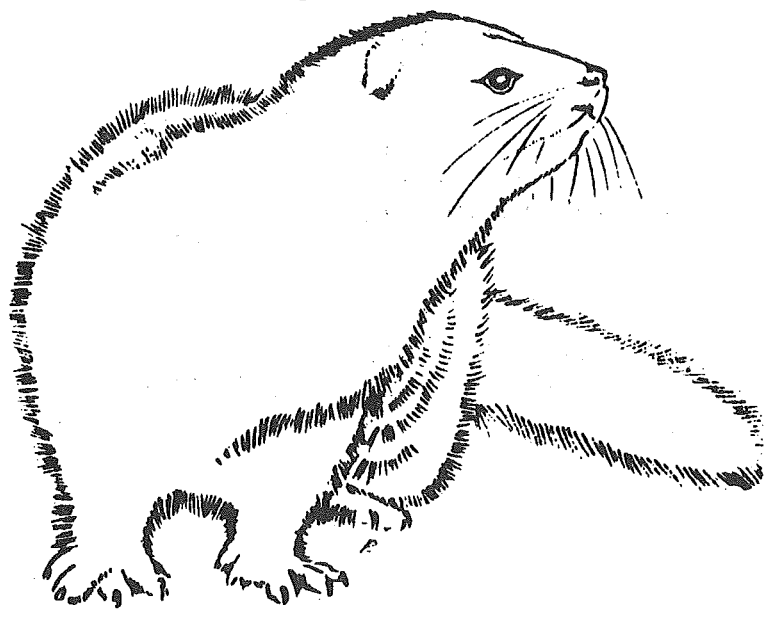
SCIENTIFUR

No. 2, May 1978.

Contents.





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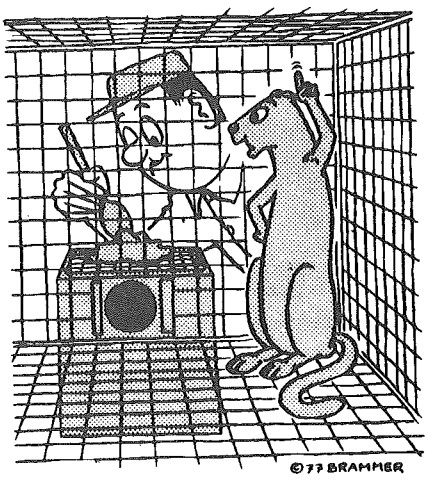
Please, place the feed on the top wire. I want to clean my sleepingroom after the kits moving from home !



NOTES

SCIENTIFUR

Vol.2, no.2, May 1978.

After I came home from a wonderful and very interesting trip to the USA I had a lot of work to catch up on before I could begin to concentrate on SCIENTIFUR no. 2. It is therefore that it is a little late.

I was overwhelmed by the friendliness and hospitality I met from all my colleagues in USA, from Travis in the East to Oldfield in the West. I would like to take this opportunity of thanking all of you for making my trip an experience which far surpassed my expectations (which were high) both professionally and personally.

I will make a complete report on my tour at NJF's meeting in October (see under COMMUNICATION) but I will now say that I am convinced that both mink production and fur bearer research in the USA has been through a period of adjustment and is now very progressive, with the accent on quality rather than quantity.

In order to obtain the resources for research into fur bearing animals it has to a high degree been necessary to gather researchers from various disciplines together in special teams to co-operate on the solution of particular problems. That this method of research has been fruitful can be seen in the enormous progress which has been made in the plasmacytose question. Another example is the work of Hegreberg et. al. on the Ehlers-Danlos syndrome, which is the subject of several abstracts in this issue of SCIENTIFUR.

All in all, I received many valuable reports and made many good friends in the USA, and I am sure that SCIENTIFUR's readers will also come to benefit from this.

NJF's Fur Animal Division has decided to arrange the next world congress on Fur Animal Production in Denmark in April 198o. More information on this can be found in Helge Olsen's notices under COMMUNICATION.

In this issue of SCIENTIFUR we publish 2 original articles. We are indebted to Tony Rietweld for one of them - it is important to have documentary evidence on how results of basic research work in practice. The other is a complete review of the feedstuffs which have, up to the present, been investigated in Denmark. It contains brief descriptions of each feedstuff as well as chemical composition and digestibility coefficients measured on mink. We must admit that this review is somewhat lengthy for SCIENTIFUR but we think it is best to publish the information in this way, not to mention the fact that it would have been a pretty thin SCIENTIFUR if we had published only the lo abstracts we received in the period February-May 1978.

PLEASE REMEMBER THAT SCIENTIFUR IS NOTHING WITHOUT YOUR ATTENTION.

Kind regards from
your hopeful
editor.

* A HERITABLE CONNECTIVE TISSUE DISEASE OF DOGS AND MINK RESEMBLING EHLERS-DANLOS SYNDROME OF MAN.
I. SKIN TENSILE STRENGTH PROPERTIES.

Gerald A. Hegreberg, George A. Padgett, Richard L. Ott, James B. Henson, Dept. of Vet. Pathol. and Vet. Clin. Med., College of Vet. Med., Washington State University, Pullman, Washington, USA.

Clinical changes observed in a heritable connective tissue disease of dogs and mink include fragility, hyperextensibility, and laxity of the skin. Skin fragility is the most severe and consistent change noted in the affected dogs and mink. Tensile strength of the skin was reduced to one-twenty-seventh that of normal in affected dogs and one-thirteenth, that of normal in affected mink. The syndrome in dogs and mink is proposed as a homolog of the Ehlers-Danlos syndrome of man, a rare heritable connective tissue disease, which is clinically characterized by skin fragility, skin and joint hyperextensibility, and skin laxity.

The Journal of Invest. Dermatology, Vol. 54, no.5, 377-38o.
3 figs. 2o references.

Authors summary.

* CONNECTIVE TISSUE DISEASE OF DOGS AND MINK RESEMBLING EHLERS-DANLOS SYNDROME OF MAN.
III. HISTOPATHOLOGIC CHANGES OF THE SKIN.

Gerald A. Hegreberg, George A. Padgett, James B. Henson, Dept. of Vet. Pathology, College of Vet. Med., Washington State University, Pullman, Washington 99163, USA

The microscopic alterations of the skin from dogs and minkafflicted with a primary heritable connective tissue disease resembling the Ehlers-Danlos syndrome (ED-S) of man are confined predominantly

to the collagen fibers of the dermis and include fragmentation, lack of orientation with improper interweaving, and irregularity of size of collagen bundles. Characteristic microscopic changes in the dermis of affected dogs and mink are strikingly similar and are generalized throughout the entire skin. A significant decrease in dermal thickness was noted in affected dogs but not in affected mink. The microscopic changes in the collagenous component of the dermis of affected dogs and mink appear identical to those described in the ED-S of man.

Arch. Path, Vol. 9o, Aug. 197o. 159-166.
6 photos, 46 references.

Authors summary.

* BIOCHEMICAL CHANGES IN THE SKIN OF MINK WITH EHLERS-DANLOS SYNDROME: INCREASED COLLAGEN BIOSYNTHESIS IN THE DERMIS OF AFFECTED MINK.

David F. Counts, Patricia Knighten, Gerald Hegreberg,
Dept. of Vet. Microbiology and Pathology, Washington State University, Pullman, Washington 99163, USA.

The Ehlers-Danlos syndromes (ED-S) are a group of connective tissue diseases which occur in humans and other mammals. Mink inherit an autosomal dominant form of ED-S which is characterized by laxity and decreased tensile strength of the skin. We wish to report some of the biochemical changes in the skin of affected mink as compared to agematched, nonaffected mink. There was a 39% increase in acetic acid extractable collagen per wet weight of tissue of the skins of the affected mink. This was accompanied by a 26o% increase in prolyl hydroxylase specific activity, a 179% increase in lysyl hydroxylase specific activity, and a 118% increase in lysyl oxidase specific activity in the skins of affected mink. ($^{3}$H)-Hydroxyproline formation was increased 133% when skin tissue minces were incubated with ($^{3}$H)-proline. This was accompanied by a 77% increase of ($^{3}$H)-proline incorporation into protein and a 93%

increase of ($^{14}$C)-glycine incorporation into protein. Noncollagen protein synthesis, evaluated by measuring ($^{3}$H)-tryptophane incorporation into protein, revealed a 4o% increase in noncollagen protein synthesis. The increased collagen synthesis rate in the skins of the ED-S affected mink may represent either the absence of the control of collagen metabolism which contributes to the molecular defect of the ED-S in the affected mink, or a response to the damaged skin caused by the ED-S in the affected mink, or both.

The Journ.of Invest. Dermatoloty, 69, 521-526, 1977.
4 tables, 31 references.

Authors summary.

* ANIMAL MODEL OF EHLERS-DANLOS SYNDROME.

G.A. Hegreberg, Dept. of Vet. Patholoty, College og Vet. Med., Washington State University, Pullman, WA 99163, USA.

Potential Usefulness of the Model.

The basic underlying defect involved in the ED-S in unknown; however, the morphologic changes in dermal collagen and the severe decrease in tensile strength of the skin and other soft tissues suggests that the defect involves collagen. This concept is supported by studies which indicate that the process of collagen maturation, especially intermolecular collagen cross-link formation, is vital to maintenance of the mechanical properties of tissues.

The ED-S of dogs and mink represents one of the few genetically transmitted collagen defects currently recognized in animals. Further studies of the syndrome in dogs and mink offers a model for delineating the pathogenesis of the ED-S in man. Furthermore, studies of this collagen defect may provide valuable information regarding collagen maturation and cross-linking phenomena for useful extension to and manipulation of wound healing and aging

processes of man.

Availability.

Colonies of dogs and mink with ED-S are maintained at Washington State University and are available for study on a limited basis.

American Journ. of Pathology, Vol. 79, no.2, May 1975, 383-386.
1 table, 2 figs., 11 references.

Original chapter of report.

* HAIR LENGTH OF DARK MINK.
(Hårlengden hos mørk mink.)

Jostein Reiten, Agric. University of Norway, Dept. of Poultry and Fur Animal Science, 1432 Ås-NLH, Norway.

The objectives of the investigation were to study the variations in length of guard hairs and underfur within and between animals and the differences in hair length between animals of different sex and age.

The investigation includes the skin production of dark mink at the Agricultural University of Norway during the years 1973-1975, totally about 3.000 kits and 700 adults.

Hair samples removed from back, side and bellow of 3 skins showed large variations in hair length within very small areas of the skin. The numerous intermediate hairs are to a great extent determining the impression of the hair length.

Measurements of the hair length at 40 different spots of skins of 5 kits of each sex showed variations of 0.45 to 0.65 for the ratio between length of underfur and guard hairs (nap). Nap was higher at back and sides and lower on the bellow. Hairs were longer at the back than on the bellow and longer on the rear part than forwards towards the snout.

The investigation showed that skins of adults have longer hairs than skins of kits and that male skins have longer hairs than the female skins.

An analysis of the relation between length of underfur and guard hairs showed that grading of nap at Oslo Fur Auctions to a greater extent was determined of the total length of guard hairs than of the ratio between length of underfur and guard hairs.

Scientific Reports of The Agricultural University of Norway
ISSN oo25-8946, Vol. 57, 1978, no. 4, 1-12.
5 tables, 7 figs., 1o references.
(Norwegian with english subtitles and summary).

Authors summary.

* METHYL MERCURY DEGRADATION IN MINK.

Arne Jernelöv, Anne-Helene Johansson, Leif Sörensen, Anders Svenson,
Swedish Water and Air Pollution Research Institute, P.O.Box
21o6o, S-1oo 31, Stockholm, Sweden.

Degradation of methyl mercury by mink was investigated in a series of experiments. Mink were fed daily with a diet containing methyl mercury-contaminated fish. Contents of total mercury, methyl mercury and selenium were determined in different tissues from the animals, as were the contents in faeces. Of the total amount of mercury detected, only about 73% was found as methyl mercury. In liver and kidney the proportions were 46 and 55%, respectively. Selenium contents were low compared with those found in marine mammals where equivalent amounts of mercury and selenium on a molar basis have been reported. The conditions in mink are compared with earlier studies on cats and marine mammals.

Toxicology, 6, 1976, 315-321.
5 tables, 13 references.

Authors summary.

## * EFFECT OF IODINE ON REPRODUCTIVE PERFORMANCE OF FEMALE MINK.

R.J. Aulerich, R.K. Ringer, G.R. Hartsough, Fur Animal Project, Dept. of Poultry Science, Michigan State University, East Lansing, MI 48824, USA.

Female mink were fed a basal diet supplemented with either o, 1o, 1oo, or 1ooo ppm iodine, as potassium iodide, from breeding through lactation. In addition, females were housed in pens sanitized just prior to whelping with 1oo or 1ooo ppm titratable iodine disinfectant to investigate the effects of these treatments on their reproductive performance. The gestation periods of the iodine-treated mink were shorter than the controls. Kit birth weights were not significantly different from the controls. The average number of kits whelped per female mated in the control group was 5.o. No detrimental effects were observed on litter size or kit survival in the group fed 1o ppm supplemental iodine. Only 2.1 kits per female mated were whelped by the mink fed 1oo ppm supplemental iodine and none of the females that received the 1ooo ppm supplemental iodine diet whelped. Body weights of kits whelped and nursed by the females that received the 1oo ppm supplemental iodine diet were significantly lighter at 4 weeks of age. Kits nursed by females housed in pens sanitized with 1oo or 1ooo ppm titratable iodine had the greatest biomass at 3 weeks of age.

Theriogenology, 9, 1978, 295-3o3.

3 tables, 8 references.

Authors abstract.

# * EFFECTS OF PCB AND DDT ON MINK (MUSTELA VISON) DURING THE REPRODUCTIVE SEASON.

S. Jensen, J.E. Kihlström, M. Olsson, C. Lundberg, J. Örberg, National Swedish Environment Protection Board, Special Analytical Laboratory, Wallenberg Laboratory, S-104 05 Stockholm, Sweden.

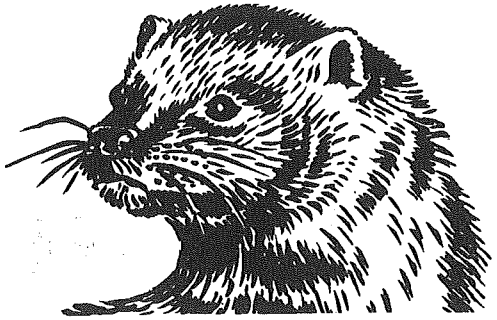
There are strong reasons to believe that the decrease in the Baltic seal populations is caused by the heavy pesticide contamination of the Baltic area. In order to test experimentally whether DDT substances and/or PCB substances are responsible for such effects, another fish-eating species with a similar pattern of reproduction, the mink, has been studied. The results show that PCB, but not DDT, decreases the number of whelps born per female mink by interrupting the pregnancy at an early stage of gestation.

**Table 1. Reproduction of mink given PCB for 66 consecutive days.**

| | Group A | B | C |
|---|---|---|---|
| No. of bitches | 25 | 22 | 22 |
| ppm PCB in feed | 0.05 | 3.3 | 11 |
| ppm PCB in extractable fat, mean values | 14 | 86 | 280 |
| Liver somatic index, mean values | 0.344 | 0.408 | 0.554 |
| Delivering bitches, percent of mated | 92 | 73 | 0 |
| No. of implantation sites/ pregnant bitch | 6.6 | 6.1 | 4.5 |
| No. of whelps born/ pregnant female | 5.1 | 2.9 | 0.0 |

Ambio., 6 (4), 1977, 239.
1 table, 7 references.

Authors abstract + the original table.



* AGE DETERMINATION IN THE RED FOX (VULPES VULPES) - AN EVALUATION OF TECHNIQUE EFFICIENCY AS APPLIED TO A SAMPLE OF SUBURBAN FOXES.

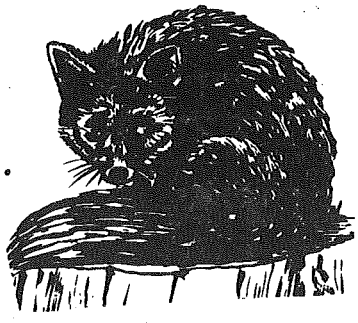
Stephen Harris, Dept. of Zoology, The University, Woodland Road, Bristol, England.

A review of age determination techniques that have been applied to the family Canidae is presented. It is shown that the pattern of growth and development of the various species is very similar, the rate of development being greater in the smaller, shorter-lived species, and vice versa.

The occurrence of annuli in the hard tissues of London foxes is demonstrated; these annuli can be used reliably for age determination, despite suggestions that temperate zone animals from weakly continental climates have indistrinct annuli. The objective ages determined by cementum annuli are then used to investigate the value of less time-sonsuming age determination techniques, particularly in the separation of the young-of-the-year from adults. The results obtained from different studies vary, and these differences are discussed. It is suggested that the speed of development varies slightly in different Red fox populations, and so caution must be exercised before data from one population are applied to another population.

J. Zool., Lond. 1978, 184, 91-117.
2 plates, 5 figs., 9 tables, 61 references.

Authors summary.



* DYNAMICS OF SPRING MOLTING IN MINK.
(Průběh jarního línání norkú).

Karel Kostroň, František Kukla, Inst. of Fur Bearing Animals, Dept. of Breeding Horses, Sheep, and Fur Bearing Animals, University of Agriculture, Zemědělská 1, 662 65 Brno, ČSSR.

Molting is doubtless one of the most important events in mink ranching. It is well known that the mink undergoes two molting period a year. Our task wa to find out the dynamics of molting in the "spring" (early summer) period under the conditions of our mink ranching.

