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Identification of appetite-stimulant potent aroma volatile organic compounds from commercial dog pellet food using comprehensive two-dimensional gas chromatography-time-of-flight mass spectrometry (GCxGC-TOF/MS) analysis

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INTRODUCTION & AIM

To enhance the taste of dry dog food pellets, dog food attractants (DFAs) have been developed and added to many formulations to improve flavor and other sensory properties, ultimately boosting acceptance by dogs.

The objective of this study was to identify the key aroma and flavor compounds in DFAs that significantly enhance the flavor of dog food.

A thermal desorption unit, combined with comprehensive two-dimensional gas chromatography--time-of-flight mass spectrometry (GCxGC-TOF/MS), was used for the analysis of volatile organic compounds (VOCs). Volatile compounds in three commercial dog pellet food samples from unknown brands were fed to three Thai Ridgebacks and successfully identified through qualitative analysis. This was done by comparing experimental mass spectrometry (MS) data and first-dimensional retention index (*RI*) values with those from the NIST 2022 database and existing literature using GCxGC. The process resulted in a total of 320 identified peaks

Using the Dynamic Headspace System (DHS) device, and combined with Thermal Desorption Unit (TDU) interfaced to a GCxGC system, the major VOCs identified in the dog pellet food included pentane (sweet, gasoline-like odor), *o*-cymene, acetone (sweet, fruity odor), hexanal (fresh grass odor), and 2-formylbenzoic acid, with peak areas ranging from 7.56×10^{7} to 4.59×10^{8}. Hexanal, identified as a key volatile compound in dog food, was found to have a positive correlation with dog food consumption.

These findings provide valuable insights into the use of comprehensive 2D DHS-GCxGC-TOF/MS for the qualitative analysis of VOCs in dog pellet food samples in future studies.

METHOD

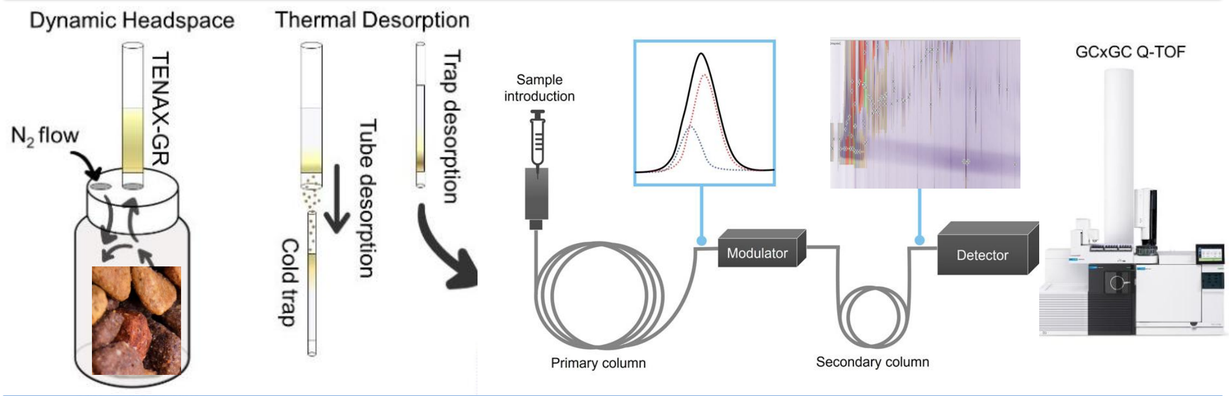

Figure 1. Sample preparation of dog pellet food was carried out using the Dynamic Headspace (DHS) method and a Thermal Desorption Unit (TDU) for the qualitative analysis of the VOC profile, utilizing the DHS-GCxGC-TOF/MS technique.

Compound Name	Odor descriptions	*RI*	1tr (min)	2tr (s)	Area %
Acetone	Sweet, fruity odor	477	4.77	1.98	4.44
Propanal, 2-methyl-	Pungent, fruity, and nutty	532	5.32	2.02	1.29
2-Butanone	Sweet, fruity, and slightly mild acetic	577	5.77	2.24	0.53
Cyclopentane, methyl-	Sweet, slightly petrol-like	620	6.33	1.96	0.48
Butanal, 3-methyl-	Pungent, fruity, and nutty	686	6.86	2.22	2.49
Heptane	Mildly pungent, hydrocarbon-like	762	7.61	2	0.99
Pentanal	Pungent, fruity, and grassy	788	7.88	2.43	0.56
1-Heptene, 4-methyl-	Sweet, fruity, and citrusy	920	9.2	2.04	0.18
Pentane, 2,3,3-trimethyl-	Sweet, hydrocarbon-like	947	9.47	2.06	0.79
Octane, 4-chloro-	Mildly pungent, chlorinated hydrocarbons	1072	10.71	2.14	0.12
1-Pentanol	Slightly floral, fresh, and herbaceous	1035	10.35	0.39	0.1
Hexanal	Grassy, fresh, and green	1142	11.42	0.2	0.19
Acetic acid, butyl ester	Sweet, fruity, and pear-like	1197	11.97	0.15	0.36

