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ABSTRACT: This study was designed to evaluate the attractiveness of eight aldehyde volatiles (octanal, nonanal, decanal, undecanal, dodecanal, tridecanal, tetradecanal, and hexadecanal) found in sheep liver extract and coyote (Canis latrans) estrous urine to determine their potential for use as odor attractants in predator control. The odors were presented to captive coyotes at the Hopland Field Station and the length of time coyotes responded to the odors was recorded. Octanal, nonanal, decanal, and undecanal all elicited as much sniffing and rub-rolling as did a known coyote attractant, trimethylammonium decanoate (TMAD). Generally male and female coyotes were equally attracted to the odors; however, nonanal was preferred by males in summer and by females in winter. In comparison to TMAD, some aldehydes were effective in eliciting sniffing and rub-rolling but ineffective in eliciting lick-chewing and biting. Thus, the aldehydes are probably best suited as odor attractants for use with capture devices such as the steel trap, and least suited for use with toxicant-delivery systems such as the M-44.

INTRODUCTION

Chemical lures are often used by fur trappers and control specialists to attract coyotes to traps or other control devices. Usually, lures consist of a mixture of fermented blood, animal organs, urine and other similar constituents. Although many odor attractants in use are effective, the specific behaviors various attractants elicit are generally unknown. In predator control, this is important since some techniques require lures that elicit specific behavioral responses such as chewing, licking, biting, or pulling (Turkowski et al. 1979, Fagre et al. 1982).

Beginning in 1972, a multidisciplinary team initiated chemical and behavioral studies to discover chemicals which evoke specific reactions from coyotes. The chemical research was done by scientists in the Biocommunication Chemistry Research Unit of the Western Regional Research Center, U.S. Department of Agriculture, Albany, California, and the research involving the responses of penned coyotes was conducted by scientists at the University of California Hopland Field Station and Davis Campus.

Since the cooperative research was initiated, hundreds of compounds have been screened. Recently, sheep liver extract (SLE) was found to be one of the most attractive odors evaluated (Barnum et al. 1982) and therefore work was done to identify the volatile constituents (Lorenz et al. 1983). Lorenz et al. (1983) identified 108 compounds which included a series of aldehyde volatiles. Since aldehydes were also found in coyote estrous urine (T.H. Schultz, personal communication), it was reasoned they could be effective coyote attractants.

A study was designed to evaluate the attractiveness of selected aldehyde volatiles and to determine their potential for use in predator control. The study involved: (1) comparing the overall attractiveness of the aldehydes to a standard odor attractant, trimethylammonium decanoate (TMAD) and a control; (2) determining behavioral responses elicited by the aldehydes; and (3) assessing how the aldehydes could be most effectively used in predator control.

METHODS

During August and September 1983, the following aldehydes were evaluated: (1) octanal (OAL), (2) nonanal (NAL), (3) decanal(DAL), (4) undecanal (UDAL), (5) dodecanal (DDAL) 80% in hexane, (6) tridecanal (TRDAL) 80% in hexane, (7) tetradecanal (TTDAL) 40% in hexane, and (8) hexadecanal (HDAL) 20% in hexane.

The testing protocol involved applying 0.5 ml of a candidate attractant to the exterior of a wool carpet piece wrapped around the short arm of a steel bait post. The 0.6-m bait post was then secured in a vertically buried pipe. The attractants were presented to each coyote in randomized pairs in 100 tests. A total of two exposures per coyote, or 20 exposures total, was obtained for each attractant in 200 separate odor presentations.

Individual coyotes were released into a 0.1-ha test area through a remote control door. Coyotes were observed for 10 minutes from a blind containing a one-way window and behaviors were recorded using an Esterline-Angus multipen event recorder. Between tests, the bait posts were cleaned with a strong detergent and hot tap water, soaked briefly in a phosphoric acid bath, and then soaked in a trisodium phosphate solution. New carpet pieces were used in each test.

A multiple comparison precedure described by Gibbons (1976) was used to statistically compare the length of time coyotes responded to the odors. The response time ofmale and female coyotes was statistically compared using a Mann-Whitney-Wilcoxin test (Gibbons 1976). Response times were considered significantly different when $P<0.05$.

