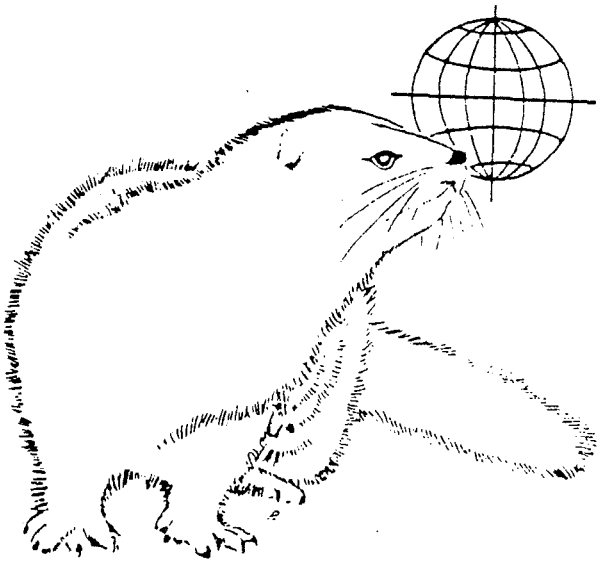


SCIENTIFUR
ISSN 0105-2403
Vol. 17, No. 4
November, 1993

Published by **IFASA**

INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

Editor	Gunnar Jørgensen	From January 1st 1994
Address	IFASA/SCIENTIFUR	SCIENTIFUR
	P.O. Box 13	P.O. Box 145, Økern
	DK-8830 Tjele, Denmark	N-0509 Oslo, Norway
Tel.	+45 89 99 15 02	+47 22 64 41 50 (private: +47 32 87 53 30)
Fax	+45 89 99 19 19	+47 22 64 35 91 (private: +47 32 87 53 30)

Subscription 1994	NOK 600,- per volume (year) Air mail delivery + NOK 80,-	
Bank	Den Danske Bank, DK-8800 Viborg, Account No. 3446-005650 **Please note:** Payment by cheque in foreign currency must be added fee of exchange, i.e. the equivalent of NOK 60,-.	Will be changed See invoice when it appears
Giro Account	No. 397 78 03, IFASA/SCIENTIFUR, P.O. Box 13, DK-8830 Tjele, Denmark	

Board of IFASA

Prof. Dr. agric. Einar J. Einarsson
(president)
P.O.Box 73, N-1430 Ås, Norway
Tel.:09 94 33 66
Fax: 09 94 33 70

Mr. Gunnar Jørgensen, Vice-president
National Institute of Animal Science
Dept. of Fur Animals
P.O.Box 39, DK-8830 Tjele, Denmark
Tel.:+45 89 99 15 01
Fax: +45 89 99 19 19

Dr. Bruce D. Murphy
C.R.R.A.
CP 5000
St. Hyacinthe
J2S 7C6 Quebec
Canada
Tel.:514 773 8521

Ing. Wim Verhagen
N.F.E.
Molenveg 7
NL-6612 AE Nederasselt, The Netherlands
Tel.:08892 - 1980
Fax:-08892 - 1465

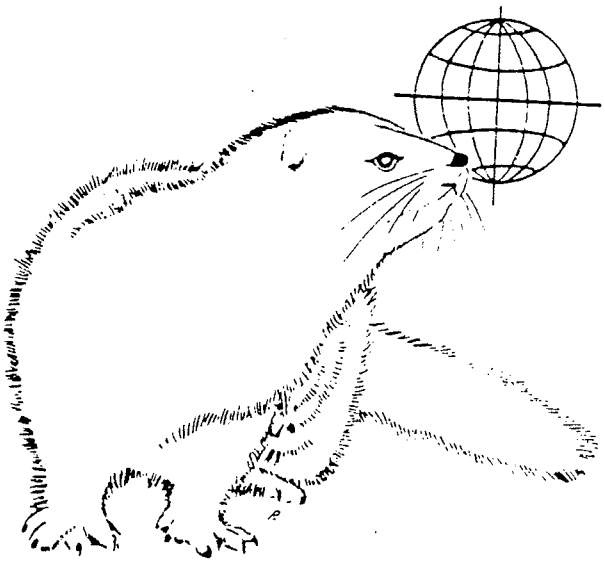
Prof. Dr. hab. Stanislaw J. Jarosz
Inst. of Animal Nutrition
Agric. Academy in Krakow
30-059, Al. Mickiewicza 24/28, Poland
Tel.:48 12 33 23 55

You're never very far from the scientific literature

...with SCIENTIFUR Electronic Index

Ordinary price, NOK 550,-
IFASA members, NOK 350,-

Prepayment, postage included



SCIENTIFUR
ISSN 0105-2403
Vol. 17, No. 4
November 1993

Published by **IFASA**

INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

4. Genetics

5. Reproduction

6. Nutrition

Notes
SCIENTIFUR
Vol. 17, No. 4, 1993

The optimism in the fur industry is again increasing.Not only are the skin prices rising considerably, but also in the organizational and scientific areas things are happening to ensure and safeguard the future of the worldwide fur animal production.

On the following pages you will be informed about the reorganisation of the European Fur Breeders Associations' Consultative Committee with the aim of being more efficient in solving common problems on the production side as well as in connection with contact to the public and to the authorities and within the scientific area.

IFASA and the Fur Animal Division under the Scandinavian Association of Agricultural Scientists hereby welcome the "new" umbrella organization CEFBA (Council of European Fur Breeders Associations).

We are convinced that this initiative will be an important step towards a more efficient international cooperation within the field of fur animal production.

As stated already under the presentation of the idea of IFASA at The International Scientific Congress in Toronto 1988, it would be a great help for the international cooperation in fur animal production if the Fur Breeders Associations worldwide could establish an efficient umbrella organisation, and here CEFBA is a good model and a good beginning.

Especially in THE NEW AGE OF FUR ANIMAL PRODUCTION where the ecconomic resources will, for many years to come, be limited it is important to create the right tools for solving the common problems which are more or less identical everywhere on the world map of fur animal production.

This summer there have been four successful scientific events in Europe. One in Denmark with participation from Russia and Holland as well as from the other Scandinavian countries. In September the annual Scandinavian scientific meeting was held in Oslo, Norway with great success. There was a successful international scientific symposium in Lublin, Poland, and finally a scientific meeting in Celle, Germany is announced. SCIENTIFUR hopes to be able to bring abstracts from the reports presented at these meetings. But that is of course based on receipt of the reports followed by an English summary or abstract.

The 2 Scandinavian meetings in which the writer has participated can be characterized by fewer participants and reports of a higher quality, reports which, because of their basic nature, had to address all fur animal scientists, advisers and producers irrespective of nationality.

In the present issue of SCIENTIFUR we bring 9 original reports which is the highest number so far. It emphasizes the increasing acceptance of SCIENTIFUR as the journal, where important scientific and technical information is given and can be found.

Another positive development is, that the number of subscribers to SCIENTIFUR has increased in 1993. We really hope, that this is a real sign of better times for all of us in the fur animal family.

At the same time it should be mentioned that SCIENTIFUR is updating all the information given over the years in THE ELECTRONIC SCIENTIFUR INDEX available at a price of NOK (Norwegian Kroner) 350.- to IFASA members and NOK 550.- to others. In case of prepayment with the order, the price includes postage.

Orders for membership of IFASA, subscription to SCIENTIFUR and for the SCIENTIFUR ELECTRONIC INDEX can be sent to:

SCIENTIFUR
P.O.Box 145, Økern
N-0509 Oslo, Norway

Tel.: +47 22644150 or
+47 32875330 (private tel.).
Fax: +47 22643591 or
+47 32875330 (private fax).

Yes you are right! **From January 1st, 1994, all correspondance to SCIENTIFUR and IFASA has to be addressed to Norway.**

Synnøve, my dear wife, who is Norwegian, gave me 17 happy years of her life in Denmark. Now I am with pleasure repaying with hopefully another 17 happy years in Norway. Thanks to the Norwegian Fur Breeders Association, which has - free of charge - given IFASA and SCIENTIFUR access to a beautiful office in The Oslo Fur Centre, there will be no difficulties in serving one of the important activities in the FUR ANIMAL WORLD, namely IFASA and SCIENTIFUR.

The main problem for me could be to find so extremely understanding, kind, willing and clever girls as Hanne, Jytte and Dorthe at the Danish secretariat. At the same time I thank you for all your help during the years, and I thank you for your promise, that you will still be there for me, should I need your assistance.

I also thank the National Institute of Animal Science for giving us room and facilities during all the years since SCIENTIFUR was just an idea. And even though the cooperation is planned to continue I would also take this opportunity to thank The Danish Fur Breeders Association for printing SCIENTIFUR all these years at a very favourable price. Thank you Børge, and also thank you to your staff, for excellent cooperation during all the years. My special thanks - with the hope of further cooperation - are also extended to the libraries of the Agricultural University in Copenhagen and of The National Institute of Animal Science, Research Centre Foulum, as well as to Janne Hansen who has carefully corrected the text and especially the "Scandinavian English" for several years. We realize, however, that so many people could not be involved in the production of SCIENTIFUR, had it not been for the great support from the European Fur Breeders Associations, the subscribers and our faithful advertizer during all the years, i.e. The Schering Plough Animal Health Division (ASL). We thank all of you for your contribution. Also thanks to all of you who contribute with original reports and abstracts. Without your publications a journal like SCIENTIFUR would be impossible.

The invoices for membership of IFASA and subscription to SCIENTIFUR will be sent to you at the beginning of January 1994. The price which will be stated in Norwegian Kroner (NOK) has been increased slightly. The subscription price for IFASA-members will be NOK 500.- and NOK 600.- for others.

As you will see, a membership of IFASA can also be an ecconomic advantage for you. Please contact us to join the IFASA family.

With all our thanks and a lot of optimism regarding our common future, we hereby - on behalf of IFASA and SCIENTIFUR - send you our best wishes for a MERRY CHRISTMAS and a HAPPY NEW YEAR .

Best Regards
Your Editor

Gunnar Jørgensen

C E F B A

COUNCIL OF EUROPEAN FUR BREEDERS' ASSOCIATION

Umbrella organization of the European Fur Breeders

In all fur producing countries in Europe the producers are organized in national associations which attend to the members' economic, professional and trade political interests. In 1968 the umbrella organization EFBACC, European Fur Breeders' Associations' consultative Committee, was established, and at the time only consisting of the 6 EC-countries with the object to have a platform for better communication between the 6 member organizations and to be able to work for common interests.

To intensify this cooperation for instance in relation to coming legislative initiatives and recommendations from European fur breeders' associations have decided to strengthen their umbrella organization. In this connection the name of the organization has been changed to CEFBA, Council of European Fur Breeders' Associations, and from the statutes it is seen that the main objects of CEFBA are:

- *to contribute to making the fur animal production accepted and respected as a natural part of the animal husbandry production in all member countries, including to contribute to making legislation and regulations of fur animal breeding acceptable.*

To fulfill the mentioned objects the tasks of CEFBA are:

- *to urge that research regarding the welfare of the fur animals and other relevant research of common interest will be effected and the results will be implemented;*
- *to inform the politicians, authorities, organizations and public in such a way to secure that it is relevant and exact knowledge based on proctical experience and research results which form the basis of coming legislation and regulations of the fur animal production. This applies to both national level and to the level of the council of Europe and the EC;*
- *to contribute to making legislation and regulations regarding fur animal production based on exact knowledge but alos as equal as possible considering the national characteristics.*

Today CEFBA has fur breeders' associations in 12 countries as members, i.e. Belgium, Denmark, Finland, France, the Netherlands, Ire-

land, Italy, Norway, Spain, Sweden, Germany and United Kingdom. As a geographic limit regarding membership of CEFBA it is claimed that the nation which the asociation in question represents is to be member of the council of Europe. Other fur producing countries in Europe as well as Canada and USA can obtain observer status in CEFBA.

In 1993 the member organizations represent a production of 13 million mink skins and 1.7 million fox skins which correspond to about 70 per cent of the world production of both mink and fox skins.

Mr. Wim Goezinnen of the Netherlands is chairman of CEFBA, and Mr. Knud Vest of Denmark is vice-chairman. Both chairman and vice-chairman are fur farmers. CEFBA's secretariat of administrative functions is placed with the Dutch fur breeders' association, whereas Mr. Helge Olsen, director, is responsible of the carrying through of CEFBA's political and professional tasks, and his office is placed in Denmark.

September 1993

More information:

Council of
European Fur Breeders' Associations
PB 6, Molenweg 7
NL-6612 AE NEDERASSELT

Telephone: +31 8892 1980
Telefax: + 31 8892 1465

Council of
European Fur Breeders' Associations
Vejlesøvej 36
DK-2840 Holte

Telephone: +45 42 42 55 66
Telefax: +45 42 42 33 11

Original Report

Content of some mineral elements in chosen organs of silver foxes (*Vulpes vulpes*)

K. Süvegova[1], D. Mertin[1], P. Sviatko[2], E. Oravcova[1]

[1]Research Institute of Animal Production, Dept. Fur Animal Rearing, Hlohovská 2, 949 92 Nitra, Slovakia

[2]Association Workplace of Ecology in Animal Production at the RIAP and IFAP SAS, Palackého 12, 040 01 Kosice

Summary

We determined the concentration of some mineral elements (Co, Cu, Mn, Zn, Ca, Mg, K, Fe, Cd, Pb) in chosen organs (liver, stomach, heart, striated muscle, lung, kidney) in healthy silver foxes during the fur maturity period. The elements were determined by means of the atomic absorbtion spectral photometry method and results were elaborated by means of a t-test. We observed statistically significant differences in the concentration of mineral elements between the sexes on the level of significance $P \leq 0.05$ and $P \leq 0.01$ in some organs.

Introduction

There does not exist an important biochemical process in the organism without the presence of mineral elements. The rational system of animal nutrition can be elaborated only with the knowledge of mineral metabolism. The norms of mineral nutrition of animals are revised and defined more precisely, new effective sources of mineral additives are being searched for and the technology of their feeding to animals has been improved in many countries of the world with intensively developing animal production during the last years (*Georgievskij et al., 1982*).

The organism is able to regulate the homeostatis of mineral elements to a great extent. The mineral composition of tissues remains quite stable irrespective of large fluctuations of the macro and micro element contents in feed. However, these regulation mechanisms are also limited, so that disorder of the mineral metabolism can become a serious limiting factor of production in intensively-used animals (*Georgievskij et al., 1982*).

The interest in the role of mineral elements in the metabolism of fur animals arose during the eighties and nineties. There were some authors dealing with the content of mineral elements in blood (*Bialkowski and Saba, 1985*) and in fur of silver foxes (*Saba et al., 1982; Saba and Bialkowski, 1985; Mertin et al., 1990, 1991, 1992*). Samkov, (1972) and Mertin et al. (1991, 1992) studied the influence of mineral element additives on the production of silver foxes. Kopczewski et al. (1990) studied the accumulation of heavy metals in tissues of mink, foxes and fitch-ferrets.

Our work is an introduction to the problems of metabolism of mineral elements in fur animals and we would like to deal with these problems in the future, too. The content of mineral elements in the fur of fur animals gives evidence of the quality of mineral metabolism during a long period - during the development of the fur. On the other hand, we get an actual picture of the present state of the organism after analysis of the inner organs. We studied the mineral composition of the organs in healthy individuals of silver foxes during the period of fur maturity.

From the knowledge gained in this work, our further experiments can be aimed at the research of mineral metabolism and the requirements of mineral elements in fur animals. The gained values can also serve for comparison in the analysis of damages of production in breeding herds of silver foxes, if there is suspicion of metabolic disorders and shortcomings in nutrition. A more precise study of the reaction of the organism to various infectious and non-infectious diseases, medical products, feeds and other chemical as well as physical factors can also be done.

Material and methods

We used 30 males and 30 females silver foxes from the Department of Fur Animal Rearing of the Research Institute of Animal Production (RIAP) in the experiment. The animals were clinically healthy, in optimum condition, with good fur quality. They were kept in cages made from zinc-coated netting of standard type, located in two rows in sheds, and they were fed a common feed ration which covered the needs of the animals with regard to basic nutrients. Its composition is given in table 1.

The animals were skinned in the period of fur maturity. The organs of 10 animals of the same sex were homogenized and one sample was made of them. We gained 3 samples of each organ of females and males in this way. This method was necessary because of the low weight of the organs. The samples were analysed by means of the atomic absorbtion spectraphotometry method using the apparatus of the firm Perkin-Elmer, model 5000 and in the graphite cell HGA 500 in the Associated Department of Ecology in Animal Production at the Research Institute of Animal Production in Nitra and the Institute of Farm Animal Physiology of the Slovak Academy of Sciences in Kosice under the leader of Mr. P. Sviatko.

The obtained values of concentration of the observed elements were processed to the basic variance and statistic characteristics ($x \pm s$). The significance of differences of the arithmetical means was tested by means of the t-test.

Table 1. Feed rations for silver foxes at the RIAP Nitra in 1992 (g. 418 kJ ME)

Feed	Calendar month					
	I.-II.	III.	IV.-V.	VI.-VIII.	IX.-XI.	XII.
Beef	24.0	20.0	-	3.0	12.0	20.0
Poultry byproduct-mixed	20.0	22.0	15.0	25.0	30.0	30.0
Rabbit liver	5.0	7.0	10.0	-	-	-
Feed mixture of meat	-	-	25.0	10.0	9.0	-
Proventriculi of cattle	-	-	10.0	8.0	-	3.0
Beef tallow	-	-	-	1.2	-	-
Nor II (coarse meals)	8.0	7.4	5.5	8.0	7.0	8.0
Cooked hen eggs	0.6	0.5	0.2	0.2	0.1	0.6
Dried milk	1.5	2.0	2.0	0.5	1.5	1.5
Dried yeast + mineral and vitamin additives	0.8	1.2	1.2	1.2	1.5	0.8
Digestible crude proteins	9.7	9.9	10.5	8.0	9.4	9.9
Digestible fats	3.5	3.6	3.7	4.4	3.9	3.5
Digestible saccharides	5.9	5.9	4.9	5.6	5.3	5.7

Results and discussion

The results are given in table 2 and graphs 1-11. Differences were noticed between males and females in the concentration of mineral elements in some organs on the level of significance $P \leq 0.05$ and $P \leq 0.01$. We observed statistically significant higher values of Co and Zn in muscle, Cu in liver, stomach and lungs, Mn in liver and lungs, Ca in lungs and kidneys, Mg, K and Na in liver, stomach and muscle, Fe in lungs, Cd in heart and Pb in liver, muscle and lungs of males.

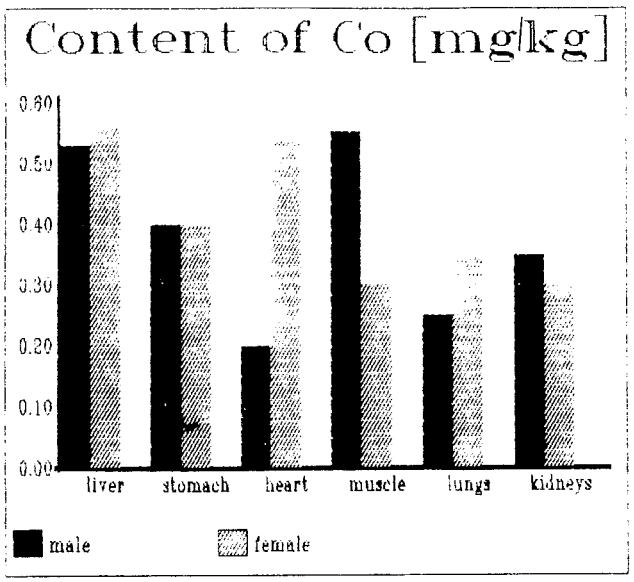
Significantly higher concentrations of Co, Zn were observed in heart, Cu in stomach and lungs, Mn in stomach, heart and kidneys, Ca in stomach, heart and muscle, Mg in heart, lungs and kidneys, K, Na in heart, lungs and kidneys, Fe in liver, stomach and heart, Cd in stomach and Pb in stomach and heart of females.

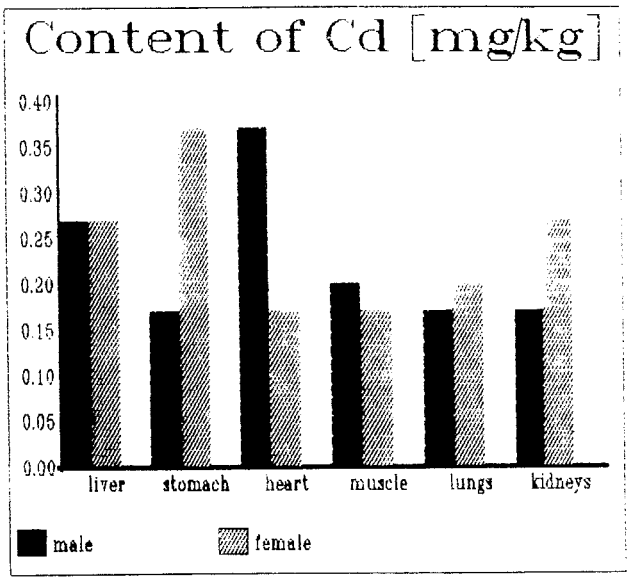
The obtained results are comparable only with the results of Kopczewski et al. (1990) who measured 0.025-0.085 mg/kg cadmium in female and 0.052-0.140 mg/kg in male, 0.08-0.40 mg/kg lead in female and 0.07-0.42 mg/kg in male, 9.30-20.00 mg/kg copper in female and 9.10-26.00 mg/kg in male, 21.0-29.0 mg/kg zinc in female and 24.0-34.0 mg/kg in male mink, fox and fitch-ferret liver. All these values are lower than the values we measured in our experiment.

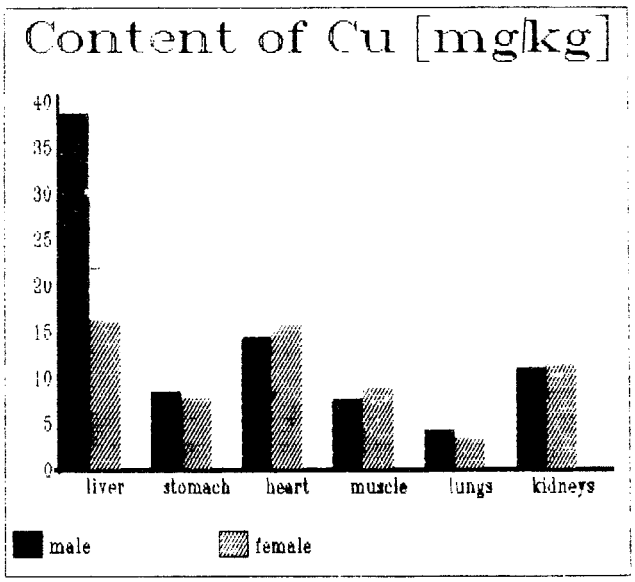
We suppose that mainly the composition of feed ration caused the differences. The feed ration in Kopczewski's experiment was composed only of sea fishes and fish by-products. Perhaps the results are deformed a bit because organs from 3 different animal species were evaluated together.

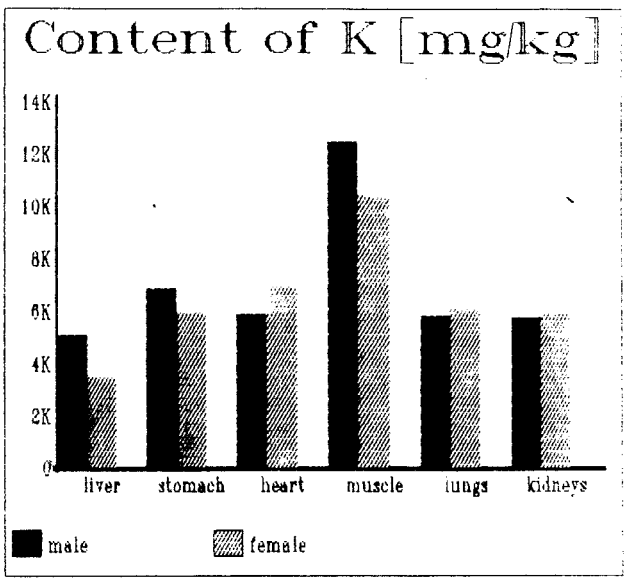
Table 2. Content of some mineral elements in chosen inner organs of silver foxes during the period of fur maturity (in mg/kg dry matter)

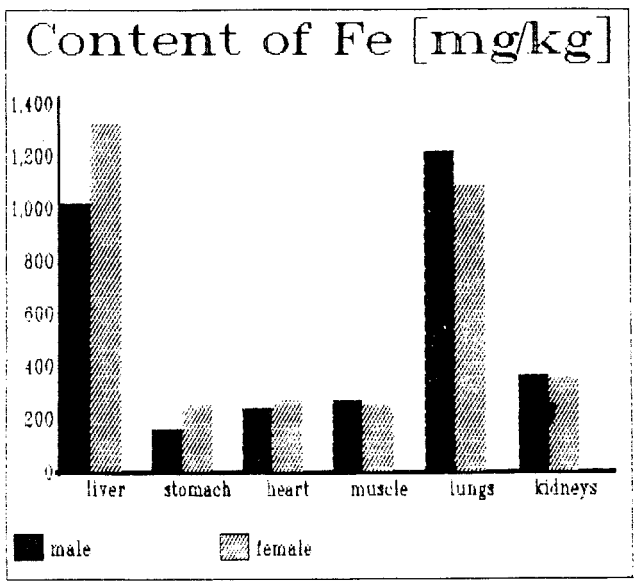
Organs		Co	Cu	Mn	Zn	Ca	Mg	K	Na	Fe	Cd	Pb
Liver	♂ x	0.53	37.73++	8.23++	79.20	116.77	487.37++	5096.77++	4639.90++	1020.37++	0.27	1.77+
	s	0.03	1.20	0.25	0.31	5.86	16.21	155.17	135.12	27.08	0.06	0.06
	♀ x	0.557	16.17	7.40	82.07	116.50	395.13	3490.30	3292.73	1322.17	0.27	1.57
	s	0.051	0.45	0.20	2.1	5.63	13.38	90.45	89.32	30.15	0.06	0.06
Stomach	♂ x	0.40	8.53++	2.87++	71.33++	175.80++	693.20++	6891.80++	3631.77++	160.73++	0.17+	1.57+
	s	0.005	0.21	0.15	1.15	5.19	11.43	68.07	38.32	1.27	0.06	0.06
	♀ x	0.40	7.77	3.77	68.43	639.13	608.97	5943.57	3210.80	256.67	0.37	2.17
	s	0.10	0.15	0.06	1.25	16.62	8.49	71.32	41.20	5.77	0.06	0.06
Heart	♂ x	0.20++	14.33++	1.87++	43.70++	40.20++	597.83++	5877.77++	3833.34++	241.13++	0.37+	1.30++
	s	0.00	0.28	0.06	1.54	0.35	15.78	84.93	30.64	10.19	0.06	0.10
	♀ x	0.55	15.67	2.17	56.77	75.37	688.40	6929.27	3125.47	271.33	0.17	2.17
	s	0.06	0.42	0.06	0.68	5.04	16.11	74.48	28.59	2.31	0.06	0.06
Striated muscle	♂ x	0.55++	7.63+	1.80	84.90++	35.17++	889.30+	12500.60++	1894.20++	271.30	0.20	1.97+
	s	0.06	0.21	0.10	0.85	5.01	16.74	131.93	21.88	10.25	0.00	0.06
	♀ x	0.30	8.97	1.70	77.00	60.40	825.53	10419.90	1646.03	256.73	0.17	1.76
	s	0.006	0.23	0.10	1.00	0.69	22.18	127.51	24.39	25.18	0.06	0.06
Lungs	♂ x	0.25	4.20++	1.56++	41.13	697.43++	341.20+	5810.20++	5569.33++	1219.23++	0.17	2.50++
	s	0.05	0.10	0.06	1.02	6.54	10.21	36.39	60.18	16.69	0.06	0.10
	♀ x	0.35	3.37	1.16	40.63	225.80	366.30	6162.03	6031.57	1088.90	0.20	2.00
	s	0.05	0.06	0.06	1.51	5.19	5.48	55.28	38.67	8.40	0.00	0.10
Kidneys	♂ x	0.35	11.07	3.37++	51.86	277.03++	418.06+	5782.23+	5605.93++	367.70	0.17	1.77
	s	0.06	0.23	0.06	0.81	6.11	7.289	82.37	135.09	6.85	0.06	0.06
	♀ x	0.30	11.40	3.80	53.13	182.16	470.57	6112.20	6208.30	359.23	0.27	1.63
	s	0.006	0.26	0.10	1.85	10.68	17.83	131.29	127.84	8.87	0.06	0.11

