

Data Descriptor

# Volatile Compounds Emitted from the Cat Urine Contaminated Carpet Before and After Treatment with Marketed Cleaning Products: A Simultaneous Chemical and Sensory Analysis

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**Abstract:** Urination on carpet and subflooring can develop into persistent and challenging to mitigate odor. Very little or no information is published on how these VOCs change over time when urine is deposited on the carpet covering a plywood-type subflooring. This research has investigated the VOCs emitted from carpet+subflooring (control), carpet+subflooring sprayed with water (control with moisture), and cat urine-contaminated carpet+subflooring (treatment) over time (day 0 and 15). In addition, the effect of popular cleaning products on VOCs emitted and evaluated their efficacy in eliminating those indoor odors over time (day 0 and 15). Carpet-subflooring with all treatments were also contaminated with *Micrococcus luteus*, nonmotile obligate aerobe commonly found in household dust, to observe the impact of the aerobe on carpet-subflooring VOCs emission. VOCs emitted from carpet+subflooring receiving different treatments were collected from headspace using solid-phase microextraction (SPME). The VOCs were analyzed using a multidimensional gas chromatography-mass spectrometer attached to an olfactometry (GC-MS-O). Many common VOCs were released from the carpet on day one and day fifteen, specifically from urine contamination. Cleaning products were effective in masking several potent odors of cat urine contaminated carpet VOCs on day one but unable to remove the odor appeared on day 15 in most cases.

**Dataset:** Supplementary material is submitted in the form of a well-organized Excel spreadsheet (Carpet-caturine-cleaningpdt-final)

**Dataset License:** license under which the dataset is made available (CC0, CC-BY, CC-BY-SA, CC-BY-NC, etc.)

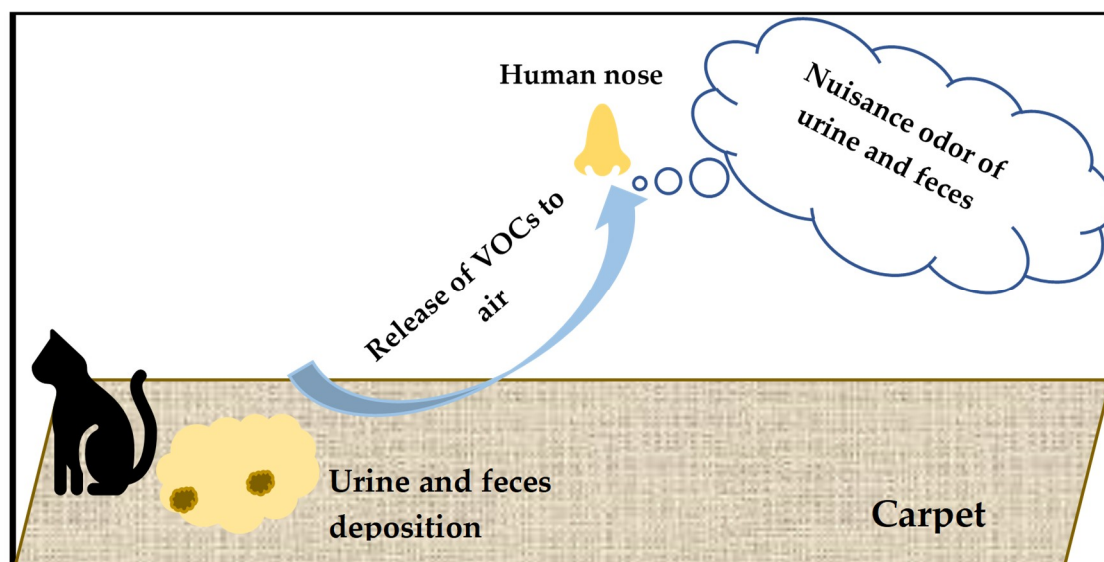
**Keywords:** cat urine; odor mitigation; odor; volatile organic compounds; emission; indoor air quality, solid-phase microextraction; SPME; diffusion; *Micrococcus luteus*

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## 1. Summary (required)