The spring molting in mink commences in April and continues showing a trend to rising through May, June, and July to be completed in the course of August.

The molting proceeds as a continous asequence of events showing a rising trend; the advance however, being not linear. In its final stage a retardation in the molting occurs.

Acta Univ. Agric., fac. agron. XVI, 1968, 3., 513-518.
1 table, 5 figs., 5 references.

Authors introduction and conclusions.

* THE OCCURRENCE OF FLEAS (SIPHONAPTERA) ON MINK FARMS IN CZECHOSLOVAKIA.
(K problematice výskytu blech (Siphonaptera) na farmách norku v ČSSR).

Milan Jurík, František Kukla, Dept. of Zoology, University of Agric., Zemědělska 1, 662 65 Brno, CSSR.

During the years 1968-1969 the mass occurrence of fleas could be observed, for the first time, in the mink farms of Czechoslovakia. Since 197o, systematic investigation of this problem took place by sampling nesting material from mink cabins. This investigation took place, in an extensive scale, on two mink farms of South Moravia.

In total, 153 individual and box cabins of mink were sampled, of which 67 were positive for flea occurrence, i.e. 44,5%.

The prevailing material of sampled fleas belonged to the species M. sciurorum (92,5% of infested cabins). C. gallinae was found on 7,5% of cabins (nests). In all the cases observed the two species excluded each other, so that they only could be observed separate from each other.

On the basis of our investigations, we may conclude that M. sciurorum adapted well to the mink farming in Czechoslovakia being a serious ectoparasite to this fur animal. This species may continuously develop in mink cabins between February to October. As for C. gallinae, this species occurred more sporadical, in several farms its original occurrence disappeared and was followed by the infestation of M. sciurorum. Both species, however, play an important role as ectoparasites of mink.

Acta univ. agric. (Brno), fac. agron., XXII, 1974, 1, 131-139.
1 figure, 2 tables, 21 references.

Authors abstract.

* CHANGES OF THERMOREGULATION IN MINK KITS WITHIN THE 45 DAYS OF ONTOGENESIS.
(Vývojproměn tělesné teploty norčat v prvních 45 dnech ontogeneze).

Karel Kostroň, František Kukla, Inst. of Fur Bearing Animals, Dept. of Breeding Horses, Sheep, and Fur Bearing Animals, Zemědělska 1, 662 65 Brno, CSSR.

Thermoregulation in young minks has been studied in this Institute since 1964; the period under observation covering the interval from birth until 45 days of life when the animals attain full maturity and hair cover. Results of the observations are summarized below:

1. The temperatures measured on mouth and belly of the mink kit are found reflecting best actual temperature of the body when a variety of such possible places is considered; those established

on distal parts of the body are least representative.

2. The younger the mink kits are, the more sensitive their response to the environmental temperature.

3. The rate of temperature loss is in direct correlation to age and environmental temperature; from 25th day of life onwards this rate becomes distinctly slowed down even at $10^{o}$C, while from 35th day onwards nearly full homoiothermism in the animals is attained.

4. Such changes as for instance an increase in the environmental temperature induce elevation in the body temperature in direct correlation to age; the younger the kit, the more sensitive its response.

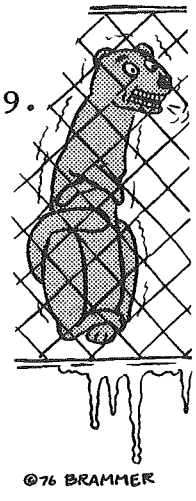
5. Undercooling to 15-$17^{o}$ C induces the condition of stiffness in mink kits. Reduction of the body temperature to 12-$13^{o}$ C (short-time) and allowing the kits to stay in a $10^{o}$ C environment for one hour does not result in their death.

6. The mink kits over 35 days of age suffer from excessive temperature at $30^{o}$ C.

7. No correlation is established between the sex and the body temperature, and the correlation between the mink kits weight and the body temperature is not invariably significant. Thus, the stage of body development, attained, which need not always be in accord with the body weight, appears to be decisive for the ability of maintaining the body temperature constant.

Acta univ. agric. (Brno), fac. agron. XVIII, 1970, 3, 461-469.
1 table, 4 figs., 30 references.
Czechoslovakian with summary in english and russian.

Authors summary.



* UNDERFUR COLOUR IN CZECHOSLOVAK NUTRIA.
(Zbarveni podsady československých nutrií)

Karel Kostroň, František Kukla, Inst. of Fur Bearing Animals, Dept. for Breeding Horses, Sheep and Fur Bearing Animals, Univ. of Agriculture, Zemědělská 1, 662 65 Brno, CSSR.

Colouring is one of the most important factors in the furrier business. The colour pattern of nutria fur takes regard foremost to the colour of the underfur. The colour shade or tint of this underfur is difficult to discribe. The discussed shades are deep dusky brown, swarthy, tawny gray, sombre, graish brown or murky. Some of these may be sometimes attractive in the fur business. Fur breeders are righly interested in producing nutria furs in one of the required tints and select them for this goal.

We made investigations about the present underfur pattern conditions in the Czechoslovak nutria breeding stock.

We are able to conclude that:

1. the colouring of underfur is not influcenced by the age of animals. Only in high age there are some changes in the quality of underfur.
2. The colouring of underfur does not change during the ontogenesis of animals.
3. There is no relationship between the sex and the shade of underfur.
4. The colouring of underfur is depending from the racial typus (breeding strain).
5. The colouring of underfur in Czechoslovak nutria peltries is of top quality.

Acta univ. agric. (Brno), fac. agron. XVIII, 197o, 3, 456-459.
3 tables, 18 references.

Authors introduction and conclusion.

* CARCASS VALUE AND FOOD PROPERTIES OF NUTRIA MEAT.
(Jatečná hodnota a konzumní vlastnosti masa nutrií).

Karel Kostroň, František Kukla, Inst. of Fur Bearing Animals, Dept. for Breeding Horses, Sheep and Fur Bearing Animals, Univ. of Agriculture, Zemědělská 1, 662 65 Brno, CSSR.

Our analyses of nutria meat revealed:

1. The carcass value of nutria meat is favourable for the combined use of these animals, i.e. as the fur-bearing and meatproducing animals;
2. The dressing percentage is slightly decreasing with age in nutria females and increasing in males. Young males in particular are suitable as meat producers, while culled females should be well fed before slaughter and stripping;
3. Chemical analyses indicate that nutria meat ranks among the best kinds in respect of quality;
4. Organoleptic properties of nutria meat are very good.

Acta univ. agric. (Brno), fac. agron., XVII, 1969, 4, 801-803.
3 tables, 8 references.
Czechoslovakian with english and german summary.

Authors summary.

* LABORATORY EVALUATION OF HAIR COAT OF NUTRIAS REARED IN DIFFERENT SYSTEMS.
(Ocena laboratoryjna futerek nutrii odchowywanych w różnych systemach.)

Jadwiga Kawińska, Stanislaw Niedźwiadek, Józefa Tuczyńska, Instytut Zootechniki, 32-083 Balice k. Krakowa, Poland.

Laboratory investigations of the physical characteristics of skins obtained from nutrias reared in bath-, bathless- and cage systems have been carried out in the Fur Laboratory of the Institute of Zootechnics at the Zootechnical Experimental Station in Zator.

The area, weight and specific weight of 1 $dcm^2$ were estimated for both rough and dressed skins. The following values for the fur cover parameters have been found: the thickness and the length of down hair ranged from 9 to 11 microns, and from 13 to 15 mm, respectively, the average length of cover hair varied between 95 and 38 mm. Calculated mean density of down hair amounted to 11.3-15.2 thousand per 1 $cm^2$ of skin and was highest on skins derived from animals reared in the cage system. The value of the skins of nutrias from this group was confirmed by the results of organoleptic examination by experts, at they attained the average quality grade of 2.7. The results of the experiment proved the cage system to be suitable to the rearing of young nutrias for fur skin production.

Rocz. nauk. Zoot. T. 4, 2, 1977, 237-243.
3 tables, 6 references.
Polish with english subtitles and english and russian summary.
Authors summary.

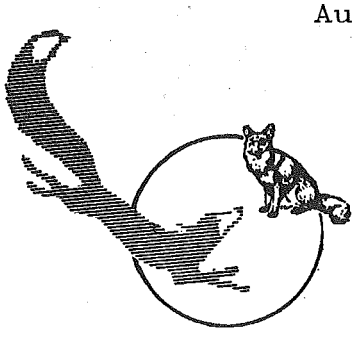
* ALLELIC EXPRESSION IN INTERGENERIC FOX HYDRIDS (ALOPEX LAGOPUS X VULPES VULPES). III. REGULATION OF THE EXPRESSION OF THE PARENTAL ALLELES AT THE Gpd LOCUS LINKED TO THE X CHROMOSOME.

O.L. Serov, S.M. Zakijan, V.A. Kulichkov, Inst. of Cytology and Genetics, Siberian Branch of the Academy of Sciences of the USSR, Novosibirsk, USSR.

The electrophoretic pattern of glucose-6-phosphate dehydrogenase (G6PD) was studied in 6o intergeneric fox hydrids (Alopex lagopus x Vulpes vulpes), 33 females and 27 males. It is shown that the structural gene for G6PD, designated Gpd, is located on the X chromosome in both Arctic and silver foxes. Analysis of G6PD patterns in the erythrocytes of hybrid females demonstrated that the phenotypic expression of parantal alleles at the Gpd locus varied considerably: from 1:1 to the hemizygous manifestation of an allele of either the Artic or the silver fox. The expression of the parental alleles at this locus is different in the various tissues of single female hybrids. It is suggested that the variable quantitative expression of the alleles at the Gpd locus in hybrid females is related to the presence of two cell populations having in an active state either the X chromosome of the Arctic fox or that of the silver fox. It is also proposed that the size of the two cell populations is largely affected by the different relationships between cells having different activated X-chromosomes among initiator (stem) cells from which various definitive organs and tissues develop. The number of initiator cells for erythroid tissue has been calculated to be five or six.

Biochemical Genetics, Vol. 16, no. 1/2, 1978, 145.

Authors summary.



* SIZE VARIATION OF THE FOX, VULPES VULPES IN THE PALAEARCTIC REGION TODAY, AND IN ISRAEL DURING THE LATE QUARTERNARY.

Simon Davis, Dept. of Zoology, The Hebrew University, Jerusalem, Israel.

Fox mandible measurements from different parts of Israel showed that within this region no significant size change could be observed. However, considering a wide geographic range encompassing Europe, north Africa, the Middle East and N.W. India, fox size was found to decrease in correlation with mean January and July-August temperatures (r= -o.75 and -o.8o respectively).

The possibility that size change is due to character displacement by the jackal is considered unlikely, since size changes of the fox are clinal and do not coincide with the jackal' s distribution. Fossil fox mandibles were examined from a serie of prehistoric sites from the upper Pleistocene and Holocene in Israel. The fox increased in size, attaining a maximum towards the end of the Pleistocene, and dwarfing took place during or after the Natufian period, that is, at the end of the Pleistocene, as has been reported for several other mammals from this area. The order of magnitude of this dwarfing was observed to be equivalent to that correlated with a temperature change of 8-9$^{o}$ C in recent foxes, and a similar temperature change has therefore been suggested for the Pleistocene-Holocene boundary.

J. Zool., Lond. 1977, 182, 343-351.
2 tables, 3 figs., 3o references.

Authors summary.

* POPULATION-GENETIC STUDIES ON THE PROCREATION OF POLAR FOXES. PART I. REPEATABILITY AND HEREDITABILITY OF THE TIME OF THE OCCURRENCE OF OESTRUS.
(Genetyczno-populacyjne badania nad rozrodem lisów polarnych. Cz. I. Powtarzalność i odziedziczalność terminów wystepowania rui.).

Janusz Maciejowski, Instytut Biologicznych Podstaw Produkcji Zwierzecej Wydzialu Zootechnicznego, Akademii Tolniczej w Lublinie, Poland.

On 5 different farms, 3495 cases of oestrus in 1401 female polar foxes were recorded, and on the strength of these records the correlation between the time of oestrus and the age of the female was investigated. The repeatability and heritability of this characteristic were also assessed.

A statistically significant positive correlation was found between the date of birth of the female and the date of the first oestrus (r from +0.201 to +0.279). In one year old females, oestrus occurs later, on the average by 5 to 14 days in comparison with older females. The coefficient of the repeatability of this characteristic is fairrly high; it varied from 0.374 to 0.532 for the individual farms and was contained with in comparatively narrow confidence intervals. An atempt at assessing the heritability coefficients by the method of regression, mother-daughter, within the herds produced fairly divergent results. The coefficients obtained vary between 0.068 and 0.674.

Ann. Univ. Mariae Curie-Sklodowska, Lublin-Polonia, XXVII, 22, E, 1972, 343-358.
6 tables, 1 fig., 15 references.
Polish with english subtitles and summary.

Authors summary.

* POPULATION-GENETIC STUDIES ON THE PROCREATION OF POLAR FOXES. PART II. THE SIZE OF LITTERS AND THE PROPORTION OF OFFSPRING SEXES.
(Genetyczno-populacyjne badania nad rozrodem lisów polarnych. Cz. II. Wielkość miotów i liczbowy stosunek płci w potomstwie.)

Janusz Maciejowski, Instytut Biologicznych Podstaw Produkcji Zwierzecej Wydzialu Zootechnicznego, Akademii Rolniczej w Lublinie, Poland.

The research covered 25,747 polar fox kits born in 2,984 litters and coming from 1,401 females. The size of the litters and their repeatability, the frequency of litters, the distribution of sex among kits in relation to the age of mothers and size of litter, were studied. The examined material came from 5 different farms.

It was ascertained, that the average size of a litter is 8.75 kits, but from one year old females 7.94 kits were attained. Older females up to the age of 5 years had litters of a similar size (above 1 kit). A noticeable decline in the fertility of females occures at the age of 6 years. It was found, that the fertility feature is subject to a sever culling. It finds expression in a great difference between the size of litters of culled females of all ages and those left for further utilization. In the first three years of utilization this difference is: 1.95, 1.60, 1.39, respectively. The coefficients of the repeatability of the size of the litter, was evaluated by two methods (the analysis of variance and size regression of the second in comparison with the first litter), was; 0.129 and 0.136 respectively. An almost ideal consistence of the value of this coefficient was obtained by both methods, separately for individual farms. The repetitive differences between farms were rather large and were contained within the limits of 0.060 to 0.214, which indicates a difference in the degree of genetical variability in individual herds.

In all the studies farms among the kits separated from their mothers, a statistically important predominance in the number of males to females was found. On an average in all the studied material there were 114 males to 100 females. In the offspring of the primaparas the predominance in the number of males was higher (117:100). In subsequent years of utilization of females, this predominance decreased and for females 2-6 years old was: 114:100, 113:100, 112:100, 110:100, 110:100 respectively.

The dependance between the size of a litter and the proportion of sexes of kits was not ascertained.

Ann. Univ. Mariae Curie-Sklodowska, Lublin-Polonia, XXVII, 23, E, 1972, 359-381.
9 tables, 2 figs., 23 references.
Polish with english subtitles and summary.

Authors summary.

* AN IMMUNOGENETIC CHARACTERISTIC OF POLAR FOXES.

Henryk Balbierz, Maria Nikolajczuk, Wlodzimierz Pisański,
Wroclaw Agric. Academy, Inst. of Anim. Path. and Therapy,
52-423 Wroclaw, ul. J. Stanki 7 m. 2, Poland.

In the blood serum of 345 polar foxes the transferrin types (Tf) and activity of ceruloplasmine and amylase, and in the erythrocytes - the activity of acid phosphatase (Acp) and lactate dehydrogenase (LDH) were determined. For quantitative analysis of the proteinogram and for the immunoelectrophoretic analysis, 115 sera were chosen at random. For comparison the blood sera from 16 silver foxes and 8 dogs were also examined. The following types of transferrin were ascertained: in 49 foxes - Tf AA, in 11o - Tf B, in 154 - Tf AB. Tf C type, not described so far, occurred in 17 foxes as Tf BC in 9 as Tf AC and in 6 as Tf C. The erythrocyte acid phosphatase also showed polymorphic differentiation, and appeared as type a in 257 animals, as type ab in 31 animals, and as type b in 1 fox only. LDH demonstrated an activity of izoenzyme LDH I, LDH II and to a small degree LDH III. In individual cases the presence of LDH V was ascertained. Ceruloplasmine did not demonstrate migrational differences, and amylase showed no activity at all.

The immunoserum, directed against the polar fox serum, had a considerable antigen affinity, particularly within albumins and

$\alpha$- and $\beta$-globulins. The immunoserum directed against the dog erythrocyte haemolizate precipiated both the dog and the fox (polar and silver) Hb. It can be assumed that this similarity lies in the alpha chains of haemoglobin.

Prace i Materialy Zootechniczne, 13, 1977, 7-13.
1 table,4 figs., 1o references.

Authors abstract.

* THE USE OF TRANSFERRIN POLYMORPHISM (Tf) IN FAMILY INVESTIGATIONS AND IN THE SIRE IDENTIFICATION IN POLAR FOXES.

Henryk Balbierz, Maria Nikolajczuk, Wanda Gut-Koryzna,
Wroclaw Agric. Academy, Inst. of Anim. Path. and Therapy,
52-423 Wroclaw, ul. J. Stanki 7 m. 2, Poland.

The triangle mating system in carnivorous fur-bearing animals has been used for a long time, but the effects of mating a female with two males could be demonstrated only in the case of well expressed differences in the conformation or coat colour of the males.