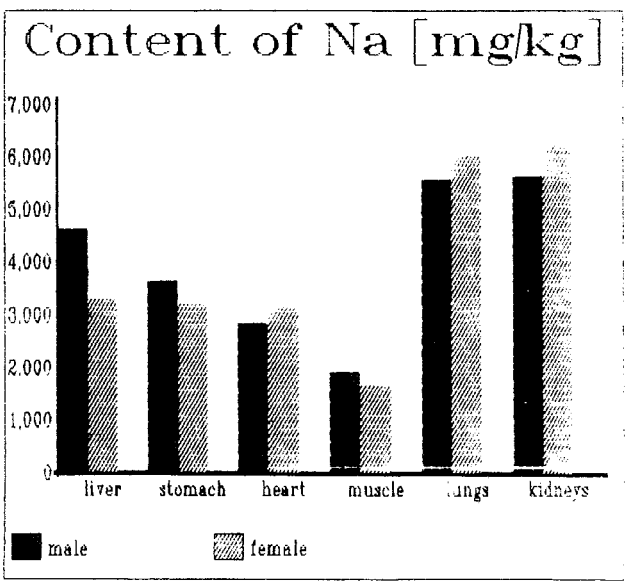

Content of Co [mg/kg]
0.60
0.50
0.40
0.30
0.20
0.10
0.00
liver
stomach
heart
muscle
lungs
kidneys
male
female

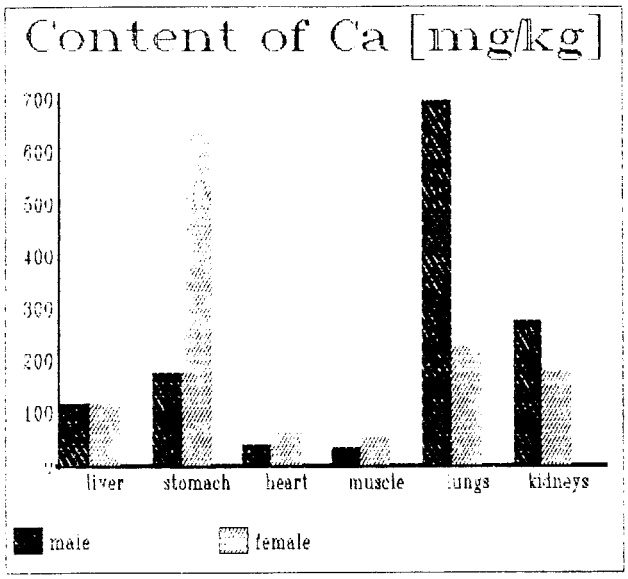

Content of Cd [mg/kg]
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
liver
stomach
heart
muscle
lungs
kidneys
male
female

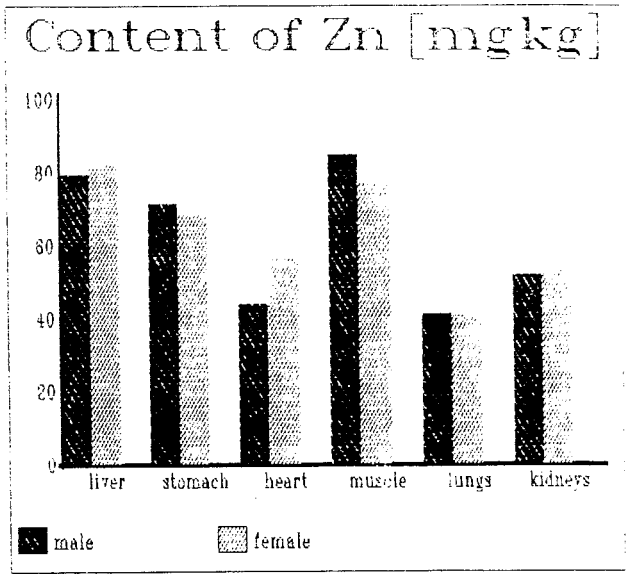

Content of Cu [mg/kg]
40
35
30
25
20
15
10
5
0
liver
stomach
heart
muscle
lungs
kidneys
male
female

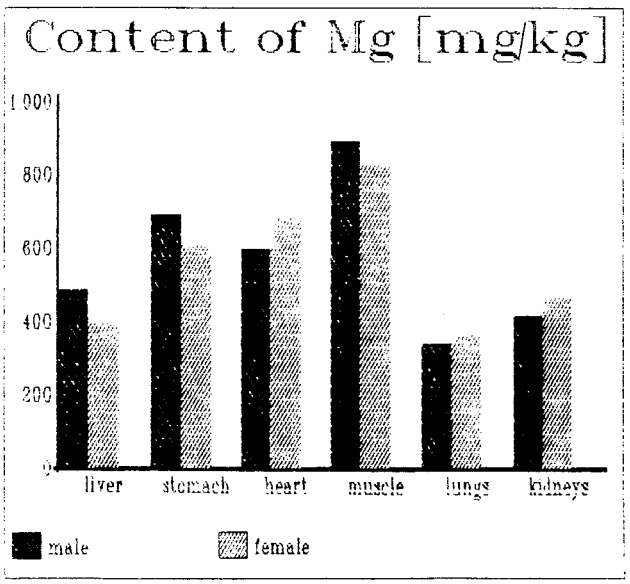

Content of K [mg/kg]
14K
12K
10K
8K
6K
4K
2K
0
liver
stomach
heart
muscle
lungs
kidneys
male
female

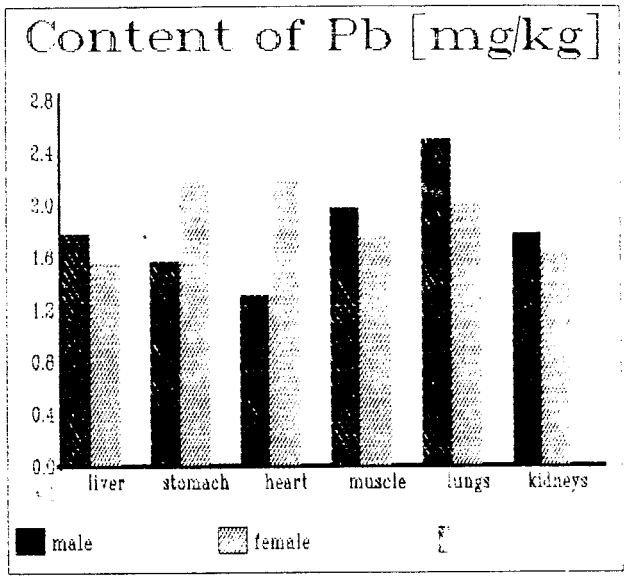

Content of Fe [mg/kg]
1,400
1,200
1,000
800
600
400
200
0
liver
stomach
heart
muscle
lungs
kidneys
male
female

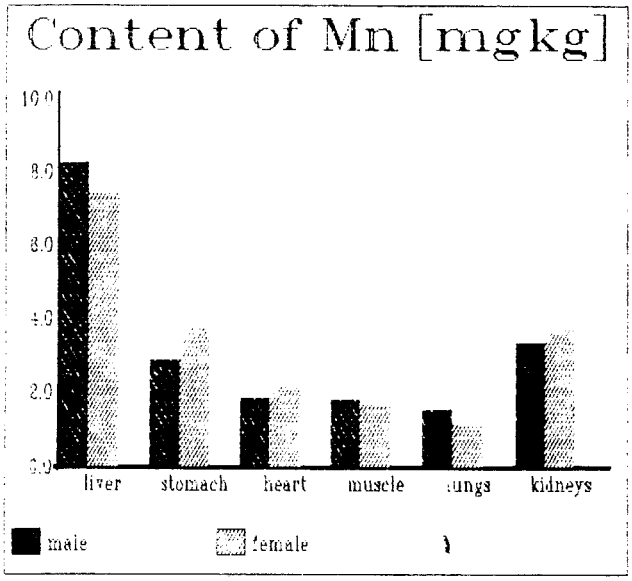

Content of Na [mg/kg]
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
liver
stomach
heart
muscle
lungs
kidneys
male
female











References

Bialkowski, Z. and Saba, L. 1985. Investigations over the relationship between occurrence of mineral elements in blood serum and hair of black-silver foxes. Scientifur, Vol. 9, No. 1, p. 21-23.

Georgievskij, V.I., Annenkov, R.N., Samochin, V.T. 1982. Minerálna výziva zvierat. Príroda Bratislava.

Kopczewski, A., Wroblewska, M., Zdunkiewicz, T. 1990. Okreslenie xawartosci pestycydow polichlorowych, polichlorowanych dwufenyli, oraz metali: olowiu, kadmu, miedzi i cynku w tkankach norek, lisow i tchorzofretek. Przeglad naukowej literatury zootechicznej, Vol. 35, p. 218-223.

Mertin, D. 1992. Vplyv solí zinku, kremíka a selénu na reprodukciu a rast striebornych lisok. Pol'nohospodárstvo, Vol. 38, No. 4, p. 298-304.

Mertin, D., Rafay, J., Berestov, V., Stepanok, V. 1991. Content of some mineral elements in hair of silver foxes during ontogenesis. Scientifur, Vol. 15, No. 3, p. 183-189.

Mertin, D., Rafay, J., Stepanok, V. 1990. Koncentrácia niektorých minerálnych prvkov v srsti striebornych lísok v obdbí kozusinovej zrelosti. Pol'nohospodárstvo, Vol. 36, No. 9, p. 830-836.

Mertin, D., Stepanok, V., Georgevskij, V. 1992. Effect of dietary zinc, silicium and selenium on mineral content of fur in silver foxes during fur maturity. Norwegian J. of Agri. Sci., No. 9, p. 620-625.

Mertin, D., Tocka, I., Oravcová, E. 1991. Effect of Zn, Se on some morphological fur properties in silver foxes in period of fur maturity. Scientifur, Vol. 15, No. 4, p. 287-293.

Saba, L., Bialkowski, Z., Wojcik, S., Janecki, T. 1972. Content of mineral elements in the hair of black-silver foxes. Scientifur, No. 4, p. 8-11.

Samkov, J.A. 1972. Vlijanie vitaminov a mikro elementov na kacestvo mecha lisic. Krolokovodstvi i Zverovodstvo, No. 1, p. 29-30.

"Finding fossilized bones of arctic animals in the tropics indicates either climatic upheaval, continental drift or that paleolithic man had a zoo there."

Original Report

Content of some mineral elements in chosen organs of polar foxes (Alopex lagopus) during fur maturity

D. Mertin[1], E. Oravcova[1], P. Sviatko[2], K. Süvegova[1]

[1]Research Institute of Animal production (RIAP), Department of Fur Animal Breeding, Hlohovska 2, 949 92 Nitra, Slovakia

[2]Associated Workplace of Ecology of Animal Production at RIAP, Nitra and the Institute of Physiology of Farm Animals of the Slovak Academy Sciences, Kosice, Palackeho 12, 040 01 Kosice, Slovakia

Summary

The concentrations of cobalt, copper, manganese, zinc, calcium, magnesium, potassium, sodium, iron, cadmium and lead were studied in liver, stomach, striated muscle and brain tissue of female and male Polar foxes (Alopex lagopus).

30 female and 30 male foxes reared in the Department of Fur Animal Breeding of RIAP, Nitra were used in the trial. The animals were healthy, in optimum condition and fed the full-value feed ration.

The organs were removed after skinning during the fur maturity period. The mineral elements in organs were determined with atomic absorbtion spectral photometry. The results were elaborated by means of variance and statistical characteristics (x ± SD); significance of differences of arithmetic means was tested with a t-test. Statistically signi-ficant differences in the concentration of mineral elements between sexes on the level of significance P≥0.05 and P≥0.01 were observed in some organs.

Introduction

We determined the concentration of some mineral elements on chosen organs of silver foxes in our previous work and we aimed our attention at the study of concentration of some mineral elements in Polar foxes in our present work. Other authors have also studied the mineral composition and role of mineral elements in the organism. Bialkowski and Saba (1985) dealt with the content of mineral elements in blood, Saba et al. (1982) as well as Saba and Bialkowski (1985), Mertin (1992 a, b,), Mertin et al. (1990, 1991, 1992) with their content in the fur of silver foxes. Samkov (1972), Mertin et al. (1991, 1992) studied the influence of mineral element additives on production of silver foxes. Kopcziewski et al. (1990) observed the deposition of heavy metals in the tissue of mink and fitchferrets.

Materials and methods

The experiments were performed in the Department of Fur Animals Breeding of the Research

Institute of Animal Production in Nitra. 30 males and 30 females Polar foxes during the fur maturity period were used. The animals were clinically healthy, in optimum condition and with good hair quality. They were kept in cages made of zinc-coated netting of standard type, located in two rows in sheds. They were fed a common feed ration which covered the needs of the animals in regard to the content of basic nutritients. Its composition is given in Table I.

The obtained values of concentration of the studied elements were processed to the basic variance and statistical characteristics ($\bar{x} \pm SD$). The significance of differences of arithmetical means was tested by use of a t-test.

Results and discussion

Average values of the content of some mineral elements in chosen organs of Polar foxes during the fur maturity period are given in Table II.

Table 1. Feed rations for foxes in RIAP Nitra in 1992 (g. 418 kJ)

Feed	Calendar month					
	I.-II.	III.	IV.-V.	VI.-VIII.	IX.-XI.	XII.
Beef	24.0	20.0	-	3.0	12.0	20.0
Mixed poultry waste	20.0	22.0	15.0	25.0	30.0	30.0
Rabbit liver	5.0	7.0	10.0	-	-	-
Feed mixture of meat	-	-	25.0	10.0	9.0	-
Proventriculi of cattle	-	-	10.0	8.0	-	3.0
Beef tallow	-	-	-	1.2	-	-
NOR II(coarse meals)	8.0	7.4	5.5	8.0	7.0	8.0
Cooked hen eggs	0.6	0.5	0.2	0.2	0.1	0.6
Dried milk	1.5	2.0	2.0	0.5	1.5	1.5
Dried yeast+mineral and vitamin additives	0.8	1.2	1.2	1.2	1.5	0.8
Digestible crude proteins	9.7	9.9	10.5	8.0	9.4	9.9
Digestible fats	3.5	3.6	3.7	4.4	3.9	3.5
Digestible saccharides	5.9	5.9	4.9	5.6	5.3	5.7

Note: - Feed mixture of meat (40% cattle muscular substance, 40% mixed poultry waste, 20% cattle viscera)
- according to norm

The animals were skinned in the period of fur maturity and the organs were removed as follows: liver, stomach, striated muscle and brain. The organs of 10 animals of the same sex were homogenized and one sample was made of them. Three samples from each organ of males and females were gained in this way. This method was necessary because of the low weight of the organs. The samples were analysed by use of the atomic absorption spectral photometry method in the apparatus of the firm PERKIN-ELMER, model 5 000 and in the graphite cell HGA 500.

Differences between males and females were noticed at the level of significance $P \geq 0.05$ and $P \geq 0.01$ from the given results (Table III.).

Significantly higher values of Co content in muscle, Cu in brain, Mn and Fe in stomach and muscle, Ca in stomach, liver and brain, Mg in stomach and liver, Na in stomach and brain, Cd in stomach, and Pb in muscle were observed in males compared with females. On the other hand, a higher content of Zn and Cu was observed in stomach, liver and muscle, Co in brain,

Na and K in stomach, Fe in liver and Pb in brain and liver of females.

The highest concentration was of potassium in males (12 936.40 - 3 575.30 mg/kg) as well as in females (13 015.40 - 5 655.90 mg/kg), absolutely expressed. On the contrary, the lowest content was observed with cadmium. Its concentration varied from 0.47 mg/kg to 0.17 mg/kg in males, and from 0.20 mg/kg to 0.17 mg/kg in females.

Analogical results were obtained in silver foxes. These results were given in the previous work (Süvegova et al. 1993, in press). The highest concentration was noticed with potassium and the lowest with cadmium.

Table 2. Content of some mineral elements in chosen organs of Polar foxes in the period of fur maturity (mg/kg dry matter)

Organ		Co	Cu	Mn	Zn	Ca	Mg	K	Na	Fe	Cd	Pb
Liver	♂ x	0.30	15.17	9.50	69.50	126.87	563.23	5891.10	3896.97	1390.33	0.27	1.78
	SD	0.01	0.41	0.26	1.80	5.95	15.11	153.18	106.47	36.61	0.06	0.12
	♀ x	0.36	23.77	9.00	82.27	76.63	449.60	5655.90	3632.67	1502.10	0.17	2.10
	SD	0.05	0.91	0.36	3.10	5.74	19.40	219.26	134.62	56.49	0.06	0.10
Stomach	♂ x	0.25	7.63	4.40	57.67	975.80	651.90	3575.30	2251.50	245.70	0.47	1.77
	SD	0.05	0.21	0.30	0.58	14.17	20.27	39.29	18.76	5.15	0.06	0.06
	♀ x	0.25	9.97	3.63	68.87	251.37	558.03	5736.76	2734.83	155.83	0.20	1.18
	SD	0.05	0.42	0.21	0.81	20.14	25.55	64.24	32.56	15.07	0.00	0.10
Striated muscle	♂ x	0.70	7.90	1.77	98.00	80.40	763.87	9397.63	1889.57	135.70	0.17	1.57
	SD	0.01	0.10	0.06	1.73	10.02	21.09	122.09	25.97	5.15	0.06	0.06
	♀ x	0.45	9.73	1.50	108.27	70.50	750.27	9572.17	1842.90	116.13	0.20	1.27
	SD	0.05	0.15	0.10	1.42	10.04	10.40	144.08	37.41	4.63	0.00	0.06
Brain	♂ x	0.40	11.83	1.67	46.00	596.53	561.10	12936.40	5186.70	91.00	0.17	2.07
	SD	0.00	0.38	0.06	2.00	15.10	36.56	289.79	110.21	10.15	0.06	0.06
	♀ x	0.51	10.57	1.67	46.03	207.40	527.67	13015.40	4461.47	91.07	0.17	2.27
	SD	0.01	0.21	0.06	1.05	6.50	26.58	284.76	107.45	1.85	0.06	0.06

Table 3. Significance of differences of arithmetic means of studied mineral element concentrations in chosen organs between female and male Polar foxes.

Element (mg/kg)	Liver	Stomach	Striated muscle	Brain
Co	-0.06	0.00	0.25**	-0.11**
Cu	-8.60**	-2.34**	-1.83**	1.26**
Mn	0.50	0.77*	0.27*	0.00
Zn	-12.77**	-11.20**	-10.27**	-0.03
Ca	50.24**	724.43**	9.90	389.13**
Mg	113.63**	93.87**	13.60	33.43
K	235.20	-2161.46**	-174.54	-79.00
Na	264.30	-483.33	46.67	725.23**
Fe	-111.77*	89.87**	18.97**	0.07
Cd	0.10	0.27**	-0.03	0.00
Pb	-0.37*	-0.03	0.30**	-0.20*

It is possible to compare the obtained results only with the results of Kopczewski et al., (1990). They noticed 0.025-0.085 mg/kg cadmium in female liver of mink, foxes and fitch-ferrets, and 0.052-0.140 mg/kg in males, 0.08-0.40 mg/kg lead in females and 0.07-0.42 mg/kg in males, 9.30-20.00 mg/kg copper in females and 9.10-26.00 mg/kg in males, 21.0-29.0 mg/kg zinc in females and 24.0-34.0 mg/kg in males. All these values are lower than values measured in our experiment.

We suppose that the differences are related mainly to the composition of the feed ration which was composed only of sea fishes and fish waste in Kopczewski's experiment (1990).

The results can also be slightly deformed by having three various animal species whose organs were tested.

References

Bialkowski, Z., Saba, L., 1985: Investigation over the relationship between occurence of mineral elements in blood serum and hair of black-silver foxes. Scientifur, 9, p.21-23.

Georgievskij, V. I., Annenkov, B. N., Samochin, V.I., 1982: Mineralna vyziva zvierat, Priroda Bratislava.

Kopczewski, A., Wroblewska, M., Zdunkiewicz, I., 1990: Okreslenie zawartosci pestycydow polichlorowych, polichlorowanych dwufenyli oraz metali: olowium, kadmium, miedzi a cynku w tkankach norek, lisow i tchorzofretek. Przeglad naukowej literatury zootechnicznej, 35,p.218-223.

Mertin, D., 1992 a: Koncentracia niektorych mineralnych prvkov v letnej srsti mladat krizencov lisky obycajnej cervenej so striebornou liskou. Polnohosp. 38,1-2, p.110-116.

Mertin, D., 1992 b: Vplyv soli zinku, kremika a selenu na reprodukciu a rast striebornych lisok. Polnohosp. 38,4, p. 298-304.

Mertin, D., Rafay, J., Stepanok, V. 1990: Koncentracia niektorych mineralnych prvkov v srsti striebornych lisok v obdobi kozusinovej zrelosti. Polnohosp. 36, 9, p. 830-836.

Mertin, D., Rafay, J., Berestov, V., Stepanok, V., 1991: Content of some mineral elements in hair of silver foxes during ontogenesis. Scientifur, 15, 3, p. 183-189.

Mertin, D., Tocka, I., Oravcova, E., 1991: Effects of Zn, Se on some morphological fur properties in silver foxes in period of fur maturity. Scientifur, 15,4, p. 287-293.

Mertin, D., Stepanok, V., Georgievskij, V., 1992: Effects of dietary zinc, silicium and selenium on mineral content of fur silver foxes during fur maturity. Scientifur, 15,4, p. 287-293.

Mertin, D., Stepanok, V., Georgievskij, V., 1992: Effects of dietary zinc, silicium and selenium on mineral content of fur in silver foxes during fur maturity. Norwegian J. of Agri.Sci., 9,p.620-625.

Süvegova, K., Mertin, D., Sviatko, P., Oravcova, E., 1993: Content of some mineral elements of chosen Organ of silver foxes (Vulpes vulpes). Scientifur, in press.

Saba, L., Bialkowski, Z., Wojcik, S., Janecki, T., 1972: Content of mineral elements in the hair of black-silver foxes. Scientifur, 4, p. 8-11.

Samkov, J. A., 1972: Vlijanie mikroelementov nakacestvo mecha lisic. Krolikov. i zverovod., 1, p. 29-30.

Original Report

Cycle housing in nutria breeding using the method of synchronization of oestrus

E. Oravcová[1], D. Mertin[1], M. Oberfranc[1], I. Tocka[2]

[1]Research Institute of Animal Production, Dept. Fur Animal Rearing, Hlohovská 2, 949 92 Nitra, Slovakia

[2]University of Agriculture, 949 01 Nitra, Slovakia

Summary

The influence of synthetic progestagene in two various forms (Evertas P and Regumate porcine) on the synchronization of oestrus in primiparous standard nutria females (*Myocastor coypus*) kept in cages with pools in a hall was studied. With Evertas P application the number of days from the moment the females were given to the males to parturition varied from 128 to 135 days. 11 experimental females gave birth and two remained infertile of the total 13 experimental females. The period from the moment the females was given to the males to parturition varied in eight cases (80%) from 131 to 135 days with the application of Regumate porcine. This period varied from 132 to 221 days in the control group.

The obtained results show that Evertas P and Regumate porcine influence positively the sexual cycle in female nutria and they can be recommended for synchronization of oestrus in nutria.

Introduction

The introduction of gonadotrophic hormones into the experimental as well as practical sphere of reproduction biology helped to increase the influence of stimulating effects on ovarial activity. The present knowledge of the processes which precede fertilization is on such a level that it is possible to apply the biotechnical methods for controlled reproduction.

Problems of synchronization of the sexual cycle are elaborated very well mainly in cattle (*Fulka et al., 1975; Pivko and Majerciak, 1981; Shilling et al., 1981; Hasler et al., 1983*) and pigs (*Webel, 1978; Schlieper and Holtz, 1984; Ebert et al., 1988; Fursel et al., 1987; Oberfranc et al., 1989; Jin et al., 1991, and other*).

The control of the sexual cycle as well as the elaboration of synchronizing methods is not confined to cattle and pigs, certain positive results have also been achieved in laboratory animals

and rabbits (*Deborah et al., 1983; Babusik et al., 1983, and other*).

Nutria is a polyestrous animal which is supposed to be in oestrus every 25-30 days with a possible tolerance of 14-42 days (*Barta and Jakubicka, 1983*). Younger females are in oestrus each 24-27 days, the older ones each 28-30 days (*Iljina, 1975; Skrivan et al., 1976*). In spite of this, Kopanski (1981) mentions that the sexual cycle varies from 17 to 35 days in nutria. According to Scheuring (1983), the new oestrus in nutria appears 12 hours after parturition and again 28-30 days after parturition.

It is possible to explain the difference of opinion on the sexual cycle in nutria by the fact that oestrus in nutria is inexpressive (so-called silent oestrus) and the given problem is not explored enough. Tocka (1985) mentions that oestrus in nutria lasts 1-4 days, pregnancy 128-132 days with a possible time deviation of 1-4 days.

Barta and Jakubicka (1985) dealt with the influence of gonadotrophic hormones on ovarian activity in nutria. The results they obtained show that ovulation in nutria takes place 12 to 14 hours after coitus. Ovulation of hormonally-treated nutria set in 15-18 hours after the HCG application. The authors state that further study is necessary to improve the reproductive traits of nutria in breeding practice.

The possibility of cycle housing in nutria in the form of hormonal treatment has not been studied neither in our country nor abroad so far. However, from the above-mentioned works follows that it is possible to synchronize the female nutria and to create a precondition for rotation mating with subsequent rotation weaning. This system of rearing would make the production of nutria more efficient.

Materials and methods

The experiment was performed in the Department of Fur Animals Rearing of the Research Institute of Animal Production in Nitra. 39 primiparous female standard nutria (*Myocastor coypus*) at the age of 8 months were used in the experiment. They were kept in cages with pools in a hall. Three females were kept in one cage. The animals were fed a mois mixture of coarse meal containing 50% barley, 15% maize, 5% ground pea meal and 5% COS II mixture on the basis of Zinc metallibur (Evertas P, f. VUBL Jílové u Prahy) and Altrenogest (Regumate porcien, f. HOECHST, France) during the experiment. Fodder beet was given as supplementary feed.

Three groups were created according to the following scheme:

1. Experimental group (n=13).
The females received an additive of synthetic progestagene "Evertas P" (8 g/600 g food) for the oestrus synchronization for 25 days. The rate 8:600 was used with respect to the expected losses during the manipulation (2 g of preparation). The feed ration consisted of 200 g mixture per head and day. The animals were fed 2 times daily, at 7.30 in the morning and 14.30 in the afternoon. The females were treated with serum gonadotropin for veterinary use (PMSG Bioveta Ivanovice na Hané) 200 i.u. per head intramuscularly after the application of Evertas P was finished. 56 hours later the chorion gonadotropin Preadyn (f. Léciva Praha) was applied intramuscularly of a dose of 100 i.u. per head. Immediately after HCG application the females were given to the males.

2. Experimental group (n=10).
Synthetic progestagene "Regumate porcine" (10 ml per 3 heads and day) was added to the feed mixture for 20 days. The preparation was applied to the feed mixture 1 time daily during the morning feeding. After the Regumate application was ended the females were treated in the same ways as in the first group.

3. Control group (n=16).
The animals were fed two times daily without hormonal preparations. We observed the length of the period from the time the female was given to the male to parturition, number of live born and still-born.

The basic variance and statistical characteristics ($x \pm s$) were calculated from the obtained results.

Results and discussion

Results of reproduction in females after Evertas P application are given in table 1.

Table 1. Results of female reproduction after Evertas P application (n=13)

Serial number of female	Number of days from the moment the female was given to male to parturition	Fertility (heads)	
		Live born	Still born
1	infertile	-	-
2	135	6	2
3	134	5	0
4	infertile	-	-
5	129	1	3
6	135	7	2
7	133	7	0
8	128	8	2
9	135	2	0
10	132	5	0
11	135	5	2
12	134	4	0
13	128	0	6

Number of days from the moment the females were given to males, i.e. from the end of hormonal treatment to parturition, varied from 128 to 135 days (table 1). 11 females gave birth and two remained infertile of the total 13 experimental females. According to Tocka (1985) the females should give birth on the 128th-132th day with oestrus synchronization. The author allows 1-4 days tolerance as a result of oestrus duration.

Our results correspond to the above-mentioned author and we can state that the Evertas p with active substance Zinc metallibur influences positively the synchronization of oestrus in primiparous nutria.

Table 2. Results of female reproduction after Regumate porcine application (n=10)

Serial number of female	Number of days from the moment the female was given to male to parturition	Fertility (heads)	
		Live born	Still born
1	131	3	0
2	134	3	0
3	135	6	0
4	147	6	0
5	135	5	1
6	135	4	0
7	134	6	6
8	148	8	1
9	135	0	2
10	131	9	0

The period from the moment the female was given to the male to parturition varied from 131 to 148 days when Regumate porcine was applied (table 2). It is obvious from the achieved results that eight females gave birth on the 131st-135th days after the hormonal treatment was finished, the synchronization of oestrus took place, and it represents 80% of the total number in the given experimental group.

In cases with a maximum length of the mentioned periods, which represented 147 and 148 days, we can also assume a certain influence on the oestrus beginning.

