Effect of reduced protein in the growth and furring period in 2010 and 2011 in mink

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Abstract

Effects of reduced protein content and content of some essential amino acids on skin length and skin quality was studied in the growth and furring period in Black and Brown/Glow mink in 2010 and 2011. In 2010 five groups of each 276 male and female Brown/Glow mink kits were used. In 2011 five groups of each 155 male and female Black mink and three groups of each 155 Brown/Glow male and female mink were used. The mink were feed diets containing varied protein and amino acids from mid-July to pelting. Results showed that reduced protein content down to 21.5% of the metabolizable energy (MEp) from July to pelting or from mid-August to pelting and a changed amino acid profile cannot be used, since the skin length is shorter, the pelt quality is poorer and there is an increased risk of fatty liver. 28 MEp from mid-July to mid-August and thereafter 24 MEp resulted in the longest skins but a little reduced pelt quality in both mink types, most likely due to low protein content in July in the period where plant for wool and hairs are formed, since the skins were generally flatter and less heavy/voluminous.

Keywords: mink, low protein diet, amino acids, skin quality, skin length

Introduction

Danish mink farmers have to reduce the content of protein in the feed by 15% before 2015 (compared to the protein level in 2009) in order to reduce the emission of ammonia from the mink farms to the environment (Clausen *et al.,* 2012a). Thus some studies have already shown that it is possible to lower the protein content in some periods (Clausen *et al.,* 2012b). To obtain more knowledge on the period from July to pelting a series of studies was initiated in order to detect the periods/windows where it would be safe to lower the protein content without jeopardizing the health of the animals, the reproduction or the skin quality/skin length.

Most experiments in the growing season, to reduce the protein content, have been conducted on Brown/Glow mink. Black mink has been used to study the need for some important amino acids (phe and tyr) for coat color (Clausen and Larsen, 2012; Clausen and Sandbøl, 2011, Clausen and Sandbøl, 2010) and to determine the ratio among met and cys (Sandbøl and Clausen, 2005). Thus it is necessary further to examine protein requirements in July and August, and clarify whether the same protein requirements apply to Black mink as for Brown/Glow mink.

The aim of this paper is to combine studies of reduced protein levels and some essential amino acids in the growth and furring period from mid-July to pelting in Black and Brown/Glow mink in 2010 and 2011.

Materials and methods

In 2010 there were 5 groups of Brown/Glow mink consisting of each 276 males and females. In 2011 there were 5 groups of Black mink consisting of 150 to 155 males and females, and 3 groups of Brown/Glow mink consisting of 130 to 135 males and females. The setup is shown in Table 1.

Mink kits were placed into trial groups in late June. First week of July feed production initiated and there was a gradual transition from feed kitchen feed (starting level 40:45:15) to experimental feed during the first two weeks of July. The 15th of July there were 32 MEp in control groups in Black and Brown/Glow mink, 30 MEp in 2 Black groups and 28 MEp in the remaining groups, except 2 groups with 30 MEp and one 21.5 MEp in the Brown/Glow mink in 2010. Control groups continued at 32 MEp until pelting. The 10th of August 2011the protein content for one Brown/Glow group and two Black groups were reduced to 24 MEp, and from the 15th of September 2011 one Brown/Glow group and two Black groups were reduced to 24 MEp. The 10th of August 2010 the protein content was lowered to 24 MEp and 21.5 MEp.

The norm of grams of digestible amino acids / 100 kcal was followed in July (Sandbøl and Lassen, 2006) and the norm for met and phe were followed throughout the whole period. The requirement for his (0.11), leu (0.41), ile (0.23) and val (0.22) was decreased slightly from 10/8 in the low protein groups.

Table 1. Experimental setup for Black and Brown/Glow mink in the growing season 2010 and 2011. The proportion of metabolizable energy from protein, fat and carbohydrate. 2011: Group 71-75 are Black mink (B), group 21-23 are Brown/Glow mink (BG) and 2010: 21-23 are Brown/Glow mink (BG).

Groups	Start level	Gradual transition 1/7-15/7	15/7	10/8	15/9-pelting
71 B Control	40:45:15	40 → 32:53:15	32	32:50:18	32:50:18
72 B		40 → 30:55:15	30	28:54:18	24:55:21
73 B		40 → 30:55:15	30	24:58:18	24:55:21
74 B		40 → 28:57:15	28	28:54:18	24:55:21
75 B		40 → 28:57:15	28	24:58:18	24:55:21
21 BG Control		40 → 32:53:15	32	32:50:18	32:50:18
22 BG		40 → 28:57:15	28	24:58:18	24:55:21
23 BG		40 → 28:57:15	28	28:54:18	24:55:21
31 BG Control		40 → 32:53:15	32	32:53:15	32:50:18
32 BG	40:45:15	40 → 30:52:18	30	30:52:18	25:54:21
33 BG		40 → 28:54:18	28	24:54:22	24:52:24
34 BG		40 → 21.5:57.5:21	21.5	21.5:57.5:21	21.5:57.5:21
35 BG		40 → 30:52:18	30	21.5:57.5:21	21.5:57.5:21

Male kits were weighed at the start of the experiment (6/7), 8/8, 14/9 and at pelting. The skins were length measured and quality sorted on Kopenhagen Farm and sent for sorting at Kopenhagen Fur.

