

Studies on Coprophagy in the Mouse

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ABSTRACT Adult IVCS mice (derived from the dd strain), housed individually in a semi-barrier system room under a light cycle of 14 hours light and 10 hours dark were fed commercial pellets and tap water *ad libitum*. They were then examined for coprophagous and feeding and drinking behaviors. Their behaviors during the dark period was observed by means of an infrared television monitor. Coprophagy was observed in 5 of the 10 male mice (50%) and 18 of the 20 female mice (90%); the percentage in the female was significantly higher ($p < 0.05$). There were two coprophagous patterns, one in which mice picked up fecal pellets from their anuses and the other where they picked them up from the bottom mesh of their cages. In most cases, the former pattern was observed. Coprophagy was observed frequently from 5:00 to 12:00 in the day-time. The average number ($\pm$ S.D.) of consumed fecal pellets were 1.0 ± 1.2 in males and 3.3 ± 2.3 in females; females exceeded males in ingesting feces ($p <$

0.01). The consumed rate of daily fecal pellets ranged from 0 to 4.9% in males and from 0 to 8.5% in females. Coprophagous behavior was not synchronized with those of feeding and drinking. (*Zool. Mag.* 92: 397-401, 1983).

A document concerning coprophagy in the rabbit can be found in the Bible. Details concerning habitual coprophagy were first reported by Morot (1882). Following his study, coprophagy in the rabbit has been researched by many investigators (Madsen, 1939; Eden, 1940a, b; Southern, 1940; Krull, 1943; Kulwich *et al.*, 1953; Huang *et al.*, 1954; Kulwich *et al.*, 1954; Watson, 1954; Thacker and Brandt, 1955; Watson and Taylor, 1955; Yoshida *et al.*, 1968), and found to be a normal physiological behavior intended to utilize fecal nutrients produced by intestinal microflora (Hagen, 1974). Coprophagy in the Mongolian gerbil (Schwentker, 1968) has also been observed and is believed to be a physiological behavior similar to that in the rabbit.

Though we often see rodents (mice and hamsters) practice coprophagy, it is not clear whether they reingest their own feces to utilize fecal nutrients or not.

In toxicological studies where these animals are used, the toxicological effects are evaluated without considering the problem of reingestion of feces which may include the administered chemical substances.

In order to gather some information pertaining the problem mentioned above, we have made detailed observations on coprophagous behaviors in female and male IVCS mice (Nobunaga *et al.*, 1973) (derived from the dd strain commonly used in Japan).

Materials and Methods

Ten to 12-week-old IVCS mice (10 males and 20 females) were examined. Mice were kept in a semi-barrier system

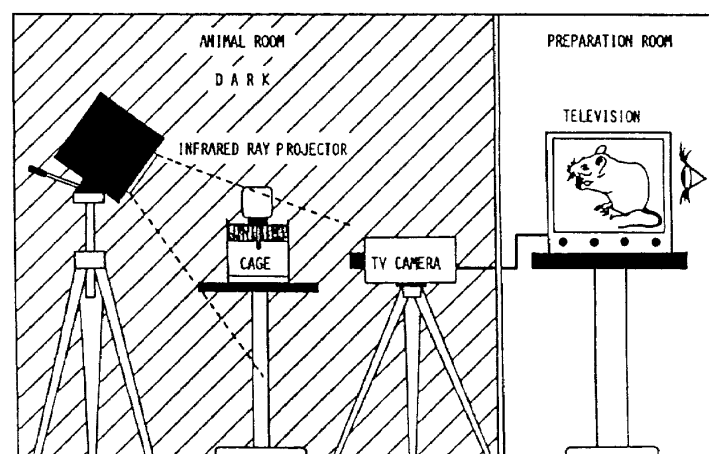


Fig. 1. Method for observation of coprophagy of mice during the dark period.

Table 1. Distribution of the number of fecal pellets consumed by male IVCS mice at each time of day.

