Analysis of Feeding Patterns of Albino Rats on Powder Bait Containing Norbormide

Toshiaki SHIMIZU and Youzi TAKADA

Institute of Agriculture and Forestry, The University of Tsukuba, Niihari, Ibaraki 305, Japan

(Received July 1, 1982)

The poor acceptability by albino rats to sweetened powder baits containing norbormide was examined by recording electronically their feeding behavior. Before offering norbormide, rats were divided into two groups based on two feeding patterns, meal eaters and nibblers. These two feeding patterns were changed when norbormide was added to the food. An acute poison, such as norbormide may be more suitable for meal eater rats, especially model-types (M-1 and M-2) rats.

INTRODUCTION

Baiting with acute rodenticides has been accepted as a practical way to control rats, but the effectiveness of rodenticides depends on their acceptability by rats. However, consumption of baits containing norbormide by rats is low as compared to control powder baits (SHIMIZU, 1982). MADDOCK and SCROPH (1967) suggested that both Norway (Rattus norvegicus) and roof rats (R. rattus) discontinued eating norbormide-poisoned food before ingesting a lethal amount, and other workers have also reported low acceptability of norbormide by rats (GREAVES, 1966; RENNISON et al., 1968; OGUSHI and TOKUMITSU, 1970). All these results indicated “poison-shyness”, “aversion” or “toxiphobia”. KAWAMURA et al. (1968) reported that norbormide (insoluble form) had no unpleasant gustatory effectiveness. A possible cause of its poor acceptability might be the rapid speed of the toxic action (KUSANO, 1975).

To control rats, it is necessary to overcome “bait-shyness” with norbormide. SHIMIZU (1982) reported that meal-eater type rats showed fewer but longer feeding bouts whereas the nibbler types had many but shorter feeding bouts. He suggested that acute poisons such as norbormide were suitable for meal-eater type rats. We carried out an analysis of the food approach patterns and measured the actual food consumption by albino rats of sweetened baits containing norbormide.

MATERIALS AND METHODS

Animals. Male Wistar-strain rats were kept in our laboratory at 25°C. They were fed a pellet diet (CE2, Nihon Clea Co. Ltd.) and water ad lib. The weight of the animals is given elsewhere. The laboratory was illuminated by a fluorescent lamp every day from 5:00–19:00. Each rat was confined in an individual cage and exposed

---

1 The main points of this paper were presented at the annual meeting of the Japanese Society of Applied Entomology and Zoology (April 2, 1982, Nagoya).

569
to a non-choice test.

Preparation of test food. The basic bait (CE₂) used was a commercially available powdered balanced food (348 Cal. per 100 g) purchased from Nihon Clea Co. Ltd. The powdered balanced food (CE₂) consists of 24% protein, 4.5% fat, 6.6% ash, 8.0% water and 4% fiber. The powder bait contained 1% norbormide and 10% sucrose. It was prepared by following method-1 and method-2 as done by Shimizu (1982). Powder only was used as a control. Norbormide appears to be practically nonhazardous to animals other than rats when exposed in a bait at a concentration of 1% or less (Crabtree et al., 1964). The prepared foods were packed in nonspillable food cups (feeder, 8.0 cm in diameter and 4.5 cm in height; Toyo Rikou Co. Ltd.).

Method-1: recording of food approach behavior. The apparatus used in method-1 is shown in Fig. 1. A reflex type photocell was fixed on one side of the food holder (the photo-master, HU1-31P, was supplied by Hokuyo Electronics Co. Ltd.). When the head or muzzle of a rat was extended into the food holder the beam was intercepted. This pulse was amplified by an amplifier (PH-1U1) and the information stored by a recorder.

Method-2: continuously monitoring the weight of food. Food consumption was directly measured by a photocell and electronic balance (Fig. 2). A light source (OPE-S10L) and a photo electric receiver (OPE-S10D) were fixed on each side of the food holder. This changed output following interception by a rat was then fed through an inter-

Fig. 1. Diagram of apparatus used in the experiment of method-1. A, reflector type infra-red photocell (HU1-31P); B, food cup; C, water bottle.

Fig. 2. Diagram of apparatus used in the experiment of method-2. B, infra-red photocell (OPE-S10) and food cup; C, water bottle; E, electronic balance (PC-180); F, interface unit (NSK-1); G, character display (JB-1203M); H, cassette tape recorder; I, personal computer (PC-8001); J, expansion unit (PC-8011); K, thermal printer (MP-80).
face unit (NSK-1: Nippon Electric Co. Ltd.) into a personal computer system (PC-8001, PC-8011 and JB-1203 M: Nippon Electric Co. Ltd.) and thermal printer (EPSON MP-80: Shinshu Seiki Co. Ltd.). In this way, continuous food consumption during 18 hrs was recorded.

