Effect of an Empty Cage between Female Ranch Mink in the Reproduction Period

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Introduction

Under natural conditions mink will avoid reproducing in the vicinity of each other. However under farm conditions they must do it. The aim of this study was to evaluate whether the high density of animals in a shed would affect the reproduction of female mink and the behaviour of the females during the nursing period.

Methods

During two reproduction periods primiparous mink were placed in cages either adjacent to or separated from each other. The mink were separated by means of an empty cage.

Experimental groups:
1998: ☞ 64 mink in adjacent cages
☞ 67 mink in separated cages
1999: ☞ 64 mink in adjacent cages
☞ 40 mink in separated cages

The reproduction results and the incidences of 'sticky kits' were registered (1998 and 1999).

The females' activity was evaluated according to how often they varied between being in the nest box and in the cage during 10-minute observation periods twice a week for 5 weeks (only 1999).

In a 'kit-retrieval-test' it was recorded how and when the female reacted to a kit that was removed from the nest box and placed in the cage (only 1999).

Results

Females placed in separated cages weaned more (Fig. 1) and larger kits (Fig. 2) than females placed in adjacent cages, and they had lower kit mortality from birth to weaning (Fig. 1). In both years there was a significantly higher incidence of 'sticky kits' when the females were placed in adjacent cages (Table 1).

Females placed in adjacent cages more often alternated 3 times or more during the observation periods than females placed separated from each other (Fig. 3) and they had a higher total number of alternations.

The females were less willing to leave the cages and used more time to fetch the kit back to the cage when they were placed in separated cages than in adjacent cages (Fig. 4). Compared to their lower number of alternation it seemed that the females in separated cages reacted more calmly than the females in adjacent cages.

Conclusion

A greater distance between females had a positive effect on the reproduction period.

Table 1

Sticky kits in %	1998	1999
Adjacent cages	6.3%	43.8%
Separated caged	1.5%	25.0%*

Figure 1

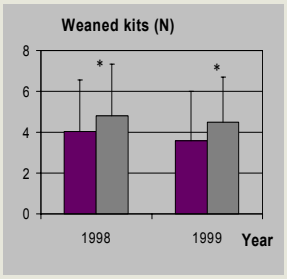


Figure 2

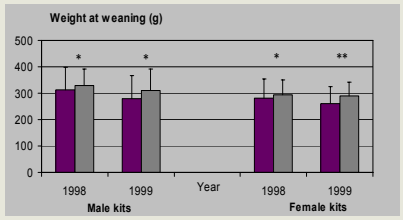
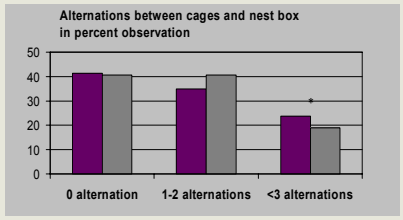


Figure 3



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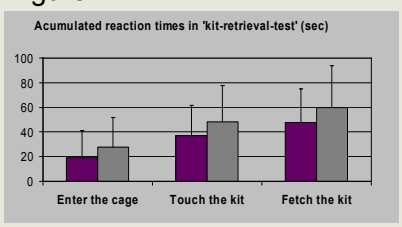

Digestibility Trials with Moulting Mink

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Introduction

Digestibility trials with mink are traditionally conducted in periods with out moulting.

If conducted in a moulting period faeces is contaminated with hair, which is rich in nitrogen (N). Consequently, N-digestibility may be underestimated.

Knowing the magnitude of the theoretical error it is possible to define whether it is recommendable to perform digestibility trials in the moulting periods or not.

Methods

Four samples of feed ingredients for mink feed were use both in trials in the moulting periods and outside. There were 3 samples in a Regression design;

* Meat-and-bone meal
* Fish meal
* Peas

and 1 sample in a Simple design
* Mackerel graks.

In the moulting periods larger tufts of hair were removed manually during collection of faeces.

After freeze drying faeces was ground. When grinding, a unknown quantity of hair separated from the faeces because it stuck to the sides of the laboratory mill, due to static electricity.

Results

Digestibility of N

The apparent digestibility of nitrogen (ADN) was underestimated by up to 2 percentage points or overestimated by 1 percentage point in the moulting peri-ods versus outside. Allthough only 4 observations - the correlation was high (R^2>0.99)(Figure 1).

Digestibility of fat

The correlation between digestibility of fat (DF) was relatively low (R^2=0.85) (Figure 2). In the trial with peas fat from peas only made up 5% of the total fat in the feed. This implicitly makes the DF relatively uncertain.

Digestibility of carbohydrate

Carbohydrate in feed and in faeces is calculated by "The Method of Difference". But as moulting does not influence the digestibility of N and fat noteworthy, it follows that the digestibility of carbohydate is neither affec-ted.

This was confirmed in the trial with peas, where digestibility of carbohydrate was exactly the same in the moulting period (56.3%) as outside (56.4%).

SEM/Std

Especially concerning N digestibility it could be justified to expect a greater variation among animals when performing trials in the moulting period than outside. The SEM/Std (Figure 1) shows that this was not the case.

Effect of the digestibility of the feed ingredient

The quantity of hair in the faeces was not measured. Generally it was obser-ved to increase when the quantity of faeces increases. But when the quantity of faeces and so the quantity of hair increases the total quantity of indigestible N also increases. Therefore the determination of N-digestibility is not affected by the actual digestibility of the feed ingredient in question.

Conclusion

Performing digestibility trials in a moulting period may result in digestibility values that is slightly under- or over estimated compared to values achieved outside. Different or not, the values determined in a moulting period is well inside the 95% confidence interval of the values determined outside the moulting period.

It is concluded, that digestibility of N, fat and carbohydrate might as well be determined in a moulting period as outside.

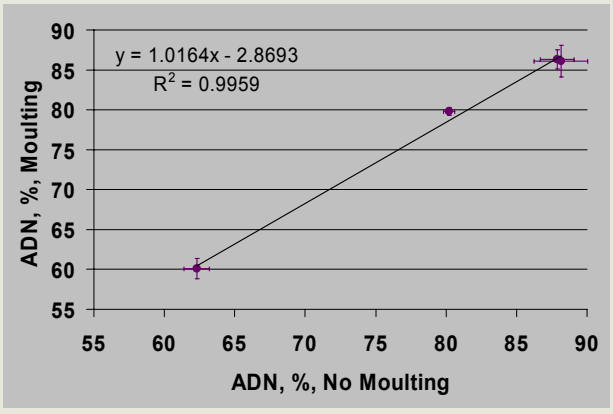

Figure 1. Apparent digestibility of nitrogen (Mean ± SEM)

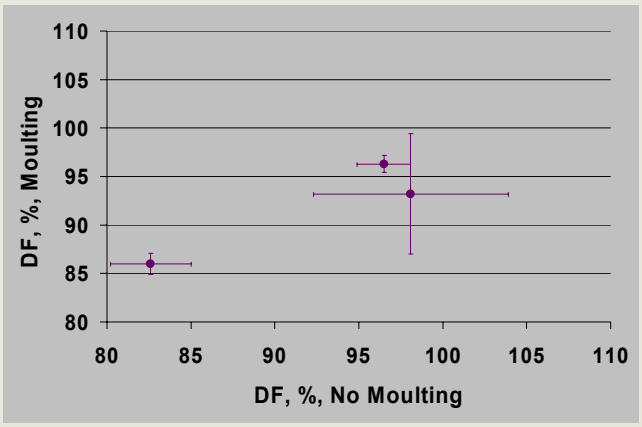

Figure 2. Digestibility of fat (Mean ± SEM)

Improvement of Reproduction in Scanblack Mink

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Introduction

Scanblack and wildtype have identical colour-genotypes. But scanblack have one kit less per litter than wildtype.

The aim of the presented experiment was to investigate:
1) The possibility of creating a scanblack line with the same good reproduction as wildtype by crossing scanblack and wildtype followed by selection within the cross-line ?
2) The difference between reproduction result depending on whether the male is scanblack or wildtype.

Methods

The experiment was established in 1998. Starting with 20 scanblack males and 100 wildtype females in one line (#54) and with 20 wildtype males and 100 scanblack females in an other line (#55).

Kits born by generation 0 were breed within the two lines. In generation 1 20 males and 100 females were selected from each line as breeding animals.

In 1999 the animals were mated within lines, but the kits were pooled into one line (#56). In each of the following years 200 females and 40 males were selected for breeding.

The 2/3 best part of the kits in the line/lines were preselected according to their parents information on reproduction traits. Among these breeding animals were selected by a breeding index based on information of the individual kit and its family´s performance on quality, colour, clarity, weight, littersize-index and silkiness.

Results

Crossing of scanblack male and wildtype female gave the highest number of kits at weaning (fig. 2) and the lowest percent of barren females (fig. 3). Wildtype females had one more kit at weaning than scanblack females.

This is similar to the farm average of the respective female colour-genotypes.

This difference between the two genotypes was significant in all three years.

The cross (#54, #55 and #56) seems to be at least as good as wildtype or even better according to number of kits at weaning and the percentage of barren females.

The distribution by skin colourtype on the auction, of this cross-production can be seen in fig. 4. After two years only 14 % of the production is graded as scanblack-skin (plus unknown part of the breeders). If we shall create a scanblack-line with better reproduction characteristics the distribution of scanblack skins has to increase.

Conclusion

It is possible to create a cross between scanblack and wildtype with the same good reproduction or even better as in wildtype. The best result was achieved by using wildtype as female in the first generation. There were no significant difference in the second generation.

In the second generation only 14 % of the skins were classified as scanblack plus an unknown part of the breeders.

Figure 1. Flowdiagram of the experiments

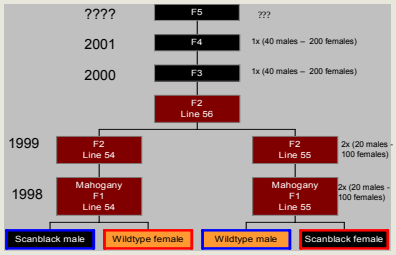


Figure 2. Kits per mated female at weaning

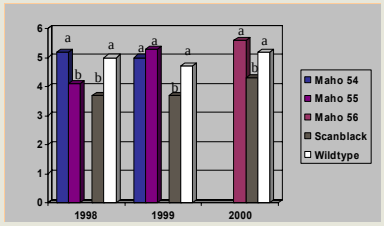


Figure 3. Percent barren females

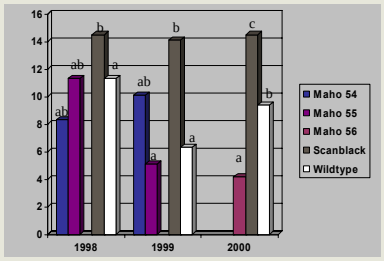
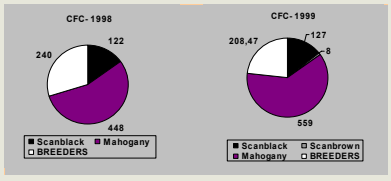


Figure 4. Distribution of skintype



Fiber as a Satiety Factor in Mink Feed

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Introduction

It is widely accepted that animals eat to meet their energy needs, thus energy intake and energy needs are the primary controllers over feed intake. However it have been shown, that low digestible fibers can reduce the feeling of hunger, increase the feeling of stomach fullness and reduce the voluntary energy intake, (for example Benini et al., 1995, Sparti et al., 2000 and Anonymous, 1997).

It was investigated if animals fed a restricted energy supply would compensate for addition of low digestible fibres by increasing the feed intake per unit of time or if the fibers has a satiety effect causing an increase in the time spent eating the allotted feed.

Methods

The investigation comprised 3 experimental groups each consisting of 5 adult male mink (colour type scanglow). To a control diet (C) either barley hulls (H) or chopped barley straw (S) were added. The diets were fed to the animal for 11 days. All three groups were allotted 836 kJ/day (about 15% less energy than normally consumed at this time of year). Due to the water binding capacity and the filling effect of the added fibre the group C, H and S were fed respectively 176, 228 and 331 g per day.

Prior to the experiment all animals were fed a central feed kitchen diet.

On the 3rd, 7th and 11th day, feed intake was calculated as allotted minus remaining and wastage at 8, 16, 20 and 24 hours after feeding.

Composition of experimental diets, % (before addition of water)

Group	C	H	S
Fish offal	77.7	68.1	67.6
Soya oil	7.7	6.8	6.7
Barley	13.8	12.1	12.0
Barley hulls	-	12.4	-
Barley straw	-	-	13-1
Vit. & Min.	0.7	0.6	0.6

Results

The S diet had a palatability or a consistency which was aversive to the males. Especially in the first days of the experiment, the males spat out a great part of the straws. As the experiment continued, the S group apparently became more hungry and ate more of the allotted diet. Due to the selective wastage the measurement of energy intake was not calculated for the S group.

In a 10 day period animals on a restricted energy supply (Group C) increased the proportion of allotted energy ingested within 8 hours from 66% on day 3 to 86% on day 10.