Table 3. Results of reproduction in control group (n=16)

Serial number of female	Number of days from the moment the female was given to male to parturition	Fertility (heads)	
		Live born	Still born
1	134	3	0
2	153	6	0
3	132	4	0
4	158	4	0
5	134	3	0
6	134	4	0
7	158	5	0
8	132	1	2
9	159	7	2
10	161	2	2
11	221	7	0
12	134	3	7
13	158	6	0
14	134	3	2
15	134	4	2
16	144	5	6

The results of reproduction in the control group are given in table 3. The period from the moment the female was given to male to parturition varied from 132 to 221 days. The per cent of females which gave birth in a similar time span after they were given to males as the hormonally treated, i.e. to 135 days, represented only 50%. From the above mentioned facts follows that it is a natural time course of reproduction process in nutria.

It can be assumed that the placement of male to female also represents a certain stimulating factor for the onset of oestrus mainly in young females (visual stimulation, smell information, activity of the male when it tries to mate, etc.). However, the hormonal treatment of females stimulates significantly the onset of oestrus in females according to our results.

Table 4. Basic variance and statistical characteristics of reproduction traits in female nutria (x±s)

Trait	1st exp. group (n=13)	2nd exp. group (n=10)	3rd control group (n=16)	Significance
Number of days from the moment the female was given to the male to parturition	132.54 ± 2.87	136.50 ± 6.00	148.75 ± 22.56	1:3'
Number of live born youngs per experimental female	4.54 ± 2.58	5.00 ± 2.62	4.19 ± 1.72	
Number of live born youngs per female with litter	3.85 ± 2.91	5.00 ± 2.62	4.19 ± 1.72	

The results given in table 4 show that the stimulation of oestrus did not influence negatively the fertility of females expressed with the average number of young per female with litter. The testing results of the significance of differences between the individual studied groups of nutria confirmed it, too, although the tendency of increasing young was noticed in the experimental groups.

Conclusion

The results show that Evertas P and Regumate porcine positively influence the sexual cycle in nutria and they can be recommended as preparations for stimulation of oestrus in nutria.

This procedure is suitable from the technical point of view mainly for cycle housing in intensive breeding conditions with supposed economic profit because it is possible to shorten the time interval of the cycle.

References

Babusik, P., Karác, S., Ráckovic, E., Tománek, M. 1983. Hodnotenie muzskej fertilitytestom penetrácie spermií do vajícok chrcka sýrskeho (*Mesocricetus auratus*). Cs. Gynek., 48, 10, 731-736.

Barta, M., Jakubicka, I. 1985. Synchronizácia ruje u nutrií. Záverecná správa R-529-036-02-04, VÚZV v nitre, p. 16.

Deborah, M.E., Rothwell, J.N., Stock, M.J., Wil son, C.A. Physical changes associated with the onset precociouns puberty in rats after treatment with PMSG. J. Reprod. Fert., 69, p. 201-206.

Ebert, K.M., Low, M., Overstoom, E., Miohoko, F., Baile, C.F., Roberts, T.M., Lee, A., Nandel, G., Goodman, R. 1988. A moloncy NLV-Rat. Somatotropin fusion gene produced biologically active somatotropin in a transgenic pig. Molec. Endocrinol., 2, p. 277-283.

Fulka, J., Motlík, J., Pavlok, A. 1975. Fertiliza tion rate after synchronization of the oestrus cycle in heifers with prostaglanding F_2 alphe. Theriogenology, 3, p. 107-112.

Hasler, J.F., Melandey, A.D., Schermerhorn, E.C., Foote, R.H. 1983. Superovulary responses of holstein cows. Theriogenology, 11, p. 83-99.

Iljina, E.D. 1975. Zverovodstovo, Izdatel'stvo Kolos, Moskva.

Jin, D.I., Petters, R.M., Johnson, B.H., Shuman, R.M. 1991. Survival of early preimplantation porcine embryos after co-culture with cell producing an avian retrovirus. Theriogenology, 35, p. 521-526.

Kopanski, R. 1981. Chow nutrii. Panstwowe Wydawnictwo Rolnicze i Lesne. Warszawa.

Oberfranc, M., Grafenau, P., Pivko, J., Bavin, V. 1989. Optimalizácia metod získavania a prenosu vcasnych embryí pri tvorbe transgénnych osipanych.. Záverecná správa za subetapu P. 06-529-820-01-02-05/02, VÚZV v Nitre, p. 33.

Pivko, J., Majerciak, p., Hácik, T. 1975. Mozno stiintenzívnejsej exploatácie infantilných prasniciek. Veterinária Spofa, 17, p. 96-116.

Pursel, V.G., Rexroad, C.E., Bolt, D.J., Miller, K.F., Wall, R.J., Hammer, R.E., Pinkeht, C.A., Paimiter, R.D.. Brinster, R.L. 1987. Progress on gene transfer in farm animals. Vete. Imunol. Imunolopat., 17, p. 303-312.

Scheuring, W. 1983. Choroby nutrii. Panstwowe Wydawnictwo Rolnicze i Lesne. Warszawa.

Schlieper, B., Holtz, W. 1986. Transfer of pig embryos collected by laparotomy or slaughter. Anim. Reprod. Sci., 12, p. 109-114.

Schilling, E., Haupt, P., Smidt, D., Sacher, B., Elsaesser, F., Schutzbar, W. 1981. Die Variabilität des superovulationserfolges bei Kühen und deren möbliche Ursachen. Z. Tierzücht. Zücht. Biol., 98, p. 88-89.

Skrivan, M. et al. 1976. Chov kozesinových írat. Státní zemedelské nakladatelství. Praha, p. 282.

Tocka, I. 1985. Chováme nutrie. Vydavatel'stvo Príroda, bratislava, p. 142.

Webel, S.K. 1978. Ovulation control in the pig. In: control of ovulation. At Chrighton etd. Butterworths, London and Boston, p. 421-434.

Original Report

Use of resting platforms by growing blue foxes

Hannu Korhonen, Paavo Niemelä

Agricultural Research Centre of Finland, Fur Farming Research Station, SF-69100 Kannus, Finland

Summary

The main objective of the present study was to clarify whether farmbred foxes use different types of resting platforms or otherwise benefit from them. The results showed that only one out of five foxes used the platforms markedly. Those foxes that were interested in the platforms stayed on them 307 ± 184 min/24 h. Of the three different platform types tested type V was the most favored (amount of use 34.1% during total observation period). The amounts of use for types E and L were 12.3% and 22.6%, respectively. Platform usage in general was highest in the summer and declined significantly ($p<0.05$) towards winter. The colder the ambient air temperature was, the less the platforms were used. The platforms remained rather clean and unbitten throughout the experiments. No statistical differences were found between body weight gain and skin lengths. However, the amount of wearing of the ventral side in the furs of platform foxes was twice as much as that of the controls. The foxes did not markedly use the platforms for observation or as a hiding place. The question of whether platforms affect the temperament or well-being of foxes remained open.

Introduction

The Standing Committee of the European Convention on the Protection of Animals Kept for Farming Purposes has recommended that each weaned fox should have a nest box or a resting platform available, and preferably both. Finland ratified the above recommendations of the Standing Committee in October 1991. However, at the present moment, Finnish farmers have a kind of transitional stage because those recommendations are not capable of being executed before the experiments of most practical box and platform models are available. Furthermore, it has not been shown that the well-being of farmbred foxes actually requires platforms of any kind, or that foxes otherwise benefit from them. At least the previous work (*Harri et al., 1992*) supports the conclusion that use of such platforms by foxes is rather slight. Thus, more data are needed concerning the use of platforms, and their effects on the general behaviour, welfare, reproduction and fur quality of foxes (*Harri et al., 1988; 1991a, b; Korhonen et al., 1991*).

The present study aims to clarify to what extent growing blue foxes use different types of resting platforms, and what the possible effects of such platforms are on the growth, behaviour and fur quality of those animals.

Materials and methods

The experiments were carried out at the Fur Farming Research Station of Kannus (Finland) from July to November in 1992. Altogether, 240 blue fox kits were used in the study. Four different experimental groups were formed at weaning: (1) a control group; no platform available, (2) platform group L (platform was made of a 5"

board. The platform was 22 mm thick, 107 cm long and 26 cm wide, and had a 10 cm chink on the bottom), (3) platform group E (otherwise the same as L, except this group's platform had a partitioning wall that divided the platform into two equal parts), (4) platform group V (a board of 4" at both ends of the platform, 28 cm in length. It had a 10 cm chink on the bottom. The platform was 102 cm long and 25 cm wide). All of the platforms were placed 23 cm below the cage roof. An additional comparison was made between the platform of group L by forming another experimental group (group 5) at the beginning of October. The aim was to compare if the provision of platforms at a later date would affect their use.

Each group consisted of 30 males and 30 females. They were raised in pairs in cages measuring 107 cm wide x 120 cm long x 70 cm high. The raising experiments started on July 16th. The foxes were fed a commercial fox feed ad libitum. The animals were weighed five times during the course of the experiments.

The behaviour of the foxes, including their daily usage of the platforms, was monitored by means of video camera equipment (CDD video camera 720, Bische UB-480 tape recorder, Koyo monitor, Bische 12-300 infrared light). Video recordings were made at four intervals during the experiments.

Platform usage was also monitored by direct visual observation. This was carried out twice a day (8-9 a.m. and 12-13 p.m.) by scanning the platform groups and marking up which foxes were on the platforms.
Platform dirtiness was estimated on a scale of 1-4, where 1=clean, 2=slightly dirty, 3=moderately dirty, 4=very dirty. The extent to which the foxes had bitten the platforms was estimated according to the following scale:
1=unbitten, 2=slightly bitten, 3=moderately bitten, 4=substantially bitten (requiring replacement).

Fur quality parameters were evaluated by Finnish Fur Sales Ltd. in Helsinki, according to the standard quality criteria normally used also for commercial furs.
Regression analyses, analyses of variance (ANOVA, MANOVA) and Pearson's product moment correlations were used for the statistical treatment of the data.

Results

Use of platforms by visual data
The use of platforms was different ($p<0.05$) for foxes given platforms at weaning in comparison to those given platforms from October onwards (table 1); platform use was more common (22.9%) in the former group than in the latter one (7.1%). The percentage of foxes that jumped onto or off the platforms just at observation time was about the same in both groups.

Table 1. Summary of platform use (%) from weaning to pelting. Use was compared between the platform groups both from July 16th onwards and from October 1st onwards. Platform use is also presented by platform type and sex. The data was gathered by daily visual samplings

	Out of platform	On platform	Jump on	Jump off
Platform available				
from Jul 16 onwards	77.1	17.7	3.3	1.9
from Oct 1 onwards	92.9	5.6	0.7	0.8
Group L	77.4	16.6	3.7	2.3
Group E	87.7	9.1	1.9	1.3
Group V	65.9	27.5	4.3	2.3
Males	82.2	11.8	4.8	1.2
Females	71.9	23.6	1.8	2.7

The foxes that used the platforms were divided into four different subgroups according to the degree of use: (1) only a very short time on the platforms (amount of use 0-20%), (2) a short time on the platforms (20-40%), (3) moderate time on the platforms (40-60%) and (4) a long time on the platforms (60-80%). The amount of foxes in the subgroups 1-4 were 43.5%, 35.4%, 14.6% and 6.1%, respectively.

A comparison on platform usage was also carried out between sexes. Of the females, 28.1% used the platforms and the figure for the males was 17.8% (table 1).

There were significant differences ($p<0.05$) in platform usage among the experimental groups (table 1). The animals in group E (12.3%) and group L (22.6%) used the platforms the least. The platforms were used most frequently by the foxes in group V (34.1%).

It was also analyzed how often two foxes from the same cage were simultaneously on the platform. Most often, two foxes were at the same time on the platform in group V; 16.0%. The figures for group L and E were 6.3% and 5.9%, respectively.

There were also seasonal differences ($p<0.05$) in platform usage. Their peak usage was in August-September (22.1%). After that, usage clearly declined towards winter, being only 14.8% in November. In addition, a significant relationship ($p<0.05$) between usage and ambient air temperature was found. Thus, the colder the weather, the less the platforms were used.

A significant relationship ($p<0.01$) also existed between platform use and body weight of the animals (final weight in November), i.e. the heavier the fox, the less the platform was used.

Use of platforms as monitored by video recordings

Of those foxes that seemed to use the platforms, 18 were selected for the experiment involving accurate 24 h video recordings. The results are presented in table 2. The foxes spent on average 21.3% (307 ± 184 min) of their daily 24 h on the platforms. Most often, (in 80.3% of cases) only one of the two foxes from the same cage were on the platform at the same time. During the workday (8 a.m.-4 p.m.) platform usage was slightly over one-third (8.9%) of the daily 24 h use. Thus, it is very obvious that platform use during the workday correlates well with their usage during a 24 h period.

Figure 1 provides a summary of the hourly distribution for platform use during daily 24 h. As can be seen, the use of platforms was almost evenly distributed for each hour. Only in the morning (8-9 a.m.), when the farmwork started, was their usage less. Slight usage was also evident during the evening (8-9 p.m.) and at night (2-3 a.m.).

When the foxes did use the platforms, it was mainly for sleeping (82.1% of total use). The platforms were used for lying and staying 16.5%, and only 1.4% for jumping (table 3).

We also analyzed to what extent a relationship could be found between platform use by video recordings and by visual sampling observations.

Table 2. Platform use (%) during 24 hours and work time. The data are based on video recordings of 18 foxes made between July 18th and October 30th. 1=only one of the two foxes from the same cage on the platform. 2=both foxes simultaneously on the platform

Period	Platform use (%/24 h)			Platform use (%/workday)		
	1	2	Total	1	2	Total
18.7.-29.7.	14.3	6.9	21.2	7.2	2.2	9.4
26.8.-3.9.	18.4	6.2	24.6	9.6	2.0	11.6
29.9.-9.10.	21.7	3.2	24.9	7.8	1.8	9.6
21.10.-30.10.	14.1	0.4	14.5	4.5	0.2	4.7
Mean	17.1	4.2	21.3	7.3	1.6	8.9

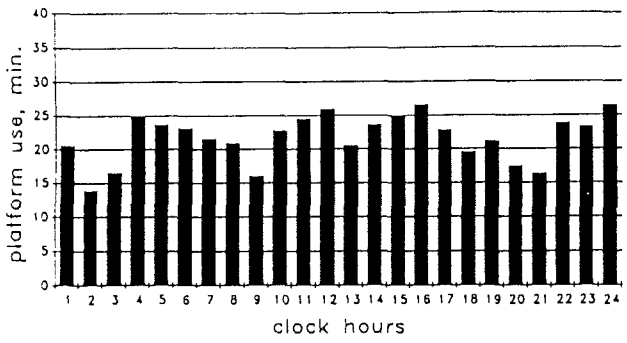


Fig. 1. Circadian (24 h) distribution of platform use by foxes (N=18). The data are based on video recordings made between July 18th and October 30th

Table 3. Distribution of platform use (% of total 24 h use) for sleeping use, lying use (short duration 1-10 min) and jumping use. The data are based on video recordings of 18 foxes

Period	Lying	Sleeping	Jump on
18.7.-29.7.	85.2	14.5	0.3
26.8.-3.9.	88.2	10.8	1.0
29.9.-9.10.	77.2	20.9	1.9
21.10.-30.-10	77.6	19.9	2.5
Mean	82.1	16.5	1.4

Regression and correlation analyses showed a statistically significant dependence between these two methods ($F=9.350$; $r=0.607$; $p<0.0075$). Thus, also the sampling observations provided an accurate picture of platform usage.

Dirtiness, cleaning time and platform biting
The platforms were dirtiest in July (table 4). Dirtiness decreased towards autumn, however. The same held true for cleaning time. There was a significant relationship between a platform's dirtiness and its use ($p<0.05$); the dirtier the platform, the less it was used.
Platform biting was negligible. Thus, the platforms remained in rather good condition until the end of the experiment period (table 4).

Weight gain
Body weight development is depicted in table 4. There were no significant differences in the initial body weights between the platform groups and the control group. Furthermore, weight gain in all of the groups was very similar throughout the experiment, and no significant differences were found in their final body weights in November.

Fur quality parameters
A summary of the fur quality parameters is given in tabel 5. The length of the skins was similar in each group. On the other hand, the mass and quality of the furs were poorest in the foxes of group L ($p<0.05$). The other platform groups did not significantly differ from the control group, although some tendency towards poorer mass and quality parameters was evident.

As concerns fur defects, the differences between the platform groups and the control were more pronounced (table 5). Wearing of the ventral side, which would be caused by the platforms, was in the control half of that in the platform groups. In the furs of those foxes that frequently used the platforms (amount of use 60-80%), wearing of the ventral side was found in every individual. In the foxes of the platform groups a statistically significant positive correlation was found between the amount of platform useage and ventral wearing ($p<0.01$).

Discussion

The results showed that most of the foxes used the platforms only slightly. This is in agreement with previous observations by other Finnish studies (*Harri et al., 1991a,b, 1992; Mononen et al., 1991, 1992; Alasuutari & Korhonen, 1992).* Thus, it is tempting to conclude that farmed blue foxes do not necessarily require any kind of platforms in their cages. However, our selected video recording results indicated that those foxes that did use platforms used them quite a lot during a 24 hour period. This finding makes a final conclusion somewhat difficult; should foxes that use platforms somehow be taken into account or would it be better to omit platforms altogether?

Table 4. Weight gain (kg), platform dirtiness (scale 1-4) and time (s) used to clean dirty platforms. Also the amount of bitten platforms (scale 1-4) is presented. For the scales see the text

	Control	Group L	Group E	Group V
July				
Weight (16.7.)	1.6 ± 0.4	1.8 ± 0.5	1.7 ± 0.5	1.7 ± 0.4
Dirtiness	-	2.8 ± 1.4	2.5 ± 1.2	2.5 ± 1.3
Cleaning time	-	45 ± 37	41 ± 41	41 ± 37
August				
Weight (5.8.)	2.8 ± 0.6	2.8 ± 0.7	2.7 ± 0.6	2.9 ± 0.6
Dirtiness	-	1.9 ± 1.1	1.8 ± 1.0	1.8 ± 1.1
Cleaning time	-	25 ± 38	20 ± 26	24 ± 36
September				
Weight (8.9.)	5.6 ± 0.8	5.6 ± 0.8	5.5 ± 0.7	5.7 ± 0.7
Dirtiness	-	1.8 ± 1.2	1,4 ± 0.8	1.4 ± 0.9
Cleaning time	-	25 ± 43	11 ± 29	14 ± 35
Platform bitten	-	1.1 ± 0.3	1.5 ± 0.5	1.3 ± 0.5
October				
Weight (6.10.)	7.3 ± 0.9	7.2 ± 0.9	7.2 ± 0.8	7.4 ± 0.9
Dirtiness	-	1.3 ± 0.7	1.0 ±0.1	1.1 ± 0.5
Cleaning time	-	7 ± 18	1 ± 5	3 ± 10
Platform bitten	-	1.5 ± 0.5	1.7 ± 0.5	1.6 ± 0.5
November				
Weight (10.11.)	8.9 ± 1.2	8.7 ± 1.1	8.8 ± 1.1	9.0 ± 1.2
Dirtiness	-	1.3 ± 0.5	1.0 ± 0.2	1.1 ± 0.3
Cleaning time	-	6 ± 11	1 ± 2	1 ± 4
Platform bitten	-	1.6 ± 0.5	1.7± 0.5	1.6 ± 0.5

Table 5. Summary of fur quality parameters and fur defects. *p<0.05:significantly different from the control

Variable	Control	Group L	Group E	Group V
Skin length, cm	103.9 ± 4.9	103.7 ± 4.7	103.8 ± 5.7	103.7 ± 5.2
Mass	8.1 ± 1.3	7.4 ± 1.2*	8.0 ± 1.2	7.5 ± 1.6
quality	7.9 ± 1.4	7.0 ± 2.1*	7.6 ± 1.5	7.3 ± 1.8
Feed spot	0	1	0	0
Bitten	1	0	1	1
Damaged	0	3	0	3
Ventral wearing	12	27	22	24
Urine spot	6	9	1	5
Excrement spot	0	1	0	0

It is obvious that the foxes did not use the platforms for protection against the weather. This conclusion was confirmed by at least two facts; firstly, platform usage decreased markedly towards winter and, secondly, platform use correlated positively with ambient air temperature. This agrees with the results of Harri et al. 1992 also.

It is reasonable to point out that despite different factors affecting the amount of platform usage, the individual differences (i.e. animal itself) seem to account for a great part of the variance. Table 6 provides a summary of significant factors affecting platform use in the present data. Furthermore, it should be noted that although several statistically influencing factors

were found, estimation of their practical meaning is not necessarily easy.

Table 6. Summary of significant factors affecting platform use. Their practical meaning is also estimated here

Variable	Statistical conclusion	practical meaning
Animal	Differences existed	Yes
Time from weaning	The later platform was given, the less it was used	Yes
Season	Towards winter useage decreased	Yes
Platform type	Type V most favored	Yes
Air temperature	The colder the weather, the less were platforms used	Yes
Body weight	Heaviest foxes used less	Probably
Sex	Females used most	Probably
Time of day	Evenly used	No/Probably

It is not as easy to estimate the extent to which platforms affected the wellbeing and satisfaction of the foxes. One measure of wellbeing is the quality properties of the fur. As the results showed, wearing of the ventral side of the furs was twice as common in the platform animals as in the control animals. Thus, one may conclude that platforms have more of a tendency to decrease rather than increase well-being.

From the farmer's point of view, considerable wearing of the ventral side of furs is undesirable because such a fur defect will automatically lower the price of the fur, thus decreasing the general economic benefit derived from fur farming.

It has been previously speculated (*Harri et al., 1992*) that the function of the platform could be that of an observation post. However, the present results do not actually confirm this theory because use of the platforms did not differ between working time (when the presence of farm personnel could be observed by a fox) and during the balance of the 24 h period. Moreover, our previous experiment carried out in large enclosures (*Korhonen et al., 1991*) did not support the idea that the function of platforms is that of an observation post. Nor do the present results actually support the opinion (*Harri et al., 1988*) that the platform can serve as a hiding place. As table 1 shows, the number of foxes that jumped onto or off the platforms was insignificant.
The present results showed that there were clear differences in the use of different platform types. Thus, it is obvious that more studies will be needed to clarify why some types are favored over others (*c.f. Harri et al., 1992*). Furthermore, the present experiments generated more questions as to what are the best platform prototypes and materials, the height of the platform from the cage roof and what is the optimal platform shape for a fox to be able to lie on in the best position. Finally, the most interesting question on whether the presence of platforms can influence the temperament of foxes is still unresolved and will therefore require further studies.

References

Alasuutari, S. & Korhonen, H. 1992. Environmental enrichment in relation to behaviour infarmbred blue foxes. Norwegian J. Agric. Sci.,9,569-573.

Harri, M., Korhonen, H. & Mononen, J. 1988. Use of sleeping plates by raccoon dogs and foxes. In: B.D. Murphy & D.B. Hunter (eds). Biology, Pathology and Genetics of Fur Bearing Animals. Proc. 4th Int. Congr. Fur Anim. Prod. 21-24 August 1988, Rexdale, Ont. University of Saskatchewan Press, Canada. pp. 145-152.

Harri, M., Haapanen, K., Mononen, J., Korhonen, H. & Rouvinen, K. 1991a. Bruk av liggehyller hos farmet blårev, sölvrev og mårdhund. Norsk Veterinärtidskrift 103(2), 131-132.

Harri, M., Mononen, J., Korhonen, H. & Haapanen, K. 1991b. A study of the use of resting platforms by farmbred blue foxes. Appl. Anim. Behav. Sci., 30, 125-139.

Harri, M., Mononen, J., Rekilä, T. & Korhonen, H., 1992. Whole-year nest boxes and resting platforms for foxes. Norwegian J. Agric. Sci., 9, 512-519.

Korhonen, H., Alasuutari, S., Niemelä, P., Harri, M. & Mononen, J. 1991. Spatial and circadian activity profiles of farmbred blue foxes housed in different-sized ground floor enclosures. Scientifur, Vol. 15, No. 3, 191-199.

Mononen, J., Harri, M., Rouvinen, K. & Korhonen, H. 1991. Användning av liggunderlag för unga silverräver. NJF-seminarium nr. 200. 4.-6.9.1991, Esbo, Finland.

Mononen, J., Harri, M., Haapanen, K., Korhonen, H., Rouvinen, K. & Niemelä, P. 1992. Ligghyllor för räv. Finsk Pälstidskrift 26, 88-90.

Short Communication

Preference behaviour of raccoon dogs in a cage-enclosure housing system

Hannu Korhonen*, Sakari Alasuutari**

**Agricultural Research Centre of Finland, Fur Farming Research Station, SF-69100 Kannus, Finland*

***University of Helsinki, Muddusjärvi Exp. Farm SF-99910 Kaamanen, Finland*

Introduction

Farmed canids have traditionally been housed in wire-mesh cages under shadehouses. In recent years, on the other hand, there has also been more interest in the use of alternative housing conditions such as ground floor enclosures (*Korhonen & Alasuutari, 1992; Alasuutari & korhonen, 1992*). This development has mainly come about in response to the increasing demands of anti-fur campaigns for improved housing conditions, including environmental enrichment. However, it is not very easy to draw the right conclusion as to what constitutes the best housing environment and vice versa (*Nicol, 1991*). Probably, it would be wiser to let the animal make its own choice.

To this end, the present authors devised a housing system which combined both cage and enclosure conditions, thus allowing the animal the possibility to selectively seek out its preferred housing environment. The present paper provides a functional example of the preference behaviour of a raccoon dog pair and their kits housed in such a combined environment.

Materials and methods

The experiments were carried out at the Exp. Fur Farm of the University of Helsinki in Muddusjärvi (69 N, 27 E). The design of the combination cage-enclosure system is shown in Fig. 1. The enclosure was 2 m wide, 4 m long and 1.5 m high. It included two conventional wooden nest boxes. Three cages (60 cm long x 105 cm wide) were connected together in the shadehouse by cutting 40 cm x 40 cm openings through them. One wooden nest box was placed in the cage. A wooden tunnel was constructed in order to connect (diameter 30 cm, length 1 m) the cages and the enclosure.

A raccoon dog pair aged about 4 years was placed into the test system at the beginning of February. This pair was selected for the study because of its environmentally variable living history: the pair had spent its first year housed in a large ground floor enclosure (17 m long x 8 m wide). After that it was raised for about a half year in a cage (120 cm wide x 105 cm long) under a shadehouse. Thereafter, the pair had lived freely for about 6 months in an enclosed farming

area measuring 100 m long x 70 m wide. After that, the pair spent most of its time in a cage under shadehouse conditions, except during a short winter period when the animals were housed in a farming enclosure. Thus, the pair had considerable experience both in cage and enclosure conditions.

The behavioural patterns of the pair were monitored either visually or by using video recording equipment (JVC TK-5100 video camera, TM-9060 system monitor) 4-6 days weekly over the course of the experiment.

Results and conclusions

The experimental pair exhibited a rather fixed behavioural pattern. Most often the day was spent in the cage under the shadehouse. Late in the evening (about 7-9 p.m.) they entered the enclosure through the tunnel, where they were active, moving around for several hours maximally. The pair frequently spent the night asleep in the nest box situated in the shadehouse (see Fig. 1). In the morning they typically left the nest box, and again spent the day in the cage. A summary of the pair's location in the experimental combination housing system during the daytime is given in Fig. 2. Most often the rac-coon dogs were found to be on the cage floor (54% of observed cases) and inside the cage nest box (23%). The corresponding values for enclosure floor and enclosure nest box were 8 and 15%, respectively.

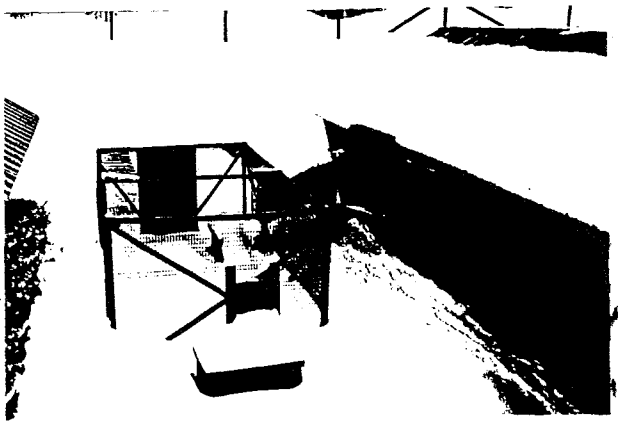


Fig. 1. General picture of the cage enclosure combination system employed in the experiments. a wooden tunnel connects the shadehouse cages to ground enclosure. This photo was taken in April On May 10th, the female whelped inside the cage nest box. Two days later we calculated the number of kits: 7 were living and one was still-born. Probably the female perceived our calculation operation as a disturbance as she soon transferred the kits into the furthest nest box of the enclosure. However, the next day she again transferred the kits into another nest box (below the tunnel) of the enclosure. Two days later, she carried the kits back to the cage nest box.