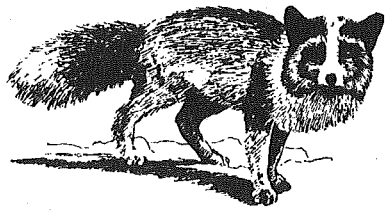
Thus, it seemed useful to take advantage of the polymorphism of serum proteins and other components demonstrating a genetical differentiation to confirm the effects of such matings. This would make possible, to indicate the progeny after one or the other sire irrespectively of the presence of simple morphological traits. These reasons became the basic assumption of the present investigations.

1. An adequate differentiation of the transferrin types in the mated fox triangles, makes it possible to indicate the progeny after each sire.
2. Using a uniform time table for mating in all cases, a greater number of progeny was obtained after the sire who mated first.

3. The progeny of the males who mated second constituted about 4o% of the offspring obtained. This quantity of cubs may be considered as a favourable effect of mating in the triangle system.
4. The possibility of more extensive application of the analysis of group arrangements in foxes for breeding or legal purposes is still very limited.

Prace i Materialy Zootechniczne 13, 1977, 15-2o.
3 tables, 5 references.

Authors introduction and conclusion.



* ORIGINAL PAPER.

# THREE YEARS OF PRACTICAL APPLICATION OF H.C.G. AT NORTHWOOD FUR FARMS, INC.

A.A. Rietveld, Genl. Mgr., P.O. Box 4o, Cary, IL 6oo13, USA.

This article is a very good example of a scientific concept that triggered some dramatic results in the industry. It also proves that these concepts in order to get the attention, need to be put before an international forum, and we are therefore very much indebted to Dr. Adams and the York Conferences. Nearly a decade has gone by since the original ideas and it is good that we now have an international fur publication, Scientifur, in which the results of all of this can be published.

In 1971, Dr. Adams addressed the Fur Breeders Association of the United Kingdom for the first time. In each of the following conferences, without interruption, he has developed some very practical ideas of how to control female behavior during the difficult breeding season of mink.

Our first contact was made in 1974. As a result of that we initiated a field trial in 1975 with 3oo females split up in various groups. It was our objective to study the feasibilities and chances for practical application.

From the start we never had the intention of increasing the whelping results of our farm as they were already in an optimum situation. The research materials were two year old pastel females because we wanted to be sure of reproduction performance. We wery much impressed with the ease of breeding. Those particular groups of mink were injected during the normal breeding season of the mink and there were no problems or detrimental effects. The over all averages in the various groups did not deviate from our farm results which are very high for this type of female - from 6 1/2 to 7 1/4 at birth. There were no statistical differences when analyzed. It then struck us to use this method as a work equalizer

on the farm. The normal breeding season has two peaks, both for man and beast. One in the beginning of breeding season, and one around the 15th and 16th of March. The 10th, 11th, and 12th of March were traditionally very low volume days and really wasted. It was our idea to use those days productively.

In 1976 we explored the limits of the use of H.C.G. and injected approximately 1/3 of a portion of the breeding herd. From that year we learned that it was possible but not practical to inject a small farm size unit with H.C.G. and get all the mink bred. This was a separate 500 female unit.

We also learned in 1976 that there were optimum dates for practical application. Very early or very late injection dates did not give adequate response. Shortening the interval between injection and mating to 5 days resulted in easier mating but smaller litters. In 1977 we once more explored the limits from early or late injected mink.

In our past season, 1978, we have experienced breeding season as a walk over by the combination of prelighting for the males and 1/3 of the females injected with H.C.G..

Our 1978 breeding season started in the fall of 1977 by the purchase of H.C.G. in late October, and we checked the potency of the batch on 12 rabbits. This was done by our veterinarian. x)

On the 26th of January, 1978, the lighting program was started for all the breeder males - 40 watt bulbs, 8 feet apart, one hour extra light at night. This program has been developed on our ranch

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x) The product we use is manufactured by Paines & Byrne, Ltd., Pabryn Laboratories, 177-179 Bilton Rd., Perivale, Greenford, Middlesex UB6 7HG, England.

over the last 5 years and has been in use by Canadian ranchers for quite some time. At a seminar that was held in the summer of 1975 on our farm, Dr. Adams provided us with some very practical hints that made this program successful.

Just prior to moving the males out to the breeder field, which was done on the 1st of March, the testicles of the males were checked. Any male with one or no testicles was pelted which amounted to 1% of the herd. In one group of high grade darks, the percentage was double that of the rest of the herd. Injection dates were March 2, 3, 4, 5, and 6, depending on the color phase and the age of the mink.

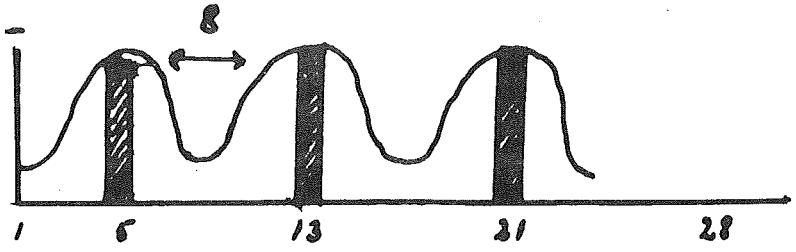
In 1978, the normal starting date, the 5th of March was on a Sunday. For that reason we decided to work only 1/2 a day, and we started old dark females on the 3rd, all old mutations on the 4th except for violets, opals and aleutians and the real breeding started on the 6th of March except violets which were started on the 7th or 8th.

The name of the game is kits - you will not get kits if you do not have conception - you will not have conception without mating - you will not have matings if your males do not work and the first four days of the season are mainly devoted to getting the males started. Pre-lighting surely helps to do that. We therefore run our mink twice a day, in the morning and in the afternoon.

On the first days with the old females, we get those female mated twice, each time with a different male, once in the morning, and once in the afternoon. On the 7th of March there were only 35 males, 1% that did not have a mating. By setting aside 1/3 of the herd, the male/female ratio at the beginning of the season is very favorable, one in three. We therefore double up as many females as possible in the first heat cycle. The 10th, 11th, 12th and 13 of March are the days for the injected mink plus the balance of the herd that was not bred. From the 13th onward, we work with

the normal bred mink covering them twice if possible.

The behavior pattern of H.C.G. injected females is following:




The heat cycle of a female is like an oscillating process with 3 peaks, approximately 7 to 8 days apart. To go on with this electronic terminology, all we do with H.C.G. injection is bring the mink in phase. 8 days after the injection a peak will occur. Those with an electronic background know that in an oscillating process you can have a positive and negative feed back. The H.C.G. injection in my opinion acts more or less like a negative feed back in which the height of the peak is mildly suppressed, and this will fool people who were going to use it for the first time. From 1oo injected mink, 7o will accept the first male and everyone will have a smile on his face and say how beautiful it can be. The other 3o however, have to be mated on the same day or the day thereafter and that means some switching around. Every female that does not accept the first male might be exposed to 5 or 6 males during those days and if the very small unbred portions is left alone, quite a few will get bred in the next cycle if the injection was early enough.

| | No. of female | | | | % of fem.unbred | | Over-all matings per fem. | % of single bred mink over-all |
|---|---|---|---|---|---|---|---|---|
| | total | inj. HCG | unbred HCG | total | HCG | Reg. breeding | | |
| 1976 | 18.132 | 3369 | 128 | 3o5 | 3.8 | 1.2 | 2.66 | 9.2 |
| 1977 | 19.oo1 | 6477 | 1o5 | 2o7 | 1.6 | o.8 | 2.84 | 4.9 |
| 1978 | 16.274 | 5157 | 54 | 95 | 1.o4 | o.4 | 3.o1 | 3.o |
| | 53.4o7 | 15oo3 | | | | | | |

As a close, some statistics of our H.C.G. experience over the past 3

years. From this it can be seen that the application of H.C.G. has definitely improved our breeding results. At first we had to go through a learning process. The number of unbred mink in the H.C.G. group was relatively high, but in subsequent years this has dropped and more important, the number of matings per female has increased by 13% and the number of single mated mink has dropped by 6%. From a season which was named "hetic", and a strain on people, it has become a very manageable and rewarding time on the ranch.

The 1oth of May 1978, we have a 93% whelp. The variance is from over 96% to 9o% between the different sections. The kits are doing extremely well and if we had a better lactation performance on some of our young females, we possibly would reach some fantastic average. We are not complaining but there is still room for improvement.

Fig. 1.

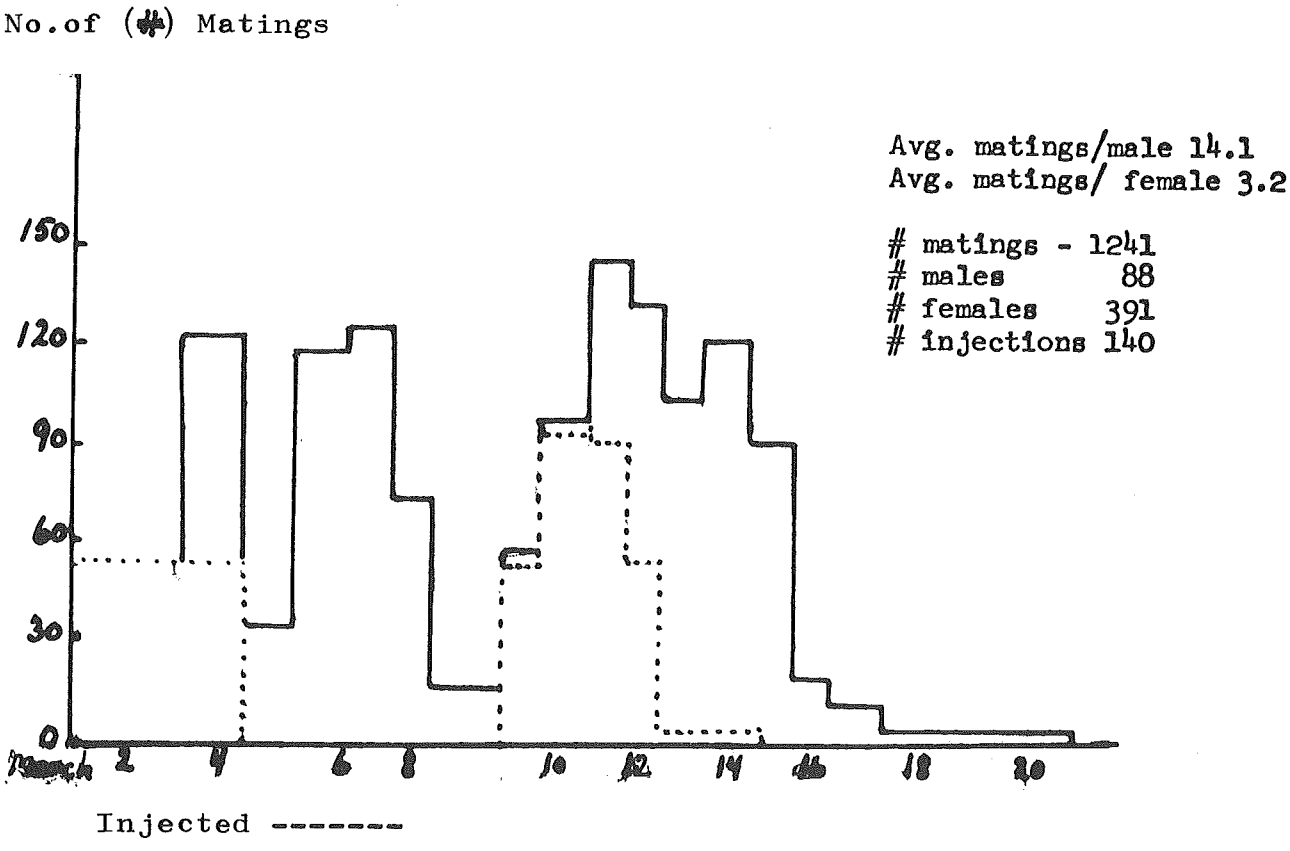



Figure 1 - This histogram represents the mating results of one shed.

The first block of dotted lines are the injections.
The second block of dotted lines, the mating pattern of injected mink.
The full line are the matings of the regular mink after the 1oth.
The full line includes HCG breedings.

The application of H.C.G. has not effected our over all results on the ranch as our average kit count at 1o days has not changed and has been a little above 5. In all these years, however, it has changes our working habits considerably. For all practical purposes, breeding season is finished on the 18th of March and breeder males are killed on that day. We do not have the late bred mink until the 1st of April. Consequently our whelping is condensed much more than it used to be. After the 5th of May, very few litters are born which helps the work flow on our ranch for the rest of the summer.

Figure 2.

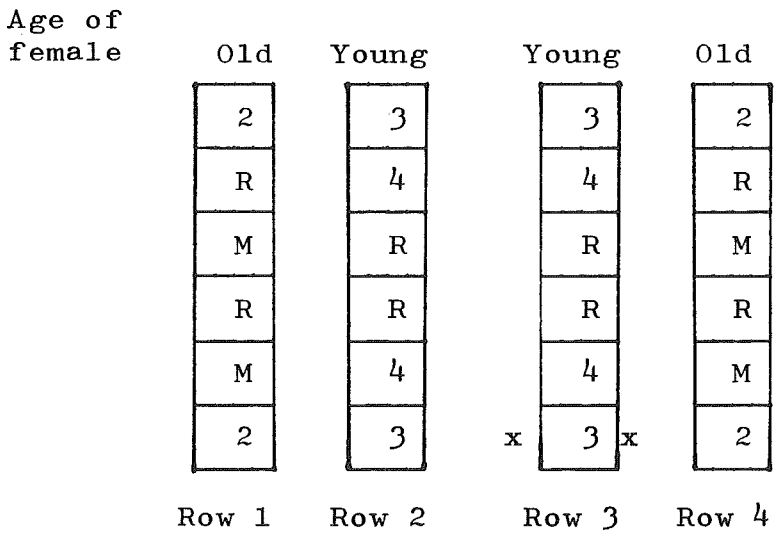



Figure 2 - We have the breeding organization of this particular shed. The outside rows of this shed, row 1 and 4 have the old females and were used to get the males started. The inside rows, 2 and 3 have the young females. The blocks marked 2, 3, and 4 indicate the position of the blocks of females that were H.C.G. treated. 2, 3, and 4 being the injection date. Notice that there were no young females injected on the second of March.

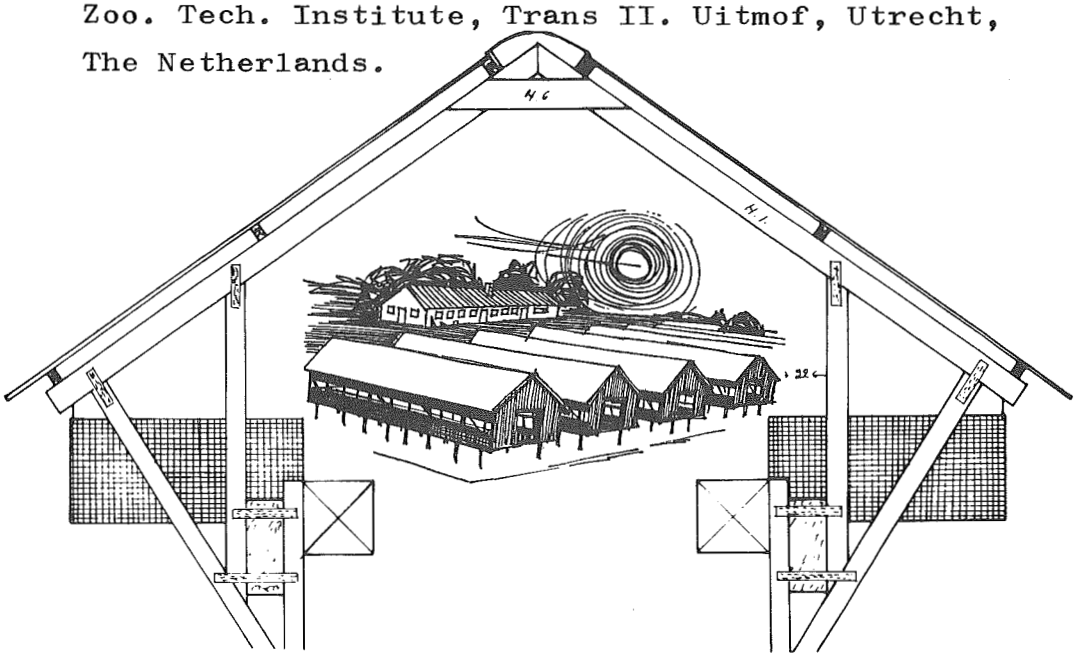
The "R"s represent regular bred mink. Of all the H.C.G. injected mink the block marked with "X"s behaved irregularly. Only 6 mink out of 1o injected females were mated according to the pattern 11, 12. One of them refused a remating. Two of them were mated 12, 14, and one 13,15.

When analyzing the situation of the spot, it was apparent that this block of females was exposted to more than usual light because of the irregular roof of the shed which allows the sun to get to those pens more than in the other locations. This has been our general experience, extreme light or extreme dark will cause the deviation of the pattern, but if that is the case, the normal mink also behaved irregularly and were harder to breed, so it is not really characteristic of H.C.G. injected mink.

References.

1. Adams, C.E. Proceedings, sixth through thirteenth training course and conference the fur breeders association of the U.K. and Ireland. 1971-1978. Janssen Services, 14 The Quay, Lower Thames Street, London EC3

2. Van Grunsven, Daphne. - Survey of Use of H.C.G. for reproduction of mink in The Netherlands - 1977. Zoo. Tech. Institute, Trans II. Uitmof, Utrecht, The Netherlands.



