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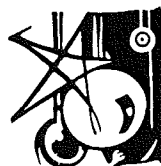
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Prof.dr.hab. STANISLAW J. JAROSZ
HONORARY MEMBER OF IFASA



It was not just by coincidence that "STANISLAW" at his termination of a fruitful period as member of IFASA's Board of Directors was elected honorary member of IFASA at the IFASA council meeting on August 20, 1996 in connection with the VIth International Scientific Congress in Fur Animal Production, Warsaw, Poland.

Stanislaw's personality, his high scientific level and enthusiasm as well as his political flair and activity regarding international contacts have all been ingredients in the cocktail creating the catalyst who has more or less melted the iron curtain as regards cooperation in fur animal science about 20 years before it was a political reality

Not only because of our respect for Professor Stanislaw J. Jarosz as a scientist, teacher and colleague, many of us welcome this opportunity to pay tribute to him, but many of us would also like to thank Professor Jarosz and his family for all the cooperation and friendship between us and our families over the past years. We shall never forget the hospitality we have met at your institute and in your home over the years.

This friendship and this cooperation - dear friend - will continue, and we shall meet again at the international fur animal scientific arena - also in the years to come.

As Honorary member, you will be associated with the history of IFASA as THE EAST EUROPEAN CATALYST IN THE FUR ANIMAL SCIENTIFIC WORLD.

THE EDITOR

**Vth INTERNATIONAL
SCIENTIFIC CONGRESS
IN FUR ANIMAL
PRODUCTION**

NOW GLORIOUS HISTORY

**NOTES
SCIENTIFUR
Vol. 20, No. 4, 1996**



We did it again. The Vth International Scientific Congress in Fur Animal Production, organized by IFASA and going on in Warsaw, Poland, August 21-23, now stands as a very important milestone in the history of fur animal research and IFASA.

With almost 200 participants representing 20 fur producing countries and 115 scientific reports and posters presented as well as the social programmes, the professional set up and the rich representation from the East European countries made all participants feel that with this congress the fur animal world was made larger and richer.

The persons behind the arrangement of the congress did their job well and we wish to thank The Polish Society of Animal Production and its president, Dr. Józef Luchowiec, for being the national umbrella over the congress and the arrangement committee with its president, Prof. Grazyna Jezewska, and its secretary, Dr. Marian Brzozowski. Also to Dr. Andrzej Frindt as chairman of the scientific committee and Dr. Jerzy Slawon from the Fur Breeders Association of Poland we wish to extend our sincere thanks for a job well done.

In this issue of SCIENTIFUR we bring the abstracts from the 115 reports presented at the congress. The reports are in full length printed in the proceedings from the congress as APPLIED SCIENCE REPORTS NO. 27, 28 AND 29 in the Journal of Animal Production Re-view published by the Polish Society of Animal Production. In connection with the abstracts, the full address and price of the proceedings are given.

The variety of themes discussed and the scientific quality of the majority of the reports further confirm the importance of fur animal research and international

cooperation in our field. Thus the importance of IFASA and SCIENTIFUR is also underlined.

On the following pages - under the heading NEWS FROM IFASA - you will find a report from the council meeting held in connection with the congress and the corrections made of the constitution of IFASA during the council meeting.

According to these corrections, the highest authority of IFASA will be the membership meeting (general meeting) held every 4 years in connection with the International Scientific Congresses, of which the membership meetings will be an obligatory part of the programme.

The first meeting under the new constitution will be in Kastoria, Greece, in the year of 2000. See you there as an active participant of the IFASA General Meeting.

During the year of 1996 IFASA and SCIENTIFUR have made further progress regarding number of members as well as subscribers. We hope that this progress will continue in 1997.

We who are involved will do our best, and if this is not enough we hope for your understanding. Here I am thinking of JYTTE who has for several years taken care of all administrative matters, but who now wants to end this important work at the end of 1996. We wish to express our sincere thanks for the comprehensive work done by Jytte.

We are sorry to say that we have not yet found a full replacement for her, so we hope for your understanding should there be some disturbances in the administrative procedures - which of course we hope will not be the case.

Here at the end of 1996 and Vol. 20 of SCIENTIFUR we also wish to thank the Norwegian Fur Breeders Association for housing us and for giving us access to the necessary facilities, the Danish Fur Breeders Association for printing and binding SCIENTIFUR at a relatively low price, and the Danish Institute of Animal Science, Research Centre Foulum, Denmark, for showing their good will in making available the necessary facilities for the editor to finish each and every issue of SCIENTIFUR.

The personal staff around the editor, i.e. Jytte (already mentioned above), Dorte and Hanne as well as our language adviser Janne Hansen, have also in 1996 with their help obtained an even bigger place in my heart, and please accept my sincere thanks for all your help.

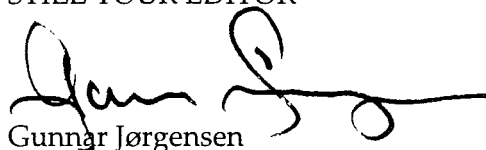
I also thank CEFBA for their considerable economic support. It is important for me to thank the individual organizations and persons who have made my job as an editor free of problems and a great pleasure.

Also my sincere thanks to contributors and subscribers for our cooperation in 1996.

WE WISH YOU ALL A MERRY CHRISTMAS AND A HAPPY AND PROSPEROUS NEW YEAR.

BEST REGARDS,

STILL YOUR EDITOR



Gunnar Jørgensen



Member fee & Subscription price 1997

Member fee and subscription price will be the same in 1997 as in previous years.

NOK 170,- for individual members and

NOK 1700,- for institutional members

Subscription NOK 500,- for members and NOK 600,- for others



REPORT FROM THE COUNCIL MEETING OF IFASA
Warsaw, Poland, 20 August 1996

Participant: B. Murphy, S. Jarosz, O.A. Eldøy, M. Bakken, C. Børsting, P. Ikonomidis, K. Kondo, B. Barabasz, A. Frindt, M. Brzozowski, G. Jezewska, J. Slawon, M. Valtonen, T. Juokslahti, T. Mejerland, LG.C. Ellis, M.K. Jackson, N.E. Hansen, W. Verhagen, G. Jørgensen, E.J. Einarsson

1. Approval of the agenda.

The agenda was approved.

2. Report regarding present status of IFASA and Scientifur.

The annual report from the auditor was presented, showing total receipts NOK 341,137 and total expenditure NOK 309,365. The main receipts came from membership fee (40,800), subscription Scientifur (79,550) and support from CEFBA (215,005). Total net capital is NOK 230,493.

3. Discussion of the Constitution.

The board suggested some changes in the constitutions, first of all that the Council is replaced by a meeting of the membership. It was moved by LG.C. Ellis that the change in the Constitution as recommended by E.J. Einarsson was accepted and effected. The new Constitutions will be published in Scientifur.

4. Election.

No nominations were received prior to the meeting. The following persons were all elected by acclamation:

Einar J. Einarsson, President
Bruce D. Murphy, Vice president
Wim Verhagen, Board member
Maija Valtonen, Board member
Marian Brzozowski, Board member

Personal alternate

Anders Skrede
William Wehrenberg
Henning Jensen
Niels Enggaard Hansen
Pascalis Ikonomidis

Gunnar Jørgensen, the editor of Scientifur, will act as secretary of IFASA.

5. Place of the VII Int. Congress.

An invitation was received from Kastoria in Greece. The Council accepted the nomination for Kastoria, hosting the VII IFASA Congress in 2000.

6. The working groups and further activities of IFASA.

It was decided that the resources could not result in activities for the working groups, however, that a pilot project for information exchange should be developed (B.M.).

7. Miscellaneous.

Stanislaw Jarosz was elected Honorary member by the Council.



International Fur Animal Scientific Association

Constitution (August 1996)

Article I - Name

The name of this organization is the International Fur Animal Scientific Association, referred to as the IFASA.

Article II - Objectives

1. To promote the advancement of knowledge of all aspects of fur animal science and the fur industry.
2. To act as a formal link between scientists, the Fur Breeders Associations and governmental agencies on an international level.
3. To be responsible for the arrangements of international fur animal congresses and other international meetings within the field of fur animal science.
4. To cooperate with other international organizations in achieving these aims.

Article III - Membership

1. Application for membership shall be made to the secretary to be approved by the Board.
2. Type of membership.
 - A. Individual membership may be held by any person who is interested in the objectives of the Association.
 - B. Organizations, companies or institutions can be associated members.
 - C. Honorary members, elected by the Membership.
3. The Membership may appoint as Honorary Life Members such members as it consider to have made a noteworthy contribution to the work of the Association or to fur animal science.

4. The annual fee is to be paid before February 1st of each year to the secretary of IFASA. If the fee is not paid before July 1st the same year, the member's name shall be removed from the list of memberships.

5. A member may forfeit his membership for failure to act in accordance with the objectives of the Association set out in Article II.

Article IV - Meetings of the Membership and Board Members

1. Membership

The meeting of the Membership will be held in conjunction with the IFASA Congress.

The agenda of the meeting will be published in Scientifur.

2. Board

The Association shall be managed by the members of the Board, according to the guidelines set forth in this Constitution and the policies established by the Membership. The Board shall consist of a President, a Vice President, three members and the Past President. The members of the Board are elected for a period of four years. Election of the Board will take place at the Membership meeting held at the IFASA international congresses.

The Board shall be responsible for the approval of the projected annual programs and budgets of IFASA. Each Board member has a personal alternate. If the President is unable to attend the Board meeting, the Vice President will replace him. In absence of both the President and the Vice President, the members of the Board will elect an interim chairman. The quorum for the Board will be four.

3. Nominations and voting

Nominations for Board members may be made by any individual member. The nominations should reach the secretary not later than thirty days before the election. Voting for Board members will be by secret ballot. The simple majority is sufficient for election to the Board. Each Board member is elected individually, beginning with the President.

The past President remains a regular member of the Board for the subsequent term.

Article V - Working Groups

The working groups must be approved by the Board of IFASA. The working groups may have their own board, but their by-laws and activities must be in accordance with the IFASA constitution. All members of a working group must be members of IFASA.

Article VI - Publications

1. The official organ of IFASA is *Scientifur*.
2. The official language of IFASA is English.

Article VII - Meetings

1. The Membership of IFASA shall meet at least once every fourth year, and at the same time as the International Congress.
2. The Board of IFASA shall meet at least once a year.
3. Upon a request signed by at least ten members of IFASA representing at least four countries, the Board will be required to communicate with all members and seek their votes on any matter which has been raised.

4. Between annual board meetings the President together with the Vice President will have the authority to make decisions on behalf of the Board. Financial commitments will require a written approval by the quorum of the Board.

Article VIII - Honorary Members

An individual member can be elected as an honorary member by the Council.

Article IX - IFASA's Congresses

1. World congresses shall be held every fourth year.
2. The venue of the next Congress shall be decided at the meeting of the Membership.
3. Countries that wish to host the Congress, should send an invitation to the Board at least sixty days before the Membership meeting.

Article X

An annual report shall be published in *Scientifur*.

Article XI - Disposal of Assets

If it is decided by two thirds of the members that the Association should be dissolved, the Membership will decide on the disposal of the assets.

The above articles were approved unanimously by the Council in Oslo, August 13th, 1992 and revised by the Council in Warsaw, Poland, August 20th, 1996.



Original Report

Effects of domestication on the adrenal cortisol production in silver foxes during embryonic development

L.V. Osadschuk

*Institute of Cytology and Genetics, Siberian Branch of the Russian Academy
of Sciences, Novosibirsk 630090, Russia*

Summary

The present study was designed to examine cortisol production by fetal adrenals and their response to ACTH at different periods of prenatal life in two groups of silver foxes: the first was from the population selected for three decades for lack of aggression towards humans and the second was an unselected control group. Serum levels of cortisol were determined on days 35, 40, 45 and 50 of gestation (term on day 52) in embryos of both sexes. Cortisol content in adrenal tissue and its *in vitro* adrenal production were also investigated at the same times. Hormones were measured by RIA. A decreased adrenal and serum cortisol content and *in vitro* production were demonstrated in domesticated groups as compared with control ones at the end of embryogenesis. ACTH increased the *in vitro* cortisol production in all groups but to smaller values in domesticated animals than in the controls. These results indicate that selection of silver foxes for lack of aggression has resulted in reduced cortisol adrenal production and adrenal cortisol response to ACTH during embryonic development.

Introduction

The hereditary shift in silver fox behaviour has been realised in the course of selection for domestic behaviour (Belyaev, 1980). Selection for reduced aggression towards humans has been accompanied by endocrine changes in adrenocortical function. The adrenal corticosteroid secretion has decreased significantly in response to selection for domesticated behaviour in comparison with that of farm-raised silver foxes (Naumenko & Belyaev, 1980; Naumenko et al., 1987; Oskina & Tinnikov, 1991; Oskina, 1996). The data obtained suggests that changes in cortisol production in adult domesticated foxes might take root during the functional maturation of the pituitary-adrenal system. Of particular relevance is the period of embryonic life when corticosteroids act as important morphogenetic factors and play a key role in tissue differentiation and metabolism in the developing organism. It has been assumed that timing shifts of developmental formation of the pituitary-adrenocortical system during prenatal life could be of crucial importance in changes of this function in adult animals.

Adrenals of several species, including man, rat and sheep, start to synthesise corticosteroids as early as the prenatal period (Brieu *et al.*, 1988; Boudouresgue *et al.*, 1988; Rainey *et al.*, 1991). An increase in fetal plasma corticosteroid levels has been demonstrated during late pregnancy in several animal species (Challis *et al.*, 1977; Brieu *et al.*, 1988). In sheep, the increase in fetal corticosteroid secretion at the end of embryonic life can be associated with a rapid growth of the fetal adrenals and their higher sensitivity to ACTH (Challis *et al.*, 1977; Brieu *et al.*, 1988).

Experiments have pointed to ACTH as an important regulating hormone for the fetal corticosteroid biosynthesis and adrenal differentiation. ACTH stimulation increased *in vitro* cortisol production by a definitive zone in human fetal adrenals (Jaffe *et al.*, 1978). Adrenal cortisol biosynthesis can be activated by infusing ACTH into the ovine fetus in utero (Manchester *et al.*, 1983). Negative regulation of ACTH secretion by corticosteroid feedback occurs also during prenatal life (Brooks & Chalis, 1988). For example, pituitary corticotropes of ovine fetuses are sensitive to the corticosteroid-negative feedback at least during the second half of fetal life (Durand *et al.*, 1986).

The purpose of the present paper is to describe the embryonic development in endocrine adrenal function of silver fox after 30 years of experimental domestication. The present work was undertaken to compare the cortisol contents in serum and adrenals and its *in vitro* production by the adrenals from embryos of silver foxes and to elucidate the regulating role of ACTH in fetal adrenal steroidogenesis in selected and control groups.

Materials and methods

The study was performed on silver foxes of domesticated and control populations bred at the Experimental Fur Farm of our Institute. Methods of selection and estimation of

behavioural responses have been described (Trut, 1980). Pregnant foxes (50 domesticated and 59 undomesticated) were sacrificed humanely on days 35, 40, 45 and 50 of pregnancy, whose total duration was 52 days. The day of mating with a male was taken as the first day of pregnancy. All females were mated once. The embryos were removed from the uterine horns, weighed and decapitated. The blood of embryos was collected and the serum was frozen.

Both fetal adrenals from each fetus were weighed and stored in 0.2% saline at -20°C. For cortisol measurements, the adrenals were homogenised in the same saline portion after thawing. To investigate the *in vitro* cortisol production, the adrenals from part of the embryos were incubated for 2 h at 38°C in a shaking water bath in Eagle's medium, in the presence or absence of porcine 50 mIU ACTH (Sigma, St. Louis, USA). Continuous gassing of the medium with 95% oxygen and 5% carbon dioxide was used before incubation. The incubation volume was 0.7 ml. The right adrenal was taken as control and the left one was incubated with ACTH. After incubation, the samples were frozen and stored for measurement of cortisol.

The cortisol contents in serum, adrenal homogenates and incubation media were determined by RIA using commercial kits (Institute of Bioorganic Chemistry of the Academy of Sciences of Byelorussia, Minsk) with preliminary extraction with ethyl ether. The assay had an intraassay coefficient of variation less than 10% and an interassay coefficient less than 15%. The percentages of cross-reactions show the specificity of the antiserum used: cortisol 100%; corticosterone 14%; 11-deoxycortisol 14%; 17-OH progesterone 100%; prednisolone 10%; progesterone 2%; androgens and estrogens 2%.

Mean \pm SEM values were calculated for hormone contents in serum, adrenals and incubation medium. Three-way analysis of variance (between different time points of

pregnancy, behaviour and sexes) and Duncan's multiple range tests were conducted. ANOVA program of Statistics for Windows was used.

Results

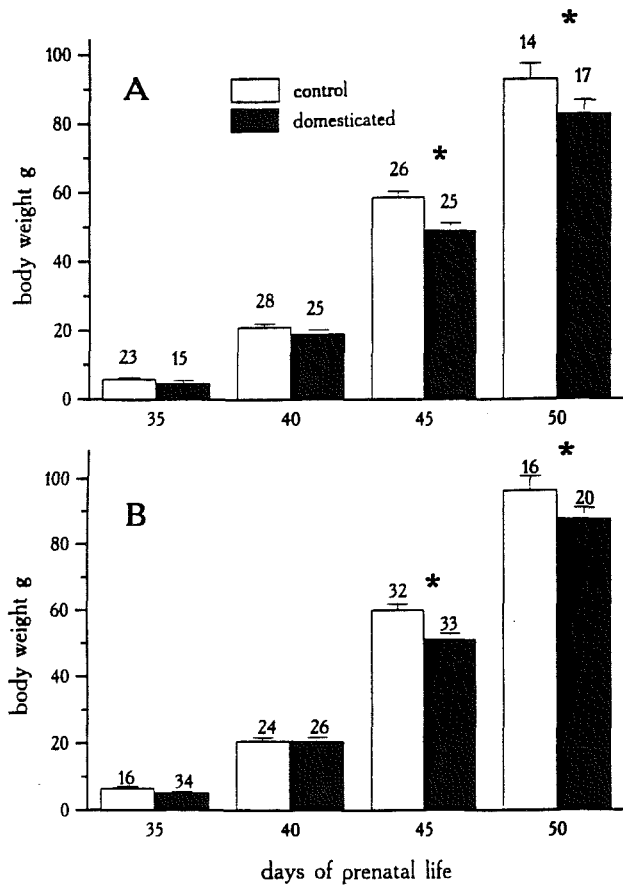


Fig. 1. Effect of selection for behaviour on body weights of silver fox fetuses aged from 35 to 50 days of fetal life. Values are mean \pm SEM. Asterisks designate significant differences (P at least < 0.05) between domesticated and control groups. The different numbers above the bars indicate the numbers of foxes in a group. A - females, B - males.

Embryo and adrenal weights

The weight of embryos increased rapidly with advancing age in males and females of all groups (Fig. 1). No significant sex difference was observed in embryo weight throughout the experimental period. The weight of a pair of adrenals from both male

and female embryos also increased with advancing embryonic age, and no significant sex difference was observed in adrenal weight throughout the experimental period (Fig. 2).

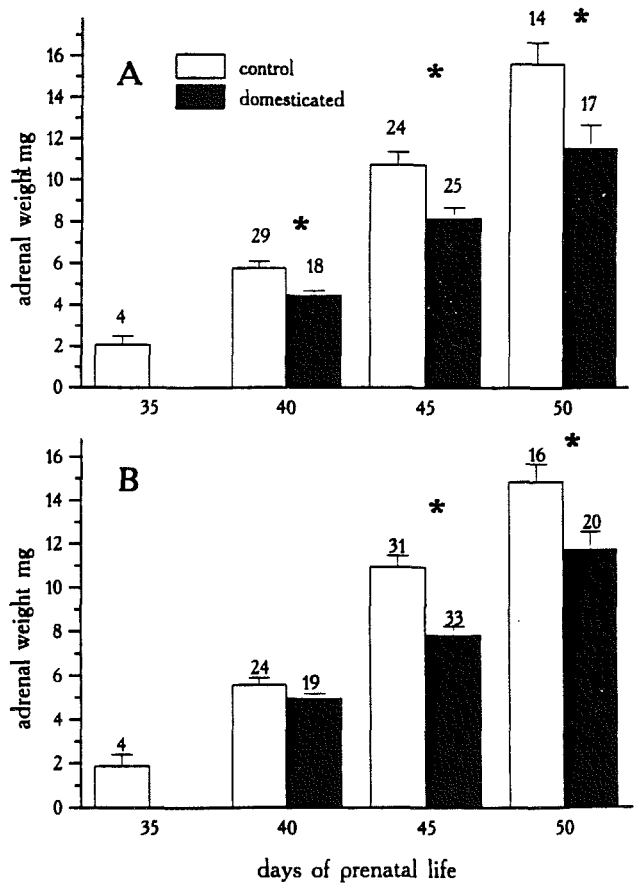


Fig. 2. Effect of selection for behaviour on adrenal weights of silver fox fetuses aged from 35 to 50 days of fetal life. For details, see the legend to Fig. 1.

There were significant differences in the body weights between the behaviour groups (Fig. 1). At the end of pregnancy, the weights of male and female embryos from domesticated groups were smaller than those of controls. The same differences were discovered in the adrenal weights. The weights of adrenals in males and females from the domesticated groups were smaller than those in controls towards the end of pregnancy (Fig. 2).

Serum cortisol levels

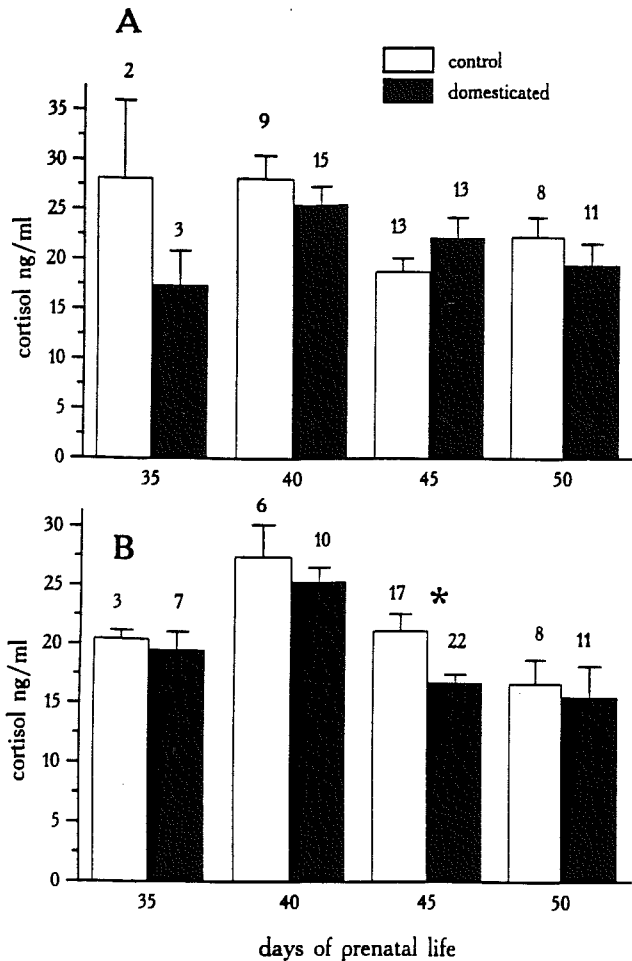


Fig. 3. Effect of selection for behaviour on serum cortisol levels in silver fox fetuses aged from 35 to 50 days of fetal life. For details, see the legend to Fig. 1.

Cortisol was found to be present in silver fox serum of both sexes already from day 35 of embryonic development. The mean serum cortisol for male and female fetuses of both experimental groups altered slightly throughout the experimental period (Fig. 3). Overall ANOVA showed a change in serum cortisol concentrations during the experimental period in both behaviour groups. Serum cortisol levels reached peaks at day 40

of pregnancy in all groups of fetuses and then remained fairly high (Fig. 3). The hormone levels showed a significant decline after day 40 in all groups. There were no significant differences in the serum cortisol levels between the sexes.

There was no clear difference between domesticated and control animals of both sexes, although ANOVA showed a small, but significant effect of behaviour on hormone levels. The most prominent difference was between domesticated and undomesticated males at day 45, the serum cortisol levels being smaller in domesticated ones (Fig. 3).

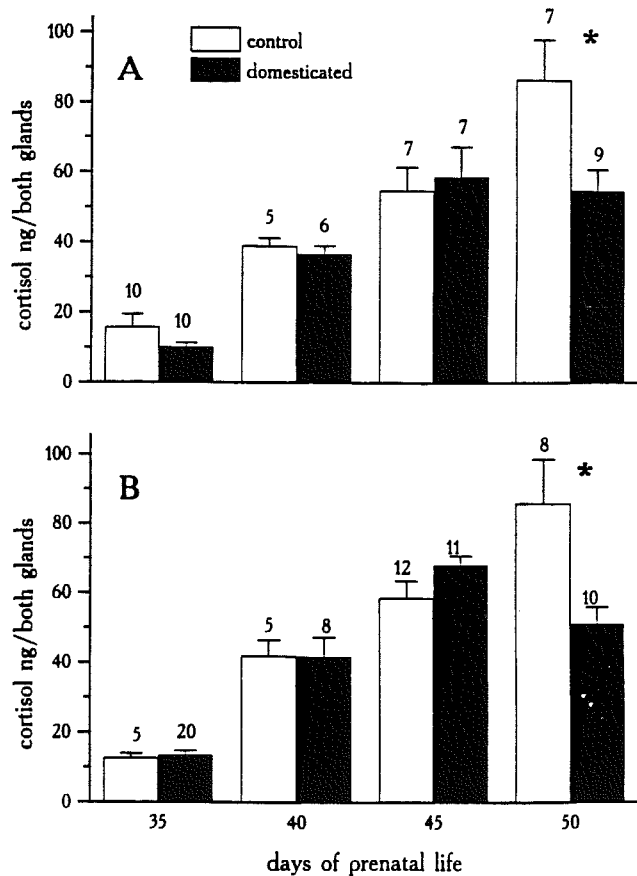


Fig. 4. Effect of selection for behaviour on adrenal cortisol contents in silver fox fetuses aged from 35 to 50 days of life. For details, see legend to Fig. 1.