It was interesting to note that also the male exhibited direct parental care during the early rearing period. Often (in 67% of the observed cases), both parents were together in the nest box with their kits. Similarly, Yamamoto (1987) has made the observation that both raccoon dog parents could be together with the kits for over 50% of the day during the first 10 days post partum. This is an exceptional habit among canids. At the age of 5-6 weeks, the kits started to move outside the nest box to a larger extent. Video monitoring revealed that the kits and the parents spent time in the cage section 64% and 61% of the daily observations, respectively.

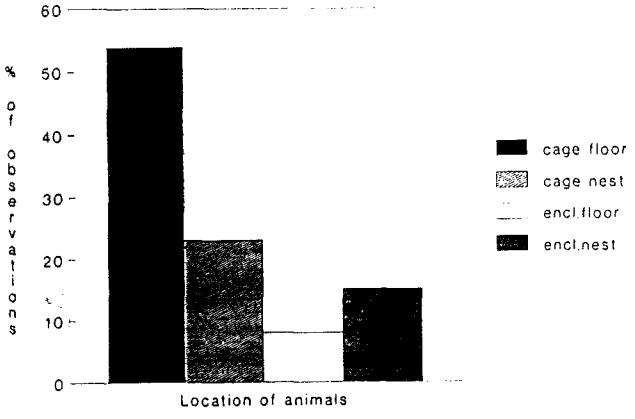


Fig. 2. Summary of raccoon dogs' location (as % of observed cases) in a system employing a cage-enclosure combination. Based on scanning observations made twice a day: (8-9 a.m. and 4-5 p.m.) from March 15th to whelping (May 10th)

It can be concluded that raccoon dogs can also be housed in a system employing a cage-enclosure combination. The animals flourish under such circumstances, as indicated also by the successful whelping and kit care. The results also revealed that raccoon dogs do not prefer just one part of the combination system but utilize both. The function of the cage section seems to be different from that of the enclosure; the latter being mainly used for locomotion. It is quite possible that raccoon dogs felt safe in the cage as they spent

the majority of the day there, and also whelped in the cage nest box.

Thus, it is possible that farm cages are not perceived as poor habitats by farm animals, despite claims to the opposite made by animal welfare advocates.

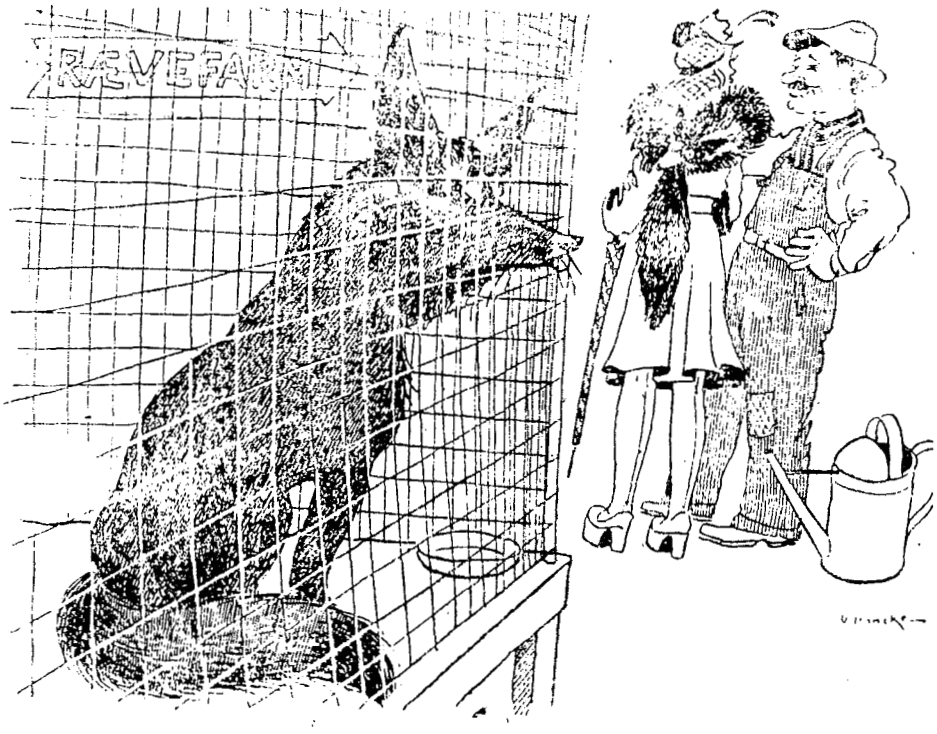
References

Alasuutari, S. & Korhonen, H. 1992. Environmental enrichment in relation to behaviour in farm bred blue foxes. Norwegian J. Agric. Sci. 9, 569-573.

Korhonen, H. & Alasuutari, S. 1992. Hierarchical development in captive arctic blue fox pack. Scientifur, Vol. 16, No. 1, 13-22.

Nicol, C.J. 1991. Effects of environmental enrichment and gentle handling on fearfulness in transported broilers. In: M.C. Appleby et al. (eds). Applied Animal Behaviour: Past, Present and Future. Universities Federation for Animal Welfare, Edinburgh. pp. 51.

Yamamoto, I. 1987. Male parental care in the raccoon dog, *Nyctereutes procyonoides*, during the early rearing period. In: Y. Ito et al. (eds). Animal Societes: Theories and Facts. pp. 189-195. Japan Sci. Soc. Press, Tokyo.



ADVERTISE

IN

SCIENTIFUR

- and thereby give your message to the leaders of the fur industry

- ask for prices

Choice of resting sites by female foxes *Vulpes vulpes* in a mountainous habitat

Jean-Steve Meia, Jean-Marc Weber

The resting sites of seven radio-tracked Red fox *Vulpes vulpes* (Linnaeus, 1758) vixens were determined in the Swiss Jura mountains. During their nocturnal active period, foxes rested above ground near their foraging areas.

In daytime, some foxes always used dens in areas with little cover, while some other individuals often rested above ground when cover was abundant. Weather did not influence the choice of the resting place, except in extreme conditions. Each fox used several resting places, sometimes moving from one to another during the day, especially when lying above ground.

Acta Theriologica 38 (1), 81-91, 1993. 5 tables, 3 figs., 18 refs. Authors' summary.

Isolation of nest boxes in the period with feeding on the nest box lid.

Ulla Lund Nielsen, Niels Therkildsen

In the period 14.4.-25.6 the nest boxes were isolated by means of a wooden plate placed over the nest box at night. This isolation showed several positive effects in this experiment.

The male kits had a significantly higher weight gain and a higher weight at weaning with isolation than without.

The female kits also had a higher weight gain from the age of 21 to 45 days, but a lower weight at weaning with isolation than without. None of these results were significant.

The females had a lower weight loss with isolation than without. The result was not significant, however.

If a few "outliers" are removed from the data material, there was no difference in the two treatments. These outliers can be caused by poor mothering qualities, disease or erroneous recordings etc. not necessarily caused by the treatment. Furthermore, the experimental year was unusual, as the temperature was very high in the experimental period. It is therefore difficult to draw an unambiguous conclusion from this experiment as to whether there is a positive effect of isolating the nest boxes at night in the period when the kits are fed on the nest box lid.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 139-145, 4 tables. In DANH. Authors' summary.

Suggestion of a weighing programme in the mink production.

Steen Møller

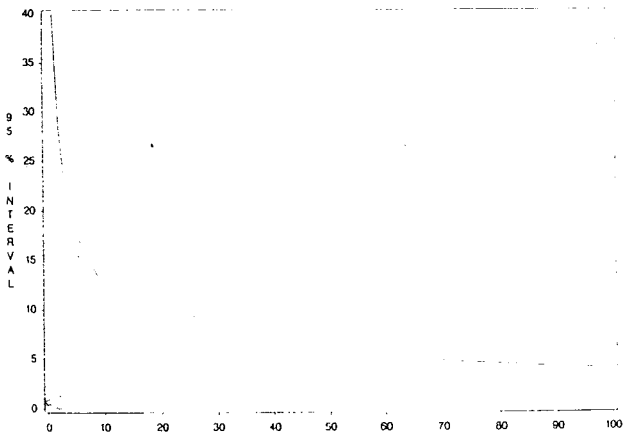


Fig. 1. Variation in the average weight of different weighing groups as a function of number of mink weighed. 95 out of 100 weighing groups will have an average weight within the average of the entire group of animals ± half the per cent stated.

This paper discusses the purpose of weighing and the use of weighing results as part of a production control programme during the nursing, growth and premating periods.

Number of animals, which animals to weigh and when to weigh are discussed, and a comprehensive weighing programme for the three periods is suggested. If the weighing group is selected according to colour type, sex, age and litter size, the coefficient of variance is app. 10%. Thus, 25 animals give a satisfactory estimate of the mean weight irrespective of farm size.

In the nursing period males from 25 litters of 5-7 kits should be weighed at 4, 6 and 8 weeks of age in order to evaluate the lactation, how the kits learn to eat, and how they learn to drink. In the growth period 25 males from litters of 5-7 kits of the same age should be weighed every 2 weeks in order to evaluate their growth potential, and as a control of restricted feeding in the autumn. In the winter period 25 first year females from litters of 5-7 kits should be weighed every 2 weeks from November to March in order to guide the preparation for flushing in March.

The first years of weighing will establish the potential of the herd. In general, shorter intervals between weighings are needed if the aim is to adjust the production rather than to compare between years. In either case a general variation in growth between years should be considered, before any action is taken.

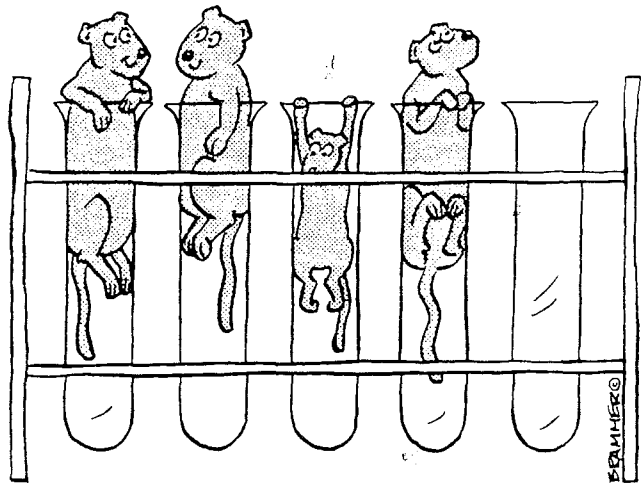
Danish Fur Breeders' Association. Technical Year Book 1992, pp. 155-161, 1 table, 1 fig., 6 refs. In DANH. Author's summary.

Selection for litter size, body weight and pelt quality in mink (*Mustela vison*)

Gabrielle Lagerkvist

Mrs. Gabrielle
Lagerkvist
Swedish University of
Agricultural Sciences
Funbo - Løvsta
S-755 97 Uppsala
Sweden

New Doctor in the family. We congratulate Gabrielle Lagerkvist with the fine work and the new title and wish you all the best in the future.



The present thesis describes results from a five-generation selection experiment, in which separate lines of dark mink (*Mustela vison*) were subjected to selection for improved litter size at 3 wk (F-line), body weight in September (BS-line) and underfur density, subjectively judged on live animals in November (P-line), and combined selection for litter size and body weight (I-line). One unselected line served as a control (C-line). From a common base population, separate and closed lines were formed. Each line comprised approximately 80 breeding females, except for the I-line with 160 females. Selection was performed using a full- and half-sib index, for all traits except fertility which was selected using a pedigree index.

Genetic parameters for body weight and underfur density used in the selection indices were estimated in the foundation stock. Correlations between gradings of summer fur and winter fur and relationships between these scores and sale price are also reported (Publ. I).

Significant changes were achieved in each trait under selection: litter size in the last generation was 5.3 in the F-line vs 3.7 in the C-line; September weight in males was 2,254 g in the BS-line vs 1,979 g in the C-line, and the underfur density score, graded using a five-point scale, was 4.1 in the P-line vs 2.9 in the C-line. Litter size was only slightly improved in the I-line, whereas body weight was substantially increa-

sed. Genetic trends and heritabilities were estimated using univariate restricted maximum likelihood (REML) techniques with a reduced animal model in a derivative-free way.

Correlated responses to selection were studied. Genetic and environmental parameters were estimated with REML techniques, using a multitrait, reduced animal model in a derivative-free way.

Selection for litter size at 3 wk increased litter size at birth and reduced kit mortality. September weight was found to be negatively correlated with fertility and kit viability as well as with fur traits. Selection for underfur density had a positive effect on all important fur traits except color shade and almost eliminated the fur defect metallic sheen. Selection for fertility and fur quality seems to have only minor adverse consequences, whereas selection for body size leads to the deterioration of other important traits.

Reciprocal crossings were performed between the BS- and F-lines. F-female crossings improved reproductive performance. The heavy BS-females had a poor maternal ability that prevented the expression of kit heterosis. Body size was also improved by crossing. Crossings should be performed in yearling females, since the major positive effects on reproduction were observed in these.

Nutrient digestibility and carcass composition were studied in male mink from the BS-, F-lines and control. Retained protein, fat and energy were significantly affected by line (BS vs F).

Swedish Univesity of Agricultural Sciences, Department of Animal Breeding and Genetics, Publication No. 103, Uppsala 1993. In ENGL. 1 table, 31 pp. 39 refs. Author's abstract.

The present thesis is based on 5 publications, which will be referred to by Roman numerals I-V, and abstracted in the following and presented in full length in the actual thesis.

I. Fur quality traits in standard mink - price relationships, heritabilities and genetic and phenotypic correlations

Gabrielle Lagerkvist, Nils Lundeheim

During 1980, 1981 and 1983, 3000 mink kits of standard type had their weights measured in September and their fur traits graded in August and November. In addition, pelt gradings were performed on 1100 skins. Individual auction reports were collected. The effects of body weight and fur traits on sales price were estimated, as were genetic variation and heritabilites. Relationships between traits at a given grading were studied, and correlations between different gradings were measured. It was estimated how sales price was affected by fur darkness, underfur density, guard hair quality and overall impression, at the time of grading in August and November. The August grading of overall impression explained slightly more of the variation in sales price than the November grading. Heritabilites for underfur density and guard hair quality were low (h^2=0.1-0.2), while they were medium for overall impression and high for colour shade (h^2=0.5-0.9). Genetic and phenotypic correlations between September weight and fur traits were nonexistent or slightly negative. High genetic correlations were obtained between underfur density and guard hair quality (r_g=0.8-1.0). The incidence of metallic sheen was 19% in August, 14% in November and 22% in pelts. Only 3% of the animals exhibited metallic sheen on all three occasions.

Acta Agric. Scand. 40: 367-376, 1990. 6 tables, 1 fig., 20 refs. Authors' summary.

II. Selection for litter size, body weight and pelt quality in mink (*Mustela vison*). Experimental design and direct response of each trait

Gabrielle Lagerkvist, K. Johansson, N. Lundeheim

In a five-generation selection experiment, separate lines of mink (*Mustela vison*) were subjected to selection for litter size at 3 wk (F-line), body

weight in September (BS-line) and underfur density (P-line), and combined selection for litter size and body weight (I-line). Underfur density was subjectively judged on live animals. One unselected line served as control (C-line). Significant changes were achieved in each trait: litter size in the last generation was 5.3 in the F-line vs 3.7 in the C-line; September weight in males was 2,254 g in the BS-line vs 1,979 g in the C-line, and the underfur density score, graded using a five-point scale, was 4.1 in the P-line vs 2.9 in the C-line. In the combined line (I-line) litter size was only slightly improved, whereas body weight was substantially increased (male mean=2,194 g). Genetic trends and heritabilites were estimated using univariate restricted maximum likelihood (REML) techniques with a reduced animal model. Heritability estimates were .14 ± .09 for litter size, .39 ± .06 for September weight and .21 ± .06 for underfur density. It was confirmed that the reproductive performance of heavy or fat animals is poor. Responses were higher than predicted when selecting for September weight and underfur density. In the last generation the average breeding values, relative to the base generation, were + .8 kits for litter size (F-line), + 365 g for male September weight (BS-line), and 0.1 point for underfur density (P-line). The study suggests that negative maternal effects on litter size may exist in mink.

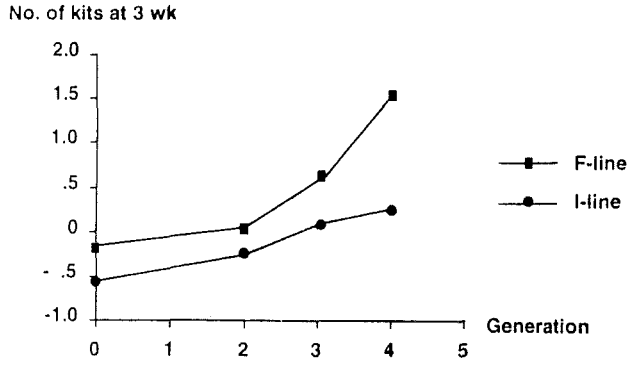


Fig. 3. Phenotypic deviations from the control in litter size at 3 wk in the F-line and I-line.

5 tables, 9 figs., 41 refs, 30 pp. Authors' abstract. Accepted for publication in J. Anim. Sci.

III. Selection for litter size, body weight and pelt quality in mink (*Mustela vison*). Correlated responses

Gabrielle Lagerkvist, K. Johansson, N. Lundeheim

In a 5 generation selection experiment, separate lines of standard mink (*Mustela vison*) were subjected to selection for litter size at 3 wk (F-line), body weight in September (BS-line), underfur density (P-line) or combined selection for litter size and body weight (I-line). One unselected line served as a control (C-line). The present paper focuses on correlated responses to selection regarding fertility and fitness traits, fur quality and body size traits. Genetic and environmental parameters were estimated with REML (Restricted Maximum Likelihood) techniques, using a multi-trait, reduced animal model in a derivative-free way. Genetic and phenotypic correlations were estimated from four subsets of data comprising A) female September weight, litter size and kit mortality; B) body size traits, C) September weight and fur traits graded on live animals and D) fur traits graded on live animals and skins. September weight was found to be negatively correlated with fertility and fitness traits as well as with fur traits. Selection for underfur density resulted in an improvement in guard hair quality and in general impression of the fur, and almost eliminated the fur defect metallic sheen.

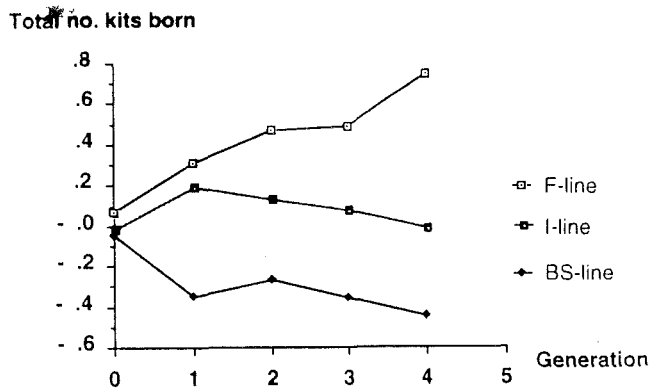


Fig. 1. Genetic trends in litter size (total born) in the F-, BS- and I-lines. (Data set A).

9 tables, 4 figs., 21 refs, 24 pp. Authors' abstract. Submitted for publication.

IV. Selection for litter size and body weight in mink. Effects of reciprocal crossings

Gabrielle Lagerkvist, Nils Lundeheim

During a five-generation selection experiment, in which litter size at 3 wk (F-line) and September weight (BS-line)were selected for, reciprocal crossings between lines were performed in generations 3 and 4 (1987 and 1988) and after terminating the experiment (1990). Furthermore, one line was subjected to combined selection for fertility and body size (I-line), and a randomly mated control was maintained. In 1987 and 1988, only 2-yr-old animals from the F- and BS-lines were used for crossings. However, in 1990 both yearlings and 2-year-old animals were used in order to evaluate effects of age and heterosis. Crossings using F-females gave the best reproductive result; i.e. 6.2 (1987), 7.2 (1988) and 5.4 and 6.6 (1990, yearlings and 2-yr-old females, respectively) kits per litter at 3 wk. The reproductive output of separate selection followed by crossing greatly exceeded that of the I-line. The heavy BS-females appear to have a poor maternal ability that conceals any expression of kit heterosis, in terms of increased pre- and postnatal viability. Body size was also improved by crossing. Results of this experiment indicate that crossings should be performed in yearling females in order to maximize reproductive output.

7 tables, 3 figs., 19 pp. Authors' abstract. Submitted for publication.

V. Effect of selection on digestibility and carcass composition in mink

Gabrielle Lagerkvist, Anne-Helene Tauson

3 tables, 15 refs., 13 pp. Arch. Anim. Nutr. (in press). Abstract will appear in SCIENTIFUR when published.

Original Report

Prospects of embryotechnology in fox research

Liisa Jalkanen

Veterinary Research Station, University of Kuopio

P.O.Box 1627, SF-70211 Kuopio, Finland

Abstract

The progress in embryotechnology in several species has also encouraged fox researchers in this field. This review focuses on the current status of this work and its prospects in fox breeding. The term "embryotechnology" includes a variety of methods dealing with embryos out of their natural environment. Transferring early silver fox embryos from a sacrificed donor to a recipient females uterus has been successful. *In vitro* methods for ova maturation, *in vitro* fertilization and later embryo culture have been applied in foxes. Preliminary experiments in fox embryo freezing are reported. The main advantage of embryotechnology in foxes lies in embryo freezing, which will in the future create possibilities to conserve genetic material of valuable or rare individuals and types in gene banks. The research in embryotechnology will not serve only fox breeding but will also create models for conservation of endangered canine species. The work is still at an early stage, but the results show that embryo technologies may be successfully adapted also to foxes.

Introduction

Man has long been eager to conserve and to manipulate genetic material of himself and other species. An essential means of doing this is manipulation of reproduction - ranging from artificial insemination (AI) and freezing of semen to biotechnological methods of selecting or changing single genes.

In fur animals the introduction of the intrauterine technique for artificial insemination in foxes in Norway in 1973 by Fougner & al. has had the most prominent success in assisted reproduction. Since then, AI has become a routine method in fox breeding in all Scandinavia, and the use of frozen semen will be routine in the near future. This progress has encouraged fox researchers to apply other reproduction techniques to foxes.

The purpose of this review is to focus on the background and current status of research in embryotechnology and its prospects in fox breeding.

Physiology of reproduction

Before applying any method of assisted reproduction to a new species, the fundamental knowledge of its normal reproduction is essential. Even in closely related species like the blue fox (*Alopex lagopus*), the silver fox (*Vulpes vulpes*) and the domestic dog (*Canis familiaris*) of the family *Canidae* there are differences in reproduction, especially in the duration of different phases of oestrus, fertilization and early pregnancy (*Valtonen & al.1993*). These features must be known and thoroughly considered before any adaptation of embryotechnology can be successful.

Reproduction of farmed foxes has been studied since the 1930s and reviewed by Venge in 1959. In the 1980s there was a lot of interest in methods of detecting ovulation (e.g. *Møller 1980; van Beek & al. 1988*). The steroid hormone concentrations in fox plasma have been determined in several studies since the 1970s (e.g. *Møller 1973; Bonnin & al.1978*). Periovulatory endocrinology, oocyte maturation and fertilization in blue fox have been studied by Farstad & al. (1989, 1991) and Hyttel & al. (1990). Valtonen & al. in 1985 concentrated on embryonal development in the blue fox. Pearson & al. studied the physiology of ovulation and fertilization in the silver fox as early as 1943, but the early embryo development has been studied only recently (*Jalkanen 1991; 1992*).

Embryotechnology

The term "embryotechnology" includes a wide range of biotechniques dealing with embryos out of their natural environment. The traditional embryo transfer (ET) procedure includes collection of early embryos at the preimplantation stage from a donor female's genitals and transplanting them into the uterus or oviducts of one or several recipient females. The first successful ET is known to have been performed in the rabbit as early as 1890, and the method was gradually applied to many experimental and farm animals: to sheep and goats in the 1930s, to cattle and pigs in the early 1950s and in the 1970s to horses. Today ET is commonly used in cattle and sheep breeding and has grown to be a useful tool in the research of reproduction and biotechnology.

Embryo production

Superovulation

One of the most important aims of ET in farm animals is to increase the breeding capacity of females. In most species this is achieved by treatment of the donor with exogenous gonadotrophins or their agonists. This results in superovulation, which is defined as multiplication of the number of ovulating follicles and the number of fertilized eggs after insemination or mating.

The data on superovulation in canine species is very limited and negative (*Tsutsui & al. 1989*). The difficulties in affecting the follicular development in the dog and fox may be due to their monoestrous nature. The hormone treatment should probably be given in very early proestrus and thus the right timing is difficult to define. In addition, in practice there is great variation in the response to any hormone treatment in all canine species. There are no reports of successful superovulation in foxes and the suitable method for this remains to be found.

Embryo collection

For transfer the embryos are collected by flushing from the oviducts or the uterus. In most species the collection is performed either from sacrificed donors (e.g. laboratory animals) or surgically under anesthesia (e.g. sheep, pigs). Methods for nonsurgical embryo flushing are under development for several species and they are in routine use in large farm animals like cattle and horses.

In dogs, flushing is done either surgically from the uterus in situ (*Kraemer & al. 1980*), from removed uterus after ovariohysterectomy (*Tsutsui & al. 1989*) or after euthanasia (*Holst & al. 1971; Renton & al. 1991*). In foxes all reported embryo collections so far have been performed after euthanasia. (*Valtonen & al. 1985; Farstad & al. 1989; 1991; 1993; Jalkanen 1991; 1992*).

The number of embryos obtained by flushing varies greatly in reports on foxes, but the percentage of recovered ova in relation to the number of corpora lutea has been around 80 %. This difference may be due to unovulatory luteinization or even to loss of ova in the abdomen during ovulation. However, mistakes in flushing and laboratory techniques cannot be excluded.

In vitro fertilization (IVF)

In addition to "natural" embryo production with or without superovulation there is also another method for this purpose, i.e. *in vitro* fertilization. IVF includes fertilization of mature oocytes with fresh or frozen-thawed sperm in suitable culture media. The procedure may be performed with ovulated ova matured in female genitals (*in vivo*) or the eggs may be collected straight from the ovaries and matured in special media *in vitro*. IVF is extensively used in human medicine for the treatment of infertility and has gained great importance in biotechnical research.

Ova maturation in vitro
In mammalian ovaries the oocytes are in the premature stage. The LH surge is considered to trigger the final maturation, which in canine species occurs a few days after ovulation. As the collection of ova from oviducts is rather complicated and *in vivo* matured oocytes have proved not to give optimal results in IVF in some species, methods for *in vitro* maturation of premature ova collected from the ovaries have been developed.

In fur animals, methods for ova maturation *in vitro* have been used with success both in the raccoon dog (*Qin & al. 1992*) and in the blue fox (*Krogenæs & al. 1993*). In the latter study ova were collected from females in natural proestrus, but preliminary experiments have shown that also ova collected at pelting time may be matured *in vitro* (*Farstad, pers. comm.*)

The first successful IVF in the blue fox has recently been reported by Farstad & al. (1993). They managed to fertilize *in vitro* blue fox ova collected from oviducts six days after LH peak and some of these developed in culture, one even to the morula stage. This study showed that blue fox ova matured *in vivo* may be fertilized and undergo initial development *in vitro*.

Embryo culture
Finding conditions for ova and embryos that can replace the natural environment for shorter or longer periods has been under active research for decades. Rather simple solutions with physiological pH and osmolality can be used for flushing and transferring embryos, but when actual embryo culture is needed, the requirements for different species and for embryos of different stages are still rather unknown. Well defined species-specific *in vitro* culture methods are needed not only in IVF techniques but also in evaluating the viability of frozen-thawed embryos.

The knowledge of *in vitro* culture of canine embryos is limited. Successful culture of an egg recovered from a bitch from one cell stage to a morula was reported in 1991 (*Renton & al.*). In the blue fox, *in vitro* culture has been used for ova maturation (*Krogenæs & al. 1993*) and IVF (*Farstad & al. 1993*), but there are no reports of culture of older embryos. The first experiments on embryo culture with moderate success in the silver fox were performed in 1992 (*Lindeberg & al. 1993*). In that study embryos of more than 8-cell stage up to expanding blastocysts developed well *in vitro*, but younger embryos did not. However, this result was satisfactory as the actual aim of the study was to develop a culture method for evaluation of frozen-thawed embryos in future studies.

Embryo manipulation

Embryo manipulation techniques are at the present under active research. Some microsurgical methods like embryo splitting and biopsy for sex determination are already in commercial use for some farm animals.

Methods affecting the embryo genome include pronuclear and nuclear transfer, chimera production, gene injections, etc. These techniques are currently used only in research. There are no reports of embryo manipulation in fur animal species. In recent reviews by Wilmut & al. (1992) and Yang & al. (1992), the principles and prospects of embryo manipulation and other biotechniques in research and animal breeding are widely discussed.