Animal No.	Artificial illumination				Total
	Light	Dark	Light		
A					0
B					0
C			1 1 1		3
D	1 1				2
E			1		1
F					0
G					0
H			1		1
I					0
J			1 2		3
Time (hrs)	1200	1900	2400	0500	1200
					1.0 ^{a)}

a) Value represents mean.

room with 14-hours of light (5:00 to 19:00) and 10-hours of dark (19:00 to 5:00). The room was ventilated 12 times an hour. Mice were housed individually in polycarbonate cages (92W x 205D x 127H mm) equipped with stainless mesh on the bottom, and fed commercial pellets (CA-1, CLEA Japan INC.) and tap water *ad libitum*. After acclimation to these cages for more than 3 days, observations were begun. We were as careful as possible not to disturb the

animal's biological rhythm; the infrared television monitor was used during the dark period (Fig. 1). Coprophagous, feeding and drinking behaviors, and the total number of fecal pellets (including feces consumed) for 24 hours were noted. Thereafter, mice were maintained in their cages for more than 3 days in order to see whether their biological rhythms had been disordered by 24 hour observation. In female mice, vaginal smears were taken to ascertain their

Table 2. Distribution of the number of fecal pellets consumed by female IVCS mice at each time of day.

Vaginal Estrous Stage	a) Animal No.	Artificial illumination				Total
		Light	Dark	Light		
Proestrus	a	1		1 1 3 1	7	
	b		1	1 1 1	4	
	c			1 2	3	
	d	1	1	1	3	
	e				0	
Estrus	f				0	
	g		1	2 1	4	
	h			2 1 3 1	7	
	i	1		2 1	4	
	j	1		1	2	
Metestrus	k			1 2 1	4	
	l		1	1 1	3	
	m		1	2 2	5	
	n			1	1	
	o	1		1 1 4 1	8	
Diestrus	p			3 2	5	
	q			1	1	
	r			1	1	
	s			1 1	2	
	t			1	1	
Time (hrs)		1200	1900	2400	0500	1200
						3.3 ^{b)}

a) Showing the stages at the beginning of coprophagy examination.

b) Value represents mean.

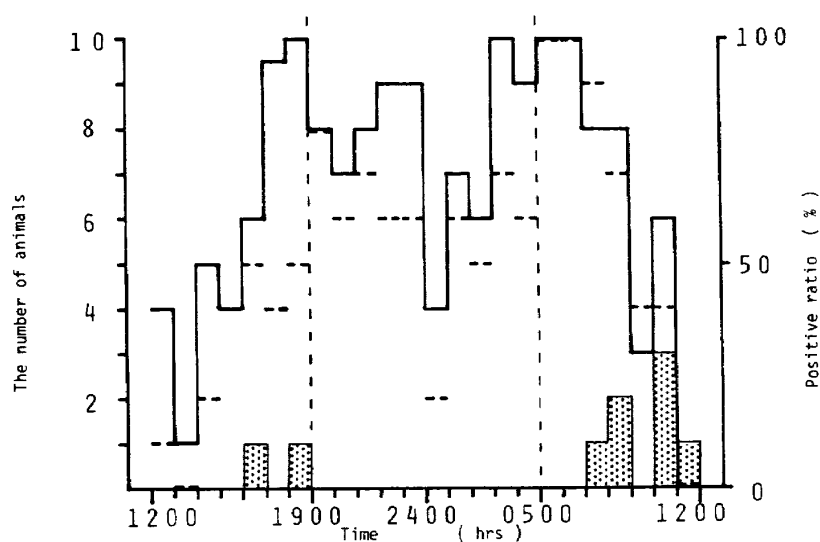


Fig. 2. Appearance of coprophagous, feeding and drinking behaviors during the day in male IVCS mice. Dotted area, eating behavior of fecal pellet; full line, eating behavior of food; broken line, drinking behavior of water.

regular 4-day estrous cycle. For statistical evaluation, Student's *t*-test and the Chi-square test were used.

