

Technical note Communication:

Case report of alopecia in rats fed a high-fat diet containing fish oil

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INTRODUCTION

In the course of studies on the effects of dietary fats on serum triglycerides in rats, alopecia was found in animals fed fish oil. Here we describe our findings.

MATERIALS AND METHODS

Male HsdCpb:WU rats (outbred, SPF) were purchased at the age of three weeks. The animals were housed under conventional conditions in Macrolon type III cages, five animals in a cage. The cages were located in a room with controlled temperature (21°C) and relative humidity (36–40%). Fluorescent light was provided from 0700 to 1900 h.

Five days after arrival, the rats were divided into four experimental groups consisting of 12 animals each and were randomly assigned to one of four semipurified diets. The dietary groups had similar distributions of initial body weight (Table 1). The rats were now housed three in a cage.

There were two low-fat and two high-fat diets, one of each of the two diets containing either corn or fish (menhaden) oil. Fresh diets were prepared every two days by adding the oils to base mixtures. The low-fat base mixture consisted of (g/880 g): casein, 151; corn oil, 10; cholesterol, 0.42 (if corn oil was to be added) or 0.0 (if fish oil was to be added); sucrose, 628.98 (if corn oil was to be added) or 629.4 (if fish oil was to be added); cellulose, 30; CaCO₃, 12.4; NaH₂PO₄·2H₂O, 15.1; MgCO₃, 1.4; KC1, 1.0; KHCO₃, 7.7; mineral premix, 10.0 and vitamin premix, 12.0. To 880 g of this base

mixture either 120 g of corn oil or 120 g of fish oil was added. Thus the low-fat diets contained 13% (w/w) of fat. The high-fat base mixture was formulated by adding 180 g of coconut fat to the low-fat base mixture at the expense of an isocaloric amount of sucrose, that is 405 g. To 655 g of this mixture either 120 g of corn oil or 120 g of fish oil was added. Thus the high-fat diets contained 40% of fat. The composition of the mineral and vitamin premix has been described (Beynen *et al.* 1986). The corn oil diets contained added cholesterol so as to balance for cholesterol in the menhaden oil preparation, which was found to contain 351 mg of cholesterol per 100 g. When fed to the animals, the diets were in meal form. Unlike the low-fat diets, the high-fat diets had an oily appearance. The diets were provided in stainless steel trays (1xwxh = 10x6x5.5 cm) that hung against the inner wall of the Macrolon type III cages. Diets and tap water were fed *ad libitum*. Feed intake was not recorded.

After 14 days, between 0900 and 1200 h, the

Table 1. Body weights (g) of rats fed diets differing in fat amount and fat type (n = 12; mean ± SD).

Fat type	Fat amount		
	Low	High	
Corn oil	initial	59.2 ± 5.0	58.8 ± 3.0
	final	104.8 ± 9.3	110.3 ± 16.0
	change	45.6 ± 9.3	51.6 ± 14.9
Fish oil	initial	59.1 ± 4.2	59.4 ± 3.8
	final	96.1 ± 8.1	96.7 ± 7.8
	change	37.0 ± 6.6	38.1 ± 7.4

non-starved rats were bled by orbital puncture under light diethyl-ether anaesthesia. The anaesthetized rats were killed by cervical dislocation. The livers were removed for lipid analysis. While carrying out these procedures, a considerable between-animal variation in greasiness of fur and degree of hair loss were noted. It was then decided to examine the fur of each animal more carefully. The carcasses of the rats were turned belly-side down. Then, the fur of each rat was examined by a person (HvH) who is familiar with laboratory rats, but did not know the design of the study. Examination of the furs was performed "blind" and in random order. Three parameters were scored: greasiness of fur, loss of hairs on the cranial part of the body and loss of hairs on the caudal part of the body. Scores ranging from 1 to 3 were assigned. If no abnormal variation was detected a score of 0 was given. The most severe abnormality present in the examined rats was set at a score of 3. Three rats were not scored because of the presence of blood in the fur. The furs of selected rats showing loss of hairs were examined for the presence of ectoparasites.

Body weights of the dietary groups fed either corn or fish oil were compared for statistically significant differences with the use of Student's *t* test. Distributions of scores from

examination of furs were statistically analysed using Kruskal-Wallis one-way Anova.

RESULTS AND DISCUSSION

At the end of the experiment, body weights of the rats fed fish oil were significantly lower ($p < 0.01$) than those of their counterparts fed corn oil (Table 1).

