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USE OF MICROCOMPUTERS FOR RANDOMLY ASSIGNING ANIMALS TO TREATMENT GROUPS, FORMULATING BAITS, AND KEEPING RECORDS

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ABSTRACT: A computerized laboratory animal tracking database system and several interactive microcomputer application programs for monitoring captive animals, selecting and randomly assigning animals to treatment groups, formulating baits, and other tasks are described.

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INTRODUCTION

Today personal computers are widely available and can be invaluable tools for scientists and technicians involved in wildlife research and animal damage control. Common applications include preparing manuscripts, tracking budgets, managing files, reviewing literature, electronically interacting with other researchers, and analyzing data. Microcomputers can also increase the efficiency and productivity of personnel responsible for procuring and maintaining test animals, formulating baits, and conducting feeding trials.

Researchers working with animals or collecting data for pesticide or drug registration purposes must comply with the Animal Welfare Act and Good Laboratory Practices (GLP) standards. This requires keeping accurate records of captive animals and documenting all test procedures. Personnel at the Denver Wildlife Research Center's Hawaii field station routinely capture wild rodents (*Rattus exulans*, *R. norvegicus*, and *R. rattus*) for use in laboratory bait efficacy studies. We regularly maintain over 300 rats of 3 different species for use in several tests. Keeping accurate records of these animals can be a formidable task. This paper describes a computerized animal tracking database system and several interactive application programs that we utilize to provide current information on the status of each animal, reduce tedious and error-prone manual calculations involved with formulating baits and conducting laboratory feeding trials, and standardize data collection procedures.

LABORATORY ANIMAL DATABASE

We developed and maintain a computer master database with an individual record of every animal brought to the field station. We weigh and inspect each animal, record its apparent condition, and quarantine it for 3 weeks before testing. After testing has commenced, we keep a daily record of each animal's food consumption and apparent health. The master database includes species, origin or trapping location, date of receipt or capture, identification number, sex, age class, weight, quarantine cage number, and current status (i.e. whether it is in quarantine or is being used for a test). When an animal dies, is euthanized, or is used for a test, its record is updated to indicate its current weight, new cage number, current status and test identification number, or final disposition. The master database can be queried for a summary of the animals used for any particular test. Records can be retrieved easily based on any combination of variables, including those animals of a particular species and sex held in quarantine and available for testing. Daily bait consumption and survival/mortality data can be appended to the animal database. The master database can be used directly by popular software

packages such as PC-SAS[®] (SAS Institute, Cary, NC), Harvard Graphics[®] (Software Publishing Corp., Mountain View, CA), or Freelance Plus[®] (Lotus Development Corp., Cambridge, MA) to generate summaries, perform statistical analyses, and display graphics.

RANDOM SELECTION OF TEST ANIMALS

Statistical validity of experimental results requires the random assignment of animals to treatment groups. Using numbered or colored plastic chips, dice, a random number table, or other commonly used methods to assign subjects to treatment groups can be time-consuming and unnecessarily complicated, especially when several classification variables are involved.

I have developed a computer program that randomly selects animals from our master database and assigns them to treatment groups. The program is first used to search the master database to locate the pool of quarantined animals available for testing. Animals can be selected based on species, sex, age class, weight, or any other selection criterion (Table 1). To avoid potential bias resulting from animal weight being confounded with a treatment, the program ranks animals by weight, eliminates any individuals lying outside a specified weight range, divides the ranked animals into weight groups based on the number of treatments and the number of replicates per treatment, and randomly assigns a treatment to the animals in each weight group. A proven and reliable uniform random number generator (UNIF, Bratley et al. 1983) generates the pseudo-random sequence of numbers used in the selection program. The program generates a computer printout of the selected animals with their assigned treatments (Table 2).

Table 1. Input variables used by a computer program to select and randomly assign animals to treatment groups.

Selection variables	Examples ^a
Species	(N)orway
Sex (male, female, both)	(b)oth
Age class	(a)dult
Upper/lower weight limits (g)	350, 100
Number of treatments	4
Number of replicates/sex/treatment	2
Random generator seed	4987123

^aTwo adult Norway rats per sex between 100-350 g body weight to be evaluated in each of 4 treatment groups.

