. Authors' summary.

Helicobacter mustelae-induced gastritis and elevated gastric pH in the ferret (*Mustela putorius furo*)

J.G. Fox, G. Otto, N.S. Taylor, W. Rosenblad, J.C. Murphy

Helicobacter mustelae has been cultured from the stomachs of ferrets with chronic gastritis; the lesions in the stomach have many of the same histological features seen in *H. pylori* gastritis in humans. To determine whether *H. mustelae*-negative ferrets with normal gastric mucosa were susceptible to colonization and whether gastritis developed after infection, four *H. mustelae*-negative ferrets treated with cimetidine were inoculated orally on two successive days with 3 ml (1.5 x 10^8 CFU) of *H. mustelae*; eight age-matched *H. mustelae*-negative ferrets served as controls. All four ferrets became colonized; *H. mustelae* persisted through week 24 of the study, as determined by positive gastric culture, tissue urease, and Warthin-Starry staining of gastric tissue. Superficial gastritis developed in the oxyntic gastric mucosa, and a full-thickness gastritis, composed primarily of lymphocytes and plasma cells plus small numbers of neutrophils and eosinophils, was present in the antrum. The inflammation was accompanied by an elevation of immunoglobulin G antibody to *H. mustelae*. At 4 weeks post-inoculation, the four infected (experimental) ferrets developed an elevated gastric pH (4.0 to 5.2) for 2 weeks. The eight control ferrets did not have gastritis; *H. mustelae* could not be demonstrated in gastric tissue via culture, nor was there an immune response to the bacteria. In ferrets, *H. mustelae* readily colonized the stomach and produces a gastritis, a significant immune response, and, like *H. pylori* infection in humans, a transient elevated gastric pH after *Helicobacter* infection.

Infection and Immunity, Vol. 59, No. 6, pp. 1875-1880, 1991. 1 table, 6 figs., 40 refs. Authors' summary.

Purification and characterization of *Helicobacter mustelae* urease

B.E. Dunn, C.-C. Sung, N.S. Taylor, J.G. Fox

Helicobacter mustelae is a urease-rich bacterium associated with gastritis in ferrets. The ureases of *H. mustelae* and *Helicobacter pylori*, a bacterium implicated in human gastritis, share many characteristics. *Helicobacter* sp. ureases appear to be unique among bacterial enzymes in exhibiting submillimolar K^m values and in being composed of two subunits.

Infection and Immunity, vol. 59, No. 9, pp. 3343-3345, 1991. 1 table, 1 fig., 24 refs. Authors' summary.

Detection of *Echinococcus multilocularis* DNA in fox faeces using DNA amplification

S. Bretagne, J.P. Guillou, M. Morand, R. Houin

In order to identify *Echinococcus multilocularis* DNA in fox faeces for epidemiological purposes, we have developed a new method to prepare DNA suitable for PCR amplication. DNA isolation from fox excrement was performed accor-

ding to a novel procedure involving lysis in KOH, phenol-chloroform extraction and a purification step on a matrix (Prep-A-Gene®). The target sequence for amplification was the *E. multilocularis* U1 snRNa gene. PCR products were indistinquishable for 32 different *E. multilocularis* isolates and no signal was observed after ethidium bromide staining with DNAs from other tapeworm species, including *E. granulosus*. The sensitivity of amplification was monitored by the addition of *E. multilocularis* DNA or eggs to faeces free of *E. multilocularis* and was estimated to be 1 egg per 4 g of faeces. PCR products were blotted onto nylon membranes and hybridized with an internal oligonucleotide probe in order to confirm the results. Twenty nine faecal samples from foxes shot in Franche-Comté (East France) were tested. Out of 10 samples from foxes in which no *E. multilocularis* adult worms could be observed after necropsy, 7 were PCR positive, showing that the PCR test is more sensitive than microscopical examination. Out of 19 samples from foxes harbouring *E. multilocularis* adult worms, 18 were PCR-positive. The remaining PCR-negative sample could be due either to the misidentification of the species of adult worm (*E. granulosus* and *E. multilocularis*), or to DNA variation between different isolates of *E. multilocularis*. Further work in the field should be initiated in order to confirm these results.