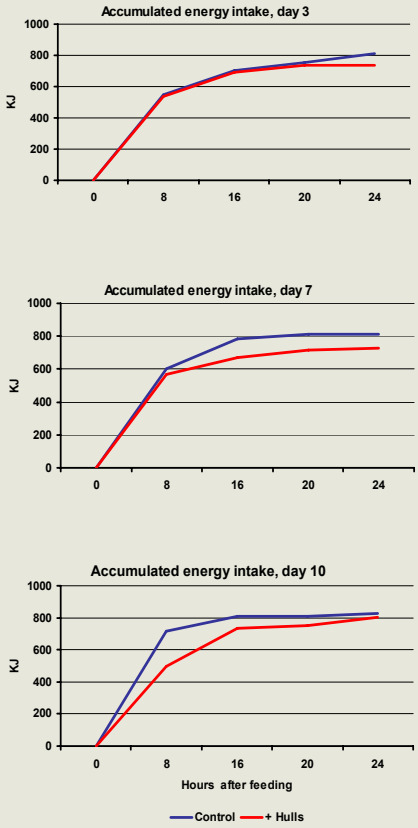
Addition of barley hulls to the diet influenced the time the animals spent eating the allotted feed.

On the 3rd day group H compensated for the lower energy concentration by increasing the quantity of feed ingested within 8 hours.

Because of the increment, the ingested quantity of ME equalled the quantity ingested by group C.

Ten days after introducing the hull containing diet, the animals ate a smaller proportion of the allotted diet within 8 hours than the control group and less than on the 3rd day.

As the allotted diet were eaten within 24 hours the animals spent more time eating it.



Conclusion

- The used quantity of straw caused the diet to have a palatability or a consistency which is aversive to the male mink.
- After a habituation period, inclusion of barley hulls prolonged the time the animals spent eating a restricted quantity of feed/energy.
- The overall conclusion is, that barley hulls can be used as a satiety factor in mink feed.

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Digestibility of Different Sources of Starch

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Introduction

The increasing environmental restrictions can make it necessary to reduce the dietary protein content.
Hence, the focus on carbohydrates increases.

In an experiment we focused on the glycemic index and starch digestibility in 7 different heat treated starch sources.

We were not successful in determining the glycemic index, and the method used for analysis of starch content was insufficiently accurate. Hence only digestibility of crude carbohydrate are reported.

Starch sources testet

Flaked Maize, (Majs BIO-WOLFF)

Wheat Starch, (Weizenquellstärke 20892)

Maize Starch, (C*Gel-Instant 12018)

Maize Starch, waxy, (C*Gel-Instant 12410)

Rice Starch, (Remy FG-P)

Tapioca Starch, (C*HiForm A 72391)

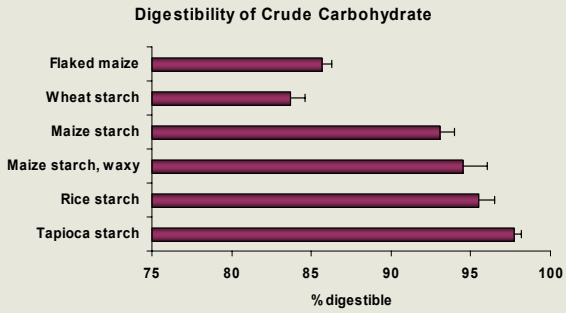
Potato Starch, (C*Mix 32155)

Methods

Digestibility trials were performed with 5 males per starch source, where the diet contained the starch ingredient as the only carbohydrate source. The trials consisted of a 7-day preliminary period and a 4-day collection period.

Crude carbohydrate was calculated as dry matter ÷ (crude protein + crude fat + crude ash).

Digestibility was calculated as percentage of consumed component not excreted in faeces.



Results

Animals receiving the potato starch containing diet developed diarrhoea and the trial had to be prematurely terminated. This was in discrepancy with results from Jørgensen and Glem-Hansen (1975), who reported that mink could tolerate raw as well as heat treated potato starch.

The digestibility of crude carbohydrate in the non- and semipurified starches were lower than in the purified. Assumably this reflects that Flaked maize and Wheat starch contains NSP which is indigestible to mink.

In the purified starches the digestibility of crude carbohydrate ranged from 93% to 98%. Mainly because of the missing results of starch content analysis, it is not possible to conclude on the factor(s) causing this. But assuming that the crude carbohydrate content was starch and glucose only, it could be an effect of differences in the distribution among amylose and amylopectine.

Being a branched and shorter polymer than amylose it is possible that the digestive enzyme (amylase) more rapidly and thereby more efficiently breaks down the polymer to glucose that subsequently is absorbed. The difference between maize starch and waxy maize starch could indicate this. It could also be differences in purity among the purified starches, differences in the gelatinisation or level of retrogradation during storage.

Digestibility cage, designed for measurement of feed intake, faeces and urine excretion

Conclusion

Among the tested starch sources different digestibility of crude carbohydrate was found; but it is not revealed whether this is caused by processing and storage, different contents of NSP or amylose and amylopectine composition of the starches.

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Amino Acid Profiles in the Furring Period of Mink *(Mustela vison)*

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Introduction

Animals utilise protein for maintenance, growth, reproduction and milk production. The ideal amino acid profiles (IAAP) for these purposes, are different and the profile changes during an animals growth period, as the maintenance requirement increases and that for growth decreases (i.e. Anon, 1987 and Rodehutscord et al., 1997). For fur bearing animals this is also influenced by the onset of winter fur growth.

It is known, that the AAP of milk or whole body, is a good basis for the determination of the IAAP (i.e. Kim & Lall, 2000).

The AAP, of the norm for mink (N) in the growing-furring period (Børsting & Clausen, 1996 and Børsting, 1998), and that of mink body and pelt (M) (Glem-Hansen & Hansen, 1981 and Chavez, 1980) shows considerable difference for certain amino acids. The AAP of the cat norm (C) (NRC, 1996) is relatively close to either that of N or that of M (Table 1).

A trial was carried out in the furring period to test the consequences on growth, fur quality and health, of diets having AAP's, based on either M or C.

Table 1. AAP (relative to lysine) of mink norm (N), mink body+pelt (M) and cat norm (C).

	N	M	C
Arg	115	119	125
Cys	22	67	44
Met	59	32	50
M+C	81	99	94
His	56	38	38
Ile	96	54	63
Leu	185	122	150
Val	130	78	75
Lys	100	100	100
Phe	107	62	50
Tyr	67	56	56
Thr	70	74	88
Trp	22	22	19

Materials and Methods

Animals

3 groups of 50 (full sibling) male mink of the wild colourtype were used. They were each housed with a female in a two row open house with 6 cages per section. The trial was carried out from September 4th and until pelting.

Feed

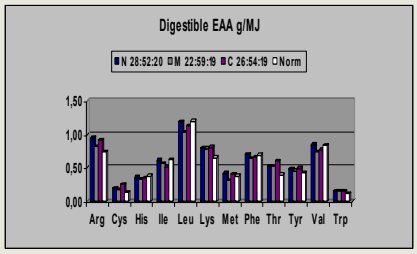
A standard feed kitchen diet was fed until the initiation of the experiment. Trial feeds were composed in an attempt to keep the AAP's within +/- 10% of the three profiles with regards to the amino acids Arg, Lys, Thr and Trp. The same was valid for Met+Cys in groups N and C, while it was assumed that the high relative requirement calculated for group M was a result of their deposition in the fur over a longer period. It was accepted that the level should fulfil the present requirement (norm minus 10 %). For the remaining essential AA's, excesses were allowed if they didn't exceed the norm for mink.

Results

Feed

The energy distribution and the content of essential amino acids in the feeds are shown in figure 1.

Figure 1. Energy distribution and g digestible essential amino acids/MJ.

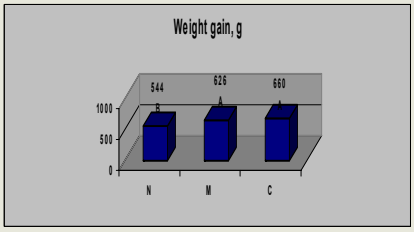


As the diets were composed with respect to the amino acids, it is noteworthy to see that the energy distribution in group M ended up being 22:59:19 in comparison to group N (28:52:20) and group C (26:54:19).

Weight gain

Group C and M had live weight gains of 660 g (± 183) and 626g (± 187) which were significantly (p=0.005) better than group N (544 g ± 215) (Figure 2).

Figure 2. Average weight gain (g) from September to pelting.

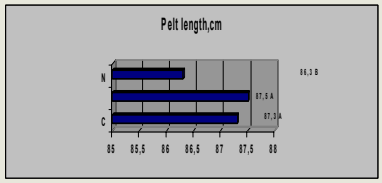


The weight gain results indicate, that the requirement for methionine *per se* in the furring period is not above 0.31 g digestible/MJ. A possible negative effect from an excess of sulphur containing amino acids in group N should be excluded, as the level was higher and the weight gain better in group C.

Pelt length and fur quality

The pelt length reflects the live weight gain in the period. The groups C and M had significantly longer pelts (p=0.02) (figure 3).

Figure 3. Pelt length in cm.



There was no significant differences in fur quality, colour, number of silky furs or wool quality between the groups. The only significant difference in the quality parameters where for clarity, where group M had the least red furs as compare to groups N and C (p=0.003).

The lacking differences in length and quality between groups C and M also indicate, that the requirement for methionine *per se* in the furring period is not above 0.31 g digestible/MJ.

Conclusion

•The results indicate that an amino acid profile different from the present norm (containing quite a number of so called maximum norms) may give equal or better performance results.

•The requirement for methionine *per se* in the furring period is not above 0.31 g digestible/MJ.

•That 22 % of the metabolizable energy from protein could be sufficient in the furring period.

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Methionine and Methyldonors for Mink *(Mustela vison)* in the Furring Period

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Introduction

Glem-Hansen (1976) showed, that methionine and cystine were the first limiting amino acids in typical Scandinavian mink feed. In following trials, to establish the requirement for sulphur containing amino acids in the growing period, dl-methionine was used (Glem-Hansen and Hansen, 1980).

Investigations with other species have shown a varying degree of utilisation of dl-methionine. Teeter et al. (1978) concluded, that d-methionine was well utilised by cats. A calculation from their data indicates abt. 80 % of growth as compared to l-methionine. Due to the trial design, they could not quantify the degree of utilisation.

An alternative to methionine is the Methionine Hydroxy Analog (MHA). Teeter et al. (1978) tested MHA to growing cats. On a semipurified diet, the MHA group achieved a growth of about 78 % of that achieved by the group receiving l-methionine.

Besides being an essential amino acid in itself, methionine is converted to cystine and may cover the requirement for this amino acid. This process liberates methyl groups, which in themselves have metabolic functions.

Methyl groups may also be supplied by the vitamin choline chloride or betaine.

Børsting og Riis (2002) tested a partial substitution of methionine with betaine to mink in the growing and furring period. The results indicated a certain methionine sparing effect of betaine in the furring period.

The following preliminary trial was carried out in order to clarify whether MHA or betaine may possibly substitute a part of the present methionine requirement (norm) to mink in the furring period.

Materials and Methods

The trial was carried out in the period from September 6th and until pelting.

Animals

Three groups of 120 male mink of the wild colourtype were used.

Feed

A standard feed kitchen diet was fed until the initiation of the experiment. The basal feed was composed to have a 20 % deficiency of methionine as compared to the norm for mink in the furring period.

In the 1st group, 0.14 % of dl-methionine was added (only l-methionine calculated as utilisable). The 2nd group received 0.079 % MHA as Alimet©, corresponding to the lacking methionine and the 3rd group received 0.022 % betaine as betaine monochloride, corresponding to the amount of methyl donors lacking.

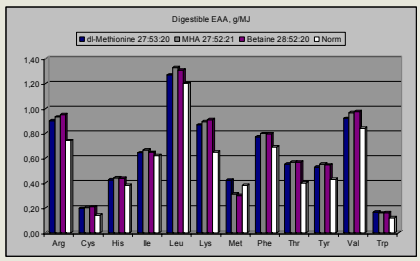
The diets were composed to have a ME distribution of respectively 28:53:19 from protein, fat and carbohydrates.

Results

Feed

The energy distribution and the content of essential amino acids in the feeds are shown in figure 1.

Figure 1. Energy distribution and g digestible essential amino acids/MJ.



The amino acid content was generally above the requirement for mink in the furring period. Methionine had successfully been lowered about 20 % in the basal feed as compared to norm (the analysis results from the groups MHA and Betaine). The group with added dl-methionine ended up with about 5 % excess as compared to the plan. This is within the normal variance in the analysis results (only l-methionine given nutritional value). However, if one considers the content of d-methionine as a possible nutritional source of methionine, the excess might be as much as 20 %.

Weights and gain

There was no significant difference in weight gains from September to pelting. This indicates that the methionine requirement *per se* for gain in the furring period is covered by a content of 0.31 g of digestible methionine/MJ, as this was the amount available in the Betaine group. As the total sum of sulphur amino acids was only just below norm level in the MHA group and the Betaine group there is - at present - no reason to believe that the recommendations for total sulphur amino acids should be lower than the norm. However it seems that the present balance between methionine and cystine of 73:37 may at least be changed to at balance of 60:40.

