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Original research article

Effects of dry dietary protein on digestibility, nitrogen-balance and growth performance of young male mink

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ABSTRACT

The experiment was to study the nutrient digestibility and metabolism performance of male minks, which were fed different protein level diets during growth period. Effects of protein quantity on growth and development of minks and feed conversion ratio (FCR) were also investigated. Sixty healthy male minks of 45 d were randomly allocated into six groups with ten replicates, which was one sable for each replicate. The minks in six groups were fed diets in which protein levels were 28, 30, 32, 34, 36 and 38%, respectively. The six groups were denoted as P28, P30, P32, P34, P36 and P38. After 2 wk, all minks were weighed, average daily gains (ADG) were calculated, and the digestibility values of nutrients were determined. The results indicated that digestibility of calcium, nitrogen of fence, nitrogen deposition, net protein utilization (NPU), and biological value of protein (BV) were similar ($P > 0.05$), however, nitrogen intake greatly varied among groups ($P < 0.01$). Compared with group P28, groups of P34, P36 and P38 showed significant difference ($P < 0.01$) in ADG and FCR. In conclusion, it was recommended that adding 34% protein to mink diet would optimize production parameters including ADG, digestibility of nutrition, and FCR, and negative result was observed when diet protein was lower than 28%.

1. Introduction

Mink (*Mustela vison*) is a strict carnivore that originated from North America, and is a precious fur-bearing animal (Søren and Anne-Helene, 1998; Stubbe, 1993). Mink has been raised for more than 25 million yr in European and cultivated as the main animal species that is kept for fur throughout the world (Sari et al., 2008; European Commission, 2001).

Wild minks always capture fish, frogs, and small mammals to eat. Although mink is carnivorous, carbohydrate plays an important role as a dietary ingredient for farmed mink (Børsting et al., 1995). Mink is unable to digest carbohydrates in the small intestine, which was normally observed in monogastric animals (Glem-Hansen et al., 1977; Graham et al., 1986). Several technological means such as the conventional drum dryer and extrusion can increase the digestibility of plant materials for mink (Østergard and Mejbom, 1989).

The ingredients of mink diet varied greatly in the past couple of decades. Since plant stuff was employed in the diet, the fat and protein contents were different from those of previous feed formula diets. Therefore, the recommendations of diet ingredient for mink that is currently based on fresh meal research for juvenile mink (NRC, 1982; Hansen et al., 1991) needs to be amended and take animal growth condition into consideration. Mink kids are capable of growing very fast during lactation, which is the first three wk after birth (Tauson, 1994), and they can keep growing rapidly in the early period after weaning.

Due to high protein demand of dams, nutritional intake from feed could not meet the requirement of baby minks, and resulted

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in weight losses (Hansen, 1997; Tauson, 1988). Protein quality has a direct influence on the growth and the health of juvenile mink, and contributes greatly to the fur area and fur quality in the pelting period.

The current study aims to determine the requirement of dietary protein for young male minks fed dry power feed. The effects of experimental diet on body growth rate, feed conversion ratio (FCR), nutrients digestibility and nitrogen balance were investigated.

2. Material and method

2.1. Animal and feeding management

Sixty healthy 45-day-old male sables (initial weight 1.065 ± 0.118 kg) were randomly divided into six groups. Each of the six groups contains ten biological replicates. There was no significant difference in body weights (BW) among groups ($P > 0.05$). The minks were fed six experimental diets in which serial protein levels were 28, 30, 32, 34, 36 and 38%, respectively. The six groups were denoted as P28, P30, P32, P34, P36 and P38. All the animals were injected with distemper vaccine and canine parvovirus before the trial started. Diets were distributed at 0800 and 1600, and water was taken freely by animals.

The minks were individually housed outdoors in traditional cages (70 cm × 30 cm × 45 cm) with two row sheds. The animals in this experiment were well taken care of according to the guidelines provided by Canadian Council on Animal Care (1993).

2.2. Experimental diets

According to the feed component of previous studies, protein concentrations of feed were designed as 28, 30, 32, 34, 36 and 38% in this experiment. The nutrients of feeds were listed in Table 1.

2.3. Digestion metabolism experiment

Six minks with similar BW were chosen from their respective groups to undergo the digestive experiment on day 14. The digestive experiment lasted for 4 d that was from July 28, 2009 to July 31, 2009. During the period, excretions of animals were collected every day. Sulfuric acid (H_2SO_4) that accounted for 10% of the weight of fresh drains was used to protect samples from decaying. Urine samples were stored at −20 °C until later analysis.