Research studies have identified several volatile organic compounds in the urine and feces of domestic cat species [1-3]. However, there is no report on volatile compounds from cat urine contaminated carpet material over time. About 25% of U.S. households own a cat as a pet [4], and approximately 48% of carpet contributes to the U.S. total flooring market [5]. In addition to cat urine odor, new carpet material can also contribute to the indoor VOCs source generates health and odor issues [6]. Thus, investigation and identification of the types of volatiles emitted from cat urine

contaminated carpet material over time are noteworthy. Figure 1 illustrates a few of many ways for humans to expose to cat urine or feces when deposited on carpet. Bouillard et al. (2005) reported that in office building carpets, bacterial concentrations ranged from  $0.73\text{--}185 \times 10^5$  CFU/g, with  $7.28 \times 10^5$  CFU·g<sup>-1</sup> as the median value. *Micrococcus luteus* was among the most commonly isolated microorganisms [7]. Therefore, *M. luteus* was selected to represent microbes commonly found on household surfaces that might interact with cat urine. Solid-phase microextraction (SPME), used to extract the VOCs in his study, is a non-invasive, solventless sampling method to extract and characterize volatiles from a source at trace levels [8-12].



**Figure 1.** Schematic diagram showing the pathway of emitting odorous compounds from cat excretes deposited carpet to human nose in a domestic environment

The objective of this study is to record VOCs emitted from cat urine contaminated carpet material followed by pet odor-controlling cleaning product treatment impact on those carpet VOCs over time, by using simultaneous chemical and sensory analysis using SPME and multidimensional GC-MS-olfactometry (GC-MS-O). The data presented in the supplementary material can be used to evaluate and assess the indoor air quality in the presence of cat urine contaminated carpet-subflooring over time. The data also contains useful data on the efficacy of four different marketed products that claim to remove cat urine odor from the carpet on the application day and 15 days after application to the carpet.

## 2. Data Description (required)

The data provided in the Supplementary Material in Excel spreadsheet 'Carpet-caturine-cleaningpdt-final.xlsx,' organized in sheets with names as follows. Figures A1-A4 present examples of the data collected by sampling gases with DVB/CAR/PDMS Stableflex (2 cm) SPME fiber for 60 min at 37 °C:

- an overlay of aromagram and total ion chromatogram of the carpet subflooring urine microbe (Figure A1),
- the carpet-subflooring-cat urine- microbe on day 15 (Figure A2),
- the carpet-subflooring-cat urine-microbe Product 3 on day0 (Figure A3), and
- the carpet-subflooring-cat urine-microbe-Product 3 on day 15 (Figure A4); e.

Table S1 contains information of volatile compounds emitted on day zero data (Table 1) as read from left to right: number of volatiles emitted, name of the volatiles, gas chromatography (GC) column retention time (RT; min), MS Spectral Library (NIST & WILEY7) match (%), published odor, Chemical abstract Service number, a relative abundance of the volatile compounds (peak area counts) of carpet +sub-flooring, a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + water, a relative abundance of the volatile compounds (peak area counts) of carpet +

sub-flooring + water + *M. luteus*, a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring+ cat urine, a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring+ cat urine + *M. luteus*, and Ion abundance (% relative abundance).

Table S2 contains information on volatile compounds emitted on day 15 data. Table 2 as read from left to right: number of volatiles emitted, name of the volatiles, gas chromatography (GC) column retention time (RT; min), MS Spectral Library (NIST & WILEY 7) match (%), published odor, Chemical abstract Service number, a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring, a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + water, a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + water + *M. luteus* (day 15), a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + cat urine (day 15), a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + cat urine + *M. luteus* (day 15), and ion abundance (% relative abundance).

Table S3 contains information of volatile compounds emitted from commercial odor removal product applied to urine + *M. luteus* contaminated carpet on day 0 data (Table 3) as read from left to right: the number of volatiles emitted, name of the volatiles, gas chromatography (GC) column retention time (RT; min), MS Spectral Library (NIST & WILEY 7) match (%), Chemical abstract Service number, a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + cat urine + *M. luteus* + Product 1 (day 0), a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + cat urine + *M. luteus* + Product 2 (day 0), a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + cat urine + *M. luteus*+ Product 3 (day 0), a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + cat urine + *M. luteus* + Product 4 (day 0), and Ion abundance (% relative abundance).

Table S4 contains information of volatile compounds emitted from commercial odor removal product applied to urine + *M. luteus* contaminated carpet on day 15 data (Table 4) as read from left to right: the number of volatiles emitted, name of the volatiles, gas chromatography (GC) column retention time (RT; min), MS Spectral Library (NIST & WILEY 7) match (%), published odor, Chemical abstract Service number, a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + cat urine + *M. luteus* + Product 1 (day 15), a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring+ cat urine + *M. luteus* + Product 2 (day 15), a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + cat urine + *M. luteus* + Product 3 (day 15), a relative abundance of the volatile compounds (peak area counts) of carpet + sub-flooring + cat urine + *M. luteus* + Product 4 (day 15), and Ion abundance (% relative abundance).

