Accelerant detection canines' ability to detect ignitable liquids

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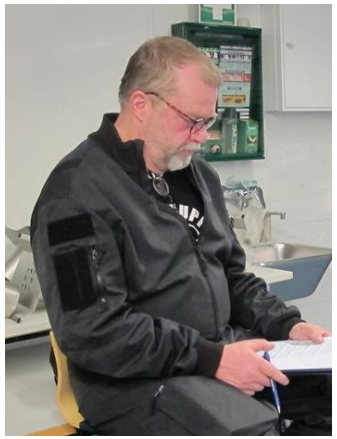

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Arson or an accident?

- ADCs (Accelerant Detection Canines) are dogs used in arson investigation and they search for potential ignitable liquid residues (ILR, e.g. gasoline, lighter fluid etc.)
- An ADC DOG is brought to the fire scene as soon as it is possible and safe, usually within 1–3 days after the fire
- Alert → sample is collected and analyzed at a forensic laboratory, and the compounds in the sample are identified
- Dog alerts – lab cannot find anything..?
- In Finland, ONLY samples that are **above reporting limit** (>0.1 µl/l) in **forensic laboratory** testing are admissible as evidence in court
- Earlier research done with **unburned liquids –** 97% probability to find the target
- However, **burning is known to alter the composition** of ILR, thus liquid is likely to smell very different to the dog after burning.

Main questions

- How well ADC dogs are able to detect liquid residuals **after burning**?
- Are **all ignitable liquids (gasoline, lighter fluid, isopropyl alcohol)** equally easy to detect?
- **Time after burning** – how evaporation over several days affects the ADC's ability to detect the substance? Is there a hurry to the fire seen?

Methods?

- Five trained Finnish accelerant detection canines
- Three substances (gasoline, lighter fluid and isopropyl alcohol)
- The effect of evaporation - 24 and 72 hours after the fire was extinguished (1 and 3 days)
- Each dog went through **six tracks** in one day, three in the morning and three in the afternoon.
- All target samples, and also all the control samples that the dogs marked, were analysed with gas chromatography-mass spectrometry (GC-MSD) to determine the exact amount of substance
- I day before experiment, dogs searched three hidden samples (ISO, LF, GAS) in a 70 m^2 apartment. Each sample contained approximately 3–5 µl **of unburnt** ignitable liquid. (CERTIFICATION TEST)

6 control burn
2 burns / eac

Test track - Each track had **three control samples and one containing the target substance**, located at a random spot

50 ml of ign

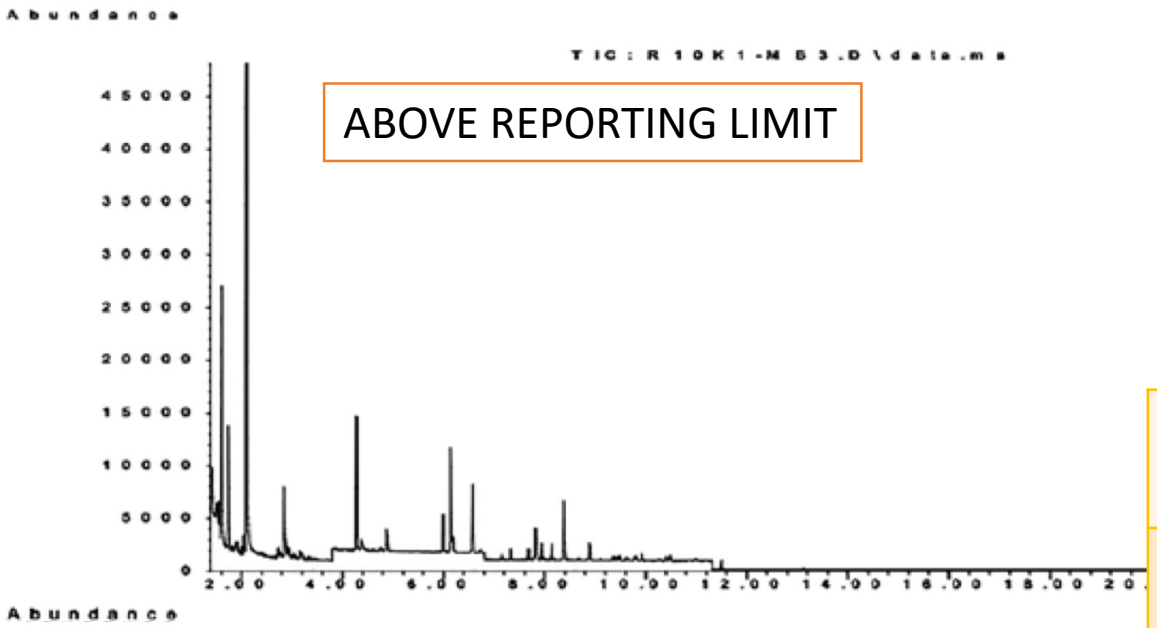
Results

Lots of variation between dogs when the task is difficult!