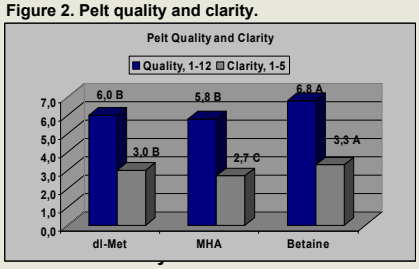
Due to the above we are not able to conclude whether the mink is able to utilise either d-methionine or MHA during the furring period. In case d-methionine has nutritional value, one has to consider the possible negative effect that excess methionine may have. Negative influences have been reported in performance and health parameters in cats (Schaeffer et al., 1982; Maede et al., 1987 and Fau et al., 1987).

Pelt length and fur quality

The group receiving MHA had the longest pelts and the group receiving dl-methionine the shortest; but there was no statistically significant difference between the groups.

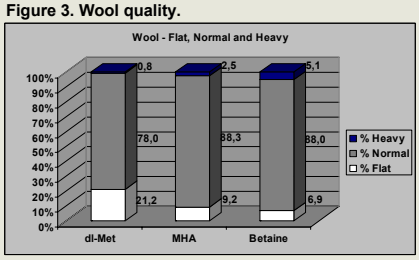
The group receiving Betaine had significantly better quality (p=0.0007) and the most reddish furs (p<0.0001) when compared to the two other groups (figure 2). The group receiving MHA had the least reddish furs (p<0.0001) when compared to the two other groups.

Figure 2. Pelt quality and clarity.



group receiving methionine and this group had significantly lower wool quality (p=0.0006) as compared to the two other groups (figure 3).

Figure 3. Wool quality.



Conclusion

Substituting 20 % of the methionine with either MHA or Betaine had no negative effect on the weight gain from September to pelting nor for the pelt length. There was an improved quality when substituting the dl-methionine with Betaine. The group receiving Betaine had longer pelts (NS) and a better quality (p=0.0007) than the group receiving dl-methionine. This indicates that the requirement for methionine *per se* in the furring period, is fulfilled at 0.31 g of digestible methionine/MJ. The results further indicate that a balance of 60:40 between methionine and cystine should be sufficient.

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Correlation between liver fat and dry matter

Tove Clausen & Peter Sandbøl

Introduction

Liver function is highly influenced by the feed. Investigating the consequences of different feed compositions on growing mink kits, often makes it interesting to see if there are any fat infiltration in the livers. In investigations on the protein requirement of mink in the growing period, we often observed an increased fat content in the liver, with reduced protein / increased fat content in the feed (Damgaard et al., 1994; 1998a & 1998b).

A chemical analysis of the fat content is slow and expensive. In order to screen livers from many animals, we searched for a fast and cheap method to determine the liver fat content.

A semiquantitative test (Herdt et al., 1983), has been used at the Research Center (Clausen, 1992; Damgaard et al, 1994; 1998a & 1998b). Liver samples were submerged into water and copper sulphate solutions with specific gravities of 1.000, 1.025 or 1.055. Based on buoyancy, liver samples were classified as containing > 34 % fat, 25 – 34 % fat, 13 – 25 % fat, or less than 13 % fat. The method is cheap but rather inaccurate. Furthermore the liquid can only be used for a few liver samples before it has to bee replaced.

The dry matter (DM) content of fat is almost 100 percent. In this investigation we analysed dry matter and crude fat content of the livers and estimated the correlation between these two variables.

Methods

To the investigation we used liver samples from mink dying during October 2003. A total of 15 livers were chosen from their macroscopic appearance. 9 livers had a normal size and colour, 6 livers were very enlarged and yellow. From all livers we took two equal samples from the same liver lobuli. One sample was analysed for crude fat (Stoldt fat, EU(98/64EØF)) and DM (104 ºC in 4 hours, EU(71/393/EØF)), at the Danish Fur Animal Feed A/S, Analytical Laboratory, and one sample was analysed for DM at the Research Center. At the Center we divided the liver sample into two parts each 2 - 4 grams and dried at two different temperatures 80 ºC and 110 ºC. We dried the samples 26 hours for practical reasons, as the samples were taken in the morning and we then had the results the following day. The liver samples were mashed with a fork, and placed in small tin foil cubs before drying.

Results and discussion

DM analyzed at the laboratory and at the Research Center was very equal. The best correlation was found between laboratory DM and DM determined at 110 ºC for 26 hours (correlation coefficient 0.998, $p<0.0001$). Relationship between liver DM and crude fat content is shown in Figure 1.

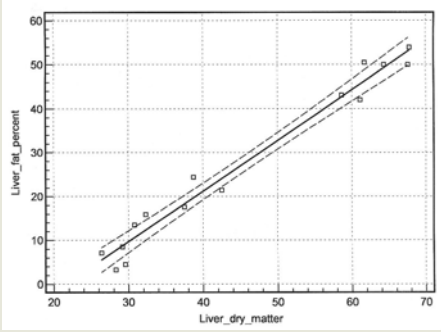
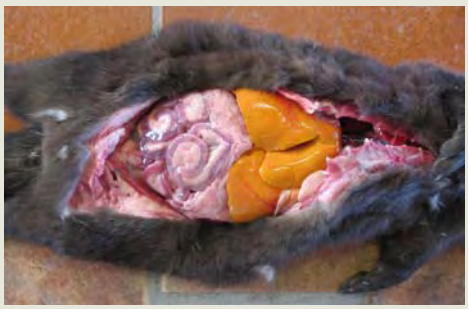


Figure 1. Dry matter and the corresponding fat content of 15 mink livers. Regression line (y = 1,1523x - 24,903; R^2 = 0,973) with 95 percent confidence interval for the regression line.

The analyzed livers split up into two groups; one with DM > 58 percent and fat > 43 percent, and one with DM < 43 percent and crude fat < 22 percent. Macroscopic appearance of the livers corresponded well to the crude fat content; all livers in the high fat group were big and yellow. A calculation based on an earlier investigation (Clausen, 1992) also showed a good relationship between liver fat and DM.

Conclusion

The results showed a very fine correlation between the dry matter and the crude fat content of the livers:
Liver fat, % = 1.15 * liver DM – 24.9 (r^2 = 0.97)
It is concluded that this method can be used for a quick, cheap and acceptably precise evaluation of liver fat content.



Mink with fat infiltrations in the liver.

Equipment used at the Research Center.

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The Effect of Protein Level on N-balance in Adult Mink (*Mustela vison*)

Carsten Hejlesen

Introduction

Basically the need for nitrogen is a requirement for maintenance and a requirement dependent on a given production.

If the requirement for maintenance is known, it is possible to (g)estimate the total requirement for a given production.

The main purpose of the present experiment was to measure N-balance in adult male mink fed decreasing levels of protein with a constant amino acid profile.

Methods

Three groups of 5 male mink were fed diets ad libitum according to table 1. The amino acid profile [1] was the same in all 3 diets (amino acids relative to lysine (%): ala 107, arg 115, asp 133, cys 22, glu 241, gly 111, his 41, ile 74, leu 163, met 59, phe 85, pro 111, ser 89, thr 70, trp 22, tyr 67 and val 100).

The experimental period was 11 days. Ingested ME and weight change were measured, whereas digested and excreted (urine- and faecal-) nitrogen were only measured in the last 4 days.

Table 1. Distribution and content of energy in the diets used in the experiment.

Percent ME from:			
Protein	14.9	19.0	26.7
Fat	54.0	53.8	52.0
Carbohydrate	31.1	27.2	21.3
DM, %	38.9	38.0	38.9
ME, Kcal/100 g	201.6	193.9	188.0

Results

Energy intake

For the entire experimental period, the average daily voluntary energy intake (ME) decreased (figure 1) as dietary protein increased, which is in accordance with obser-vations for adult cats [2] and mink [3], but also in contrast with findings for mink [4].

Weight change correlated to the intake of ME and were ÷3.6, ÷13.6 and ÷16.5 g/day in the 11 day experimental period for 14.9, 19.0 and 26.7% of ME from protein

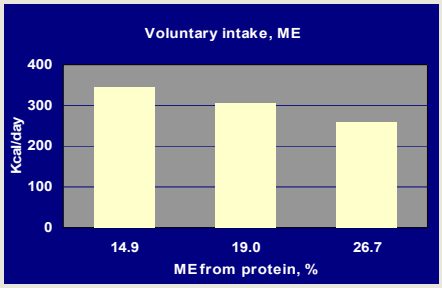

Figure 1. Voluntary energy intake (ME) in relation to ME from protein.

N-balance

The N-balance was positive for all three groups (table 2), which is in contrast to the weight loss. A discrepancy between excreted and recovered urine N has been reported [5,6]. In this experiment the recovery rate of urinary N was 93% or 86% if weight change was assumed to be either fat or muscle.

Table 2. N-balance data and weight change in g/day, in the collection period.

ME from protein,%	14.9	19.0	26.7
Digested N	1.88	2.07	2.75
Urinary N	1.64	1.99	2.60
N-Balance	0.24	0.08	0.15
Weight change	-4.4	-1.6	-8.3

Urinary excretion of N declines linearily when digested N decreases (figure 2). This applies for animals at maintenance as long as the digested quantity of N is above the requirement of the animal. That the urinary excretion of N from animals fed 14.9% of ME from protein fits well with the regression for animals fed 19.0 and 26.7 % of ME from protein indi-cates that 14.9% of ME from protein meets the animals requirement for protein (amino acids).

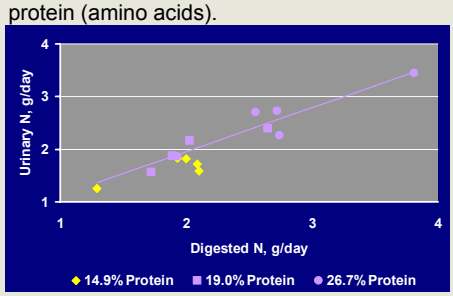

Figure 2. Urinary N excretion in relation to digested N on three levels of ME from protein. (Purple regression line is for 19.0 and 26.7 % of ME from protein.)

Oxidation of protein

When 14.9 % of ME from protein meets the animals requirement for N it implicates that oxidation of protein in % of total heat production (OXP/HE) must increase with increasing digested N.

A calculated OXP/HE did increase as digested N increased (table 3). This is in accordance to results for non productive and lactating females [7,8,9,10]. The results in this experiment however shows that the minks ability to reduce OXP/HE when protein supply is reduce is huge, as only 12% of HE was OXP on 14.9% of ME from protein.

Table 3. Oxidation of protein in percent of total heat production.

ME from protein,%	14.9	19.0	26.7
OXP/HE, %	11.7	18.7	20.6

As stated [9] a low supply of protein does require a sufficient supply of carbohydrates to maintain glucose homeostasis.

Conclusion

Voluntary intake of energy decreases with increasing dietary content of protein.

Adult male mink reduces oxidation of protein, when dietary protein content is reduced from 26.7 to 14.9% of ME.

With the used amino acid profile a diet containing 14.9% of ME from protein does fulfil the protein (amino acid) requirement of adult male mink.

In the experiment 14.9% of ME from protein corresponted to 0.85 g digestible N/kg$^{0.75}$.

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Fasting of mink kits fed different feed rations and its effect on liver fat content, plasma metabolites and enzymes

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Introduction

Earlier investigations have shown, that mink fed on a low protein diet in the furring period, tend to develop a fatty liver and increased mortality may be observed (Damgaard et al., 1994; 1998a & 1998b). Shavila et al. (1994 & 1996) likewise found that liver fat, plasma metabolites and enzymes in ferrets were influenced by feed composition. Further Biourge et al (1994b) found that the response to fasting, in liver fat content and plasma metabolites were dependent on the prior feeding history of cats. An increased fasting period also results in increased liver fat in mink (Clausen, 1992) and cats (Biourge et al, 1994a). This investigation was carried out to test the following hypothesis:

- Fasting results in metabolic adjustments, leading to fatty liver.
-The period from onset of fasting and until the appearance of these changes, will be related to the pervious feeding history.

Methods

From mid September until pelting two groups each consisting of 20 male mink kits were given feed with an energy distribution (protein : fat : carbohydrate) of either 30:52:18 (HP) or 18:58:24 (LP). Two other groups FC and F48 with 40 vs. 20 male mink kits had feed from the local feed kitchen (33.7:48:18.3).
At pelting 15 male mink kits from HP and LP groups were fasted 12 hours before they were euthanized with Pentobarbital-Na, and 5 male mink kits from groups HP and LP were fasted 48 hours before euthanatizing. Kits from group FC had access to feed until they were euthanized, kits from group F48 were fasted 48 hours before euthanatizing.

The HepatoSomatic Index (HSI) was calculated as liver weight in percent of body weight. Liver fat content (LFC) was calculated according to Clausen & Sandbøl (2004).
Blood plasma samples were taken for determination of different enzymes and plasma metabolites. Results from these are shown in the manuscript.

Results and discussion

The HSI in the F48 group was significantly lower and LFC significantly higher as compared to the FC group (table 1).
There was no difference in HSI or LFC between the HP and LP groups after fasting for 12 hours. After 48 hours the LP group had significantly lower HSI and higher LFC values (table 2). For both groups, fasting for 48 hours compared to 12 hours significantly increased the liver fat.
The changes in HSI and LFC over time corresponds with the earlier results of Clausen (1992) and that of HSI also to the observations of Bjornvad et al. (2004), The significantly higher LFC in the LP group after 48 hours corresponds to the observations of Biourge et al. (1994b).

