TECHNICAL NOTE

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Effect of Background Interference on Accelerant Detection by Canines

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ABSTRACT: Additional studies were performed with respect to examining the lower limits at which canines can reliably detect products commonly used as accelerants and distinguish them from pyrolysis products or background hydrocarbons. As part of a testing exercise performed in conjunction with a national conference of the Canine Accelerant Detection Association (CADA), 34 canines were subjected to a series of tests, some of them were a recertification proficiency. In one of the tests, the dogs were nearly unanimously successful in locating one can (out of five) containing 50% evaporated gasoline at the 5 μL level on a burnt carpet matrix, and pinpointing the 6-in. square sector on a piece of plain carpeting where the same amount of gasoline (5 μL) was applied. However, only half were able to detect a second doped sample containing a lesser amount (0.05, 0.1, or 0.2 μL) of gasoline, and registered a number of alerts on samples containing only burnt carpeting material. The dogs were also tested on measured amounts (2 or 5 μL) of a variety of other light, medium, and heavy petroleum products applied to a variety of substances containing significant pyrolysis products. As a group, the canines were much less successful in pinpointing these products than they were with gasoline at this same level, and again registered a number of alerts on cans containing only pyrolysis products. The significant number of alerts by canines on samples not containing gasoline or other products points out the importance of obtaining laboratory confirmation on samples on which dogs alert, and on keeping accurate field and training records of the canines to establish their credibility.

KEYWORDS: forensic science, fire debris, chromatographic analysis, charcoal adsorption, canine detection, pyrolysis background, gas chromatography

Canines have been successfully used for nearly a decade to aid fire investigators in detecting accelerants at fire scenes in many parts of the country. Trainers have estimated that the dogs have saved many man hours in fire scene investigation by accurately pinpointing accelerant residues that in some cases would not have readily been found. Despite the increasing usage of canines at fire scenes, the literature with respect to its efficacy is rather sparse and has appeared in nonreferred articles (1,2). Recently, we reported on a study that focused on detection limits for accelerants by canines and their ability to differentiate potential accelerants from background substances or pyrolysis products (3). That work, which was primarily concerned with detection of petroleum products in the absence of interfering background, suggested that canines could detect petroleum products at levels down to, and in some cases, beyond the typical detection limits of gas chromatography with flame ionization detectors (3). A recent report substantiated that observation (4). Similar testing carried out at fire scenes (3) and other studies (5,6) showed somewhat of a drop-off in the ability of the canines to alert reliably on trace levels of accelerant in samples containing significant background interference. Although most canines are trained to discriminate between background substances and petroleum products, there are indications that some dogs alert on samples in which the lab has only been able to detect the former (3). As part of a testing exercise performed in conjunction with a national conference of the CADA 34 canines were subjected to a series of tests, some of them were a recertification proficiency. One of the issues we wished to explore further was the effect of heavy pyrolysis products on the ability of canines to detect trace petroleum residues (detection limits), and to compare this with the ability of the laboratory to recover and detect petroleum residues by passive charcoal adsorption recovery techniques coupled with gas chromatography using a flame ionization detector (GC-FID).

Materials and Methods

Testing took place on Oct. 25, 1994 with each handler working his/her canine through four different tests described below. Some of the tests were used for certification purposes for dogs trained in Maine, but the Varied Product Test and part of the Common Matrix Test were run as part of this research survey. Canines and their handlers came from many parts of the United States including Florida, Nebraska, Indiana, Maryland, New York, Ohio, Idaho, Pennsylvania, Tennessee, Illinois, and other states as well as Alberta, Canada. Although the majority of these canines had been trained by the Maine State police using a combination of food and praise reward for positive responses (3), others were developed in Connecticut and New York or were privately trained. The canine/

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handler teams exhibited a wide variation in experience ranging from over six years of extensive work to a few who had only recently began to be used for field work.

Four different tests were set up. The first three, a scent discrimination test, a common matrix test, and a pinpoint test, used 50% evaporated gasoline, whereas many different products were used in the varied product testing. Small pieces [ranging from 1/2 by 4 in. (13 by 102 mm) to about 4 in. (102 mm) square] of unused yellow pine, nylon carpeting, chipped foam pad, or cleaned high density polyethylene milk carton were ignited with a propane torch and allowed to burn for about a minute before dropping into a can and smothering by putting on the lid momentarily. These samples, sealed in cans, and a combination of all four burned substances (mixed matrix) were used for most of the testing. All testing was done blind (i.e., the handler/dog team did not know which samples were doped).