1 **Table 1:** Example of a summary of volatiles emitted on day zero from Carpet + Subflooring, carpet + subflooring + water, Carpet + subflooring + water + *M. luteus*, Carpet  
 2 + subflooring + cat urine, and Carpet + subflooring + cat urine + *M. luteus*. Complete data is summarized in Table S1 (Supplementary Materials, Carpet-caturine-cleaningpdt-  
 3 final.xlsx).

#	Compounds	RT (min)	Library match %	Odor 'character' published/recorded	CAS #	carpet+ subflooring (day 0)	carpet+ subflooring+ water (day 0)	carpet+ sub-flooring + water+ <i>M. luteus</i> (day 0)	carpet+ subflooring+ cat urine (day 0)	carpet+ sub-flooring+ cat urine+ <i>M. luteus</i> (day 0)	Ion (% rel. int.)
MS Detector response, peak area counts (PACs), arbitrary units											
1	2- Pentanone	5.39	74		107-87-9			178,878			43(100), 86(35), 71(15), 58(10)
2	Pentanal	5.55	85	Fruity, berry	110-62-3	1,353,390	2,092,914	453,059	1,411,250	932,775	44(100), 41(60), 58(50), 57(40), 43(30)
3	Octane	6.74	86	alkane	111-65-9	80,360	343,847		287,855	245,386	43(100), 85(80), 41(70), 57(50), 71(45)
4	Toluene	7.11	88		108-88-3	390,976	573,315		678,603	249,961	91(100), 92(60), 65(10), 51(5)
5	Hexanal	8.06	95	Green, leafy, fruity	66-25-1	20,876,330	36,530,640	12,196,949	29,052,691	22,302,835	56(100), 41(95), 44(90), 57(70), 43(60), 39(40)
6	1,2 - Dimethylcyclopropane	8.83	63		2511-95-7	167,106				441,161	55(100), 70(90), 42(80), 41(50), 39(30), 43(20)
7	1-Pentanol	9.37	76	Sweet, balsam	71-41-0	1,973,782	5,537,880	3,520,261	4,733,304	4,656,524	55(100), 42(80), 41(75), 70(70), 39(35), 57(30)
8	1,2- Dimethylcyclohexane	9.85	50		2207-01-4				1,120,465	326,959	97(100), 41(80), 81(70), 55(70), 70(65), 39(50), 69(40)
9	2,4-Octadienal	10.23	54	Green, fruity	30361-28-5	429,872	1,777,135		1,721,952	273,430	81(100), 69(35), 124(25), 53(20)
10	2- Heptanone	10.54	79	Cheesy, banana, woody	110-43-0	1,714,716	3,091,780	2,777,763	3,923,538	2,256,583	43(100), 58(75), 71(15), 114(10)
11	p-Mentha-1,5,8-triene	10.82	42	roasted	21195-59-5	9,665,111	32,947,411	38,148,205	34,872,658	33,253,410	119(100), 93(90), 91(70), 92(40), 134(30)

12	Styrene	11.24	94	Sweet, balsam, floral, plastic	100-42-5	606,000	389,091	602,067	104(100), 103(40), 78(40), 77(20), 51(15)
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4 **Table 2:** Example of a summary of volatiles emitted on day 15 from carpet + subflooring, carpet + subflooring + water, carpet + subflooring + cat urine, and carpet +  
5 subflooring + cat urine +*M. luteus*. Complete data is summarized in Table S2 (Supplementary Materials, Carpet-caturine-cleaningpdt-final.xlsx).