Feed plans are available upon request from the corresponding author. The raw materials were analyzed before the start of experiment, feed composition for the experimental groups was checked by analysis of protein, fat, dry matter and ash at regular intervals throughout the period. Pooled samples of the feed for relevant sub-periods were analyzed for amino acid content.

The statistical calculations were performed using the statistical program SAS (SAS Institute Inc., 1996). The procedures GLM (SS4), LSMEANS / PDIFF were used with 5% significance level for calculations of the weight and length. Relevant covariates were included in the cases they were significant. For fur quality, colour and clarity using a non-parametric test (GENMOD). Silkiness, wool quality and metallic were analyzed with PROBIT procedure or χ^2.

Results and discussion

Analyses of the feed chemical composition indicated in general a good agreement with the plan. Amino acid analyses varied in proportion to the level numbers (data not shown), but in most cases followed the plan strictly. Some amino acids were below the norm, although most were within the measurement uncertainty of 10%.

At the start of the experiment there was no difference in the weights among groups (Table 2), but in august, for both mink types, the heaviest mink were observed in the groups that had received low protein diet and thus the highest energy content. This difference persisted for Brown/Glow mink groups until pelting in both 2010 and 2011. For the Black mink, there was no significant difference in weights at pelting. Skin lengths showed the same as the weights (Table 2), namely that the longest skins were observed in the group fed low protein diet. In previous studies it has been demonstrated that 32 MEp in July gives the best growth in July, but that low protein content in July and August does not reduce the skin length at pelting (Clausen *et al.*, 2008). In the growing period in 2010 the skins of groups fed a diet containing 28 MEp in July to mid-August, and then 24 MEp until pelting, were of at least the same size as the control group (32 MEp) (Clausen *et al.*, 2012b). Therefore there is nothing that suggests a negative effect on the size, either in Black or Brown/Glow mink, if we lower the protein content in mid-July to 28 MEp.

Independently of the protein content was lowered to 24 MEp in August or September skin quality in the Black mink was slightly reduced compared to the control group (Table 3). No difference was observed in colour, silkiness or wool, however there were the fewest flat skins in the control group. The quality of Brown/Glow mink group was not significantly different in 2011, the slightly lower quality in the low-protein groups are mainly a result of the skins being a little longer than in the control group (Table 3). Whether the protein was lowered to 24 MEp in August or September seems to have had the same influence on the size and quality of the skins. The wool of Brown/Glow mink skins was affected by protein level, there were more heavy/voluminous and fewer flat skins in the control group rather than the low-protein groups, especially when protein was lowered to 24 MEp already in august (group 22). The effect of low protein in the early growth period is most likely due to disturbance in the formation of the under-wool and the hair fibre

Table 2. Weight for male kits in grams (2011 and 2010).[1]

2011	**06 July**	**08 August**	**14 September**	**Pelting**
71 B Control	959 (136)	1,794 (167) b	2,474 (250) b	2,902 (308)
72 B	960 (150)	1,804 (198) b	2,510 (264) ab	2,973 (330)
73 B	954 (150)	1,798 (179) b	2,542 (273) a	2,952 (308)
74 B	952 (120)	1,869 (161) a	2,527 (249) a	2,978 (295)
75 B	952 (130)	1,863 (176) a	2,565 (319) a	2,972 (412)
	NS	<0.0001	0.03	NS
2011				
21 BG Control	1,065 (145)	1,945 (192) b	2,925 (315) b	3,496 (413) b
22 BG	1,065 (124)	2,005 (223) a	2,982 (339) ab	3,597 (441) a
23 BG	1,065 (121)	2,026 (169) a	3,026 (282) a	3,634 (403) a
	NS	0.004	0.03	0.03
2010	**08 July**	**10 August**	**27 September**	**Pelting**
31 BG Control	1,188 (129)	1,890 (192) ab	2,800 (275) b	3,168 (322) a
32 BG	1,189 (143)	1,842 (207) c	2,731 (328) c	3,051 (344) b
33 BG	1,200 (125)	1,898 (193) a	2,868 (289) a	3,150 (376) a
34 BG	1,196 (130)	1,865 (180) bc	2,824 (298) ab	3,146 (359) a
35 BG	1,198 (144)	1,862 (187) c	2,754 /319) c	3,037 (380) b
	NS	0.002	<0.0001	<0.0001

[1] Numbers in parentheses are the standard deviation; NS show that there is no difference between the groups, different letters in a column shows that there are differences among different groups.

thickness (Rasmussen and Børsting, 1997). In 2010 there was a significant difference in skin quality in the Brown/Glow mink in the low protein groups.