## * THE SEXUAL CYCLE IN CHINCHILLA (CHINCHILLA VELLIGERA).

Stanislaw Jarosz, Inst. of Anim. Nutr., University of Agric.,
Crakow, Poland.

Between 1966 and 1969 the author investigated 154 sexual cycles and post-partum periods in chinchillas bred in rooms heated and unheated in winter. The cycles were recognised by external symptoms and vaginal smears.

Independently of the kind accomodation, two periods were prominent in the proliferation of chinchillas: a) a period of increased sexual activity (December-May 31) features by regular cycles the length with was in the average 4o.9 days; b) a period of decreased sexual activity (June-November) with irregular cycles (36-13o days). Also, the length of the first cycle post partum in the two period was in the average 4o.1 and 8o.o days, respectively.

The oestrus was featured by appearance - in vaginal smears - acidophilus cells, cells with af pycnotic nucleus, and cornified cells. The phases of the sexual cycle (oestrus, metoestrus, dioestrus, proestrus) were featured only in the part (68% of investigated cycles). The mean lengths of the phases were respectively as follows 2.36, 2.2o, 34.8, 1.8 days.

Zoologica Poloniae, 23, 1973, 1-2, 119-128.
3 tables, 1 figs., 26 references.
English with abstracts in polish and russian.

Authors abstract.

# * INVESTIGATIONS ON FACTORS CONTROLLING FERTILITY OF THE COYPU (NUTRIA). PART II. ATTEMPTS AT DETERMINING THE POTENTIAL FERTILITY, BASED ON HISTOLOGICAL STUDIES OF THE OVARY.

(Badanie czynników plodności u nitrii. Cześć II. Próby określenia potenecjalnej plodności na podstawie badań histologicznych jajnika.

Witold Gluchowski, Janusz Maciejowski, Z Katedry Ogólnej Hodowli Zwierzat Wydzialu Zootechnicznego W.S.R. w Lublinie, Poland.

The purpose of the present paper was to determine the potential fertility of the coypu by means of the histological picture of the ovary. It was assumed that one mature Graafian follicle or corpus luteum corresponds to one foetus. The potential fertility was determined by counting in a series of ovary sections either the Graafian follicles or corpora lutea, according to the phase of the vaginal cycle. Before killing, smears of the vaginal mucus of the studies females were prepared in order to evaluate the usefulness of the smear method for determining the phases of the vaginal cycle in the coypu. In pregnant females the number of foetuses developing in both uteri was studied.

Examination of vaginal mucus and of histological sections of ovaries disclosed that of 28 females 5 were in the proestrus phase, 1 in oestrus, 6 in metoestrus, 7 in dioestrus; 9 females were pregnant. A complete agreement was found between the phase of the vaginal cycle, determined by means of the vaginal smear, and the phase of the ovarian cycle. In the ovaries of the females passing through the metoestrus phase different degrees of organisation of the corpora lutea were observed in individual ovaries; this points to the lack of synchronism in the ovulation of the individual Graafian follicles and confirms the observation, published in Part I of the present paper (4) that the oestrus phase is long in comparison with the length of the vaginal cycle.

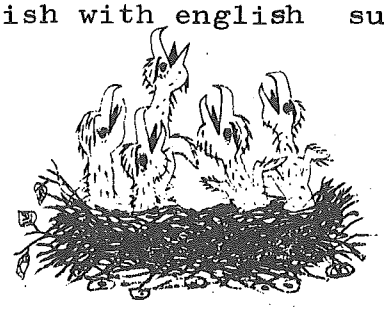
In 4 pregnant females there was found a discrepancy between the number of foetuses in the separate uteri and the number of corpora lutea in the corresponding ovaries. In 3 females this discrepancy concerned only the individual uteri, the general number of foetus being lower than the number of corpora lutea. In the remaining females there were present 4 corpora lutea (2 in each ovary) and 7 foetuses. These discrepancies between the actual and the expected state are explained in the first three cases, among other reasons, by extrauterine migration of the ova, in the fourth case either by the presence of several ova in one Graafian follicle, or by the occurrence of monozygotic twins.

In one female, which had miscarried, a developing foetus was found in the left uterus while the vaginal smear and the histological picture of the ovary pointed to the proestrus phase.

The potential fertility of the coypu, calculated as the arithmetical mean of the results obtained during the examination of the ovaries of 28 females, is 7.64 young in one litter. The actual fertility, according to the data found in the literature, is 4.5 young, and therefore only 58.9 percent of the potential fertility. This result is similar to that obtained by Konieczna (6). The present study points to the necessity of further research on the fertility of the coypu. The most interesting questions which remain to be cleared are: the possibility of extrauterine migration of oocytes, the possibility of the development of two oocytes in one Graafian follicle, and the problem of the frequency of occurrence of monozygotic twins.

Ann. Univ. Mariae Curie-Sklodowska Lublin-Polonia, Vol. XIII, 14, E, 1958, 345-361.
2 tables, 1 figure, 7 photos.
Polish with english subtitles and summary in english and russian.

Authors summary.



ORIGINAL PAPER.

# * DIGESTIBILITY OF FEEDSTUFFS DETERMINED ON MINK.

N. Glem-Hansen, G. Jørgensen, National Inst. for Anim. Science, Research in Fur Animals, Roskildevej 48 H, DK 3400 Hilleroed, Denmark.

During the past few years the digestibility of many feedstuffs has been determined in experiments with mink at our institute. The results have occationally been published in connection with other experiment while others have just been used for the preparation of feedstuff tables. This is the background for the present publication which includes results from about 150 digestibility experiments covering 63 different feedstuffs used for mink. The material was divided into the following groups of feedstuffs which have something in common and was published as a series of reports in the Danish fur journal "Dansk Pelsdyravl".

Grouping of feedstuffs:

I. Fats.
II. Grains
III. Potato products.
IV. Vegetable feedstuffs, rich in crude fibre.
V. Other feedstuffs, rich in carbohydrate.
VI. Vegetable feedstuffs, rich in protein.
VII. Fresh animal feedstuffs.
VIII. Dehydrated animal feedstuffs.
IX. Single cell protein and similar feedstuffs.

The experiments were carried out as comparative experiments or as regression experiments. The former method determines the digestibility by means of the difference between an experimental diet and a control diet, while the latter method is based on calculation of the digestibility from several levels of the feedstuff in the diets using a regression analysis.

The comparative experiments were carried out with groups of 4 standard males for each feedstuff in question, and the regression experiments with 5 groups of 2 standard males per

feedstuff in question. The experiments were carried out in a laboratory at a constant temperature of 15-17°C, using special cages which enable full control with feed consumption and collection of faeces.

The experimental diets were mixed for the entire experimental period, weighed into cups containing one days ration and kept at -18°C until thawing the day before use.

The feed and the faeces were analyzed for content of dry mattter, ash, nitrogen, and fat. The analytical method used for the fat analyses (Stoldt's method) included hydrolysis with hydrochloric acid.

To determine the digestibility of a nutrient in a feedstuff accurately it is necessary that the nutrient from the feedstuff in question constitutes a certain amount of the total nutrient in the experimental diet. Some feedstuffs used in mink diets are low in one of the major nutrients and can not be used in amounts large enough to enable a reasonable determination of the digestibility of this particular nutrient. Therefore, in such cases the digestibility determined with other animal species is used in the tables. In cases where this is done it is mentioned in the text underneath the tables.

In the following the feedstuffs will be described briefly and their chemical composition and the digestibility of the nutrients will be given in tables.

## I. Fats.

In the mink industry in Denmark fats which are qualitatively suitable for human consumption such as lard and soy bean oil are often used, but also inedible fats are now used as mink feed.

Tallow has previously been given to mink in certain amounts

through the use of slaughter house offal in the diet. The digestibility of raw tallow and rendered tallow was determined.

Lard is a quality of fat from pigs which is normally used for human consumption.

Rendered lard is fats (largely from pigs) from the rendering factories. This fat is normally purchased with a guaranteed content of maximum 5% free fatty acids.

Fish oil has been shown to be an excellent source of fat if the quality is good. Usually it is cheaper than lard and experiments have recently shown that half of the fat in a mink diet could be added as fish oil. Hydrogenated fish oil is poorly digested by mink.

Soy bean oil contains high amounts of the essential fatty acids, linoleic- and linolenic acid, which should be taken into consideration when it is evaluated as feedstuff for mink.

Soy lecithin is a product from the soy bean industry which has an effect as an emulsifier. The content of the essential fatty acids is almost comparable to soy bean oil.

Biofosfatin is the trade name of a product which is a by-product from an industry producing emulsifiers. This product is also rich in essential fatty acids.

Sheaoil is periodically cheaper than other vegetable oils, but its content of essential fatty acids is low compared to soy bean oil products, and the digestibility is low.

Soap stock is a by-product from the fish oil industry. When soap stock constituted above 50% of the fat in the diet, a negative palatability effect appeared.

## The influence of the fatty acid content on digestibility.

It has been investigated in a series of experiments how the content of fatty acids influences the digestibility of fats of different origins. The general conclusion was that a high content of linoleic- and linolenic acid increased the digestibility, and a high amount of stearic acid decreased the digestibility. Based on the content of stearic acid the following equation can be used for evaluation of the digestibility coefficient:

Digestibility coeff. = 98,4 - o.877 x % stearic acid in the fat.
The coefficient of correlation (r) is = -o.93.

The degree of oxidation of the fats has a negative effect, not only on the palatability of the fats, but also on the digestibility, because some of the compounds formed from the free fatty acids by oxidation are poorly digested.

## II. Grains.

Carbohydrates are poorly digested by the mink. The reason for that is possibly that the mink, being a carnivore, has a short digestive tract, and probably has a smaller production of the enzymes required for the digestion of carbohydrates.

The digestibility of carbohydrates in grain is increased when the feedstuff is cooked prior to feeding. The effect of cooking is not the same for different species of grain.

The same increase in digestibility as can be obtained by cooking can also be obtained by mixing grain with fish silage, which is conserved with sulphuric acid to a pH at 3 for 24 hours. The digestibility of raw and cooked wheat, oats, barley and maize has been determined.

## III. Potato products.

Dehydrated potatoes are an excellent source of carbohydrates for mink. Unfortunately this feedstuff has, during the last few years, been too expensive for that purpose. Therefore, it has been of interest to investigate by-products from the potato industry for their suitability as feedstuffs for mink.

Dehydrated potatomeal is normally heat-treated during manufacturing to a degree comparable to a normal cooking. This is a necessity because the mink is completely incapable of digesting raw potato starch. Experiments have shown that the procedure of manufacturing (heat treatment) has a great influence on the digestibility.

Potato pulp is a by-product from the potato starch industry. This industry extracts that part of the carbohydrates which is most soluble and thus most easily digested. Therefore, the content of crude fibre is rather high and the carbohydrates poorly digestible.

"Potfor" is the trade name of a by-product from the potato starch industry. This product contains the dehydrated juice from the potatoes and thus its content of potassium is very high. This is probably the reason for its inferior dietetic effect on mink.

Potato starch is normally too expensive as a feedstuff for mink. However, it has been used in some experiments for technical reasons. As mentioned above it should be cooked to be digested by mink.

Potato pectine is produced from the potato peelings. Experiments have shown that the digestibility of protein in a diet decreases by increasing amounts of potato pectine in the diet.

## IV. Vegetable feedstuffs, rich in crude fibre.

This group of feedstuffs includes several products which are poorly digestible for mink. The reason for investigating such feedstuffs was the fear of using diets, which were too concentrated during the later part of the growth period, when sulphuric acid-conserved fish were added to the diet. Therefore most of these feedstuffs should be considered rather as matters for reduction of the energy concentration in diets than as feedstuffs of real interest for the mink industry.

This group of feedstuffs contains only limited amounts of protein and fat and, therefore, only the digestibility of carbohydrates is determined on mink.

Wheat bran has a good dietetic effect and it is used in amounts from 1-3% in nearly every diet for mink. It has been shown that the digestibility of wheat bran depends on its degree of grinding. Digestibility coefficients for the carbohydrates from 21 to 47 have been found, but most of the experiments showed coefficients close to 3o.

Wheat sharps contain less crude fibre than wheat bran and, therefore, the carbohydrate is more easily digested by the mink.

Rye sharps and maize bran are not commonly used in mink diets but were investigated as possible alternative feedstuffs.

Oat husk meal contains approximately 25% crude fibre and should, therefore, be a well suited feedstuff if the energy concentration in the diet is to be reduced. The experiment showed that it has a good dietetic effect and it appears that palatability will not be influenced by the amounts which could, eventually be used under practical conditions.

Dried grass meal contains a considerable amount of vitamin E. Unfortunately, its taste appeal and dietetic effect is negative and, therefore, a mink diet should not contain more than 1-2% dried grass meal.

Malt sprouts have a good dietetic effect but a negative effect on the taste of the diet. Malt sprouts contain considerable amounts of the B-vitamins.

Dried sugar beet chips does not have any influence on the taste appeal in the diets and it has a good dietetic effect.

Kosetter is the trade name of a mixture of 1/3 molasses and 2/3 dried sugar beet chips and it is primarily used as a feedstuff for cows.

Dehydrated apple pulp does not have any negative influence on the taste appeal and dietetic effect of the diet.

Dehydrated tomato pulp has a negative effect on the taste of the diet, but a positive dietetic effect.

## V. Other feedstuffs, rich in carbohydrate.

This group includes some feedstuffs which are too expensive for practical use. However, the digestibility has been determined because they are of interest as feedstuffs in certain special experiments.

Maize starch is well suited as a source of carbohydrate in experimental diets where the carbohydrate content should be regulated without affecting the protein quality. Maize starch does not influence the taste appeal of the diet, but experiments have shown that raw maize starch has a strong negative dietetic effect and in addition to that it has a much lower digestibility than cooked maize starch.

Wheat starch should also be cooked to obtain a reasonable high digestibility. Raw wheat starch has a strong negative dietetic effect.

Tapioca meal is of interest as an alternative feedstuff in mink diets. Experiments have shown that it should be cooked before use in diets for mink. Raw tapioca meal does not show any inferior dietetic or palatability effects but only 32% of the carbohydrates are digested by the mink.

Dextrose influences the taste positively and does not have any inferior dietetic effect. It is easily digested by the mink and has been used in practise during lactation and early growth.

Wheat germ has primarily been used as a source for vitamin E. This should be taken into consideration when wheat germ is evaluated as a feedstuff for mink.

Rye bread meal is a by-product from the bakeries. The experiments have shown that it is very easily digested by the mink.

## VI. Vegetable feedstuffs, rich in protein.

The price of protein from vegetable feedstuffs is usually cheaper than that from animal feedstuffs. Therefore, several experiments have been carried out to investigate the possibilities of replacing a certain amount of the animal protein with vegetable protein. Much of the work has been concentrated on soy bean products. Generally, it can be concluded that limited amounts can be used without any negative effect on the skin production, but the use of 2o% or more of the protein from soy products often gives rise to an undesirable pelt quality. This undesirable quality can, apparently, be avoided by using soy bean concentrates or - isolates, but unfortunately these products are still too expensive for practical use.

Soy bean meal, which is finely ground, has a few percent higher

digestibility of the carbohydrate fraction than has more coarse grained soy bean meal. Similarly, a higher crude fibre content depresses the digestibility of the carbohydrate in soy bean meal.

Full fat soy bean meal has been heat treated like soy bean meal, but the oil has not been extracted from the product. Experiments have shown that full fat soy bean meal can replace 2o% of the protein in the diet through the growing season. A full fat soy bean meal with the trade name Nurupan is heat treated at higher temperature and it was shown that both protein and carbohydrates are more easily digested by the mink.

Soy bean concentrate is soy beans from which the oil and some of the carbohydrates are extracted. The left-over carbohydrates are almost indigestible. Until now soy bean concentrates have been too expensive for practical use.

Maize gluten meal is rich in sulphur amino acids, which usually is the first-limiting factor for protein utilization in mink. Experiments have shown that maize gluten meal has a positive effect on the pelt quality when replacing up to 2o% of the protein in the diet throughout the growing season.

## VII. Fresh animal feedstuffs.

This group of feedstuffs has until now been the basic element in diets for mink. This is still the case eventhough the feedstuff-market during the recent years is in favour of a replacement of these feedstuffs with some of the alternatives mentioned elsewhere in this report.

Besides the traditional fresh animal feedstuffs, this group include acid conserved fish- and slaughter house offal.

Cod offal constitutes the main part of the protein in most diets for mink in Denmark. Norwegian experiments have shown

a difference in digestibility of cod offal, rich in bone, and cod meat of 12 percent units in favour of cod meat. Therefore, the meat content of cod offal is of importance for its value as a feedstuff.

Cod meat is occasionally on the market as cuttings from the production of cod fillets.

Fish silage conserved with sulphuric acid or a combination of sulphuric- and acetic acid has been used on a large scale (that means 1o-2o% in the diet) during the growth period. Several experiments have confirmed that this feedstuff is suitable for mink during this period.

Slaughter house offal from pigs such as throats-, backbone- and feet from pigs is differently digested by mink. The digestibility coefficients for protein were determined to 85, 6o and 77, respectively. Therefore, the origin of the offal is of great importance for the value of the feedstuff.

Cooked offal from pigs produced by the rendering industry is a potential feedstuff which is available in considerable amounts and, therefore, its digestibility was determined.

Cooked poultry offal has been used in the practical mink diet for many years with good results. The raw material includes heads, feet, and entrails but not the feathers. The treatment includes heating under pressure (12o$^{o}$C for 2o minutes) which sterilizes the offal. After cooking it is cooled and kept at -2o$^{o}$C until use.