#	Compounds	RT (min)	Library match %	Odor 'character' recorded/published	CAS #	carpet+ sub-flooring (day 15)	carpet+ sub-flooring+ water+ <i>M. luteus</i> (day 15)	carpet+ sub-flooring+ cat urine (day 15)	carpet+ sub-flooring+ cat urine+ <i>M. luteus</i> (day 15)	Ion (% relative intensity)
MS Detector response, peak area counts (PACs), arbitrary units										
1	Acetone	3.19	68		67-64-1	152,540			147,139	43(100), 58(30), 42(10), 39(5)
2	Acetic acid methyl ester	3.33	63	Sweet. fruity	79-20-9			1,499,733		43(100), 74(35), 59(15), 42(10)
3	2- Pentanone	5.39	72		107-87-9	1,704,070			241,509	43(100), 86(35), 71(15), 58(10)
4	Octane	6.74	75		111-65-9	338,270	750,351			43(100), 85(80), 41(70), 57(50), 71(45)
5	Toluene	7.11	81		108-88-3	464,988			465,549	91(100), 92(60), 65(10), 51(5)
6	2-Hexanone	7.81	74		591-78-6	380,781				43(100), 58(60), 100(20), 57(20), 85(15), 71(10)
7	1-Pentanol	9.37	76	Balsamic, sweet	71-41-0			3,766,579		55(100), 42(80), 41(75), 70(70), 39(35), 57(30)
8	2-Methylpyrazine	10.03	79		109-08-0	818,701			1,053,616	64(100), 67(45), 40(25), 53(15), 81(10)
9	4-Pyridinamine	10.3	79		504-24-5			797,924	1,145,074	94(100), 67(40), 40(35), 53(10)
10	2- Heptanone	10.54	79		110-43-0	1,882,830		8,674,944	2,855,575	43(100), 58(75), 71(15), 114(10)
11	$\alpha$ -Pinene	10.85	91		80-56-8	137,164,634	119,185,423	74,314,748	94,769,143	93(100), 91(40), 119(30), 77(30), 79(20), 105(12)
12	Styrene	11.24	91	Balsamic, plastic	100-42-5	838,213	1,463,607	1,513,994	803,525	104(100), 103(40), 78(40), 77(20), 51(15)

7 **Table 3:** Example of a summary of volatiles emitted on day zero from carpet + subflooring+ cat urine + *M. luteus* + Product 1, carpet + subflooring + cat urine + *M. luteus* +  
 8 Product 2, carpet + subflooring + cat urine + *M. luteus* + Product 3, carpet + subflooring + cat urine + *M. luteus* + Product 4. Complete data is summarized in Table S3  
 9 (Supplementary Materials).

Compounds	RT (min)	Library match %	CAS #	U+M.I+P1 (day 0)	U+M.I+P2 (day 0)	U+M.I+P3 (day 0)	U+M.I+P4 (day 0)	Ion (% relative intensity)	
MS Detector response, peak area counts (PACs), arbitrary units									
1	Acetone	3.24	68	67-64-1	358,744	380,560	474,903	430,839	43(100), 58(30), 42(10), 39(5)
2	2,4 Hexadienal	5.33	81	110-62-3	131,308				81(100), 96(40), 53(30), 65(10)
3	Pentanal	5.56	88	110-62-3	1,354,983	1,653,133	725,418	1,945,524	44(100), 41(60), 58(50), 57(40), 43(30)
4	Toluene	7.11	85	108-88-3	808,174	893,198		1,315,643	91(100), 92(60), 65(10), 51(5)
5	Hexanal	8.06	95	66-25-1	24,237,673	29,383,184	11,078,995	15,770,078	56(100), 41(95), 44(90), 57(70), 43(60), 39(40)
6	(Z)-2-Pentene	8.83	63	646-04-8				1,139,618	55(100), 70(90), 42(80), 41(50), 39(30), 43(20)
7	1-Pentanol	9.37	72	71-41-0		6,742,800	6,744,690	9,292,407	55(100), 42(80), 41(75), 70(70), 39(35), 57(30)
8	Pentane, 1-chloro-	9.4	59	543-59-9	4,209,417				55(100), 42(90), 41(75), 71(60), 39(35), 57(30)
9	2-Butylfuran	10.21	68	4466-24-4		1,463,055		1,006,109	81(100), 41(30), 55(30), 69(25), 124(25), 53(20)
10	2- Heptanone	10.54	86	110-43-0	2,818,994	6,796,498	990,983	5,096,800	43(100), 58(75), 71(15), 114(10)
11	$\alpha$ -Pinene	10.8	91	80-56-8	16,649,718	46,983,540	9,096,994	25,095,633	93(100), 91(40), 92(35), 119(30), 77(30), 69(25), 41(25)
12	1-Butanol, 3- methyl-, acetate	10.97	76	123-92-2			1,560,496		43(100), 70(55), 61(30), 55(30), 42(25)