Preparation of Accelerant Plants—All petroleum product plants were dispensed using a positive displacement syringe (0.5 μL accurate to the nearest 0.05 μL or 5 μL accurate to 0.1 μL). The samples containing 2 to 5 μL of petroleum products were prepared 2 to 16 h before needed and sealed in their appropriate cans until testing time, whereas those with 0.2 μL or less were prepared 1 to 3 h before testing. Care was taken to prevent cross contamination throughout the testing process. One person did all the gasoline and petroleum product dispensing, another handled all cans containing doped samples, whereas two others worked only with cans not containing petroleum products.

Scent Discrimination Test

Five metal quart cans were placed in a row about 5 ft (1.5 m) apart. Four contained burned background materials (carpeting, foam pad, plastic, and wood), whereas the fifth contained a cotton ball to which 2 μL of 50% weathered gasoline had been added. The handler walked his/her canine by each can and notified the testing officials of any positive alerts ("hits"). Fresh "hot samples" were provided for each canine to prevent cross contamination; most of the samples containing only burnt debris were used over again because no alerts were recorded on them.

Common Matrix Differentiation Test

Five metal quart cans, labeled 1 through 5, containing similar burnt carpeting, were placed in line in random order. Two of the cans also contained 50% evaporated gasoline (5 μL in one and a smaller amount, 0.05, 0.10, or 0.20 μL, in the other). The handlers walked their canines past each of the cans and were responsible for notifying the testing officials of any positive alerts. The cans were shuffled and the procedure repeated. A fresh set of cans (two doped and three burnt carpeting blanks) were provided for each canine. All doped samples, as well as any others on which a dog made a positive alert, were taken back to the lab and were processed and analyzed by gas chromatography to confirm the presence or absence of gasoline.

Pinpoint Test

This test site consisted of one fresh, unused carpet sample [18 by 24 in. (457 by 610 mm)] that was divided into six equal numbered regions [6 by 8 in. (152 by 203 mm)]. Five microliters of 50% weathered gasoline were placed near the center of one of these regions by one person whose duties were limited to dispensing onto, setting out, and collecting the carpet squares for this test. The handlers led the canines over the carpeting and notified the testing official as to the numbered regions on which their canines alerted.

Varied Product Test

Six metal quart cans were placed in a line in random order. All the cans contained some burnt substance (e.g., carpet, wood, plastic or foam, or a mixed matrix of all four). An undetermined number, typically two or three, also contained 2 or 5 μL of any of a variety of petroleum products from the light, medium, or heavy classification and other related products (e.g., acetone, alcohol). The handlers worked their canines past each of the cans and notified the testing official of any positive samples. The cans were then shuffled and the procedure repeated.

Substances used for this test included lighter products such as cigarette lighter fluid, Coleman fluid, lacquer thinner, ethanol, and acetone. Among the medium petroleum products tested were charcoal lighters, isopars (e.g., "Gulf-Lite"), paint thinners, mineral spirits, xylenes, two-cycle engine oil (which contained some medium petroleum distillates), and naptha. Heavier products included kerosene, Stoddard Solvent, diesel fuel, and odorless lamp oil. All samples from the Varied Product Test on which there were positive alerts were taken back to the lab, processed and analyzed by gas chromatography to confirm the presence or absence of an added petroleum product.

We carried out additional laboratory studies to determine the effects of background hydrocarbons on GC detection limits as well as canine alert success, using similar background substances as had been used in the conference testing. Gasoline (50% evaporated) was doped onto the different types of background at levels of 0.1, 0.2, and 0.5 μL, and the samples were processed and analyzed by GC as before.