Adrenal cortisol contents

The adrenal cortisol contents in silver fox embryos are given in Fig. 4. The cortisol content increased in all groups in parallel during embryogenesis, reaching a maximum by the end of prenatal development, 2 days before delivery. No significant sex difference in adrenal cortisol content was observed. The adrenal cortisol contents showed changes similar to the adrenal weights in both sexes. There was no positive correlation between the cortisol content in adrenals and serum throughout the experimental period of prenatal life. Moreover, towards the end of embryogenesis (from 40 to 45 days) the cortisol serum level decreased, while the adrenal content of cortisol continued to increase rapidly (compare Figs. 3 and 4).

The adrenal cortisol content did not vary significantly between behaviour groups until day 50 of prenatal life. At the end of pregnancy, the adrenal cortisol contents were relatively low for silver fox embryos in domesticated groups of both sexes in comparison with controls ($P < 0.01$ for males and females). Whereas hormone content for the control groups increased gradually from day 35 through day 50 of embryonic life, cortisol adrenal content for the domesticated groups remained unchanged from day 45 to day 50.

Effects of ACTH on the *in vitro* cortisol production

In the present study we investigated pituitary-adrenal interactions using *in vitro* adrenal incubations with or without exogenous ACTH and compared a release of cortisol at different time points of prenatal life in different behaviour groups. The overall conclusion is that at the given dose, ACTH increased the *in vitro* cortisol production on all days of prenatal development studied, and on day 35 a maximal response was observed (compared Figs. 5 and 6). The cortisol response to ACTH decreased gradually with advancing age; in other words there was

age-dependent progressive decreasing response to ACTH in all animal groups.

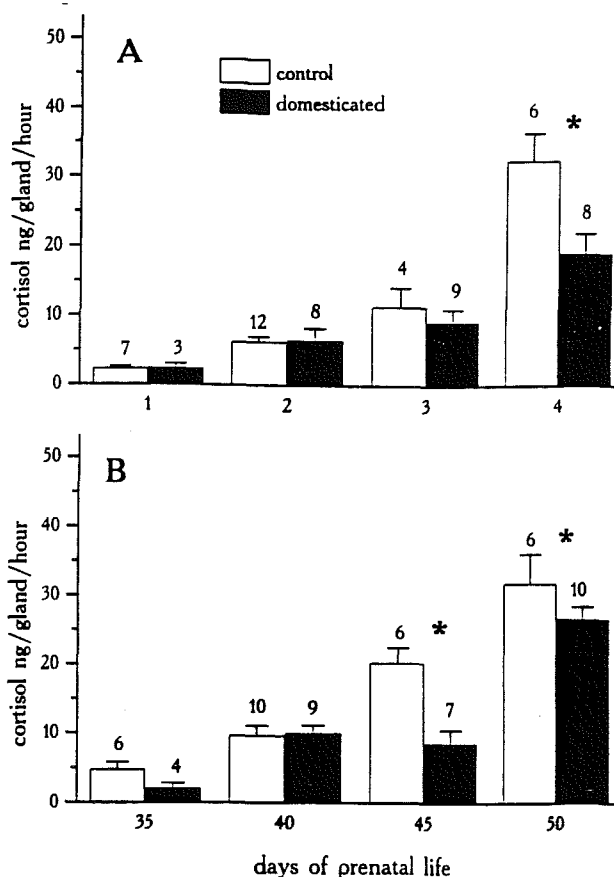


Fig. 5. Effect of selection for behaviour on the *in vitro* basal adrenal production of cortisol in silver fox fetuses aged from 35 to 50 days of fetal life. For details, see legend to Fig. 1.

It should be noted that the *in vitro* cortisol production by fetal adrenals not stimulated by ACTH (baseline production) increased rapidly towards the end of embryogenesis (Fig. 5). The differences between the selected and the control groups were again evident at the end of pregnancy (Fig. 5). At that time (on day 45 and 50 for females and day 50 for males), but not earlier, the mean cortisol concentration in the incubation medium of control animals was higher than in selected ones.

After ACTH treatment the cortisol concentration in the incubation medium varied

with stage of embryonic life and followed a pattern that was similar to the baseline production. For all control animals, the cortisol production stimulated by ACTH was relatively low on day 35 and 40 before increasing steadily through day 45 and day 50 of prenatal life (Fig. 6). Animals in the control groups had the highest cortisol production stimulated by ACTH on day 50.

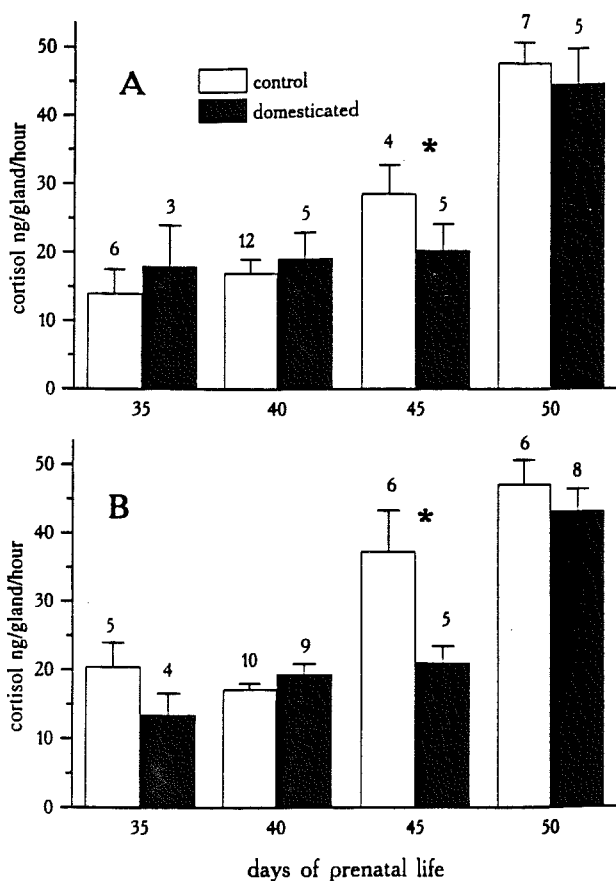


Fig. 6. Effect of selection for behaviour on the *in vitro* adrenal production of cortisol, stimulated by ACTH (50 mIU/adrenal) in silver fox fetuses aged from 35 to 50 days of fetal life. For details, see the legend to Fig. 1. The cortisol production in domesticated groups of both sexes after ACTH stimulation increased sharply from day 45 to the peak at day 50 (Fig. 6). Mean cortisol production on day 45 in domesticated groups of both sexes was significantly smaller than in controls indicating the weaker adrenal cortisol response to ACTH in this group.

Discussion

The results of these studies show that the fetal adrenals in the silver fox are functionally capable of producing cortisol and responding to exogenous ACTH starting on day 35 of gestation and that developmental changes in the pattern of these responses are observed. It was found that the magnitude of the adrenal response to the given dose of ACTH depends on the developmental stage of embryogenesis. The increase in cortisol production after ACTH treatments on day 35 was approximately 4 fold and on day 50 was only 1.5 fold. So, there was an age-dependent progressive decrease in response to ACTH in all groups of animals.

The capacity of the fetal adrenals to secrete large amounts of corticosteroids, which are needed for fetal development, has long been recognised in many mammalian species. The present results demonstrate for the first time that the embryonic adrenals in silver foxes are very active in cortisol biosynthesis. The serum cortisol level, its adrenal content and the *in vitro* production by adrenals could be detected as early as 35 days of prenatal life. The fetal adrenal cortisol content and its *in vitro* production then increased gradually and in parallel during the third part of pregnancy until the peaks were reached on day 50 (2 days before parturition).

The patterns of changes in the adrenal cortisol content and its *in vitro* production conform to those of the adrenal weight, thereby supporting the hypothesis that the changes in the cortisol biosynthesis by fetal adrenals may result in part from the increase in the growth rate of the fetal adrenal glands. These data are generally in good agreement with previous findings in rats establishing that resting levels of corticosteroids during development are closely tied to the size of the adrenal itself (Sapolsky & Meaney, 1986). The other factor responsible for these alterations in the fetal adrenal cortisol content

and the *in vitro* production may be the increase in pituitary output and blood concentration of ACTH. The changes in cortisol secretion during silver fox embryogenesis may also possibly be related to changes in the number of receptors for ACTH or intraadrenal changes in the enzyme activities along the pathway of cortisol biosynthesis. These possibilities have yet to be investigated.

It is interesting that a sex difference in serum cortisol levels was not revealed during embryogenesis, while it was demonstrated for adult silver foxes (Naumenko *et al.*, 1987). It is known that the plasma cortisol concentration is higher in adult females than in males of silver foxes (Pavlova, 1973; Naumenko *et al.*, 1987). There were no sex differences in the adrenal cortisol contents and *in vitro* adrenal production between female and male silver fox embryos. Neither were sex differences in the weight of adrenals and bodies observed in this study. It is suggested that the sex of the silver fox embryos cannot affect cortisol secretion during prenatal life. It may be thought that the sexual differences in the glucocorticoid adrenal function are formed during postnatal development in the silver fox. A recent study has demonstrated clear sexual differences in ACTH and cortisol levels in silver fox neonates similar to those in adults (Oskina, 1996).

The main aim of the present study was to investigate embryonic development of adrenal cortisol biosynthesis in silver foxes in two behaviour lines. There was an attempt to identify the differences in the fetal adrenal cortisol between domesticated and control foxes. The cortisol content in serum and adrenals and *in vitro* production in the fetuses from the domesticated population were significantly lower than those of the control population at the end of fetal life. Our results also demonstrate that the functional capacity of the silver fox fetal adrenals to respond to exogenic ACTH is present in both lines of animals. However, the magnitude of the responses is specific

for each behaviour type. The cortisol responses to ACTH in silver foxes selected for domestic behaviour were weaker as compared with controls at the end of fetal life. These findings are in accordance with previous findings in adult silver foxes, in which adrenal cortisol production by adrenals and cortisol plasma concentration were shown to be lower in domesticated animals vs. control (Naumenko *et al.*, 1987; Oskina & Tinnikov, 1991).

Taken together the data relating to the pituitary-adrenal system development during embryonic life could suggest that the decrease in cortisol adrenal biosynthesis of domesticated compared to undomesticated foxes at the end of embryogenesis is due to developmental features in the formation of close functional relationships between the pituitary and adrenals in domesticated animals. With this in mind, one could assume that there is a timing destabilisation in maturation of separate units of hypophysis-adrenal axis during embryonic life, at least concerning hypophysial control over the adrenal cortisol biosynthesis under the course of silver fox selection.

In rats, it has been demonstrated that the hypothalamus-pituitary-adrenal axis (HPA) is in function in late gestation (Sapolsky & Meaney, 1986) and that the negative feedback mechanism of corticosteroids in the fetus begins to operate also in late gestation (Dupouy & Catelain, 1984). Recent reports indicate that transplacental passage of corticosteroids from the mother to the fetuses and back takes place during pregnancy (Zarrow *et al.*, 1970). In the present study the attenuation of adrenal corticosteroid function in domesticated silver foxes during late prenatal life is established. In relation to the above findings, care should be taken in the interpretation of differences in adrenal fetal cortisol production between domesticated and undomesticated animals since there is evidence of changed maternal adrenal function in pregnant vixens (Oskina & Tinnikov, 1991). This means that hypoproduction of

maternal corticosteroids in domesticated pregnant vixens (*Oskina & Tinnikov, 1991*) may be involved in the ontogenic development of embryonic adrenal function. Consequently, these permanent effects of maternal corticosteroids on hypothalamo-pituitary-adrenal axis of fetuses could be an additional factor in control of fetal adrenal function in domesticated animals.

It cannot be excluded that the lower level of the adrenal cortisol biosynthesis which was formed in domesticated silver foxes is determined exclusively by the state of the central regulatory mechanisms controlling corticosteroid biosynthesis. The present data suggest that long-term selection for domestic behaviour in silver foxes leads to a reduction in the adrenal glucocorticoid function already beginning from prenatal development. In addition to the alterations in the glucocorticoid function in adult silver foxes from the domesticated population (*Pavlova, 1973; Naumenko et al., 1987*), the same diminution of the pituitary-adrenal function was also found in Norway rats selected for reduced aggressiveness towards humans (*Naumenko et al., 1989*). Some studies have demonstrated changes in brain monoaminergic mechanisms during behaviour selection in silver foxes and Norway rats (*Naumenko et al., 1989; Popova et al., 1992*).

They have shown that catecholamines and serotonin can be involved in modification of adrenal function under experimental domestication in both animal models. The above finding provides evidence that some changes in embryonic maturation of neurochemical brain systems in domesticated animals may be responsible, at least partly, for changes in their adrenal cortisol biosynthesis. To fully understand the developmental pattern of the adrenocortical axis during experimental domestication of silver foxes

we need to investigate some important levels of regulation for adrenal function, including the release of corticotrophin releasing factor (CRF) from neurons within the mediobasal hypothalamus, catecholamines, which potentiate CRF action to stimulate the secretion of ACTH and the release of ACTH from the hypophysis which, in turn, promotes the adrenocortical secretion of cortisol. So, further studies are needed to elucidate the changes in the regulation of fetal adrenal function in silver foxes after selection for domesticated behaviour.

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Original Report

***In Vitro* protein kinase activity of skin biopsies from silver foxes displaying the "curly hair" defect**

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Summary

Silver foxes, and Silver/Blue-fox crosses, can display a pelt defect commonly known as "curly hair". Such animals are of no commercial value and, unfortunately, the defect can be passed on to the next generation without the carrier-fox showing the "curly hair" phenotype. Previous studies point to a defect in the expression of the keratin genes. This defect may be associated with the system responsible for the regulation of keratin synthesis. Many biochemical reactions are known to be regulated by phosphorylation and dephosphorylation of specific proteins. This study was carried out in order to see if a difference in the system responsible for this post-translational modification of proteins could be found in affected foxes. The activity of the *in vitro* kinase/phosphatase system was found to be different in animals carrying the "curly hair" defect compared to normal foxes. These results strongly indicate a malfunction somewhere in the keratine gene expression system.

Introduction

Silver foxes (*Vulpes vulpes*) and crosses between silver foxes and blue foxes (*Alopex lagopus*) can display a pelt defect known as "curly hair", "scruffy-looking", "spiky", "rough coat" or "wavy appearance". The defect makes the animal look non-attractive with a deteriorated coat and the farmer will normally dispose of affected animals because the pelt has no commercial value. The defect is genetic in origin and transmitted as a recessive allele and microbial causes have been ruled out (*Saarenmaa and Niemelä, 1989*). Foxes with "curly hair" can display the defect to various degrees either at birth or later in life when they already have been used for breeding purposes. This shows the defect to be partly controlled by developmental genes or triggered by environmental conditions. The defect is manifested as scarce underfur and guard hairs, especially on some parts of the animal. The hairs look curly and are bent lengthwise, and are not regularly round when seen in cross section (*Ingo et al., 1989*).

Not all guard hairs show the defect when studied by light microscopy (*Rasmussen, 1988*) and uneven keratinization of the hairs has been described (*Blomstedt, 1989*). Additionally, low levels of Zn in the guard hairs sampled from affected animals have been found while the content of Cu was found to be the same (*Riis, unpublished*). The affected protein(s) and the altered gene(s) are unidentified, but experiments utilising transgenic mice expressing sheep wool keratins have shown that it is possible to create similar phenotypes in the mouse (*Powell and Rogers, 1990*). Therefore, the "curly hair" defect must be related to the keratin gene expression - either as over-expression of one keratin, disturbance in the balance between the expression of the various keratins or as a defect in the keratin synthesizing process.

Many biological processes, including protein synthesis, are known to be regulated by phosphorylation. The regulation acts like a switch where one state is when a phosphate-group is covalently attached to the protein, and the other state is encountered when the protein is dephosphorylated. The regulation is performed as a balance between the two opposite biochemical reactions (*Riis et al, 1990; Riis et al, 1995*). The protein phosphorylation is enzymatically performed by protein kinases (*Hunter, 1987*) and the opposite reaction, the dephosphorylation, is catalysed by protein phosphatases (*Cohen, 1989; Charbonneau and Tonks, 1992*).

Although these two processes are known to be involved in the regulation of many biological processes, the underlying molecular events are still poorly understood.

The biochemical basis for the "curly hair" defect is totally unknown at present. These experiments were conducted in order to reveal if a change in phosphorylation pattern could be found between affected and normal foxes. Finding such a difference would strongly indicate a malfunction in the regu-

lation of one or more of the biochemical processes in the hair-producing cells.

Materials and Methods

Skin biopsies were taken from the same area on the left hip of the seven tested foxes. Samples were taken from animals expressing curly hair to various degrees and from a non-affected normal control animal. The biopsies (\varnothing 4 mm) were taken after the animal had been locally anaesthetised and the hair had been removed by shaving.

The samples were immediately transferred to Eppendorf tubes containing ice-cold isotonic protection buffer A (25 mM Tris/HCl pH: 7.5, 0.25 mM Sucrose, 100 mM KCl and 0.5 mM PMSF) and frozen in liquid nitrogen. The samples were kept at -80°C until the described tests were performed. All operations were performed at $0-4^{\circ}\text{C}$ unless otherwise indicated. The samples were thawed and homogenised in buffer A using a glass/glass homogenisator. The homogenate was centrifuged at $12000 \times g$ for 10 min to remove unbroken cells, hair roots and cellular debris. The supernatant was used for all further analysis. The content of total soluble proteins was measured employing the protein dye-binding method (*Bradford, 1976*) using a Bio-Rad protein assay kitTM and bovine serum albumin as the standard. The *in vitro* kinase activity test was performed by incubating equal amounts (7.2 mg) of soluble protein from the samples with [$g\text{-}^{32}\text{P}$]ATP in buffer B (20 mM Tris/HCl pH: 7.6, 0.1 M KCl, 1.5 mM MgCl_2 , 5 mM b-mercaptoethanol and 0.5 mM CaCl_2). After addition of the radioactive labelled ATP, the samples were incubated at 37°C for 2 min without the addition of any phosphatase inhibitors. The reaction was stopped by adding 10 ml Laemmli sample buffer to the samples followed by boiling for 1 min. The samples were loaded onto a 10% SDS-PAGE gel made as described (*Laemmli, 1970*).

This procedure separates the proteins according to size. After performing the run, the gels were dried in a BioRad GelAir dryerTH and exposed to a X-ray film for 7 days at -80 °C in a Kodak X-ray cassette with an intensifying screen.

After exposure to the X-ray film, the gel was silverstained using the method of Ansorge as described (Riis, 1996).

Results and Discussion

When the proteins were run on the SDS-PAGE and silverstained no difference was found in the protein pattern between normal and "curly hair" samples which indicates that no protein was expressed at altered levels in skin cells from affected foxes compared to normal animals (fig. 1).



Fig. 1. SDS polyacrylamide gel electrophoresis of skin proteins from the samples. Equal amounts of proteins were loaded onto the gel, which was silverstained after the run. Numbering is: Lanes 1-3 affected animals, lane 4 is a normal control and lanes 5-7 are affected animals. The affected animals are of different age and sexes.

When the gel containing ³²P-labelled proteins was exposed to X-ray film a difference in the *in vitro* phosphorylation pattern from affected animals compared to non-affected animals was found (fig. 2).

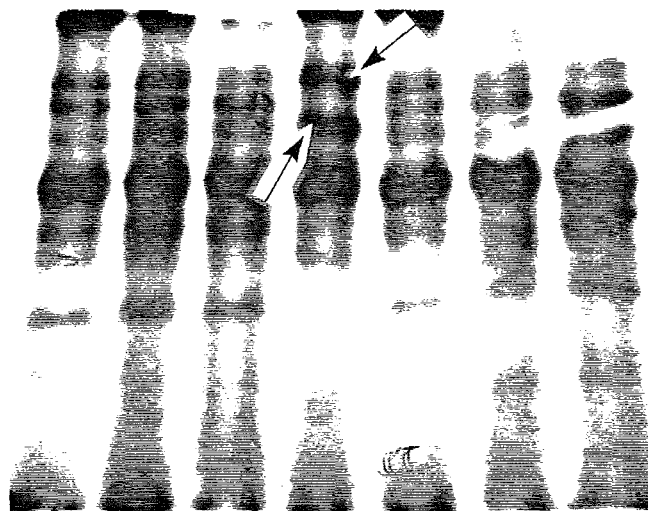


Fig. 2. Autoradiography of the same gel as in figure 1 after the gel has been dried and exposed to X-ray film for 7 days.

This difference can be seen as additional bands on the autoradiography shown in figure 2, lane 4 (arrows). This difference is due to an overactivity of a protein kinase or of a non-functioning protein phosphatase. It is difficult technically to distinguish between these two alternatives because such a test requires knowledge of the identity of the proteins.

A high kinase activity can be caused by several mechanisms. One possibility is that a single kinase is synthesised in abnormally large amounts thus making this kinase more active than normal. Such an abnormally high expression cannot be ruled out because some kinases are very active and a small over-expression may result in very high activity. This cannot be deduced by employing SDS-PAGE techniques followed by silverstaining because a small over-expression of a kinase can result in a very large increase in activity. Another possibility is a fault in the regulation of the kinase activity. Several hundred different ways of regulating kinases are known (Johnson *et al*, 1996). This regulation is often performed by an internal domain found within the kinase itself, but other regulatory methods are known (Hunter, 1987). This makes it difficult to dis-

close if a regulation problem in a kinase is causing the "curly hair" problem. Yet another possibility is a malfunction in a protein phosphatase the task of which is to dephosphorylate proteins carrying a phosphate-group. Phosphatases can be mono- or polyspecific and thus more or less active towards a given protein (*Charbonneau and Tonks, 1992*).

A defect in one or more phosphatases cannot be ruled out by experiments because the identities of the affected proteins are not known. Many other possibilities involving the kinases and/or the phosphatases can be envisioned, but these are pure speculations and cannot be tested experimentally without great difficulties. Another likely explanation may be a defect in the mechanism responsible for protein synthesis and regulation (*Riis et al, 1990*). However, none of these possibilities are simple to test and a quest for the defect gene using transgenic techniques seems at the moment to be the most fruitful way of attacking the problem.

Conclusions and Perspectives

The main conclusion from these experiments is that farmed foxes with the pelt defect "curly hair" have a different phosphorylation pattern when compared to non-affected animals. Such a finding strongly indicates a malfunction in the phosphorylation-operated regulating systems in the skin, probably in the hair-producing cells. Previous genetic experiments involving animals with the "curly hair" defect have shown that it is inherited as a recessive trait. Several genetic loci are probably involved because animals can show the defect to various degrees and because the appearance of the defect is spread in time. The available data could be interpreted as a regulation problem in controlling the distribution and/or synthesis and hardening of the keratins in fox hairs. This could mean that a close study of the keratin genes may be a way of revealing the exact molecular problem. Several prob-

lems are faced in trying to find the biochemical basis of the defect because the "curly hair" defect intensity in the phenotypes varies and affected animals can look normal for a period and then start to display the defect. Identifying the affected genes is the ultimate goal because this will make it possible to develop a test capable of detecting affected animals. Such a test will allow the producer to identify these animals and eliminate them from the breeding pool. Preliminary experiments are on the way for studying the problem by exploiting probes from transgenic mice and sheep showing a similar morphological hair defect. However, identifying the faulty proteins and developing a reliable test may take a long time.

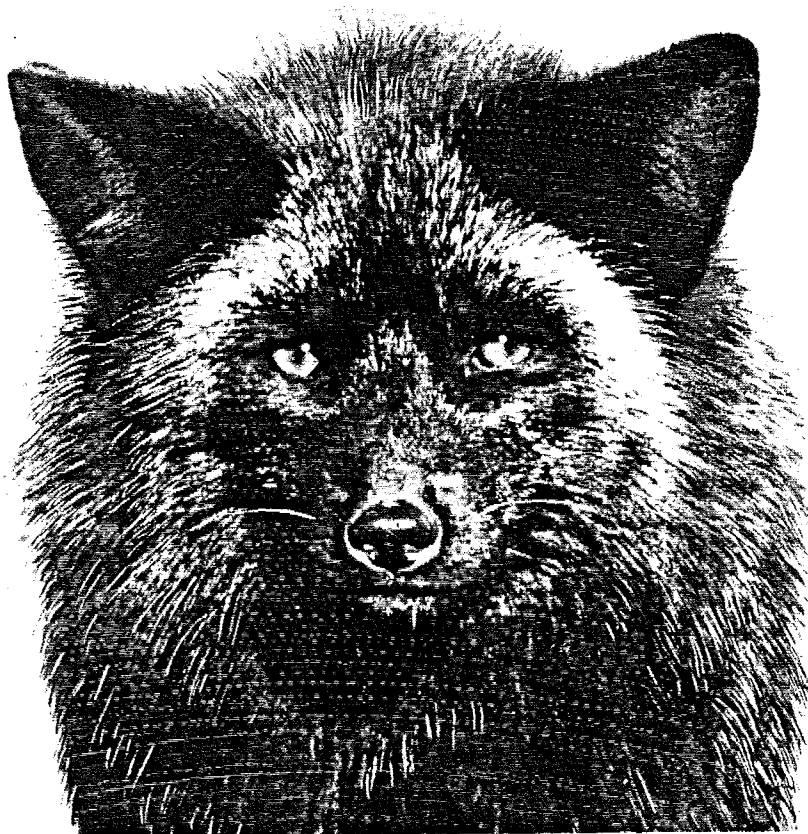
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Original Report

Transmission of Aleutian disease virus by air

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Summary

Aleutian disease virus was isolated from air under both laboratory and field conditions in order to investigate whether horizontal transmission of Aleutian Disease Virus (ADV) is a substantial factor in the epidemiology of Aleutian disease in mink. The results of the laboratory experiments show that infectious ADV can be filtrated from air containing nebulized ADV. We furthermore showed that under these conditions ADV is transmitted efficiently by air. Infectious ADV was also filtrated from the air on a mink farm positive for Aleutian disease. From the experiments it can be concluded that horizontal transmission of ADV by air appears an important factor in the epidemiology of Aleutian disease in mink.