Parasitology 106, pp. 193-199, 1993. 1 table, 5 figs., 28 refs. Authors' summary.

Detection of *Echinococcus* coproantigens by enzyme-linked immunosorbent assay in dogs, dingoes and foxes

P. Deplazes, B. Gottstein, J. Eckert, D.J. Jenkins, D. Ewald, S. Jimenez-Palocios

An enzyme-linked immunosorbent assay (ELISA) was developed for the detection of *Echinococcus* coproantigens in fecal samples from dogs, dingoes or foxes infected with either *E. granulosus* or *E. multilocularis*. The ELISA was based on protein-A-purified polyclonal antibodies [anti-*E. granulosus* excretory/secretory (E/S) antigens]. The specificity of the assay as determined in 155 samples derived from carnivores that were free of helminth infection (n=37) or infected with non-*Echinococcus* cestodes (n=76) or with various nematodes (n=42) was found to be 98% overall. The diagnostic sensitivity was strongly dependent on the homologous worm burden. All 13 samples from foxes harboring >1,000 *E. multilocularis* worms and 13 of 15 (87%) samples from dogs or dingoes containing >200 *E. granulosus* worms were ELISA-positive, whereas 34 of 46 samples from foxes harboring <1,000 *E. multilocularis* and 9 of 10 samples from dogs or dingoes bearing <200 *E. granulosus* tested negative. Experimental prepatent infections of dogs with *E. granulosus* revealed positive ELISA reactions within the prepatent period (10-20 days post-infection) for six animals bearing >1,000 *E. granulosus* each; a low worm burden (<1,000 tapeworms/animal) resulted in ELISA positivity in only 2 of 3 animals at 30 days post-infection at the earliest. All five dogs that had been experimentally infected with *E. multilocularis* tested positive in the coproantigen ELISA as early as on day 5 post-infection.

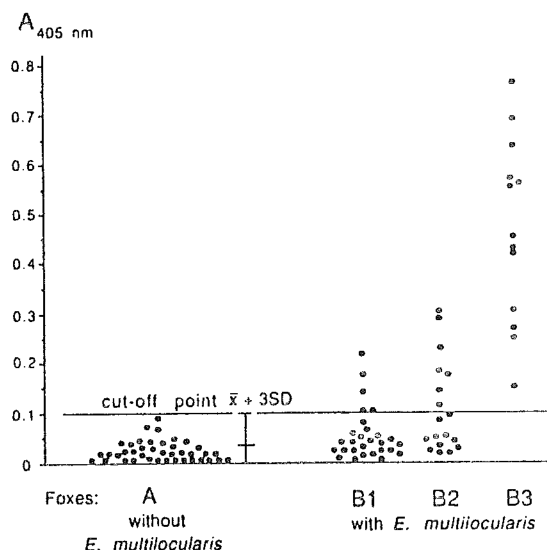


Fig. 5. Detection of *Echinococcus multilocularis* coproantigens by ELISA in samples obtained from Swiss foxes. Evaluation of the sensitivity and specificity of the assay in samples obtained from group IV animals; A, foxes (n=40) with no *E. multilocularis* infection; B1, foxes (n=28) with 1-100 *E. multilocularis*; B2, foxes (n=18) with 101-1000 *E. multilocularis*; B3, foxes (n=13) with >1000 *E. multilocularis*. The cut-off point (---) was determined by calculating the mean $A_{405\,nm}$ value + 3 SD for group A.

Parasitol Res 78, pp. 303-308, 1992. 5 figs., 26 refs. Authors' abstract.

The fox (*Vulpes vulpes*) as a reservoir for canine angiostronglylosis in Denmark. Field survey and experimental infections

G. Bolt, J. Monrad, P. Henriksen, H.H. Dietz, J. Koch, E. Bindseil, A.L. Jensen

Until recently, *Angiostrongylus vasorum* was not considered to be an endogenous Danish parasite, since demonstration of this worm had been confined to necropsy findings in 2 dogs, both of which had visited France. During the last 2 years, however, clinical cases have been diagnosed among a considerable number of Danish dogs, none of which had ever been outside Denmark. All these cases have occurred north of Copenhagen, where an endemic focus seems to exist. In this field survey *A. vasorum* was found for the first time in wild Danish red foxes. Furthermore, experimental infections showed that the parasite can be transferred between foxes and dogs. Consequently, the wild fox population must be considered a potential reservoir for transfer of *A. vasorum* to domestic dogs.