Results and Discussion

The number of fecal pellets consumed by male and female mice at each time of day is shown in Tables 1 and 2. Coprophagy was observed in 5 out of 10 males (50%) and 18 out of 20 females (90%); the percentage in females was significantly higher ($p < 0.05$). There were two coprophagous patterns, one in which mice took fecal pellets directly from their anuses and the other where they picked them up from the bottom mesh of their cages. The former pattern was observed in most cases. Mice can easily practice coprophagy even if they are housed in cages with wire mesh floors. Coprophagy was most frequently practiced between 5:00 and 12:00 in the daytime, but never seen during the dark period in either males or females. The range of the number of consumed fecal pellets were 0–3 in males and 0–8 in females, and the average numbers ($\pm$ S.D.) were 1.0 ± 1.2 and 3.3 ± 2.3 , respectively.

Females consumed more fecal pellets than males ($p < 0.01$). The average number of fecal pellets consumed by females in proestrus, estrus, metestrus and diestrus were 3.4 ± 2.5 , 3.4 ± 2.6 , 4.2 ± 2.6 and 2.0 ± 1.7 , respectively; there were no significant differences among them. The frequency of coprophagy in females seems to be uninfluenced by each stage of the estrous cycle.

The average number of daily fecal pellets, including consumed ones, were 61.4 ± 25.2 (range: 54–91) in males and 91.6 ± 15.2 (72–132) in females; the latter was significantly higher ($p < 0.001$). But, daily average food consumption in male mice was 3.7 ± 0.8 g and 4.3 ± 0.4 g in females; there was no significant difference between them. The consumed rate of daily fecal pellets was 0–4.9% in males and 0–8.5% in females. As male IVCS mice had a low average number of consumed fecal pellets and some of them did not exhibit coprophagy, it was difficult to assume that they practiced coprophagy in order to utilize their fecal pellets. On the contrary, female IVCS mice had high average numbers,

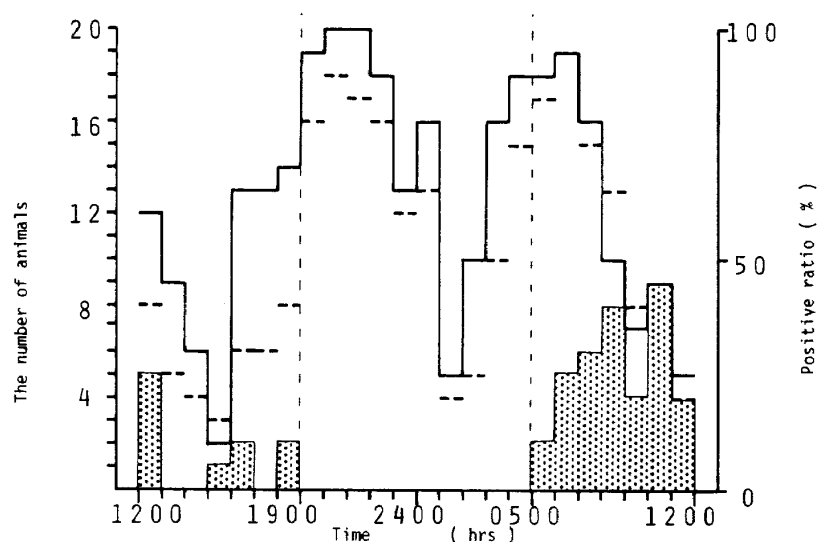


Fig. 3. Appearance of coprophagous, feeding and drinking behaviors during the day in female IVCS mice. Dotted area, eating behavior of fecal pellet; full line, eating behavior of food; broken line, drinking behavior of water.

with some consuming as many as 8 fecal pellets; they might utilize their fecal nutrients.

The appearance of coprophagous, feeding and drinking behaviors at each time of day is shown in Figs. 2 and 3. Both in males and females, coprophagy was practiced frequently between 5:00 and 12:00 in the daytime, while feeding and drinking had two peaks of frequency, at the time the lights were turned on and off. This indicates that coprophagous behavior is not synchronized with those of feeding and drinking. Before the present observation, we had expected coprophagous behavior to be synchronized with those of feeding and drinking, because the latter are known to be caused by the excitation of feeding and drinking centers. But judging from our results, it seems that the mechanism of coprophagy is different from those of feeding and drinking.

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