Introduction

Aleutian disease (AD) of mink is an immune complex disease associated with persistent infection by the Aleutian Disease Virus (ADV) which has been characterised as an

autonomous parvo virus (Bloom et al., 1980). The pathology of AD causes serious losses in mink production and is characterised by glomerulonephritis, arthritis, plasmacytosis and hypergammaglobulinemia with high levels of non-neutralising antiviral antibodies (Alexandersen, 1990). Both vertical and horizontal transmission were earlier indicated as possible routes for the spread of ADV in mink on farms (Gorham et al., 1964; Padgett et al., 1967; Haagsma et al., 1969). Vertical transmission was already reported in 1964, e.g. by Gorham et al. and confirmed by others (Padgett et al., 1967; Haagsma et al., 1969)). The possible importance of horizontal transmission was recognised by Gorham et al. and supported by experiments performed by Alexandersen who successfully infected mink with ADV using aerosols based on nebulized suspensions of organs obtained from AD positive animals (Alexandersen, 1986). In that study, however, the presence of infectious virus in air was not directly demonstrated. To investigate whether horizontal transmission by air indeed plays a role in the AD epidemiology on mink farms, we chose an experi-

mental protocol to sample ADV from air by air filtration under controlled as well under field conditions. The results indicate that horizontal transmission by air is underestimated in the epidemiology of ADV.

Materials and methods

Animals

Female standard mink, age 3 years, used in the experimental infections were obtained from a farm which was certified by the Dutch Federation of Fur Breeders as ADV negative (determined by Counterimmunoelectrophoresis) for more than 6 years.

The mink were kept individually at the Institute of Animal Science and Health DLO, Lelystad, The Netherlands, and fed ad libitum with mink feed from a feed kitchen. The experiments performed were approved by the animal ethical committee of the Institute of Animal Science and Animal Health.

The field experiment was executed in a shed of 700 square metres with 1000 standard and 2000 wild mink. The construction of the shed was in such a way that air circulation occurred via open windows located 1m above the unpaved floor.

Nebulization of virus

Aerosol fluid, used for nebulization consisted of 5 ml of ADV Utah strain virus stock solution (Invenex Veterinary Laboratories Wi, USA, batch no 80210, kindly supplied by Dr. A. Uttenthal, National Veterinary Laboratory, Copenhagen, Denmark) mixed with 20 ml sterile 3% (w/v) peptone in demineralized water and 3 ml sterile 1% (w/v) Dow-Corning anti-foam substance in demineralized water.

Aerosol equipment and characterisation procedures have been described (Van Eck, 1990). Aerosol was generated by a Wright nebulizer (Aerosol Products Ltd, London) at an air pressure of 3 bar resulting in a flow of 20 ml h⁻¹ and was transported by an air stream of 20 m³ h⁻¹ via a 0.085 by 2.25 m (w x l) pipe into

an isolator of 4.75 m³. Aerosol generation and exposure time was 30 min. During aerosol generation both isolator temperature and the temperature of the room in which the isolator was situated were kept at 15°C. Relative humidity of the air in the isolator was kept between 50% and 60% by cooling the aerosol transport air followed by heating to 15°C. This procedure results in complete evaporation of droplets before reaching the isolator. Thus the dispersal phase of the aerosol consisted of virus loaded dry particles with a size of approximately 1 µm. Aerosol characteristics were as follows: dry mass concentration after 30 min of generation: 12-15 mg m⁻³, number of particles after 30 min of generation: 2×10^{11} m⁻³, particle spectrum: $M_{10} = 0.4$ µm, $M_{50} = 0.7$ µm, $M_{90} = 1.8$ µm.

Isolation of ADV from air

In both the isolator and on a minkfarm, ADV was isolated from 1.875 litres of air per filter using the Sartorius MD8 air filtration system (Gottingen, Germany) in combination with gelatine filters (Sartorius, type SM 12602 ALK).

Sample preparation and inoculation

Gelatine filters containing air filtrates were dissolved at 37°C in 9 ml 0.9% NaCl containing 4000 IU penicillin (Gist Brocades, The Netherlands). This solution was transferred to 10 ml syringes equipped with a 21 gauge needle and subsequently injected intraperitoneally (IP) into ADV negative mink.

Counterimmunoelectrophoresis (CIEP)

Electrophoresis was performed as described by Cho et al., 1972. Briefly 10 ml of mink blood plasma is obtained by clipping a toenail and collecting the blood in a heparinized capillary tube. This is followed by centrifugation, and loaded at the anode side in wells punched in 0.7% agarose in 0.05 M TRIS/barbital pH 8.6 on 10 X 10 cm² glass plates.

Ten ml DANAD antigen (Glostrup, Denmark) was loaded on the cathode side of the wells. Samples were electrophoresed for 45

minutes at 4-6 V/cm. After electrophoresis, precipitation lines were scored as a measure for ADV positivity.

Results

Laboratory experiments

The viability of the ADV used in this study was determined by titration as shown in Table 1. This shows that the original material has a titre of infectious virus of about 10⁷.

The table further indicates a relationship between the virus dilution and the interval between the moment of virus inoculation and seroconversion.

Table 1. Development of ADV positivity following IP inoculation of 1 ml virus stock dilutions (see materials and methods). Mink were weekly tested by CIEP to determine ADV positivity. +: ADV positive by CIEP, -: ADV negative by CIEP

Animal	Dilution	Time in weeks after inoculation								
		1	2	3	4	5	6	7	8	9
25	10 ³	+	+	+	+	+	+	+	+	+
24	10 ⁵	-	+	+	+	+	+	+	+	+
23	10 ⁷	-	-	-	-	-	-	-	-	±

To investigate whether ADV can be reliably detected in air by the filtration system used we performed an experiment in which the AD Utah strain virus was filtrated from air during virus nebulization. Two air filtrates from 1.875 m³ made under the experimental conditions were applied. These filtrates were subsequently inoculated in mink.

Three weeks after ip inoculation of the filtrates both originally AD negative mink became ADV positive (Table 2). The histopathological findings after necropsy of the animals used were related with pathological features of AD (results not shown). This experiment shows that ADV can be reliably detected in air and that nebulized virus remains infectious in air.

Table 2. Development of AD following IP inoculation of air filtrates, obtained in an isolator chamber containing nebulized ADV virus. Mink were weekly tested by CIEP to determine ADV positivity. +: ADV positive by CIEP, -: ADV negative by CIEP positive

Animal	Time in weeks after inoculation							
	1	2	3	4	5	6	7	8
1	-	-	+	+	+	+	+	+
2	-	-	+	+	+	+	+	+

To address the question whether ADV is horizontally transmittable, three AD negative mink were simultaneously exposed for 30 minutes to nebulized ADV. After exposure, the mink were observed for development of ADV positivity for a period of 8 weeks.

All mink became AD positive within two weeks after exposure to nebulized ADV (Table 3).

Table 3. Development of ADV positivity in mink exposed to nebulized ADV. ADV positivity was weekly determined by CIEP. +: ADV positive by CIEP, -: ADV negative by CIEP, +/-: probably ADV positive by CIEP

Animal	Time in weeks after exposure of Standard mink to nebulized ADV Utah strain							
	1	2	3	4	5	6	7	8
12	-	-	+	+	+	+	+	+
13	-	+	+	+	+	+	+	+
14	-	±	+	+	+	+	+	+

Field experiment

The filtration system used for air sampling of ADV under experimental conditions was also used for air sampling of ADV on an AD positive farm in which >80% of mink were ADV positive by CIEP. Filtrates of 1.875 m³ air were taken 0.2, 0.75, and 1.75m above the floor between mink cages, which were at 0.75 m above the floor, placed in rows 1 m apart, directly adjacent to each other. The results of this experiment show that all air samples

obtained at heights of 0.2 and 0.75m resulted in ADV positivity after ip inoculation within 5 weeks (Table 4).

Table 4. Development of ADV positivity upon IP inoculation of air filtrates obtained at various heights in an AD positive farm. Air samples were IP inoculated in mink as indicated under M&M. Mink were weekly tested by CIEP to determine ADV positivity. +: ADV positive by CIEP, -: ADV negative by CIEP, +/-: probably ADV positive by CIEP. *: After filtration the filter showed a small spot of saliva or urine

Animal	Height	Time in weeks after inoculation								
		1	2	3	4	5	6	7	8	9
15	0.2m	-	-	-	-	+	+	+	+	+
18	0.2m	-	-	-	+	-	+	+	+	+
16*	0.75m	-	+	+	+	+	+	+	+	+
19	0.75m	-	-	-	-	+	+	+	+	+
17	1.75m	-	-	-	-	-	-	-	-	±
20	1.75m	-	-	-	-	-	-	-	-	±

This shows the presence of infectious ADV in the air of an AD positive mink farm. In contrast, a delayed seroconversion was detected in the mink which were inoculated with air samples obtained at 1.75m. All the animals in this experiment showed histopathological features which could be related to AD (results not shown).

Discussion

At this moment no vaccine, inducing neutralizing immune responses against ADV, is commercially available. Insight into the quantitative contribution of vertical and horizontal ADV transmission is therefore important for optimal farm management to prevent and/or eradicate AD. Up to now the importance of ADV transmission by air was questionable as clear experimental evidence for this horizontal transmission was lacking.

Before studying transmission on a mink farm we confirmed the usefulness of an air filtration unit under strictly controlled conditions

(Table 2) for detection of nebulised ADV Utah strain virus. This filtration unit makes use of gelatine filters that can be dissolved in water, thereby circumventing the problem of quantitative recovery of virus from conventionally used air filters. As appears from the results in Table 2 infectious ADV of the Utah strain can be shown in air filtrates since seroconversion occurs 3 weeks after ip inoculation of the isolated virus thereby illustrating the usefulness of the filtration method chosen.

During the same study it was shown that 30 minutes exposure of ADV-free mink to the Utah strain in the isolator, led to seroconversion (Table 3) showing that nebulized ADV of this strain conserves its virulence. In the given situation nebulized ADV obviously induces Aleutian Disease be it by inhalation and/or by the oral route (licking of the fur).

To investigate whether infectious ADV is present in air on an ADV positive mink farm air filtrates were sampled by gelatine filters at various heights above the floor of a mink farm housed in a closed shed and subsequently ip inoculated into AD negative mink. The results of this experiment (Table 4) show that infectious ADV is present in the air mainly at a height of 0.2 m and 0.75 m above the stable floor.

In the experiments described here, the nature (free virus or virus bound to particles) of infectious ADV in air on the farm has not been investigated. However, from the observation that air filtrates, obtained at 1.75 M above the stable floor, induce delayed seroconversion upon IP inoculation, it can be hypothesised that infectious virus is present in air possibly in association with relatively large dust particles, a condition which may stabilise the virus. Another important aspect, namely the half life of infectious ADV in air has not been addressed in this investigation. Future experiments should clarify this question. In view of the results it seems important to generate as few as possible dust and air disturbances for example during handling and

feeding of the mink. Especially the use of high pressure squirts should be considered. The observation of infectious ADV in the air of an AD positive mink farm does not prove in itself that ADV, transmitted by air, is a major factor in transmission of the disease. However, the indications are very strong that this is in fact the case: although the type of the AD virus on the farm was not known, it proved infectious after ip injection since it caused seroconversion within 2 to 5 weeks as shown in Table 4.

The results from both the laboratory and field experiments make it highly probable that transmission by air is a major factor in the horizontal ADV transmission on mink farms. Whether airborne ADV transmission plays a role in spreading of AD infection between mink farms is subject to further research.

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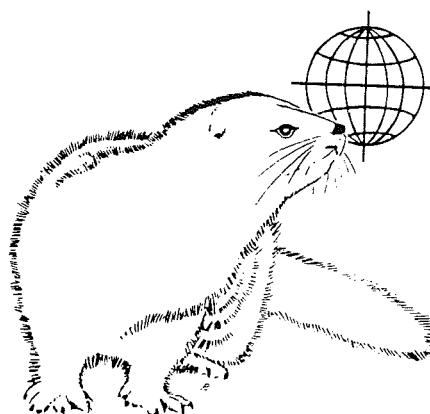
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Progress in the ethology of fur animals

Leif Lau Jeppesen

Animal behaviour is an integrated part of many other disciplines and important for many aspects of fur animal production. Currently much of the animal behaviour research is focused on animal welfare problems in mink and foxes and so is the present lecture. Recent reviews by Braastad (1992), Bakken et al. (1994) and Hansen (1994) cover the latest scientific development. The review by Hansen is in Danish but translations are available from CEFBA.

Animal Prod. Review, Applied Science Reports, 27, pp. 9-11, 1996. 4 refs. Author's introduction.

Chromosomes and genome maps of domestic canids

Marek Switonski

Plenary lecture without summary.

Animal Prod. Review, Applied Science Reports, 27, pp. 13-17, 1996. 25 refs.

***In vitro* survival and hatching of mink embryos in diapause**

Geneviève M. Moreau, Lawrence C. Smith, Jianhua Song, Bruce D. Murphy

The mink embryo reaches the blastocyst stage at approximately the same time that it arrives in the upper reaches of the uterine horns, some six days after the initiation of ovulation by coital stimulus. It remains in diapause for a variable period, known as the period of delayed implantation. The corpus luteum and the embryos are reactivated some days prior to nidation. We studied

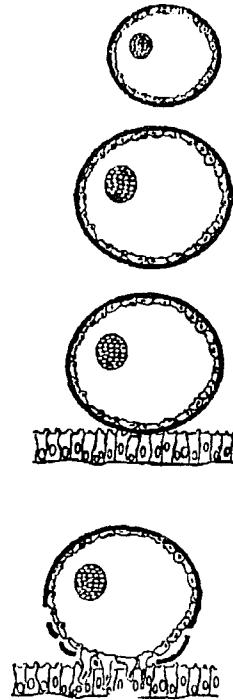


Fig. 1. Diagrammatic representation of the events in mink implantation. Blastocysts of approximately 0.2 mm arrive at the uterus approximately 6 d after the mating that induces ovulation, where they remain in diapause for a variable period. The embryos are reactivated, and increase in size, due primarily to fluid uptake. Soon after that, the zona pellucida adheres to the endometrial epithelium, and trophoblastic syncytial plaques penetrate the zona, adhere to the epithelium, and invade between epithelial cells.

diapause and embryo activation *in vitro* in blastocysts collected from the uteri of mink during early gestation. It was determined that complex culture media containing amino acids and serum are amenable to the continued development of embryos reactivated *in vitro*. Further, coculture of blastocysts with monolayers of uterine and hepatic cells enhances embryo survival, and allows some embryos to escape from diapause and resume development *in vitro*. We experimentally induced reactivation of blastocysts by treatment of the dam with prolactin. The consequent redevelopment of the embryo begins somewhat slowly, but there is a precipitous elevation in protein synthesis after 7-10 days. We conclude that the state of obligate embryonic diapause is terminated by a stimulus which is not specific to the uterus, and does not need to be constantly present for continued development after reactivation.

Animal Prod. Review, Applied Science Reports, 27, pp. 19-31, 1996. 8 figs., 23 refs. Authors' summary.

Fur animal health - current status

Per Henriksen

The health status of fur-bearing animals varies in various countries. The spectrum of diseases is influenced by the general disease situation and feeding regime in different countries. During the years the frequency of different diseases varies, i.e. some diseases almost disappear while "new" syndromes appear on the scene of fur animal disease.

In the past the classical infectious diseases such as distemper and mink virus enteritis caused high mortality but the development and use of efficient and inexpensive vaccines have reduced the economical importance of these diseases. The only significant

contagious mink disease without an available vaccine is Aleutian disease and in world-wide perspective this disease is the greatest threat to profitable mink production. The same threat from a single source doesn't exist in fox farming.

In countries with an intensive mink production and relatively good control of infectious diseases other syndromes appear. An example is E.coli-associated diarrhoea in kits both in the weaning period and in the later growth period. This syndrome plays an important role both in Scandinavia and in US and the pathogenesis is still not clear.

Animal Prod. Review, Applied Science Reports, 27, pp. 33-38, 1996. Author's introduction.

GENETICS - REPRODUCTION - BREEDING

A DNA microsatellite containing cosmid mapping to American mink (*Mustela vison*) chromosome Y by in situ hybridisation

K. Brusgaard, S. Malchenko, O. Lohi, K. Kristensen

A Cosmid library was established. The library was screened for (CA)_n DNA microsatellites using a (GT)_n oligonucleotide as a probe. Positive clones was subcloned in the pUC19 plasmid vector. (CA)_n containing subclones was sequenced using Automated Laser Fluorescence detection (ALF) DNA Sequencer. The Cosmid SH644 was shown by in situ hybridisation to map to the Y chromosome of mink.

Animal Prod. Review, Applied Science Reports, 27, pp. 41-44, 1996. 2 figs., 5 refs. Authors' summary.

Chromosome localisation of the gene for somatostatin peptide in silver fox (*Vulpes fulvus*)

I.V. Koroleva, S.N. Malchenko, K. Brusgaard, T.M. Khlebodarova, N.B. Rubtsov, S.M. Zakian

The localisation on the chromosome of the gene encoding somatostatin peptide (SST), was determined by Southern blotting of DNA obtained from a panel of silver fox x Chinese hamster hybrid somatic cell clones using human SST DNA as a probe.

The SST gene is localised on chromosome 3 of the silver fox.

Animal Prod. Review, Applied Science Reports, 27, pp. 45-49 1996. 1 table, 11 refs. Authors' summary.

Chromosome localisation of the gene for growth hormone in silver fox (*Vulpes fulvus*)

S.N. Malchenko, L.V. Koroleva, K. Brusgaard, T.M. Khlebodarova, N.B. Rubtsov, S.M. Zakian

The localisation on chromosomes of the gene encoding growth hormone (GH) was determined by Southern blotting of DNA obtained from a panel of silver fox x Chinese hamster hybrid somatic cell clones using mink GH DNA as probe. The GH gene is localised on chromosome 2 of the silver fox.

Animal Prod. Review, Applied Science Reports, 27, pp. 51-55, 1996. 2 tables, 1 fig., 12 refs. Authors' summary.

The effect of inbreeding on reproduction and production traits in mink

Peer Berg

Data from a four year study with alternating inbreeding and outbreeding are utilised to estimate the effect of inbreeding on both reproduction and production traits. A total of 3998 and 885 animals are included in the analyses for production and reproduction traits, respectively. Effect of inbreeding is estimated as the partial regression of coefficient of inbreeding on the trait in an animal model. For reproduction traits both inbreeding of the kits (direct inbreeding) and of the females (maternal inbreeding) are considered.

For production traits the effect of 10% inbreeding is generally small, though significant for some traits, in most cases below 1% of the mean or 0.1 phenotypic standard deviation. Also for dates of mating and birth and duration of pregnancy, a small effect of inbreeding was found. For litter size, a significant effect was found for both direct and maternal inbreeding. An increase in direct (maternal) inbreeding of 10% results in a

loss of 0.2 to 0.3 (0.3 to 0.4) kits, equivalent to 3% to 5% (5% to 7%) of the mean.

Animal Prod. Review, Applied Science Reports, 27, pp. 57-62, 1996. 3 tables, 7 refs. Author's summary.

Genetic and environmental factors affecting fertility traits in foxes

Hilkka Kenttämies

In Finland, 40% of the foxes are inseminated. Data from an AI project in 1990-1994 consisting of a total of 1749 pure-bred Silver fox and 2907 Blue fox mating records were analysed using ANOVA and animal model REML. Fixed effects of year, age of female, mating method and date of mating were significant on conception rate or whelping rate and litter size. Year and age of female affected nursing rate and date of heat. Random effects of farm and mating male were also obvious. In Silver foxes, the estimates of heritability based on records with several parities were 0.12 to 0.15 for litter size, 0.05 for whelping rate, 0.15 for nursing rate, and 0.09 for date of heat. In Blue foxes, the corresponding estimates were 0.03 to 0.06, 0.01, 0.05 and 0.18. Fairly large effects of common environment mostly resulted in moderate repeatabilities.

Animal Prod. Review, Applied Science Reports, 27, pp. 63-66, 1996. 1 table, 10 refs. Author's summary.

Applying the antisense RNA technology for inhibition of mink Aleutian disease virus proliferation

Oleg L. Serov, Vladimir M. Blinov, Oleg I. Serpinski, Galina V. Kochneva, Alexander V. Taranin, Olga Yu. Volkova, Ludmila V. Mechetina

This work is a part of the project for generation of the transgenic mink with inherited resistance to Aleutian disease virus (ADV)

infection. The project is based on antisense approach. Computer modelling analysis of the ADV DNA revealed two regions which do not contain elements of the secondary structure and can be accessible to hybridisation with exogenous antisense complementary RNA.

These regions contain the enhance-like elements, the TATA-box, the CAAT-box, as well as the transcription initiation and elements of translation initiation of NS1. The corresponding DNA sequences were generated using PCR and inserted into pRc/RSV vector containing the neomycin resistance gene.

The constructions were stably transfected into cells permissive for ADV infection. The transfected cells were cloned on selective media and their resistance to ADV infection was studied.

Animal Prod. Review, Applied Science Reports, 27, pp. 67-70, 1996. 9 refs. Authors' summary.

Embryonic mechanism underlying the formation of the *star* coat colour mutation in silver fox

Ludmila Prasolova

The embryonic mechanism of the Star mutation was studied in the skin of developing silver fox embryos. Mason's method demonstrated that melanoblasts enter the potentially depigmented skin areas of mutated embryos two days later than the pigmented areas of Standard fox.

It is suggested that derangement of melanoblasts - hair follicle cell interactions underlies the formation of the Star coat colour mutation.



Fig. 2. Phenotype of a fox homozygous - SS (a) and heterozygous - Ss (b) for the *Star* gene.

Animal Prod. Review, Applied Science Reports, 27, pp. 71-76, 1996.2 figs., 5 refs. Author's summary.

Assessment of genetic variability and genetic distance between wild and ranched American mink using microsatellites

A.M. Belliveau, M.O'Connell, A.H. Farid, J.M. Wright

Wild mink were first captured and ranched 140 years ago and have undergone years of intense selection for production traits under uniform environmental conditions compared to the wild. This may have led to a decrease in genetic variability within and an increase in genetic distance among different mink populations. Wild American mink (n=20) and ranched mink (20 each of black, pastels and wild-type), were assessed for

genetic variability and genetic distance using three different microsatellite loci. The wild mink had the lowest genetic variability (0.41) while the black mink had the highest (0.52). The lowest genetic distance was between the wild-type and pastel populations (0.08) and the highest was between the wild mink and the pastel (0.32).

Animal Prod. Review, Applied Science Reports, 27, pp. 77-80, 1996.3 tables, 1 fig., 6 refs. Authors' summary.

Influence of reduced daylight on reproductive and embryonic developmental parameters in mink

Rimma Gulevich, Galina Isakova, Dmitry Klotchkov

Influence of reduced daylight (8L:16D from July 22 till October 10) on reproductive and embryonic developmental parameters was investigated in mink of Standard and Sapphire genotypes. Percentage of barren females, unfertilised egg number and embryonic losses at single mating were less in experimental Sapphire mink than in control animals. On the contrary in the experimental Standard mink embryonic losses were increased.

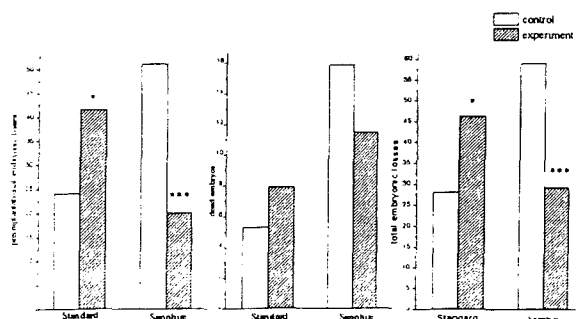


Fig. 2. Influence of reduced daylight on embryonic losses (%) on the 35th day of pregnancy. *-P<0.05; ***-P<0.001 comparison with control.

Animal Prod. Review, Applied Science Reports, 27, pp. 81-85, 1996. 2 figs., 18 refs. Authors' summary.

Cytogenetical mechanisms underlying the mink diapausing blastocyst size growth

Galina K. Isakova, Natalia N. Zholgoleva

Number of cells, size of cell nuclei and activity of the nucleolus organising regions were studied in the mink blastocysts during their delay in implantation. Polytenization of trophoblast cell nuclei till the DNA content of 16c - 512c, nonmitotic division of giant nuclei and extremely high nucleolar activity in the new cells were found to occur during the blastocyst size growth. Biological significance of the phenomenon discovered is discussed.

Animal Prod. Review, Applied Science Reports, 27, pp. 87-90, 1996. 2 tables, 7 refs. Authors' summary.