Two dogs privately trained in Tennessee (food and praise, passive alert) took part in separate exercises somewhat similar to earlier work at the CADA conference. At each exercise, six metal quart cans labeled 1 through 6 containing similar burnt carpeting, two of them contained small amounts (0.1, 0.2, or 0.5 μL) of 50% evaporated gasoline as well, were placed in a line in random order. The handler walked each canine past the set of cans and indicated each dog alert to the testing scorers. The cans were then shuffled and the procedure repeated. Upon completion of this test, the handler was responsible for verifying any and all recorded "hits." Other substances (burnt foam, wood, and mixed matrix) were applied with 0.1 to 0.5 μL gasoline samples and used in additional exercises. Undoped samples were reused unless or until they caused any alerts.

In the laboratory, the carpet, foam, or wood samples were first subjected to a passive charcoal adsorption technique (7) to remove any volatile substances from the sample matrix and concentrate them onto activated charcoal. A small bag containing charcoal was suspended in the sealed sample can for 24 h, and then the charcoal was transferred to a small tube. The solution resulting after flushing with carbon disulfide was adjusted to 0.1 mL and a portion (0.2 to 1.0 μL) was injected onto a Hewlett-Packard 5840 or 5890 gas chromatograph equipped with flame ionization detectors and Supelco SPB-1 30-m by 0.53-mm fused silica columns, 1.5 μm film thickness. The helium carrier gas flow was set at 18 to 20 cc/min, and the column oven was programmed at 50 to 200°C at a rate of 10°/min after an initial time of 3 min. The ASTM Test Method for Flammable or Combustible Liquid

Residues in Extracts from Samples of Fire Debris by Gas Chromatography (E 1387) was used to discern the five-peak grouping of C_9 alkylbenzenes and a few C_{10} alkylbenzenes for positive identification of gasoline. GC-mass spectrometry was performed on a Hewlett-Packard Mass Selective Detector equipped with a 5790 GC with an Alltech AT-1 30-m by 0.25-mm fused silica column, 1.0-μm film thickness with a similar temperature program as above. Illinois Crime Lab samples were analyzed after using the vacuum purge and trap method recovery method (8). Extracted ion profiles were used to help identify gasoline in presence of significant background interference (9,10).

Results and Discussion

As expected, qualitative observation of the canine/handler teams during the testing process indicated a wide range of skill levels among the teams. The results of the testing performed with the group of canines at the conference are summarized in Tables 1, 2, and 5.

The canines all performed flawlessly on the scent discrimination test, in each case alerting on the one can with 5 μL of 50% evaporated gasoline applied to a cotton ball and ignoring the other four cans containing different types of burnt materials only (Table 1). It is possible that some dogs may have used sight discrimination to help in this test, but in general, the alerts were very swift and seldom required more than one quick walkthrough.

The results of the pinpoint testing, also done with doses of 5 μL of 50% evaporated gasoline, are presented in Table 1. More than 80% alerted on the actual sector (of six) of the unburned carpet sample to which the gasoline had been applied, whereas another 12% alerted on an adjacent sector. Two of the 32 canines did not alert on the carpet at all. Because not all dogs are trained uniformly to pinpoint the exact origin of the odor, these results are not surprising.

Nearly all of the canines tested alerted on the sample doped with 5 μL of 50% weathered gasoline out of five cans, all containing a common matrix and burnt carpeting material (Table 2). The positive alert rate by the dogs on the can containing the smaller quantity (0.05, 0.10, or 0.20 μL) of that same type of gasoline was considerably lower, just over 50% (17 out of 32 overall), and did not correlate systematically with dose level (Table 2). For example, only 5 of 12 canines alerted on 0.2 μL and 4 of 8 on 0.05 μL, whereas 8 of 12 successfully found samples containing 0.1 μL of gasoline. Not only did the canine-handler teams miss many of these trace samples, but nearly two-thirds of the dogs alerted on samples containing only burnt background. More specifically, 11 canines alerted only on spiked samples, whereas 17 had one and 4 registered multiple alerts on undoped samples. Subsequent GC analysis of most of these samples on which the dogs alerted showed significant levels of background pyrolysis products (see Fig. 1). One suspected blank sample on which a canine made an alert was subsequently shown to contain trace levels of gasoline by GC analysis.