Embryo transplantation

There are two main aspects that must be considered in ET. First, the uterus of the recipient must be in a suitable condition to accept the foreign embryos. In most species this is achieved by synchronization with hormone treatment. Second, at the preimplantation stage the uterine mucosa is very sensitive and the instruments used in embryo transplantation must be constructed so as to cause minimal injury to the uterine wall. However, the transplantation of embryos into the recipient female's uterus is a relatively simple technique. In large farm animals embryo transplantation is performed transcervically, but in most species the surgical method under anesthesia is used.

Among carnivores, research in ET focuses on feline species, but some success in canids has been reported. In dogs, live offspring have been produced in the USA (*Kinney & al. 1979; Kraemer & al. 1980*) and in Japan (*Tsutsui & al. 1989*). In silver fox, ET is known to have be successful in Russia in the 1980s (*Osadchuk, pers.comm.*) and recently in Finland (*Lindeberg & al. 1993*). In the latter experiment one reci-

pient out of nine gave birth to two pups 47 days after transplantation of four expanding blastocysts.

In all reports on ET in canids the animals have been chosen as a pair from a relatively large flock on the basis of their natural cycles. The reliable hormone treatment for donor-recipient synchronization remains to be examined. All transplantations reported have been performed surgically in anesthestized animals and the embryos have been placed cranially into the uterus. However, as the embryos at blastocyst stage migrate randomly in both uterine horns (*Jalkanen, 1992*), the transfer of embryos to caudal parts of uterine horns transcervically might give equal results. In preliminary trials in Finland with silver fox embryos transferred to blue fox recipients, transcervical AI instruments were used, but those trials did not lead to pregnancy.

Embryo freezing

The benefit of cell cryopreservation arises from its ability to reversibly arrest all biological processes. Thus embryo freezing gives the possibility to conserve whole individuals for unlimited periods.

The successful freezing of bull semen in 1950 (*Smith & Polge*) led to attempts to freeze ova and embryos, but the first success in producing offspring from frozen embryos was reported as late as 1972 in the mouse by Wittengham & al. (1972) and Wilmut & al. (1972). Embryo freezing is based on relatively high concentrations of cryoprotectants, such as glycerol and ethylenglycol. Currently, there are two principal methods in use, the "conventional slow cooling" and vitrification. The older method with a slow controlled cooling rate is in routine use in commercial embryo freezing, but the vitrification method is under active research and has given very promising results (*Rall 1992*). The pregnancy rates with frozen-thawed bovine embryos are comparable to fresh ET, with 80 % efficiency, which means 40 - 50 % pregnancy rates.

There are no reports concerning embryo freezing in canine species available, but preliminary experiments in blue fox and silver fox embryos were performed in Finland this spring. Blastocysts were collected from donors inseminated 7 - 9 days before euthanasia. Propanediol was used as a cryoprotectant and the slow cooling method used for cattle embryos was applied for freezing. The experiment will be continued with *in vitro* culture after thawing and perhaps with transfers to recipients in 1994.

Discussion

Embryo technology has gained great interest among scientists during the last two decades. Success in embryo transfer, IVF and embryo freezing in many species has also encouraged fox researchers in this field. Their work is still at an early stage and the success rates are not too high, but the results show that embryo technologies may be also adapted to foxes.

An important advantage of ET is the possibility to increase the female's breeding capacity by a multiplied number of oocytes. In foxes this is not yet possible because of limited knowledge about hormonal manipulation in canine species. The basic endocrinology in foxes has been widely studied, but suitable methods for superovulation and recipient synchronization remain to be found.

Other embryotechnologies for increasing the number of offspring from one female may also be used. *In vitro* fertilization of *in vitro* matured ova collected from ovaries after pelting would multiply the number of embryos. This might even be made more effective by embryo splitting in the future.

The techniques for embryo collection and transplantation have been rather primitive. Embryo flushing can hardly be performed nonsurgically due to the genital anatomy of foxes, but the method must be developed to be carried out with the uterus *in situ* in future. For embryo transplantation it should be possible to apply the transcervical AI method.

However, it is unlikely that the costs of embryo transfer or other biotechnological methods in fox will ever be low enough to be used to the same extent as AI. Thus, the main advantage of embryotechnology in foxes lies in embryo freezing, which allows unlimited conservation of an entire individual. It will create possibilities to conserve genetic material of valuable or rare individuals and types in gene banks for future breeding purposes.

With frozen semen, the use of frozen embryos offers many practical advantages in ET over fresh embryos. Embryo collection and freezing can be performed independently from recipients. Transport, import and export of breeding material is simple and cheap and the risks of contagious diseases are minimized compared to the use of live animals.

There is also a wider aspect in developing embryo technology in foxes. With increasing numbers of endangered species all over the world, genomic cryopreservation has aroused interest as a means of securing the biodiversity in nature (*Wildt & al. 1992*). Among the endangered species there are several canids, including the Scandinavian arctic white fox, *Alopex lagopus*. There has to be comparative data available from a domesticated animal model before techniques can be adapted to the endangered species. Thus the farmed foxes make an excellent model for providing knowledge for conservation of endangered species.

Embryo technology is still new in fox research, but in the future progress in techniques will consolidate its position as a unique means of meeting many requirements not only in research but also in practical farming.

Litterature

van Beek, P.N.G.M., H.A.P.Urlings and Vresen, J.C.S.M.: Evaluation of progesterone assay (ELISA method) for ovulation detection in foxes. 4th Int. Sci. Congr. Fur Anim. Prod., Ontario, Canada, 56-63 (1988).

Bonnin, M., Mondain-Monval, M. and Dutour ne, B. Oestrogen and progesterone concentrations in peripheral blood in pregnant red foxes (*Vulpes vulpes*). J. Reprod. Fert. 54:37-41 (1978).

Farstad, W., Mondain-Monval, M., Hyttel, P., Smith, A.J. and Markeng, D. Periovulatory endocrinology and oocyte maturation in unmated mature blue fox vixens. Acta vet. scand. 30:313-319 (1989).

Farstad, W., Hyttel, P., Mondain-Monval, M. and Smith, A.J. Oocyte maturation and fertilization in the blue fox. Assisted Reproductive Technology / Andrology 2:132-133 (1991).

Farstad, W., Hyttel, P., Grøndahl, C., Krogenæs, A., Mondain-Monval, M. and Hafne, A.L. Fertilization in vitro of oocytes matured in vivo in the blue fox (*Alopex lagopus*). J.Reprod.Fert.,Suppl.47 (1993) In press.

Fougner, J.A., Aamdal, J. and Andersen, K. In trauterine insemination with frozen semen in the blue fox. Nord.Vet.Med 25:144-149 (1973).

Holst,P.A. and Phemister R.D. The prenatal de velopment of the dog: Preimplantation events. Biol.Reprod.5:194-206 (1971).

Hyttel, P., Farstad, W., Mondain-Monval, M., Bakke Lajord, K. and Smith, A.J. Structural aspects of oocyte maturation in the blue fox (*Alopex lagopus*). Anat.Embryol. 181:325-331 (1990).

Jalkanen, L. Early embryo development in the silver fox. NJF-seminar Nr.200. NJF-report Nr.70:9-14 (1991).

Jalkanen, L. Embryonal development and em bryo-losses during the preimplantation period in the silver fox. Norwegian Journal of Agricultural Sciences. Suppl. 9:108-114 (1992).

Kinney, G.M., Pennycook J.W., Schriver, M.D., Templeton J.W. and Kraemer D.C. Surgical collection and transfer of canine embryos. Biol.Reprod. 20, Suppl. 1, 96A (1979).

Kraemer, D.C., Kinney G.M. and Schriver M.D. Embryo transfer in the domestic canine and feline. Arch.Androl. 5 (1):111 (1980).

Krogenæs, A., Nagyová, E., Farstad, W. and Hafne, A.L. In vitro maturation of blue fox oocytes and cAMP production in oocyte-cumulus cell complexes. Theriogenology 39:250 (1993).

Lindeberg, H., Jalkanen L. and Savolainen R. In vitro culture of silver fox embryos. Theriogenology, in press. (1993).

Møller, O.M. Progesterone concentrations in the peripheral plasma of the blue fox (*Alopex lagopus*) during pregnancy and the oestrous cycle. J. Endocr. 59:429-438 (1973).

Møller, O.M. and Frøysedal, K. Measurement of electrical resistance of the vaginal smear / mucous membrane in the blue fox (*Alopex lagopus*) and the silver fox (*Vulpes argenteus*) as an aid in heat detection. Scientifur 4:21-22 (1980).

Pearson, O.P. and Enders, R.K. Ovulation, ma turation and fertilization in the fox. Anat. Rec. 85:69-81 (1943).

Rall, W.F. Cryopreservation of oocytes and em bryos: methods and applications. Anim. Repr.Sci. 28: 237-245 (1992).

Renton, J.P., Boyd, J.S., Eckersall, P.D., Fergu son, J.M., Harvey, M.J.A., Mullaney, J. and Perry, B. Ovulation, fertilization and early embryonic development in the bitch.(*Canis familiaris*). J. Reprod. Fert. 93:221-231 (1991).

Smith, A.U. and Polge, C. Storage of bull sper matozoa at low temperatures. Vet.Rec. 62:115-116 (1950).

Tsutsui, T., Shimada, K., Nishi, M., Kubo N., Murao I., Shimizu T. and Ogasa A. An experimental trial on embryo transfer in the dog. Jpn.J.Vet.Sci. 51 (4):797-800 (1989).

Qin, P.C., Feng, H.L. and Liu, J.M. In vitro maturation of follicular oocytes of the raccoon dog (*Nyctereutes Procyonides Gray*). Therio-genology 37,(1):279 (1992).

Valtonen, M., King, W.A., Gustavson, I. and Mäkinen, A. Embryonic development in the blue fox. Nord Vet.Med. 37, 243-248 (1985).

Valtonen, M. and Jalkanen L. Species-specific features of oestrous development and blastogenesis in domestic canine species. J. Reprod. Fert., Suppl.47 (1993). In press.

Venge, O. Reproduction in the fox and mink. Anim. Breed. Abstr. 27:129-145 (1959).

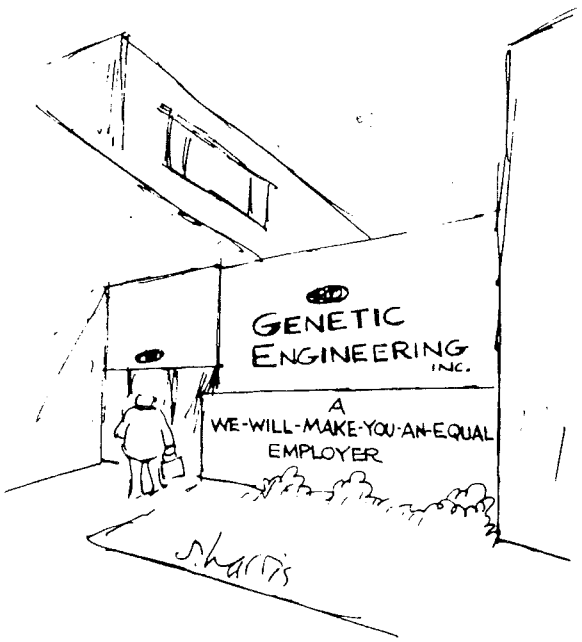
Whittingham, D.G., Leibo S.B. and Mazur P. Survival of mouse embryos frozen to -196° and -269°C. Science 178: 411-414 (1972).

Wildt, D.E., Monfort S.L., Donoghue A.M., Johnston L.A. and Howard J.G. Embryogenesis in conservation biology - or, how to make an endangered species embryo. Theriogenology 37 (1): 161-185 (1992).

Wilmut, I. The effect of cooling rate, warming rate, cryoprotective agent and stage of development on survival of mouse embryos during freezing and thawing. Life Sciences 11:1071-1079 (1972).

Wilmut, I., Haley, C.S. and Woolliams J.A. Impact of biotechnology on animal breeding. Anim.Repr.Sci. 28:149-162 (1992).

Yang, X. and Anderson, G.B. Micromanipula tion of mammalian embryos: principles, progress and future possibilities. Theriogenology 38: 315-335 (1992).



Original Report

Ermine reproduction and embryo development (*Mustela erminea*)

S. Ya. Amstislavsky, L.F. Maksimovsky, Y.G. Ternovsky, D.V. Ternovsky

The Institute of Cytology and Genetics, The Institute of Biology,

Russian Academy of Sciences, Siberian Branch, Novosibirsk

Summary

The peculiarities of ermine reproduction and embryo development have been investigated. The 20 days old females manifest oestrus and become receptive for males. The possibility of successful mating of ermine females in the early childhood is the unique reproductive feature of this animal species. Ovulation was induced by mating and occurred 3-4 days post coitum. Live spermatozoa were present in the reproductive tract during all this period, which made fertilization possible. The period between copulation and ovulation was shorter in PMSG treated animals. In these stoats cleavage eggs were found in the oviducts on the 2nd day after mating.

The stoat embryo development after fertilization was slower compared to other animal species. The embryos on the 7th day of pregnancy were present in the oviducts and consisted of 3-4 blastomeres. The embryos moved into the uterus on the 10-12th day of pregnancy at the stage of compacted morula-early blastocyst.

The implantation of embryos was delayed. Stoat blastocysts were unimplanted in the uterus for 9 months. The implantation occurred only on the 270th-272nd day of pregnancy. The size of the diapausing blastocysts increased markedly and at the end of preimplantation stage was more than 1000 mkm.

The reproductive potency of the right halves of the reproductive tract was higher than of the left. More eggs were flushed from the right oviducts and uterine horns compared to the left ones. PMSG treatment leads to increased ovulation rate in the right, but not in the left ovaries.

Introduction

The early sexual development of female stoats is the unique feature of this animal species (refs. 1, 2). The young ermine females (17-20 days old) are capable of mating with adult males (fig. 1). The eyes of these suckling females are not opened and teeth are not yet formed. Nevertheless, these young ermine females produce normal litters 240-393 days after mating.

There are very few papers on the embryo development of the stoat (refs. 3-5). In this paper the ermine pre-implantation embryo development was studied after fertilization of the above mentioned young females. The embryo development

was studied in naturally mated and PMSG treated stoat females.

Fig. 1. Mating of the adult male and young female (25 days old) stoat.

Materials and methods

To obtain the embryos young ermine females (26-92 days old) were mated with adult males. The weight of 30 day old females was 45 g. At the 90th day the weight of the young stoats was similar to adult ones (100-180 g). All the ermine females were oestral. The results of mating were estimated by male sperm cells available in the vaginal smear preparations made after coupling. The washing out of embryos was conducted during the period from the first till the 272nd day of pregnancy. To obtain the embryos from the uterus or oviducts standard techniques were used (ref. 6).

All the ermine females were tested twice. The first time, one uterine horn and oviduct were flushed with 199 medium and the flushing was checked for embryos. Then the incision was sewed up with silk and the young was returned to the familiar nest. The second time, the female was decapitated and the embryos were flushed out of the second uterine horn and oviduct. The Wild Leitz inverted microscope was used to investigate and photograph the embryos.

To induce superovulation the animals were treated with PMSG (pregnant mare serum gonadotropin) 10 IU and mated with adult males 48 hours later.

Results and discussion

The qualitative changes of the content of the oviductal and uterine flushings are summarized in table 1. Live spermatozoa were present in the uterus as well as in the oviducts on the days 1-3 after mating. There were no mobile spermatozoa in the ermine reproductive tract after the 4th day post coitum.

The long period of the ermine sperm viability in the female reproductive ways (up to 4 days post coitus) may be connected with the mating-induced ovulation and the presence of a latent period between the mating and ovulation in the Mustelidae family. Sperm viability in the reproductive tract in some other Mustelides is comparable to that of the stoat (126 hours in the ferret) (ref. 7).

Probably the environment in the reproductive ways of the stoat might promote the physiological conservation of the germ plasm. One female stoat was operated 1 hour after mating. The right ovary and the right oviduct and a part of the right uterine horn were ectomized. The left half of the reproductive tract of this animal was checked for embryos 8 months later. Normal delayed blastocysts together with unfertilized eggs were flushed out of the uterus. The presence of unfertilized eggs in the uterus may be connected with the operative intervention at the time when fertilization took place. The unfertilized eggs were persistent in the uterus of the stoat for 8 months (fig. 2). Only mares have demonstrated such prolonged persistence of the unfertilized eggs in the reproductive tract. In the mares these eggs did not enter the uterus but slowly degenerated in the oviducts (ref. 8).

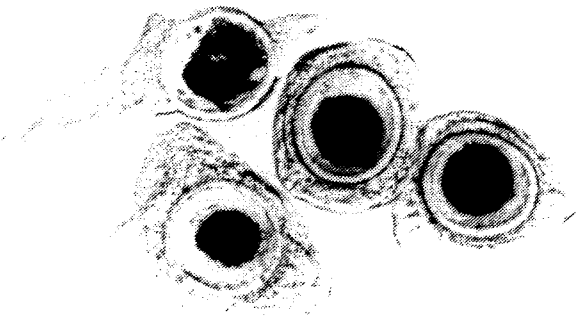


Fig. 2. Unfertilized eggs flushed out of the uterus of the stoat 240 days post coitus.

Table 1. Changes in the reproductive tract of the female stoats during 9 months of pregnancy

Day p.c.	Presence of spermatozoa		Presence large follicles	Presence ovulated oocytes	Presence cleavage embryos		Implantation	N
	uterus	oviduct	ovaries	oviducts	oviduct	uterus	uterus	
Naturally ovulated animals								
1	+	+	+	-	-	-	-	2
2	+	+	+	-	-	-	-	2
3	±	+	±	±	-	-	-	2
4	-	+	-	+	-	-	-	1
7	-	-	-	-	+	-	-	1
9	-	-	-	-	+	-	-	1
11	-	-	-	-	+	+	-	1
12	-	-	-	-	-	+	-	1
21-251	-	-	+	-	-	+	-	12
270-272	-	-	+	-	-	-	-	2
PMSG-treated animals								
2	+	+	-	-	+	-	-	1
3	+	+	-	-	+	-	-	1
6	-	-	-	-	+	-	-	2
7	-	-	-	-	+	+	-	1
21	-	-	+	-	-	+	-	1
32	-	-	+	-	-	+	-	1
270	-	-	+	-	-	-	+	1

+: presence; -: absence; ±: presence in one of two cases; N: number of animals;

The large graafian follicles were present in the ovaries of the young female ermines at the 1st-2nd day post coitus. These follicles were punctured with a glass needle and preovulated oocytes surrounded by the follicular cells were extracted from them (fig. 3a). Ovulated oocytes with polar bodies (fig. 3b) appeared in the oviducts only on the days 3-4 post coitus (table 1). Evidently, gonadotrophic stimulation of the follicles take place between copulation and ovulation. Other species of animals with induced ovulation demonstrate a latent interval between copulation and ovulation that is long enough and comparable with that of the stoat. In Llamas *Llama glama*) ovulation occurs 48 hours after mating (ref. 9). Domestic cat (*Felis catus*) ovulates 24-50 hours post coitus (ref. 10). Treatment with PMSG shortened this period between copulation and ovulation and cleavage eggs were flushed from the oviducts of treated stoats on the second day after mating (table 1).

Cleavage eggs were flushed from the oviducts of the naturally mated stoats on the 7th day post coitus (fig. 3c). Morulas (fig. 3d) and early blastocysts (fig. 3e) were present in the oviductal and uterine flushings of the female stoats on the 9-12 day of pregnancy (table 1). On the 9th day of pregnancy the embryos were in the oviducts but at the 11th day p.c. part of the embryos had moved to the uterus. At the 12th day of pregnancy the embryos were present in the uterus exclusively. For most animal species, entry to the uterus occurs earlier in embryo development: murine embryos present in the uterine horns on the 3-4th day post coitus (ref. 5, 10): dog and polar fox embryos were found in the uterus on the 6-8th day of pregnancy (ref. 11-12).
Moreover, one significant point to notice is the acceleration of ermine embryo development in MSG-treated females (table 1). In PMSG-treated females embryos entered the uterus on the 6th day of pregnancy compared to 10th-11th day

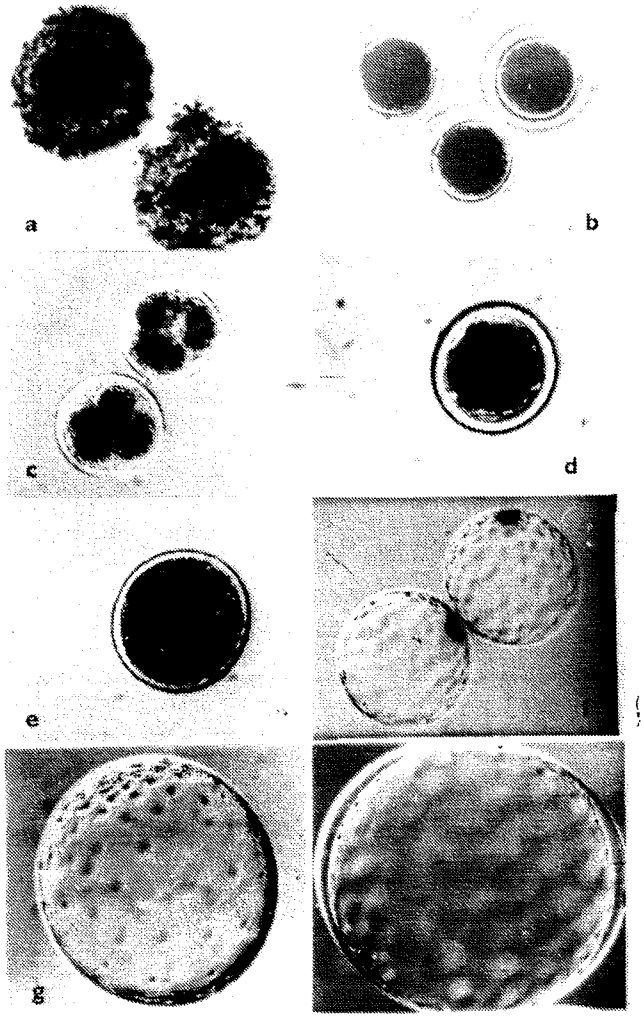


Fig. 3. Development of the ermine embryos before implantation.

post coitus in naturally mated animals. Acceleration of embryo development in these animals may be connected with enhanced secretion of ovarian estrogens and progesterone. Increased blood level of these steroids was found in PMSG treated rats (ref. 13). Moreover, addition of estrogens and progesterone to embryo-uterine monolayer co-culture enhanced embryo survival and implantation in mice (ref. 14), but treatment with monoclonal antiprogesterone antibodies arrested the embryo development and implantation in the ferrets (ref. 15).

The implantation delay was present in the stoats (table 1). Dormant blastocysts were persistent in the uterus nine months p.c. (fig. 3e, f, g, h). All these unimplanted blastocysts had been flushed out of the uterine horns easily. On the 270th-272nd day of pregnancy implantation occurred and it was impossible to flush the embryos from the uterus. Delayed blastocysts increased in size markedly (fig. 4).

The large size of the ermine blastocysts may be connected with the implantation delay but the cause may be different. Giant preimplantation blastocysts were found in a number of carnivorous species (refs. 3, 4, 12, 16). Some of these species have a diapause in preimplantation development (spotted skunk (ref.1 6)), but some have not (polar fox (ref. 12)).

Table 2. Ovulation rate in right and left ovraies of the naturally mated and PMSG-treated female stoats

Position	Number of embryos and eggs flushed			
	Naturally mated group		PMSG-treated group	
	No. of embryos	N	No. of embryos	N
Right uterine horns and oviducts	6.4 + 1.0 *	7	10.25 + 0.75 **	4
Left uterine horns and oviducts	4.0 + 0.66	9	4,25 + 0.62	4

*: $p<0.05$ compared with the left oviducts and uterine horns
**: $p<0.05$ compared with the right oviducts and uterine horns in naturally mated group and $p<0.001$ compared with the left oviducts and uterine horns in PMSG-treated group
N: number of oviducts and uterine horns investigated

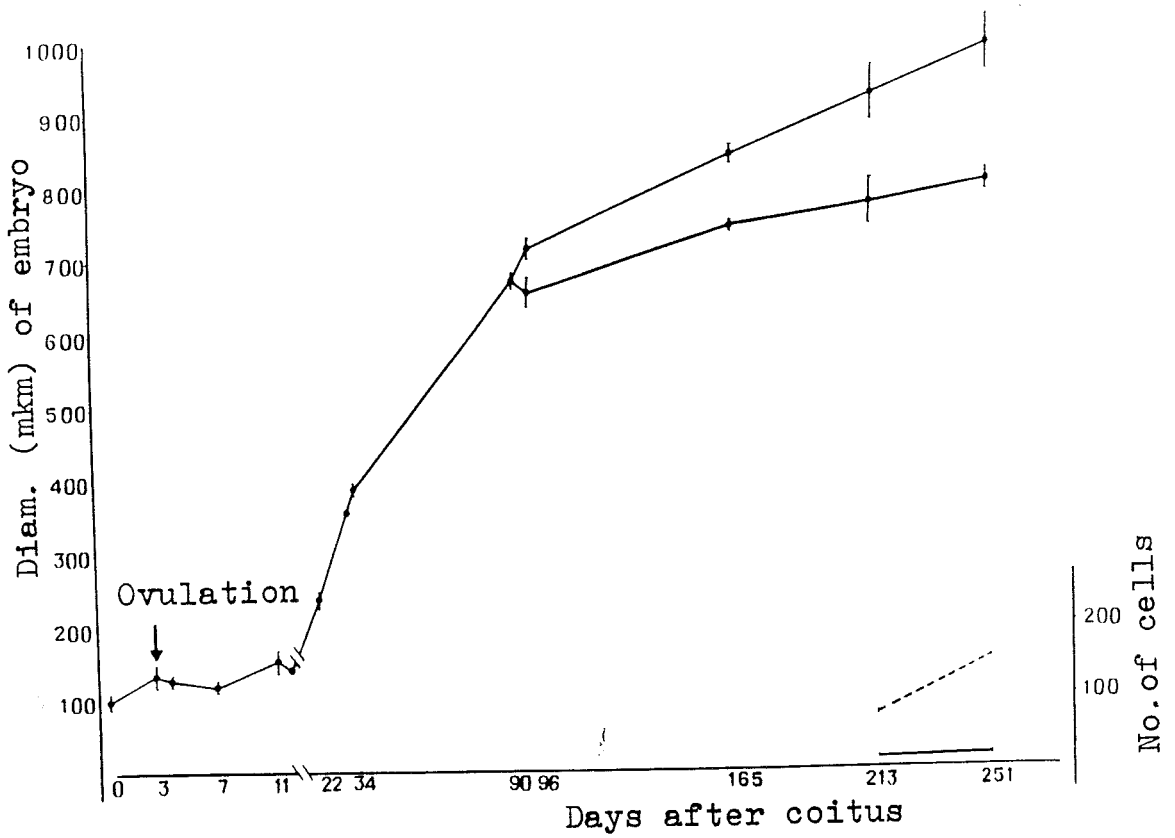


Fig. 4. Diameter of preimplantation stoat embryos

Inequality in function of the stoat right and left ovaries was evaluated in this paper. There were more embryos in right oviducts and uterine horns compared with left ones (table 2). Similar assymetry of the reproductive potencies of the right and left reproductive organs was shown recently in mice (ref. 17).

Moreover, inequality of reproductive organ's potencies with reference to the position in the reproductive tract was more pronounced in PMSG treated stoats. Superovulation was achieved in the right, but not in the left ovary (table 2). The ovulation rate in the left halves of reproductive tracts of PMSG treated animals was similar to that of naturally mated ones.

References

1. Ternovsky, D.V. 1977. Biology of the Musteli dae. Novosibirsk, Nauka, 279 p. (in Russian).
2. Ternovsky, D.V. 1983. Biology of the breed ing and development of the stoat (*Carnivora mustelidae*). Zoological Journal, N 7, p. 1097-1105. (in Russian).
3. Deanesly, R. 1943. Delayed implantation in the stoat (*Mustela erminea*). Nature, vol. 151, N 3830, p. 365.
4. Watzka, M. 1940. Mikroskopisch-anatomische Untersuchungen über die Ranzeit und Trogdauer des hermelins (*Putorius ermineus*). Z. mikr.-anat. Forsch., vol. 48, p. 359-379.