Cryobanking and embryo development of mustelidae species

Sergei Amstislavsky, Leonid F. Maksimovsky, Elena Kizilova, Yulia Ternovskaya, Dmitry Ternovsky

There are several endangered Mustelidae species to be saved and a variety of rare genotypes to be preserved. The aim was to adopt embryo cryobanking technology (embryo cryopreservation, embryo transfer, and superovulation) for preservation of mustelids. The results obtained with ferret and stoat embryos demonstrated that cryobanking of endangered or valuable mustelids is a real possibility. The viability of frozen-thawed embryos was evaluated by culturing them in vivo (stoat) or using fluorescein diacetate technique (ferret). To provide successful cryobanking, more has to be known about the reproductive biology of species to be cryopreserved and preimplantation embryo development is of particular interest in this respect. Stoat and ferret have been used as a model species for developing approaches to embryo transfer, superovulation, and investigation of preimplantation

embryo development in mustelid species. Stoats impregnated at early ages were used as embryo donors. Embryo development and superovulation after gonadotrophic treatment was studied in detail in these precociously mature stoats. It has been shown that superovulation response can be elicited in the right, but not left ovary of the stoat. Different models of embryo transfer have been used in ferret and stoat. Live-born pups developed well from transferred ferret embryos.

Animal Prod. Review, Applied Science Reports, 27, pp. 91-96, 1996. 1 fig., 10 refs. Authors' summary.

Cortisol biosynthesis during embryonic development in silver foxes under selection for domestic behaviour

Ludmila V. Osadchuk

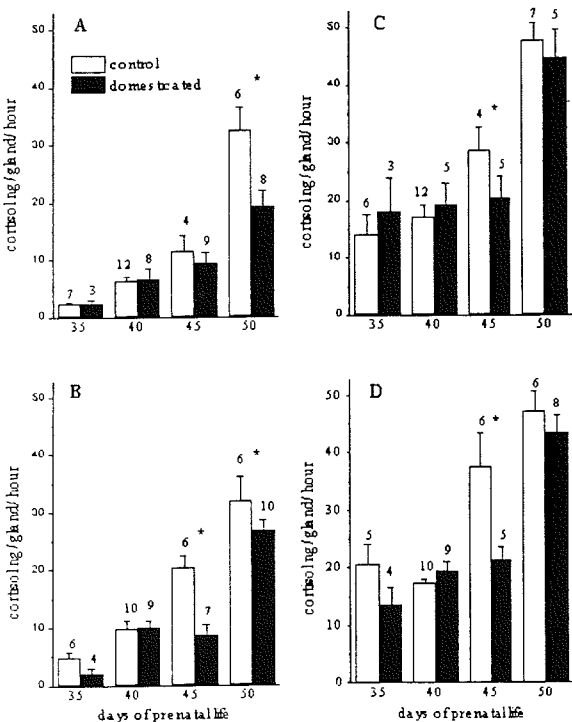


Fig. 2. Basal (A and B) and ACTH - stimulated (C and D) the *in vitro* cortisol production in female (A and C) and male (B and D) silver foxes during prenatal life.

A reduction of cortisol secretion occurred in adult silver foxes as a result of selection for domestic behaviour. To investigate the effects of selection for domestic behaviour on fetal cortisol biosynthesis, serum and adrenal cortisol levels and its *in vitro* production by adrenals were measured by RIA in embryos on days 35, 40, 45 and 50 of pregnancy. A decreased adrenal and serum cortisol content and its lower *in vitro* production were demonstrated in the domesticated group as compared with the control at the end of embryogenesis. ACTH increased the *in vitro* cortisol production but to smaller values in domesticated animals. The data have demonstrated that behavioural selection resulted in reduced cortisol biosynthesis and cortisol adrenal response to ACTH already during embryonic development.

Animal Prod. Review, Applied Science Reports, 27, pp. 97-102, 1996. 2 figs., 11 refs. Author's summary.

Development of the mammary glands during gestation and lactation in mink in relation to feeding intensity

Marian Brzozowski, Steen H. Møller

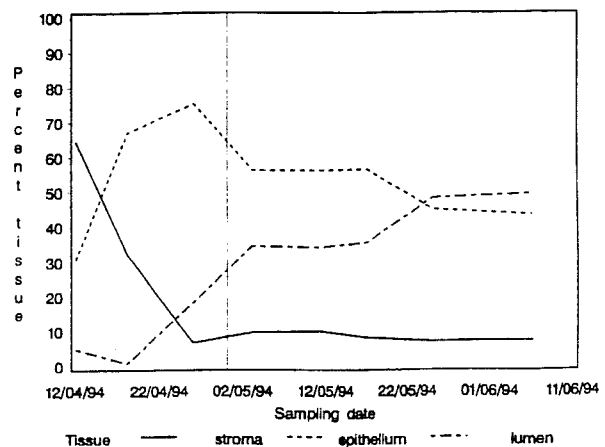


Fig. 1. Changes in the percentage area composition of tissue in the mammary gland during gestation and first lactation in normally fed mink females. Vertical line indicates parturition at April 30.

The mammary glands of mink are developed shortly before parturition. This period of rapid development is therefore of special interest to the milk producing capacity of the mink female. The objective of the present investigation was to describe the development and function of mammary glands during late gestation and lactation in mink, and the effect of normal vs. restrictive feeding (20% less than farm level) from early April until parturition. Each week from April 4 to June 9 one female from each group was sacrificed, the belly was cut off, gland tissue area was measured and biopsies of two glands per female were taken for microscopy. Percentage area of parenchyma, connective, fat, and other tissues was determined by microscopy.

The proportion of milk producing parenchyma increased from around 40% to above 80% during gestation, and remained high for the rest of the sampling period. The gland area increased as well. The relative area of alveolar lumen was highest in the restrictively fed group, indicating a negative effect on mammary gland development.

Animal Prod. Review, Applied Science Reports, 27, pp. 103-113, 1996. 1 table, 7 figs., 16 refs. Authors' summary.

Morphological examination of the mammary gland in polar fox females (*Alopex lagopus* L.) during lactation

W. Bielecki, W. Piusinskin, H. Sendekca, M. Brzozowski, A. Frindt, D. Dzierzanowska-Goryn, R. Glogowski

The aim of this study was to describe the histological structure of the mammary gland in polar fox females during the lactation period. Some regularity can be observed in tissues of polar fox mammary glands during the lactation period, especially in the alveo-

lus. At first lactation day the alveolar epithelium consists of flattened cells, with basophilhomogenous substance observed in some of the alveolar lumens.

In later lactation glandular epithelial cells were cuboidal or flattened. Gland tissue activity was observed in all detected milking periods, with the intensity of cellular activity decreasing during lactation.

Animal Prod. Review, Applied Science Reports, 27, pp. 115-120, 1996. 4 tables, 4 figs., 2 refs. Authors' summary.

Development of the mammary glands in female mink from weaning through first lactation

Steen H. Møller



Fig. 2. Average percentage area of parenchymal tissue in the mammary gland at each sampling, from 9 weeks before to 15 weeks after parturition. Vertical lines indicate parturition and weaning at 0 and 7 weeks, respectively.

With increasing litter size, the milk producing capacity of the mink female become increasingly important to the survival and development of kits. From other species it is

known that the capacity for milk production is affected by feeding, especially in periods of rapid growth. The present investigation was conducted in order to identify periods of special interest. At regular intervals from weaning through first lactation, 64 mammary samples were taken by biopsy from 24 anaesthetised scanblack mink female kits. Percentage area of parenchyma, connective, fat, and other tissues was determined by microscopy.

By 10-weeks of age, parenchymal structures were present in the skin near the teat. During the next 8 months development was very limited. From 7 weeks before until 4 weeks after parturition, the parenchyma increased from around 15% to almost 100% of the gland area. The greatest changes were during the last 3 weeks of gestation, where the main part of parenchymal proliferation of the gland took place.

Animal Prod. Review, Applied Science Reports, 27, pp. 121-128, 1996. 2 figs., 19 refs. Author's summary.

An analyse of reproduction results of blue fox vixens (*Alopex lagopus* L.) with particular consideration to loss of pups in a female population with disturbances in rearing of their newborn

Danuta Dzierzanowska-Goryn, Monika Gebaska

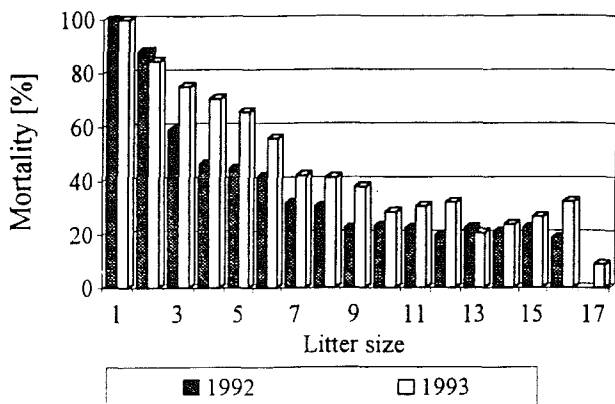


Fig. 1. The effect of litter size on cub mortality.

The subject matter of the work is an analysis of the reproduction of blue foxes; in particular, the cub mortality in a population of females with cubrearing difficulties. The total population involved in the study included 1791 females, during 1992 and 1993. The data were analysed by a least squares analysis of variance.

The results showed that the highest mortality was uncovered in the smallest litters, and occurred during the first and second week of cub life. The lowest mortality was observed among cubs born in April. The mother's age does not have a significant effect on cub mortality.

Animal Prod. Review, Applied Science Reports, 27, pp. 129-135, 1996. 1 table, 6 figs., 11 refs. Authors' summary.

Development changes in testicular size and spermatogenic activity in young male raccoon dogs

Piotr Niedbala, Olga Szeleszczuk

Studies were conducted on a total of 16 males aged from 3 to 12 months. Material for the studies was obtained through castration at the beginning of every month. The weight of testes from June to March increased from 0.3 to 5.6 g, as did the volume of testes from 0.164 to 5.327 cm³. Volume and weight of testes were highly correlated with body weight of the experimental animals. A pronounced increase in spermatogenesis was observed in September.

An increase in diameter and thickness of seminiferous tubules was highly correlated with increased testosterone levels in the blood serum. Maximum testosterone level was attained in January (15.81 mmol/l) before the mating season.

Animal Prod. Review, Applied Science Reports, 27, pp. 137-144, 1996. 2 tables, 6 figs., 9 refs. Authors' summary.

The effect of extender on the survivability of spermatozoa in diluted nutria semen (*Myocastor coypus*)

Olga Szeleszczuk

The aim of the study was to evaluate spermatozoa survivability in nutria semen diluted by the tested extenders. Trials with spermatozoa survivability were conducted in two temperature ranges: 43.5°C and 4°C. In addition, a test of spermatozoa resistance to 1% NaCl was performed. The spermatozoa survivability at 43.5°C was for R I and R II - 105 min. for R III - 45 min. At cold store temperature a cessation of spermatozoa motility was observed in the semen diluted with R I and R II extender after 72 h while with R III after 48 h. Resistance coefficient (R) was on average 864 (ranging from 600 - 1100). Based on the performed experiments it was found that R I extender containing TRIS and fructose proved to be more suitable for nutria semen dilution.

Animal Prod. Review, Applied Science Reports, 27, pp. 145-150, 1996. 4 tables, 17 refs. Author's summary.

Improvement of mink management by systematic operation programmes

Steen H. Møller

Mink production is characterised by Annual cycles of long quiet production periods followed by short labour intensive periods. Each period requires very different management, experience is gained slowly, and often helpers need introduction in intensive periods. To support the management, a systematic operation programme (SOP) for the mating and nursing periods of mink has been developed and tested on private farms.

A SOP systematises the management by describing all relevant operations in a certain parts or periods of production as a set of ob-

served situations that release actions, and as a set of periods or intervals in which actions should be carried out. Each situation observed is described clearly and unambiguously making the release of the action as independent as possible of the judgement of the herdsman. The development of SOPs is described and the concept and best use of SOPs in the mink productions is discussed. Based on the test on private farms, the best use of SOPs in the mink production seems to be in situations where new farmers are building up experience, different persons are involved in the operation, dissatisfactory results are continuously obtained in certain periods, as a tool for the adviser or a group of farmers for discussion of the coming production period or as a tool for the adviser to introduce new routines or topics based on new knowledge.

Animal Prod. Review, Applied Science Reports, 27, pp. 151-158, 1996. 2 tables, 4 refs. Author's summary.

Perspectives of application of the physiological-biochemical monitoring in fur animal breeding

N.N. Tyutyunnik, L.K. Kozhevnikova

On the basis of the data given it is expedient to note that the evaluation of the fur animals' physiological state according to a number of physiological-biochemical tests is necessary and sufficient for the control of their health. All these investigations have been carried out systematically during last years in the fur farms of Karelia. Having prophylactic character they are aimed at the protection from the further pathology deepening, evaluation of the perspectivity of the new feeds and biologically active compounds.

The present methods of physiological-biochemical monitoring can be used for any animal mass introduced in zooculture, tak-

ing into consideration specific features of their metabolism and some physiological functions.

Animal Prod. Review, Applied Science Reports, 27, pp. 159-165., 1996. 2 tables, 9 refs. Authors' conclusion.

Genotype - environment interactions in relation to selection for and against pelt chip in mink

Ulla Lund Nielsen

In a 5-generation selection experiment, separate lines of mink (*Mustela vison*) were selected for or against pelt nibbling (having nibbled its cage partner in the neck) at live grading in November. After 5 generations (1995) we moved old breeding animals (2-year olds) to another research farm to examine the genotype-environment interactions.

The results are clear. At both stations there is significant difference between the two lines. For animals with the same generation number - offspring from 1994 at one farm and offspring from 1995 at the other farm - the frequencies of pelt chip on the neck for the two lines were 47.5% and 3.4%, respectively, at one farm and 19.2% and 0.5%, respectively, at the other farm. Pelt chip on the body and at the tail showed the same trend in differences.

Movement to another environment showed an environmental effect. With the structure of the data it was not possible to differentiate between decidedly environmental factors (feed, management, etc.) or differences in the age of the parents.

Animal Prod. Review, Applied Science Reports, 27, pp. 167-172, 1996. 6 tables, 2 refs. Author's summary.

Lowering dietary electrolyte balance in lactation feed for mink stimulates milk production

Jan P.G. de Rond

This paper gives guidelines for the prevention of a syndrome in mink, commonly referred to as MMA (mastitis, metritis, agalactia) in other domestic animals. The most important preventive measure appears to be controlling the dietary electrolyte balance (dEB) during lactation.

A trial is reported which demonstrated that lowering the dEB enhanced the number of pups weaned with 0.25 pup per female. This could be explained as an effect of the change of the electrolyte balance in lactating mink.

Animal Prod. Review, Applied Science Reports, 27, pp. 173-182, 1996. 2 tables, 4 figs., 6 refs. Author's summary.

Mink kit growth performance in the suckling period - estimates of sources of variation

Bente Krogh Hansen, Peer Berg

Records of 4103 scanblack mink kits born in 1989-94 were used to estimate genetic parameters for body weight and body length during the growth season with special emphasis on the suckling period. Additive direct effect, maternal effect, and effect of permanent and specific environment were estimated, using REML in univariate and bivariate animal models. The direct additive variance for body weight decreased from $h_a^2=0.19$ at birth to $h_a^2=0.12$ at 4 weeks but increased to $h_a^2=0.50$ from August to December. The maternal genetic effect was constant the first 4 weeks after parturition at



$h_m^2 \approx 0.30$ for weight and decreased thereafter.

The permanent environment was important only at 2 and 4 weeks, $c_p^2 \approx 0.10$. The effect of the specific environment, common within the litter, increased from $c_s^2 = 0.24$ at birth to $c_s^2 \approx 0.40$ at 2 and 4 weeks and then decreased to $c_s^2 \approx 0.10$ in December. The results indicate that selection for maternal traits should be based on kit body weight at 4 weeks. The largest direct response for body weight would be obtained by selection on body weight in August-December.

Animal Prod. Review, Applied Science Reports, 27, pp. 183-189, 1996. 1 table, 22 refs. Authors' summary.

A new dominant mutant in mink (*Mustela vison* Schreber)

O.V. Trapezov, I.B. Tikhomirov, V.V. Tikhomirova

A novel coat colour mutation in mink was revealed in 1984 in the commercial state fur farm "Znamensky" near Toropec town, Tver region Russia. An ordinary dark coloured Standard female mink was observed to have 6 kits of Standard dark colour and one kit (female) with unusual colour of fur like "Cacao with milk". The colour of the winter coat of the new mutants also is near to "Cacao with milk" with the variation of "milk" expression. Various matings between the new colour phase and Standard mink were made for genetic studies. A total of 380 litters containing 2363 kits were analysed.

The total material averaged 5.3 ± 0.3 kits per litter, which is a typical mean litter size for the ranch bred mink and indicates that there had been no selective culling of kits prior to registration. The distribution of "Cacao with milk" kits among the offspring is a good approximation of the expected result with a dominant gene. The majority of the matings were between "Cacao with milk" mink and unrelated Standard coloured animals.

The matings were made reciprocally in regard to the sex of the parents, and the similarity of the two distributions excluded sex-linked inheritance. To date, 102 "Cacao with milk" to - "Cacao with milk" matings have been made, and the proportion of "Cacao with milk" offspring is consistent with an expected 3:1 ratio in "Cacao with milk" to Standard matings. The mutant gene has been designated as *Talitsa* (the name of the river where the fur farm is located) and symbolised by *Tl* in the Russian system of gene symbols.

The new *Talitsa* coat colour phase makes it possible to create other colour types by combining it with certain other wellknown mutations: *Talitsapastel* (*Tl/+b/b*), *Talitsaaleutian* (*Tl/+a/a*), *Talitsapearl* (*Tl/+k/k* p/p). The new *Talitsa* coat colour phase and its combination types attracted considerable attention of the mink breeders.

Animal Prod. Review, Applied Science Reports, 27, pp. 191-194, 1996. 1 table, 7 refs. Authors' summary.

The development and performance of a highly inbred strain of mink

Peer Berg

The development of a highly inbred strain of dark mink by half-sib matings is described, together with the reproductive performance of the strain in the period from 1986 to 1995. Earlier investigations showed decreased reproduction as a function of both direct and maternal inbreeding. However, the negative effect of inbreeding on the mean seems not to have continued in later generations. Inbreeding continues from the present level of 70%, with full-sib and parent-offspring matings.

Animal Prod. Review, Applied Science Reports, 27, pp. 195-197, 1996. 1 table, 1 fig., 3 refs. Author's summary.

Phenotypic and genetic variability of some reproductive features in blue fox (*Alopex lagopus*)

Grazyna Jezewska, Janusz Tarkowski, Grzegorz Niezgodna, Andrzej Jakubczak

The phenotypical and genetic parameters for some reproductive features were estimated in a population of 6000 blue foxes, bred on the fur-bearing animal farm Vera-Rol in Jeziory Wielkie for 11 years. Average values of kitting term defined as successive day of the year, number of pups at birth and after rearing were, respectively: 132 days, 8.1 and 5.7 pups. The least variability was characterised by kitting term - CV=12.9%, the highest, the number of pups after rearing - CV=56.9%. Simple correlations between kitting term and the other traits were close to zero, and for pups number at birth and after rearing the correlation coefficient was $r=0.6$. Estimated heritability and repeatability were in the range of values found in literature. Heritabilities for pups number at birth, after rearing and for kitting term were 0.15, 0.31 and 0.34, respectively. Repeatabilities of number of pups were similar and low - $r'=0.12-0.14$, and for kitting term - $r'=0.26$.

Animal Prod. Review, Applied Science Reports, 27, pp. 199-204, 1996. 3 tables, 1 fig., 6 refs. Authors' summary.

A modification trial of the evaluation and selection of polar blue fox (*Alopex lagopus* L.)

Stanislaw Socha

The work aimed at evaluation of selection indexes for Polar blue fox taking into consideration body size and fur quality. Selection based on selection indexes should lead to increased efficiency as compared to common mass selection. The paper presents

different selection indexes. Evaluated regression coefficients (b) and correlation between index and breeding value differed due to source of information, economic weight and number of traits. Based on own phenotype correlation varied between 0.455 and 0.603, while that from own plus full-sibs phenotype from 0.625 to 0.709. Evaluated values were usually higher for indexes with three or four traits than for index with five elements.

Sperman's rank correlation between phenotype evaluation by licence judgement or Station index and some of the presented indexes were positive and statistically significant but differentiated from mean up to high. It can be suggested that on the basis of selection criterion different animals could be left for further breeding.

Animal Prod. Review, Applied Science Reports, 27, pp. 205-211, 1996. 2 tables, 15 refs. Author's summary.

Trends and efficiency of polar blue fox (*Alopex lagopus* L.) selection

Stanislaw Socha

The work aimed at evaluation of genetic and phenotypic trends for fur traits and body size of animals as well as for expected genetic gain in a population of Polar blue foxes. Trends were evaluated based on seven years characteristics. Genetic trends were evaluated from regression of genetic group and time. Genetic group comprised of sires born in the same year and used in breeding for two years. Phenotypic trends were evaluated as a regression of the trait's value and time. Trends which were contemporary were presented in points and in percents of mean values of basal generation (F_0). The lowest values of genetic trends were stated for body size and general appearance. Values did not exceed 1% of the

positive change for one year. Colour intensity reached the highest value equalling 0.6% of the positive change in one year. Fur density and hair length equalled 0.3 and 0.4%, respectively. Phenotypic trends were higher than 1% for colour clarity and hair length. Positive trends are a proof of proper direction of breeding work whereas low values ascertain low efficiency of applied methods and criterions in fox selection. Expected breeding gain was higher than evaluated genetic trend for most of the analysed traits.

Animal Prod. Review, Applied Science Reports, 27, pp. 213-225, 1996. 4 tables, 12 refs. Author's summary.

The effect of age and mating date on some reproductive traits of silver fox vixens, *Vulpes vulpes*

Jozsef Lanszki, Jenő Udvardy, Zsolt Szendro

Data on 1160 mated silver fox vixens gathered in the course of six years on a Hungarian farm were analysed. The ratio of vixens not producing after one or two matings was: 50.0 and 10.4% ($P < 0.0001$), average 14.2%.

The CR depending on age of females at 1, 2, 3, 4, 5 and 6 yr: 76.7, 90.3, 91.8, 94.7, 94.2 and 92.3%, respectively ($P < 0.0001$), average 85.9%, the difference between years was significant ($P < 0.01$). The litter size per mated female at birth was: 3.43, 4.09, 4.52, 4.69, 4.77 and 4.87 ($P < 0.01$), average 4.01; at weaning (at 6 weeks of age) 2.71, 4.69, 4.77 and 4.87 ($P < 0.01$), average 3.27. The ratio of females losing the total litter before weaning was: 15.1, 12.4, 8.4, 9.0, 4.1 and 13.9% (NS), average 12.0%. The cub mortality up to weaning: 21.2, 15.9, 16.1, 17.7, 18.1 and 32.1% ($P < 0.0001$), average 18.6%. The CR accor-

ding to date of mating (January; February 1-14; February 15-28/29; March 1-15; after March 15) was: 85.7, 90.1, 91.4, 78.8 and 79.3% ($P < 0.0001$); the litter size per cubbed female at birth was: 5.00, 4.83, 4.73, 4.54 and 4.31 (NS), at weaning: 3.92, 3.96, 3.91, 3.63 and 3.08 ($P < 0.01$), respectively.

Animal Prod. Review, Applied Science Reports, 27, pp. 227-232, 1996. 4 tables, 7 refs. Authors' summary.

The effect of age on sexual activity of arctic silver fox males

Jozsef Lanszki, Jenő Udvardy, Krisztina, Lengyel

Data were analysed on 566 arctic fox and 385 silver fox males showing sexual activity between 1982-89 and 1987-92, respectively, using natural mating on a Hungarian farm. For arctic fox males, aged 1, 2, 3, 4, 5 and 6-7 yrs, the days between the first and last mating averaged 21.2, 28.4, 31.9, 30.8, 29.9 and 27.8 ($P < 0.0001$), respectively and the numbers of matings in the breeding season were 4.9, 7.4, 7.9, 8.0, 8.1 and 5.7 ($P < 0.0001$). The ratio of males with successful first mating between March 1 and 15; 16 and 31; and in April were 51% and 40% and 9%, respectively. For silver fox males aged 1, 2, 3 and 4 yrs, the days between the first and last mating averaged 18.4, 22.5, 23.5 and 25.8 ($P < 0.01$), respectively and the number of matings in the breeding season were 4.4, 6.7, 7.0 and 7.9 ($P < 0.01$). The ratio of males with a successful first mating in January and between February 1 and 14; 15 and 28/29 and in March were: 6, 56, 31.5 and 6.5%, respectively.

Animal Prod. Review, Applied Science Reports, 27, pp. 233-240, 1996. 6 tables, 8 refs. Authors' summary.



The growth and development of the body and its parts in New Zealand and wild rabbits and their crosses

Pavel Fl'ak, Jan Rafay, Jozef Bulla, Vavrinec Roman, Jaroslav Zelnik

The static growth analyses and development of the body and its parts were studied by the crossbreeding of New Zealand White (NZ) and Wild rabbits (W). The adult live weights were (NZ 4311 g and W 1922 g, crossbreeds ranked from 3000 to 3400 g). The weights of head, forelegs, thighs and trunk in crossbreeds had intermediate values. Similar results were found in the bone measurements. Statistical significant differences were found in all traits between genotypes and in most traits between sexes. We also observed significant interaction terms of genotype and sex in several traits. Significance of between genotype variability and GS interaction marked on existing genotype diversity.

Animal Prod. Review, Applied Science Reports, 27, pp. 241-244, 1996. 2 tables, 7 refs. Authors' summary.