Acta vet. scand,33, pp. 357-362, 1992. 36 refs. Authors' summary.

Murine *Pneumocystis carinii* adherence to vertical monolayers of cultured mink lung cells (MiCl1)

R. E. Garner, A.N. Walker, M.N. Horst

We describe a method for adherence and culture of murine *Pneumocystis carinii* in mink lung cells (MiCl1) grown on vertical supports. The vertical cultures were infected with *P. carinii*; the surrounding medium and inoculum were stirred to ensure circulation and contact with MiCl1 cells. When compared with conventional horizontal culture, the vertical method offers a more suitable system for assessing *P. carinii* adherence. This approach has proved suitable for quantitative evaluation of *P. carinii* adherence of MiCl1 cells in the presence of inhibitors.

Journal of Clinical Microbiology, Vol. 30, No. 9, pp. 2467-2470, 1992. 5 figs., 8 refs. Authors' abstract.

Molecular cloning of a mink prion protein gene

H.A. Kretzschmar, M. Neumann, G. Riethmüller, S.B. Prusiner

Transmissible mink encephalopathy (TME) is a rare disease which is presumably transmitted to ranch-raised mink from scrapie-infected sheep offal or bovine spongiform encephalopathy-infected cattle products. Although the infectious agent of TME has not been isolated, there is circumstantial evidence that TME is caused by prions. The experimental host range of TME includes sheep, cattle, monkeys and hamsters.

However, TME has never been transmitted to mice. Since experiments in transgenic animals have shown that the prion protein (PrP) gene modulates the susceptibility, incubation time and neuropathology of prion-induced disease, we have started to analyse the mink PrP gene. PrP, as deduced from a genomic DNA sequence, consists of 257 amino acids and overall shows similarity of 84 to 90% with the sequences of the PrPs of other mammalian species. It remains to be determined whether these differences in the primary structure of PrP will explain the peculiar host range of TME.

Journal of General virology, 73, pp. 2757-2761, 1992. 1 table, 3 figs., 27 refs. Authors' summary.

Pseudomonas aeruginosa* infection in a *Chinchilla lanigera

B.J. Doerning, D.W. Brammer, H.G. Rush

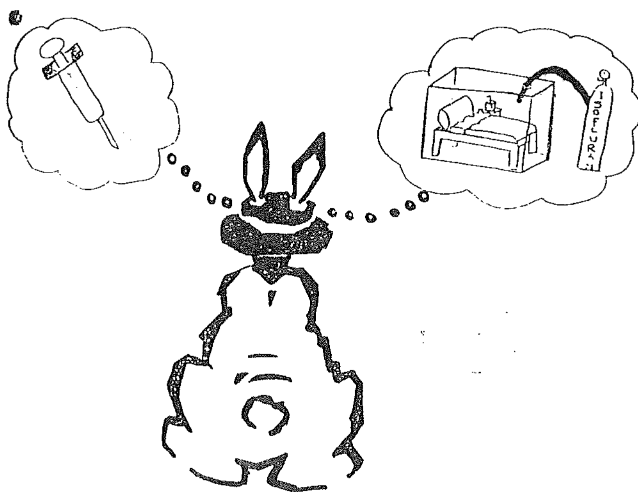
This report describes a case of *Pseudomonas aeruginosa* infection in a chinchilla. The affected animal displayed a variety of clinical signs including genital swelling, conjunctivitis, anorexia, weight loss, corneal and oral ulcerations and, most unusually, intradermal pustules which developed 8 days after recovery from the initial illness. The occurrence of these pustules has not been documented previously.

Laboratory Animals 27, pp. 131-133, 1993. 1 fig., 9 refs. Authors' summary.

