The Attractiveness of a Liquid Bait to White-Tailed Deer in the Central Appalachian Mountains, Virginia, USA

Authors: Hakim, S., McShea, W. J., and Mason, J. R.

Source: Journal of Wildlife Diseases, 32(2) : 395-398

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-32.2.395

Journal of Wildlife Diseases, 32(2), 1996, pp. 395–398

The Attractiveness of a Liquid Bait to White-Tailed Deer in the Central Appalachian Mountains, Virginia, USA

S. Hakim,[1] W. J. McShea,[1] and J. R. Mason[2] [1]National Zoological Park Conservation and Research Center, Front Royal, Virginia 22630, USA; and [2]U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control, Denver Wildlife Research Center, % Monell Chemical Senses Center, 3500 Market Street, Philadelphia, Pennsylvania 19104, USA

ABSTRACT: We determined the attractiveness of a bait composed of apple juice, apple odor, water, glycerin, and salt to captive white-tailed deer (*Odocoileus virginianus*) at the National Zoological Park Conservation and Research Center, Front Royal, Virginia, USA. Thirty-nine deer (three adult males, 20 adult females, eight male fawns, eight female fawns) were presented with the bait formulation in a 22-ha enclosure during January, February, and May 1994. Daily consumption, and the frequency of visits to bait dispensers and the frequency of drinking bouts were recorded. Overall consumption was greatest in May ($P < 0.001$). While adults and fawns visited bait dispensers equally often, fawns drank more frequently ($P < 0.001$).

Key words: Attractant, bait, white-tailed deer, flavor, olfaction, *Odocoileus virginianus*, taste.

Browse damage by white-tailed deer (*Odocoileus virginianus*) is important to wildlife managers and farmers alike (Conover and Decker, 1991; Vecellio et al., 1994). In some areas, burgeoning deer populations also threaten health and safety. Deer-automobile collisions have become common (Witmer and deCalesta, 1992), and deer are important to breeding ticks (*Ixodes* spp.) that transmit Lyme disease (Anderson, 1988).

Nonlethal methods to reduce deer numbers or slow population growth in suburban and urban areas are being sought (Kirkpatrick and Turner, 1985). Although a variety of chemical and immunosterilant substances may become available presently (Turner et al., 1990), the problem of inoculating large numbers of deer remains. Silastic implants (Plotka and Seal, 1989) and direct intramuscular injections (Harder and Peterle, 1974) are neither economical nor efficient. Although oral vaccines for sterilization or the oral delivery of other medications would be relatively inexpensive and easy to use, no carrier formulations currently are available for drug delivery.

We have been studying the acceptability of various bait formulations to free-ranging white-tailed deer (Mason et al., 1993, 1995; Mason and Bean, 1995). Mason et al. (1995) found that a liquid bait composed of apple odor, apple juice, water, glycerin, and salt is a promising candidate for the delivery of pharmaceutical substances. Nonetheless, a number of important variables remain unaddressed. These include the age of the deer encountering bait (Bernstein, 1991), seasonal and geographic differences in bait attractiveness (Jones and Hanson, 1985), and the availability of preferred and alternative foods within and across years (McShea and Schwede, 1993). We designed the present experiment to evaluate the influence of age and season on bait attractiveness.

Testing occurred in a 22-ha enclosure at the National Zoological Park Conservation and Research Center, Front Royal, Virginia, USA (38°52′N, 78°7′W). We used 39 white-tailed deer (three adult males, 20 adult females, eight male fawns, and eight female fawns) for a density of 180 deer/km^2. All adults were individually identified with ear-tags. Fawns were not individually marked. There was no supplemental feeding; animals relied on vegetation within the enclosure for browse. A stream passing through the enclosure provided free access to water.

We randomly selected three sites along a diagonal transect bisecting the enclosure. Sites 1 and 2 were separated by 100 m, and sites 2 and 3 were separated by 280 m. We mounted liquid bait dispensers at

each site, about 1 m above-ground (Mason and Bean, 1995). These dispensers consisted of 1-l polyethylene bottles with a metal 15-mm diameter single-ball sipper tube attached. Once filled, the bottles were placed in a 32 cm high, 14 cm diameter section of polyvinyl chloride (PVC) pipe. An end cap through which the sipper tube passed was permanently attached to the pipe. Each dispenser was filled with a solution of 60% (vol/vol) water, 20% apple juice (Acme Store Brand, Philadelphia, Pennsylvania, USA), 18% glycerin (Sigma Chemical Company, St. Louis, Missouri, USA), 2% apple odor (International Flavors and Fragrance, Union Beach, New Jersey, USA), and 2% (mass/mass) sodium chloride (Sigma Chemical Company) (Mason et al., 1995). A control solution for the bait solution was not presented; based on pilot investigations, no measurable consumption occurs from dispensers in the absence of the bait.