Length of claws in coypus reared in different cages

Cholewa Ryszard

In 50 coypus of standard variety the length of claws was measured on all paws. The animals were reared in the same conditions in cages without access to bath water on solid, slatted or wire net floors. They remained in these cages from weaning at 12 weeks of age to slaughter at 30 weeks. The animals were related and of uniform size. The comparison of claw length showed rather low sex differentiation; thus the values for both sexes were pooled. Claw length did not much differ in forepaws on all kinds of floor on which the animals were reared.

The claws on the hind paws were longer than those on the forepaws. Their length increased depending on successive floor variant. In animals kept on solid floor they were considerably shorter than in those reared on other kinds of floor. The kind of floor could influence the length of claws on the hind paws which could cause the differentiation in this trait.

Animal Prod. Review, Applied Science Reports, 27, pp. 245-248, 1996. 1 table, 2 refs. Author's summary.

The age and the exterior trait values of chinchilla females

Malgorzata Sulik, Ryszard Cholewa

The assessment of chinchilla exterior is performed with the use of a 30-point scale in the first year of their life, when they are of the mature type of coat. To determine if there are any changes in the exterior trait values and whether they occur with age, animals from the breeding farm were taken into special assessment. The assessment included 348 standard variety chinchilla females at the age of 0.5-6 years. They were divided into six age groups, and the values of their exterior traits were analysed. The best scoring, i.e. 30 points, was obtained only by 1.72% of studied animals, and all of them were 1-2 years old. Among the youngest animals (0.5 year old), as many as 50% of them had gained the score of 28 points. In older chinchilla groups most individuals were of 26 points. The 2-3-year-old animals, on the other hand, had gained the worst assessment. It can be evident then that the exterior trait values of chinchilla females, which had been subjected to the assessment, may not change much with the age.

Animal Prod. Review, Applied Science Reports, 27, pp. 249-254, 1996. 2 tables, 6 refs. Authors' summary.

Influence of selected factors on fecundity in chinchilla (*Chinchilla velligera*) females

Iwona Szatkowska, Malgorzata Sulik

In the presented study an attempt was undertaken to determine the influence of parturition time, type of birth (the size of litter from which a female came) and parturition succession on the chinchilla fecundity rate. The analysis included 364 females used for breeding at a chinchilla breeding farm at Nowogard, taking into account their 1220 kittenings in total. It was found that females from multiple litters had the highest fecundity ratio up to the fourth parturition.

Animal Prod. Review, Applied Science Reports, 27, pp. 255-259, 1996. 3 tables, 9 refs. Authors' summary.

Values of exterior traits in chinchilla females originating from litters of different size

Ryszard Cholewa, Malgorzata Sulik

In October 1994, a 30-point scale was used for estimating exterior in 329 chinchilla females of Standard variety. They differed in age and were born in litters of different sizes. The evaluation concerned the following traits: 1. body conformation, 2. coat structure, 3. purity, 4. colour and 5. white colour zone. These traits were analysed taking into consideration the size of litters in individual years of females birth. The first four traits and the total sum of their values changed depending on the size of litters in

which the animals were born. This differentiation was observed in all age groups. The evaluation of exterior in animals born in the litters of the same size showed that the sum of points for exterior traits in one year old females was higher than those in older animals. The highest were values of individual traits in the animals originating from litters of medium size (2-3 cubs).

Animal Prod. Review, Applied Science Reports, 27, pp. 261-264, 1996. 1 table, 3 refs. Authors' summary.

Preliminary study of chinchilla (*Chinchilla velligera*) semen quality in the context of its practical employment in selection

I. Szatkowska, M. Sulik, J. Udala

This study was aimed at the attempt to determine the best possible conditions for collection and evaluation of chinchilla semen in the context of their practical employment during selection. The semen was collected from 28 males from the chinchilla breeding farm at Nowogard. The following traits were taken into evaluation: semen density, mass motility and spermatozoa progressive motility, spermatozoa major and minor morphological defects, and the percentage of spermatozoa with an intact acrosome. It was found that as many as 28.5% of males should not be used for breeding, due to the questionable quality of their semen.

Animal Prod. Review, Applied Science Reports, 27, pp. 265-271, 1996. 1 table, 4 figs., 4 refs. Authors' summary.



NUTRITION

Influence of protein quantity and quality on mink

T. Dahlman, P. Niemelä, T. Kiiskinen, J. Mäkelä, H. Korhonen

A three-year protein project with dark mink was started in early July, 1995. In this project different types of protein feeds and their effects on breeding result, growth and skin quality are determined as well as the digestibility and content of amino acids. In the present study, several types of protein supplements at two different levels were fed from weaning to pelting. Feed consumption, weight gain, hemoglobin, histological analyses and skin quality were measured. The group fed a high level of low-quality protein had a significantly higher feed consumption and lower skin length in comparison with the other groups. In other skin quality variables, no statistically significant differences were found. Conclusively, these results indicate that increasing the amount of low-quality protein would not only be useless but it might also have some adverse effects on mink production parameters.

Animal Prod. Review, Applied Science Reports, 28, pp. 9-14, 1996. 3 tables, 2 figs., 7 refs. Authors' summary.

Requirements of essential amino acids for mink in the growing-furring period

Christian Friis Børsting, Tove Nørgaard Clausen

The aim of the present project was to determine the requirements of protein and individual amino acids for mink during the growing-furring period. Five experiments comprising 2 to 5 groups fed increasing levels of protein were performed. Simultaneously, four experiments applying - for the first time in mink - the ideal protein concept

for utilising up to 50% of all essential amino acids in crystalline form were carried out in order to study the effect of reducing the amount of individual amino acids. It was found that the requirements of all essential amino acids are normally met when 25-30% of metabolisable energy (ME) is from protein. Deficiency in sulphur containing amino acids, especially methionine, resulted in the most pronounced effects on fur quality.

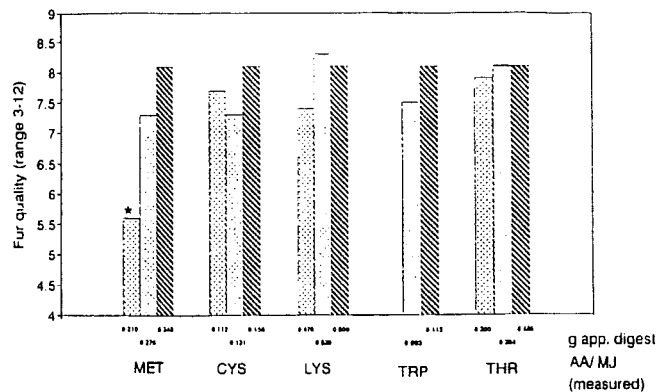


Fig. 1. Fur quality of scanblack male mink fed varying levels of individual amino acids.

Therefore, methionine is considered the first limiting amino acid in diets composed of the protein sources traditionally used in mink feed. The requirements of methionine for mink is approx. 2,7-fold higher than for pigs. The supply of threonine, lysine, and tryptophan had only little influence on fur quality. The requirements of cystine, threonine, lysine and tryptophan per unit ME were measured to be only 0-20% higher than those for pigs. The supply of histidine, phenylalanine, tyrosine, leucine, isoleucine and valine are not limiting for mink performance under practical conditions. The requirements set for these amino acids can be considered only as maximal requirements. Based on the effects on growth, health, fur quality and skin length the following requirements of the essential amino acids were determined (g apparent digestible amino acids/MJ ME): Methionine: 0.38; cystine: 0.14; lysine: 0.65; tryptophan: 0.12;

threonine: 0.40; histidine: <0.38; phenylalanine: <0.69; tyrosine: <0.43; leucine: <1.20; isoleucine: <0.62 and valine: <0.84.

Animal Prod. Review, Applied Science Reports, 28, pp. 15-24, 1996. 4 tables, 1 fig., 9 refs. Authors' summary.

Investigation on the experimental techniques for determination of metabolic fecal nitrogen and amino acid excretion in mink

Margot B. White, Derek M. Anderson, Kirsti I. Rouvinen

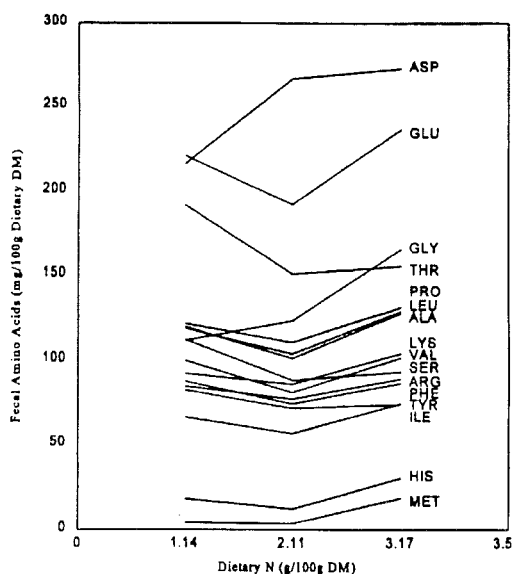


Fig. 2. Effect of feeding graded levels of herring on fecal excretion of amino acids in mink.

The aim of this investigation was to estimate excretion of metabolic fecal nitrogen (MFN) and amino acids (MFAAs) in mink using 2 different experimental techniques. Twelve mature standard type mink were confined to metabolic cages equipped for quantitative feeding and collection of feces and urine. The trial consisted of an 11-day period, having a six day adjustment followed by a

five day collection. Experimental diets were prepared by adding graded levels of herring to a semipurified protein-free diet to provide low levels of N (0, 1.14, 2.11 and 3.17%). The amounts of MFN and MFAAs excretion in mink were determined indirectly by feeding graded levels of N and extrapolating to 0% N (503 mg N, 100 g dietary DM⁻¹) and directly through the use of a protein-free diet (494 mg N, 100 g dietary DM⁻¹). The excretion of MFAAs determined with the indirect regression method were lower (-1/4 less) than those obtained with the direct, protein-free method.

Animal Prod. Review, Applied Science Reports, 28, pp. 25-30, 1996. 1 table, 2 figs., 8 refs. Authors' summary.

Dietary manipulations to reduce ammonia liberation from mink manure

Kirsti I. Rouvinen, Cory W. Newell, Margot B. White, Derek M. Anderson

The objective of this study was to reduce ammonia liberation from mink manure by supplementing the diets with graded levels of formic acid (pH 5.5, 6.0, 6.5, 7.0). *Yucca shidigera* extract (0, 175, 350, 500 ppm), or *Sphagnum sp.* peat moss (0, 0.4, 0.8, 1.2%). Three nitrogen balance trials were conducted with standard male mink during the growing-furring season. Each trial was run with 24 mink according to completely randomised design in two experimental periods. Each period had a 4-day adjustment followed by a 3-day total collection. Nitrogen (N) intake, N excretion and N balance were calculated. Total N and ammoniacal N was determined on fresh faeces samples and samples left uncovered for five days to determine nitrogen liberation. Peat fed at 0.8% of the diet showed a significant increase compared to the control diet in feed DM intake, N excretion and N balance ($P < 0.0$). Dietary supplementation with peat moss of

Yucca shidigera at the studied levels did not affect ammonia liberation, however, acidifying the diet to pH 5.5 with formic acid increased nitrogen loss from mink manure.

Animal Prod. Review, Applied Science Reports, 28, pp. 31-36, 1996. 3 tables, 7 refs. Authors' summary.

Use of animal and plant fats in mink feeding

Manfred O. Lorek, Andrzej Gugolek, Tadeusz Rotkiewicz, Marek Podbielski

The objective of the studies was to determine the possibility of using unconventional energetic feeds for growing mink.

A whey-fat concentrate was used, consisting of dried whey with pork fat and "00" rape seed flakes added to the diet at the rate of 10 and 5%.

Analyses were performed of body weight and pelt quality, as well as of the morphological changes in the internal organs.

The best results were obtained in the group of animals fed the feeds supplemented with whey-fat concentrate, the worst in the case of animals fed flaked rape supplemented diet.

Animal Prod. Review, Applied Science Reports, 28, pp. 37-46, 1996. 5 tables, 12 refs. Authors' summary.

Hyperchylomicronaemia in mink caused by lack of lipoprotein lipase

Knut Nordstoga, Bjørn Christophersen

The term hyperlipaemia is used to describe conditions characterized by raised levels of one or more lipid fractions in plasma. A familial type of hyperlipaemia, with pronounced elevation of total plasma lipids and

triglycerides has been known in mink in Norway for some years. We have now shown that the condition is caused by deficiency of the enzyme lipoprotein lipase; the function of this enzyme is to hydrolyse triglycerides to chylomicrons and very low density lipoprotein. The condition in mink seems to be a useful animal model for the study of a corresponding ailment in humans.

Animal Prod. Review, Applied Science Reports, 28, pp. 47-49, 1996. 1 table, 4 refs. Authors' summary.

Inclusion of fish fat in mink diets

Ricarda M. Engberg, Christian F. Børsting

The effect of feeding high amounts of oxidized fatty fish (mackerel) and fish oil (55% of metabolizable energy) on growth and health was examined in a series of experiments with mink. The fat sources chosen were fed either fresh or oxidized with or without stabilization by a synthetic antioxidant. The feeding of unstabilized fish oil especially of the oxidized oil (200 and 400 meq. O₂/kg oil) resulted in low plasma α -tocopherol concentrations and anemia characterized by a decrease in the erythrocyte number and hemoglobin content. The anemia was accompanied by an elevated number of platelets. With increasing rancidity of the oil the number of segmented neutrophile leucocytes increased as a sign of enhanced phagocytosis following cell damage. Histopathological changes related to the quality of the dietary oil quality were seen in the form of diffuse or centrilobular fatty infiltrations of liver and single liver cell necrosis. All the above mentioned severe pathological findings were not very pronounced in growing male mink following intake of fresh and oxidized fish oil with more moderate peroxide values (10-100 meq. O₂/kg oil) stabilized with ethoxyquin. However, females fed these oils during rearing, reproduction and lactation were very severely af-

fectured with respect to reproduction performance and health. The addition of vitamin E at concentrations of 14.3 mg/MJ ME to diets with poor fat quality could effectively prevent severe pathological changes due to oxidative stress.

Animal Prod. Review, Applied Science Reports, 28, pp. 51-59, 1996. 4 tables, 10 refs. Authors' summary.

Marine fat versus carbohydrates as energy sources in diets for blue foxes in the reproduction period

Øystein Ahlstrøm, Anders Skrede

The experiment was carried out to study the effects of marine fat in diets for blue foxes in the reproduction period. Fat from marine sources as accounted for 9, 30 and 44% of metabolizable energy (ME) whereas corresponding carbohydrate levels were 32, 16 and 4% of ME, respectively. The diet containing the highest ratio of marine fat:carbohydrates resulted in an extremely high kit mortality (75%) compared with the other diets. This negative effect on kit viability appeared not to be caused by the fish fat as such, but was more likely caused by a suboptimal supply of glucose due to the extremely low level of dietary carbohydrate. This was indicated by ketogenesis in females receiving this diet 1-2 days after parturition. The present study indicates that blue foxes can consume high levels of marine fat in the reproduction period, but a minimum of dietary carbohydrates is required to ensure glucose supply.

Animal Prod. Review, Applied Science Reports, 28, pp. 61-65, 1996. 3 tables, 4 refs. Authors' summary.

The influence of dietary fibre on nutrient digestibility in polar foxes

Roman Szymeczko, Henryk Bieguszewski, Katarzyna Burlikowska

The aim of this study was to examine the effect of variations in fibre content on nutrient digestibility in twenty five polar foxes divided into control group and four experimental groups. The control animals were fed a balanced meat-fish diet without wheat bran. The experimental foxes were kept on the control feed to which was added adequate quantities of wheat bran to receive 1, 3, 5, and 7% of crude fibre in the diets, respectively. Apparent digestibility of dry matter decreased from 86.01 to 65.80% and crude fibre from 84.35 to 43.92% with added fibre. Responses of nitrogen and fat were less pronounced but higher fibre concentration than 1 and 3% caused a significant decline of fat and nitrogen assimilation. The increase of dietary fibre content evoked the apparent digestibility of all of the amino acids.

Animal Prod. Review, Applied Science Reports, 28, pp. 67-72, 1996. 3 tables, 2 figs., 11 refs. Authors' summary.

Digestive enzyme pattern in various fur-bearing animals

Victor M. Oleinik

The aim of the present work was to reveal the peculiarities of enzyme patterns in the digestive tracts in different fur-bearing animals. The activity of digestive enzymes was estimated in the stomach, pancreas and small intestine in mink, ferret, blue fox, silver fox and raccoon dog. The first four spe-



cies had a powerful proteolytic enzymatic chain and low-power carbohydrase and lipolitic ones. Much lower activity of pepsin in the stomach and much higher activity of amylase and lipase in the pancreas was found in the raccoon dog. The latter has much in common with omnivorous animals in the digestive enzyme pattern.

Animal Prod. Review, Applied Science Reports, 28, pp. 73-76, 1996. 1 table, 8 refs. Authors' summary.

Phosphoric acid in modern mink and fox nutrition

William L. Leoschke

For a period of 40 years, phosphoric acid at a dietary level of 1.5% (dehydrated basis) has proven useful as a mink feed preservative and as an effective prophylactic program for minimizing the formation of urinary calculi in mink and fox. Recent field observations indicative of the relative ineffectiveness of this nutritional basis for bladder stone prevention prompted the employment of a 25% increase in dietary phosphoric acid concentration with the net result of field observations indicating (a) superior mink feed preservation, (b) minimal incidence of urinary calculi and (c) reduced incidence of wet-belly disease of the mink manifestations.

Animal Prod. Review, Applied Science Reports, 28, pp. 77-78, 1996. 4 refs. Authors' summary.

Preserved slaughter-house offal as mink feed

I. Pölönen, P. Niemelä, Y. Xiao, L. Jalkanen, H. Korhonen, J. Mäkelä

A year-round production trial, starting with weaned mink was carried out in order to evaluate formic acid - sodium benzoate preserved slaughter-house offal as mink feed. Based on the weight development, skin

quality and histological evaluation of livers and testicles, use of preserved offal does not have a detrimental effect on animal health or performance. However, the highest inclusion of the preserved offal (26%) caused a slight reduction in preweaning growth of kits. In conclusion, the recently introduced preservation method for slaughter-house offal is welcome. It improves offal hygiene and protects ready mixed feed from yeast fermentation. It also makes offal handling and use very convenient in practice, prevents environment contamination and compared to frozen storage brings significant savings to feed costs.

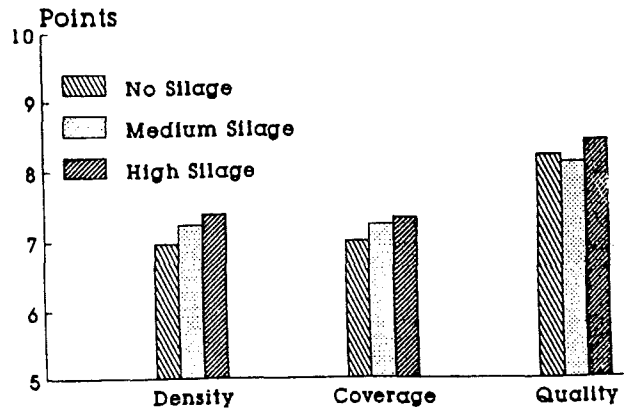


Fig. 2. Hair quality. There were no statistically significant differences between the treatment means.

Animal Prod. Review, Applied Science Reports, 28, pp. 79-86, 1996. 3 tables, 3 figs., 13 refs. Authors' summary.

Effects of dietary salt supplementation on clinical and subclinical nursing sickness in lactating mink (*Mustela vison*)

Tove N. Clausen, Søren Wamberg, Otto Hansen

An investigation of the consequences of a varying salt content in the feed for mink dams in the nursing period was carried out. Two groups of female standard mink (115 dams per group), were treated equally except for a difference in feed salt content. The females fed the basis diet containing 0.53 g

NaCl/MJ had significantly higher weight loss in the nursing period than the females fed the diet with 1.00 g NaCl/MJ. In the group fed the low-salt diet (group 12), 22% of the females developed nursing sickness, compared to 7% in the high-salt group (group 8). A dietary salt content of 1.00 g NaCl/MJ for nursing mink was recommended.

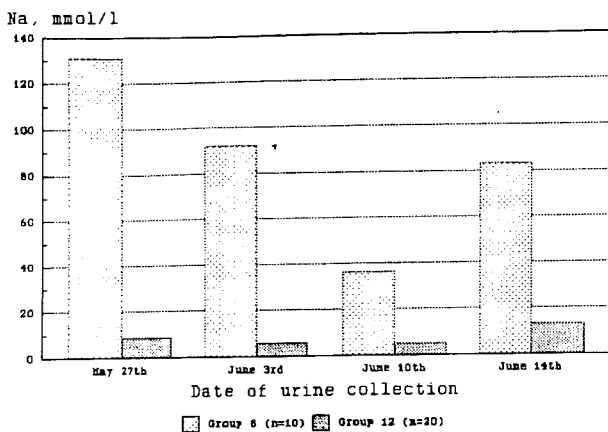


Fig. 1. Na in urine of female mink during the nursing period.

Animal Prod. Review, Applied Science Reports, 28, pp. 87-91, 1996. 2 tables, 2 figs., 8 refs. Authors' summary.

Raw ground herring (*Clupea harengus*) and acid or fermented herring silages as feedstuffs for mink

Margot B. White, Derek M. Anderson, Kirsti I. Rouvinen

Digestibility coefficients (DC) of dry matter (DM), crude protein (CP), crude fat (CF), gross energy (GE) and amino acids (Aas) of three test feedstuffs from whole herring, raw ground herring (RGH), acid silage (ASH) and fermented silage (FSH) were determined with mink using the total collection method. The ASH was prepared with the addition of 2.5% (w:w) formic acid (conc. 85%) and 200 ppm antioxidant

(ethoxyquin) to raw ground herring. The FSH was produced with the addition of the commercial biopreservative Marisil® (Finn Sugar), (1%) and extruded wheat (15%) to the raw ground herring. The trial consisted of three, 11-day periods, each having a six day adjustment followed by a five day collection. Experimental diets were prepared by adding graded levels (0, 15, 30 or 45%) of the test feedstuffs to a basal diet balanced to contain 35:45:20 (CP:CF:Carbohydrate). The DC of DM, CP, CF and GE for the RGH, ASH and FSH were 0.86, 0.90, 0.99, 0.93 and 0.93, 0.94, 1.00, 0.95 and 0.85, 0.88, 1.00, 0.92 respectively. The DC in RGH, ASH and FSH were 0.94, 0.98, 0.94 for lysine and 0.95, 0.98, 0.97 for methionine, respectively. The high availability of nutrients in the herring feedstuffs tested indicates a quality ingredient for mink diets.

Animal Prod. Review, Applied Science Reports, 28, pp. 93-98, 1996. 4 tables, 4 refs. Authors' summary.

Maximizing the proportion of fresh poultry waste in the feeding of blue foxes

Stanislaw Niedzwiadek, Jan Zajac, Pawel Bielanski, Andrzej Zon

In the region of south-eastern Poland, the main feed sources for carnivorous fur bearers are poultry waste (63%), followed by meat and slaughter waste of large mammals (25%).

Studies at the National Research Institute of Animal Production Experimental Station in Chorzew were conducted to determine the upper limit (in %) of a fresh poultry waste ration in the feeding of arctic foxes.

The studies involved arctic foxes of both sexes divided into four experimental groups with regard to two feeding periods, of intensive rearing of young foxes and of winter hair coat forming. The poultry waste

accounted for 29, 31, 38 and 50% depending on the group in the first period, and 10, 20, 30 and 50% in the second.

The results showed that the experimental animals fed the highest proportion of poultry waste in both periods had the highest body weight in relation to the rest of animals and the control group. Preliminary analysis of fur value showed no significant differences among the groups.

Animal Prod. Review, Applied Science Reports, 28, pp. 99-104, 1996. 3 tables, 14 refs. Authors' summary.

The variability of hematological indices in polar fox blood at different times after feeding

Beata Glowinska, Roman Szymeczko, Katarzyna Burlikowska, Romuald Rajs, Monika Boguslawska

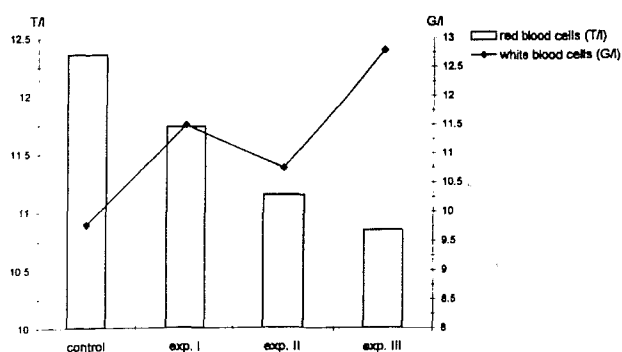


Fig. 2. The number of red and white blood cells in polar fox blood at different times after feeding.

The aim of the study was to estimate the variability of some morphological and biochemical indices in polar fox blood at different times after feeding.

The experiment was carried out with 10 polar foxes (females) fed the standard dry diet. Blood samples were collected from the foxes four times: 2 hours before feeding and 1, 3 and 7 hours after feeding.

Analysis of the results showed a statistically significant decrease of hemoglobin content, haematocrit indice and number of red blood cells in each tested period after feeding. A statistically significant increase of total protein content and urea level in blood plasma in each period after feeding was observed.

Animal Prod. Review, Applied Science Reports, 28, pp. 109-112, 1996. 1 table, 5 figs., 6 refs. Authors' summary.