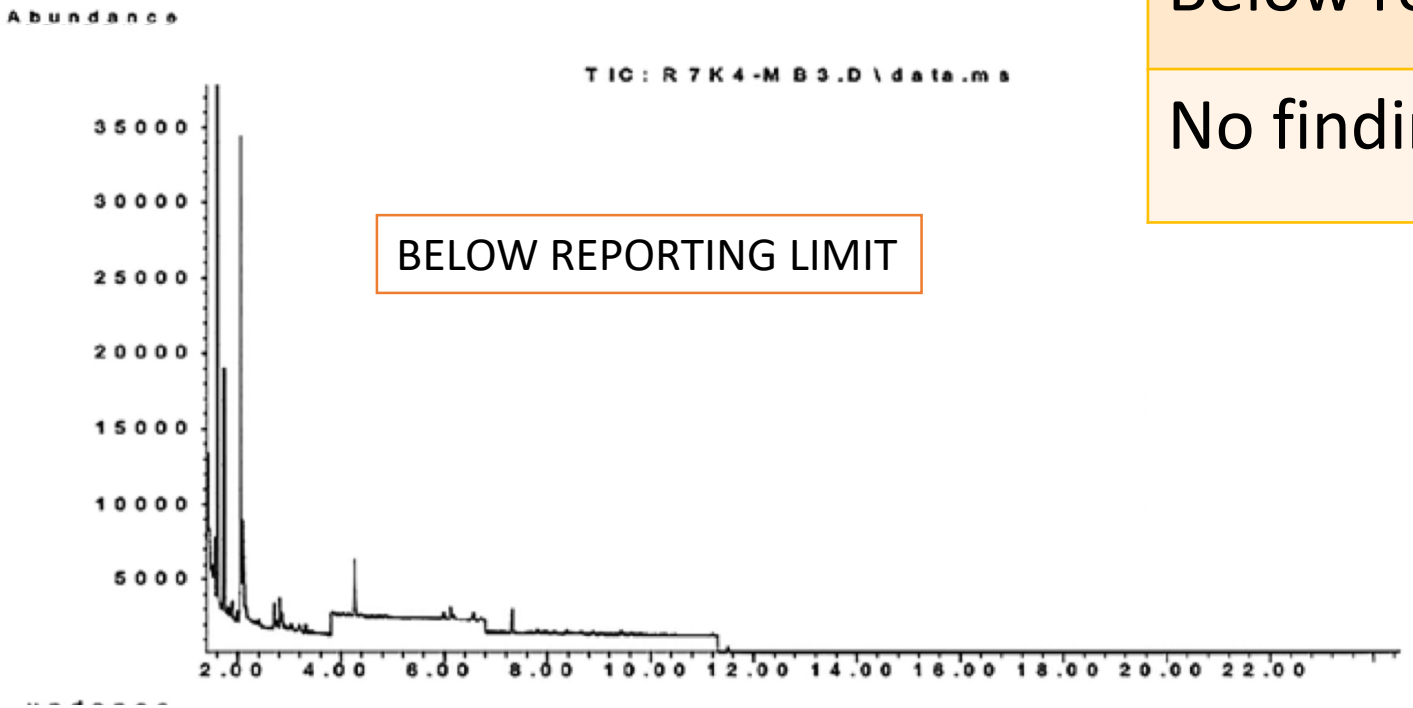
EASY! DIFFICULT!

CORRECT MAX 3	FALSE POSITIVE	ADC
3	0	K1
3	0	K2
3	0	K3
3	0	K4
3	0	K5
		total

CERTIFICATION / UNBURNED EXPERIMENT / BURNED



ABOVE REPORTING LIMIT



BELOW REPORTING LIMIT

Above reporting limit
Below reporting limit
No finding

Gas chromatography-mass spectrometry (GC-MSD) analysis

Results

THE EFFECT OF AMOUNT OF SUBSTANCE, EVAPORATION AND SUBSTANCE ON THE PROBABILITY OF FINDING TARGET

a) Probability of ADC finding the substance, false alerts allowed					95 % Bayesian credible interval	
Amount of substance	S[illegible]letected i[illegible]	Average	Standard deviation	Median	Lower control limit	Upper control limit
		0,59	0,17	0,60	0,25	0,89
		0,89	0,07	0,91	0,72	0,99
Evaporation	24 hours	0,81	0,11	0,82	0,55	0,96
	72 hours	0,81	[illegible]	[illegible]	[illegible]5	0,96
Substance	ISO	0,66	0,15	0,67	0,33	0,91
	GAS	0,88				0,99
	LF	0,88	0,10	0,91	0,62	0,99

NO FINDING

ABOVE & BELOW REPORTING LIMIT

No effect

ISO difficult

*logistic regression using a mixed model, Bayesian modeling, posterior distribution of success probability using the Markov chain Monte Carlo (MCMC) simulations.

Conclusions

- Dogs found with **100 % probability** and without false positives when the concentration was **above reporting** limit (>0.1 µl/l) or **if it was unburned** (3-5 µl/l)
- Dogs also found relatively well those (0,89 probability) samples that had some residue (above & below reporting limit,) **AND** also those samples that GC-MSD did not detect at all (with 0,59 probability)

  → Dog's sense of smell is more sensitive than a laboratory analysis

  → Training with unburned liquids – dogs are also able to detect burned liquids

  → Difficult tasks reveal variation between dogs

Many thanks for all the handlers & dogs participating this experiment!