A visit was defined as an approach to within 2 m of a bait dispenser, and a drink was defined as a muzzle contact with the dispenser. Visit and bout frequencies by individual deer at each site were recorded daily from 3 January to 28 February and 1 May to 1 June 1994. Observations were made by individuals with binoculars positioned approximately 200 m from the enclosure fence. Each observation period lasted about 2 hr. Over days, the timing of observation periods was evenly distributed from sunrise until sunset.

Consumption from each bait dispenser was recorded daily, and solutions were replenished each morning at 09.00 hr. During the periods of observation, bait always was available. Between 28 February and 1 May 1994, all dispensers were left empty.

Mean consumption was averaged over 4-day intervals and evaluated in a two-factor repeated measures analysis of variance (Keppel, 1973). The factors were month (three levels; January, February, May) and dispenser site (three levels). Subsequent to the omnibus procedure, Tukey's tests (Winer, 1962) were used to distinguish significant ($P < 0.01$) differences among means.

The frequency of visits and drinking bouts by fawns and adult females were ranked on each observation date. Adult males were excluded from the formal analysis because of their small number. Ranks were evaluated using Friedman's analyses of variance by ranks (Siegel, 1956), and a chi-square was calculated in Friedman's analysis.

There were significant differences in consumption of liquid among months ($F = 24.4$; 2, 8 df; $P < 0.001$). Mean (±SE) drinking was significantly higher during May (1254.4 ± 207.2 ml) than during January (267.1 ± 47.6 ml) or February (448.9 ± 81.5 ml). There were no significant differences in drinking between the winter months ($P > 0.25$).

Although visit frequencies varied considerably among individuals, all of the adult females and two of the adult males visited a bait dispenser at least once. Only seven of the 20 adult females were observed drinking. Neither of the adult males were observed to drink.

There were no differences ($P > 0.25$) between fawns and adult females in the mean (±SE) number of visits to bait sites (3.9 ± 0.6 versus 3.6 ± 0.4 visits/day, respectively). However, there was a significant difference in the number of drinking bouts (Chi-square = 15.64; 2 df; $P < 0.001$); fawns drank more often than adult females (2.7 ± 0.5 versus 1.3 ± 0.4 bouts, respectively).

There was large individual variability in visit and drinking bout frequencies. Reasons for this variability remain obscure, although differences in physiology or nutritional status may be important.

Seasonal differences in bait acceptance were observed. Mean consumption during May was 3.5 times greater than during January and February. While deer might have drunk more during May because of increasing familiarity with the formulation and bait dispensers, this seems unlikely. The observed increase in consumption was

abrupt, occurring at the beginning of May. There was no appreciable increase in consumption during January and February. Factors that might underlie this difference include shifts in diet composition that make bait more attractive (Jones and Hanson, 1985), or dietary deficiencies that enhance the sampling of new potential foods, such as the bait (Moe, 1993). Regardless of the explanation, increasing consumption during the spring was consistent with prior observations (Mason et al., 1995).

Age differences in bait acceptance were observed. Although fawns and adult females visited bait dispensers equally often, fawns were more likely to drink. We speculate that young deer may be more likely to accept and prefer sweet and salty tastes than mature animals. This possibility is consistent with available evidence for other mammals (Bernstein, 1991; Beauchamp and Mason, 1991).

Although not explicitly evaluated in the present experiment, the data are consistent with the notion that spring presentations of liquid baits composed of apple extract, apple juice, water, glycerin, and salt may be effective vehicles for the delivery of pharmaceutical substances to fawns. The same also may hold for adult females. Whether adult males are likely to accept the liquid baits remains undetermined. Investigation of this variable is important because sexual status can influence taste preferences of deer (Crawford and Church, 1971). Finally, while deer did not compete for access to the bait dispensers in the present study, the number of animals present (180 deer/km^2) was much greater than numbers considered high in most situations, such as 28 deer/km^2 reported in central Pennsylvania (USA) by Vecellio et al. (1994). Because population density affects food acceptance (Leopold, 1933), the attractiveness of bait formulation to both captive and free-ranging deer at various densities should be investigated.