A slightly reduced skin quality and more flat and less heavy/voluminous furs at 28 MEp from July, and 24 MEp from August or September, corresponds among experiments in 2010 and 2011. Thus, whether the altered amino acid requirement at 24 MEp may have had an impact on the experiment will be examined in future studies with increased addition of essential amino acids in the low protein groups in the growth period in 2012.

Generally the health status on the farm was good (Table 4). In the Brown/Glow mink control group six mink died in 2011, half of these from bladder/kidney infections. Totally only three minks died from enlarged fatty liver, all in the groups fed 24 MEp from August. In 2010 more mink died but few in the control group and fewest from enlarged fatty liver. It is well known that a low protein diet during the growing season increases the risk of enlarged fatty liver (Clausen *et al.*, 2012a; Clausen, 2007; Clausen and Sandbøl, 2005; Damgaard *et al.*, 1998a,b, 1994, 2012).

Table 3. Skin length and quality parameters for male mink (2011 and 2010).[1]

2011	Length cm	Quality [2]	Colour [3]	Metallic %	Silkiness %	Wool, %		
						flat	normal	heavy/ voluminous
71 B Control	88.7 (4.0)	7.2 (2.2) a	2.9 (1.0)	1.6	7.0	2.3	85.9	11.7
72 B	89.2 (4.4)	6.3 (2.4) b	2.9 (0.9)	2.3	8.6	7.8	82.0	10.2
73 B	89.3 (4.6)	6.3 (2.4) b	3.0 (0.8)	6.8	5.3	8.3	85.0	6.8
74 B	89.6 (4.1)	6.5 (2.3) ab	3.1 (0.9)	5.3	6.0	4.5	86.8	9.0
75 B	89.3 (5.4)	6.5 (2.7) b	3.1 (1.0)	5.5	12.6	11.0	75.6	13.4
P-value	NS	0.03	NS	NS	NS	NS		
2011				Clarity [4]				
21 BG Control	94.7 (4.8) b	7.1 (2.4)	2.9 (1.0)	3.0 (1.0)	46.7	4.2	61.7	34.2
22 BG	96.1 (4.2) a	6.4 (2.3)	3.2 (0.9)	3.1 (0.9)	40.2	13.4	69.3	17.3
23 BG	96.1 (4.7) a	6.5 (2.3)	3.0 (1.0)	3.0 (1.0)	45.8	3.8	77.9	18.3
P-value	0.02	NS	NS	NS	NS	0.005		
2010								
31 BG Control	91.9 (3.9) ab	6.9 (2.3) a	2.9 (0.9)	3.2 (1.0) a	19.3	5.0	78.2	16.8
32 BG	90.6 (4.3) c	7.0 (2.4) ab	3.0 (0.9)	3.0 (0.9) a	21.4	3.0	81.6	15.4
33 BG	92.2 (4.4) a	6.4 (2.5) bc	3.0 (1.0)	3.1 (1.0) a	20.8	11.4	80.5	8.1
34 BG	91.3 (4.1) bc	6.1 (2.5) cd	3.1 (0.9)	2.8 (1.0) b	22.3	10.9	80.4	8.7
35 BG	90.7 (4.3) c	6.0 (2.4) d	3.0 (1.0)	3.0 (1.0) a	20.0	9.6	86.5	3.9
P-value	<0.0001	<0.0001	NS	0.002	NS	<0.0001		

[1] Figures in parentheses are the standard deviation; NS show that there is no difference between the groups, different letters in a column shows that there are differences between groups.

[2] Quality scale 1-12, 12 is best.

[3] Colour scale 1-5, 5 is darkest.

[4] Clarity scale 1-5, 5 is most reddish.

Conclusion

The mink were feed diets containing varied protein and amino acids from mid-July to pelting. Results showed that lowering protein content down to 21.5% of metabolizable energy (MEp) from July to pelting or from mid-August to pelting and a changed amino acid profile cannot be used, since the skin length is shorter, the pelt quality is poorer and there is an increased risk of fatty liver.

In august, for both mink types, the heaviest mink were in the groups that were fed the low protein diet (28 MEp) from mid-July rather than 32 MEp. This difference continued for the Brown/Glow mink group to pelting, where the skins were also longest in the low-protein groups. For the Black mink this difference in fur length was not significant.

Table 4. Registration of mortality in the experiment (2011 and 2010).

2011	Mortality	
	Total %	Enlarged fatty liver %
71 B Control	1.6	0
72 B	0.7	0
73 B	1.0	0.3
74 B	1.0	0
75 B	1.6	0.3
21 BG Control	2.3	0
22 BG	0.8	0.4
23 BG	0.7	0
2010		
31 BG Control	0.5	0.4
32 BG	2.2	0.5
33 BG	2.4	1.1
34 BG	2.4	1.4
35 BG	2.7	1.4

Skin quality in the Black group was slightly reduced compared to the control group, independently of whether the protein content was lowered to 24 MEp in August or September. In the Brown/Glow mink group the quality was not significantly different, but wool quality was affected by protein levels, indicated by more heavy and fewer flat skins in the control group compared to the low-protein groups.

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