The variability of thyroid hormones level and plasma protein fractions in polar fox blood at different times after feeding

Romuald Rajs, Beata Glowinska, Roman Szymeczko, Monika Boguslawska, Katarzyna Burlikowska

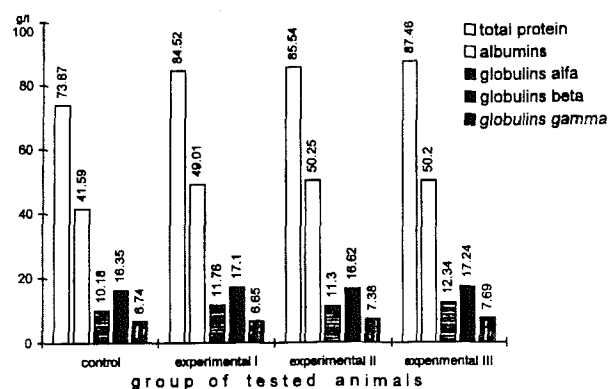


Fig. 3. The level of plasma protein fractions of polar fox blood at different times after feeding.

The purpose of this experiment was to determine triiodothyronine (T₃) and thyroxine (T₄) concentration and the level of plasma protein fractions in 10 adult polar fox females at different times after feeding.

Blood samples were collected from the animals 2 hours before feeding and 1, 3 and 7 hours after feeding. The level of T₃ and T₄ was estimated by the radioimmunity method with a kit of RIA. The division of plasma protein was determined by low-

plasma protein was determined by low-voltage blotting-paper electrophoresis. Analysis of the results showed a statistically significant increase of T_3 concentration 1 hour after feeding. In the second tested period (3 hours after feeding) the level of T_3 decreased and then (7 hours after feeding) neared the value before feeding. There was no difference in T_4 concentration. A statistically significant increase of albumin fraction level in each period after feeding was observed.

Animal Prod. Review, Applied Science Reports, 28, pp. 113-118, 1996. 3 tables, 3 figs., 13 refs. Authors' summary.

Studies on restricted feeding of carnivorous fur animals

Andrzej Zon, Stanislaw Niedzwiadek, Pawel Bielanski, Jan Zajac

It was found that traditional feeding of foxes in the period before reproduction with high monthly temperatures made the animals too fat, which delayed the onset of their breeding season and decreased the breeding indices.

The foxes fed on a restricted diet achieved good breeding condition, measured by a decrease in the body weight by 15.4 to 17.1%. In the same period, the females fed on a traditional diet lost 12.0%, while the males only 9.3% of their body weight. The breeding season of the foxes fed on half a diet daily started about 7 days earlier than that of the traditionally fed foxes. In the groups fed on a restrictive diet before the breeding period, a higher percentage of females mated and gave birth, and a smaller percentage of barren females was achieved than with the traditionally fed females.

Animal Prod. Review, Applied Science Reports, 28, pp. 119-125, 1996. 2 tables, 17 refs. Authors' summary.

Utilization of protein and other nutrients by nutria fed diets supplemented with feeds of animal origin

Boguslaw Barabasz, Stanislaw Jarosz

Digestibility of protein as well as proteolytic enzyme activity and the number of microorganisms in the digestive tract were examined in nutria fed vegetable diets supplemented with feed of animal origin (powdered milk, meat-bone meal, casein, blood meal) meeting about 20% of their total requirement for protein. Protein digestibility coefficients in the experimental groups ranged from 71.5% to 78.8%, however, the highest digestibility was obtained with rations supplemented with casein while the lowest one when diets were supplemented with powdered milk. The highest digestibility of fat was found in animals fed rations supplemented with powdered milk. Proteolytic enzyme activity in the digestive tract was significantly higher in animals fed the rations supplemented with the components of animal origin than in those fed exclusively vegetable feeds.

Animal Prod. Review, Applied Science Reports, 28, pp. 127-133, 1996. 2 tables, 11 refs. Authors' summary.

Utilization of cod fillet in mink nutrition

Dusan Mertin, Karin Suvegova, Jan Rafay, Boguslaw Barabasz, Zuzana Ceresnakova

The balance experiment was performed with five male mink at the age of 4 months in RIAP Nitra in August-September 1995.

The experiment was divided into three periods: the basic feed ration, the feed ration in the second period included 41% and in the third period 62.5% cod fillet. Digestibility of the studied feed was observed. The results of the study showed that the digestibility of the feed ration rose proportionale with

higher cod fillet content - the digestibility in the first period was 67.661%, 72.327% in second period, and 82.563% in the third period.

Animal Prod. Review, Applied Science Reports, 28, pp. 135-141, 1996. 6 tables, 10 refs. Authors' summary.

Excretion rates of urinary water, electrolyte and nitrogen in fed and fasted female mink (*Mustela vison*)

S. Wamberg, J. Elnif, A.-H. Tauson

Accurate determination of daily urinary excretion rates of xenobiotics, dietary constituents and end products of metabolism in experimental animals is a prerequisite for measurements of renal function and for the evaluation of nutritional requirements. In balance studies with small carnivores whole-body balances are usually over-estimated because of the excretion of a highly concentrated urine and because of their habit of squirting.

In the present study we have used implanted osmotic pumps containing labelled p-aminohippuric acid (PAH) and inulin (IN) for accurate determination of quantitative urine collection in conscious mink (Wamberg et al., 1996). Ten female mink of the pastel type, weighing 1100±34 g, had a 2-ml Alzet® osmotic pump, containing known amounts of [³H]-PAH (1.95 Mbq/ml) and [¹⁴C]-IN (0.92 MB1/ml), implanted intraperitoneally during ketamine anaesthesia. The in vitro pumping rate (9.96±0.12 µl/h; n=10) of the pumps measured at 39.0°C verified the nominal value (10.00±0.46 µl/h) supplied by the manufacturer. On recovery the animals were maintained in

metabolic cages on a conventional mink diet and studied for a 5-day feeding period followed by a 2-day fast. Drinking water was available ad lib throughout the study. In the fed animals the recovery rates of [³H]-PAH and [¹⁴C]-IN were almost identical (77.0±8.3% vs. 77.2±7.4%), and a little lower in fasted animals (72.2±17.2% vs. 71.1±13.0%). The glomerular filtration rate (GFR) was calculated as the renal clearance of [¹⁴C]-inulin.

The results (mean±sd) obtained in fed and fasted mink, corrected to 100% recovery, are presented in the table below. During feeding urinary volume was not influenced by the experiment, whereas short-term fasting caused a dramatic reduction in GFR and in daily urinary water and solute excretion, due to withdrawal of the normal dietary protein and water load.

Urinary excretion rate	Fed mink	Fasted mink
Urine, g/d	87 ± 32 ^a	22 ± 7
Sodium, mmol/d	2.3 ± 0.9	0.1 ± 0.1
Potassium, mmol/d	8.4 ± 2.7	1.3 ± 0.2
Urea, mmol/d	119 ± 37	12.0 ± 2.9
Creatinine, mmol/d	0.53 ± 0.09	0.18 ± 0.03
Total nitrogen, g/d	3.64 ± 1.18	0.65 ± 0.14
GFR, ml/min	7.66 ± 2.82 ^b	3.93 ± 0.52 ^b

^aValues are mean±sd (n=10), ^bexcept for GFR (n=15)

Reference: Wamberg, S., Elnif, J. & Tauson, A.-H. 1996. Assessment of the accuracy of quantitative urine collection in mink (*Mustela vison*) using osmotic pumps for continuous release of p-aminohippuric acid and inulin. *Laboratory Animals* 30, 267-273.

Poster section VI.



PATHOLOGY AND DISEASES

Analysis of Aleutian mink disease parvovirus types in Denmark

Elisabeth Gottschalck, Aase Uttenthal, Jørgen Østergård, Mogens Hansen, Per Henriksen

Sequence analysis of Aleutian mink disease parvovirus (ADV) DNA have shown that different sequence types are present and they have up to 12% nucleotide differences. This knowledge was used to distinguish between different Danish ADV isolates, which has not been possible by serology. DNA was isolated from the mink mesenteric lymph node, and by the PCR technique regions of 500 to 900 base pair ADV DNA were amplified. The fragments were added restriction enzymes and recognised by gelelectroforese. The differences in digestion pattern are used for the ADV DNA typing.

Animal Prod. Review, Applied Science Reports, 28, pp. 145-148, 1996. 1 table, 3 refs. Authors' summary.

Evaluation of the polymerase chain reaction (PCR) as a tool for diagnosing infections with the Aleutian mink disease parvovirus (ADV) and for discriminating among various ADV isolates

Marshall E. Bloom, Katrina L. Oie, James B. Wolfenbarger, Gary R. Durrant

We compared the sensitivity of PCR and counterimmune electrophoresis (CEP) in detecting infection in 94 serum samples collected from commercial mink ranches during an outbreak of ADV in Utah. A single round of PCR, amplifying a 0.6 kilobase pair hypervariable portion of the ADV capsid gene, can identify fg of ADV DNA in 2.5

ml of serum, equivalent to <4,000 viral genomes/ml of serum. Results of the 2 assays agreed 85% of the time. Of serums positive by either or both assays, CEP was more effective (97%) than PCR (62%) in identifying the presence of ADV infection. Thus, for routine screening in a field setting, the determination of anti-ADV antibody by CEP was a superior diagnostic assay to the detection of ADV DNA by PCR.

DNA sequence comparisons of the hypervariable region captured in the diagnostic PCR was done with the known pathogenic isolates of ADV. Polymorphisms for several restriction enzyme recognition sites were noted. By performing restriction enzyme analysis on the PCR amplification products from serum, it was possible to discriminate DNA from several distinct pathogenic and non pathogenic isolates of virus.

This method may be suitable for identifying the particular isolate of ADV causing outbreaks on commercial mink ranches.

The full paper was published in *Journal of Virology*, 1996.

Animal Prod. Review, Applied Science Reports, 28, pp. 149, 1996. Authors' summary.

Further development of dot-immuno-binding assay for diagnostics of mink Aleutian disease

Alexander V. Taranin, Svetlana M. Miroshnikenko, Olga Yu. Volkova, Vasily G. Djachenko

We have previously described a dot immunobinding assay (DIA) on nitrocellulose as an alternative to counterimmuno-electro-

phoresis in Aleutian disease diagnostics. The assay procedure was further improved by employing alkaline phosphatase as the enzyme label instead of horse radish peroxidase.

This resulted in a higher sensitivity (4-fold) of DIA and dramatically increased the intensity of the colour reaction. Consumption of virus antigen per test decreased 2-fold. To utilize the advantages of DIA, we developed an economic procedure of blood sampling and processing excluding capillary tubes.

The whole procedure of sampling and testing using DIA significantly decreases expenses on AD diagnostics without losses in detection capacity.

Animal Prod. Review, Applied Science Reports, 28, pp. 151-156, 1996. 1 table, 2 figs., 4 refs. Authors' summary.

Immune modulators diminish mortality from Aleutian disease and other causes of mortality in mink

LeGrande C. Ellis

Mink of several colour phases were implanted with one of three silastic implants containing either melatonin or two other immune modulating compounds to ascertain if they would ensure protection against Aleutian disease.

All three compounds afforded protection against the virus infection and some other non-diagnosed disease agents. All blue iris mink treated with the two non-melatonin compounds and injected with the virus died, whereas only one dark mink succumbed. The two non-melatonin compounds did not appear to disrupt reproduction as melatonin does. All three com-

pounds were more effective when given to mink before being exposed to the virus than after becoming infected.

Animal Prod. Review, Applied Science Reports, 28, pp. 157-160, 1996. 19 refs. Authors' summary.

New trends in mink vaccinology

Aase Uttenthal, Jesper Christensen, Mogens Hansen, Kristian Dalsgaard, Ignacio Casal, Rob Meloen, Jan Langeveld, Per Henriksen, Jørgen Østergaard, Søren Alexandersen

Viral diseases of mink have been studied for many years. In order to give prophylactic protection several commercial vaccines exist. During the last decade the developments in biotechnology have conferred new inspiring possibilities in vaccinology. The deeper insight in pathogenesis leads to better understanding of the disease. But also molecular gene technology and new expression systems allow for purer, more controllable antigen preparations. When combining these with new adjuvants a new generation of vaccines appears. We have studied the mink parvovirus, mink enteritis virus (MEV), using virus specific proteins expressed in the baculovirus expression system and vaccines composed of MEV peptides of only 15 amino acids.

The different vaccines have been tested both for the immunogenic potential as well as their threshold in a challenge test. The results of experiments with these vaccine candidates as well as the capabilities of such new vaccines will be discussed, and compared to the abilities of traditional vaccines.

Animal Prod. Review, Applied Science Reports, 28, pp. 161-165, 1996. 2 tables, 5 refs. Authors' summary.

Distemper virus diagnosis in foxes and mink

A.M. Shestopalov, B.N. Sazonkin, O.V. Trapezov

Broad application of effective vaccines against fur animal distemper in veterinary practice caused a significant change in the disease clinical picture. Classical clinical signs and pathoanatomical changes became rare, which made clinical diagnosis rather difficult. To solve the problem of diagnosis we developed a solid-phase dot enzyme-immune assay in nitrocellulose (dot-IEA). Water washing-out from nasal and conjunctival mucous membranes of foxes and mink were used as material for detection of carnivorous distemper virus antigens. Canine distemper virus, Snyder Hill strain was used as a control positive sample. The possibility of application of dot-IEA for quick (within an hour) detection of canine distemper virus was evaluated for the first time on the basis of the study of a great number of clinical data and laboratory analysis of water washing-out.

In 78 of the cases the dot-IEA method provided laboratory confirmation for fur animals with the clinical diagnosis of carnivorous distemper, which can be associated with the fact that some of the animals received specific therapy or were mistaken in the clinical diagnosis. Analysis of material from foxes and mink challenged with adenoviral hepatitis (CAV-I strain) and parvoviral enteritis (Rodniki strain) gave only negative results. It was also shown that post vaccine virus did not influence the diagnostic value of the proposed method one week after vaccination. Quite obviously, dot-IEA carnivorous distemper is effective in ascertaining clinical diagnosis and can be widely used in veterinary practice.

Animal Prod. Review, Applied Science Reports, 28, pp. 167-171, 1996. 3 tables, 6 refs. Authors' summary.

A new continuous feline kidney cell culture (FK-91) for reproduction of the carnivore parvoviruses

A.G. Durimanov, A.M. Shestopalov, O.V. Trapezov

The continuous FK-91 cell culture was produced from kidneys of a 5-month-old cat. The cell culture was frozen and stored at the temperature of liquid nitrogen at passage 57. FK-91 cell culture was tested for virus-specificity (for MEV and CPV) up to passage 190. The seeding multiplicity was 1:4-1:8, the interval between the passage was 3-4 days. The cell culture provided a yield of mink enteritis virus (MEV) at the titers from 1:4096 to 1:32768 according to hemagglutination reaction. Cytopathic effect and hemadsorption are observed in the infected culture. FK-91 cell culture is suitable for primary isolation of the natural carnivore parvovirus. Thus, we have developed a new continuous feline cell culture showing promise for isolation and production of mink and fox parvovirus which is necessary for vaccine production.

Animal Prod. Review, Applied Science Reports, 28, pp. 173-176, 1996. 1 table, 3 refs. Authors' summary.

Virological examination of foxes which died of a lung heart syndrome

J. Wojcik, B. Mizak, M. Chrobocinska, A. Kopczewski, L. Saba

A disease of non-defined etiology was observed in the middle eighties in common foxes (silver, platinum, pastel and red). The disease occurs in 8-14 week-old pups, especially in August-September. The most important clinical symptom is a strong dyspnoea leading to an abrupt death. The disease has been temporarily called "a lung heart syndrome". Autopsies show a great amount of hemorrhagic exudate in the chest and

pericardium. The lungs are congested and strongly swollen; pneumonia does not always occur. The myocardium is usually enlarged. The aim of this report is to present the results of virological examination of foxes suffering from the lung heart syndrome. Lungs, hearts, kidneys, spleens and livers of 15 infected foxes put to sleep in the state of agony were the material used for the research. The internal organs were homogenised in a 10% buffer suspension in isotonic salt solution (PBS) with antibiotics added. This suspension was frozen and unfrozen three times at a temperature of -70°C and processed in the centrifuge. The supernatant obtained was filtered in membrane filters and stored at a temperature of -20°C . The growth cell cultures (continuous line of cat lung cells, dog kidney cells and monkey kidney cells (Vero)) were contaminated with an internal organ filtrate.

A microscopic observation was carried on for 5 days. Five successive passages were done. The filtered homogenate was tested by hemagglutination reaction with 1% suspension of erythrocytes of hen, ram, rabbit, dog, pig and man. A biological test was conducted on white mice, guinea pigs, rabbits, dogs and foxes. The animals were infected subcutaneously or peritoneously.

None of the cells contaminated with the tested material showed cytopathic lesions as a result of virus replication. A factor agglutinating human (blood group 0) and the tested animals' erythrocytes were found in one of the homogenates made of the internal organs. A biological test made after the 14 day observation of mice, guinea pigs, rabbits and dogs and the 35 day observation of foxes was negative. Nor were any pathological lesions found during an autopsy made after a diagnostic slaughter. In conclusion it can be said that a virus does not seem to be the cause of the lung heart

syndrome. The full text was published in *Medycyna Weterynaryjna* (Veterinarian Medicine), 1996.

Animal Prod. Review, Applied Science Reports, 28, pp. 177-178, 1996. Authors' summary.

Bacteriological culture and pleural fluid evaluations in mink

P.E. Martino, J.J. Martino

Pleuritis, a poorly understood entity in the mink (*Mustela vison*) is characterized by the presence of large amounts of pleural exudate, which may vary in appearance from a reddish-brown fluid to a creamy yellow inspissated material. Frequently dead animals were presented without a history other than sudden death, to which the mink seems particularly liable. From field cases included in this survey, evaluation of pleural fluid, bacteriological studies and virological attempts were done. The most common microorganisms isolated were coliforms, *Bacillus* Spp., *E. coli*, *Proteus* Spp., *Staphylococcus aureus*, and *Streptococcus epidermidis*.

The mean value of the total viable microorganism counts was $2.7 \times 10^6 \pm 6.59 \times 10^6$ CFU x ml. Fungi were detected in 7.6% of the total isolates. Cases were observed in farms with a high incidence of Aleutian disease infection. Non-degenerate and degenerate neutrophils and macrophages in large numbers (mean value 12.2 ± 1.2 nucleated cells 1000/ul blood), specific gravity (mean value 1.023 ± 0.003) and high total protein concentrations (mean value 3.9 ± 0.1 g/dl) were common findings in the effusions investigated.

Animal Prod. Review, Applied Science Reports, 28, pp. 179-182, 1996. 1 table, 7 refs. Authors' summary.

Production and isolation of adenovirus in fox farms in western Siberia

A.M. Shestopalov, A.G. Durimanov, Y.N. Ras-sadkin, E.N. Ustinova, O.V. Trapezov

Total disease of 1.5-3 month-old animals were found in some fox farms in W. Siberian last years. The clinical picture was characterized by symptoms of the central nervous system with a lethal effect after 1-2 days. In some farms 35% of the young animals had been affected. Pathogenic agents were not revealed at bacteriological investigation.

Homogenate (10%) from brain, liver, spleen and mesenteric lymphatic tissues was tested in suckling mice and on the reproduction possibilities in *Vero* and *MDCK* cell culture. The pathological material was examined by electron microscopy and by enzymeimmuno analysis. *MDCK* monolayer cells displayed after three days cytopathic effect consistent with virus infection of canine hepatitis. Plenty of virus particles, morphologically similar to the adenoviruses were revealed electron microscopically in virus affected cells. Suppression effect (100%) was observed at the specific immunoglobulin reaction with adenovirus.

Animal Prod. Review, Applied Science Reports, 28, pp. 183-185, 1996. 1 ref. Authors' summary.

Isolation of C-reactive protein from fox and canine serum and development of specific antibodies

Krzysztof Kostro, Magdalena Sobieska, Pawel Ciesielczy, Stanislaw Woloszyn, Krzysztof Wik-torowicz

The acute phase response is the reaction of an organism to different stimuli disturbing its homeostasis. Among others, several changes in concentration of serum proteins are observed. One of the best known acute phase proteins is CRP (C-reactive protein),

identified in sera of many domestic animals species. However, there was no data on the CRP in breeding foxes.

Canine and fox CRP were isolated from serum samples, collected from animals with severe injuries or different bacterial infections, using affinity chromatography on O-phosphorylethanolamine column. Next, the trace contamination with albumin was removed from canine CRP preparation by chromatography on Blue Sepharose. CRP preparation from fox serum was filtrated on Sephacryl S-300 column, to remove traces of other proteins. The purity of the preparations was next examined by SDS-PAGE electrophoresis.

The antibodies against fox and canine CRP was raised in goats, using standard immunization procedure. Both kinds of antibodies showed a sharp precipitation in Mancini's single immunodiffusion and clear rockets in Laurell's immunoelectrophoresis. Thus, both kinds of antibodies can be used in various laboratory tests to determine serum level of fox or canine CRP. The isolated preparations of both proteins in stabilized solution may be used as concentration standards.

Animal Prod. Review, Applied Science Reports, 28, pp. 187-192, 1996. 16 refs. Authors' summary.

Aleutian disease of mink: the population analyses of the problem

V.A. Ilukha, L.B. Uzenbaeva

Using the various methods of diagnostics the dynamics of Aleutian disease in cage bred mink populations in dependence on colour, age and physiology-biochemical features of the animal was investigated. The connection between litter size and steadiness of mink to Aleutian disease was established. It is shown that the groups of cage

bred mink had autoregulatory mechanisms as in natural populations.

Animal Prod. Review, Applied Science Reports, 28, pp. 193-197, 1996. 1 table, 2 figs., 8 refs. Authors' summary.

Effectiveness of bioxydant and clorox in killing Aleutian mink disease parvovirus

M. Keven Jackson, Scott G. Winslow

Experiments were performed to determine the effectiveness of household bleach (Clorox) and Bioxydant in killing Aleutian mink disease parvovirus. Preparations of spleen homogenates were incubated with disinfectants, dialysed against phosphate buffered saline, and titillated by bioassay in mink. Results indicated that bioxydant completely kills the virus at titers reported here (10^4 50% mink infectious doses) but that killing by Clorox is incomplete.

Animal Prod. Review, Applied Science Reports, 28, pp. 199-202, 1996. table, 10 refs. Authors' summary.

Varied protein content in mink feed. Effects on hepatic fatty infiltration and mortality

Birthe M. Damgaard, Tove N. Clausen, Hans Henrik Dietz

Mink are carnivorous and consequently their natural diet contains a high proportion of energy as protein. The purpose of the present study was to investigate the effects of dietary protein levels on hepatic fatty infiltration and to estimate the requirements of protein to ensure health and growth in the growth period. The investigation was carried out in three consecutive years with male scanblack mink kits. Groups were fed

diets with 15%, 20%, 25%, 30%, and 35% of metabolizable energy from protein. The estimated fat content of the liver and the histological fatty infiltration were significantly higher at low protein levels than at high protein levels. At 25% of metabolizable energy from protein, the mortality varied between 4% and 13% from year to year. The mortality was each year below 4% at 30% and 35% of metabolizable energy from protein.

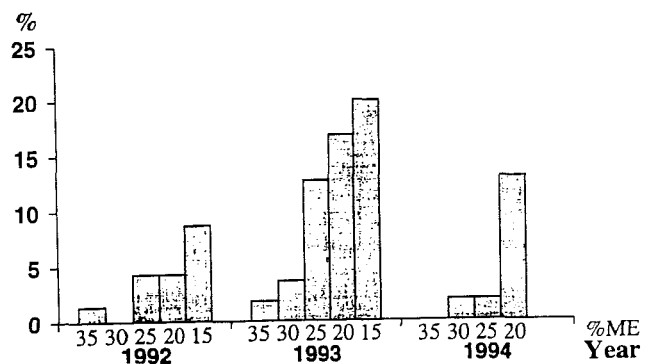


Fig. 2. Dead males (%) in the experimental groups at different dietary levels of metabolizable energy (ME) from protein in 1992, 1993, and 1994.

Animal Prod. Review, Applied Science Reports, 28, pp. 203-207, 1996. 2 figs., 8 refs. Authors' summary.

Hematological indices of blood in coypus reared in cages on different floors

Ryszard Cholewa

The aim of the investigations was to find the values of hematologic indices in coypu reared in a farm without access to bath water in cages with different floors. The experiment was carried out in the summer-autumn season on 50 related Standard coypu of both sexes. The animals were 12 weeks old and of uniform size. They were

placed in cages with solid, slatted or wire net floors. They were reared under identical conditions. There was rather little differentiation of erythron indices among the animals at 30 weeks reared on different floor. Only the haematocrit value was higher in the animals kept on slatted floors than that in the other groups. The values in leukogram differed from those in the erythrogram. Only the hematocrit value was higher in the animals reared on slatted floor. There was a marked differentiation in the values of eosinophil, neutrophil and lymphocyte content. It was supposed that the different floors could influence some values of hematological indices which could be the result of stress.

Animal Prod. Review, Applied Science Reports, 28, pp. 209-213, 1996. 1 table, 7 refs. Authors' summary.

Infectious encephalitis in polar foxes

A. Kopczeński, J. Roszkowski, T. Zdunkiewicz, L. Strzalkowski, W. Ulewicz

The infectious encephalitis cases in polar foxes were observed in 1995. The description of cases, anatomopathological

lesions, diagnosis and epizootic procedure were carried out.

Animal Prod. Review, Applied Science Reports, 28, pp. 215-216, 1996. Authors' summary.