*Procedures in method-1 and -2.* Servicing of the test foods was done at 2 hr before the lights were turned off on each day, since the onset of active food consumption is reported to occur about 2 hr before the onset of darkness (Oatley, 1971). An animal was put in a test box (15×35×46 cm) with an inverted water bottle. With method-1 nontoxic powder was fed for 3 days. On the forth day the test food was fed. The animal was allowed one day to adapt to the feeder and to the test box. The recording of each approach a rat made to the food started on day 2. In method-2 control powder was fed for 2 days, with the test food offered on day 3. Recording of food consumption started the first day.

RESULTS AND DISCUSSION

The feeding patterns of twenty-one rats were divided into two groups based on two feeding patterns, meal-eater type (14 out of 21) and nibbler type. These two

![Graph showing food approach patterns of metal-eater type animals to the test baits.](image)

Fig. 3. Food approach patterns of metal-eater type animals to the test baits. A, B and C show each individual. Upper and second column of each individuals show feeding behaviour of control powder offered on the second and third day of the experiment, respectively. Norbormide was offered at 4th day.
typical feeding patterns were changed when norbormide was added to the food (Figs.
3 and 4). Figure 3 shows three typical food approach patterns of meal-eater type
animals to the test baits; the rat (180 g) had initial feeding only (Fig. 3-A), the rat
(270 g) stopped feeding for a while (Fig. 3-B), the rat (220 g) showed repeatedly the
food approach patterns (Fig. 3-C). Figure 4 shows two typical food approach patterns
of nibbler type animals to the test baits; the rat (330 g) had initial feeding only (Fig.
4-A), the rat (610 g) showed repeatedly the food approach behavior (Fig. 4-B).

Already, KUSANO (1975) reported that the activity of food-lever pressing in
norbormide was remarkably lowered from 10 min to 20 min after the starting the
experiment with the Osaka University type Skinner-Box. These patterns may
indicate figure 3-1, -2 and 4-1 patterns in the present experiment.

It will be clear that food approaches are not necessarily representative of food
intake. Therefore, to evaluate the experimental set-up of method-1, we monitored
the food approach behaviour and actual food consumption (Fig. 5). From this figure,

![Fig. 4. Food approach patterns of nibbler type animals to the test bait.
A and B show each individuals. Upper and second column of each individuals show feeding
behaviour to control powder offered on the second and third day from the experiment, respecti-
vely. Norbormide was offered at 4th day.](image)

![Fig. 5. Typical patterns of cumulative number of food approach behaviour and food
consumption. Weight of the animal is 540 g.](image)
cumulative number of food approach was correspond to food consumption \( r=0.997 \). Rietveld et al. (1978) examined that the relationship between actual (weighed) food intake and the number of approaches recorded during the measuring periods appeared to be essentially linear for each rat, and that correlation coefficients ranged from 0.90 to 0.99. In the present experiment it was found that food consumption corresponded to conventionally measured food approach patterns.

Next, we evaluated the feeding patterns to the test baits from the actual food consumption. The cumulative food consumption patterns of succumbed animal (500 g) was different from that of one which survived (620 g) (Fig. 6). Succumbed animal (B) repeatedly consumed the test baits, while the surviving one (A) was slow, and repeated little consumption over a dark period. From this data, rats showed in figure 6-A and -B might consume the test baits like figure 3-3 or 4-2, and figure 3-1 types, respectively. Figure 7 indicates two model-types of the feeding approach patterns. As shown in figure 3, the feeding approach patterns on the initial day (second day) was similar with that on the consecutive day (third day). The meal-eater type rat did not change in the nibbler type feeding patterns. Therefore, we could estimate two types on the previous day before offering norbormide. The feeding types in figure 3-A(4), -B(4) and -C(4) were correspond with M-1, -2 and -3 in figure 7, respectively. The feeding types in figure 4-A(4) and -B(4) correspond with N-1 and
-2 in figure 7, respectively. Accordingly, norbormide may be suitable for these meal-eater type, especially model-type (M-1 and M-2) rats, but it is not suitable for nibbler type rats (N-1 and N-2).

REFERENCES