5. Amstislavsky, S.Ya., Maksimovsky, L.f., Ternovsky, Yu.G., Ternovsky, D.V. 1993. Early preimplantation developmen tof the stoat. Siberian Biologial Journal, N 2, p. 30-35. (in Russian).
6. Amstislavsky, S.Ya., Maksimovsky, L.F., Vorotnikov, M.T. 1991. Methods of Biotechnology in Animal breeding Practice. Novosibirsk, 170 p. (in Russian).
7. Chang, M.C. 1965. Fertilization life of ferret sperm i the female tract. J. Exp. Zool., Vol. 158, N 1, p. 87-100.
8. Van Niekerck, C.H., Gerneke, W.H. 1966. Persistence and parthogenetic cleavage of tubal ova in the mare. Onderstepoort J. Vet. Rec., vol. 31, p. 195-232.
9. Adams, J.P., Sumar, J., Ginter, O.J. 1990. Effect of lactational and reproductive status on the follicular waves in llamas (*Llama glama*). J. Reprod. Fert., vol. 90, p. 535-545.
10. McDonald, L.E. 1975. Veterinary Endocri-no logy and Reproduction. Lea & Febiger, Philadelphia, 493 p.
11. Austin, C.R. 1982. The Egg/Reproduction in mammals. vol. 1. Germ cells and fertilization. Eds. C.R. Austin, L. Short. Cambridge, p. 46-62.
12. Valtonen, M., King, W.A., Gustavsson, I., Mäkinen, A. 1986. Embryonic development in the blue fox. Scientifur, Vol. 10, No. 4, p. 270-271.
13. Miller, B.G., Armstrong, D.T. 1981. Effect of superovulatory dose of pregnant mare gonadotropin on ovarian function, serum estradiol and progesterone levels and early embryo development in immature rats. Biol. Reprod., Vol. 25, p. 261-271.
14. Lavranox, T.c., Seamark, R.F. 1989. Addition of steroids to embryo-uterine monolayer coculture enhances survival and implantation in vitro. J. Reprod. Fert., vol. 1, N 1, p. 41-47.
15. Rider, V., Heap, R.B. 1986. Heterologous antiprogesterone monoclonal antibody arrest early embryonic development and implantation in the ferret (*Mustela putorius*). J. Reprod. Fert., Vol. 76, p. 459-470.
16. Enders, A., Schlafke, H., Hubbard, N.E., Mead, R.A. 1986. Morphological Changes in the Blastocyst of the Western Spotted Skunk during Activation from Delayed Implantation. Biology of Reprod., Vol. 34, p. 423-437.
17. Wiebold, J.L., Becker, W.C. 1987. Inequality in function of the right and left ovaries and uterine horns of the moust. J. Reprod. Fert., Vol. 79, p. 125-134.

Genetic and endocrinological factors influencing reproduction in blue foxes

Nina Marie Valberg Nordrum

New doctor in the family. We congratulate Nina Marie Valberg Nordrum with the fine thesis and the new degree and wish all the best for the future.

The thesis contains four separate papers aiming at providing genetic and endocrinological information of importance for reproductive performance in blue foxes.

The first two papers deal with the secretion of plasma progesterone and plasma prolactin during the luteal phase and pregnancy in blue fox vixens. The vixens were grouped according to stage of pregnancy. Data were fitted with an animal model. In all vixens there was a substantial increase in plasma progesterone after mating, and maximum values were observed on day 8-12 after mating. Then the progesterone levels decreased gradually until basal levels (<2 ng/ml) were obtained about day 40-52 after mating. Statistically significant differences in progesterone levels were found between non-pregnant and pregnant vixens from day 22 after mating. Thus, the plasma progesterone level seems to be affected by the presence of fetuses. Plasma prolactin levels increased slowly during the early post mating period in both non-parturient and parturient vixens. Thereafter, there was a progressive increase in prolactin concentration in the parturient vixens until parturition, whereas there was only a slight increase in the non-parturient vixens. Prolactin is suggested to be a luteotrophic stimulus in blue foxes.

The third paper concerns the effects of inbreeding on litter size at birth, and the potential litter size in the prenatal and postnatal period. Litter size at birth declined at a rate of 0.71 and 0.47 pups per 10 percent increased inbreeding of dam (P=0.01) and litter (P=0.05), respectively. Depression due to maternal inbreeding was manifested by an increased preimplantation mortality. The litter component of the inbreeding depression was explicable as postimplantation mortality and reduced viability during the first three days after parturition.

The fourth paper comprises genetic and phenotypic parameters of reproduction traits in blue foxes as estimated from field data. A single trait REML procedure was applied using an animal model. With data from parturient vixens the estimates of heritability for litter size at birth ranged from 0.05 to 0.08 and for three weeks post partum from 0 to 0.11. Analyses using both non-parturient and parturient vixens gave heritabilities in the range of 0.08 to 0.13 for litter size at birth. Generally, the estimated heritabilities for litter size in blue foxes were lower than corresponding figures in earlier studies. Thus, the possible genetic response to selection may be lower than previously expected.

11 pp, 27 refs. Author's abstract.

The thesis is based on the following 4 reports:

I. Valberg, N.M. & Farstad, W. Plasma progesterone during the luteal phase and pregnancy in parturient and barren blue fox vixesn. Acta Agric. Scand., Sect. A, Animal Sci. 42, 232-239, 1992. Abstracted in SCIENTIFUR, Vol. 17, No. 1, p. 37.

II. Valberg, N.M. & Mondain-Monval, M. Plasma prolactin during the luteal phase and pregnancy in non-parturient and parturient blue fox vixens. Acta Agric. Scand., Sect. A, Animal Sci. 42, 240-

245, 1992. Abstracted in SCIENTIFUR, Vol. 17, No. 1, p. 37.

III. Nordrum, N.M. Valberg. Effect of inbreeding on reproductive performance in blue fox vixens. Submitted to Acta Agric. Scand.

IV. Nordrum, N.M. Valberg. Genetic and phenotypic parameters of reproductive traits in blue fox vixens. To be submitted to Acta Agric. Scand.

III. Effect of inbreeding on reproductive performance in blue fox vixens

Nina M. Valberg Nordrum

Multiple regression models were used to determine the effects of inbreeding on litter size at birth, and on the potential litter size in the prenatal and postnatal period. Inbreeding was achieved by repeated sire-daughter matings for three generations. In addition, "contrast matings" in the form of inbred dams carrying non-inbred litters and vice versa, reduced the colinearity between inbreeding of dam and inbreeding of litter. Average inbreeding coefficients were: Dams, 16% (range 0-41%), litters, 24% (range 0-53%), and sires, 9% (range 0-41%). Inbreeding of sire had no significant effects. Total number of pups born per mated vixen declined significantly by 0.71 pups per 10% increased inbreeding of the dam (P=0.01). Litter inbreeding caused a significant reduction of 0.47 pups per 10% increase in inbreeding (P=0.05). Maternal inbreeding did not affect ovulation rate, but caused increased loss of ova or early embryos before implantation. Litter inbreeding caused increased mortality in the postimplantation period and during the first three days after parturition. Litter size shortly after parturition declined at a rate of 0.41 pups per 10% increase in litter inbreeding (P=0.02). Litter size at weaning was not affected by inbreeding. This suggests that genes affecting prenatal and early postnatal survival exhibit dominance effect.

22 pp, 4 tables, 39 refs. Author's abstract.

IV. Genetic and phenotypic parameters of reproductive traits in blue fox vixens

Nina M. Valberg Nordrum

In order to estimate genetic and phenotypic parameters for reproductive traits in blue fox vixens, a single trait REML procedure was applied using an animal model. Data was gathered from two of the largest fox areas (Norangdal and Vesterålen) included in the Norwegian field recording system for the years 1986 to 1989. The material was partitioned into first parity and overall parities (1-5), giving a total of 4 data sets. Litter size at birth and at three weeks post partum were recorded on 673 and 512 first parity vixens and 1302 and 1137 overall parities vixens, respectively, in the two fox areas. About the same heritability level was revealed for first parity and parity 1-5. With data from parturient females, the heritabilities for litter size at birth and three weeks post partum ranged from 0.05 to 0.08 and from 0 to 0.11, respectively. Analyses using both non-parturient and parturient vixens gave heritabilities in the range of 0.08 to 0.13 for litter size at birth.

19 pp, 4 tables, 30 refs. Author's abstract.

Undifferentiated spermatogonia and their role in the seasonally fluctuating spermatogenesis in mink, *Mustela vison*

T. Tiba, I. Kita

Three classes of spermatogonia were discerned: undifferentiated A spermatogonia (A_{is}, A_{pr}, A_{al}), differentiated A spermatogonia (A_1, A_2) and differentiated B spermatogonia (B_1, B_2). Cell counts performed throughout the seminiferous epithelial cycle in the breeding season revealed that the number of undifferentiated A spermatogonia was lowest in the presence of differentiated A_1 and A_2 spermatogonia during stages I-II to III-IV. In the non-breeding season a highly significant increase in the number of undifferentiated spermatogonia occurred in an animal with moderate germ cell

loss exclusively at sta-ges I-II to III-IV, when the A_1 and A_2 spermatogonia degenerated. In three other animals involved in severe cell loss, enhanced proliferation of undifferentiated spermatogonia was much greater than in the animal mentioned above. These results suggest the presence of a feedback mechanism between undifferentiated and differentiated spermatogonia, which may be considered to play an important role in regulating seasonal changes in spermatogonial proliferation.

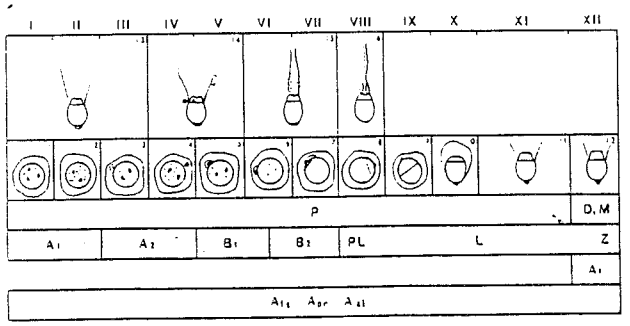


Fig. 1. Cycle of the seminiferous epithelium in the ferret[a]
I-XII: Stages of the cycle, 1-16: Steps of spermiogenesis, A_{is}, A_{pr}, A_{al}: Undifferentiated A spermatogonia, A_{is}: Isolated type, A_{pr}: Paired type, A_{al}: Aligned type, A_1: Differentiated A_1 spermatogonia, A_2: Differentiated A_2 spermatogonia, B_1: Differentiated B_1 spermatogonia, B_2: Differentiated B_2 spermatogonia, PL: Preleptotene primary spermatocytes, L: Leptotene, Z: Zygotene, P: Pachytene, D: Diplotene and diakinesis, M: Meiosis
[a]Classification of the cycle of the seminiferous epithelium in the ferret (*Tiba and Kita, 1990*) was applied without modification to this study (see the text)

Anat. Histol. Embryol. 20, 118-128, 1991. 5 tables, 11 figs., 16 refs. Authors' summary.

Examination of sperm from mink

Ulla Lund Nielsen, Niels Therkildsen

By taking a sample of sperm from the female vagina by means of a pipette immediately after mating, the quality of the sperm, the number of sperm cells and their movement can be observed under a microscope, in fresh sperm as well as in a dried sample.

The evaluation of the sperm sample showed that there were very high and significant correlations (0.3-0.6) between the evaluations of the sperm of the males and their breeding results.

By simulating a reduction of poor males by removing males with poor sperm evaluations from the data material, the breeding result could be improved. If 31 males with one or more poor sperm evaluation grades out of a total of 88 males are removed, the percent of barren females was almost halved and the number of kits per mated female increased by 0.5 kit.

Examinations of sperm can be used for prediction of the potential fertilizing capacity of a male. The evaluation can, however, only take place in the mating season and not at the selection of breeding animals.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 146-149, 3 tables. In DANH. Authors' summary.

Evaluation of mink testes.

Ulla Lund Nielsen, Niels Therkildsen

The development of testes from November and until the end of the mating season at the end of March showed in the experiment that there are differences between colour types and lines.

High and significant correlations were found between evaluations of testes sizes from late December and in the spring months until the end of the mating season at the end of March. On the contrary, evaluations in November had low correlations to the other evaluations. The evaluations of the testes size corresponded very well with the actual weights of testes.

Neither the evaluations nor the actual testes weights were of importance to the breeding ability of the male when the testis had developed normally. Abnormally developed testes may, however, be of importance to the fertilizing capacity of the male.

Evaluation of testes cannot be used as a criterion in the selection of breeding animals. After selection of breeding animals, the males should be examined for the presence of abnormally developed testes.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 150-154, 4 tables, 1 fig., 1 ref. In DANH. Authors' summary.

Original Report

Some regularities in enzyme spectrum formation in the digestive tract of mink

V.M. Oleinik, E.B. Svetchkina

Institute of Biology, Karelian Research Centre of the Russian Academy of Sciences, 185610, Petrozavodsk, Puschkinskaya 11, Russia

Summary

Digestive enzyme activity in pancreatic tissue and small intestine of mink was investigated at 1, 2, 10, 20, 32, 49 and 180 days of life. On the basis of the present experiment and previous ones, age peculiarities in digestive enzyme spectrum in mink were revealed. These peculiarities are as follows: the proteolytic enzyme system forms at an earlier age in comparison with the carbohydrate-hydrolysing one and there is a high lipolytic activity during the period of transition from milk to solid feed.

Introduction

In a previous publication (*Oleinik & Svetchkina, 1992*) devoted to the studies of the dynamics of enzyme activity in mink digestive tract were shown some differences from the dynamics characterizing well-investigated omnivorous animals (*Henning, 1987; Robberecth et al., 1971; Corring et al., 1978; Ugolev et al., 1979*). Some differences from data of previous experiments on mink kits (*Elnif et al. 1988*) were also found. The present investigation was performed in order to confirm or to disprove these discovered regularities in ontogenetic development of the enzyme spectrum of mink digestive tract.

Materials and methods

Mink kits of a standard genotype were investigated at 1, 2, 10, 20, 32, 49 and 180 days of life. In every age group 5 individals were used. Mink 49 and 180 days old were examined after night fasting, whereas kits of the other age groups were investigated 2 hours after the morning feeding. In mink of 32-180 days of age, enzyme activity in homogenates of small intestine mucosa was investigated, whereas within other age groups enzyme activity in entire intestine homogenates was defined. In the pancreatic tissue alfaamylase, lipase and total proteolytic activity (TPA) were determined. In the small intestine alfa-amylase, monoglyceridlipase, invertase, dipeptidase, lactase activity and TPA were determined. Methods of enzyme activity assay and experimental conditions of the present investigation were similar to the ones used in the previous work (*Oleinik & Svetchkina, 1992*).

Results

Age changes of digestive enzyme activity in the mink pancreatic tissue are shown in fig. 1. It is obvious that age increases in amylase activity and TPA were regular enough and amylase activity was constantly relatively lower than TPA.

Lipase activity at the beginning of the observation period was nearly the same as on the adult level, but gradually declined by the 20th day of life. Furthermore, lipase activity increased up to the 49th day after birth, and then declined again.

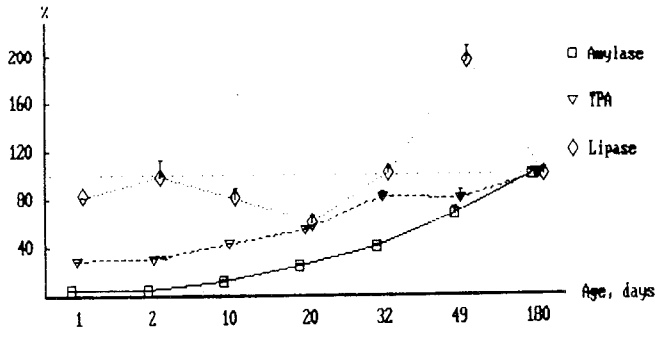


Fig. 1. Digestive enzyme activities in the pancreas of mink of different ages (in % of the adult level)

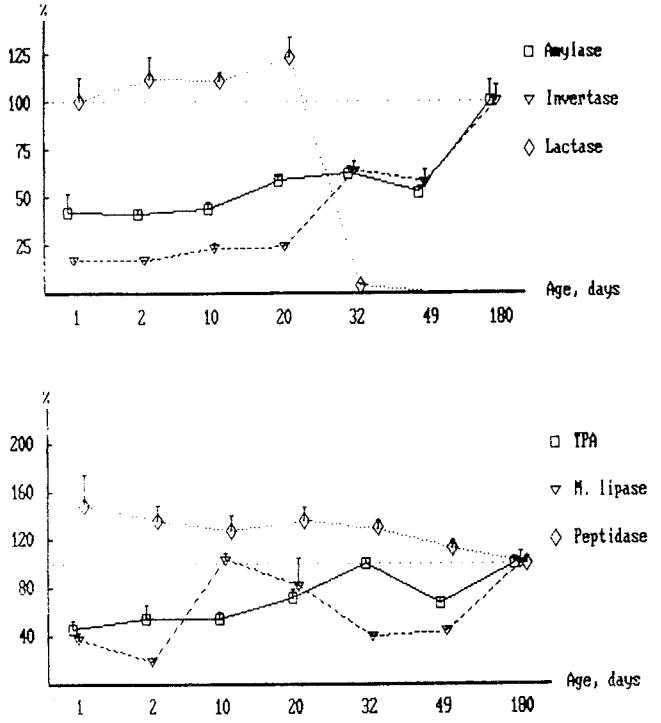


Fig. 2. Digestive enzyme activity in the small intestine of mink of different ages (in % of adult level; for lactase - in % of newborn level)

Age changes of digestive enzyme activity in the small intestine of mink kits are shown in fig. 2. A rather even increase of amylase and invertase activity and TPA was concomitant to age. Lactase activity slightly increased during the first days after birth, but then began to decline abruptly up to its complete disappearance. Dipeptidase activity declined very slowly according to age. Lipase activity reached its local maximum in 10 day old mink kits, then declined and increased again only in adult animals.

Discussion

Results of present experiments correspond to the ones of the previous investigation (*Oleinik & Svetchkina, 1992*). Age increase of amylase activity and TPA in the pancreatic tissue of mink kits was similar in both cases; moreover formation of a definitive TPA level was observed at an earlier age than amylase activity. Substantional age oscillation in lipase activity level took place in both cases, although in the present experiment the peak of this activity was defined at an older age.

Dynamics of enzyme activity changes in the small intestine were of 3 types, as well as in the previous investigation. Lactase activity declined abruptly after the milk feeding period up to its complete disappearance. Dipeptidase activity was rather high from birth and changed little according to age. Carbohydrate-hydrolysing enzyme activities occurred later than TPA and lipase activity.

Substantial differences in age dynamics of enzyme activity between our two experiments took place only during the period of early ontogeny (1th and 2nd days of life). It was demonstrated (*Saroux & Girad-Globa, 1982*) that abrupt changes of digestive enzyme activities take place during the first hours after birth. It is possible that the age of mink kits taken for 1 day old ones in the two experiments could differ by several hours, causing the mentioned disparity.

Summing up the results of these two investigations, we can reveal some regularities in age changes of digestive enzyme activities in mink, which differ from omnivorous animals. These regularities are as follows: outstripping development of proteolytic enzyme system in comparison with the carbohydrate-hydrolysing one (it is possible this phenomenon is connected with ecological specialization in predatory animal feeding), and a rather high level of lipase activity during the period of transition to solid feed.

Such a high lipase activity level in mink kits is not quite understandable from the point of view of their digestive needs during this period. Some investigators (*Robberecht et al., 1971*) have mentioned an increase of lipase activity during the period of transition from the milk to solid feed also in rats, though it was not so significant. There is information (*Simoes-Nunes et al., 1984*) that lipase activity changes more substantially under the influence of diet in mink, whereas in omnivorous animals lipase is less labile in comparison with other digestive enzymes (*Ugolev et al., 1979*). It is possible that a rather high lability of the lipase activity is a specific feature of mink.

References

Corring, T., Aumaitre, A., Durand, G. 1978. De velopment of digestive enzymes in the piglet from birth to 8 weeks. J. Nutr. Metabol., 22, 4, 231-243.

Elnif, J., Enggaard Hansen, N., Mortensen, K. 1988. Production of digestive enzymes in mink kits. Proc. IV Int. Congr. Fur Anim. Prod., Toronto, 320-326.

Henning, S. 1987. Functional development of the gastrointestinal tract. "Physiology of the gastrointestinal tract". Ed. L.R. Jonson, N Y., 285-300.

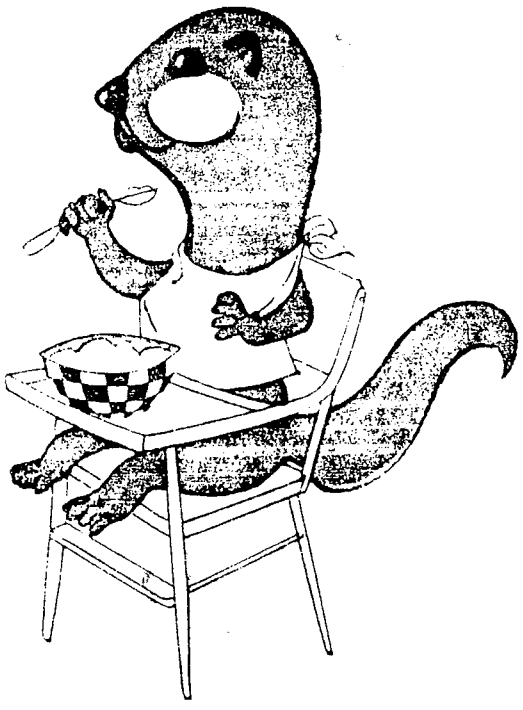
Oleinik, V.M. & Svetchkina, E.B. 1992. Change of the enzyme spectrum of the digestive tract in mink during postnatal ontogeny. Scientifur, Vol. 16, No. 4, 289-292.

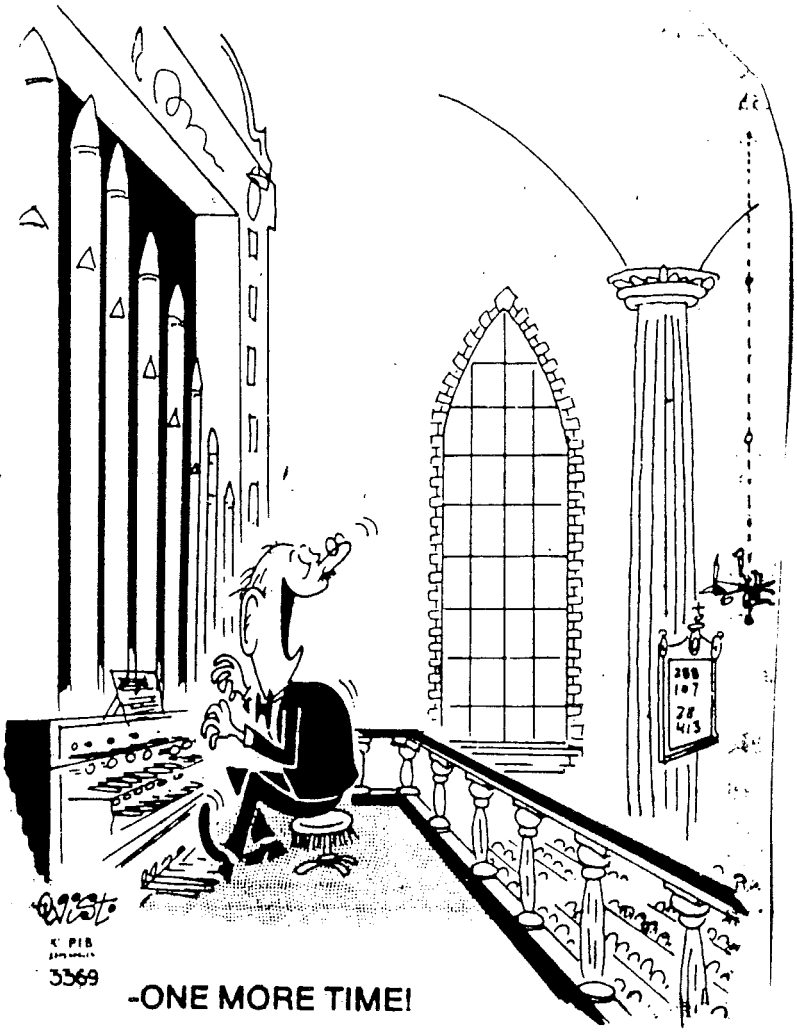
Robberecth, P., Deshodt-Lancman, M., Camus, J. 1971. Rat pancreatic hydrolases from birth to weaning and dietary adaptation after weaning. Amer. J. Physiol. 221, 376-381.

Saraux, B., Girard-Globa, A. 1982. Development of pancreatic anzymes inf etal and suckling rats with emphasis on lipase and colipase. J. Develop. Physiol. 4, 121-137.

Simoes-Nunes, C., Charlet-Lery, G., Rougeot, J. 1984. Adaptation of the exocrine pancreatic secretion to diet composition in mink. III cong. Int. Sci. Prod. Anim. Fourrure. Versalles (France), Comm. 16, 1-6.

Ugolev, A.M., De Laey, P., Iezuitova, N.N. 1979. Membrane digestion and nutrient assimilation in early development. Ciba Foundation Symposium 70 (new series) Development of Mammalian Absorptive Processes, Amsterdam; Oxford; N Y., 221-246.





ADVERTISE

IN

SCIENTIFUR

Original Report

Influence of papermill line activated sludge on the activity of blood enzymes and quality of skins of farm mink

L.K. Kozhevnikova, N.N. Tyutyunnik, V.A. Ilukha, H.I. Meldo

Institute of Biology, Karelian Research Centre, Russian Academy of Sciences, Petrozavodsk, Pushkinskaya, 11

Summary

It has been shown that papermill line activated sludge used as a feedstuff at a rate of 2 g/100 kcal of feed in mink diets has no negative effect on the blood enzymes and fur quality of breeding females of one reproductive cycle and their kits.

Introduction

The problem of new feed production sources is rather actual for fur farming. Use of timber industry waste, namely activated sludge of the papermill line, envisages a solution to such global problems as additional feed production and environmental protection.

Papermill line activated sludge (AS) is a product of microbiological synthesis by means of special non-unit processing with succeeding thermal drying. AS is of a high nutritional value and is characterized by a high protein content (more than 30%) with a wide spectrum of amino acids including indispensible ones, and B-group vitamins, B_{12} (6-8 mg per kg of dry substance). It also contains a series of macro and micronutrients. Due to the nutritional value of the AS it can be used as a feedstuff in farm mink diets.

Earlier it was reported (*Tyutyunnik et al., 1990*) that AS addition at a rate of 2 g per 100 feed kcal to mink diets during the period of growth and development has no negative effect on the physiological state of animals and fur quality. There are data obtained on the use of papermill line activated sludge as a feedstuff in diets of ruminants (*Laurent, 1983*), cattle, pigs, poultry (*Reizinsh et al., 1980*), and fish (*Ostroumova, 1972*).

Large-scale use of AS in fur farming requires knowledge on its effects on the mink organism, the influence on the breeding female population and the kits fed with AS feedstuff for several generations.

Materials and methods

The darkbrown mink of "Karelpushnina" LTD were studied. Several groups of mink were formed for the experiment.

a) Adult breeding females: P - initial parents originating from animals fed without the AS foodstuff; F_1 - P generation; F_2 - F_1 generation, etc.

b) Kits of F_1, F_2, and F_3 mink generations were slaughtered in November. The adult breeding females received AS as a feedstuff at a rate of 2 g per 100 kcal feed daily during the whole reproduction period. The kits received the same AS dose from weaning to slaughter.

The breeding females and mink kits kept on a general diet were control animals.

The serum enzyme activities of aspartate aminotransferase (ASAT; EC 2.6.1.1.), alanin aminotransferase (ALAT; EC 2.6.1.2.), laktate dehydrogenase (LDH; EC 1.1.1.27.), and alkaline phosphatase (AP; EC 3.1.3.1.) were determined by the microexpress method, described earlier (*Berestov, 1981*); the activities of superoxidismutase (SOD, EC 1.15.1.1.) and catalase (EC 1.11.1.6.) were tested by the methods described by Ilyuha (1991) and Aebi (1984).

The activity of blood enzymes was determined in adult mink and kits in July, October and November.

Results and discussion

Feed ingredients are transformed into energy for biochemical processes and structural elements in the organism (*Sorvatshev, 1982*).

As a rule, an organism starts the system of nonspecific response reactions when it receives a new feed type to which no genetically fixed adaptation mechanisms have been formed. From the point of view of metabolism energy exchange is referred to such reactions (*Kondrashova, 1975*). This proposition is proved by analyzing the changes in blood enzyme activity in mink when AS is used as feedstuff. Evident changes in the activity of the enzymes (LDH, ASAT) connected with the organism's energetics have been revealed. The experiments show that breeding adult mink females during the reproduction process are more sensitive to the new type of feed than developing kits (fig. 1-3). The first AS feeding stage of females (P generation) in the mating, pregnancy and lactation periods did not induce any significant fluctations in the enzyme status of blood in the mink (fig. 1). It is evident that the seasonal dynamics of enzyme activity is without changes. The LDH activity in the test mink is stable in comparison with the control mink. Fluctuations of the transaminase activity in July and October (increased of 14-33% ALAT and reduced of 16% ASAT) are normalized by November. As to AP activity, being unchanged in July and October, it declines by one third in the test females by November which must be the response reaction of this intestinal enzyme to the new feed type.