Anaesthetics for small rodents. The inhalation anaesthetic method as an alternative to injectable anaesthetic method

C. Dabir

The demands on veterinary anesthesia of exotic pets are today becoming increasingly higher. The inexperience of the anesthetist combined with the sensitivity of these animals can cause serious problems, with lethal effects. The purpose of this study is to describe an inhalation anesthetic method, where isofluran is used together with an anesthetic chamber. The method had so far shown very promising results and can be an alternative to the injectable anesthetic methods. A literature summary regarding existing advices and anesthetic methods is given, so that hopefully the results will be improved when using anesthesia on small animals.



Sveriges Lantbruksuniversitet, Uppsala. 25 pp, 5 figs., 17 refs. In SWED, Su. ENGL. Author's summary.

Canine distemper virus infections: diagnosis and vaccination

Merete Blixenkrone-Møller

The properties of the canine distemper virus (CDV) particle and its taxonomic status are rewiewed in the introduction together with the present knowledge of host range, transmission, pathogenesis, clinical symptoms, immunity and epizootiology of CDV infections.

The review on laboratory diagnosis of CDV infections is based on relevant literature and concentrates on specific virological and immunological diagnosis. The diagnostic aspects of CDV-IgM-antibody detection is discussed.

In the experimental section an indirect immunofluorescence (IF) technique for detection of intracellular CDV antigen in dog and mink is presented. Using this technique, the distribution of viral antigen in various tissues and blood mononuclear leukocytes was studied in mink, whether vaccinated with an attenuated vaccine strain of CDV or experimentally infected with a virulent strain of CDV. Viral antigen was detected in cells of the lymphoid system in vaccinated mink. In mink inoculated with a virulent CDV strain viral antigen was not only detected in the cells of the lymphoid system but in a wide variety of tissues including epithelial cells of the skin, mucous membranes, lung, kidneys, and cells of the CNS. The diagnostic importance of CDV antigen detection is discussed on the basis of these findings.

An IgM- and an Ig-ELISA technique for the detection of antibodies against CDV in dog and mink sera are presented. The ELISA techniques are compared to a virus neutralisation test conducted in Vero cell cultures. The diagnostic perspectives of CDV-IgM-antibody detection are discussed on the basis of the presented results.

The third part of the thesis accounts for a canine distemper outbreak that was recognized in a highly susceptible sled dog population of Northern Greenland in the beginning of January 1988.

The actual canine distemper viurs infection was identified by isolation of the virus and demonstration of viral antigens by immunofluorescence and also by demonstration of conventional inclusion bodies. Virus specific IgM-antibodies were demonstrated in affected dogs. In places where vaccination was carried out too late to be effective, the losses were up to 80 per cent. In a settlement, which was under rabies quarantine

four weeks before the distemper outbreak started in other settlements, no cases occurred before or after vaccination. The spread of canine distemper seems connected with a Canadian outbreak and was most likely communicated by foxes. Suitable future prophylactic measures are discussed.

The final discussion and conclusion on vaccination against canine distemper and on virological and immunological diagnosis of CDV infections are based on the experimental results presented. The importance of virus isolation is illustrated in the present search for clues concerning the origin and spread of the distemper-like virus infections that caused extensive epizootics among seals in Northern Europe and in Lake Baikal in Siberia in 1987-1988.

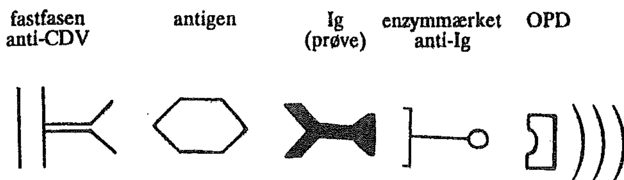


Fig. II.1a The principle of CDV-antibody ELISA

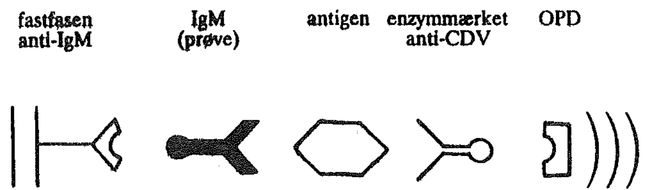


Fig. II.1b The principle of CDV-IgM antibody ELISA

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