Poultry offal silage is made from the same raw materials as the cooked poultry offal, but in addition to that the feathers are included. The silage used in the digestibility experiment was conserved with 1.5% hydrochloric acid and o.7% formic acid after cooking as mentioned for cooked poultry offal.

Cottage cheese was previously used in mink diets, but now it is too expensive for that purpose in Denmark.

Egg is not a common feedstuff for mink in Denmark, but anyway the digestibility has been determined.

## VIII. Dehydrated animal feedstuffs.

The quality of dehydrated animal feedstuffs, which also include fish meal, depends on:

1. Freshness of the raw material.
2. The chemical composition of the raw material.
3. The production process.
4. The storage conditions.

Unfortunately no single analytical method is able to give an exact value of these feedstuffs as a mink feed.

Fish meal of a good quality has in many experiments been shown to be a good feedstuff for mink. The main demand for fish meal suitable for mink is minimum 7o% crude protein, maximum 1o% crude fat, maximum 16% ash, maximum 12o mg TVN (total volatile nitrogen) per 1oo g, and maximum 1o% FFA (free fatty acids) in the fat.

Meat and bone meal in the quality usually on the market is not suitable as feedstuff for mink. However the digestibility has been determined.

Poultry meal made from poultry offal without the feathers has been used in practice in limited amounts (1-3%) during the growth period.

Feather meal has a high content of sulphur amino acids. However, these occur mainly in compounds with chemical structures, which have to be broken into simpler compounds to be digestible for mink. Therefore, it is very important to treat the feathers with heat and, possibly, acid to ensure that the main part of

the protein is hydrolized. Hydrolyzation of feathers during the production of feather meal has shown to increase the digestibility of the protein from 3o% to 8o% in rats.

Meat meal is made of fresh slaughter house offal where the ash content is low due to separation of a certain part of the bones. This product is interesting because it can be produced in rather large amounts to a reasonable price.

Blood meal can not be used in any large amounts, but as an extremely protein rich feedstuff it is of interest eventhough the content in the diet should be limited to 1-3%.

Casein is normally too expensive as feedstuff for mink, but it has been widely used in experimental diets.

ICI-protein is produced from bacteria grown on methanol. That means it is dried bacterial cells. It has been shown that the cell walls contain endotoxins which can have a negative effect on the mink, especially when they are under physiological strain. Norwegian experiments demonstrated that plasmacytosis (aleutian disease) accelerated seriously when ICI-protein was added to the diet in amounts equal to 1o% of the protein.

Non negative palatable and dietetic effects were found using up to 2o% of the protein from ICI-protein.

BP-protein is produced from fungi which are grown on mineral oil. Long term effects on mink have not to our knowledge been investigated.

The chemical composition, the digestibility coefficients, and the content of digestible nutrients of the investigated feedstuffs are shown in Table 1. The fatty acid composition of the investigated fats can be seen in Table 2 and the amino acid compostion and the content of digestible amino acids in the feedstuffs where this information is available are shown

in Table 3 and 4, respectively. The digestibility coefficients for protein in the feedstuffs in question are used as coefficient for each single amino acid. The content of certain minerals in the feedstuffs is shown in Table 5.

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Table 1. Chemical composition, digestibility coefficients and content of digestible protein, fat, and carbohydrates and metabolizable energy in feedstuffs for mink.

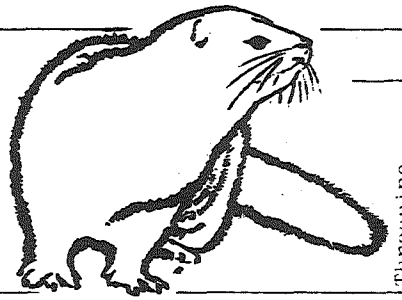
| Feedstuff | Gross content g/kg | | | | | | | kcal/kg | % digestible | | | % met. energy | Content digestible g/kg | | | kcal ME/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | dry matter | ash | crude protein | crude fat | carbohydrate | α-linked glucose | crude fibre | energy | crude protein | crude fat | carbohydrate | | crude protein | crude fat | carbohydrate | energy |
| Tallow, raw | 800 | - | 180 | 620 | - | - | - | 6916 | 80[1] | 70 | - | 69 | 144 | 434 | - | 4770 |
| Tallow, rendered | 990 | - | - | 990 | - | - | - | 9405 | - | 76 | - | 76 | - | 752 | - | 7150 |
| Lard, human quality | 990 | - | - | 990 | - | - | - | 9405 | - | 85 | - | 85 | - | 842 | - | 7990 |
| Lard, rendered | 990 | - | 25 | 965 | - | - | - | 9310 | 80[1] | 89 | - | 89 | 20 | 859 | - | 8250 |
| Fish oil | 990 | - | - | 990 | - | - | - | 9405 | - | 93 | - | 93 | - | 920 | - | 8750 |
| Soy bean oil | 1000 | - | - | 1000 | - | - | - | 9500 | - | 95 | - | 95 | - | 950 | - | 9025 |
| Soy lecithin | 990 | 56 | - | 698 | 235 | - | - | 7571 | - | 90 | 25[1] | 82 | - | 628 | 59 | 6200 |
| "Biofosfatin" | 990 | - | - | 900 | 90 | - | - | 8910 | - | 89 | 25[1] | 86 | - | 801 | 23 | 7700 |
| Shea oil | 990 | - | - | 990 | - | - | - | 9405 | - | 68 | - | 68 | - | 673 | - | 6390 |
| Soap stock | 1000 | - | - | 1000 | - | - | - | 9500 | - | 89 | - | 89 | - | 890 | - | 8455 |
| Wheat, raw | 856 | 17 | 118 | 19 | 702 | 618 | 24 | 3660 | 79[2] | 74[3] | 43 | 48 | 93 | 14 | 302 | 1760 |
| Wheat, cooked | 856 | 17 | 118 | 19 | 702 | 618 | 24 | 3660 | 79[2] | 74[3] | 62 | 63 | 93 | 14 | 435 | 2290 |
| Oats, raw | 862 | 25 | 114 | 46 | 675 | 618 | 92 | 3790 | 72[2] | 90[3] | 47 | 54 | 82 | 41 | 317 | 2030 |
| Oats, cooked | 862 | 25 | 114 | 46 | 675 | 618 | 92 | 3790 | 72[2] | 90[3] | 49 | 55 | 82 | 41 | 331 | 2090 |
| Barley, raw | 861 | 21 | 108 | 28 | 703 | 579 | 45 | 3690 | 69[2] | 55[3] | 50 | 51 | 75 | 15 | 352 | 1890 |
| Barley, cooked | 861 | 21 | 108 | 28 | 703 | 579 | 45 | 3690 | 69[2] | 55[3] | 62 | 60 | 75 | 15 | 436 | 2230 |
| Maize, raw | 882 | 14 | 93 | 41 | 734 | 639 | 23 | 3860 | 77[2] | 73[3] | 37 | 44 | 72 | 30 | 272 | 1690 |
| Maize, cooked | 882 | 14 | 93 | 41 | 734 | 639 | 23 | 3860 | 77[2] | 73[3] | 67 | 67 | 72 | 30 | 492 | 2570 |
| Dehydrated potato meal | 920 | 43 | 63 | 3 | 811 | 609 | 51 | 3632 | 77[2] | 50[3] | 80 | 78 | 49 | 2 | 649 | 2840 |
| Potato pulp | 850 | 36 | 44 | 8 | 782 | 325 | 166 | 3455 | 77[2] | 50[3] | 37 | 39 | 34 | 4 | 289 | 1350 |
| "Potfor" | 890 | 150 | 29 | 8 | 448 | 143 | 73 | 2033 | 77[2] | 50[3] | 20 | 24 | 22 | 4 | 90 | 500 |
| Potato starch | 880 | 3 | 1 | 4 | 872 | - | - | 3532 | 77[2] | 50[3] | 77 | 77 | 1 | 2 | 671 | 2710 |
| Potato pectine | 890 | 23 | 48 | 0 | 819 | 215 | - | 3550 | 77[2] | 50[3] | 6 | 10 | 37 | 0 | 49 | 360 |
| Wheat bran | 870 | 54 | 148 | 39 | 627 | 329 | 91 | 3722 | 67[2] | 33[3] | 30 | 36 | 99 | 13 | 188 | 1320 |
| Wheat sharps | 875 | 29 | 150 | 51 | 696 | 412 | 35 | 4124 | 73[2] | 64[3] | 56 | 57 | 109 | 33 | 390 | 2360 |
| Rye sharps | 860 | 49 | 143 | 30 | 635 | 338 | 56 | 3640 | 76[3] | 28[3] | 38 | 42 | 109 | 8 | 241 | 1530 |
| Maize bran | 895 | 26 | 94 | 95 | 680 | 402 | 64 | 4158 | 70[3] | 66[3] | 37 | 46 | 66 | 63 | 252 | 1900 |
| Oat husk meal | 920 | 54 | 36 | 19 | 814 | 158 | 292 | 3642 | 43[3] | 45[3] | 18 | 20 | 15 | 9 | 147 | 740 |

Table 2: see page 57

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dried grass meal | 91o | 83 | 156 | 28 | 643 | 98 | 291 | 3727 | 5o[2] | 24[3] | 33 | 34 | 78 | 7 | 212 | 126o |
| Malt sprouts | 91o | 65 | 3o7 | 13 | 525 | 141 | 111 | 3973 | 71[3] | 6[3] | 17 | 34 | 218 | 1 | 89 | 135o |
| Dried sugar beet chips | 84o | 65 | 84 | 1o | 681 | 1o9 | 174 | 3298 | 38[3] | 1o[3] | 25 | 25 | 32 | 1 | 17o | 83o |
| "Kosetter" | 88o | 72 | 1o4 | 19 | 685 | 197 | 132 | 3513 | 38[3] | 1o[3] | 32 | 31 | 4o | 2 | 219 | 1o7o |
| Dehydrated apple pulp | 91o | 19 | 64 | 44 | 783 | 297 | 16o | 3915 | 38[1] | 1o[3] | 31 | 29 | 24 | 4 | 243 | 112o |
| Dehydrated tomato pulp | 93o | 4o | 146 | 65 | 679 | 91 | 434 | 4166 | 38[1] | 1o[3] | o | 7 | 55 | 7 | o | 31o |
| Maize starch, cooked | 88o | - | - | - | 88o | - | - | 352o | - | - | 81 | 81 | - | - | 713 | 285o |
| Wheat starch, cooked | 87o | - | - | - | 87o | - | - | 348o | - | - | 87 | 87 | - | - | 757 | 3o3o |
| Tapioca meal, cooked | 87o | 47 | 32 | 12 | 79o | 678 | 45 | 3412 | 42[3] | 25[3] | 85 | 8o | 13 | 3 | 662 | 274o |
| Dextrose | 98o | - | - | - | 98o | - | - | 392o | - | - | 95 | 95 | - | - | 931 | 372o |
| Wheat germ | 88o | 46 | 264 | 95 | 475 | 376 | 28 | 43o7 | 82[3] | 68[3] | 55 | 61 | 216 | 65 | 261 | 263o |
| Rye bread meal | 92o | 35 | 15o | 36 | 785 | 739 | 8 | 4337 | 58[2] | 33[3] | 87 | 75 | 87 | 12 | 683 | 324o |
| Soy bean meal | 89o | 61 | 47o | 16 | 34o | 124 | 58 | 4191 | 8o | 54[3] | 28 | 51 | 376 | 9 | 95 | 216o |
| Full fat soy bean meal | 9oo | 45 | 387 | 211 | 257 | - | - | 5238 | 74 | 95[1] | 16 | 64 | 286 | 2oo | 41 | 335o |
| "Nurupan" | 94o | 49 | 4o4 | 234 | 255 | - | - | 5546 | 85 | 95[1] | 41 | 73 | 343 | 222 | 1o4 | 4o7o |
| Soy bean concentrate | 92o | 66 | 621 | 17 | 219 | - | - | 4577 | 81 | 54[3] | 14 | 54 | 5o3 | 9 | 31 | 247o |
| Maize gluten meal | 88o | 21 | 627 | 48 | 184 | - | - | 4766 | 84 | 73[3] | 33 | 62 | 527 | 35 | 61 | 295o |
| Cod offal | 22o | 54 | 155 | 1o | - | - | - | 979 | 87 | 93[1] | - | 7o | 135 | 9 | - | 69o |
| Cod meat | 2oo | 14 | 18o | 8 | - | - | - | 11o2 | 93 | 93[1] | - | 74 | 167 | 7 | - | 82o |
| Fish silage, acid conserved | 31o | 27 | 155 | 118 | - | - | - | 2oo5 | 88 | 93[1] | - | 82 | 136 | 11o | - | 165o |
| Throats from pigs | 247 | 1o | 148 | 99 | - | - | - | 1784 | 85 | 85[1] | - | 77 | 126 | 84 | - | 1365 |
| Back bone from pigs | 51o | 173 | 184 | 16o | - | - | - | 2569 | 6o | 85[1] | - | 7o | 11o | 136 | - | 179o |
| Feet from pigs | 47o | 12o | 219 | 131 | - | - | - | 2493 | 78 | 85[1] | - | 73 | 171 | 111 | - | 182o |
| Cooked offal from pigs | 27o | 4o | 141 | 78 | - | - | - | 1545 | 78 | 86 | - | 73 | 11o | 67 | - | 113o |
| Cooked poultry offal | 29o | 25 | 149 | 113 | 1o | - | - | 1963 | 76 | 95 | 5o[1] | 79 | 113 | 1o7 | 5 | 1545 |
| Poultry offal silage | 32o | 22 | 211 | 84 | 1o | - | - | 2o4o | 75 | 95 | 5o[1] | 73 | 158 | 8o | 5 | 149o |
| Cottage cheese | 21o | 1o | 166 | 6 | 27 | - | - | 1111 | 9o | 9o[1] | 8o[1] | 73 | 149 | 5 | 22 | 81o |
| Egg | 25o | 1o | 124 | 1oo | 4o | - | - | 1817 | 85 | 95[1] | 8o[1] | 83 | 1o5 | 5 | 32 | 15oo |
| Fish meal < 15% ash | 94o | 1o3 | 75o | 83 | - | - | - | 5o64 | 81 | 86 | - | 67 | 6o8 | 71 | - | 341o |
| Meat and bone meal | 915 | 276 | 536 | 65 | - | - | - | 3673 | 73 | 8[3] | - | 49 | 391 | 5 | - | 181o |
| Poultry meal | 93o | 163 | 655 | 88 | 17 | - | - | 4638 | 59 | 89 | 5o[1] | 54 | 386 | 78 | 9 | 252o |
| Feather meal | 915 | 54 | 811 | 59 | - | - | - | 5183 | 67 | 89[1] | - | 57 | 543 | 53 | - | 294o |
| Meat meal | 9o5 | 277 | 483 | 133 | - | - | - | 4o17 | 77 | 75 | - | 65 | 372 | 1oo | - | 262o |
| Blood meal | 91o | 37 | 885 | 5 | - | - | - | 5o92 | 9o | 41[3] | - | 71 | 797 | 2 | - | 36oo |
| Casein | 93o | 28 | 837 | 12 | 53 | - | - | 5o97 | 92 | 8o[1] | 8o[1] | 73 | 77o | 1o | 42 | 372o |
| ICI-protein | 965 | 99 | 797 | 7o | - | - | - | 52o8 | 79 | 9o[1] | - | 66 | 63o | 63 | - | 343o |
| BP-protein | 969 | 79 | 656 | 4 | 23o | - | - | 4697 | 78 | 9o[1] | 5o[1] | 6o | 512 | 4 | 115 | 28oo |

1) The very limited amount of protein, fat, and carbohydrate in these feedstuffs is estimated on the basis of similar feedstuffs.
2) Digestibility coefficients based on experiments with rats but corrected for mink according to Glem Hansen & Eggum (1974).
3) Digestibility coefficients measured on pigs.
4) Percentage metabolizable energy calculated on the basis of digested protein, fat, and carbohydrate using 4.5, 9.5 and 4.o, respectively, as energy factors.