Many of the same samples on which the canines had difficulty distinguishing low levels of gasoline on high levels of background were difficult to confirm positively by GC as a result of substantial interference from the background. Inspection of Table 2 shows that GC analysis of 7 samples containing 0.05 μL of gasoline were classified as negative (−) or inconclusive (I); 11 out of 12 samples containing 0.10 μL were negative or inconclusive, and only 5 out of the 11 tested at the 0.20 μL level were positive. With this level of background present, GC analysis failed (negative or inconclusive) in 18 out of 19 cases for samples containing 0.1 μL or less of 50% evaporated gasoline, and did not detect gasoline in any of the samples at this dose level that were missed by the canines during the common matrix test. When the burnt carpet samples were dosed with at least 0.2 μL, the GC success rate improved, approaching 50% (5 positives out of 11). Even at the 5 μL level, background interference made it impossible to identify gasoline in 6 out of 29 samples checked and was difficult to identify gasoline in another five without the use of mass spectrometry (see later).

Additional laboratory work was performed on demonstrating the effects of similar levels of background matrix materials on the ability of using GC to detect gasoline at relatively low levels. Burnt samples of carpeting, foam backing, wood, and plastic of the same or similar type as used in the CADA conference studies were doped with 50% evaporated gasoline at the 0.1, 0.2, and 0.5 μL levels. One such set of samples, left over from the CADA Conference exercises, were processed by the usual recovery and GC analysis techniques directly (Table 3). Three other sets of

TABLE 1—*Scent discrimination and pinpoint tests.*

	Scent Discrimination	Pinpoint
Canines tested	32	32
Positive alert*	32	26
Alert on nearby sector	...	4
No alert	0	2
False positive alert†	0	...

*Alert on appropriate can or sector containing gasoline.
†Alerts on samples not containing gasoline.

TABLE 2—*Common matrix test.*

Quantity of Gasoline; μL	Total Plants	Total Positive Alerts	GC Analysis* +	−	?	Total Non-alerts	GC Analysis* +	−	I
5.0	32	31	23	0	6	...	...	...	...
0.2	12	5	2	1	1	7	3	1	3
0.1	12	8	1	6	1	4	0	4	0
0.05	8	4	0	1	3	4	0	3	0

*(+) means positive identification, (−) means gasoline not detected, (I) means inconclusive as a result of low levels present or background interference.

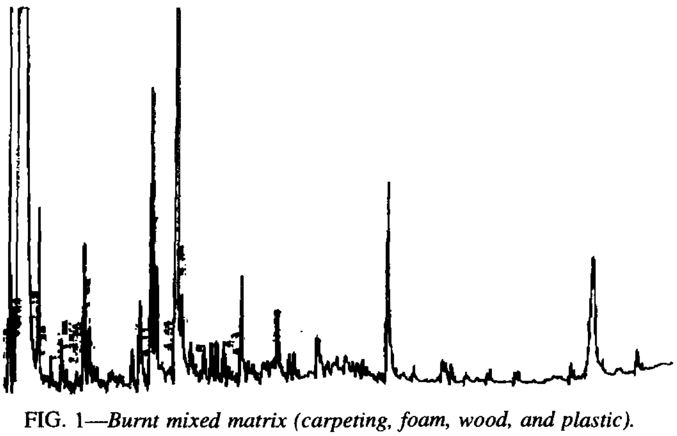

FIG. 1—*Burnt mixed matrix (carpeting, foam, wood, and plastic).*

TABLE 3—*Further GC testing on trace levels of gasoline on heavy background matrices.*

Gasoline, μL	Matrix	Number Analyzed	GC results*		
			+	−	I
0.1	Carpeting	5	3	1	1
0.1	Foam pad	2	1		1
0.1	Mixed matrix†	1			1
Total		8	4	1	3
0.2	Carpeting	4	3	1	
0.2	Plastic	2	2		
Total		6	5	1	
0.5	Wood	2	2		
0.5	Foam pad	1	1		
0.5	Mixed matrix†	3	3‡		
Total		6	6		

*(+) means gasoline confirmed, (−) means not found, (I) means inconclusive.

†Wood, carpeting, and foam pad were burned together.

‡Two out of three confirmed using extracted ion GC-MS technique (8); inconclusive by GC alone.

background prepared two to five days before testing were similarly doped and used along with blanks for field testing by two canines. Subsequent processing and GC analysis of these samples were again performed (Table 4).