Table 1. HepatoSomatic Index (HSI) and Liver Fat Content (LFC) in mink feed the same ration, either not starved or starved for 48 hours.

Group	n	HSI	LFC *
F48	40	2.13 (0.22) B	13.4 (3.6) A
FC	20	2.57 (0.24) A	7.14 (1.5) B
P-value		< 0.0001	< 0.0001

*** Liver fat content (%) = 1.15 * liver dry matter – 24.9 (R2 = 0.97)**

This could explain why we often see a higher number of animals dying from fatty liver infiltration in groups of mink fed very low amounts of protein (Damgaard et al, 1994, 1998a & 1998b).
A lower amount of fat accumulation in the livers of HP animals vs. LP animals after 48 hours of fasting, could be due to a higher amount of amino acids in the liver at start, due to which the production of lipoproteins in the liver could be maintained at a higher level for a longer time (Biourge et al, 1994b). Earlier investigations (Sandbøl et al, 2003) of livers from mink fed different protein levels showed that the higher relative liver weight was due to an increase in liver cells caused by accumulation of protein.

Conclusion

Fasted vs. fed mink kits reduced the relative liver weight and increased the liver fat percent. If mink kits fed a low amount of protein fasted for 48 hours, they developed a fat infiltration in the liver faster than mink fed a high amount of protein, probably due to a lower reserve of amino acids in the liver.

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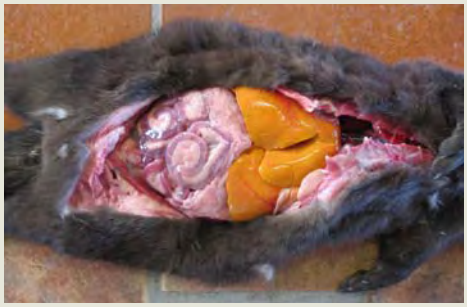


Mink with fat infiltrations in the liver.

Table 2. HepatoSomatic Index (HSI) and Liver Fat Content (LFC) in mink fed different rations, starved for 12 and 48 hours.

Group	n 12/48	HIS of mink fasted		LFC * of mink fasted	
		12 hours	48 hours	12 hours	48 hours
HP	15/5	2.20 (0.26)	2.05 (0.15) A	9.0 (1.9) # 1)	13.4 (5.0) A # 1)
LP	15/4	2.05 (0.28)	1.84 (0.07) B	9.4 (2.5) # 2)	21.9 (4.8) B # 2)
P-value		NS	0.04	NS	0.04

*** Liver fat percent = 1.15 * liver dry matter – 24.9 (R2 = 0.97)**
 # significant difference from 12 to 48 hours; 1) 0,009 2) < 0,0001;
no significant difference in HSI from 12 to 48 hours.

Collection and storage of urine in N-balance trials with mink

Sanne Lisbjerg

Introduction

Traditionally the urine is collected daily and stored frozen until analysis in N-balance trial with mink.

The purpose of this trial was to evaluate if 1 collection for a period of 4 days, preserves the N-amount in the urine.

Furthermore it has been evaluated how pH and N-percent in urine is affected by storage temperature, -time and sulphuric acid preservation.

Materials and methods

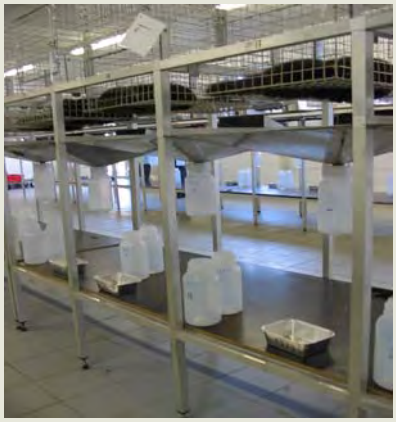
Trials have been performed with urine collected in bottles with sulphuric acid (A) and urine collected in bottles without sulphuric acid (B). In both trials the urine was collected from adult males, fed ad libitum.

Trail A

From 5 animals urine and spillage from drinking water was collected during 24 hours in bottles containing 15 ml of sulphuric acid (5% v/v). The urine from each animal was split into three bottles. 1 was analysed for pH and N percent immediately after collection (day 0) and the last 2 after storage in 4 days at 15°C and at ÷18°C respectively, simulating two different methods of urine collection.

Trial B

During a period of 10 hours the urine from 7 animals were collected in bottles without sulphuric acid. Spillage from the drinking water was separated from the urine. The urine from the 7 bottles were mixed and then split into 2 bottles - in 1 bottle sulphuric acid (5% v/v) was added. Each of the 2 bottles were split into 3 bottles, 1 of each was analysed for pH and N percent immediately after collection (day 0) and the last 4 after storage in 3 days at 5°C and 19°C respectively.



Digestibility cages for urine collection

Table 1. N percent and pH in urine with and without sulphuric acid collected in 10 hours and there after stored 72 hours either at 5°C or 19°C (trial B).

Sulphuric acid added	Storage time after collection	Temperature, °C	N %	pH
No	0h	-	2.9	7.2
	72h	5	3.0	8.9
	72h	19	2.9	9.5
Yes	0h	-	2.4	1.4
	72h	5	2.4	1.5
	72h	19	2.4	1.4

Results and discussion

The variation in urine and spillage of drinking water in trial A basically caused the different in the urinary N percent (figure 1). The urinary N percent was unaffected either by time or temperature. The N percent in trial B was higher than in trial A, due to the separation of the spillage from the drinking water. There was an increase in urine-pH, without sulphuric acid, after storage at 5 °C and 19 °C respectively (table 1). There was no change in urinary N percent or pH with time, temperature and of storage when containing sulphuric acid.

During the collection period faeces was collected every day. But it can not be excluded that during a period of 4 days there might be a contamination of the urine with faeces.

As faeces contain a certain amount of urease, there is a risk that ammonia is produced, even though the N percent in urine without sulphuric acid not was affected by time of storage or temperature in this trial, added acid will bind the ammonia.

Conclusion

When performing N-balance trials, the N percent in urine is preserved when collected once in a period of 4 days as well as a daily collection followed by freezing. However sulphuric acid (5% v/v) should be added to the collection bottles.

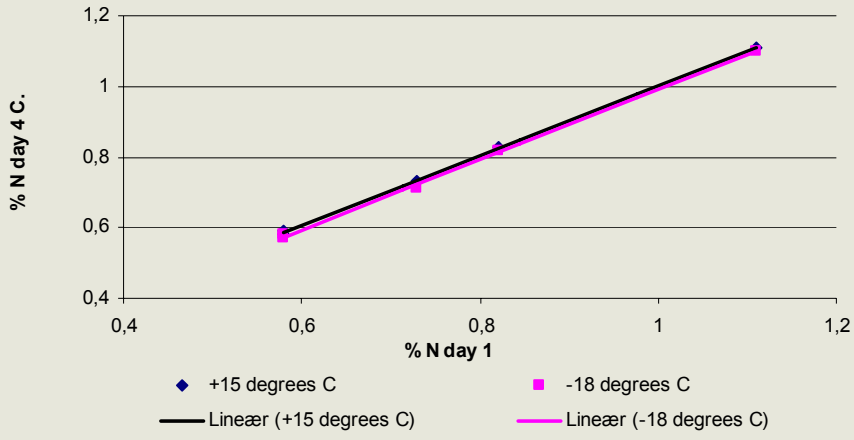


Figure 1. N percent in urine with sulphuric acid collected in 24 hours and there after stored 4 days either at 15°C or ÷18°C (trial A).

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Effect of acids in feed on pH in mink urine

Sanne Lisbjerg

Introduction

Diseases in the urinary tract/bladder stones is observed in a large number of dead mink kits in June/July [5]. To reduce the risk of urinary stones, the pH in the urine ought to be between 6.0 and 6.6 [1].

To evaluate the effect on urine-pH by adding acids to the feed, a screening with different acids/acidifiers in different levels has been performed.

Materials and Methods

90 adult males mink of the colour type Brown/Glow were used.

The basic feed which also was control feed was split into 6 groups (diets), where six different acids/acidifiers were added in different levels and pH was measured in all feeds (table 1).

Diet allowance was 400 kcal of metabolizable energy (ME) per day/animal.

The general trial period was 7 days but with Benzoic Acid it was 12 days.

Immediately after collection the urine was weighed and pH was measured (WTW pH330i SET/VWR International). Spillage from the drinking water was separated from the urine.

Results

Acids/acidifiers reduced the pH in all feed mixtures apart from two (table 1). The measured urine-pH generally was lowered with increasing addition of acid, but compared to the control group there was no effect when using Succinic Acid, level 1 and Glutaric Acid, level 1 and 2 (figure 1).

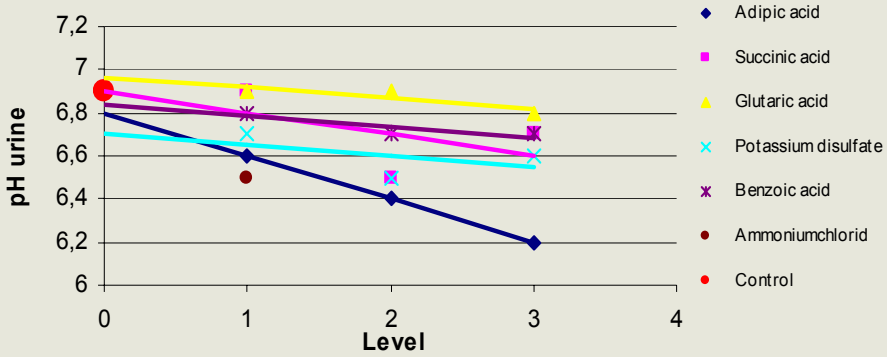

Figure 1. pH measured in urine per acid and level.

Compared to the control group the feed intake was reduced with increasing addition of Succinic Acid, Glutaric Acid, Potassium disulfate and Ammoniumchlorid to the feed. In spite of this the total intake of acid increased with increasing addition of acid.

Discussion

Compared to the control group the most markedly decrease in urine-pH was found by using Adipic Acid in all three levels, Succinic Acid and Potassium disulfate in level 2 and 3 and Ammoniumchlorid.

Using Benzoic Acid[6] in all three levels gave a marginal decline in urine-pH (figure 1).

The use of Ammoniumchlorid in feed for mink kits have in previous trials shown that pH in the urine was reduced, but there was a decline in the growth when adding Ammoniumchlorid daily [2, 3, 4].

In the collection period the urine-pH increased as a result of lower feed intake over time. When a correction for feed intake has been made, the urine-pH was not influenced by time in the tested acids/acidifiers.

As a result of diarrhoea, addition of 1.0 and 1.5% Potassium disulfate should not be used to lower pH in urine

Conclusion

By this screening of six acids/acidifiers added to the feed, the pH in the urine was lowered in all groups. Furthermore it can be concluded that Adipic Acid was the acid that lowered the urine-pH most, when corrected for feed intake.

The 3 levels of Adipic Acid reduce the urine-pH to a level that ought to prevent the development of urinary stones (Struvite Stone).

Table 1. Levels of Acids/Acidifiers (% of Wet-Feed) and pH in the feed.

Acid \ Level	1		2		3	
	%	pH	%	pH	%	pH
Adipic Acid	0.17	5.7	0.34	5.6	0.51	5.4
Succinic Acid	0.17	5.7	0.34	5.5	0.51	5.3
Glutaric Acid	0.17	5.7	0.34	5.5	0.51	5.3
Potassium disulfate	0.50	5.6	1.00	5.3	1.50	5.1
Benzoic Acid	0.05	6.0	0.10	5.9	0.15	5.8
Ammoniumchlorid	0.35	6.0	-	-	-	-
Control Feed	0	6.0	-	-	-	-

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An objective method to determine fur-priming in mink

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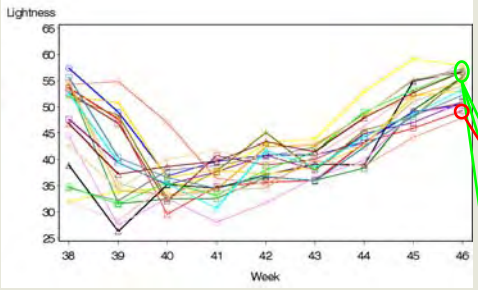
Photometry is an objective method to determine fur-priming in mink

In mink production it is important to pelt the mink at the optimum time i.e. when the winter pelage is mature and before the mink begins to loose bodyweight. Today no objective methods are available for the farmers to determine fur-priming in mink.

A portable spectrophotometer (Techkon SP 820λ) is used to measure skin lightness of 20 brown male mink once a week in the period from September 13th to November 8th.