Table 3. Amino acid composition of feedstuffs.



| Feedstuff | g amino acid/16 g N | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Threonine | Valine | Isoleucine | Leucine | Tyrosine | Phenylalanine | Lysine | Histidine | Methionine | Cystine | Tryptophan | Aspartic acid | Serine | Glutamic acid | Glycine | Alanine | Arginine |
| Wheat | 2.9 | 4.5 | 3.5 | 6.8 | 2.8 | 4.5 | 2.6 | 2.2 | 1.7 | 2.0 | 1.1 | 5.1 | 4.6 | 32.6 | 3.9 | 3.6 | 5.0 |
| Oats | 3.5 | 5.4 | 3.9 | 7.5 | 3.5 | 5.2 | 4.2 | 2.3 | 2.0 | 2.7 | 1.2 | 8.4 | 4.7 | 22.1 | 5.0 | 4.8 | 6.6 |
| Barley | 3.5 | 5.3 | 3.7 | 7.2 | 3.4 | 5.2 | 3.6 | 2.3 | 1.8 | 2.1 | 1.2 | 6.2 | 4.2 | 26.7 | 4.1 | 4.2 | 5.2 |
| Maize | 3.8 | 4.9 | 3.6 | 12.0 | 4.3 | 4.8 | 2.8 | 2.8 | 2.3 | 2.0 | 0.8 | 6.7 | 4.8 | 20.0 | 3.8 | 7.6 | 4.5 |
| Potatoes | 3.1 | 4.9 | 3.0 | 4.7 | 3.5 | 3.6 | 5.0 | 1.6 | 1.3 | 1.5 | 1.1 | 20.7 | 3.2 | 14.5 | 2.8 | 2.9 | 5.3 |
| Wheat bran | 2.9 | 4.2 | 2.9 | 5.5 | 2.8 | 3.5 | 3.5 | 2.5 | 1.6 | 2.2 | 1.3 | 6.2 | 3.9 | 18.3 | 4.7 | 4.1 | 6.3 |
| Wheat sharps | 3.2 | 5.2 | 3.4 | 6.5 | 3.0 | 3.8 | 4.4 | 2.4 | 1.8 | 2.1 | 1.2 | 7.5 | 3.9 | 20.0 | 5.0 | 4.8 | 6.7 |
| Rye sharps | 3.1 | 5.3 | 3.3 | 6.1 | 2.7 | 3.9 | 3.9 | 2.4 | 1.6 | 2.3 | 1.2 | 8.1 | 3.6 | 19.7 | 5.1 | 4.6 | 6.2 |
| Maize bran | 3.5 | 4.7 | 3.0 | 7.9 | 3.4 | 3.9 | 3.9 | 2.5 | 1.8 | 2.0 | 0.9 | 6.6 | 4.0 | 15.0 | 4.5 | 5.8 | 5.7 |
| Oat husk meal | 3.7 | 5.1 | 3.7 | 7.2 | 3.4 | 4.9 | 4.3 | 2.1 | 1.9 | 2.2 | 0.7 | 8.2 | 4.3 | 18.2 | 4.9 | 5.1 | 6.2 |
| Dried grass meal | 3.9 | 5.2 | 4.1 | 7.0 | 3.5 | 4.3 | 4.4 | 2.2 | 1.5 | 1.1 | 1.4 | 11.4 | 4.0 | 9.3 | 4.7 | 5.2 | 4.5 |
| Malt sprouts | 3.0 | 4.3 | 3.0 | 5.2 | 2.4 | 3.0 | 4.2 | 1.6 | 1.3 | 1.1 | 0.9 | 10.6 | 3.1 | 11.4 | 3.8 | 4.4 | 4.4 |
| Dried sugar beet chips | 4.3 | 6.1 | 3.6 | 5.8 | 4.6 | 3.2 | 5.5 | 4.4 | 1.8 | 1.4 | 0.8 | 7.3 | 4.3 | 10.7 | 3.9 | 4.4 | 4.2 |
| "Kosetter" | 3.5 | 4.8 | 3.4 | 5.3 | 4.4 | 2.8 | 4.8 | 2.5 | 1.4 | 1.1 | 0.8 | 7.3 | 3.9 | 19.1 | 3.8 | 4.1 | 4.0 |
| Tapioca meal | 3.6 | 4.5 | 3.6 | 5.4 | 2.4 | 4.4 | 4.4 | 1.4 | 1.1 | 1.0 | - | 8.4 | 3.6 | 16.1 | 3.8 | 5.5 | 4.2 |
| Wheat germ | 3.6 | 5.0 | 3.2 | 6.1 | 2.8 | 3.4 | 5.5 | 2.2 | 1.8 | 1.6 | 1.1 | 8.2 | 3.9 | 14.9 | 5.2 | 5.3 | 7.3 |
| Rye bread meal | 3.8 | 4.6 | 2.7 | 6.5 | 3.2 | 5.0 | 4.3 | 2.5 | 1.4 | 2.0 | 0.8 | 8.0 | 4.1 | 24.1 | 4.5 | 5.7 | 5.2 |
| Soy bean protein | 3.7 | 4.7 | 4.6 | 7.5 | 3.6 | 5.0 | 5.8 | 2.6 | 1.4 | 1.4 | 1.3 | 11.2 | 4.8 | 19.1 | 4.1 | 4.1 | 7.4 |
| Maize gluten meal | 3.4 | 4.8 | 4.2 | 16.5 | 5.2 | 6.1 | 1.6 | 2.1 | 2.6 | 2.1 | 0.6 | 5.7 | 5.1 | 22.3 | 2.8 | 8.5 | 3.5 |
| Cod offal | 3.7 | 3.8 | 3.3 | 5.4 | 2.2 | 3.1 | 5.7 | 1.6 | 2.4 | 0.8 | 1.1 | 8.1 | 4.5 | 12.0 | 11.1 | 6.4 | 6.1 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cod meat | 4.1 | 4.8 | 4.3 | 7.4 | 3.3 | 3.8 | 7.7 | 2.2 | 2.9 | 1.o | 1.1 | 9.7 | 3.9 | 15.2 | 5.2 | 5.8 | 6.2 |
| Fish silage, acid cons. | 4.1 | 5.1 | 4.2 | 7.2 | 3.3 | 3.8 | 7.1 | 2.2 | 2.6 | 1.o | o.8 | 8.7 | 3.6 | 12.8 | 5.6 | 5.7 | 5.6 |
| Troats from pigs | 3.4 | 5.1 | 3.1 | 6.8 | 2.4 | 3.5 | 3.5 | 1.7 | 1.o | 1.1 | o.7 | 7.5 | 3.7 | 12.o | 1o.3 | 6.7 | 5.9 |
| Backbone from pigs | 2.8 | 4.1 | 2.8 | 6.2 | 1.9 | 3.1 | 5.3 | 2.1 | 1.2 | o.5 | o.8 | 8.o | 4.1 | 13.9 | 18.1 | 8.7 | 8.5 |
| Feet from pigs | 3.1 | 4.o | 2.4 | 5.4 | 1.8 | 3.o | 4.6 | 1.9 | 1.3 | o.6 | o.6 | 7.3 | 4.1 | 13.4 | 15.3 | 7.6 | 7.5 |
| Cooked offal from pigs | 2.8 | 4.1 | 2.5 | 5.2 | 2.o | 3.1 | 4.9 | 1.8 | o.9 | o.5 | 1.o | 7.o | 3.3 | 12.5 | 15.3 | 7.7 | 7.o |
| Cooked poultry offal | 3.7 | 4.4 | 3.7 | 6.4 | 2.3 | 3.5 | 6.2 | 2.2 | 1.9 | 1.1 | 1.7 | 7.9 | 3.7 | 13.1 | 1o.1 | 6.5 | 6.7 |
| Poultry offal silage | 4.6 | 5.4 | 4.1 | 7.1 | 1.9 | 4.1 | 3.5 | 1.3 | 1.3 | 3.7 | 1.o | 5.9 | 7.1 | 11,o | 7.9 | 5.2 | 6.o |
| Cottage cheese | 3.8 | 6.4 | 5.1 | 9.4 | 5.5 | 5.o | 6.8 | 2.9 | 2.6 | o.6 | 1.5 | 7.2 | 5.3 | 22.4 | 1.9 | 3.o | 3.5 |
| Egg | 5.1 | 7.5 | 5.8 | 8.9 | 3.6 | 6.7 | 6.7 | 2.5 | 3.o | 2.3 | 1.5 | 1o.4 | 7.7 | 14.7 | 3.6 | 6.1 | 6.2 |
| Fish meal <13% ash | 4.4 | 5.3 | 4.5 | 7.4 | 3.1 | 4.o | 7.8 | 2.5 | 3.1 | 1.o | 1.3 | 9.3 | 4.1 | 13.6 | 5.9 | 5.9 | 6.o |
| Meat and bone meal | 3.o | 4.1 | 2.6 | 5.7 | 1.9 | 3.2 | 4.8 | 1.7 | 1.2 | o.6 | 1.1 | 7.3 | 3.6 | 12.2 | 14.6 | 7.5 | 6.9 |
| Poultry meal | 3.6 | 4.5 | 3.5 | 6.2 | 2.6 | 3.6 | 4.9 | 1.5 | 1.2 | 1.2 | 7.6 | 7.6 | 4.2 | 12.7 | 11.o | 6.4 | 6.6 |
| Feather meal | 4.9 | 7.7 | 4.8 | 8.7 | 2.5 | 4.8 | 2.3 | o.8 | o.7 | 5.8 | o.5 | 7.8 | 11.o | 12.o | 8.4 | 4.8 | 6.1 |
| Meat meal | 3.1 | 3.7 | 2.7 | 5.8 | 1.9 | 3.o | 5.1 | 1.7 | 1.2 | o.6 | 1.o | 7.5 | 3.6 | 13.2 | 15.3 | 7.2 | 6.7 |
| Blood meal | 3.7 | 9.7 | 1.4 | 13.7 | 3.2 | 7.9 | 9.3 | 7.2 | o.8 | o.9 | o.4 | 11.6 | 4.5 | 1o.o | 4.8 | 8.1 | 4.8 |
| Casein | 4.3 | 6.8 | 5.3 | 9.5 | 5.7 | 5.1 | 8.3 | 3.1 | 3.4 | o.5 | 1.2 | 7.5 | 5.5 | 23.5 | 2.o | 3.1 | 3.9 |
| ICI-protein | 4.2 | 5.3 | 4.5 | 6.8 | 3.4 | 3.6 | 6.2 | 1.9 | 2.2 | o.5 | 1.4 | 9.o | 3.1 | 11.1 | 5.2 | 7.o | 4.8 |
| BP-protein | 4.8 | 5.6 | 4.6 | 7.2 | 4.o | 5.1 | 7.o | 1.9 | 1.7 | 1.o | 1.5 | 11.o | 4.7 | 15.5 | 4.6 | 6.o | 5.2 |

Table 4. **The content of digestible amino acids in feedstuffs for mink.**

| | g digestible amino acid/kg feedstuff | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Threonine | Valine | Isoleucine | Leucine | Tyrosine | Phenylalanine | Lysine | Histidine | Methionine | Cystine | Tryptophan | Aspartic acid | Serine | Glutamic acid | Glycine | Alanine | Arginine |
| Wheat | 2.7 | 4.2 | 3.3 | 6.3 | 2.6 | 4.2 | 2.4 | 2.1 | 1.6 | 1.9 | 1.0 | 4.7 | 4.3 | 30.3 | 3.6 | 3.4 | 4.7 |
| Oats | 2.9 | 4.4 | 3.2 | 6.2 | 2.9 | 4.3 | 3.4 | 1.9 | 1.6 | 2.2 | 1.0 | 6.9 | 3.9 | 18.1 | 4.1 | 3.9 | 5.4 |
| Barley | 2.5 | 4.0 | 2.8 | 5.4 | 2.6 | 3.9 | 2.7 | 1.7 | 1.4 | 1.6 | 0.9 | 4.7 | 3.2 | 20.0 | 3.1 | 3.2 | 3.9 |
| Maize | 2.7 | 3.5 | 2.6 | 8.6 | 3.1 | 3.5 | 2.0 | 2.0 | 1.7 | 1.4 | 0.6 | 4.8 | 3.5 | 14.4 | 2.7 | 5.5 | 3.2 |
| Dehydr. potato meal | 1.5 | 2.4 | 1.5 | 2.3 | 1.7 | 1.8 | 2.5 | 0.8 | 0.6 | 0.7 | 0.5 | 10.1 | 1.5 | 7.1 | 1.4 | 1.4 | 2.6 |
| Potato pulp | 1.1 | 1.7 | 1.0 | 1.6 | 1.2 | 1.2 | 1.7 | 0.5 | 0.4 | 0.5 | 0.4 | 7.0 | 1.1 | 4.9 | 1.0 | 1.0 | 1.8 |
| "Potfor" | 0.7 | 1.1 | 0.7 | 1.0 | 0.8 | 0.8 | 1.1 | 0.4 | 0.3 | 0.3 | 0.2 | 4.6 | 0.7 | 3.2 | 0.6 | 0.6 | 1.2 |
| Potato pectine | 1.1 | 1.8 | 1.1 | 1.7 | 1.3 | 1.3 | 1.9 | 0.6 | 0.5 | 0.6 | 0.4 | 7.7 | 1.2 | 5.4 | 1.0 | 1.1 | 2.0 |
| Wheat bran | 2.9 | 4.2 | 2.9 | 5.5 | 2.8 | 3.5 | 3.5 | 2.5 | 1.6 | 2.2 | 1.3 | 6.1 | 3.9 | 18.1 | 4.7 | 4.1 | 6.2 |
| Wheat sharps | 3.5 | 5.7 | 3.7 | 7.1 | 3.3 | 4.1 | 4.8 | 2.6 | 2.0 | 2.3 | 1.3 | 8.2 | 4.3 | 21.8 | 5.5 | 5.2 | 7.3 |
| Rye sharps | 3.4 | 5.8 | 3.6 | 6.7 | 2.9 | 4.3 | 4.3 | 2.6 | 1.7 | 2.5 | 1.3 | 8.8 | 3.9 | 21.5 | 5.6 | 5.0 | 6.8 |
| Maize bran | 2.3 | 3.1 | 2.0 | 5.2 | 2.2 | 2.6 | 2.6 | 1.7 | 1.2 | 1.3 | 0.6 | 4.4 | 2.5 | 9.9 | 3.0 | 3.8 | 3.8 |
| Oat husk meal | 0.6 | 0.8 | 0.6 | 1.1 | 0.5 | 0.7 | 0.7 | 0.3 | 0.3 | 0.3 | 0.1 | 1.2 | 0.7 | 2.7 | 0.7 | 0.8 | 0.9 |
| Dried grass meal | 3.0 | 4.1 | 3.2 | 5.5 | 2.7 | 3.4 | 3.4 | 1.7 | 1.2 | 0.9 | 1.1 | 8.9 | 3.1 | 7.3 | 3.7 | 4.1 | 3.5 |
| Malt sprouts | 6.5 | 9.4 | 6.5 | 11.3 | 5.2 | 6.5 | 9.2 | 3.5 | 2.8 | 2.4 | 2.0 | 23.1 | 6.8 | 24.9 | 8.3 | 9.6 | 9.6 |
| Dried sugar beet chips | 1.4 | 2.0 | 1.2 | 1.9 | 1.5 | 1.0 | 1.8 | 1.4 | 0.6 | 0.5 | 0.3 | 2.3 | 1.4 | 3.4 | 1.3 | 1.4 | 1.3 |
| "Kosetter" | 1.4 | 1.9 | 1.4 | 2.1 | 1.8 | 1.1 | 1.9 | 1.0 | 0.6 | 0.4 | 0.3 | 2.9 | 1.6 | 7.6 | 1.5 | 1.6 | 1.6 |
| Tapioca meal | 0.5 | 0.6 | 0.5 | 0.7 | 0.3 | 0.6 | 0.6 | 0.2 | 0.1 | 0.1 | - | 1.1 | 0.5 | 2.1 | 0.5 | 0.7 | 0.6 |
| Wheat germ | 7.8 | 10.8 | 6.9 | 13.2 | 6.1 | 7.3 | 11.9 | 4.8 | 3.9 | 3.5 | 2.4 | 17.7 | 8.4 | 32.2 | 11.2 | 11.5 | 15.8 |
| Rye bread meal | 3.3 | 4.0 | 2.4 | 5.7 | 2.8 | 4.4 | 3.7 | 2.2 | 1.2 | 1.7 | 0.7 | 7.0 | 3.6 | 21.0 | 3.9 | 5.0 | 4.5 |
| Soy bean meal | 13.9 | 17.7 | 17.3 | 28.2 | 13.5 | 18.8 | 21.8 | 9.8 | 5.3 | 5.3 | 4.9 | 42.1 | 18.1 | 71.8 | 15.4 | 15.4 | 27.8 |
| Full fat soy bean meal | 10.6 | 13.4 | 13.2 | 21.4 | 10.3 | 14.3 | 16.6 | 7.4 | 4.0 | 4.0 | 3.7 | 32.0 | 13.7 | 54.6 | 11.7 | 11.7 | 21.1 |
| "Nurupan" | 12.7 | 16.1 | 15.8 | 25.7 | 12.4 | 17.1 | 19.9 | 8.9 | 4.8 | 4.8 | 4.5 | 38.4 | 16.5 | 65.5 | 14.1 | 14.1 | 25.4 |