In rats fed the high-fat diets, greasiness of fur was significantly ($p < 0.001$) more intense than in rats fed the low-fat diets (Table 2). There was no significant effect of fat type. The semipurified, powdered diets were provided in stainless steel mangers. The rats were frequently seen within these mangers. This explains the greasy furs of the rats fed the high-fat diets.

In the rats fed the low-fat diets containing either corn oil or fish oil, the incidence of hair loss on the cranial and caudal part of the body was low (Table 2). Likewise, rats fed the high-fat diet containing corn oil did not show significant loss of hair. In contrast, the rats fed the high-fat diet containing fish oil displayed marked alopecia. Hair loss on the caudal half of the body was more pronounced in rats fed fish oil than in rats fed corn oil ($p < 0.05$). The rats fed the high-fat diet containing fish oil had also lost more hairs on the cranial part of the body ($p < 0.06$). In general, this involved a thin-haired

Table 2. Frequency distribution (%) of scores from the examination of furs of rats fed diets differing in fat amount and fat type.

Appearance of fur	Fat type	Fat amount								
		Low					High			
		Score					Score			
		0	1	2	3	0	1	2	3	
Greasiness	Corn oil	67	25	8	0	9	45	36	9	
	Fish oil	45	55	0	0	0	27	73	0	
Hair loss, cranially	Corn oil	92	8	0	0	91	9	0	0	
	Fish oil	82	9	9	0	55	27	18	0	
Hair loss, caudally	Corn oil	92	8	0	0	82	0	9	9	
	Fish oil	100	0	0	0	64	18	18	0	

Results refer to 11 rats per dietary group, except for the low-fat/corn oil group, which consisted of 12 animals.

neck region. No ectoparasites were found in the rats with extensive hair loss.

It is clear that rats fed the high-fat diet containing fish oil showed extensive hair loss. We have no explanation for this phenomenon. Alopecia can be caused by various conditions (Siegmund *et al.* 1979), and a careful description of dermatological and histological characteristics would be required to evaluate a possible cause. We hypothesize tentatively that fish oil in the fur, but not corn oil is repellent to rats, which induces overgrooming leading to alopecia. In any event, this study suggests that rats should be prevented from entering food hoppers, especially when powdered, high-fat, diets are used.

Summary

In a study on the effects of dietary fats on lipid metabolism, male rats were fed semipurified, low- or high-fat diets containing either corn oil or fish oil. Rats fed the high-fat diets showed significantly higher degrees of fur greasiness than rats fed the low-fat diets. The rats fed the high-fat diet rich in fish-oil, but not those fed corn oil, also showed extensive loss of hairs. The diets were in meal form and were offered in stainless steel mangers, that were visited by the animals. This case report would indicate that rats should be prevented from entering food hoppers when powdered, high-fat diets are used.

Sammendrag

I et studie over indflydelsen af kostens fedtindhold på fedtmetabolismen, blev hanrotter fodret med et formalet foder, der havde enten lavt eller højt fedtindhold, hvor fedtet bestod af enten majs eller fiskeolie. Rotter, der fik foder med højt fedtind-

hold, udviste en signifikant højere grad af fedtet pels end rotter, som blev fodret med lavt fedtindhold. De rotter, der blev fodret med fiskeolie som fedtkilde, havde desuden udbredt hårtab i modsætning til de rotter, der fik foder indeholdende højt indhold af majsolie. Foderet, der var formalet, blev givet i ståltrug, som dyrene ofte var oppe i. Denne case rapport viser klart betydningen af, at rotter skal forhindres i at komme i kropskontakt med foderet.

Yhteenveto / K. Pelkonen

Eräessä kokeessa syötettiin urosrotille maissiöljyä tai kalaöljyä ruokaan sekoitettuna. Tutkimuksen tarkoituksena oli selvittää ravintorasvojen vaikutuksia rasva-aineenvaihduntaan. Runsaasti rasvaa sisältävää rehua syöville rotilla oli rasvaisempi turkki kuin vähän rasvaa syöville. Runsaasti kalaöljyä syöville rotilla oli myös runsaasti karvanlähtöä, jota ei havaittu maissiöljyä syöville. Rehut olivat jauhemuodossa ja ne tarjottiin teräskupeista, joihin eläimet mahtuivat ryömimään. Yhtenä syynä karvanlähtöön esitetään sitä, että runsaasti kalarasvaa saaneet rotat olivat yrittäneet puhdistaa turkkiaan kalanrasvasta, johon olivat tahrintuneet ruokakupeissa. Tämän tapausselostuksen perusteella suositellaan, että eläinten pääsy ravintoastiaan pitäisi estää kokeissa, joissa syötetään runsasrasvaista rehua.

References

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