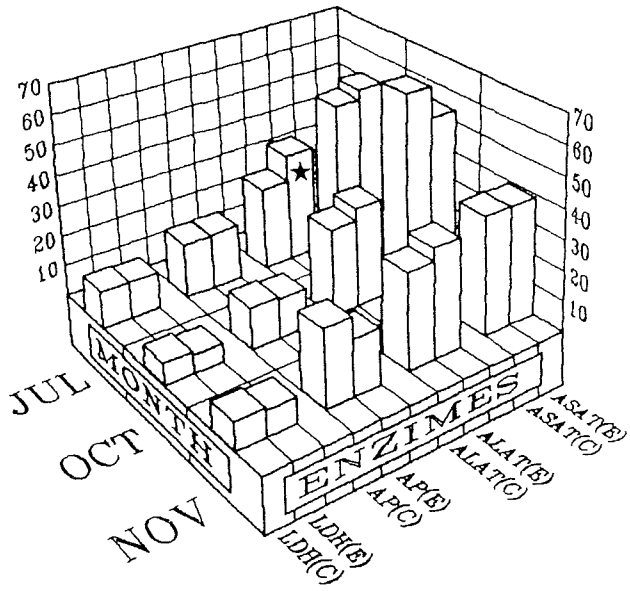


Fig. 1. The influence of activated sludge on blood enzyme activity in female mink (generation P). (C): control; (E): experiment.
*: significant differences between control and experimental groups (Student t-test, $P<0.01$)

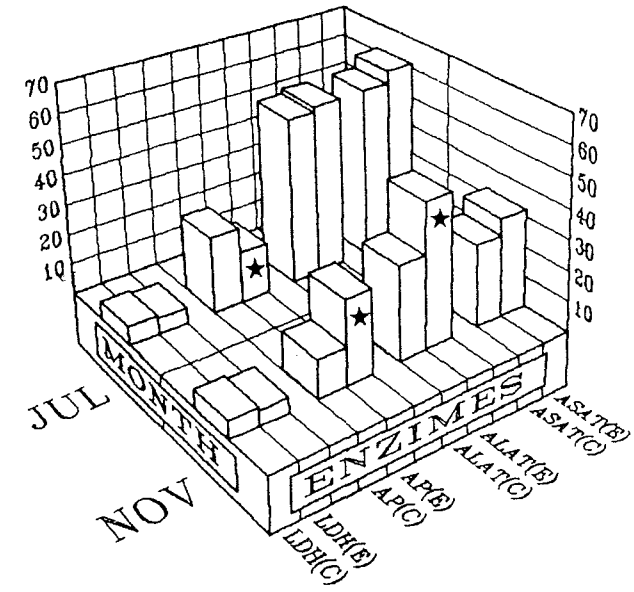


Fig. 2. The influence of activated sludge on blood enzyme activity in female mink (generation F1). Symbols as in fig. 1.

In the mink females of the F_1 generation kept on a diet with AS feedstuff, the disturbance in the enzyme activity is more considerable than in the P-generation; this mainly depends on the general level of enzyme activity in the herd. It is noticed that AS redoubled the low or stimulates the high

enzyme activity level which may be explained by the decline of compensatory processes in the organism under the effect of AS.

While analyzing the enzyme activity in the F_1 generation females, it was revealed that in July the transaminase activity reflected the level in the test females of the P-generation in autumn.

Subsequent AS addition to the females' diets (up to autumn) in duced the activity increase of ALAT by 55% and ASAT by 20% as compared to the control. LDH kept being a little reduced while AP reacted upon the duration of the experiment. While in July AP activity remained the same as in autumn in the P-generation (30% lower the level in the control animals) the subsequent feeding resulted in inversion of activity i.e. it was increased more than twice as much as the control.

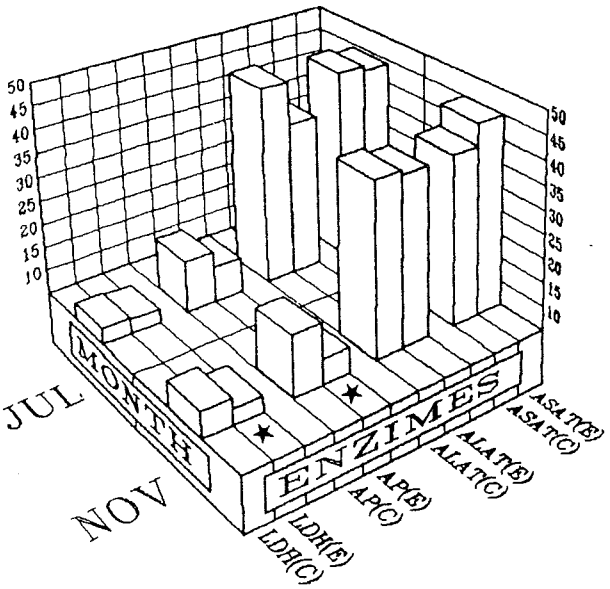


Fig. 3. The influence of activated sludge on blood enzyme activity in female mink (generation F2). Symbols as in fig. 1.

Serum enzyme activity in the females of the F_2 generation (fig. 3) was accompanied by relatively stable transaminase levels but the levels of LDH and AP were reduced by 22% and 42%, relatively, as compared with the activity in the control animals. Obviously, adaption to AS as a protein feedstuff addition is through peak enzyme activity (ASAT, ALAT) in the F_1 generation with subsequent normalization in the F_2 generation. At the same time, LDH and AP in most cases were characterized by the same stereotype reaction on AS that is, activity suppression in the females of the P - F_2 generations.

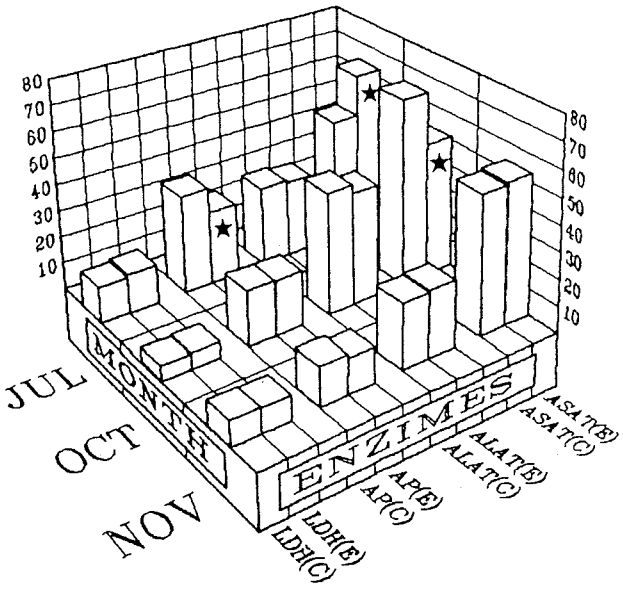


Fig. 4. The influence of activated sludge on blood enzyme activity in mink kits (generation F1). Symbols as in fig. 1.

The analysis of serum enzyme activity in the mink kits of the F_1-F_3 generations (fig. 4-6) indicates a comparative transaminase stability in the whole period of AS feedings. Change of ASAT activity for one third as compared with the control was revealed only in 2-month-old (July) and 5-month-old mink (October) of the F_1 generation, while in succeeding generations the ASAT and ALAT levels were unchanged as compared to the control groups. The stable level of LDH was noted in mink of two generations (F_1-F_2) at the age of 2 and 6 months. As to AP activity it noticably declined in 2-month-old kits of the F_1 generation by 26% and 6-month-old kits of the F_2 generation by 53% as compared with the control. These changes of activity of the blood enzymes cannot be estimated simply. Obvious activity supression of AP in the kits of the F_2-generation is combined with activity inhibition of SOD by 47% and catalase by 28% as compared with the level in the test kits. The low activity of SOD and catalase due to the AS addition may testify to the lack of pathological shifts, decrease of superoxide radicals and peroxydes that indicate the antioxidative effect of the AS. But the mechanism of the decrease of activity of SOD, cata-

lase, AP, LDH may lie in inhibition synthesis of these enzymes in response to the AS introduction, since it is well known that regulation of biosynthesis and catalytic activity of enzymes plays a special role in homeostasis.

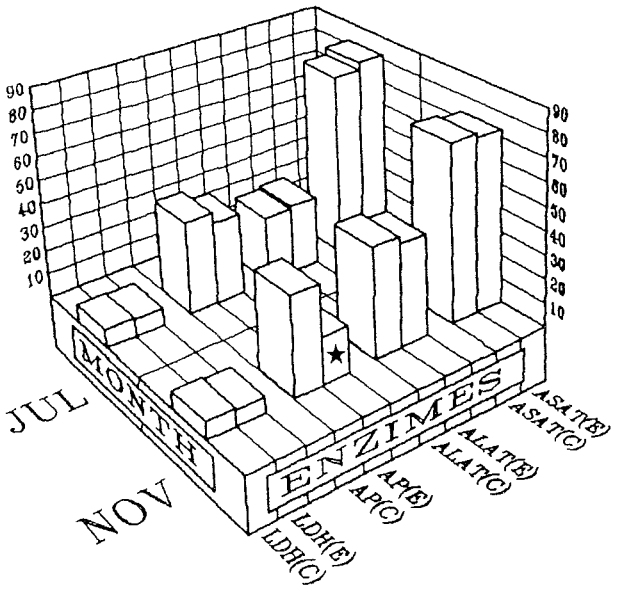


Fig. 5. The influence of activated sludge on blood enzyme activity in mink kits (generation F2). Symbols as in fig. 1.

On the other hand, decrease of the serum enzyme activity may be the result of changing the degree of permeability of cellular membranes under the AS effect, since it has been proved that short term introduction of the AS into the mink diets leads to the compactness of the membrane structures due to intensified synthesis of phospholipids (*Lizenko, Zagorskih, 1992*). There is the third option of the enzyme activity change - namely, presence of enzyme activity modulators in the AS.

It is possible that the kits received overdoses (because of feeding duration) of this feedstuff, since in the F_3-generation (fig. 6) LDH activity decrease by 20% was revealed in 6-month-old kits and the inverse (in relation to F_2) effect of AP reaction - the activity increase by 37% as compared with the level of control animals. Obviously, not only the duration of the AS feeding of the kits in onthogenesis has influence, but also maternal effects as the result of keeping the breeding females on the AS feedstuf diets for two generations there is a "remote" effect of the new feedstuff. In this connection, it is expedient to add the AS as a feedstuff in the mink diets only during one reproduction cycle of the breeding females and during the period of growth and development of their kits (F_1).

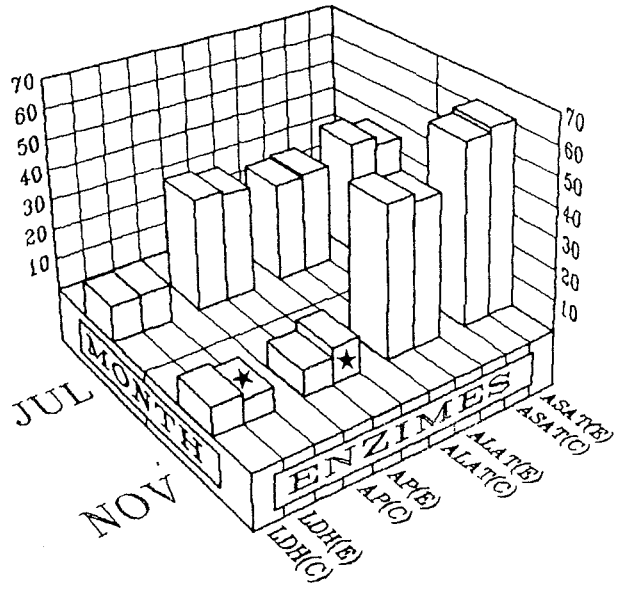


Fig. 6. The influence of activated sludge on blood enzyme activity in mink kits (generation F3). Symbols as in fig. 1.

The analysis of the fur quality of F_1-F_3 kits after slaughter illustrates the statement (fig. 7). One can see that the fur quality of F_1 mink kits became better under the AS effect. The number of especially large A,B skins increased by 15%, there were more skins without defects and quality rate was higher. As to the fur quality of subsequent kit generations, no pronounced AS effect was observed.

So one comes to the conclusion that papermill line activated sludge may be recommended as a feedstuff in mink diets for one generation.

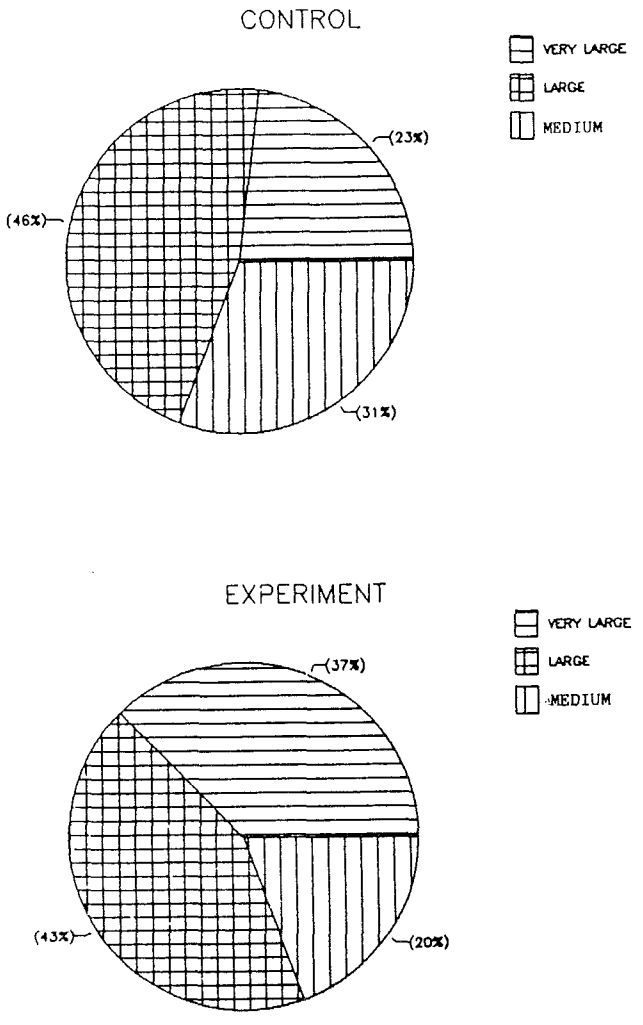


Fig. 7. The effect of activated sludge on the quantitative distribution of the different mink skin sizes (male+female), in per cent.

References

Aebi, H.E. 1984. Catalaze in vitro. Methods enzymol., 105, p. 121-126.

Berestov, V.A. 1981. Laboratornie methodi ot senki sostojaija pushnih zverei. Petrozavodck, "Karelia".

Ilukha, V.A. 1992. Modificatsija methoda opredelenia aktivnosti SOD v reaktsii tormogenija avtookislenija adrenalina. Metabolitseskaja regulatsija fisiologitseskogo sostojanija pushnih zverei, p. 135-139.

Kondrashova, M.N. 1975. Vvedenie. Regulijatsia energetitcheskogo obmena i ustoitchivosti organizma. Pushino, p. 3-21-

Lizenko, E.I., Zagorskih, O. 1992. Lipidni i sostav sivorotki krovi norok pri skarmlivanii belvitamila. Metabolitsheskaja regulatsija fisiologitcheskogo sostojania pusnih zverei. Petrozavodsk, p. 102-107.

Ostroumova, I.N., Timoshina, L.N., Knijazeva, L.M. 1976. Ispolzovanie aktivnogo ila tzellijulozno-bumajnoi promishlennosti v katshestve stimulirujushej dobavki k kormam rib. Nautshn. tr. Gos. NIORH. Leningrad, t. 122, p. 3-70.

Reezinsh, R., Tunureine, A.D., Volkov, A.I. 1980. Belkovo-mineralno-vitaminnaia massa stothnih vod tzellijuloznogo proizvodstva dlja zivotnovodstva. Izvestija AN Latv. SSR, N1, p. 109-111.

Sorvatchev, R. 1982. Osnovi biochimii pitanija rib. Legkaja i pishevaja promislennost, 247 p.

Tyutyunnik, N.N., Kozhevnikova, L.K., Oleinik, V.M. 1990. Vlujanie belvitamila (papermill line activated sludge) na fisiologitcheskoe sostojanie i vosproizvoditelnie sposobnost i temno-koritchnevih norok. Puti povishenija productivnosti selskohozjaistvennih zivotnih na Severo-Zapade RSFSR. Petrozavodsk, p. 93-99.

On the utilization, retention and status of vitamin E in mink (*Mustela vison*) under dietary oxidative stress

Ricarda M. Engberg, Kirsten Jakobsen, C.F. Børsting, Helle Gjern

Sixteen male scanblack mink kits were challenged for a period of 8 weeks with a diet containing high levels of dietary PUFA (25% of dietary fat, peroxide value: 473 mequ 0_2/kg fat) derived from whole minced mackerel. The selenium content of the experimental diet was sufficient (0.33 ppm). After intake of increasing amounts of dl-α-tocopheryl acetate (0, 14.3, 28.6 and 57.2 mg/MJ ME) the apparent digestibility, retention as well as status of vitamin E were determined. The apparent digestibility of α-tocopherol decreased from 77% to 60% with increasing dietary α-tocopherol concentrations from 14.3 to 57.2 mg/MJ ME. In the vitamin E deficient group the dietary treatment resulted in steatosis rather than in myodegeneration, degeneration of the myocardium and sudden death. The results obtained from this study lead to the conclusion that mink are quite resistent to dietary oxidative stress. Vitamin E concentrations of 14.3 mg/MJ ME corresponding to 83 mg dl-α-tocopheryl acetate/kg diet were adequate in order to prevent all signs of steatosis. This fact indicates that the allowances for vitamin E supplementation in mink under practical feeding conditions are sufficient.

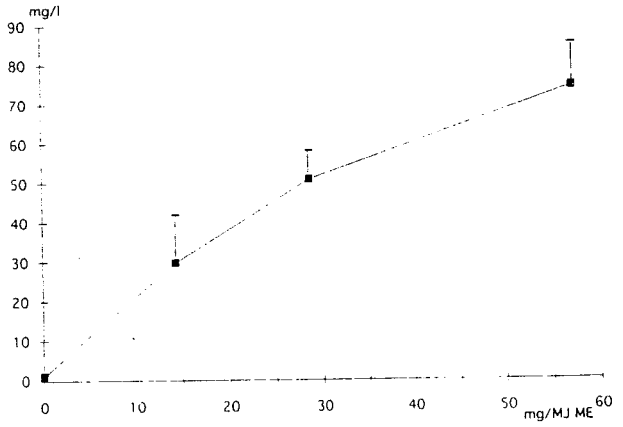


Fig. 2. Concentration of α-tocopherol in plasma in relation to dietary concentration of dl-α-tocopheryl acetate in mink (mean ± SD).

J. Anim. Physiol.a.Anim. Nutr. 69, 66-78, 1993. 6 tables, 2 figs., 32 refs. Authors' summary.

A comparative study on selenium, zinc and magnesium concentrations, glutathione peroxidase and alkaline phosphatase activities in plasma of various animal species

R. Zamorski, J. Koper, K. Borowska

Selenium, zinc and magnesium levels, glutathione peroxidase and alkaline phosphatase activities and their mutual relations were investigated in the plasma of cow, sheep, swine, horse, fox, dog, rat, guinea pig, rabbit and man. Marked species differences in selenium concentrations and GSH-Px activities were found. The mean values for rat were respectively 10 and 26 times higher than those for cow. The orders of both values were similar. The species differences in zinc and magnesium levels did not exceed 50 and 150%, respectively. Highest values were noted for guinea pig, lowest for cow and swine. AP was most active in the pig plasma, and was 12 times less active in the cow, fox, dog and rabbit plasma. The orders of Zn, Mg and AP mean values demonstrated marked differences. Significant correlations were found for the relation Se vs GSH-Px for the 5 species. The relations between the bioelements were not univocal. High values of the coefficient r were noted for guinea pig and rabbit AP vs Zn and Mg levels, including also the relation Zn vs Mg. Species differences in feeding and assimilation of the ingested nutrients, as well as genetic reasons must be significant sources of the magnitude of variation in the investigated parameters between the species.

6th International Trace Element Symposium, Vol. 3, 835-842, 1989. 2 tables, 23 refs. In ENGL. Authors' summary.

Iron, copper, zinc, manganese and selenium in growing mink

Jouko Työppönen, Erik Smeds, Paul Lindberg

Two groups of mink were fed from weaning to pelting with a standard ranch feed or a feed with high amounts of raw anemiogenic fish species. Blood samples and samples from liver and spleen were collected throughout the experiment. The feed and tissue samples were analyzed for Fe, Zn, Cu, Mn and Se. The trace element contents in the basal feeds were adequate except for iron which was below recommendations. During the

early growth period, iron stores in liver and spleen remained constantly low. Zinc levels increased and copper levels decreased in these tissues during the same period. Manganese content increased in the liver but decreased in the spleen. Selenium levels in the analyzed tissues remained unchanged. During the late growth period, iron stores in the liver and spleen increased. The concentrations of the other analyzed trace elements tended to stabilize to their levels. Plasma content of iron, zinc and copper reflected to a varying degree tissue levels of these elements.

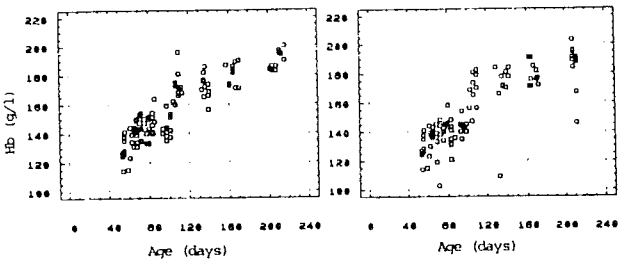


Fig. 2. Hemoglobin development of mink in group I (left) and group II (right)

6th International Trace Element symposium, Vol. 8, 858-864, 1989. 1 table, 11 figs., 16 refs. In ENGL. Authors' summary.

The use of flushing in the nutrition of mink

D. Mertin, K. Süvegova

13 standard mink females were maintained on a diet reduced from 836 kJ per animal daily at the beginning of Feb. to 577 kJ on 19 Feb. and to 334 kJ on 28 Feb., flushed to 1463 kJ daily from 1 to 9 Mar., then given 815 kJ daily until 31 Mar. and 1045 kJ daily thereafter. 13 controls were maintained on 836 kJ daily to the end of Feb., 815 kJ daily in Mar. and 1045 kJ daily thereafter. For the 2 groups, body weight averaged 949 and 1039 g resp. in Jan., 790 and 799 g in Feb. and 770 and 741 g in Mar., the percentage mated was 100 and 100, the percentage whelping was 100 and 60 (P 0.01), and litter size averaged 5.7 and 3.2 (P 0.01).

Pol'nohospodarstvo 37, 9-10, p. 824-829, 1991. In SLOVAK, Su. ENGL, RUSS. CAB-abstract.

Taste appeal trials with concentrated salmon for lactating mink

Bente Lyngs

The purpose of taste appeal trials is to achieve an expression of the effect of ingredients and feed composition on the feed consumption of the animals, primarily as a response to smell and taste.
The experiment lasted four weeks, and two groups of 10 scanbrown females were used. In weeks 1 and 4 all the animals had the opportunity of choosing their feed, in weeks 2 and 3 the two groups were only offered one of two kinds of feed. Feed consumption and weight development of females and kits were recorded.

Concentrated salmon is made of whole salmon, guts from salmon and offal from salmon slaughterhouses. These things are conserved with formic acid, heated, defatted and concentrated.

Taste appeal trials where concentrated salmon was added to the feed at a rate of 5% and given to lactating scanbrown mink females showed that:

- the animals' immediate response (week 1) to the two diets was different in the two groups. Group 1 reacted indifferently whereas group 2 preferred feed without concentrated salmon.

- in weeks 2 and 3 animals given feed containing concentrated salmon consumed more feed.

- after 2 weeks of potential habituation to the two kinds of feed, both groups showed a significant preference for feed without concentrated salmon (week 4).

- weight development of females and kits was not different in the two groups.

It is concluded that concentrated salmon has a negative effect on taste which might in fact be due to a decrease in pH. Added to the feed at a rate of 5% it does not affect the weight development of females nor kits.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 12-19, 6 tables. In DANH. Author's summary.

Taste appeal trials with offal from coalfish or redfish for mink kits in late growth

Bente Lyngs

The experiment was carried out in the month of October and lasted four weeks. Two groups of 10 scanblack male kits and 10 scanblack female kits were used. In weeks 1 and 4 all the animals had the opportunity of choosing their feed, in weeks 2 and 3 the two groups were only offered one of the two kinds of feed. Feed consumption and weight development of females and kits were recorded.

Taste appeal trials where coalfish offal or redfish offal is added at a rate of 15% showed that:

- in both groups the animals' immediate response was in favour of coalfish offal (week 1).

- in weeks 2 and 3 feed consumption was higher in the group given coalfish offal.

- after 2 weeks of potential habituation to the two kinds of feed both groups wanted to change diet. Group 1 preferred redfish offal and group 2 preferred coalfish offal.

- weight development of males and females did not differ in the two groups. More energy consumed in group 2 did not result in heavier kits.

The experiment did not give an unambiguous answer as to the question of taste of the two fish products.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 20-25, 5 tables. In DANH. Author's summary.

Concentrated salmon silage for mink in the summer period

Georg Hillemann

The product examined is salmon silage including whole fish and fileting by-products, which is heated, defatted, and concentrated. Formic acid is used for ensiling. The products is sold under the denomination fish protein concentrate.

In the experiment two products were used. One made on the basis of scrap salmon, guts and offal from salmon slaughterhouses. This is called salmon concentrate I.

The other consisted of dead fish collected from the basin daily and ensiled. This is called salmon concentrate II.

To examine how these products affect the development and fur properties of mink, a trial was carried out in summer 1991 at Research Farm North with the two products in quantities of 7 and 14 % in the feed. The effect on the consistence of faeces was with concentrate II tried also on 20 percent's level. No effect on growth, the appearance and consistance of faeces or molting was seen. Positive effects were seen in fur quality especially with concentrate I, whereas skin size was not affected significantly.

It can therefore be concluded that salmon concentrate of the types and in the quantities used is extremely applicable for mink in the growth period.

Danish Fur Breeders' Association, Technical Year Book 1992, pp 26-38, 11 tables. In DANH. Abstract Gunnar Jørgensen, translated by Hanne Artved.

Combinations of trawl fish and offal from slaughterhouses in the feed for mink during the breeding, pregnancy, and lactation periods

Georg Hillemann, Bente Lyngs

Trawl fish was used with 0%, 10% or 20% of the feed and slaughterhouse offal was used with 0%, 10% or 20% of the feed. Different combinations of these ingredients were offered for scanbrown females from January 10th until June 15th, 1992. Number of barren females, litter size and weight development of females and kits were recorded.

Conclusions of the experiment were:

- trawl fish had no significant effect on the breeding result and no effect on the weights of male

and female kits 28 days p.p, nor on the weights of female kits 42 days p.p. There was a positive effect of trawl fish on the weight of male kits at the age of 42 days. This effect appeared when 10% trawl fish was added to the feed but did not increase further when 20% trawl fish was added.

- slaughterhouse offal had a negative effect on the number of kits per pregnant female. Because of fewer barren females this effect disappeared if breeding result was recorded as number of kits per mated female. Corrected for the effect of litter size on kit weight there was a positive effect of slaughterhouse offal on the weights of male and female kits 28 days and 42 days p.p.

- no interaction of the two ingredients was found with respect to breeding results and weights of kits.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 39-47, 6 tables. In DANH. Authors' abstract.

Preliminary trials with sodium and potassium combined with fibres from peas and rape seed

Georg Hillemann

The effect of sodium and potassium content in the feed on growth and fur quality of mink has not been studied very much.

Therefore, a pilot trial was carried out with two levels of these minerals (Na 2.4-6.4 g, K 4.4-12.9 g/kg DM) combined with 2 and 4 % fibres from peas and rape seed, respectively.

All research diets produced poorer fur quality than "normal" diet, but skin size was not affected. A combination of high K/low Na seemed to have a positive effect on fur colour.

Further trials with larger groups are necessary to demonstrate more precisely the effects of these minerals, maybe in combination with others, on the development and fur quality of the mink.

Danish Fur Breeders' Association, Technical Year Book 1992, pp 48-58, 10 tables. In DANH. Abstract Gunnar Jørgensen, translated by Hanne Artved.

Preliminary trials with sodium and potassium in the breeding period

Georg Hillemann

Experiments were carried out in the breeding period of 1992 with 10 groups of 39 scanblack females given different quantities of Na (0.17-0.31 and 0.41% w/w) and K (0.28-0.55 and 0.75% w/w). Two starting points; week no. 2 and week no. 17 were tried in order to find the best possible time to start supplementation of Na.

The behaviour, appetite, mating willingness and other relevant conditions were normal. Even though the experimental animals were young standard females, the per cent of barren females must be considered high.