T.4.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soy bean concentrate | 18.6 | 23.6 | 23.1 | 37.7 | 18.1 | 25.2 | 29.2 | 13.1 | 7.o | 7.o | 6.5 | 56.3 | 24.1 | 96.1 | 2o.6 | 2o.6 | 37.2 |
| Maize gluten meal | 17.9 | 25.3 | 22.1 | 87.o | 27.4 | 32.2 | 8.4 | 11.1 | 13.7 | 11.1 | 3.2 | 3o.o | 26.9 | 117.5 | 14.8 | 44.8 | 18.5 |
| Cod offal | 5.o | 5.1 | 4.5 | 7.3 | 3.o | 4.2 | 7.7 | 2.2 | 3.2 | 1.1 | 1.5 | 1o.9 | 6.1 | 16.2 | 15.o | 8.6 | 8.2 |
| Cod meat | 6.8 | 8.o | 7.2 | 12.3 | 5.5 | 6.3 | 12.9 | 3.7 | 4.8 | 1.7 | 1.8 | 16.2 | 6.5 | 25.4 | 8.7 | 9.7 | 1o.4 |
| Fish silage, acid cons. | 5.6 | 6.9 | 5.7 | 9.8 | 4.5 | 5.2 | 9.7 | 3.o | 3.5 | 1.4 | 1.1 | 11.8 | 4.9 | 17.4 | 7.6 | 7.8 | 7.6 |
| Troats from pigs | 4.3 | 6.4 | 3.9 | 8.6 | 3.o | 4.4 | 4.4 | 2.1 | 1.3 | 1.4 | o.9 | 9.5 | 4.7 | 15.1 | 13.o | 8.4 | 7.4 |
| Backbone from pigs | 3.1 | 4.5 | 3.1 | 6.8 | 2.1 | 3.4 | 5.8 | 2.3 | 1.3 | o.6 | o.9 | 8.8 | 4.5 | 15.3 | 19.9 | 9.6 | 9.4 |
| Feet from pigs | 5.3 | 6.8 | 4.1 | 9.2 | 3.1 | 5.1 | 7.9 | 3.3 | 2.2 | 1.o | 1.o | 12.5 | 7.o | 22.9 | 26.2 | 13.o | 12.8 |
| Cooked offal from pigs | 3.1 | 4.5 | 2.8 | 5.7 | 2.2 | 3.4 | 5.4 | 2.o | 1.o | o.6 | 1.1 | 7.7 | 3.6 | 13.8 | 16.8 | 8.5 | 7.7 |
| Cooked poultry offal | 4.2 | 5.o | 4.2 | 7.2 | 2.6 | 4.o | 7.o | 2.5 | 2.2 | 1.2 | 1.9 | 8.9 | 4.2 | 14.8 | 11.4 | 7.4 | 7.6 |
| Poultry offal silage | 7.3 | 8.5 | 6.5 | 11.2 | 3.o | 6.5 | 5.5 | 2.1 | 2.1 | 5.9 | 1.6 | 9.3 | 11.2 | 17.4 | 12.5 | 8.2 | 9.5 |
| Cottage cheese | 5.7 | 9.5 | 7.6 | 14.o | 8.2 | 7.5 | 1o.1 | 4.3 | 3.9 | o.9 | 2.2 | 1o.7 | 7.9 | 33.4 | 2.8 | 4.5 | 5.2 |
| Egg | 5.4 | 7.9 | 6.1 | 9.4 | 3.8 | 7.o | 7.o | 2.6 | 3.2 | 2.4 | 1.6 | 1o.9 | 8.1 | 15.4 | 3.8 | 6.4 | 6.5 |
| Fish meal <15% ash | 26.8 | 32.2 | 27.4 | 45.o | 18.9 | 24.3 | 47.4 | 15.2 | 18.9 | 6.1 | 7.9 | 56.5 | 24.9 | 82.7 | 35.9 | 35.9 | 36.5 |
| Meat and bone meal | 11.7 | 16.o | 1o.2 | 22.3 | 7.4 | 12.5 | 18.8 | 6.7 | 4.7 | 2.4 | 4.3 | 28.5 | 14.1 | 47.7 | 57.1 | 29.3 | 27.o |
| Poultry meal | 13.9 | 17.4 | 13.5 | 23.9 | 1o.o | 13.9 | 18.9 | 5.8 | 6.2 | 4.6 | 4.6 | 29.3 | 16.2 | 49.o | 42.5 | 24.7 | 25.5 |
| Feather meal | 26.6 | 41.8 | 26.1 | 47.2 | 13.6 | 26.1 | 12.5 | 4.3 | 3.8 | 31.5 | 2.7 | 42.4 | 59.7 | 65.2 | 45.6 | 26.1 | 33.1 |
| Meat meal | 11.5 | 13.8 | 1o.o | 21.6 | 7.1 | 11.2 | 19.o | 6.3 | 4.5 | 2.2 | 3.7 | 27.9 | 13.4 | 49.1 | 56.9 | 26.8 | 24.9 |
| Blood meal | 29.5 | 77.3 | 11.2 | 1o9.2 | 25.5 | 63.o | 74.1 | 57.4 | 6.4 | 7.2 | 3.2 | 92.5 | 35.9 | 79.7 | 38.3 | 64.6 | 38.3 |
| Casein | 33.1 | 52.4 | 4o.8 | 73.2 | 43.9 | 39.3 | 63.9 | 23.9 | 26.2 | 3.9 | 9.2 | 57.8 | 42.4 | 181.o | 15.4 | 23.9 | 3o.o |
| ICI-protein | 26.5 | 33.4 | 28.4 | 42.8 | 21.4 | 22.7 | 39.1 | 12.o | 13.9 | 3.2 | 8.8 | 56.7 | 19.5 | 69.9 | 32.8 | 44.1 | 3o.2 |
| BP-protein | 24.6 | 28.7 | 23.6 | 36.9 | 2o.5 | 26.1 | 35.8 | 9.7 | 8.7 | 5.1 | 7.7 | 56.3 | 24.1 | 79.4 | 23.6 | 3o.7 | 26.6 |

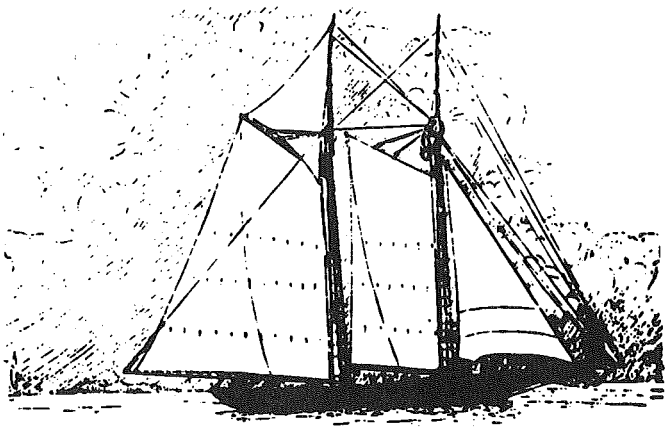
Table 2. The fatty acid composition of fats.

| Feedstuff | C12:1 | C14:o | C14:1 | C16:o | C16:1 | C18:o | C18:1 | C18:2 | C18:3 + C2o:1 | longer unsaturated fatty acids |
|---|---|---|---|---|---|---|---|---|---|---|
| Tallow | o.1 | 4.1 | o.8 | 3o.7 | 2.1 | 22.6 | 37.2 | 1.3 | o.6 | - |
| Lard, human quality | o.1 | 3.o | o.7 | 29.7 | 5.4 | 18.7 | 38.5 | 2.7 | 1.2 | - |
| Lard, rendered | o.1 | 2.3 | o.7 | 26.8 | 3.8 | 14.8 | 44.1 | 6.6 | o.8 | - |
| Fish oil | o.3 | 13.1 | o.3 | 23.8 | 7.3 | 2.8 | 14.3 | o.6 | 13.9 | 23.6 |
| Soy bean oil | o.1 | o.2 | - | 1o.3 | o.1 | 3.8 | 2o.4 | 56.9 | 8.2 | - |
| Soy lecithin | o.1 | o.3 | - | 16.4 | - | 4.4 | 15.o | 56.4 | 7.4 | - |
| "Biofosfatin" 1) | - | - | - | 16.o | - | 4.7 | 19.8 | 52.5 | 7.o | - |
| Shea oil | o.6 | o.5 | - | 5.1 | o.1 | 3o.3 | 53.o | 9.4 | 1.o | - |
| Soap stock | - | 13.1 | - | 25.2 | 12.2 | 4.5 | 17.1 | 1.9 | 13.3 | 7.7 |

1) The composition as given by the manufacturer.

Table 5. The content of certain minerals in feedstuffs.

| Feedstuff | g/kg | | | | mg/kg | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Calcium, Ca | Phosphorus, P | Magnesium, Mg | Sodium, Na | Iron, Fe | Manganese, Mn | Copper, Cu | Zinc, Zn | Cobalt, Co | Selenium, Se |
| Wheat | o.4 | 3.2 | 1.o | o.1 | 67 | 21 | 4 | 26 | o.o1 | o.o2 |
| Oats | o.8 | 3.2 | 1.o | o.2 | 69 | 34 | 4 | 26 | o.o1 | o.o2 |
| Barley | o.4 | 3.2 | 1.o | o.1 | 6o | 13 | 4 | 26 | o.o1 | o.o2 |
| Maize | o.1 | 3.3 | 1.1 | o.1 | 33 | 6 | 3 | 44 | o.o9 | o.o7 |
| Dehydrated potato meal | o.3 | 2.1 | o.8 | o.1 | - | 7 | 5 | 17 | - | o.o2 |
| Potato pulp | 2.3 | o.4 | o.6 | o.5 | - | 9 | - | - | o.o9 | - |
| "Potfor" | 1.o | 4.4 | 2.4 | o.3 | 33o | 29 | - | o.4 | 6.6 | - |
| Potato pectine | 1.9 | o.4 | - | 1.o | 52 | - | - | 18 | - | - |
| Wheat bran | 1.5 | 1.o | 3.8 | o.3 | 1o9 | 74 | 13 | 1oo | o.o4 | 1,6 |
| Wheat sharps | 1.1 | 7,7 | 2.7 | o.2 | 1o9 | 74 | 13 | 87 | o.o4 | - |
| Rye sharps | o.4 | 3.2 | o.9 | o.1 | 77 | 26 | 8 | 66 | o.o4 | - |
| Oat husk meal | 1.2 | 6.2 | o.9 | o.4 | 92 | 37 | 2 | 24 | o.o5 | o.4 |
| Dried grass meal | 6.o | 2.9 | 1.2 | o.9 | - | 59 | 6 | 24 | o.o6 | - |
| Malt sprouts | 2.4 | 8.o | 1.5 | o.7 | 118 | 55 | 16 | 112 | o.o5 | - |
| Dried sugar beet chips | 7.2 | o.7 | 1.6 | 1.3 | 386 | 46 | 8 | 15 | o.o8 | o.o8 |
| "Kosetter" | 5.2 | o.6 | 1.1 | 4.3 | 352 | 31 | 8 | 2o | o.o8 | - |
| Tapioca meal | 1.4 | 1.o | o.5 | o.2 | 9 | 2 | 3 | 7 | o.o5 | o.1 |
| Wheat germ | o.9 | 1o.o | 2.7 | o.1 | 1o6 | 156 | - | 153 | - | - |
| Rye bread meal | 2.1 | 2.2 | o.6 | 7.6 | 137 | 8 | - | 2o | - | - |
| Soy bean meal | 2.9 | 6.4 | 2.9 | o.1 | 16o | 42 | 18 | 63 | o.31 | o.18 |
| Full fat soy bean meal | 2.1 | 5.5 | 2.4 | o.o2 | 79 | 29 | 14 | 5o | - | - |
| Maize gluten meal | o.2 | 2.7 | 1.9 | o.3 | 352 | 9 | 18 | 53 | o.o3 | o.o9 |
| Fish meal <15% ash | 35.3 | 22.5 | 2.o | 6.6 | 3oo | 14 | 6 | 94 | o.5 | 1.9 |
| Meat and bone meal | 88.3 | 44.4 | 1.9 | 9.8 | 494 | 14 | 9 | 92 | o.4 | o.o5 |
| Poultry meal | 24.5 | 13.6 | o.8 | 7.8 | 632 | 19 | 17 | 15o | - | 3.5 |
| Meat meal | 77.5 | 45.2 | 1.9 | 11.o | 395 | 12 | - | - | - | 2.8 |
| Blood meal | o.7 | 2.o | o.3 | 1o.o | 291o | 7 | 9 | 26 | o.o5 | o.3 |



* MICRONIZED CEREALS AND SOYBEANS FOR MINK AND CHICKENS. (Mikronisert korn og soya til mink og høns).

Anders Skrede, Olav Herstad, Agricultural University of Norway, Dept. of Poultry and Fur Animal Science, Report no. 54, 1432 Ås-NLH, Norway.

Micronization yields short-term exposure to radiant heat at high temperature. The present report deals with digestibility and feed value of micronized and flaked batches of barley, wheat, maize and soybeans in experiments with mink and chickens. Besides, the experiments included non-processed barley (in mink also cooked barley) originating from the same sources as the micronized barley.

Digestibility coefficients were determined using adult males of dark mink and colostomized laying hens of White Leghorn. Contents of metabolizable energy (ME) were investigated using male chicks of White leghorn. Experimental animals were housed individually in cage equipped for quantitative collection of feces during 4-day balance periods.

Experiments with mink revealed that N-free extracts in non-processed, cooked and micronized barley were digested at 6o.3, 69.1 and 74.2%, respectively. The corresponding values for non-processed and micronized barley in laying hens were 8o.5 and 8o.3, respectively. Compared with common values achieved by other methods of heat treatment, the mink experiments showed relatively high digestibility of N-free extracts in micronized wheat and maize.

Experiments with laying hens indicated that micronization may cause a reduction in the digestibility of protein in barley. Furthermore, experiments eith chicks indicated lower content of ME in micronized compared to not processed barley.

By comparison with common values for solvent extracted soybean meal, micronized soybeans revealed a somewhat poorer digestibility of protein in both animal species. The urease activity in the

investigated batch of micronized soybeans was very low, possibly indicating overheating.

According to the mink experiments, grinding of micronized and flaked cereals and soybeans affected the digestibility coefficients, in particular those of fat, positively.

The experiments showed that micronization may be an efficient method for heat treatment of cereals for mink. Conversely, no beneficial effects of micronization on digestibility or content of ME were found in experiments with chickens.

Scientific Reports of the Agric. Univ. of Norway, ISSN oo25-8946,
Vol. 57, 1978, no.9, pp. 11.
9 tables, 26 references.
Norwegian with english subtitles and summary.

Authors abstract.

* UTILIZATION OF FISH AND ANIMAL BYPRODUCTS IN MINK NUTRITION. I. EFFECT OF SOURCE AND LEVEL OF PROTEIN ON NITROGEN BALANCE, POSTWEANING GROWTH AND CHARACTERISTICS OF WINTER FUR QUALITY.

Anders Skrede, Dept. of Poultry and Fur Animal Science,
Agric. Univ.of Norway, 1432 Ås-NLH, Norway.

Commercially available byproducts from the Norwegian cod (Gadus morrhua) and haddock (Gadus merlangus) fisheries (fillet cuttings, filleting scrap, fish heads and filleting skin), were investigated in terms of proximate composition, amino acid pattern and performance achieved when applied at varying levels of protein in mink diets. Body growth and fur quality characteristics of mink kits were studied in three experiments involving 34 diets and 187o animals. The diets were fed ad libitum during the postweaning growing-furring period, starting at June 25-July 3 and terminating at pelting in late November or early December. With regard to 23 of the experimental diets, digestibility and N retention were determined using

4 male kits per treatment group.

Fish byproducts originating from different parts of the fish revealed characteristic differences in proximate and amino acid compositions. However, except from an adverse effect of filleting skin, the different fish byproducts did not appear to promote extensive differences in N retention. Data on body growth indicated that diets containing a conventional mixture of protein sources were slightly superior to those based solely on fish byproducts. Among fish byproducts, fillet cuttings tended to yield better growth than filleting scrap. Provided that the protein requirement was met, partial replacement of filleting scrap with fish heads appeared to improve body growth. Filleting skin caused substantially poorer growth than any other fish byproducts. This effect could to some extent be counteracted by increasing the level of protein.

When protein levels were reduced below ca. 7.5 g ADP/1oo kcal ME, N balances of male kits tended to decline with decreasing protein concentration. The results of the feeding experiments indicated that the protein needs of the growing male mink exceed slightly those of the female. Regarding body growth and livability of male kits, 6 g ADP/1oo kcal ME appeared to be borderline or suboptimal depending on protein quality and probably the source of nonprotein energy. On the other hand, little or no advantage appeared to be obtained by using more than ca. 7 g ADP/1oo kcal ME.

The evaluation of different fur quality characteristics revealed in most cases minor and inconclusive effects of treatment factors.

Acta. Agric. Scand. 28, 1978, 1o5-129.
23 tables, 3 figs., 28 references.
English.

Authors abstract.

# * UTILIZATION OF FISH AND ANIMAL BYPRODUCTS IN MINK NUTRITION. II. EFFECT OF SOURCE AND LEVEL OF PROTEIN ON FEMALE REPRODUCTIVE PERFORMANCE; AND PREWEANING GROWTH AND MORTALITY OF THE PROGENY.

Anders Skrede, Dept. of Poultry and Fur Animal Science,
Agric. Univ. of Norway, 1432 Ås-NLH, Norway.

An experiment was carried out to study the effects of different levels of protein, approximately 11 (high), 8.5 (medium) and 6 (low) g apparently digestible protein (ADP) per 100 kcal metabolizable energy (ME), in mink diets containing byproducts from cod (Gadus morrhua) and haddock (Gadus merlangus). The diets contained filleting scrap or a half-and-half mixture of filleting scrap and fillet cuttings as the sole source of animal protein. Each diet was given to 30 dark mink females, 8 proven ad 22 one-year-old, and their offspring during the period from December 17 to 8 weeks post partum. The parameters measured included diet digestibility, female body weights and feed consumption, litter size, mortality and growth of kits, and blood hemoglobin concentrations.

Neither source nor level of protein had significant effects on overall mating and fertility performance. The litter size of 1-year-old females at parturition indicated an adverse effect of filleting scrap at the low level of protein. With this exception, the litter size at parturition did not disclose significant effects of treatment.

Litter size of proven females at weaning 6 weeks post partum was not affected by treatment. The weaning litter size of young females revealed no influence of protein source. However, there was an adverse effect of the low level of protein compared with the higher levels. This effect mainly reflected a reduced number of male kits when feeding the low level of protein. The kit mortality was generally above normal, especially among young females fed diets low in protein. By comparison with the results of the medium level, the high level of protein showed a tendency towards

reduced litter size at weaning.

During the period from 3 to 8 week post partum, the half-and-half mixture of filleting scrap and fillet cuttings promoted better growth than solely filleting scrap, although 3-week body weights were similar. The low level of protein was suboptimal as regards weight gain of kits throughout the experimental period. Comparison of the medium and high protein levels revealed no differences in body weights of female kits. However, the high level of protein appeared to be slightly beneficial with regard to growth of male kits between 6 and 8 weeks of age.