Bacteriological examination of foxes dead of lung heart syndrome

A. Kopczeński, J. Zwierzchowski, L. Saba, H. Bis-Wencel, T. Zdunkiewicz

Bacteriological examination was conducted on 325 silver foxes pups which died at the age of 8-14 weeks with lung heart syndrome. The abdominal cavity organs (liver, spleen, kidneys) and chest organs (heart, lungs) were examined. Bacteria were isolated more often from the abdominal cavity organs than from the chest organs. The microorganisms most frequently isolated were: *E. coli*, Cocci, *Staphylococcus* sp., *Salmonella* sp., *Pseudomonas aeruginosa*. The lung heart syndrome can occur in system diseases of uninflammatory etiology.

Animal Prod. Review, Applied Science Reports, 28, pp. 217-219, 1996. 1 table, 9 refs. Authors' summary.

BEHAVIOUR AND WELFARE

Selection of farm mink on the basis of two tests of temperament

Jens Malmkvist

Selection of breeding mink on the basis of their temperament took place for 5 mink generations at the Danish Institute of Animal Science by using the "stick test". In 1995, a so-called "hand test" was applied for further gradation of the animals regarding their reaction towards humans in either cu-

rious or timid direction. The purpose of this study is to compare these two tests.

716 mink kits (born spring 1995) from three selection groups were tested with both the stick and the hand test twice in September and November. Mink reacting timidly in the stick test were distributed with 93.7% in the negative score, whereas animals reacting as curious in the stick test were mainly distributed (70.0%) in the positive score of the hand test. Overall good agreement exists be-

tween the two tests, and evidence exists of the possibility to produce mink lines with different temperaments.

Animal Prod. Review, Applied Science Reports, 29, pp. 9-15, 1996. 1 table, 1 fig., 11 refs. Authors' summary.

Selection of silver foxes for domestic behaviour with reference to their welfare

Irene Plyushnina, Irina Oskina, Ludmila Trut

A domesticated population of silver foxes has been established by selecting 35 generations for tameability. This population is advantageous in terms of welfare under conditions of breeding in captivity. This conclusion is based on the behavioural responses to humans, the functional state of pituitary-adrenal system, the major in stress adaptation, high survival value and, hence reproductive success, as an integral indicator of fitness.

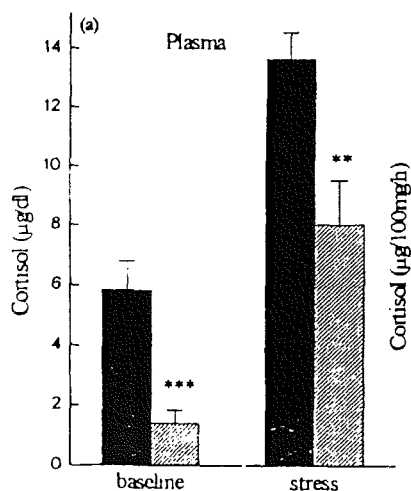


Fig. 2a. Plasma cortisol concentrations in farmed and domesticated adult foxes after exposure to foot-shock stress for 15 min.

Animal Prod. Review, Applied Science Reports, 29, pp. 17-21, 1996. 3 fig., 6 refs. Authors' summary.

Does prenatal stress affect reproductive performance, cub growth and behaviour in silver foxes (*Vulpes vulpes*)?

Morten Bakken

Earlier experiments indicate that the silver foxes' fear of humans can be reduced by offering them food titbits. Sex ratio, growth and behaviour were examined in litters produced by multiparous silver fox vixens that had been given a titbit twice a week during pregnancy (G1, N=14) or received the same amount of human contact without any titbit (G2, N=14). The cubs were tested in an open field (1.15 x 1.15 m square area divided into a 5 x 5 square grid) at 30 days of age, when they are in the early stages of primary socialisation. Cub activity was recorded (number of grid lines crossed [Lc] during 3 min).

There was no treatment-related difference in number of cubs born or cubs weaned at 49 days (4.9±0.3 and 4.1±0.4 versus 4.8±0.5 and 3.8±0.4 for G1 and G2, respectively; NS). However, G1 vixens delivered a significantly higher proportion of male cubs than G2 vixens (64% versus 51%, p<0.05; G1: 3.1±0.4 male cubs, 1.8±0.3 female cubs; G2: 2.5±0.4 male cubs, 2.3±0.3 female cubs). Female cubs from G1 vixens were more active in the open field (G1: 51.4±4.8Lc, G2: 34.2±4.7Lc, p<0.05) and heavier (49 days old, G1: 1660±42 g, G2: 1491±40 g, p<0.01) than the female G2 cubs. No significant differences in activity or live weight were found for male cubs (activity: G1: 46.4±3.4Lc, G2: 37.1±4.3Lc, NS; weight 49 days old: G1: 1716±29 g, G2: 1729±37 g, NS). Reduced fear of humans during pregnancy affected the sex ratio in the litter as well as the growth and activity of female cubs in the silver fox.

Animal Prod. Review, Applied Science Reports, 29, pp. 23, 1996. Author's summary.

Selection for tame behaviour induced the arisal of new colour phases in mink

O.V. Trapesov, N.V. Kharlamova

Thirty-two coat colour mutations have so far been recorded in mink (11 of them dominant or semidominant). Recessive mutations were accumulated in natural populations and preserved in the heterozygous conditions being hidden by the wild genotype.

They have appeared in homozygous state. Some of them have considerable value. From the end of the sixties to the present time only few new ones have been added to the list. Obtaining original new coat colours is not easy. However, fur animal breeders are continually working on it. The solution is made easier by exploiting the concept of destabilizing selection: the many morphological and physiological changes seen in domesticated animals are regarded as correlated effects of selection for tameness. During this selection for behaviour which was started in 1980, two experimental mink populations were created differing sharply in behaviour from each other and displaying genetically determined behaviour tameness and aggression towards humans respectively. In the course of this selection an increased tendency for new varieties to appear was observed, including several morphological and coat colour variants which were recorded for the first time in mink. Four colour phases ("Silvery", "Black crystal", "Star" and "Blue") were obtained *de novo* during selection for tame behaviour.

Genetic analysis has shown that the colorations of *Silvery* and *Black crystal* mink are determined by single dominant genes. The genetics of *Star* and *Blue* coat colours is presently being investigated. These new colour phases make it possible to create other new colour forms by combining these with each other and with certain other well

known mutations. The new coat colour varieties attracted considerable attention at the 117th International Fur Auction held in St. Petersburg in January 1991.

Animal Prod. Review, Applied Science Reports, 29, pp. 25-31, 1996. 4 tables, 5 refs. Authors' summary.

Validation of feeding test in farmed foxes

Teppo Rekilä, Leena Ahola, Mikko Harri

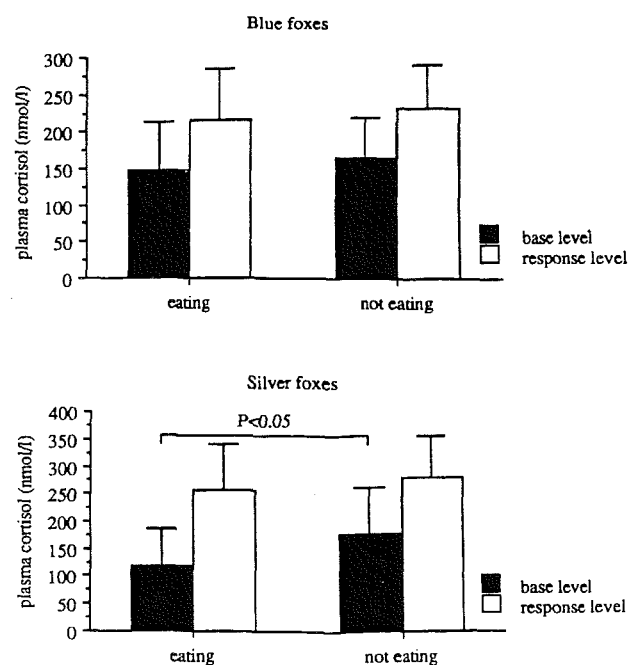


Figure. Base level and response level of cortisol in blue and silver foxes eating and not eating during the feeding test.

The internordic project aiming at selecting for more confident foxes in relation to man was started in 1995. In Finland, the feeding test has been adopted as the principal test for selecting breeding animals. In the present study, reliability and validity of the feeding test as a fear test were assessed in farmed blue and silver foxes. This study demonstrates that the feeding test is a reli-

able (repeatable and free from random errors) and valid fear test for foxes. In addition, its feasibility is good; it is easy to carry out, it is inexpensive and it is based on the natural behaviour of foxes. The feeding test looks promising when measuring fear in farmed foxes. Further investigations are needed to validate the test, especially in blue foxes.

Animal Prod. Review, Applied Science Reports, 29, pp. 33-38, 1996. 1 table, 1 fig., 3 refs. Authors' summary.

Selection for aggressiveness enhanced hair pigmentation in mink

O.V. Trapesov, L.A. Prasolova, A.V. Kharlamova, E.B. Vsevolodov, I.F. Latipov

The connection between emotional behaviour and melanin content in lines selected for reduced or high aggressive reactivity to humans was examined. The highest connection was found between aggressiveness and high level of hair pigmentation. Selection in this direction produced an the hair pigmentation degree.

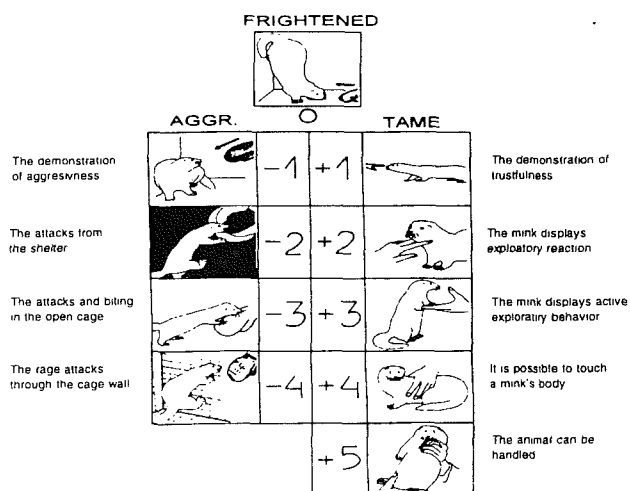


Fig. 1. Levels of mink defensive behaviour towards man.

Animal Prod. Review, Applied Science Reports, 29, pp. 39-43, 1996. 1 table, 2 figs., 5 refs. Authors' summary.

A new housing system for mink

Gerrit de Jonge

The Dutch welfare legislation has encouraged the Dutch research workers and the Dutch fur breeders to develop an improved housing system for mink in order to ensure the welfare of the animals.

The main characteristic of the new system is that mink are kept in groups in cages which are substantially larger than the usual ones. In such rows of cages mothers and their whole litter can be housed until pelting time. The larger the litter, the longer the row of cages, it is easy to enrich these cage systems with platforms, tubes and so on. At the research farm, we hardly found differences between traditionally and experimentally raised mink.

Growth and pelt quality did not differ. Increased stocking density, however, increased the number of damaged pelts. The behavioural observations suggested indeed an increased welfare.

Animal Prod. Review, Applied Science Reports, 29, pp. 45-51, 1996. 9 refs. Authors' summary.

Behaviour related to reproductive performance in silver fox vixen

Monique Henderson, Kirsti Rouvinen, Tarjei Tennessen

The effects of the behavioural response to a novel object (ball), an unknown person and age on reproductive performance of 41 silver fox vixens were studied.

As a result of the novel object test the vixens were classified as fearful with no contact, fearful with contact, aggressive or inquisitive with contact. The inquisitive vixens had larger (4.9 ± 0.8 pups) and heavier (532.6 ± 87.4 g) litters at birth than the fearful vixens who did not contact the ball (1.6 ± 0.8 pups; 175.2

± 78.0 g) and the aggressive vixens (2.0 ± 1.0 pups; 208.1 ± 108.9 g) (p). Inquisitive vixens also had larger litters at 21 days of lactation (4.6 ± 0.8 pups) and at weaning (4.5 ± 0.8 pups) than any of the other groups. The litters of inquisitive vixens also gained more weight up until 21 days of lactation (1736.3 ± 337.7 g) and weaning (5538.9 ± 983.3 g) than the fearful no contact group (451.1 ± 301.5 g; 1462.1 ± 877.8 g) fearful with contact group (755.3 ± 372.4 g; 2425.6 ± 1084.2 g) and the aggressive group (368.9 ± 420.8 g; 1147.3 ± 1225.1 g) ($P < 0.05$).

Furthermore, older vixens had larger and heavier litters at birth (3.7 ± 0.5 pups; 400.9 ± 55.0 g) and at 21 days of lactation (2.8 ± 0.5 pups; 1462.9 ± 249.9 g) than the yearling vixens (2.2 ± 0.6 pups; 236.1 ± 64.3 g) (1.6 ± 0.6 pups; 829.8 ± 291.9 g).

Animal Prod. Review, Applied Science Reports, 29, pp. 53-57, 1996. 4 tables, 5 refs. Authors' summary.

Do farmed silver foxes prefer solid floor?

Mikko Harri, Sari Kasanen, Jaakko Mononen, Leena Ahola, Teppo Rekilä

Harmfulness of a wire mesh floor has been a target of criticism in the farming of foxes, while scientific evidence supporting this claim is controversial. While some experiments have found no preference among floor types, some have detected a higher preference for wire mesh floor. In our experiments silver foxes had to balance their preference for an elevated floor against their preference for floor material. These experiments confirmed that foxes had preference for an elevated place, while they failed to confirm foxes' preference for sand floor.

The preference for cage floor material was dependent on the way the cages were connected and other factors. Over 97% of faeces were collected below the wire mesh floor. We cannot conclude that foxes either prefer nor reject wire mesh floor.

Animal Prod. Review, Applied Science Reports, 29, pp. 59-64, 1996. 2 tables, 10 refs. Authors' summary.

Resting platforms for farmed foxes - a short review

Jaakko Mononen, Hannu Korhonen, Mikko Harri

Resting platforms have been suggested as a way to enrich the cage environment of farmed silver and blue foxes. The foxes may spend a substantial percentage (60-90%) of their daily time on the platforms. However, to maximize the efficiency of the platform use, the platforms and environmental factors must meet certain criteria. The platforms are mostly used by juvenile foxes that have early experiences with such platforms.

Structural factors that most enhance the platform use are: open view from the platform, slightly depressed bottom of the platform and obstructed view from the cage floor. The material of which the platforms are made, wood or wire mesh, does not affect their use. The platforms are used the least in the winter. At present, we have enough knowledge to design platforms that are accepted by foxes. However, the effects of the platforms on foxes' welfare still need to be studied.

Animal Prod. Review, Applied Science Reports, 29, pp. 65-69, 1996. 18 refs. Authors' summary.



Family housing of blue and silver foxes in a row cage system

Leena Ahola, Mikko Harri, Jaakko Mononen, Teppo Rekilä

Any attempt to improve the current housing environment is faced with practical constraints: the standard cage does not provide space for additional furnishing and any increase in space would increase costs. One possibility to keep the costs at the present level and to give the foxes a possibility for social contacts, locomotion and stimuli would be family housing in which the vixen with its cubs are raised together but the space available for the whole family is increased. In this study a row cage system was constructed for connecting several wire mesh fox cages with openings through the walls. The total area of the system varied, according to the size of a family, from 2.4 to 14.5 m². The control animals were housed either singly or in pairs in standard fox cages (1.2 m²). There were no clear effects of different housing systems on body weight, feed intake and number of cubs weaned. In the family groups there were more minor injuries than in control animals. The present results indicate that family housing of blue and silver foxes in a row cage system could be considered as an alternative housing environment in fox farming. More detailed knowledge is, however, needed to ensure that the welfare of foxes is not impaired in family housing.

Animal Prod. Review, Applied Science Reports, 29, pp. 71-76, 1996. 1 table, 6 refs. Authors' summary.

Fur chewing in farm mink - temporal development and effect of social environment

Birthe Houbak, Steffen W. Hansen

The objectives of this investigation were to describe the temporal development of fur

chewing in the neck and on the back and tail of mink, and to study the effect of social environment on the occurrence of fur chewing in mink kits. The investigations were carried out with 80 adult mink and 392 mink kits in 1994. The most frequent form of fur chewing was chewing on the tail, followed by chewing on the neck, while the least common form was chewing on back and loin. Fur chewing occurred when the kits were two months old irrespective of weaning time and social environment. Neck chewing may occur as a consequence of normal mink behaviour in connection with mating and aggressive interactions. Tail chewing is an abnormal behaviour performed by the animal itself. It seems possible to change the threshold value for the release of fur chewing through selection.

Animal Prod. Review, Applied Science Reports, 29, pp. 77-81, 1996. 2 figs., 2 refs. Authors' summary.

Fox farming field trial to produce more trusting blue foxes

Frans Kleyn van Willigen, Gerrit de Jonge

The Dutch government will forbid fox breeding in 2004, unless fox breeders can prove that the welfare of their animals is ensured. Especially the absence of fear should be guaranteed. Therefore, two fox breeders have introduced into their housing and management all measures which have been developed in Scandinavian fox research. The measures are: 1) The use of top-nest boxes with a wire netting front door which enables the pups to observe humans in an early stage of life, 2) Observation shelves within the cages, 3) Handling the pups from 3 to 6 weeks, 4) Selection for the absence of fear and aggression towards humans, and the presence of curiosity, 5) Housing the pups until pelting in large groups in large cages with a top-box, 6) use of closed screens between the mothers, 7) A whole-year nest box for the breeding animals. So

far, the two foxbreeders have good experiences with the new housing and management systems.

Animal Prod. Review, Applied Science Reports, 29, pp. 83-87, 1996. 6 refs. Authors' summary.

Genetic determination of motility in ferret, polecat and their crosses tested in labyrinth

J. Rafay

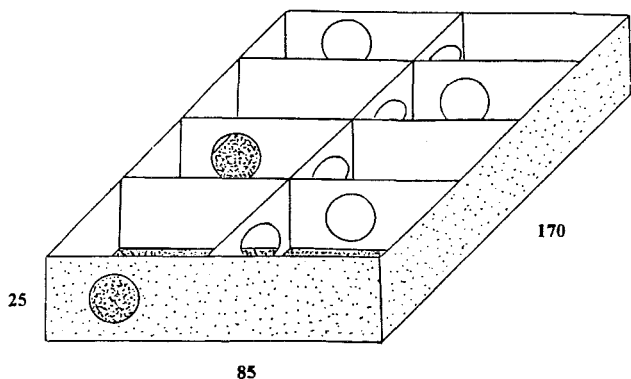


Figure. Scheme of experimental labyrinth (proportion in cm).

Motor activity of adult male and female ferrets, wild polecat and their reciprocal offsprings were observed in experimentally designed labyrinths (type T). The time which the animals spent in the corridors of the labyrinth was measured. Crossing time was recorded as a motility criterion. After statistical estimation of observed data variance analysis showed insignificant influence of repeatability following measurements (observation order). Crossing speed was influenced highly significantly by genotype and sex of observed animals.

The relation between genotypic origin of mother in initial parental pairs (female ferret x male polecat and/or female polecat x male ferret) and test results of their progeny, the spread of arithmetical means of cross generations is obvious. When accepting the additive model of inheritance the differences in motility of cross populations can be interpreted with the influence of mother during upbringing of youngs.

Animal Prod. Review, Applied Science Reports, 29, pp. 89-93, 1996. 4 tables, 1 fig.. Authors' summary.

Forms of raccoon dog behaviour

Pawel Bielanski, Andrzej Zon, Stanislaw Niedzwiadek, Jan Zajac

The studies on the behaviour of the raccoon dog were conducted on the farm of Carnivorous Furbearers of the National Research Institute of Animal Production in Chorzelow. The observations involved a herd of 40 females and 15 males. The course of mean daily activity of the raccoon dog within the successive months of the year was described, including a minute-by-minute schedule of different forms of behaviour. The mean length of daily behavioural activity of female raccoon dogs with kits was also described.

It has been found on the basis of the results that some behavioural patterns in the raccoon dog may be used in its breeding and management. A year-round cycle of the raccoon dog activity was described.

Animal Prod. Review, Applied Science Reports, 29, pp. 95-100, 1996. 4 tables, 6 refs. Authors' summary.



FUR PROPERTIES

Sensory evaluation of fur quality and physical-mathematical measurements on mink pelts

Outi Lohi, Kaj Thorhauge, Palle V. Rasmussen

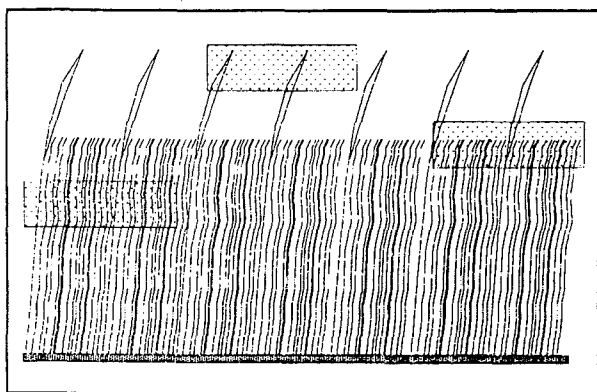


Fig. 1. Radiation technique in measuring hair mass/volume. The radiation is sent through the fur layer in three windows at the levels of 19, 14 and 9 mm above the leather. The lowest window is entirely inside the wool layer, the middle window is placed at the level of the top of wool hairs, and the top-window normally meets only guard hairs.

Three physical methods for characterisation of fur properties are described. The absorption of radiation in the fur layer and the force required to compress the fur are used to measure hair density and hair mass. A laser scanning method measures hair length and its variation. The results are compared with sensory evaluation of fur quality and with microscopic analysis of fibre composition of mink pelts.

It is concluded that the physical methods can describe special aspects of quality more accurately than it is possible by subjective grading. Physical measurements would therefore be valuable in evaluating the results of feeding or breeding work and as

objective documentation of quality differences.

Animal Prod. Review, Applied Science Reports, 29, pp. 103-108, 1996. 3 figs., 7 refs. Authors' summary.

Colour measurement applied to understanding of visual grading of colour shades in mink pelts

Palle V. Rasmussen

In mink fur production, the grading of colour shades in the colour type in question is done visually, relying on the individual colour perception. The subject of this paper is microscope spectrophotometric measurements of minor underfur samples from scanbrown mink used to provide objective correlates for visually evaluated colour shades.

The study included 21 scanbrown mink pelts (winter coat) from males and females, representing a larger experimental group of 87 mink pelts. Based on visual evaluations, the 87 pelts were subjectively graded by integer values from "1" to "5" (reddish) in respect of colour shade (CS). It was observed that the subjectively graded colour shade was significantly, positively correlated to the general colour, i.e. the subjectively graded lightness, both in the total material and in the experimental material ($r=0.68$; $N=87$) and ($r=0.75$; $N=21$), respectively. It was therefore obvious that the lightness must play a certain role to understanding of the visual evaluation of colour shade of underfur fibres in this material. The evaluation was done across the subjective grading of the general impression of colour. From each of the 21 pelts examined, leather/hair samples from the hip region were examined in three levels above the skin surface.

For the colour type in question, the stated model (the objective parameter) could demonstrate that the subjectively graded colour shade primarily seems to be correlated to the degree of lightness (L^*) and to the yellow colour direction (b^*). Although the examined material was prepared samples, the model contributed to the colourmetrical understanding of colour shade and may eventually uniform and thus improve the subjective grading. Further it may be a potentially useful indicator to establish discriminating threshold values in grading and selection of animals.

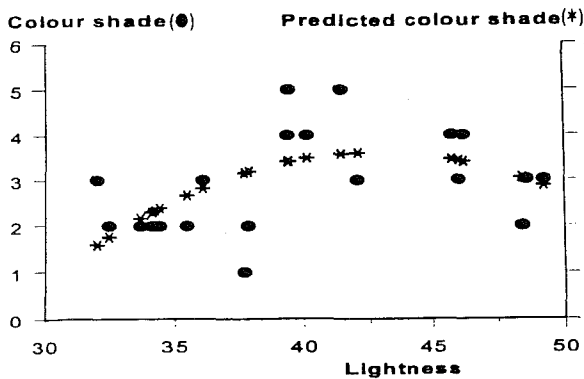


Fig. 2. It is illustrated how the subjectively graded colour shade (CS) fits a GLM-model when the predicted colour shade (CSp) is based on L^* - and L^{*2} -components alone (polynomial regression; $CSp = 28.73 + 1.51L - 0.018L^2$. ($r^2 = 0.31$; $F = 0.036$).

Animal Prod. Review, Applied Science Reports, 29, pp. 109-115, 1996. 2 figs., 11 refs. Author's summary.

Morphological changes in mink skin during hair growth cycle

Keiji Kondo, Jae In Pak, Fumio Nakamura

The morphological changes in mink skin during the hair growth cycle were observed by the cell maceration method. In telogen, flat and felt-like structures of a collagen fibrillar network with small gentle undulations covered the dermal surface. On the contrary during anagen, the rough undula-

tions consisted of collagen fibrillar bundles which caused a discernible three dimensional effects on the dermal surface. In dermal cross-section during telogen the collagen fibrillar-bundles were bundled tightly together, the inter-bundle space was minimal and the dermis was thin. However in anagen the collagen fibrillar bundles were in a looser arrangement so there was more inter-bundle space and a thicker dermis.

Animal Prod. Review, Applied Science Reports, 29, pp. 117-122, 1996. 4 figs., 9 refs. Authors' summary.