Funding was provided by U.S. Department of Agriculture Cooperative Agreement #95-7407-0040-CA between the Monell Chemical Senses Center and the Denver Wildlife Research Center (DWRC). Procedures were approved by the DWRC and Monell Animal Care and Use Committees. Paul Breslin and Krystina Rankin commented on earlier manuscript drafts.

LITERATURE CITED

ANDERSON, J. F. 1988. Mammalian and avian reservoirs for *Borrelia burgdorferi*. *In* Lyme disease and related disorders, J. L. Benach and E. M. Bosler (eds.). Annals of the New York Academy of Sciences, Vol. 539, New York Academy of Sciences, New York, New York, pp. 180–191.

BEAUCHAMP, G. K., AND J. R. MASON. 1991. Comparative hedonics of taste. *In* The hedonics of taste, R. C. Bolles (ed.). Lawrence Erlbaum Associates, New York, New York, pp. 159–184.

BERNSTEIN, I. L. 1991. Development of taste preferences. *In* The hedonics of taste, R. C. Bolles (ed.). Lawrence Erlbaum Associates, New York, New York, pp. 143–158.

CONOVER, M. R., AND D. J. DECKER. 1991. Wildlife damage to crops: Perceptions of agricultural and wildlife professionals in 1957 and 1987. Wildlife Society Bulletin 19: 46–52.

CRAWFORD, J. C., AND D. C. CHURCH. 1971. Response of black-tailed deer to various chemical taste stimuli. The Journal of Wildlife Management 35: 210–215.

HARDER, J. D., AND T. J. PETERLE. 1974. Effects of diethylstilbestrol on reproductive performance in white-tailed deer. The Journal of Wildlife Management 38: 183–196.

JONES, R. L., AND H. C. HANSON. 1985. Mineral licks, geophagy, and biochemistry of North American ungulates. University of Iowa Press, Ames, Iowa, 275 pp.

KEPPEL, G. 1973. Design and analysis: A researcher's handbook. Prentice-Hall, Englewood Cliffs, New Jersey, 658 pp.

KIRKPATRICK, J. F., AND J. W. TURNER. 1985. Chemical fertility control and wildlife management. Bioscience 35: 485–491.

LEOPOLD, A. 1933. Game management. University of Wisconsin Press, Madison, Wisconsin, 481 pp.

MASON, J. R., AND N. J. BEAN. 1995. Evaluation of the attractiveness of liquid baits containing natural and artificial sweeteners to white-tailed deer. The Journal of Wildlife Management 95: In press.

———, ———, AND L. CLARK. 1993. Development of chemosensory attractants for white-tailed deer (*Odocoileus virginianus*). Crop Protection 12: 448–452.

———, ———, L. S. KATZ, AND H. HALES. 1995. Development of a bait for the oral delivery of pharmaceutical substances to white-tailed deer

(*Odocoileus virginianus*). *In* Contraception in wildlife. T. J. Kreeger (ed.). U.S. General Publication Office, Washington, D.C., in press.

MCSHEA, W. R., AND G. SCHWEDE. 1993. Variable acorn crops: Responses of white-tailed deer and other mast consumers. Journal of Mammalogy 74: 999–1006.

MOE, S. R. 1993. Mineral content and wildlife use of soil licks in southwestern Nepal. Canadian Journal of Zoology 71: 933–936.

PLOTKA, E. D., AND U. S. SEAL. 1989. Fertility control in female white-tailed deer. Journal of Wildlife Disease 26: 643–646.

SIEGEL, S. 1956. Nonparametric statistics for the behavioral sciences. McGraw-Hill, New York, New York. 312 pp.

TURNER, J. W., I. K. M. LUI, AND J. F. KIRKPATRICK. 1990. Remotely delivered immunocontraception of captive white-tailed deer. Proceedings of the Conference on Fertility Control in Wildlife, University of Melbourne Press, Melbourne, Australia, 50 pp.

VECELLIO, G. M., R. H. YAHNER, AND G. L. STORM. 1994. Crop damage by deer at Gettysburg Park. Wildlife Society Bulletin 22: 89–93.

WINER, B. J. 1962. Statistical principles in experimental design. McGraw-Hill Book Co., New York, 907 pp.

WITMER, G. W., AND D. S. DECALESTA. 1992. The need and difficulty of bringing the Pennsylvania deer herd under control. Proceedings of the Eastern Wildlife Damage Control Conference 5: 130–137.

Received for publication 9 February 1995.