Acta Agric. Scand. 28, 1978, 13o-14o.
12 tables, 24 references.
English.

Authors summary.

* UTILIZATION OF FISH AND ANIMAL BYPRODUCTS IN MINK NUTRITION. III. DIGESTIBILITY OF DIETS BASED ON DIFFERENT COD (GADUS MORRHUA) FRACTIONS IN MINK OF DIFFERENT AGES.

Anders Skrede, Dept. of Poultry and Fur Animal Science,
Agric. Univ. of Norway, Ås-NLH, Norway.

The experiment aimed at studying the effect of protein sources from cod (Gadus morrhua) on the digestibility of macronutrients in mink males at 7, 16 and 38 weeks of age. The protein sources were raw and cooked fillet, raw and cooked backbone, and raw skin. Within the same animal age, diet contained nearly equal amount of nitrogen (N), fat and carbohydrate.

Compared with fillet, backbone and to a lesser extent skin affected adversely the digestibility of N. Diets containing fillet and backbone revealed a linear relationship between ash content and N digestibility. A one percent unit increase of ash in fish dry matter caused a depression in N digestibility of about o.6%. Fillet and

backbone appeared to respond differently to short-time cooking. Cooked fillet revealed a tendency towards reduced N digestibility, whereas slightly improved N digestibility was apparent by cooking the backbone fraction.

The digestibility of dietary fat was significantly lowered by the backbone and skin parts of cod as compared with the corresponding fillet. This effect was possibly related to ash contents.

The digestibility of carbohydrate did not disclose consistent effects of varying the source of protein.

The results obtained suggest that the process of maturation does not result in large differences in digestive capacity of mink within the interval 7-38 weeks. Values of N digestibility increased slightly with advancing age regardless of the experimental source of protein. The fat and carbohydrate digestibilities were nearly independent of the age of the animals.

Acta Agric. Scand. 28, 1978, 141-147.
5 tables, 2o references.
English.

Authors summary.

* FEEDING OF FISH SILAGE TO MINK - EFFECT ON pH OF MINK URINE. (Der Einfluss der Verfütterung von Fischsilage an Nerze auf den pH-Wert des Nerzharnes.)

H. Zimmermann, Bezirksinstitut für Veterinärwesen, Abt. Pelztiere, Petershagen-allee 1, DDR 22 Greifswald.

A fodder mix was fed to experimental minks. The mix contained a component of fish silage preserved by means of sulphuric acid which reduced the pH value to about 5.o. The pH of mink urine thus was reduces from 6.3 to 5.7 on average. Further studies are necessary to find out, if the trend towards urolithiasis can be lowered

by using fish silage preserved with sulphuric acid.

Monatshefte für Veterinärmedizin, 32, 1977, 859-860.
1 table, 1 figure, 14 references.
In german with russian and english summaries.

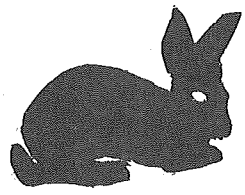
Authors abstract.

* HYPERVITAMINOSIS D IN RABBITS

R. G. Stevenson, Animal Pathology Laboratory, Box 1410, Sackville, N. B.; N. C. Palmer, Veterinary Services Branch, Guelph, Ontario; and G. G. Finley, Veterinary Pathology Laboratory, N. S. Dept. of Agriculture & Marketing, Truro, Nova Scotia, Canada.

There appears to be no report of uncomplicated Vitamin D toxicity in rabbits under normal conditions. Over a two month period 19 mature rabbits were examined at two laboratories. Main clinical signs were emaciation, diarrhea, intense thirst, ataxia and paralysis. A common factor was the feeding of one brand of commercial pelleted rabbit feed. Gross pathology revealed large mottled kidneys with mineralization of cortex on cut surface. Histopathology revealed numerous large calcium deposits in the aortic media as well as arterioles in most organs. In kidneys calcium deposits were also present in glomeruli and tubules. In bones basophilic material outlined the periosteal and endosteal surfaces, medullary trabeculae, Haversian and Volkmann's canals. Feed was analysed for vitamin D but the values were beyond the range of the standards used. The calculated value of 3300 international units vitamin D per pound of feed was an estimate so the acutal potency could have been much higher.

Can. vet. Journ., Vol. 17, No. 2, February, 1976, 54-57. 7 pictures, 4 references. (English with summary in French).



Authors summary.

## * TRANSMISSION OF ALEUTIAN DISEASE FROM MINK WITH INAPPARENT INFECTIONS.

S.H. An, D. G. Ingram, Dept. of Vet. Microbiology and Immunology, University of Guelph, Guelph, Ontario N1G 2W1, Canada.

In apparent or nonprogressive Aleutian disease virus infection was considered a subclinical but persistent viral infection in which infected mink did not develop tissue lesions, hypergammaglobulinemia, or high antibody titers. Transmission of Aleutian disease virus from mink with this type of infection was measured. Mink with inapparent Aleutian disease appeared healthy and had normal $\gamma$-globulin values, but were capable of transmitting the disease by direct and indirect horizontal contact. The risk of direct or indirect horizontal transmission from mink with inapparent infection was less than from mink with progressive Aleutian disease. Infection also was directly transmitted from the dam to the kits, but again the risk of infection from dams with inapparent infection was less than from dams with progressive Aleutian disease. Mink infected from their dams before weaning developed the disease more slowly than mink which became infected after weaning.
The Amer. Journ. of Vet. Res., Vol. 39, 2, 3o9-313.
2 tables, 14 references.

Authors summary.

## * AN OUTBREAK OF TULAREMIA IN MINK.

J.B. Henson, J.R. Gorham, D.T. Shen, Dept. of Vet. Microbiology and Pathology, Washington State University, Pullman, Washington 99163, USA.

An outbreak of tularemia in farm raised mink is reported. Twenty-six of approximately 5ooo mink succumbed within a 1o day period. Prodromal signs were minimal. Necropsy revealed necrotic nodules scattered in the parenchyma of the lungs, liver, spleen, and

mesenteric lymph nodes. Francisella tularensis was isolated from spleens, livers and lungs.

The Cornell Veterinarian, Vol. 68, no. 1, 1978, 78-83.
2 figs. lo references.

Authors abstract.

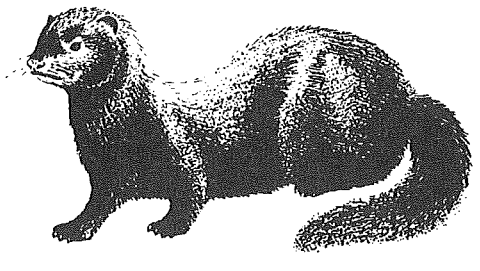
* PATHOLOGIC CHANGES IN FERRETS EXPOSED TO PSEUDORABIES VIRUS.

Kan-ichi Ohshima, John R. Gorham, James B. Henson,
Pioneering Research Laboratory, Agric. Res. Serv., U.S. Dept. of Agric., Washington State University, Pullman, Wa 99163, USA.

Ferrets experimentally infected by various routes with pseudorabies virus were examined for gross and microscopic lesions. Nonsuppurative meningoencephalomyelitis, as well as visceral lesions, occurred. The incubation period seemed related to the viral dose and to the distance between the inoculation site and the central nervous system. The distribution of the lesions in the central nervous system appeared to be closely related to the peripheral nerve pathways from the inoculation sites. Other findings indicated that the lymphohematogenous route could have a role in the dissemination of the virus in infected ferrets.

Am. J. Vet. Res., Vol. 37, no. 5, 1976, 591-596.
1 table, 9 figs.,34 references.

Authors summary.



COMMUNICATION.


NORDISKE JORDBRUGSFORSKERES FORENING

SCANDINAVIAN ASSOCIATION OF AGRICULTURAL SCIENTISTS - FUR ANIMAL DIVISION.

Scientific meeting about fur animal production in Denmark (Elsinore ) the 1oth to 12th of October 1978.

Reports will be given on genetic, reproduction, feeding and sickness of foxes, racoon (Nyctereutes procyonoides) and if possible other uncommon fur animals.

Also reports regarding actual research in mink and other fur animals will be given.

In the next number of SCIENTIFUR we will bring the final program.

Further information will be sent direct to members, other interested can contact:

N.J.F.'s Fur Animal Division
Helge Olsen
Langagervej 6o
DK 26oo Glostrup

Phone (o2) 96.71.22.


# THE SECOND INTERNATIONAL SCIENTIFIC CONGRESS IN FUR ANIMAL PRODUCTION

In 1976 the first international congress in fur animal production was held in Helsinki in Finland, arranged by The Scandinavian Agricultural Research Association. A wish was here expressed that this arrangement should be a returning event.

The Association has therefore decided to arrange The Second International Scientific Congress In Fur Animal Production in April 1980 in Denmark

if there is an interest in it.

It is expensive to arrange such a congress and it is expensive to participate in it, especially for the non-Scandinavian members.

Therefore, it has been decided to examine the interest in this international congress in 1980 among our non-Scandinavian friends before a final decision is taken on holding the congress.

If you are interested and expect to be able to participate in the congress, we kindly ask you to inform Scientifur, 48H Roskildevej, DK 3400 Hillerød, Denmark before 1st August 1978, and at the same time we ask you to make proposals for possible subjects to the congress.

HELGE OLSEN

AGRICULTURAL RESEARCH SERVICE
WESTERN REGION

OF UNITED STATES
DEPARTMENT OF
AGRICULTURE

Pioneering Research Laboratory
202 Wegner Hall, WSU
Pullman, WA 99164

9 March 1978

Dr. Gunnar Joergensen
NJF's Fur Animal Division
Scientifur
48 H Roskildevej
DK-3400 Hilleroed
Denmark

Dear Dr. Joergensen:

I have just received my copies of Scientifur. They are excellent.

I was delighted to learn that there will be another meeting of the World Scientific Congress on Fur Animal Production in Denmark in 1979 or 1980. The World Veterinary Congress will be in Moscow, Russia, July 1-7, 1979. I just mention this in case you have other veterinarians that would like to attend both meetings.

Of course, everybody has certain dates that they would be interested in but I thought I would mention the Moscow meeting to you. On the other hand, it is always helpful if the dates of the World Scientific Congress on Fur Animal Production do not coincide but come close to the York meeting dates in England.

Again, congratulations on all of your efforts in putting out your scientific newsletters.

Sincerely yours,

John R. Gorham
Research Leader

# * A BIBLIOGRAPHY OF MUSTELIDS

*Part I: Ferrets and Polecats


Compiled by

Ann U. Shump, Karl A. Shump, Jr., Gary A. Heidt and Richard J. Aulerich

*Part II: Mink

Compiled by

Ann U. Shump, Karl A Shump Jr.,

Gary A. Heidt and Richard J. Aulerich

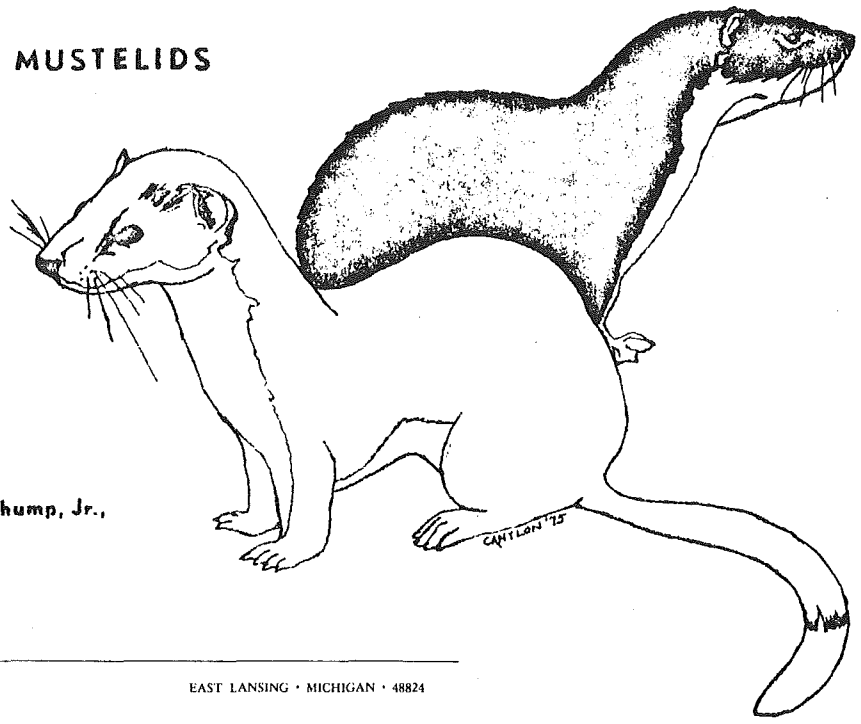
*Part III: Skunks

Compiled by

Karl A. Shump, Jr., Ann U. Shump, Thomas W. Nelson,

Gary A. Heidt, and Richard J. Aulerich

# A BIBLIOGRAPHY OF MUSTELIDS



* Part IV: Weasels

Compiled by

Gary A. Heidt, Ann U. Shump, Karl A. Shump, Jr.,

and Richard J. Aulerich

MICHIGAN STATE UNIVERSITY

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES
DEPARTMENT OF POULTRY SCIENCE

EAST LANSING · MICHIGAN · 48824

May 4, 1978

Dr. Gunnar Jorgensen
National Institute of Animal Science
Research in Fur Animals
Trollesmide
Roskeldevej 48 H
DK 3400 Hilleroed
DENMARK

Dear Gunnar:

It was nice meeting you and working with you in Salt Lake City. I hope the remainder of your visit here in the United States was pleasant. I

* have enclosed copies of our Mustelid Bibliography, Parts I-V as you requested. Parts I, III, IV and V are available to interested persons free of charge. Part II - Mink contains 1850 references and is available (while the supply lasts) for $3.00 per copy. To obtain a copy of Part II, send a check or money order, made payable to the Mink Farmers' Research Foundation, to me. (Dr. Richard J. Aulerich, Poultry Science Department, Michigan State University, East Lansing, MI 48824)

I am also enclosing a copy of an article entitled "Effect of Iodine on Reproductive Performance of Female Mink" by R. J. Aulerich, R. K. Ringer, and G. R. Hartsough. This article was recently published in THERIOGENOLOGY 9(3): 295, 1978. Perhaps you may wish to consider publishing the abstract in SCIENTIFUR.

Hope to see you again in the not too distant future.

Kindest regards.

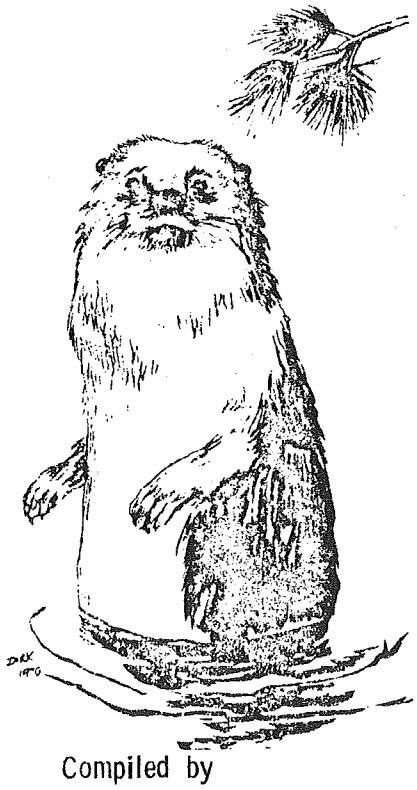
Sincerely yours,

Richard J. Aulerich
Associate Professor
Fur Animal Project

RJA/sms

Enc.

* Part V: Otters



Compiled by

Karl A. Shump, Jr., Ann U. Shump, Richard A. Aulerich,
and
Gary A. Heidt

NOVA SCOTIA
DEPARTMENT OF AGRICULTURE
AND MARKETING

Truro, Nova Scotia
B2N 5E3

May 5, 1978

Dr. Gunnar Jorgensen
Editor - Scientifur
48H Roskildenej
DK - 3400, Hillerold
Denmark

Dear Dr. Jorgensen:

This is further to your letter of December 29, 1977. We have renewed our subscription for 1978 and I hope you can continue with the journal. I mention it to everyone in a position to subscribe.

I am attaching an abstract on "Hypervitaminosis D in Rabbits", of which I am one author. A few original reprints are available upon request.

I know you have not included information on rabbits in Scientifur, so do not feel obligated to use it. We do have a small commercial rabbit industry in Nova Scotia at the present time.

I have several articles on mink and chinchilla which I will be sending in the future.

We were recently saddened to hear of the sudden death of Dr. Don Ingram of the Ontario Veterinary College. His research on AD and the CEP will certainly be missed.

Yours very truly,

G. G. Finley, D.V.M.

GGF:rms
attached

* Can You help Dr. Palm?

Gr. Thondorf, den 7. 5. 1978

Dear Mr. Joergensen,

I obtained your address from the National Board of Fur Farm Organizations in Brookfield/USA.
I try to find coloured pictures of the following fox races for my biology lessons:
silver, pearl, golden glory, amber (if possible also blue agouti, chocolate agouti and blue chocolate agouti).
Can you help me? I would be very much obliged to you.

Yours sincerely,

W. Palm.

Wolfgang Palm OStud. Rat
3119 Himbergen, Göhrde 2
(Gr. Thondorf)
Tel. 05828 / 496

Please write Dr. Palm!!

* Are You interested?

UNIVERSITY OF BRISTOL
DEPARTMENT OF ZOOLOGY

I would appreciate an exchange & reprints on carnivore biology. Many thanks.

WITH COMPLIMENTS

Stephen Harris.

Adress on page 13.