10 Note: U+M.I+P1 (day 0) = Carpet+ sub-flooring+cat urine+*M. luteus*+ Product 1 (day 0). U+M.I+P2 (day 0) = Carpet+ sub-flooring+cat urine+*M. luteus*+ Product 2 (day 0). U+M.I+P3 (day  
 11 0) = Carpet+ sub-flooring+cat urine+*M. luteus*+ Product 3 (day 0). U+M.I+P4 (day 0) = Carpet+ sub-flooring+cat urine+*M. luteus*+ Product 4 (day 0)

12

13 **Table 4:** Example of a summary of volatiles emitted on day 15 from carpet + subflooring + cat urine + *M. luteus*+ Product 1, carpet + subflooring + cat urine + *M. luteus*+  
 14 Product 2, carpet + subflooring + cat urine + *M. luteus* + Product 3, carpet + subflooring + cat urine + *M. luteus*+ Product 4. Complete data is summarized in Table S4  
 15 (Supplementary Materials).

#	Compound	RT (min)	Library match %	CAS #	U+M.I+P1 (day 15)	U+M.I+P2 (day 15)	U+M.I+P3 (day 15)	U+M.I+P4 (day 15)	Ion (% relative intensity)
MS Detector response, peak area counts (PACs), arbitrary units									
1	Acetone	3.19	63	67-64-1			643,351	332,952	43(100), 58(30), 34(5)
2	Acetic acid methyl ester	3.34	63	79-20-9		196,721	4,500,806		43(100), 74(30), 59(10)
3	2-Pentanone	5.39	79	107-87-9				1,981,899	43(100), 86(20), 58(15), 71(10)
4	1-Hexene 4-methyl	8.52	63	3769-23-1			2,200,691		41(100), 57(90), 56(80), 55(70), 70(60), 39(40), 58(20)
5	1-Pentanol	9.4	63	71-41-0			2,211,532		55(100), 42(80), 41(75), 70(60), 39(40)
6	2-Butylfuran	10.33	85	4466-24-4		832,292			81(100), 124(25), 82(20), 53(10)
7	Methyl pyrazine	10.32	76	109-08-0	874,537			1,435,565	94(100), 67(40), 39(15), 53(10)
8	2-Heptanone	10.56	83	110-43-0	1,452,480		6,756,435	1,881,383	43(100), 58(70), 71(20), 114(10)
9	$\alpha$ -Pinene	10.84	89	80-56-8	99,017,729	94,473,919	61,479,562	57,686,178	93(100), 119(60), 91(50), 92(40), 77(30), 79(20), 134(20)
10	Styrene	11.25	95	100-42-5	1,324,148	966,762	4,458,613	1,322,208	104(100), 103(50), 78(45), 77(20), 51(20)
11	Camphene	11.42	95	79-92-5	2,001,325	1,807,294		1,933,728	93(100), 121(80), 91(40), 79(35), 67(30), 136(20)
12	Verbenene	11.72	53	4080-46-0	3,218,321	6,737,442	5,177,868	2,561,949	91(100), 92(50), 119(20), 105(10), 65(10)

16 Note: U+M.I+P1 (day 15) = Carpet+ sub-flooring+cat urine+*M. luteus*+ Product 1 (day 15). U+M.I+P2 (day 15) = Carpet+ sub-flooring+cat urine+*M. luteus*+ Product 2 (day 15). U+M.I+P3  
 17 (day 15) = Carpet+ sub-flooring+cat urine+*M. luteus*+ Product 3 (day 15). U+M.I+P4 (day 15) = Carpet+ sub-flooring+cat urine+*M. luteus*+ Product 4 (day 15)  
 18