In general, the additional GC testing without dogs substantiated what had been observed in the earlier GC analyses (i.e., samples containing just 0.1 μL of 50% evaporated gasoline on heavy background were only able to be positively confirmed 50% of the time). A better success rate for identification of gasoline was observed at higher levels (0.2 and 0.5 μL), but even then, interference by pyrolysis products obscured positive identification in some cases, and required use of GC-mass spectrometry with extracted ion techniques to remove background and allow for positive identification of some of the others (Table 3).

The two canines subjected to more extensive testing of samples containing these low levels of gasoline performed well. They enjoyed a 100% success rate on one series of samples shown to have rather low levels of background by GC analysis, containing 0.1 to 0.5 μL of 50% evaporated gasoline, and the canines did not alert on any samples containing only burnt background. Samples prepared for subsequent tests for the same two dogs contained more significant pyrolysis products (checked by GC). In these cases, the dogs alerted on all but one of the doped cans, (the one missed contained 0.1 μL of gasoline on a mixed matrix background); and they registered a few alerts on samples containing only pyrolysis products (Table 4). Conclusive GC analysis of the samples containing more pyrolysis products also declined, especially for the doped samples at the 0.1 to 0.5 μL level (Table 4).

TABLE 4—*Further canine and GC testing on trace levels of gasoline in heavy background matrices.*

Gasoline, μL*	Carpet		Foam Pad		Wood		Mixed Matrix‡	
	Alerts	GC†	Alerts	GC†	Alerts	GC†	Alerts	GC†
0.1	2/2	I	2/2	+, +	2/2	+	3/4	+, I, I, I
0.2	2/2	+	2/2	+	2/2	I	2/2	I
0.5	2/2	+	2/2	+	2/2	I	4/4	I, +
1.0	2/2	+	1/8	+	2/2	···	2/2	+
Blanks	1/8	I§	1/8	I§	1/8	−	4/12	−, −

*Gasoline was 50% evaporated.

†(+) means gasoline confirmed, (−) means not found, (I) means inconclusive.

‡Wood, carpeting, and foam pad were burned together.

§No gasoline, but heavy background found.

Independently, several additional dogs were tested at the Illinois State Police, Bureau of Forensic Sciences in Joliet. On samples containing burnt carpeting, foam padding, wood or plastics, one of them was doped with gasoline, one dog alerted only on the doped sample, whereas the other two alerted on pyrolyzed carpeting and foam and/or on pine wood samples that were not spiked. Laboratory analysis, using the vacuum charcoal adsorption/elution technique, detected the 1 μL of gasoline even on pyrolyzed samples. Neither the laboratory nor any of the dogs could detect a smaller sample. However, gasoline samples placed on noninterfering substances were detected by both the laboratory and the dogs at amounts as small as 0.01 μL.

The final test performed at the CADA conference was designed as a survey of the range of products potentially used as accelerants that could be positively identified by the canines. A variety of lighter products (cigarette lighter fluid, Coleman fuel, lacquer thinner, ethanol, and acetone), medium products (charcoal lighter, isopars, paint thinner, mineral spirits, xylene, naphtha, and two-cycle engine oil), and heavier products (kerosene, Stoddard solvent, diesel fuel, and odorless lamp oil) were applied to various burnt background materials (wood, plastic, foam, carpeting, and a mixed matrix of all four) at two dose levels. Some canines received 2 μL spikes, whereas others had 5 μL of product applied to the background. In comparison to tests involving gasoline, the canines had more difficulty in finding the two or three doped samples among the six samples set out (Tables 5 and 6). During the exercise, the canines correctly alerted on 49 of the total of 86 cans (59%) to which the various products were added. The overall success rate was somewhat influenced by dose level. Just over 50% (23 of 44) successful hits were made on 2 μL plants whereas 63%