Table 2. Example output of a computer program that selects and randomly assigns animals to treatment groups for laboratory rodenticide bait efficacy tests.^a

	Cage	Animal	Age	Sex	Species	Weight(g)	Treatment
1	a06	1967	a	m	n	328	2
2	a10	1598	a	f	n	253	3
3	a13	1662	a	f	n	216	4
4	a23	1944	a	m	n	286	3
5	a18	1898	a	m	n	249	1
6	a31	1686	a	f	n	211	1
7	a27	1989	a	m	n	233	4
8	a01	1583	a	m	n	219	2
9	a14	1667	a	m	n	208	3
10	a37	1906	a	f	n	196	2
11	a07	1611	a	f	n	183	4
12	a20	1884	a	f	n	180	2
13	a34	1968	a	m	n	206	4
14	a08	1701	a	f	n	178	3
15	a29	1954	a	m	n	199	1
16	a03	1877	a	f	n	175	1

^aEight adult Norway rats per sex between 100-350 g body weight were selected, ranked in descending order by weight, divided into 2 weight groups (number of replicates/treatment), and each animal in each group was randomly assigned to 1 of 4 treatment groups.

BAIT FORMULATION

We also use microcomputers to formulate rodenticide baits for laboratory evaluation. The quantity of bait needed for each test varies and depends on the number of animals of each sex and species in each treatment, the daily ration for each animal, the length of the test, and the quantity of bait needed for reserve and assay samples. Addition of toxicants, attractants, adhesives, or other additives to baits requires careful calculation of the amount of technical grade chemical needed for the size and concentration of batch to be prepared. That technical grade chemicals are rarely 100% pure must be taken into account when calculating the amount of each material to be added. Use of approximate "correction factors" can introduce unacceptable biases because of inherent rounding errors.

An application program developed at our facility determines the exact total bait requirements for a test and calculates the precise quantities of each ingredient needed (Tables 3 and 4). The program takes into account information from chemical assays on the purity of the ingredient, the desired concentration for each ingredient, and the desired batch size. The bait type, concentration of each ingredient, batch and sample identification numbers, quantity prepared, preparation date, and the name of the technician who prepared the bait are stored in a permanent database file. Summaries by bait type and toxicant can be easily produced. The program automatically generates computer-printed labels that can be used to identify assay and reserve sample bags (Figure 1).

Table 3. Example input variables use by a computer program to formulate rodenticide baits for laboratory efficacy tests.

Input variables	Examples
Number of species to be tested	3
Number of animals per treatment	10
Number of feeding days	3
Quantity (g) of bait/animal/day/species	20, 20, 10
Quantity for reserve and assay samples	300 g
Bait preparation date	29 Jan 91
Bait batch identification number	91-225-001
Name of technician	RT Sugihara
Number of labels/batch	3
Bait base	Rolled oats
Toxicant	Zinc phosphide
Percent AI of technical material	96.8
Desired percent AI of toxicant	1.88
Number of bait additives	2
Name of bait additive 1	Alcolec-S [®]
Percent AI of technical material	98.0
Desired percent AI of additive 1	2.0
Name of bait additive 2	DMCT tracer
Percent AI of technical material	58.0
Desired percent AI of additive 2	0.5

Table 4. Output of a computer program listing ingredients used to formulate a 1,950 g batch of 1.88% (AI) zinc phosphide-rolled oats bait with 2 additives.

Bait ingredient	Concentration of technical material	Desired concentration	Quantity needed (g)
Zinc phosphide	96.8	1.88	37.87
Alcolec-S	98.0	2.00	39.80
DMCT tracer	58.0	0.50	16.81
Rolled oats	100.0	—	1,855.52
Total	—	100.00	1,950.00

1.88% Zinc phosphide-rolled oats
 2.00% Alcolec-S
 0.50% DMCT
 Prep date: 29Jan91 Batch id: 92-220-001
 Tech: RT Sugihara Sample: 1 Qty: 100 g
 USDA/APHIS DWRC Hawaii Field Station
 P.O. Box 10880 Hilo, Hawaii 96721

Figure 1. Example bait bag label generated by a computer program used to formulate rodenticide baits.

PROGRAM REQUIREMENTS AND AVAILABILITY

The computerized system described in this paper can be installed on any standard IBM-compatible microcomputer. The dBASE IV® (Aston Tate, Torrance, CA) data base

management software is used to input, store, manipulate and retrieve animal and bait formulation records. The special application programs described were written in FORTRAN. The system can be easily modified for other database management and applications development software. Examples of the database record structures, program output, program source codes, and user's instruction can be provided upon request.

SUMMARY

This paper describes special computer applications for storing and retrieving records of captive animals, formulating baits, and randomly selecting and assigning test animals to treatments. These menu-driven programs simplify and standardize data input, storage and retrieval. The programs facilitate record keeping and the documentation of test procedures, and they eliminate tedious, time consuming, and error-prone manual processing.

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LITERATURE CITED

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