It seems that the high levels of Na and K are too high. The best result as regards litter size as well as kit weight was obtained at medium level.

It is worth noticing that the weight loss of the females in the latter part of the lactation period as well as mortality was highest in the groups given feed with a high content of potassium. This is interesting, as in post-mortem examinations of mink females dead of nursing disease, changes resembling potassium deficiency were found (*Henriksen et al.*).

Future investigations must aim at clarifying these conditions further.

Danish Fur Breeders' Association, Technical Year Book, pp. 59-62, 3 tables. In DANH. Abstract Gunnar Jørgensen, translated by Hanne Artved.

Restrictive feeding of mink in the growth period

Georg Hillemann

In the summer of 1991 trials were carried out with restrictive feeding at Research Farm North.

The feed reductions in relation to the control grop were 6 and 12% respectively from 27/8, 6/9, 13/9 and 27/9 until the middle of October, when the appetite of this group decreased. From that time the other groups continued with the rations given at the time.

By restricted feeding at different times in the summer period, it was attempted to illustrate which types of mink can be given reduced amounts of feed and at which time. Changes from previous trials were that the animals got a higher amount of feed in the latter part of the growht period. Standard, pastel and wild mink were fed a normal feed kitchen.

The experiment showed that body weight, especially of males, was influenced negatively, when fed restrictively.

Skin size and skin quality in general were influenced positively in standard, neither positively nor negatively in pastel, and slightly negatively in wild mink. The guard hairs were longer when the animals were fed restrictively.

It was concluded that restrictive feeding, as practised in this experiment, had mainly positive effects.

It must, however, be emphanized that under practical conditions there is a considerable risk of producing too small skins if the development of the animals is not followed closely during the entire growth period.

Danish Fur Breeders' Association, Technical Year Book 1992, pp. 63-76, 11 tables. In DANH. Author's summary, translated by Hanne Artved.

Different energy distributions for mink in the nursing period

Georg Hillemann

In 1992 trials were carried out with various levels of carbohydrates for standard and pastel mink in the nursing period at Research Farm North.

In the winter period, metabolizable energy from carbohydrates was the same for all groups, i.e. 9%. In the nursing period this was changed in the individual groups to vary between 5 and 25%. The differences found in the results must therefore be due to the effects in the nursing period.

No difference was found in the animals' behaviour, mating willingness and other relevant conditions, and there were no significant differences in the actual breeding results.

Kit weight and the weight loss of the females were affected positively in the groups given 10% and 15% of the energy from carbohydrates. The frequency of greasy kits was highest in the groups given feed with the highest amount of fat.

Even though this and other experiments showed that the animals are not sensitive to variations in the energy distribution in the nursing period, it must be concluded that during nursing period most likely the proportion of the energy coming from carbohydrates should amount to between 10 and 15%.

Danish Fur Breeders' Association, Technical Year Book 1992. pp. 77-82, 5 tables. In DANH. Author's summary, translated by Hanne Artved.

Use of different fat sources in the breeding period

Georg Hillemann

To supplement the experiments with trawl fish and slaughterhouse by-products, trials were carried out with different types of fat in the breeding period. The trial will also contribute to clarify the effect of a varied composition of fatty acids in feed.

Each group comprised 70 scanbrown females. As other animals on the farm, they were fed with the purpose of obtaining a moderate body condition. The different fat sources were lard, fishoil and soybeanoil. A mixture of these was used in control feed.
The behaviour and breeding results of the animals were normal. No significant differences were found in breeding result or in the corrected kit weights at the age of 28 and 42 days. On the basis of the total results of the experiment it can be concluded that the three types of fat can be included in the feed of the breeding period in the quantities used in this trial and that the animals do not seem to make special demands to the fatty acid composition in the breeding period.

Danish Fur Breeders' Association, Technical Year Book 1992, pp. 83-86, 2 tables. In DANH. Abstract Gunnar Jørgensen, translated by Hanne Artved.

Different contents of sodium and potassium in the feed for mink in the growth period combined with fibre type and concentration

Anne-Helene Tauson, Georg Hillemann, Niels Enggaard Hansen

The aim was to examine possible effects of varying content of sodium and potassium in the feed for mink kits in the growth period combined with a supplement of pea and rape seed fibres in various quantities. The experiment was carried out at Research Farm North in 1991 in cooperation with the Dept. of Fur Animal Production, The Royal Veterinary and Agricultural University, Copenhagen. This experiment focuses on the influence on weight gain, body and skin length as well as excretion of sodium and potassium in the urine.
The experiment was performed with mink kits (free of plasmacytosis) of the scanblack type, and included 18 groups of 44 animals. For addition of minerals, the following combinations were used: "high sodium/high potassium", "high sodium/low potassium", "low sodium/high potassium" and "low sodium/low potassium". Each of these experimental treatments were combined with 2% and 4% of peas or rape seed fibres. As a control group, further 2 groups of animals were included with "high sodium/high potassium" and "low sodium/low potassium" without supplementation of fibres. The Na-content varied from 2.4 - 6.4 g/kg DM, the K-content from 4.4 - 12.9 g/kg DM.

The results showed that despite varied, and at the high mineral levels, large daily intake of sodium and potassium the weight gain was normal and the animals developed without any effect on their health condition. The results of the urine analyses showed clearly that the high mineral levels resulted in a strain on the renal function, but that the capacity of the kidneys was sufficient to secrete the quantities given. The secretion pattern for sodium and potassium has, however, been depending on the respective contents in the feed. The supplementation of fibres used did not result in the marked effect on fluid and mineral secretion through the kidneys seen for other types of fibre.

The Danish Fur Breeders, Association, Technical Year Book 1992, pp. 87-92, 5 tables, 9 references. In DANH. Abstract Gunnar Jørgensen, translated by Hanne Artved.

Different feeding levels in the implantation period. Effects on whelping result and on the course of the nursing period

R. Sandø Lund

Comprehensive experiments regarding feeding regimes have earlier been carried out on Research Farm West in 1990. The present paper reports result from further trials on Research Farm West and on a private farm during the breeding period in 1992.

On the basis of all 3 experiments the following conclusion are drawn:

Flushing

When flushing of mink is used in order to obtain a better whelping result a close control of the condition of the animals is necessary.

Through all the experiments concerning flushing and female condition during breeding season a far greater risk for "greasy kits" has been obtained with females in very low condition.

Nevertheless, a certain, controlled flushing is considered reasonable, but it should be based on the following guidelines:

1. The minimum average weight of females should not be below 900 g.

2. Flushing should not start before March 1.

Recommended feed practice after mating until delivery

After the matings are over, and the males and unmated females have been pelted, the animals are given a feed ration corresponding to 180-200 kcal/animal/day. From this time, the animals are fed steadily until delivery. Care should be taken that the females do not get too fat for delivery, as fat females lose more kits.

Danish Fur Breeders' Association, Technical Year Book 1992, pp. 93-98, 5 tables. In DANH. Author's summary, translated by Hanne Artved.

Perspectives in finding an amino acid profile for optimization of growth and fur development

Carsten Riis Olesen, Rudolf Sandø Lund, Christian Friis Børsting

This paper describes methods and perspectives of experiments carried out in 1991 and 1992 regarding amino acid requirements of the mink, whereas results will be reported later. The aims and perspectives for the optimization of amino acid composition are:

1) To minimize the cost of production.
2) To minimize the protein level in the feed.
3) To optimize production results.
4) To develop a better method to evaluate the value of new feedstuffs and feedstuffs treated by new methods.
5) To minimize N-excretion from mink production to the environment.
6) To examine if mink have a higher requirement for amino acids than other farm animals. To determine the influence of the ratio between essential and non-essential amino acids.
7) To examine if there is a higher risk of fat infiltration in livers of mink fed at low protein levels.
8) To examine which amino acids are the most important precursors for gluconeogenesis in the mink.
9) To examine which objectively measured morphological skin parameters best explain good skin quality obtained through optimal amino acid supply.

Two experimental series are run where up to half of each of the essential amino acids are given in synthetic form with a possibility of removing the amino acids individually, while the requirements for the other amino acids are met.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 99-105, 5 tables. In DANH. Authors' summary.

Extra fat to nursing females from different dates in May

R. Sandø Lund

Six groups of females were fed additional fat starting the first group on May 1. and the remaining groups at an interval of one week from the previous one. The control group was fed without additional fat all the way until weaning.

Energy distribution (P:F:C) was until the 1st of May 59:29:12. With additional fat it was changed to 50:38:12 in the experimental groups on 7/5, 14/5, 21/5, 28/5 and 4/6, respectively.

No significant results were found on the basis of the experimental design, but the results seem to indicate that with the feedstuffs used (25% trawl fish), 59% of the energy from protein is too much. The level ought to be in the area from 50 to 54%. No doubt most appropriate is to maintain the feed plan during the entire nursing period. Changes, intentional or unintentional, in the period 25/5-6/6 are inappropriate.

Danish Fur Breeders' Association, Technical Year Book 1992, pp. 106-108, 1 table. In DANH. Abstract Gunnar Jørgensen, translated by Hanne Artved.

The effect of nutritional composition of feed in lactation period on the final skin size and quality of mink kits

R. Sandø Lund

Until the 15th of April the distribution of energy from protein, fat and carbohydrates (P:F:C) was 60:28:12. For the period from 15th of April until 15th of June following compositions were tried: 60:38:2; 60:35:5; 60:30:10; 60:25:15; 50:47:3; 40:55:5; 40:50:10; and 40:45:15.

After weaning all kits from this experiment were fed the same feed composition until pelting.

No differences in skin results were found which could be traced back to feeding in the nursing period as regards quality or size.

This means that a protein level of 40% of ME in the nursing period is sufficient to secure the basic requirements of the animals.

No difference was found in results between kits from greasy litters and kits from healthy litters.

It should here be emphasized that the type of greasy kits we had in this group of pastels was of a late type, i.e. outbreak when the kits were between 3 and 4 weeks old. This shows that if anything negative happens to the kits in the latter part of the nursing period, this does not affect their future growth (the animals can compensate).

It is much more serious if the kits put on too little weight from birth and in the first 3 weeks of their life. The kits cannot compensate for the poorer growth of this period.

Danish Fur Breeders' Association, Technical Year Book 1992, pp. 109-112, 4 tables. In DANH. Abstract Gunnar Jørgensen, translated by Hanne Artved.

Investigations of the importance of type and quantity of fat in the nursing period to the occurrence of greasy kits.

Tove Clausen

The importance of large amounts of soybean oil, olive oil, lard, rapeseed oil, and red sand eel oil to the occurrence of greasy kits and the importance to kit weight at weaning was investigated.

Only a few litters with greasy kits were found in 1992, but the tendency was the same as the year before, namely that females which were thin in February, had large litters, and had been given a large proportion of the energy from fat in the nursing period ran the highest risk of having greasy kits.

The group given large quantities of olive oil had the most greasy kits.

A high protein content in the feed in the latter part of the nursing period is bad for kit weight at weaning, as kits which start eating by themselves need a lot of energy (as opposed to females to be weaned). The best types of fat to use in the nursing period are soybean oil and lard, whereas red sand eel oil should not be used.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 113-117, 3 tables. In DANH. Author's summary.

Examination of the correlation between dry matter percent in the feed and the course of the nursing period

Tove Clausen

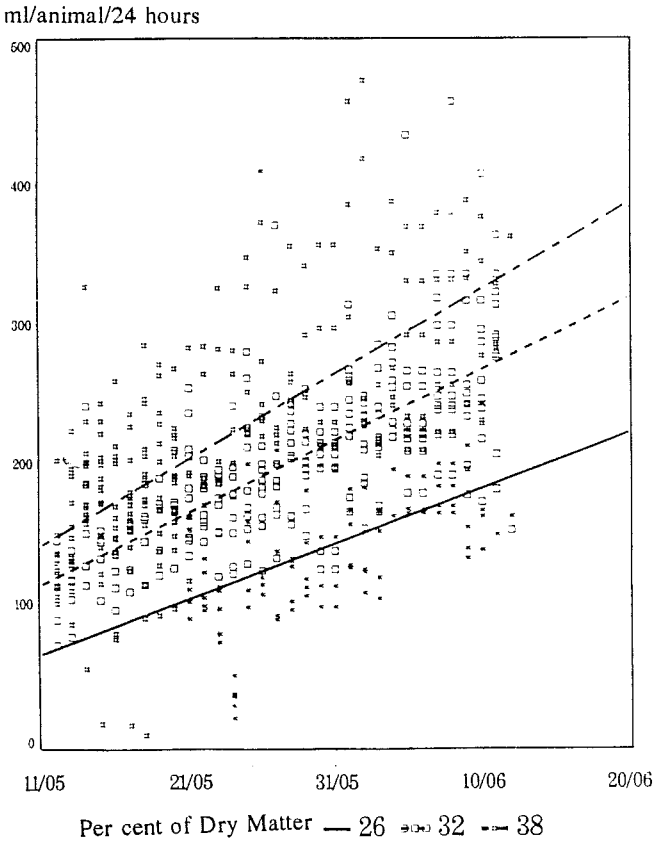


Fig. 1. Water intake in ml/animal/24 hours

The feed used in the nursing period had an energy distribution of 56:30:13 and 142 kcal. Until day 28 the dry matter content of the feed was 32-38%.

When the kits were 28 days old, the dry matter percent of the feed was changed to either 26, 32 or 38 percent, and the water intake of the females from the drinking nipple was measured from day 28 until weaning.

The milk yield of the females until day 28 measured as kit weight gain in the same period was not influenced by the feed being dry. The female simply drank more water. For the kits, it is of great importance that the feed has as high a water content as possible. The more water in the feed, the higher kit weight at weaning.

As regards female weight at weaning, this investigation did not show any effect of an increase in water content.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 118-123, 2 tables, 1 fig. In DANH. Author's summary.

Importance of the fat and protein content of the feed to fat infiltration in the liver.

Tove Clausen, Birthe M. Damgaard, Per Henriksen

From mink kits fed a low proportion of the metabolizable energy (ME) from protein (20:63:17) or a high proportion of ME from protein (45:43:12), blood samples as well as liver samples were taken several times in the growth period and at pelting.

The blood samples were examined for e.g. bile acids, ALAT, and urea. The livers were weighed and examined for fat infiltration histologically and by determination of specific gravity.

The blood content of ALAT was highest in the group given a low amount of protein and, furthermore, a significantly increased fat infiltration was found in the liver of animals given a low proportion of the energy from protein.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 124-127, 2 tables, 1 fig. In DANH. Authors' summary.

Examinations of the effect of feeding and fasting on glucose storage in the liver (glycogen) and on the regulation of blood glucose in mink females.

Tove Clausen, Carsten Riis Olesen, Otto Hansen, Søren Wamberg

Examinations have shown that the glycogen store in mink liver is quickly exhausted when fasting. The content of glucose in the liver decreases more slowly as a sign of continued gluconeogenesis or glycogen → glucose. At the same time, the content of fat increases as a result of a supply of fat from the body fat deposits. In connection with feeding the changes are seen in the parameters measured in plasma. This goes especially for urea, but also for the metabolic hormones insulin, glucagon, and aldosterone. Finally, distinct disturbances in the glucose metabolism are seen when adding large amounts of sugar to the feed, with the risk of developing a so-called glucose intolerance.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 128-134, 4 tables, 8 refs. In DANH. Authors' summary.

Weight development and water intake of fasting females.

Tove Clausen

Mink females were deprived of feed for 48 hours. In that period and in the 3 following days the kits were weighed once a day and their water intake was measured.

The females lost 70 g in the first 24 hours and 60 g in the next 24 hours. After being fed again, they regained most of the lost weight in the course of 3 days and nights. In the period when the females did not eat, they drank considerably less water than when eating.

Danish Fur Breeders' Association. Technical Year Book 1992, pp. 135-137, 1 fig. In DANH. Author's summary.

TAKE THE GAMBLE OUT OF MINK VACCINES!

DISTOX®-PLUS

. . . contains *Pseudomonas aeruginosa* Serotypes 5, 6, 7-8 & 9 which are commonly involved in outbreaks of hemorrhagic pneumonia.

In addition, Distox-Plus provides kits with solid protection against botulism, distemper and all known strains of **mink virus enteritis**. . . the other leading kit killers. So why roll the dice when it's just as easy to vaccinate with the proven winner. . . Distox-Plus. Taking the gamble out of pseudomonas protection is one less thing to worry about.

Schering-Plough Animal Health

SPASL-DIS-9R2

In Mink Vaccines, Schering-Plough Is the Leader in Innovation.

State-of-the-art health protection for mink breeding stock and kits is firmly rooted in the quality, research and technical service for which Schering-Plough Animal Health is famous worldwide.

Behind each vial stand generations of experience in developing innovative approaches to the control of mink diseases, and research that assures quality and efficacy. Today, Schering-Plough proudly carries on the traditions and record of achievement in mink immunology.

But most important—Schering-Plough is the leader in professional technical service to mink ranchers . . . supporting our products and the people who use them with solid answers and practical solutions whenever questions arise. For additional information, contact the nearest International Representative listed below.

EUROPE

Essex Tierarznel
Thomas-Dehler-Str. 27
D-8000 Munchen 83
Germany
Phone: (49) (89) 627-310
Fax: (49) (89) 627-31499

Schering-Plough S.A.
Apartado Postal No. 36220
Madrid 28080
Spain
Phone: (34) (1) 841-8250
Fax: (34) (1) 843-5344

CANADA

Schering-Canada Inc.
3535 Trans Canada Highway
Pointe Claire, Quebec H9R 1B4
Canada
Phone: (514) 426-7300
Fax: (514) 695-7641

U.S.A.

Schering-Plough Animal Health
P.O. Box 529
Kenilworth, N.J. 07033 U.S.A.
Phone: (908) 709-2800
Fax: (908) 709-2807

Schering-Plough Animal Health

© Copyright 1992, Schering-Plough Animal Health, Kenilworth, NJ 07033. All rights reserved.

Nursing disease in mink: ranch-level epidemiology

Richard R. Schneider, D. Bruce Hunter, David Waltner-Toews

A cross-sectional study on the epidemiology of nursing disease in mink was undertaken in 1990 on 64 ranches in southern Ontario, Canada. All lactating females dying on these ranches between parturition and 1 July were selected for study, and the cause of death was determined by gross necropsy. An on-site questionnaire, including questions on ranch design, management and production, was completed for each ranch.

On four ranches, data were also collected on the location of nursing disease morbidities within the ranch. The purpose of the study was to provide a basic epidemiological description of the disease at the ranch level, and to test the associations between a variety of ranch-level factors and the incidence of nursing disease.

The 64 ranches in the study represented 65% of all mink ranches in Ontario with more than 100 breeding females, and 84% of all females on an individual basis. Nursing disease was the most frequent cause of death (57% of all submissions). The incidence of nursing disease ranged from zero (five ranches) to 11.6% (median, 1.2%). Losses were almost twice as high on the west sides of barns as on the east, but there was no clustering of nursing disease morbidities within cage rows. The majority of the variation among ranches was not accounted for by the ranch level variables examined, but associations between the incidence of nursing disease and the type of water source, size of the ranch and source of feed were present.

Preventive Veterinary Medicine, 14, 181-194, 1992. 6 tables, 4 figs., 12 refs. Authors' abstract.

Nursing disease in mink: individual-level epidemiology

Richard R. Schneider, D. Bruce Hunter, David Waltner-Toews

A cross-sectional study on the epidemiology and pathology of nursing disease in mink was undertaken in 1990 on 64 ranches in southern Ontario, Canada. A subset of 14 of these ranches also was involved in a prospective case-control study, exploring the effects of several individual-level factors on the probability of nursing disease occurrence.

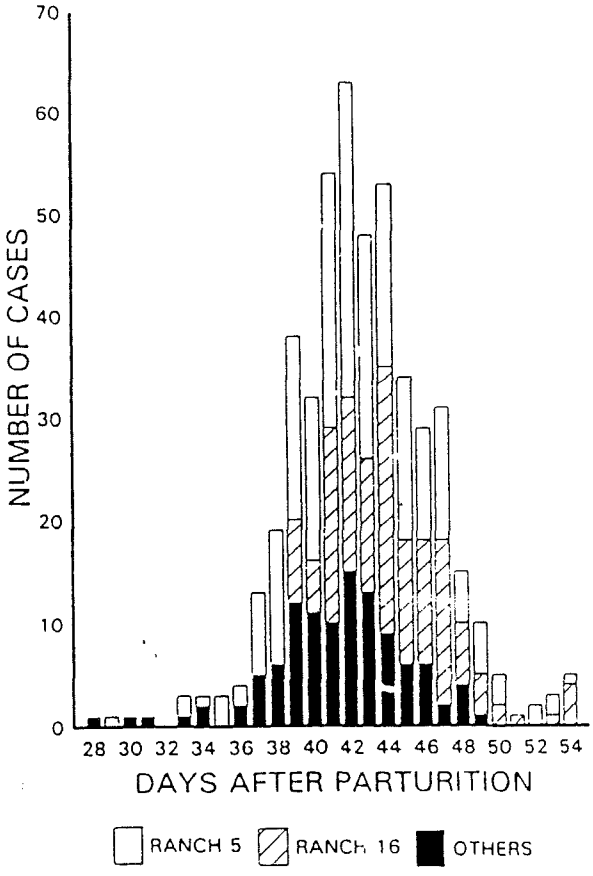


Fig. 2. Number of nursing disease morbidities relative to the number of days after parturition. Data from six ranches, highlighting the two ranches with the highest incidence (n=473).

The outcome of interest was generally mortality due to nursing disease, as determined by gross post-mortem examination; on six ranches, however, morbidity data also were collected. The factors examined were: dam age, color phase, date of parturition, number of kits raised, and date of death.

The risk of nursing disease increased with increasing litter size, though the effect tapered off somewhat in females with litters of more than seven kits. Color phase was highly significant on many individual ranches; however, the color with the greatest incidence was different from one ranch to the next. The mean time between parturition and onset of disease was 42 days

(SD=3.9). This was remarkably consistent among ranches, even though their median calendar dates of parturition and disease onset varied. Age and date of parturition were not associated with nursing disease.

Preventive Veterinary Medicine, 14, 167-179, 1992. 4 tables, 4 figs., 10 refs. Authors' abstract.

A survey of the causes of mortality in adult mink, with emphasis on the lactation period

Richard R. Schneider, D. Bruce Hunter

A study of the pattern and relative frequency of diseases in adult female mink during the lactation period was undertaken. All adult females that died between parturition (April/May) and July 1, 1990, from 48 farms in southern Ontario were selected for study, and the cause of death was determined by gross necropsy. In addition, the cause of death was determined by gross necropsy for all adults and weaned kits that died on one farm between April 1988 and March 1989.

The mortality rate among farms in the 1990 study, for adult females during the lactation period, ranged from 0.2% to 10.1%, with a median of 1.9%. Nursing disease (56%) was the most common diagnosis, followed by mastitis (11%), metritis (8%), and dystocia (7%). *Escherichia coli* and *Staphylococcus* spp. were the most frequent isolates from the cases of mastitis. In the 1988/1989 study, the mortality rate was highest from May to July, with a large increase in June as a result of nursing disease.

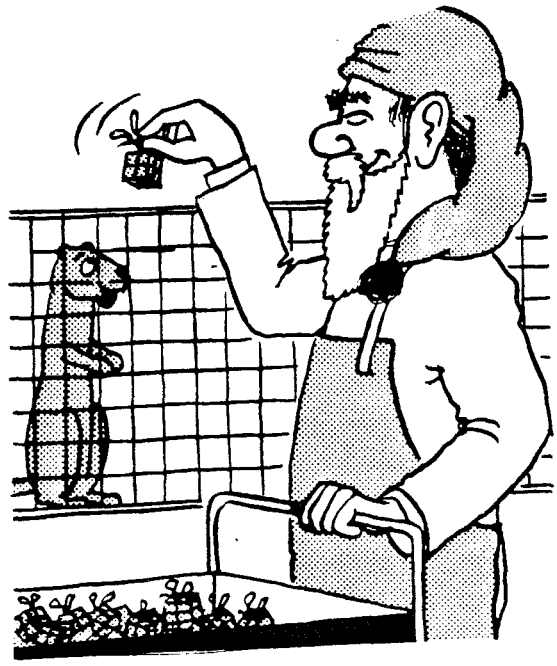
Can Vet J Volume 34, 103-108, 1993. 5 tables, 4 figs., 19 refs. Authors' abstract.

Mortality in mink kits from birth to weaning

Richard R. Schneider, D. Bruce Hunter

In 1988, a necropsy survey of the pattern and major causes of mortality in mink kits from birth to weaning was undertaken. The overall preweaning mortality rate was 20%. Mortalities occurring within the first three days after birth accounted for 91% of submissions, and 78% of the kits in this age group had no lesions or bacterial isolates. The average weight of kits which died within one day of birth (7.9 g) was significantly lower than the average birthweight of healthy kits (10.7 g). In kits under four days of age and with lesions, the most common diagnoses were dystocia (12%), systemic infection (4%), anasarc (2%), and congenital defects (1%). In unweaned kits four days of age or older, the most common diagnoses were systemic infection (19%), external trauma (6%), dystocia (5%), and cervical adenitis (2%).

Can Vet J Volume 34, 159-163, 1993. 3 tables, 4 figs., 26 refs. Authors' abstract.



List of addresses

Amstislavsky, S.Ya. The Institute of Cytology and Genetics, The Institute of Biology, Russian Academy of Sciences, Siberian branch, Novisibirsk

Clausen, T. The Research and Advisory Unit of the Danish Fur Breeders Association, Herningvej 112, Tvis, DK-7500 Holstebro, Denmark

Engberg, R.M. National Institute of Animal Science, Research Centre Foulum, Dept. of Animal Physiology and Chemistry, P.O.Box 39, DK-8830 Tjele, Denmark

Hillemann, G. Research Farm North, Hundelevvej 75, Nr. Rubjerg, DK-9480 Løkken, Denmark

Jalkanen, L. Veterinary Research Station, University of Kuopio, P.O. Box 1627, SF-70211 Kuopio, Finland

Korhonen, H. Agricultural Research Centre of Finland, Fur Farming Research Station, SF-69100 Kannus, Finland

Kozhevnikova, L.K. Institute of Biology, Karelian Research Centre, Russian Academy of Sciences, Petrozavodsk, Pushkinskaya 11, Russia

Lagerkvist, G. Swedish University of Agricultural Sciences, Department of Animal Breeding and Genetics, Box 7023, S-750 07 Uppsala, Sweden

Lund, R.S. The Research and Advisory Unit of the Danish Fur Breeders Association, Herningvej 112, Tvis, DK-7500 Holstebro, Denmark

Lyngs, B. Research Farm North, Hundelevvej 75, Nr. Rubjerg, DK-9480 Løkken, Denmark

Meia, J-S. Institut de Zoologie, Université de Neuchatel, Chantemerle 22, CH-2007 Neuchatel, Switzterland

Mertin, D. Research Institute of Animal Production (NIAP), Department of Fur Animal Breeding, Hlohovská 2, 949 92 Nitra, Slovakia

Møller, S. National Institute of Animal Science, Research Centre Foulum, Dept. of Research in Fur Animals, P.O.Box 39, DK-8830 Tjele, Denmark

Nielsen, U.L. The Research and Advisory Unit of the Danish Fur Breeders Association, Tvis, Herningvej 112, DK-7500 Holstebro, Denmark

Nordrum, N.M. Valberg. Agricultural University of Norway. Department of Animal Science, P.O.Box 5025, N-1432 Ås, Norway

Oleinik, V.M. Institute of Biology, Karelian Research Centre of the Russian Academy of Sciences, 185610, Petrozavodsk, Puschkinskaya 11, Russia

Olesen, C.R. The Research and Advisory Unit of the Danish Fur Breeders Association, Herningvej 112, Tvis, DK-7500 Holstebro, Denmark

Oravcova, E. Research Institute of Animal Production, Dept. Fur Animal Rearing, Hlohovská 2, 949 92 Nitra, Slovakia

Schneider, R.R. Department of Pathology, Ontario Veterinary College, Guelph, Ontario, N1G-2W1, Canada

Süvegova, K. Research Institute of Animal Production, Dept. Fur Animal Rearing, Hlohovská 2, 949 92 Nitra, Slovakia

Tauson, A-H. Fur Animal Production, Department of Animal Science and Animal Health, Royal Vet. and Agric. University, 13 Bülowsvej, DK-1870 Frederiksberg C., Denmark.

Tiba, T. Department of Theriogenology, Faculty of Agriculture, Gifu University, 1-1 Yanagido, 501-11 Gifu, Japan

Työppönen, J. College of Veterinary Medicine, Department of Biochemistry, P.O. Box 6, SF-00581 Helsinki, Finland

Zamorski, R. University of Technology and Agriculture, 85-029 Budgoszcz, Poland

You're never very far from the scientific literature

...with SCIENTIFUR Electronic Index

Ordinary price, NOK 550,-
IFASA members, NOK 350,-

Prepayment, postage included