RESULTS AND DISCUSSION

The amount of time coyotes spent sniffing, rub-rolling, lick-chewing, and biting the odors is listed in Table 1. Coyotes spent significantly more total time at OAL, NAL, DAL, and UDAL than at DDAL, TRDAL, TTDAL, and HDAL (Table 1). Although hexane was used as a solvent for these latter four compounds, the coyotes probably were not affected by it. Hexane is highly volatile and presumably all of it dissipated within seconds of application of the odor solution to the wool carpet piece. The decrease in attractiveness of DDAL, TRDAL, TTDAL, and HDAL was probably due to their high molecular weight and low vapor pressure.

Since TMAD was developed, it has been consistently one of the most attractive odors evaluated at Hopland. It often has been used at Hopland as a standard against which new odors could be compared. In this test, there was no significant difference in the length of time coyotes responded to TMAD, OAL, NAL, DAL, and UDAL. From mid-April to the end of December 1983, coyotes responded more to TMAD in only one other test. Thus, for the odors OAL, NAL, DAL and UDAL to equal TMAD in attractiveness suggests these odors hold promise as an effective coyote attractant.

Males were generally more attracted to the odors than were females (Table 1); however, none of these differences were statistically significant. Sex preferences for the odors differed most for NAL. The average time male coyotes spent at NAL was nearly three times greater than for females. Nonanal was also evaluated in two other tests conducted December through February 1983-1984 (Fig. 1). Although in these tests there were significant differences in the length of time males and females responded to NAL, sex preferences for NAL in these winter tests were reversed: females were attracted more to NAL than were males (Fig. 1). Possibly these differences were due to male/female preferences for NAL which vary seasonally. Developing sex-specific attractants would be significant, but future testing is needed to further elucidate the sex-specific responses of coyotes observed in these tests.

Table 1. Mean response time (seconds) for behaviors elicited by odor samples on bait posts for 10 coyotes (sexes equal) exposed twice to each odor in 10-minute tests.

	Odor[1]									
Behavior	OAL	NAL	DAL	UDAL	DDAL	TRDAL	TTDAL	HDAL	TMAD	CNTL
Sniff	15.6a[2]	14.9a	14.3a	12.4a	3.8cd	3.9bcd	5.5b	4.7bc	12.1a	1.6d
Rub-roll	31.6a	26.8a	23.8a	22.0a	5.3bc	4.9cd	9.2b	4.5bc	22.3a	1.7d
Lick-chew	1.8b-d	1.3d-f	1.1b-d	1.7ab	0.3c-f	0.2ef	0.6abc	0.4b-e	4.2a	0.1f
Bite	5.3b-d	5.9cd	4.9ab	3.3a-c	1.9d	4.5b-d	1.9b-d	1.9d	7.7a	1.7d
Total[3]	56.0a	50.4a	44.0a	39.3a	11.5cd	14.4bc	17.2b	12.9bc	46.4a	5.3d
Male[3]	66.5	74.2	48.2	43.6	15.5	17.8	20.9	18.0	42.8	3.5
Female[3]	45.4	26.5	39.7	35.0	7.5	10.9	13.4	7.8	49.9	7.0

[1]Odor abbreviations are: OAL = octanal; NAL = nonanal; DEC = decanal; UDAL = undecanal; DDAL = dodecanal; TRDAL = tridecanal; TTDAL = tetradecanal; HDAL = hexadecanal.

[2]Values followed by the same letter(s) are not significantly different ($P<0.05$). Values were compared using a multiple comparison test described by Gibbons (1976).

[3]Includes time spent scent-marking and scraping at bait posts.

Coyotes sniffed and rub-rolled OAL, NAL, DAL, and UDAL significantly more than other aldehydes; however, the response time for these four aldehydes and TMAD did not significantly differ. Coyotes spent less time lick-chewing and biting the odors (Table 1). For these two behaviors, the average response time was greatest for TMAD.

Since the aldehydes primarily elicit sniffing and rub-rolling, they probably would be best used as lures for traps and other capture devices. Contrarily, since the aldehydes do not evoke much lick-chewing and biting, their effectiveness as attractants for use with the M-44 or other toxicant-delivery systems is probably limited.