Photometric measurements of skin lightness mirror winter pelage cycle

Photometric measurements of skin lightness on the loin



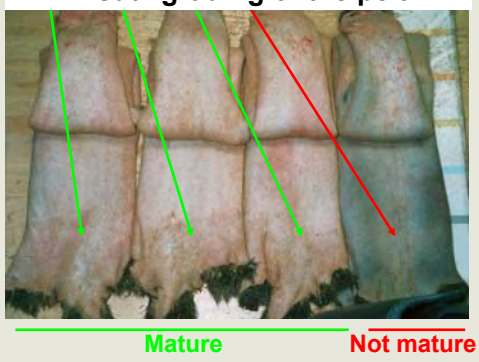
Skin lightness is measured by positioning the measuring head of the spectrophotometer on a manually prepared parting of the fur made on and in parallel with the backbone line. Measurements is done on two localities i.e. the loin and the neck and the figure show the skin lightness on the loin.

The skin is light before the winter pelage cycle begins and again when pelage cycle is completed. During the pelage cycle the skin has a darker colour.
Skin lightness decreased from week 38 to week 40 and increased from week 40 to week 46, which is in accordance to the change in skin colour during the pelage cycle.

Positive correlation between photometric measurements of skin lightness on live mink and visual pelt grading after pelting

After pelting the colour on the skin side of the pelt was visually graded in the neck and loin region. Based on the visual grading the pelt was classified as mature or not.

Visual grading of the pelt



Mink with the lowest skin lightness at the loin in week 46 were visually determined not to be mature and mink with the highest lightness in week 46 were visually determined to be mature, which indicate a positive correlation between photometric measurements of skin lightness and the visual grading after pelting.

Fasting of male mink after mating and its influence on liver fat content and blood ketone bodies

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Introduction

Earlier investigations at pelting have shown that liver fat content is dependent on the feed used (Clausen & Sandbøl, 2005; Clausen et al., 2007b; Damgaard et al., 1998a; Damgaard et al., 1998b; Damgaard et al., 1994). Liver fat content also depends on how long before investigation the mink is fasted (Clausen & Sandbøl, 2005; Clausen et al., 2007a; Clausen, 1992; Bjørnvad et al., 2004; Mustonen et al., 2005). In cats, liver fat infiltration also increases with increasing fasting time (Biourge et al, 1994). Both in cats with IFHL (Idiopatisk Felin Hepatisk Lipidose) (Pazak et al, 1998) and in cats with fasting induced fat infiltration in the liver (Biourge et al, 1994) there is a high content of ketone bodies (β-hydroxybutyrate) in the blood. In mink there also seems to be a higher blood ketone concentration when the liver fat percent is high (Clausen et al., 2007a; Clausen & Sandbøl, 2005).
The purpose of this investigation was to evaluate whether fasting male mink in normal body condition right after mating, can provoke a fat infiltration in the liver, and whether there is a correlation between liver fat content and blood ketone bodies.

Methods

We used 98 brown mink males right after mating. The males were body scored ad modem Rouvinen (Hynes et al., 2004) before and after mating. After mating they were fasted for 0 – 12 – 24 – 36 – 48 – 60 or 72 hours before they were euthanized. The animals were weighed and blood samples were taken to measure ketone bodies (β – hydroxy-butyrate) (PTS Panels Ketone Test Strips for use with CardioChek Brand Analyzer). The liver was weighed and Hepatosomatic Index HSI calculated (liver weight in percent of body weight). Liver samples were analysed for dry matter content and liver fat percent calculated according to Clausen & Sandbøl (2004). Liver fat content (%) = 1.15 * (Liver dry matter) – 24.9 (R2=0.97).

Results and discussion

The males gained weight during mating from body score 2.4 on Marts 3rd, to 3.0 on Marts 20th.
The HSI (Table 1) decreased within the first 24 hours of the fasting period, probably due to depletion of reserves of glycogen and labile amino acids, thereafter it remained constant for the rest of the period. Compared to males at pelting (who are very fat) the HSI is high in all groups (Clausen & Sandbøl, 2005).
There was no difference in liver fat percent after fasting up to 72 hours (Table 1). This does not correspond with results from fat mink males at pelting, were an increase in fasting time increase fat infiltration in the liver (Clausen & Sandbøl, 2005). In cats we also see an increased liver fat infiltration after fasting, but only in fat cats (Biourge et al, 1994), and the disease IFHL is only seen in cats with a history of obesity (Blanchard et al, 2004).
Fat mink males at pelting is probably in another physiological condition than lean males after mating. If the males are divided in groups based on body score on Marts 20 (Table 2) it is seen that fat males (body score = 4) had a lower HSI and a higher liver fat content than males with body score 2 or 3.
There is a significant difference between groups in blood keton body concentration (Table 1). After fasting 24, 48, 60 and 72 hours blood ketone increase compared to 0 or 12 hours, this probably is due to an increased catabolism of fat.
In cats with IFHL and in cats with fasting induced fatty liver (liver fat 31 %) there is an increase in blood ketone concentration (β-hydroxybutyrate) (Pazak et al, 1998; Biourge et al, 1994). There was no correlation between blood ketone concentration and liver fat content in this investigation. In all samples the liver fat percent was much lower than in previous investigations (Clausen & Sandbøl, 2007).

Conclusion

Fasting up to 72 hours of male mink with normal body score right after mating, gave a reduction in relative liver weight within the first 48 hours. There were no change in liver fat percent after fasting, but fat male mink, had the highest fat content in the liver. The blood content of ketone bodies increased after 24 hours of fasting, due to an increase in fat catabolism.

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Fasting time, hours	HSI, %	Liver fat percent	Ketone bodies, mmol/l
0	3,54 (0,42) A	5,22 (1,28)	0,34 (0,08) C
12	3,28 (0,32) AB	5,50 (1,32)	0,36 (0,08) C
24	3,14 (0,35) B	6,07 (1,55)	0,49 (0,17) A
36	3,12 (0,45) BC	5,97 (1,67)	0,39 (0,10) BC
48	2,80 (0,44) C	6,91 (1,77)	0,51 (0,20) A
60	2,95 (0,51) BC	5,72 (2,02)	0,46 (0,10) AB
72	3,01 (0,52) BC	5,69 (1,61)	0,48 (0,12) AB
p-value	0,0008	NS	0,001

Table 1. Relative liver weight (HSI), liver fat percent and blood content of ketone bodies (β – hydroxybutyrate), mmol/l.

Body score	HSI, %	Liver fat percent	Ketone bodies, mmol/l
2	3,31 (0,50) A	5,68 (2,18) B	0,45 (0,10)
3	3,15 (0,45) A	5,74 (1,53) B	0,44 (0,15)
4	2,64 (0,39) B	7,24 (0,81) A	0,40 (0,11)
p-value	0,004	0,03	NS

Table 2. Males divided in groups based on body score on Marts 20.

Adipic Acid and Benzoic Acid for Mink in the Growing Period

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Introduction

Urinary infections can be a big problem in mink farms. Especially in June and July, we find infections in the bladders of very fast growing male kits. They eat a lot of feed and thereby have a high excretion of waste products in the urine. Most often the problems stop when we start to use fish silage in the feed. The mineral acids from the fish silage are excreted in the urine, and thereby the urinary pH is lowered, crystals, if any, are dissolved and the growth of bacteria is restrained. I is recommended that the urine pH should be in the range between 6.0 and 6.6 (Case et al, 1995).

From the time when the kits start to eat and until silage is added to the feed, there might be a problem with bladder infections.

Addition of ammonium chloride lowers the urine pH, but using it daily in too high amounts might reduce feed intake (Clausen, 2000).

Adding other kinds of acids that do not influence the taste of the feed in a negative way, could be interesting.

A pilot study in the N-balance stable showed, that addition of adipic acid or benzoic acid might be a possibility (Lisbjerg, 2005).

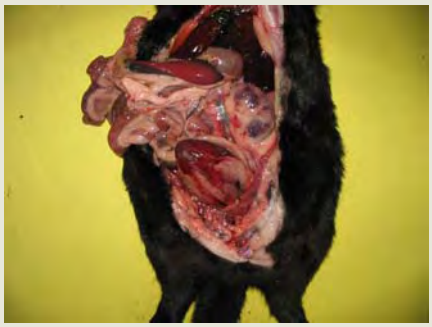
Methods

To this investigation we used three groups of siblings with 55 black male mink kits in each group.

The investigation started on July 11 and one group (CON) got control feed, one group (ADP) got feed added 0.34 % adipic acid and the last group (BEN) got feed added 0.1 % benzoic acid.

The kits were weighed on July 8, August 1, September 1, October 6 and at pelting.

Urine samples (spot-urine) were taken on July 7, July 27, August 30, October 4 and December 12.



Bladder infection in a mink kit

At pelting 15 male kits from each group were examined (siblings). Blood samples were taken for acid-base determination to see if feeding big amounts of acids had any negative consequenses for the animals. The percentage of fat in the liver was determined.

Results and discussion

The weight of the male mink kits are seen in figure 1. The ADP group had a higher weight gain than the other groups from July until pelting. Also the length of the skins were better in this group. In colour, quality, density and silky skin there were no differences. However there was a difference in the number of skins with metallic, so that CON, ADP and BEN had 13.5, 6 and 0 % skins with metallic respectively.

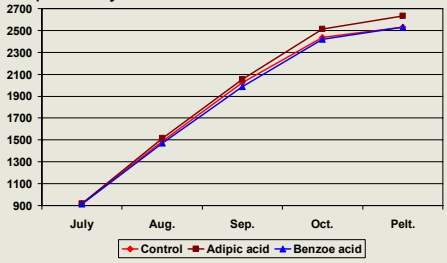


Figure 1. Weight gain during the growing period.

Only a few kits died during the growing period, Table 1. However 2 kits in the ADP group had diseases in the bladder (in August and October). By autopsy at pelting we found no abnormalities in the groups.

	Number of dead kits
CON	1
ADP	5
BEN	0

Table 1. Number of dead kits in the growing period. In the ADP group there was one kit with inflammation of the bladder, one kit with bladder stone and one kit with enlarged fatty liver.

The results of the pH measurements of the urine can be seen in figure 2. After three days there were no differences between the groups, then ADP lead to a lowering of the urine pH apart from December 2, where we saw no statistically significant difference. BEN lead to a slight lowering of the urine pH on July 27, but later measurements showed no statistically significant difference from the control group.

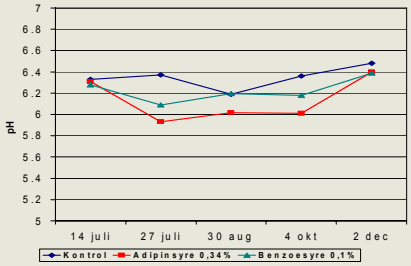


Figure 2. Urine pH during the growing period.

Some of the results of the blood samples are shown in table 2. There were no differences in the acid base balance between groups (not shown), and all values were within the normal range. Addition of these acids to the feed during the growing period had no negative effect on the acid-base balance of the kits.

	Hct	Hb	pH	Na	K
	%	mmol/l		mmol/l	mmol/l
CON	48.1	16.3	7.38	146	3.3
ADP	47.6	16,0	7.38	145	3.8
BEN	47.9	16.3	7.39	145	3.3

Table 2. Results of blood samples (15 per group) taken at pelting. Hct is hematocrit, Hb is hemoglobin, Na is natrium, K is kalium.

There were no differences between groups in the liver fat content or the relative liver weight.

Conclusion

Addition of adipic acid 0,34% or benzoic acid 0,1% in the feed for mink kits during the growing period, did not influence acid-base balance of the animals at pelting. Adipic acid gave longer skins than control kits without addition of acid and kits with benzoic acid in their feed. Compared to the control group adipic acid lowered the urine pH and benzoic acid only caused a limited, but not lasting lowering of the urine pH. In the adipic group there were most dead kits. Further investigations of adipic acid in the early growth period, is necessary before the product is recommended for use.

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Sodium-Bisulfate and Ammonium Chloride for Mink in the Growing Period

Tove N. Clausen, Peter Sandbøl & Carsten Hejlesen

Background

Over the years we have tested the addition of various acids and other compunds to the mink feed for their ability to lower the urinary pH, and thereby prevent cystitis and urinary calculi.

Urinary pH should preferably be in the interval of 6.0 to 6.6 (Case et al, 1995).

In the present trial we tested the long term effect of adding 0.5 % Na-bisulfate or 0.2 % ammonium chloride during the growing period.

Methods

We used three groups of full-siplings each of 47 male kits of the colour type Scan Black.

The trial was initiated on July 3rd and one group (CON) was fed control feed, one group (NABI) was added 0.5 % of Na-Bisulfate and one group (AMM) was added 0.2 % of ammonium chloride.

The kit were weighed July 3rd, once per month and at pelting.

Urinary spot samples were collected once monthly.

Results and discussion

Weight development is shown in figure 1. We did not find any difference between the groups. Addition of the two products in the concentrations applied, did not have any negative influence on kit weight gain.

There was no difference between groups with regards to skin length and quality.