Table 1. Qualitative analysis of VOCs, including the main odor-active compounds and their odor descriptions, was conducted in terms of the area percentage of ingredients in the sample. $^{1}t_r$ refers to the retention time in the first dimension, and $^{2}t_r$ refers to the retention time in the second dimension.

RESULTS & DISCUSSION

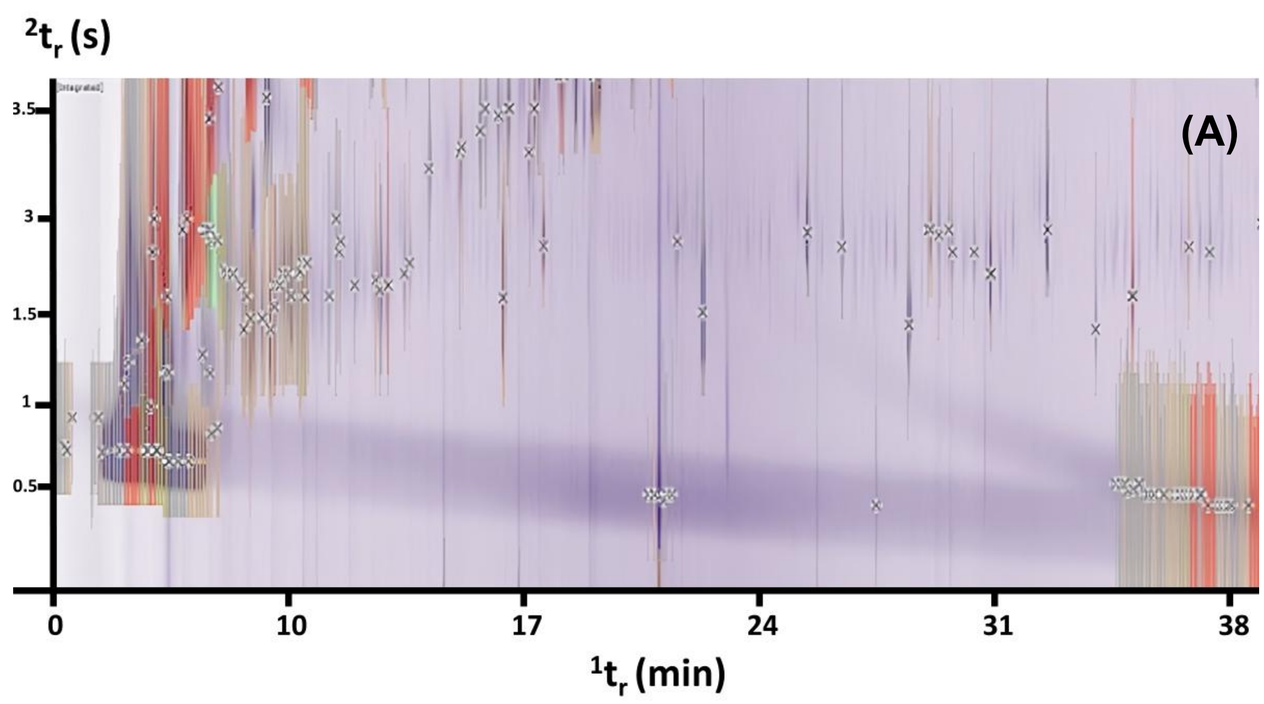

Figure 2. GCxGC-TOF-MS contour plots: **(A)** Chromatogram of the dog pellet food for selected samples. The thermochromic scale indicates intensity, with retention times given in minutes (min) and seconds (s), respectively. Each compound on the chromatogram corresponds to a compound listed in **Table 1**. **(B)** GC×GC-TOF-MS chromatogram showing the separation of compounds in the dog pellet food sample, grouped by their chemical structures, specifically those related to appetite-stimulant volatile organic compounds (VOCs) in dogs.

CONCLUSION

In conclusion, odor plays a crucial role in a dog's food preferences, and understanding how technological innovations focusing on key aroma compounds influence a dog's food intake is essential for health and nutrition considerations. The production of appetizing dog food that is fully consumed can help reduce food waste, which would otherwise contribute to greenhouse gas emissions and unnecessary resource use, thereby increasing its perceived value.

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