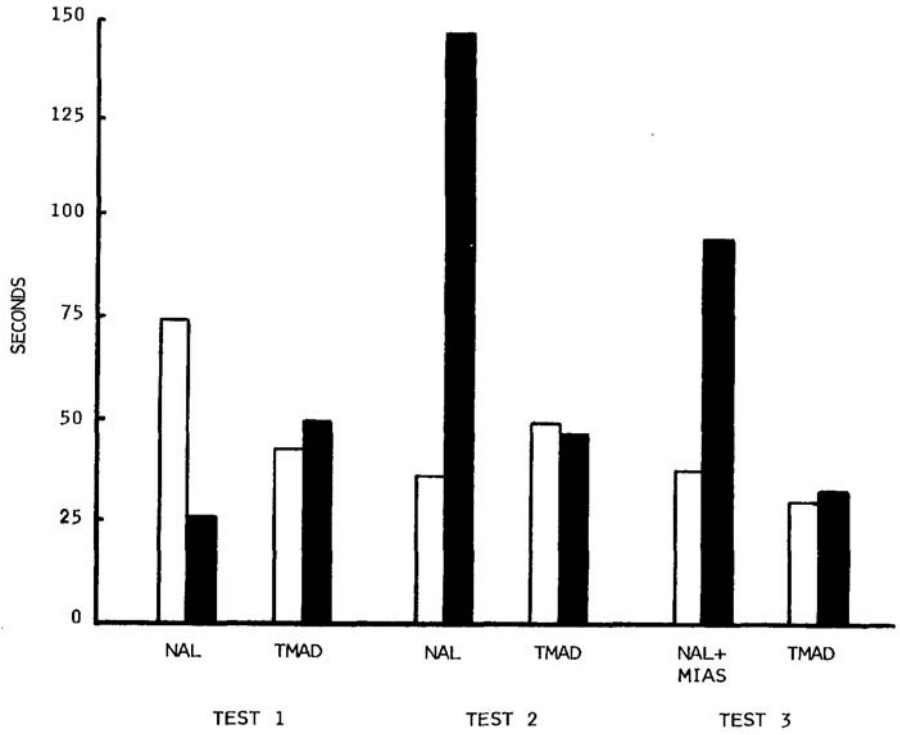

Fig. 1. Mean time spent visiting odor samples on bait posts by five male (light) and five female (dark) coyotes exposed twice to each odor in 10-minute tests. Data for test 1, 2, and 3 were gathered August-September 1983, December-January 1983-1984, and January-February 1984, respectively. Odor abbreviations are: NAL = nonanal; trimethyl ammonium decanoate = TMAD: and methyl isoamyl sulfide = MIAS.

SUMMARY AND CONCLUSIONS

Since aldehydes were found in both sheep liver extract and coyote estrous urine, they were thought to be potentially effective coyote attractants. Exposing captive coyotes to selected aldehydes and recording their responses yielded the following results:

1) Four of eight aldehydes were as attractive to coyotes as was a known coyote attractant.

2) Generally, male and female coyotes were equally attracted to the aldehydes; however, sex preferences for the aldehyde nonanal was evident: males preferred the odor in summer and females preferred the odor in winter.

3) In comparison to a known coyote attractant, some aldehydes were effective in eliciting sniffing and rub-rolling behaviors but ineffective in eliciting lick-chewing and biting behaviors. Thus, in predator control the aldehydes could probably be used most effectively with control techniques that require attractive odors but do not require predators to lick, chew or bite.

In general, synthetically derived chemicals, such as those described in this paper, have several advantages: they are relatively inexpensive and easy to obtain, and they do not require time to age or exhibit batch-to-batch variation in odor quality (Fagre et al. 1983). Identifying which chemicals coyotes find most attractive and the behavioral responses elicited by those chemicals could lead to the development of a odor attractant specific for coyotes. This should decrease the take of nontarget species which would increase the efficiency of coyote control programs and make predator management more acceptable to the public (Fagre et al. 1983).

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