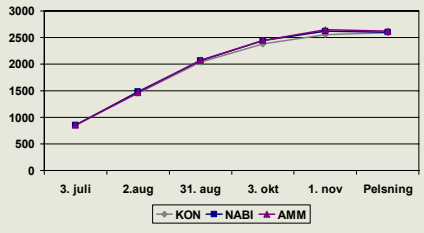
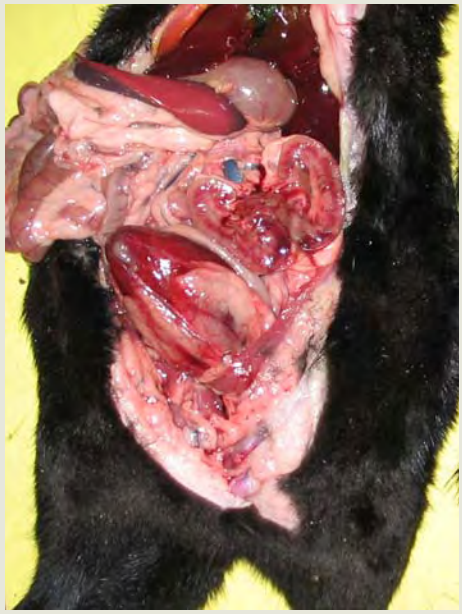
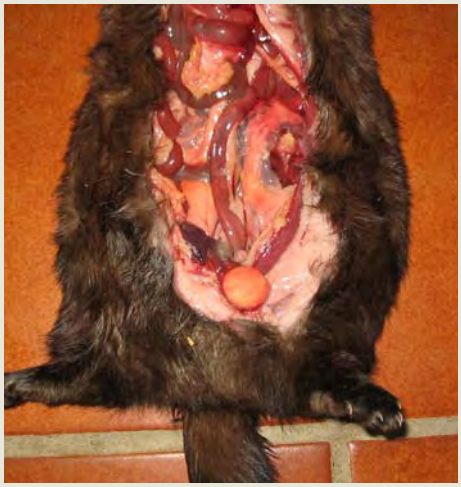


Figure 1. Weight development during the growing season.



Cystitis and nephritis in a mink kitp



Urinary and kidney calculi in a mink dam

Only few kits died in the trial groups during the growing season (table 1). In the CON group one died from cystitis and one from kidney calculi

Table 1. Kit mortality in the trial groups. (In group CON one kit had cystitis and one had kidney calculi.

	Dead kits, n
CON	4
NABI	2
AMM	1

Results of the pH measurements in spot urine are shown in figure 2. For all groups urinary ph increases during the growing period. NABI is generally about 0.3 units below the CON group (except 30th of November). AMM is very variable - at three out of five measurements it is below the CON group.

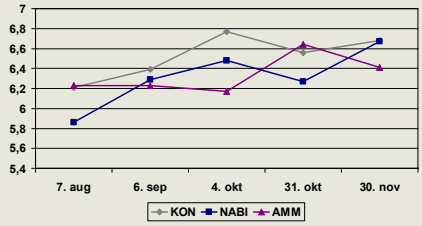


Figure 2. Urinary pH during the growing period.

Conclusion

The application of 0.5 % Na-bisulfate and 0.2 % ammonium chloride had no effect on kit weight gain, skin length, quality, colour and clarity. 0.5 % of Na-bisulfat gave a drop in urinary pH in comparison with the control group. Ammonium chloride gave a non-consistent drop.

Reference

Case, L.R., Carey, D.P & Hirakawa, 1995. Canine and feline nutrition. Cap. 32. Feline lower urinary tract disease. Mosby. 357-371.

Sodium-Bisulfate, Ammonium Chloride, Benzoic and Adipic Acid in the feed for 28 – 52 day old mink kits

Tove N. Clausen, Peter Sandbøl & Carsten Hejlesen

Background

Urinary pH should preferably be between 6.0 and 6.6 to avoid crystal formation (Fig. 1) and thereby urinary calculi (Case et al, 1995).

In the present trial we tested the effect of ammonium chloride, Na-bisulfate, benzoic acid or adipic acid on urinary pH when added to the feed in the early growing period.

Methods

We used 5 groups of each 21 litters of Scanblack mink kits. The trial groups are shown in table 1. The trial was carried out when the kits where 28 to 52 days old.

The kits were weighed at the beginning and the end of the trial period and spot samples of urine were collected on the 19th and 20th of June.

Table 1. Trial groups from day 28 to 52.

Group	Treatment	Litters, n
CON	Control (45:40:15)	21
ADP	CON + 0.34 % adipic acid	21
BEN	CON + 0.1 % benzoic acid	21
AMM	CON + 0.2 % ammonium chloride	21
NABI	CON + 0.5 % Na-bisulfate	21

Results and discussion

Weight gain from day 28 to day 52 is shown in figure 2. There was no significant difference between the treatments. In other words, addition of the used products in the present concentrations did no have a negative influence on the weight gain of the kits.

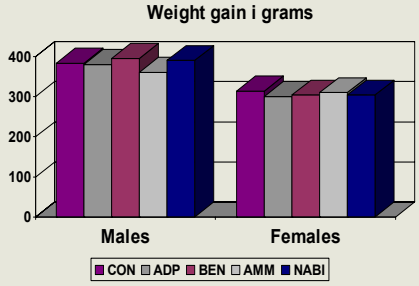


Figure 2. Weight gain from day 28 to day 52.

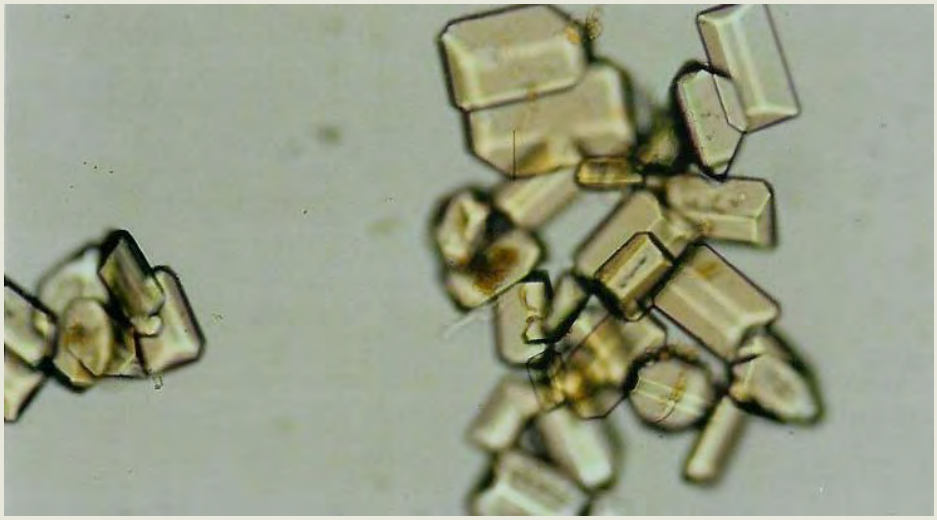


Figure 1. Struvite crystals in a urine sample

Urinary pH is shown in table 2. Benzoic acid at 0.1 % did not lower the urinary pH in comparison with the control group, whereas 0.34 % of adipic acid resulted in a significantly lower urinary pH.

Table 2. Urinary pH 19th-20th of June .

Group	Urinary pH, 19th-20th of June
CON	6,9 A
ADP	6,6 B
BEN	6,8 A
AMM	6,4 C
NABI	6,2 C

Different letter in the columns shows stat. sign. difference between groups (p< 0,0001)

The results correspond with earlier results from the growing period (Clausen et al., 2007), were adipic acid also lowered urinary pH, whereas benzoic acid gave a limited and not lasting drop in pH. 0.2 % of ammonium chloride gave a significant drop in urinary pH from 6.9 in the control group to 6.4, supporting earlier trials with addition of ammonium chloride (Clausen og Damgaard, 1999), where a larger drop in urinary pH was found with increased addition of ammonium chloride. Na-bisulfate resulted in the largest drop in urinary pH in comparison to the control group.

0.4 – 0.6 % Na-bisulfate has been tested in the USA to lower the urinary pH and as much as 1 % has been added in trials without any apparent effect on feed intake (Leoschke, 2004).

Conclusion

Benzoic acid (0.1 %) did not result in a lower urinary pH in comparison with the control group, whereas adipic acid (0.34 %) resulted in a significant drop. Ammonium chloride (0.2 %) and Na-bisulfate (0.5 %) were those of the tested products which gave the significantly largest drop in urinary pH in the early growth period, without any negative influence on weight gain.

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Feed with different energy distribution to mink kits from July to mid September

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Introduction

Investigations on the energy distribution in the feed for mink kits in the whole growing furring period has shown that 24 – 29 % of the metabolizable energy from protein (ME) results in the longest skins, whereas 29 - 34 ME from protein gives the best skin quality. Later it has been shown that a reduction in ME from 29 to 24 in middle September gives skins with the same length and quality as 29 ME from protein in the whole growing period, no matter if the energy from protein is replaced by carbohydrate or fat energy. (Clausen et al., 2006; Hejlesen & Clausen, 1999; Hejlesen & Clausen, 2000; Hejlesen & Clausen, 2001).

The main purpose of this investigation was to evaluate the effect of energy distribution on kit growth in July. The feeding was continued to observe any long term consequences of the different trial feed.

Materials and methods

We used 14 groups of each 112 brown male- and female kits. The kits were fed investigation feed from July 3 to September 15. Thereafter all groups were given feed from the local Feed Kitchen. The amount of ME from protein varied from 26 – 32 percent, the amount of ME from fat varied from 44 – 59 percent and carbohydrate varied from 15 – 27 percent of ME (Table 1).

Energy distribution
32:53:15
32:50:18
32:47:21
32:44:24
29:56:15
29:53:18
29:50:21
29:47:24
29:44:27
26:59:15
26:56:18
26:53:21
26:50:24
26:47:27

Table 1. Investigation groups in the early growth period

Results and discussion

The body weight increased from July 3 to August 2 was dependent of the interaction between the amount of energy from protein, fat and carbohydrates (Figure 1). Thus, the body growth was reduced when ME from protein and fat was reduced and when ME from carbohydrates increased. The amount of ME from protein in July should be at least 32 %, the amount of fat 53 to 56 % and the amount of ME from carbohydrates not more than 18 %, to get the best body growth in July.

Skin length and fur quality was dependent of the carbohydrate content in the feed in July. Skin length was reduced with increasing ME from carbohydrates. Fur quality was good when mink kits were fed 27 ME from carbohydrates, but the skins were short (Table 2).

Table 2. Importance of carbohydrates for skin length and fur quality.

% ME from carbohydrates	Skin length, cm	Quality *
15	88.4 (4.0) A	6.5 (2.6) AB
18	88.1 (3.6) AB	6.8 (2.5) A
21	88.1 (4.1) AB	6.5 (2.3) AB
24	87.7 (4.0) BC	6.2 (2.4) B
27	87.1 (4.3) C	6.8 (2.6) A
p-value	0.004	0.02

* 1 – 12. 12 best quality.

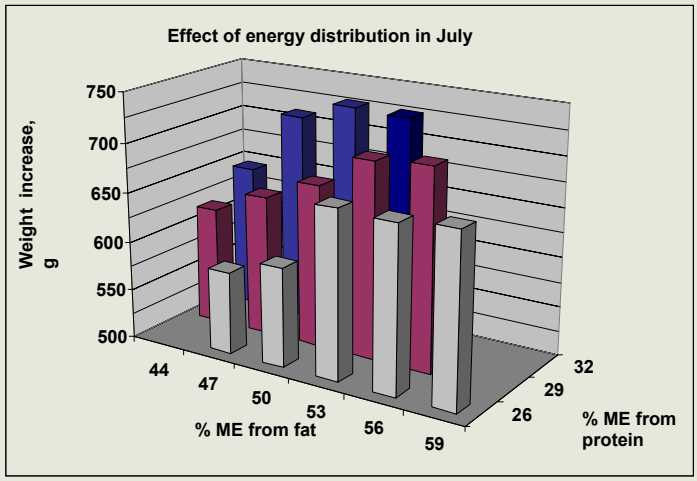

Figure 1. Body weight increased from July 3 to August 2

Conclusion

To achieve the best growth in July the amount of energy from protein should bee at least 32 percent, the amount of energy from fat should be from 53 to 56 percent and carbohydrate should not exceed 18 percent of ME in that period. Within these levels we also saw the longest skins and the best fur quality. It is still to be seen how the kits will respond to a higher protein content in July and witch energy distribution is the best from August to September.

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Iodine requirement for mink (*Mustela vison*)

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Introduction

Toxic levels of iodine in mink diets has been investigated [1,2,3]. The iodine requirement of mink has not been determined experimentally.

Recent trials with dogs[4] and cats[5] indicate that a simple balance study may be used to estimate the requirement. The hypothesis is that faecal iodine is independent of intake and that there is a positive correlation between intake and renal loss. A trial was set up with adult male mink, in order to estimate the iodine requirement for maintenance.

Materials and methods

Five male mink per group were used in two studies. 1) The pilot study should clarify: A) if the mink were willing to eat the iodine containing diets to be used in the balance study, and B) could the content of iodine in the diets, faeces and urine be analyzed. 2) The balance study should clarify the requirement of iodine to adult mink.

The balance study consisted of 5 periods of each 6 days of adaptation and 24 hours quantitative urine and faeces collection. For each new period increasing levels of iodine was added to a so-called synthetic diet[6] (Table 1).