The changes of proteoglycans during the hair cycle in the mink skin

Jae-in Pak, Fumio Nakamura, Keiji Kondo

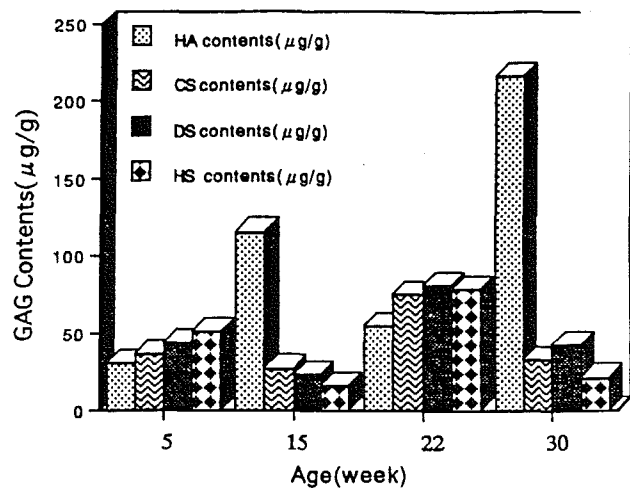


Fig. 2. The quantitative changes of glycosaminoglycans during the hair cycle in mink skin. The enzymolytic contents of glycosaminoglycan (GAG)s per 1 gram wet weight skin are shown.

The extracellular matrices play important roles in the mink skin and the proteoglycans (PGs) are major components of the extracellular matrix as well as the collagens. We studied the changes of the immunohistochemical localization and the enzymolytic content of PGs in mink skin during the hair cycle. Hyaluronic acid was present in the

stable collagen fibrillar structure of the dermis in telogen, while dermatan sulfate PG was concerned in the active three-dimensional structure of the collagen fibrils of dermis in anagen. Chondroitin sulfate PG showed the peculiar localization in the anagen dermal papilla, and the heparan sulfate PG was connected with the active dermal-epidermal interaction in the anagen basement membrane. These results suggest that the PGs are closely related with the functional state of the mink skin during the cycle.

Animal Prod. Review, Applied Science Reports, 29, pp. 123-130, 1996. 2 figs., 15 refs. Authors' summary.

The fur development in early and late born blue fox (*Alopex lagopus*)

Leena Blomstedt

Most farmed blue foxes are born in May and in the first week of June. Male blue foxes were assigned to an early (May 4-7) and a late born (June 1-4) group (4 animals/group). Fur development was studied histologically on skin samples taken from the hip between August and December. Parameters chosen to delineate the fur development were the percentage of bundles containing a growing guard hair, of bundles containing a mature guard hair, and the mean number of growing and mature underfur hairs per bundle.

The growth of winter fur was different between the groups. Growing guard hairs reached a maximum (98%) in August in the early group, and in the late group (99%) a good month later. This difference evened out by mid-November, when 97% of guard hairs were mature in both groups. The mean number of growing underfur hairs per bundle peaked in mid-September in the early group, but in the late group there was a constant great number of growing under

fur hairs in two months from mid-September. In the beginning of December there were statistically equal numbers of growing underfur hairs in both groups (8.5 ± 2.3 vs. 11.3 ± 2.7 , $p=0.060$). The share of mature underfur hairs was 81% in the early group and 77% in the late group. The pattern of fur development in the late born foxes resembles that of mink treated with melatonin or with artificial short day - long night light arrangements. Both treatments elevate melatonin concentration in the body, and cause the growth phase of underfur to synchronise.

Animal Prod. Review, Applied Science Reports, 29, pp. 131-134, 1996. 2 tables, 5 refs. Authors' summary.

Histological picture of hair pigmentation in mink due to "Talitsa" colour mutation

O.V. Trapesov, L.A. Prasolova, I.B. Tikhomirov, V.V. Tikhomirova, E.B. Vsevolodov, I.F. Latipov

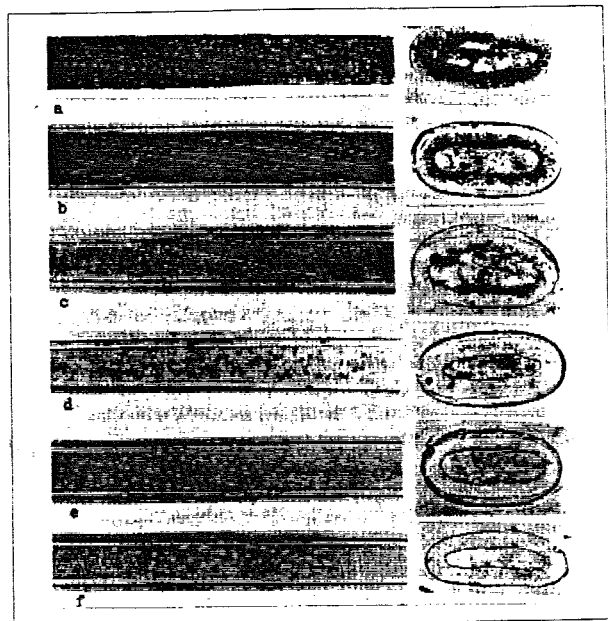


Figure 1. Midshaft region of several coat color phenotypes in the mink. (A) Black hair of Standard mink (+/+). (B) Brown hair of Royal pastel (b/b). (C) Talitsa mutation color like "cacao with milk" (TU/+). (D) Ampalosilver, pearl (k/k p/p) hair shows the results of the interaction of two loci. (E) Talitsapastel (TU/b/b) has a result of dilution effect in comparison with (b/b). (F) Talitsaampalosilver, talitsapearl (TU/+ k/k p/p) cortex and medulla practically free from pigment granules.

The various coat colour mutations investigated have specific and predictable effects on the size, colour, and distribution of melanin granules in the hair of mink.

Presented data show the effect of the dominant mutation *Talitsa* which causes a dilution of pigmentation. An increased dilution effect takes place when the *Talitsa* gene appears in combination with single or double recessive mutants. The amount of melanin granules is minimised in both cortex and medulla.

Obtained data permits us to propose the action mechanism of coat colour suppression by dominant gene *Talitsa*. Conceivably this mechanism is connected with abnormal migration of melanoblasts from neural crest or suppression of melanocyte proliferation in the hair bulb.

Animal Prod. Review, Applied Science Reports, 29, pp. 135-140, 1996. 1 table, 2 figs., 9 refs. Authors' conclusion.

Role of melatonin and prolactin in seasonal moultings in adult raccoon dog (*Nyctereutes procyonoides*)

Maija Valtonen, Yongjun Xiao

The raccoon dog has only one complete change of hairs yearly. Hair growth in adult males was studied by quantitative histology of successive skin biopsies and related to changes in serum prolactin and excretion of melatonin in urine. Moulting of underfur hairs was characterised by heavy loss of old winter hairs in spring in connection with the increase in serum prolactin. Correspondingly, intensive growth of new winter hairs occurred in autumn when melatonin increased and prolactin decreased. The first new guard hairs developed in spring and all new guard hairs had been initiated by the end of June. Melatonin implants in March decreased serum prolactin and stimulated the growth of some underfur hairs but in-

hibited the initiation of part of the guard hairs. The mechanism for initiation of summer fur in mink, involving an increase in prolactin secretion, is probably the same for the initiation of guard hairs in the raccoon dog.

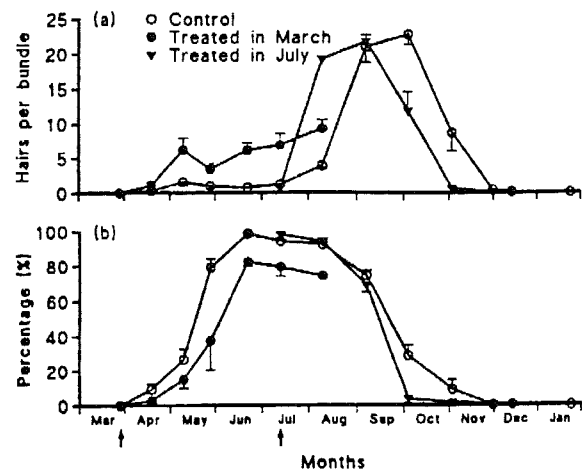


Fig. 1. Variations in number of (a) growing underfur hairs per bundle and (b) percentage of bundles with a growing guard hair in adult male raccoon dogs treated with melatonin in March and July and untreated controls. The arrows indicate the dates of melatonin implantation.

Animal Prod. Review, Applied Science Reports, 29, pp. 141-146, 1996. 3 figs., 12 refs. Authors' summary.

Amount of soluble and carbonylated collagen in oxygen-damaged mink skin

Bent Riis, Outi Lohi

"Oxidized areas" are a problem in mink pelts. Collagen is the main structural protein in the skin. Oxygen can damage proteins, including collagens, by a metal-catalysed process thereby introducing carbonyl groups on the protein. Carbonylated proteins are sensitive to degradation by various chemical processes. The samples were analysed for the content of total and carbonylated collagen. In poorly fleshed skin, the content of collagen was found to be low indicating degradation of the protein, and the

content of carbonyl groups was found to be higher compared to well-fleshed samples.

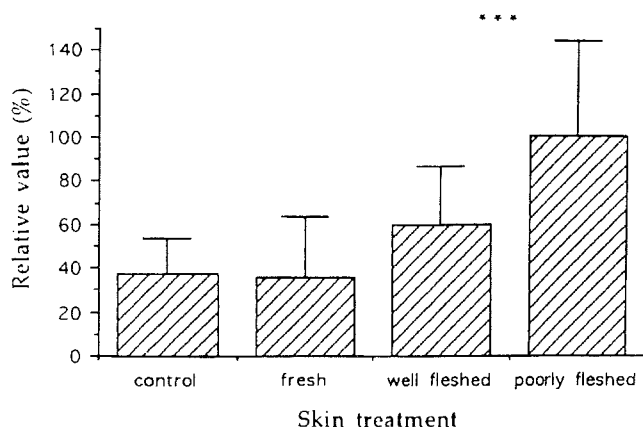


Fig. 2. Carbonyl groups per mg collagen (100% = 55.9 nmol/mg).

Animal Prod. Review, Applied Science Reports, 29, pp. 147-151, 1996. 2 figs., 9 refs. Authors' summary.

Delayed winter fur development in black mink

Kirsti I. Rouvinen, Ian G. Lawrie, Michael A. Johnson

A severely delayed winter fur priming has recently been documented in black mink. The present study investigated the histomorphology of the winter fur growth cycle of 10 mink with delayed priming in comparison to 10 phenotypically normal mink through a series of monthly skin biopsies from June until November. In addition, 10 normal and 10 affected mink were implanted with melatonin on July 21. The skin samples were analysed microscopically for the number of growing and mature guard hair and underfur fibres per skin surface area. In November, the abnormal mink had still 30% of the underfur fibres in the anagen stage compared to only 4% in the phenotypically normal animals ($P < 0.001$). Both phenotypes showed premature activation of underfur follicles in response to melatonin implantation. In August however, the level of this response measured as number of un-

derfur fibres in the anagen stage per mm^2 was lower in the delayed priming mink (100 ± 9.3) than in the normal animals (136 ± 9.3 ; $P < 0.05$). Underfur and guard hair were also found to be shorter in the abnormal mink when compared to the controls throughout the experiment. In addition, the delayed priming mink exhibited lower body weight gain during the autumn months.

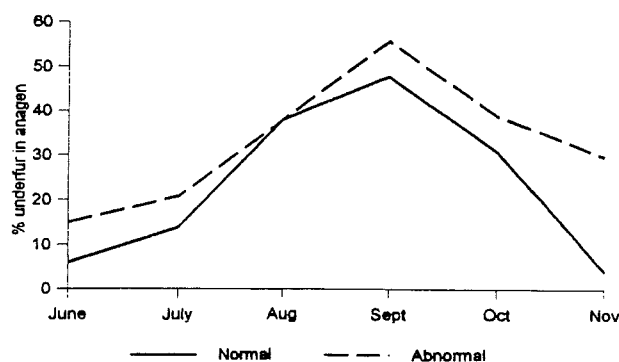


Fig. 1. Winter fur growth pattern of normal and abnormal (delayed priming) mink measured as percent underfur fibres in the anagen stage from June until November, 1995.

Animal Prod. Review, Applied Science Reports, 29, pp. 153-157, 1996. 2 figs., 6 refs. Authors' summary.

Effects of fattening on the skin length of the farmed mink

Liisa Nurminen, Juhani Sepponen

Since large-size animals have large skins farmers try to feed them as much as possible. On the other hand, the body length growth of mink ceases by mid-September. We allocated mink to two groups: the *ad libitum* group and the restricted group (-20% of *ad lib.*). As expected, the *ad lib* fed mink were heavier at pelting ($p < 0.05$). After 14 September, the *ad lib.* fed males gained 329 g and females 227 g as compared with the corresponding gain of 172 g and 76 g, respectively, in the restricted group. Despite greater weight gain, the skins of the *ad lib*

fed mink were not longer at pelting. Therefore it can be concluded that fattening the animals after the cessation of their body length growth has only a minimal effect on their eventual skin length.

Animal Prod. Review, Applied Science Reports, 29, pp. 159-165, 1996. 3 tables, 1 fig., 9 refs. Authors' summary.

Relation between the body weight of arctic foxes and the physical parameters of their pelts

Malgorzata Piorkowska

The aim of this work was to determine the relationship between the live weight of arctic foxes and the size and physical parameters of their pelt.

The studies involved 60 pelts of arctic foxes. Conformation of animals was tested and physical characteristics of untreated and treated pelts were measured. Correlation coefficients were calculated between the body weight before slaughter and the size of pelts in view of the auction requirements, and also between the live weight before slaughter and the size, length and weight of 1 dm² pelt.

The results of judging the conformation of arctic foxes showed there was only correlation between the length and weight of the body. Body weight turned out to be the most highly correlated with the physical characteristics of pelts.

Animal Prod. Review, Applied Science Reports, 29, pp. 167-174, 1996. 4 tables, 4 refs. Authors' summary.

Quality parameters of hair cover depending on nutria's age

Malgorzata Piorkowska, Dorota Kowalska, Stanislaw Niedzwiadek

The aim of this work was to determine the variation of hair cover parameters of nutria pelts, obtained at 3-9 months of age, and to determine the age when full fur maturity is achieved.

The study involved 70 pelts of Greenland nutria. The laboratory evaluation of fur coat quality accounted for those hair cover traits which were considered diagnostic and in close relation with the fur value.

It was found that the pelts of 3 to 5-month-old nutria had less favourable traits decisive of their suitability for fur except for down hair thickness and guard hair density.

Furs of older animals (6-9 months old) had the same or similar down hair thickness, length and density, and thickness of the rough side. The above traits were more varied in the case of guard hair except for density.

It was found that high quality pelts can be obtained from Greenland nutria at 6 months of age.

Animal Prod. Review, Applied Science Reports, 29, pp. 175-179, 1996. 2 tables, 1 fig., 7 refs. Authors' summary.



MULTIDISCIPLINARY

The effect of ambient temperature on energy metabolism and activity in adult male mink (*Mustela vison*)

Herald H.A.L. Hissink, Martin W.A. Verstegen, Gerrit de Jonge

Efficient production is only possible if heat production from maintenance and production processes is minimal and not unfavourably affected by housing conditions and/or by climatic environment. Therefore knowledge concerning the effects of housing conditions and ambient temperature on the energy metabolism of mink is important to optimise production. In the literature only a few results concerning the energy metabolism of mink can be found. The figures for energy requirement for maintenance (ME_m) vary between 736 kJ/kg (for animals of 0.5 kg) and 519 kJ/kg for bodyweights of 2 kg. The difference can be related to differences in experimental design.

In this study the effect of ambient temperature on the energy metabolism and activity of adult male mink with summer fur was measured. Heat production (HE) was calculated from measured ME intake and from energy in the body retained as measured by the comparative slaughter technique.

Animal Prod. Review, Applied Science Reports, 29, pp. 183-190, 1996. 3 tables, 15 refs. Authors' summary.

Serum α -MSH and follicular α -MSH receptor levels during the autumnal molt in mink

LeGrande C. Ellis

Skin and plasma samples were obtained from male dark mink during the autumnal molt and were assayed for follicular α -MSH receptor levels and plasma α -MSH levels. A

positive correlation was observed for follicular receptor levels, α -MSH levels in the blood, melanogenesis in the melanocytes of the developing hair and the presence of pigment in the hair. No differences existed in either of these two entities with respect to fur colour of pearl, pastel or dark mink indicating that control of hair colour is genetic and resides inside of the melanocyte and the keratinocytes of the hair fiber. α -MSH receptor levels were high in the inguinal pelt priming defect even though plasma levels of α -MSH had receded. Dark leather was attributed to metabolic heat from the fat pad, mastitis or inflammation of the skin.

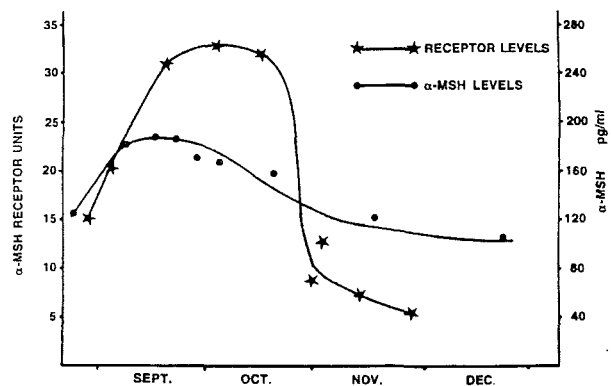


Fig. 1. Follicular α -MSH receptor levels and plasma α -MSH levels of dark male mink during the autumnal molt.

Animal Prod. Review, Applied Science Reports, 29, pp. 191-196, 1996. 2 figs., 22 refs. Author's summary.

Demonstration of skin langerhans cells in American mink (*Mustela vison*, Schreber, 1774) using transmission electron microscope method

Milan Vanek, Jana Schramlova, Keiji Kondo, Yoshio Shimizu

The study was aimed at determination of the skin Langerhans cells, and first of all, of

Birbeck granules in *Mustela vison* from the comparative aspect of pathologically changed defective (hooked and split) and non-defective guard hairs using transmission electron microscope. Biopsies were resected from 4 mink specimens (2 males, 2 females), from four somatic regions: buccal, neck dorsal, dorsal and abdominal ones. It is evident that the figures show a greater amount of vacuoles probably of endosomal system.

This may signal increased activities of the skin Langerhans cells related to hooked guard hairs.

Animal Prod. Review, Applied Science Reports, 29, pp. 197-202, 1996. 6 figs., 8 refs. Authors' summary.

Measurements of total body water in adult female mink (*Mustela vison*)

Søren Wamberg

The total body water (TBW) of adult female mink was determined by the isotope dilution method using tritiated water (THO). Six 2-year old females, live weight (LW) range 790-1130 g, were given an intraperitoneal injection of 1 ml saline containing 50 μ Ci (1.95 MBq) of THO in the postabsorptive state. Following a 2-hour equilibration period, the 3 H-radioactivity in 100 μ l of venous plasma, corrected for plasma water, was measured by liquid scintillation counting.

The results showed that the THO-dilution space in mink (mean (\pm SEM) = $60.5 \pm 0.5\%$) was in accordance with direct measurements, by desiccation, of TBW (mean = $59.5 \pm 0.5\%$) in the same animals.

Chemical analysis of the body composition of four of the female mink documented that the fractional composition of the fat free body mass is comparable to that reported in the literature for other mammals.

It is concluded that measurements of the THO-dilution space represents a reliable *in vivo* estimate of TBW in adult female mink.

Animal Prod. Review, Applied Science Reports, 29, pp. 203-209, 1996. 2 tables, 12 refs. Author's summary.

Air pollution by odours of mink farms

Jerzy, Slawon, Leon Saba, Hanna Bis-Wencel, Bozena Nowakowicz-Debek

Research was carried out on sulphur organic odour emission from a mink farm into the air. In the farm area and in the neighbourhood were found Methyl - mercaptan, Iso-propyl - mercaptan, N - propyl mercaptan, N - butyl mercaptan and Dimethyl disulfide. The Methyl - mercaptan concentration at the farm area and at the distance of 50 m from its boundaries exceeded the norms permitted humans. The sulphur - organic odours decreased from a distance of 200 m from the farm boundaries and the majority of them were undetectable 400-500 m from the farm boundaries.

Animal Prod. Review, Applied Science Reports, 29, pp. 211-214, 1996. 1 table, 8 refs. Authors' summary.

The river otter (*Lutra lutra* L., 1758) as a new fur farming animal

O.V. Trapesov

A cage bred otter population was created on the special experimental farm in our Institute in the course of 13 years. It took three otter generations to create a genetically adaptive ranch bred form. A lot of questions concerning breeding, reproduction, nutrition, pathology and diseases, behaviour and welfare, fur properties etc. were studied. The main conclusion is: only animals without fear-induced reaction towards

man have a chance to found a cage bred population.

Animal Prod. Review, Applied Science Reports, 29, pp. 215-219, 1996. 13 refs. Author's summary.

The measurement of the skin electrical conductivity at the acupuncture points in healthy and diseased polar foxes

Kazimierz Sciesinski, Andrzej Frindt, Marian Brzozowski, Robert Glogowski, Danuta Dzierzanowska-Goryn

The performed investigations were aimed at measuring the skin electrical conductivity at the representative acupuncture points (RMP) with the Ryodoraku method in healthy and diseased, male and female polar foxes on the right and left side of the body.

The performed investigations of electrical conductivity at the acupuncture points (RMP) measured with the Ryodoraku method on one side of the body may be considered as representative. The results of those measurements are similar to the mean value for two measurements taken on both sides of the body. Sex does not significantly affect the value of electrical conductivity at the Ryodoraku points.

On the basis of the obtained results the mean range of electrical conductivity (RMP) was determined for foxes clinically healthy and those having pathological symptoms on the skin. The method of measuring the skin electrical conductivity (RMP) with the Ryodoraku at the acupuncture points could be of great diagnostic and therapeutic significance for determining the functional state of healthy and diseased animal organisms.

Animal Prod. Review, Applied Science Reports, 29, pp. 221-226, 1996. 2 tables, 8 refs. Authors' summary.

Radioimmunoassay of cortisol in mink plasma and the effect of adrenocorticotrophic hormone

Birthe M. Damgaard, Steffen W. Hansen

CORTISOL

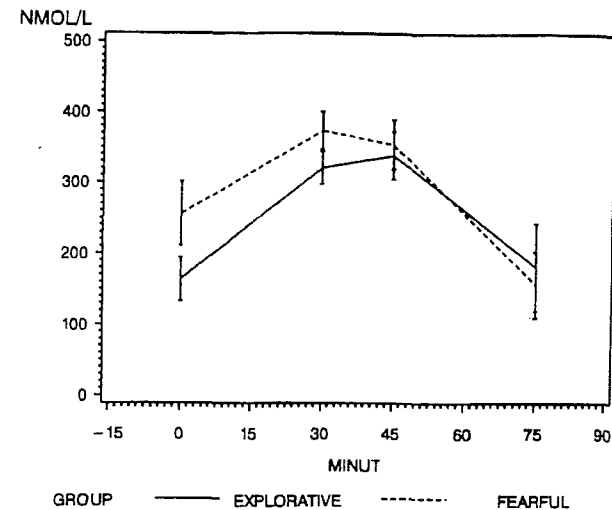


Fig. 1. Plasma cortisol concentrations relative to ACTH injection for mink females with explorative and fearful behaviour in May.

Most commercial immunoassay kits for hormones are designed for use in humans. The purpose of the present study was to validate a commercial immunoassay kit for cortisol for use in mink plasma and to evaluate the effect of adrenocorticotrophic hormone in mink females. Serial dilutions of mink plasma with high concentrations of cortisol produced a displacement curve parallel to that of the human standards. Adrenocorticotrophic hormone was administered intramuscularly to females with fearful behaviour and with explorative behaviour, respectively. Plasma samples at 0, 30, 45, and 75 min. relative to the injection were analysed for cortisol and prolactin.

The cortisol response to adrenocorticotrophic hormone was lower for the explorative group than for the fearful group, but the difference was not significant ($P > 0.05$). The

prolactin response to adrenocorticotrophic hormone decreased linearly for both groups ($P < 0.01$).

Animal Prod. Review, Applied Science Reports, 29, pp. 227-231, 1996. 2 figs., 3 refs. Authors' summary.

Content of macroelements in fur of Greenland and standard nutrias

Karin Siivegova, Dusan Mertin

At the Research Institute of Animal Production an experiment was performed with 25 male and 25 female standard, and 25 male and 25 female Greenland nutrias. The experiment lasted 8 months. Fur samples were cut from two parts of the body - the back and the abdomen, at the age of 60 (juvenile fur), 135 (moulting), and 240 days (fur maturity). The concentrations of Ca, P, K, S and Cl in % from dry matter was determined by disperse roentgen - fluorescent spectrometry. The concentration of these elements in feeds was studied, too. The results were processed mathematically and statistically. The concentrations of macroelements in the fur differed depending on age, sex and part of body.

Animal Prod. Review, Applied Science Reports, 29, pp. 233-237, 1996. 2 tables, 7 refs. Authors' summary.

Mink carcasses composted with manure and straw

Alfred Baumgarten

Composting of mink carcasses with manure and straw is a real alternative solution for disposing of mink carcasses after pelting - kind to the environment and with low cost. This study concerns the period between 1991 and 1996 but with the possibilities to go on, depending on the results.

The experimental design has a capacity for 400,000 mink carcasses per season.

The compost process of the trial concerned two steps:

- main compost, 8 months, between January and August;
- secondary compost, 7 months, between September and March.

The followed operation schedule concerned physical, chemical and bacteriological values as volume, odour, temperature, humidity, pH, C:N ratio, nutrients, and pathogens.

The investigated areas are the type of construction, substrates, control parameters, and environmental impacts. The first results showed a satisfactory evolution of the composting process.

Animal Prod. Review, Applied Science Reports, 29, pp. 239, 1996. Author's summary.



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