TABLE 5—*Varied product canine testing.*

	Amount Added				Total	
	2μL		5μL			
Petroleum Products	+ Alert	Missed	+ Alert	Missed	+ Alert	Missed
Light:						
Cigarette lighter fluid	3	0	1	1	4	1
Coleman fluid	1	3	4	1	5	4
Lacquer thinner	2	1	1	1	3	2
Ethanol	1	3	2	1	3	4
Acetone	1	2	2	0	3	2
Subtotal	8	9	10	4	18	13
Medium:						
Charcoal lighters	1	1	3	0	4	1
Isopars (e.g., "Gulf-Lite")	1	1	1	2	2	3
Paint thinners	0	2	1	2	1	4
Mineral spirits	0	3	2	0	2	3
Xylenes	1	0	1	1	2	1
Two-cycle engine oil	3	0	1	1	4	1
Naptha	1	1	2	0	3	1
Subtotal	7	8	11	6	18	14
Heavy:						
Kerosene	3	1	2	3	5	4
Stoddard solvent	2	1	1	1	3	2
Diesel fuel	3	0	2	2	5	2
Odorless lamp oil	0	2	···	···	0	2
Subtotal	8	4	5	6	13	10
Overall Total	23	21	26	16	49	37

TABLE 6—*Unconfirmed positive alerts.*

Background	2μL, 8 of 16 Dogs	5μL, 6 of 15 Dogs	Total, 14 of 31 Dogs
Carpet	2	...	2
Pad	4	4	8
Plastic	1	...	1
Wood	0	1	1
All four combined	3	3	6

(26 of 42) alerts were made on 5 μL plants. The canine overall ability to alert on light, medium, and heavy products was quite uniform (54 to 58%). Success rates with lighter and medium products improved from <50% at a 2 μL dose rate to >65% at 5 μL, yet decreased from 67% at the smaller dose to <50% at the larger dose for heavier petroleum products. Overall, the successful alert rate was lower than that in a previous report (4).

The canines did not alert unanimously any one of the 16 specific products tested. The best success rate of dog alerts occurred for samples doped with cigarette lighter fluid, charcoal lighter, and two-cycle engine oil, whereas >70% success was noted for naphtha and diesel fuel. The lowest success rate was observed for paint thinner and odorless lamp oil (<20%). The dogs correctly alerted about half the time on the remaining products. No obvious trend as to product type versus success rate was noted.

The fact that the success rate on these other products was lower than on weathered gasoline is not surprising because most canines were not trained on the majority of the products used. Thus, the large number of nonalerts in this test was not unexpected. However, a relatively significant number of alerts were made on cans containing just burnt background. Thus, among the dogs seeking out 2 μL plants on varied background, one-half of the canines registered at least one alert on background compared to 6 of 15 subjected to 5 μL plants on the same types of background. In addition to these actions formally recorded as unconfirmed alerts, a number of additional "double takes" (near alerts) were observed. The background that caused the most problems with respect to dog alerts were the burnt foam carpet backing and the mixed matrix that contained burnt foam as well as the other three types (eight and six alerts on nonspiked samples, respectively). The wood and plastic created the least interference. Burnt carpet background, even without foam, was responsible for causing a large number of alerts (Tables 2 and 3).

Conclusions

(1) As a group, the canines were remarkably accurate in alerting on 50% evaporated gasoline at the 5 μL level (primer, pinpoint, and common matrix tests). They were less successful at finding trace quantities (0.05 to 0.2 μL) of gasoline on samples containing significant pyrolysis products. This may reflect the fact that many Maine and Connecticut dogs are being trained to alert on somewhat larger amounts (e.g., a drop or two at 30 to 50 μL/drop) instead of the smaller amount, 10 μL or less of weathered gasoline used in the past. Part of the rationale for this is to condition dogs to find samples containing levels of petroleum product that should be more readily confirmed by laboratories.

(2) The canines were less successful at finding volatile products other than gasoline at both the 2- and 5-μL levels. This is not surprising because many of the dogs had not been trained to alert on many of the products tested. One area of future work is to find out which specific compounds or combinations are responsible for triggering the canines' olfactory recognition of gasoline and other products used in training.

(3) Samples containing 5 μL of gasoline on substances containing significant pyrolysis products could be readily recovered and determined by GC in most cases. However, those with 1 μL or less were more difficult to determine because of greater interference from the pyrolysis products. Many of these, which gave inconclusive chromatographic patterns on flame ionization detectors, could be distinguished on GC-MS, especially with extracted ion techniques (7).