Table 1. The dietary content of iodine (I) in the balance study

Period	I	II	III	IV	V
I, µg/100kcal	25	75	125	175	225

Feed consumption was registered daily. On day 7 the animals were weighed before feeding.

Results

Pilot study

Renal iodine excretion depended on the intake (Figure 1). The mink ate sufficient of the diets, and the methods for analysis gave reliable results in respectively diet, urine and faeces within the levels used.

Balance study

Due to analytical problems, iodine intake is based on calculated feed content (Figure 2)

Extrapolating the linear regression to zero feed intake gives a renal excretion of 21.2 µg iodine/kg0.75/24 hours. The average faecal excretion of iodine is 3.7 µg/kg0.75/24 h, resulting in an estimate of mink's iodine requirement for maintenance as 24.9 µg/kg0.75/24h. The surrounding temperature was 15.9°C.

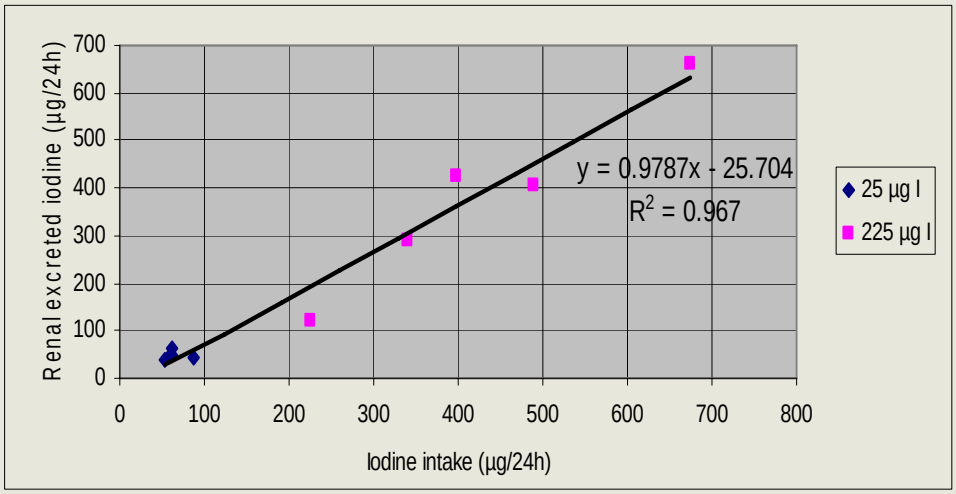

Figure 1. Renal excreted iodine as a function of dietary intake (Pilot study).

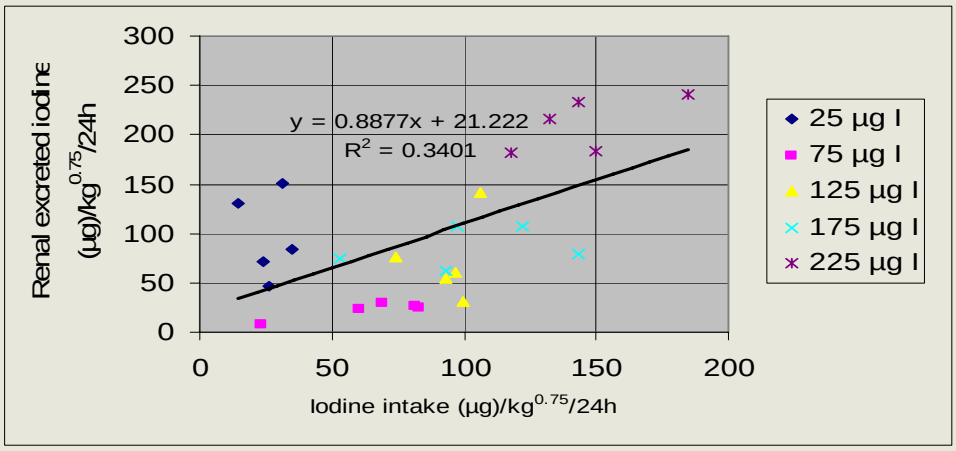

Figure 2. Renal excreted iodine as a function of calculated dietary intake (Balance study).

Discussion

The variable dietary intake may be due to the low pH in the diet (below 5.5). Some samples were below the detection limit (0.2 ppm of iodine). Consequently, we used the calculated intake to estimate the requirement, which is relatively close to the requirement of cats at 20 µg iodine/kg0.75/24h[5]. Conversion of the requirement to ppm, gives a value of 0.2 ppm of iodine, similar to the recommendations from 1962[7]. A requirement of 0.2 ppm is much lower than the toxic levels found earlier[1,2]. Their lowest concentration in the diet was 10 ppm. This is 50-fold more iodine than the present estimated. However, no reduction in reproduction was observed at this level. At 20 ppm of iodine (100 times the norm) negative effects were observed with long-term feeding. This indicates a high iodine tolerance, before the intake gets toxic.

Conclusion

In spite of analytical problems with the diet, we estimated an iodine requirement for maintenance of 24.9 µg/kg0.75/24h. With an improved analysis, the experiment should be repeated to achieve a more valid estimate.

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Sodium to mink throughout the year

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Introduction

Salt (sodium chloride) is very important for the health of the animals. If they do not get a sufficient amount of sodium (Na) they will reduce their feed consumption and loose body weight, plasma aldosterone and packed cell volume will be elevated, and urinary sodium excretion will be reduced (Yu & Morris, 1999). Consumption of too high amounts of Na likewise decrease feed consumption and body weight. Further the animals get a dark diarrhoea, rough coat, crusty nose and eyes, irritability in the early stage, and lethargy in the later stages. (Restum et al., 1995). In the nursing period we usually add sodium chloride to the feed to prevent nursing sickness (Clausen et al., 1996; Clausen et al, 2002; Hartsogh, 1960). A change in feed raw materials from animal by-products to more vegetable products, where the content of Na is often very low, has made it necessary to reconsider the Na content in mink feed throughout the year.

Materials and methods

Adult male mink

The investigation was carried out from April 11 to April 18. Four groups of 5 brown male mink were feed synthetic feed with different Na content (Table 1).

Table 1. Added NaCl and analysed Na content in the feed for adult male mink

Added, % NaCl	0	0.05	0.10	0.15
Analysed, Na g /100 kcal	0.017	0.037	0.057	0.059

Kits in early growth

Nine groups of 20 litters of black mink kits were included in the experiment from 6 to 10 weeks of age. Raw materials with a very low Na content was chosen for the experimental feed. The experimental feed was added increasing amounts of NaCl (Table 2).

Table 2. Added NaCl and analysed Na / NaCl in the feed for mink kits in early growth.

Added % NaCl	0	0.05	0.1	0.3	0.6	0.9	1.1	1.3	2.3
Analysed g Na / 100 kcal	0.028	0.042	0.052	0.105	0.193	0.269	0.341	0.396	0.732
Analysed g NaCl/100 kcal	0.07	0.11	0.13	0.27	0.49	0.68	0.86	1.00	1.85

Results and discussion

Adult male mink

There was no significant difference in bodyweight between the groups. In all groups there was a decrease in body weight during the experiment probably due to bad taste of the synthetic feed (Table 3).

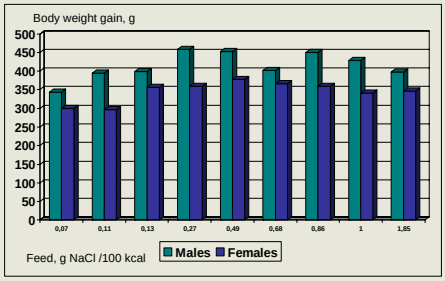
Table 3. Body weight increase and feed consumption in adult male mink feed different amounts of Na.

Consumed g Na / kg body weight / day	Body weight increase in the investigation period, g	Average daily feed consumption, g / kcal
0.019	-174 (99)	173 (54) / 197
0.0446	-147 (84)	169 (44) / 193
0.0775	-50 (50)	213 (29) / 243
0.0781	-94 (89)	199 (17) / 227
p-value	NS	NS

Kits in early growth

Kits were weaned at 6 weeks of age which can affect growth negatively, even though they were housed three together. Their body weight gain is therefore not totally reliable. Anyway there is a tendency towards the lowest weight gains in kits getting very low and very high amounts of Na (Figure 1).

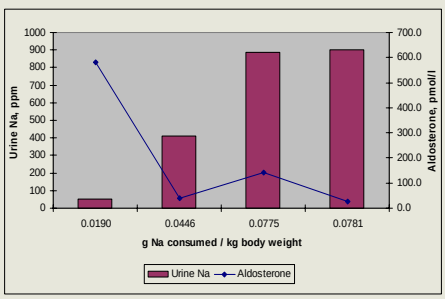
Figure 1. Body weight gain in 6 – 10 weeks old male- and female mink kits feed different amount of Na.



Adult male mink

At the end of the investigation urine samples were collected for determination of Na content and blood samples were collected for plasma aldosterone determination. The concentration of plasma aldosterone was very high and the concentration of urine Na very low in the group feed the lowest amount of Na compared to the other groups (Figure 2).

Figure 2. Urine Na content and blood aldosterone in male mink feed different amounts of Na.



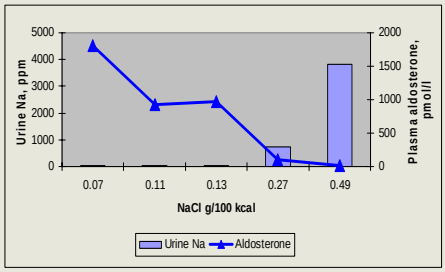
This corresponds to earlier results in mink and cats (Clausen et al, 1996, Yu & Morris, 1997; 1998; 1999). In the groups with added NaCl the urine Na was considerably higher and plasma aldosterone was within normal range.

It seems that 0.019 g Na per kg body weight per day is too little for adult male mink whereas 0.0446 g Na/ kg body weight is sufficient to fulfil the need.

Kits in early growth

At the end of the investigation urine was sampled for Na determination and blood was sampled for determination of plasma aldosterone in male mink kits from the five groups with the lowest Na (Figure 3).

Figure 3. Urine Na and blood aldosterone in male mink kits feed different amounts of Na.



The concentration of plasma aldosterone was very high and the concentration of urine Na was very low in the three groups fed the lowest Na content in the feed, indicating that the amount of Na was to low to fulfil the need of the kits. In the other two groups the concentration of urine Na was considerably higher and the concentration of plasma aldosterone was within normal range.

Conclusion

The results from these and earlier investigations (Clausen et al., 1996; Clausen et al., 2002) lead to the following recommendations on the content of NaCl in the feed throughout the year (Table 4).

Table 4. Recommended NaCl content in Danish mink feed throughout the year

Period	g Na / 100 kcal	g NaCl/100 kcal	% NaCl *
Adult mink, January	0.05	0.13	0.15
Nursing females	0.17	0.42	0.5
Growing kits 6-10 weeks	0.11	0.27	0.4
Adult mink, August – pelting	0.03	0.08	0.15

* energy concentration: 120 – 120 – 150 - 200 kcal/100g

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Increasing water intake by addition of NaCl to mink feed

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Introduction

One of the biggest disease problems in June / July is connected with the urinary tract (Hansen *et al*., 2008; Clausen, 2006). It has been suggested that you can make mink kits drink more and thereby urinate more, by adding a surplus of salt (NaCl) to the feed. This should help to reduce the formation of urinary stones.
However, it should be noticed that to high amounts of NaCl can be toxic. The symptoms on NaCl toxicity is reduced feed consumption and body weight gain, a dark diarrhoea, rough coat, crusty nose and eyes, irritability in the early stage, and lethargy in the later stages. (Restum *et al*., 1995).

Method

We used 6 groups of each 5 black male mink kits. From 10 – 12 weeks of age the kits were placed in individual balance cages and fed a basic feed with addition NaCl (Table 1).

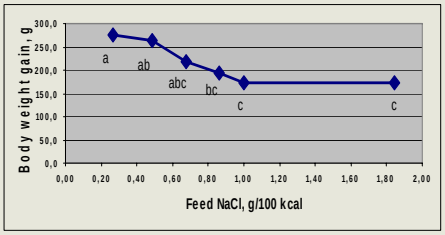
Table 1. Added NaCl, analysed sodium (Na) and calculated NaCl content in the feed

Added g NaCl / 100 g feed	0.3	0.6	0.9	1.1	1.3	2.3
Analysed g Na / 100 kcal	0.11	0.19	0.27	0.34	0.40	0.73
Calculated g NaCl / 100 kcal	0.27	0.49	0.68	0.86	1.00	1.85

Results and discussion

Kit body weight
Body weight gain during the trial period decreased with increasing NaCl in the feed (Figure 1).

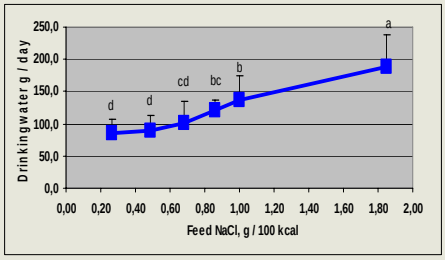
Figure 1. Body weight gain from 10 to 12 weeks, at different NaCl content in the feed



The best body weight gain was found in kits getting 0.27 or 0.49 g NaCl / 100 kcal. At 0.68 g NaCl / 100 kcal there was a decrease in growth and kits getting 0.86 g NaCl / 100 kcal and more had a significantly lower body weight gain.
Lund (1979) also found reduced growth in black mink kits receiving around 0.68 g NaCl / 100 kcal.