2.4. Body weight

All animals were weighted in the morning before feeding per two weeks. Feed intake and residues were accurately recorded to calculate ADG and FCR.

2.5. Measure parameters

2.5.1. Feed intake

Total feed supply and residual were recorded and used for calculating the feed intake for each mink and for each group.

2.5.2. Trial determined index

The feed material was stoved at 65 °C to determine dry matter (DM). Crude protein (CP) and ether extract substance were determined using Kjeldahl Nitrogen method and Soxhlet extract method, respectively. Potassium permanganate titration and ammonium heptamolybdate tetrahydrate colorimetry were employed to evaluate concentrations of Ca and P in feed, respectively (AOAC, 1991, 1995).

Table 1
Ingredients and nutrient composition of the experimental diets, % of DM.

Item	Group					
	P28	P30	P32	P34	P36	P38
Ingredients						
Extrusion corn	38.50	31.50	36.50	33.50	32.50	28.50
Soybean meal	6.00	6.00	6.00	5.00	4.00	3.00
Corn gluten	2.00	6.00	8.00	10.00	10.00	10.00
Corn germ meal	9.00	5.00	5.00	3.00	0.00	0.00
Chicken meal	8.00	6.00	5.00	6.00	6.00	6.00
Bone meat meal	15.00	16.00	12.00	16.00	16.00	19.00
Cheese meal	5.00	5.00	5.00	5.00	5.00	5.00
Fish meal	8.00	16.00	12.00	13.00	18.00	19.00
Bean oil	4.00	4.00	4.00	4.00	4.00	4.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Premix[1]	4.00	4.00	4.00	4.00	4.00	4.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition[2]						
ME, MJ/kg	10.16	10.45	10.08	10.17	10.75	10.79
CP	28.49	30.18	32.35	34.18	36.08	38.03
Ca	3.48	3.26	3.20	3.20	3.37	3.74
TP	2.78	2.61	2.56	2.67	2.81	3.12
Lys	1.98	2.30	2.42	2.62	2.76	2.91
Met + Cys	1.60	1.68	1.79	1.89	2.05	2.16

ME = metabolic energy; CP = crude protein; TP = total protein; P28 = diet contains 28% CP, etc.

[1] Premix provided per kilogram of diet: Vitamin A 10,000 IU; Vitamin D_3 2,000 IU; Vitamin E 100 IU; Vitamin B_1 6 mg; Vitamin B_2 10 mg; Vitamin B_6 6 mg; Vitamin B_{12} 0.1 mg; Vitamin K_3 1 mg; Vitamin C 400 mg; niacin acid 30 mg; pantothenic acid 40 mg; biotin 0.2 mg; folic acid 1 mg; choline 400 mg; Fe 82 mg; Cu 20 mg; Mn 120 mg; Zn 50 mg; I 0.5 mg; Se 0.2 mg; Co 0.3 mg.

[2] Nutrient contents of ME, CP, Ca and TP were measured, and other nutrient contents were calculated.

$$\text{DM digestibility}(\%) = (\text{DM intake} - \text{DM output})/\text{DM intake} \times 100,$$

$$\text{Protein digestibility}(\%) = [(\text{Protein intake} - \text{Protein in feces})]/\text{Protein intake} \times 100,$$

$$\text{Fat digestibility}(\%) = [(\text{Fat intake} - \text{Fat in feces})]/\text{Fat intake} \times 100,$$

$$\text{Ca digestibility}(\%) = [(\text{Ca intake} - \text{Ca in feces})]/\text{Ca intake} \times 100,$$

$$\text{P digestibility}(\%) = [(\text{P intake} - \text{P in feces})]/\text{P intake} \times 100,$$

$$\text{N deposition}(\text{g/d}) = \text{N intake} - \text{Urinary N} - \text{Fecal N},$$

$$\text{NPU} = (\text{N deposition}/\text{N intake}) \times 100,$$

$$\text{BV}(\%) = [\text{N deposition}/(\text{N intake} - \text{Fecal N})] \times 100,$$

$$\text{ADG (g)} = (\text{Final weigh} - \text{Initial weight})/\text{Trial days},$$

$$\text{FCR} = (\text{Final weight} - \text{Initial weight})/\text{Feed intake}.$$

2.6. Statistical analysis

The data were presented as means ± SD and analyzed by one-way ANOVA with SPSS 16.0, $P < 0.05$ means significant difference, and $P < 0.01$ means greatly significant difference.