(4) Alerts on samples not containing added petroleum products were problematic for the group of canines as a whole. It was somewhat surprising that nearly two-thirds of the dogs registered alerts on undoped samples during the common matrix test and half alerted on samples not containing additives during the varied product testing. Some of these unconfirmed alerts may have been prompted by the fact that the handlers were told that there were two doped samples among the five in the common matrix test, and consciously or unconsciously encouraged their canines to "find" a second plant. Use of cans may have prompted some of these alerts (3). Burnt carpeting provided the source of the pyrolysis materials on which the canines alerted in this case. In the varied product testing, foam backing and mixed matrix (that contained foam and other materials) were present in more than 75% of the samples without added products on which the canines registered alerts. Significant levels of background compounds were found upon GC analysis of most undoped samples on which the canines alerted. A possible source of distraction may be the fact that many of the pyrolysis components generated upon burning of common substances are known to be present in gasoline and other petroleum products (although usually in different ratios) (11). Because it is not known which specific compounds or combinations are responsible for triggering a canine alert (or even whether different canines are responding to the same odors in petroleum products), it may be that some pyrolysis products elicit alerts from some canines. Well-trained canines show a remarkable ability to distinguish between added gasoline and pyrolysis products, but canines as a group are by no means infallible.

(5) Essentially, this work suggests that more practical limits for reliable alerts by canines and confirmations by laboratories lie somewhere below 5 μL but above 0.2 μL of gasoline for samples containing significant pyrolysis background. Lower limits of about 1 to 2 μL of gasoline seem to be necessary for both canine detection and laboratory confirmation to be more reliable. This is another reason why the use of drops rather than microliters in training canines to alert makes more sense.

(6) A wide range of ability was observed among the handler-canine teams observed. Although most did well with higher levels of gasoline, some teams performed flawlessly throughout all the tests, others had difficulty distinguishing trace levels of petroleum products from high levels of background. The field and training record of the canines used are thus important to establishing their credibility. The significant number of alerts by canines on samples not containing gasoline or other products points out the importance of obtaining laboratory confirmations on samples on which dogs alert. This is the purpose for which accelerant detection canines have been developed, to aid the investigator in pinpointing flammable or combustible liquids used at fire scenes. Use of canines for this purpose has improved laboratory detection rates around the country. Accelerant-detecting canines used appropriately at fire scenes continue to be a big boon to fire scene investigation.

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References

(1) Berluti AF. Sniffing through the ashes. Fire and Arson Investigator 1989 June;4:31–5.
(2) Rogozinski RP, Knowlton ME. Arson investigators: the new breed. Fire Prevention 1990 June;46–56.
(3) Kurz ME, Billard M, Rettig M, Augustiniak J, Lange J, Larson M, Warrick R, Mohns T, Bora R, Broadus K, Hartke G, Glover B, Tankersley D, Marcouiller J. Evaluation of canines for accelerant detection at fire scenes. J Forensic Sci 1994 Nov;39(6):1528–37.
(4) Tindall R, Lothridge KL. An evaluation of 42 accelerant detection canine teams. J Forensic Sci 1995;40(4):561–4.
(5) Tindall R, Lothridge KL. Accelerant detection canine testing. Accelerant Detection Canine Newsletter 1992 June–July;3:4–6.
(6) Dabdoub G, Schultz B, Dillon S. Accelerant detection canines and the laboratory. Abstract of paper presented at the 47th annual meeting of the American Academy of Forensic Science; 1995 Jan; Seattle (WA)
(7) Dietz WR. Improved charcoal packaging for accelerant recovery by passive diffusion. J Forensic Sci 1991 Jan;36(1):111–21.
(8) Klosterman J. A simplified technique for charcoal adsorption/elution recovery by passive diffusion. Arson Analysis Newsletter 1983 July;7(2):44–7.
(9) Smith RM. Arson analysis by mass chromatography. Anal Chem 1982 Nov;54:1399A–1409A.
(10) Nowicki J. An accelerant classification scheme based on analysis by gas chromatrography/mass spectrometry (GC-MS). J Forensic Sci 1990 Sept;35(5):1064–86.
(11) Keto RO. GC-MS data interpretation for petroleum distillate identification in contaminated arson debris. J Forensic Sci 1995 May;40(3):412–23.

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