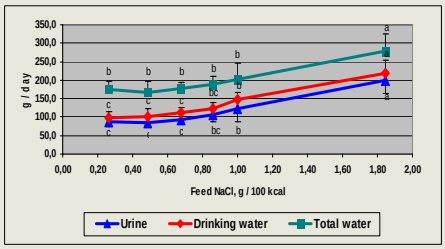
Water consumption
Average daily intake of drinking water in the period June 29 to July 13 is shown in figure 2. From a feed content of 0.68 g NaCl / 100 kcal the water consumption started to increase and from 0.86 g NaCl / 100 kcal the increase was significant. Kits getting 1.85 g NaCl / 100 kcal in the feed double their drinking water intake compared to kits getting 0.27 – 0.49 g NaCl / 100 kcal.

Figure 2. Average daily water consumption from June 29 to July 13 at different NaCl content in the feed



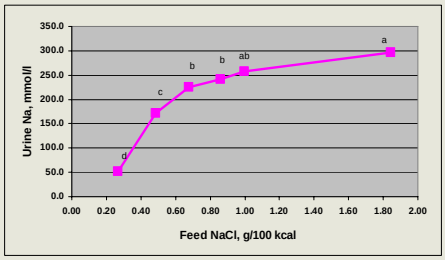
Average daily water absorption (drinking water + water from the feed ÷ water in the faeces), drinking water intake and urine production in the period July 6 to July 13 (Figure 3), increase linearly with increasing NaCl in the feed from 0.68 g NaCl / 100 kcal.

Figure 3. Total water absorption, drinking water and urine production in the period July 6 to July 13



Urine
When the kits gets a high amount of NaCl in the feed, they will get rid of excess Na by increasing the Na concentration in the urine as much as possible, but there is a limit.
As can be seen from figure 4 the limit is around 250 – 300 mmol Na / l. This corresponds with earlier investigations (Clausen et al., 2002).

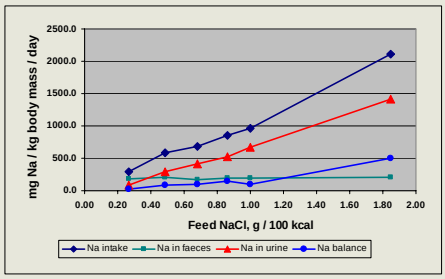
Figure 4. Na concentration in the urine, at different NaCl content in the feed



When urine gets this concentrated, the kits will have to drink more water to get rid of the excess Na. Above 0.68 g NaCl / 100 kcal in the feed the concentration of Na in the urine increased very slowly, at the same time the kits drinking water intake and urine production increased (Figure 3).

Na-balance
The Na-balance of the kits (Na intake minus Na output) was calculated (Figure 5). At the highest NaCl content in the feed the kits could no longer get rid of excess Na and would have developed symptoms of intoxication if the investigation had continued for a longer time. Excretion of Na in faeces is independent of the intake as also seen in cats (Yu & Morris, 1997).

Figure 5. Na balance at different NaCl content in the feed



Conclusion

A salt content in the feed of more than 0.68 g NaCl / 100 kcal increase the water intake and urine production, but reduce the body weight gain in 10 – 12 week old mink kits.

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Amino acid digestibility of a synthetic diet fed to mink

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Introduction

A synthetic diet has been designed with a protein fraction entirely made up by crystalline amino acids (Sandbol et al., 2007). The amino acid composition is based on the ideal protein concept (Sandbol et al., 2004). It is assumed that crystalline amino acids are 96% digestible. To confirm this hypothesis, a digestibility trial was conducted with the purpose to determine the apparent digestibility of the individual amino acids used in the diet.

Materials and methods

The trial was conducted with 4 adult male mink of the colour type Brown/Glow. The animals were offered the diet (Table 1) in an adaptation period of 7 days and in the following 4 days of collection. The mink were housed in balance cages (mod. after Jorgensen and Glem-Hansen, 1973).

In the collection period, feed consumption and faeces was registered daily and pooled across days for the individual mink.

Apparent digestibility was calculated according to the direct method as follows:

Apparent digestibility, % =

$$100 * (AA_{intake} - AA_{faeces}) / AA_{intake}$$

where AA is the individual amino acid in gram.

One animal with a low feed intake and a high faecal dry matter excretion was excluded from the calculations.

Table 1 Composition of the diet (% of fresh weight), calculated energy content and distribution.

Ingredient	Composition,% of diet
Methionine[1)]	0.20
Cystine	0.08
Lysine	0.30
Threonine	0.17
Tryptophane	0.05
Histidine	0.10
Phenylalanine	0.20
Tyrosine	0.15
Leucine	0.38
Isoleucine	0.18
Valine	0.24
Arginine	0.24
Glutamic acid	0.57
Glycine	0.26
Alanine	0.24
Serine	0.22
Aspartic acid	0.31
Proline	0.26
Corn starch	9.64
Cellulose	2.32
Soy Oil	3.62
Lard	3.74
Vitamin premix	0.24
NaCl	0.05
Water	75.94
Energy, calculated:	
ME[2)] MJ / 100 g	0.56
ME from protein, %	15
ME from fat, %	55
ME from carbohydrates, %	30
Dry matter, %	23

[1)] All amino acids are L-isomers
[2)] ME is metabolizable energy

Results and discussion

The apparent digestibility of the individual amino acids were typically between 89 and 95% (Table 2), which is slightly lower than the assumed 96%. Methionine digestibility was slightly higher with 98%.

The digestibilities of Cystine and Threonine were 74 and 79%, respectively. The method used to determine the apparent digestibility contains the endogenous excretion in the value. As a carnivore, mink has a substantial endogenous excretion of enzymes involved in the digestion processes. However, Elnif and Hansen (2004) states that the reabsorption is very efficient and therefore most amino acids will contribute little to the amount found in faeces. Only for Cystine, Threonine and Aspartic acid a low apparent digestiblity can be explained by endogenous excretion (Elnif and Hansen, 2004). This supports our findings for Cystine and Threonine.

The synthetic diet ready to be served!

Table 2. Analysed dietary content and calculated apparent digestibility of amino acids (means of 3 mink).

Amino acid[1)]	g/kg diet	Digestibility, %	SEM[2)]
Alanine	2.21	92	0.26
Arginine	2.41	94	0.20
Aspartic acid	3.09	92	0.10
Cystine	0.53	74	0.97
Glutamic acid	5.58	94	0.20
Glycine	2.52	94	0.15
Histidine	0.99	92	0.15
Isoleucine	1.83	94	0.11
Leucine	3.76	95	0.11
Lysine	2.38	95	0.08
Methionine	1.78	98	0.08
Phenylalanine	2.14	95	0.07
Proline	2.64	92	0.19
Serine	2.15	89	0.39
Threonine	1.63	79	0.63
Tryptophan	0.51	89	0.30
Tyrosine	1.64	89	0.22
Valine	2.67	93	0.16

[1)]All amino acids are L-isomers
[2)] SEM = standard error of the means

A further contribution to the lower digestibility of Cystine could be contamination of faeces with hair. However, the digestibility of Glutamic acid and Serine, also abundant in hair, suggests that contamination was without importance.

Conclusion

Apparent digestibility of individual amino acids making up the entire dietary protein fraction was between 89 and 95%. The apparent digestibility of Cystine and Threonine was 74 and 79%, respectively.

References

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Palatability of a synthetic diet in mink (*Mustela vison*)

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Introduction

In investigations that require exact control of dietary compositions, a diet mixed from crystalline amino acids has been applied (Sandbol et al., 2007). However, in some trials dietary intake was low and fluctuating (Blaesbjerg et al., 2008). Previously, Hvam et al., (2006) showed that 'taste enhancers' increased the dietary intake of the mink. In the further development of the synthetic diet, two trials were conducted. In trials, especially running for longer periods, a semi-synthetic diet might be required.

The purpose of Trial 1 was to determine the effect of increasing dietary levels of chicken breast on feed intake. In Trial 2, the purpose was to examine the effect of pH on feed intake by comparing a chicken breast- based semi-synthetic diet with a pH-regulated synthetic diet.

Materials and methods

Trial 1

25 adult male mink of the colour type Brown/Glow were allocated in five groups with five mink in each group (Table 1). The chicken breasts added were found by replacing 10, 20 or 50%, on average, of the amino acids in the negative control diet with the respective amino acids originating from the chicken breasts.

pH in diets 1 – 5 were 4.10, 4.24, 4.30, 4.71 and 4.14, respectively.

Trial 2

15 adult male mink of the colour type Brown/Glow were allocated in three groups (Table 1). The added amount of chicken breast was chosen from the results from Trial 1. pH in diet 2 was measured. Then pH in diet 3 was regulated to balance pH between diets 2 and 3 by addition of $NaHCO_3$.

pH in diets 1 – 3 were 4.01, 4.74, and 4.68, respectively.

Table 1. Dietary contents of test ingredients (% of fresh weight)

Trial 1	1	2	3	4	5
Chicken breast	0	3.3	6.4	14.6	0
Soy sauce[1)]	0	0	0	0	0.8
Trial 2	1	2	3		
Chicken breast	0	14.6	0	-	-
$NaHCO_3$	0	0	0.2	-	-

[1)] Kikkoman's Soy Sauce, naturally brewed.

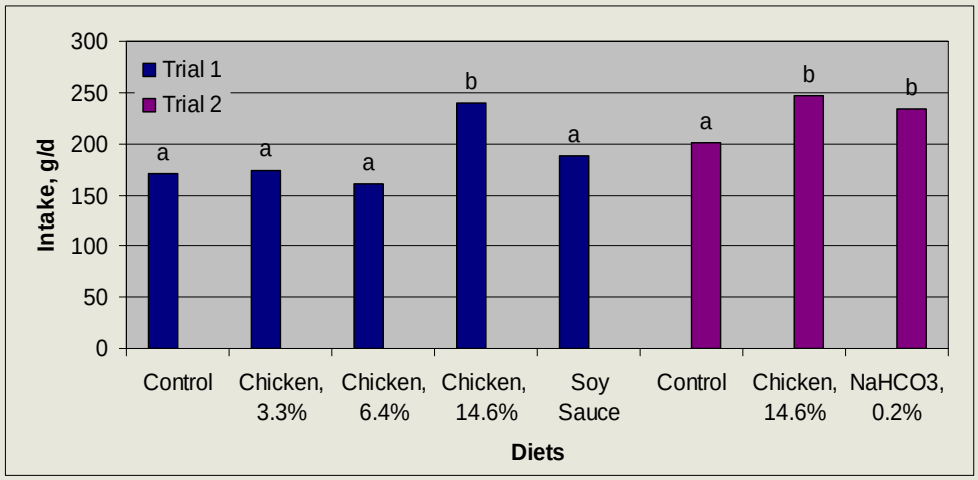

Figure 1 Average feed intake of a synthetic diet with increasing inclusion of chicken breast (Trial 1 ■) and of a pH-regulated diet containing NaHCO3 (Trial 2 ■). Dietary pH-values in control, chicken and NaHCO3 diets in trial 2 were 4.01, 4.74, and 4.68. Different letters above columns denote statistical difference within trial.

Results

The intake of the control diet and the diet with highest level of chicken breast was steady during the 10 days in Trial 1. During the first 4 trial days, the mink ingested increasing amounts of the two diets containing low levels of chicken breast and the diet with soy sauce and then dietary intake stabilized.

However, individual daily intakes varied a great deal between mink. This variation was lower in mink offered the highest level of chicken. The intake of this diet was significantly ($p < 0.0002$) higher than the intake of the other four diets (Fig. 1).

The increased dietary pH-value (Trial 2) significantly ($p < 0.0004$) increased the intake of the diets compared to the negative control diet (Fig. 1).

Discussion

Dietary intake of a synthetic diet is increased in mink when the diet is supplemented. Apparently, a broad spectrum is applicable from fish and soy sauces to pH-regulating agents and on to addition of raw chicken breasts. Which to choose will depend on the purpose of the trial in question.

However, when dietary intake was close to 100%, the mink were carrying the feed more around resulting in feed (up to 30 g), which was out of reach for the mink.

Addition of soy sauce, $NaHCO_3$, or 14.6% chicken breast improved dietary intake up to 95% of the offered diet compared to a dietary intake between 70 - 79% of the control diet.

As addition of chicken to the diet did not increase dietary intake further than $NaHCO_3$, dietary pH appears to be more important to palatability than addition of raw meat.

The diets were designed to meet the daily ME requirement of maintenance in mink (Glem-Hansen and Chwalibog, 1978). A constant daily dietary intake of 95% must be considered sufficient to meet the requirement when offering a synthetic diet to the mink.

Conclusion

In conclusion, addition of 14.6% chicken or 0.2% $NaHCO_3$ increased and stabilized dietary intake of a synthetic diet offered to adult male mink.

References

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