### 19 3. Methods (required)

#### 20 3.1 Cat urine collection and sample preparation

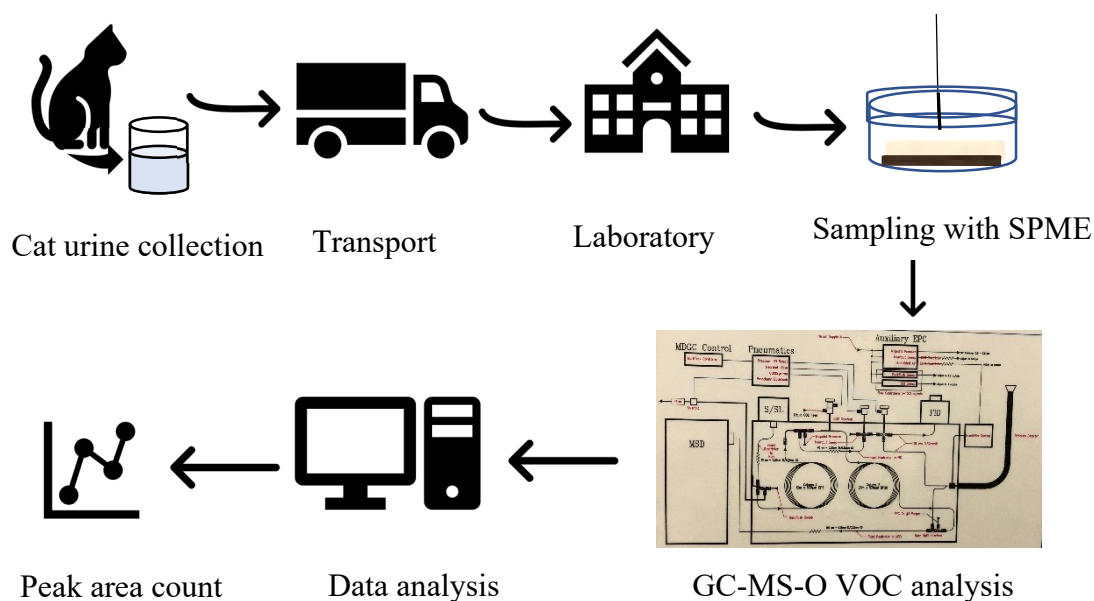
21 Cat urine was collected from healthy adult group-housed cats at the local Humane Society by  
 22 substituting nonabsorbent plastic beads for their regular cat litter in a litter box. Urine was allowed  
 23 to accumulate overnight, then filtered through cheesecloth to remove solid contaminants and stored  
 24 in a sealed container at 4°C. Urine was used within 30 d of collection to preserve its original character.

25 *Micrococcus luteus* ATCC 10240 was aerobically grown in Difco™ Nutrient Broth (BD, Franklin  
 26 Lakes, NJ) in a rotary shaker water bath at 30 °C for approximately 24 h to an optical density of 2.0-  
 27 2.5 at 600 nm. Cultures were serially diluted in 3 M Butterfield's Phosphate Buffer to a final  
 28 concentration of 10<sup>5</sup> CFU·mL<sup>-1</sup>. To ensure viability, cultures were used within 4 h of dilution.

29 The carpet and sub-flooring square (2 x 2 cm) were assembled using a rubber band. The cat urine  
 30 sample was brought to room temperature before applying to the test carpet samples. After gentle  
 31 inverting the urine sample a few times to homogenize it, 2.5±0.5 mL of urine solution was pipetted  
 32 within a (38 mm) 1.5-inch circle centered on the test carpet specimen using a stainless-steel staining  
 33 ring. For a control sample, the same procedure was followed to apply water on the carpet instead of  
 34 cat urine. The carpet specimen was tied with the specimen subflooring using a latex rubberband for  
 35 all treatments and control used in this study.

36 *M. luteus* (1 mL) was pipetted on to the appropriate samples. After waiting for 5 min for the  
 37 samples to soak in, these contaminated carpet samples were put inside a 500 mL wide mouth (9.1 cm  
 38 outer diameter) glass jar containing 10 mL of water and a petri dish separator inside (Figure A5). For  
 39 the product application, the urine and *M. luteus* contaminated carpet samples were dried overnight,  
 40 and then the following morning, cleaning products were applied according to package directions.  
 41 During the incubation period, all jars were always kept at open atmospheric conditions by removing  
 42 the green sampling septa out from the jar-lid, to have oxygen exchange for the microbes to be alive.

43 On the sampling day, the green septa were put back on the lid, and the jar was equilibrated to  
 44 accumulate the VOCs for 1-h before sample extraction. A timer was always used to keep track of the  
 45 time for each sample. The sampling jar was then put on a digital hot plate set at the desired  
 46 temperature (37 °C) and an SPME fiber inserted then and exposed for another hour to complete the  
 47 VOC extraction from headspace (Figure 2, Figure A6).



48

49 **Figure 2.** Schematic of the method for the sample collection to analysis of volatile organics emitted by  
 50 test carpet after treatments with water, cat urine, *M. luteus* and four cleaning products from market  
 51 on day0 and on day15 were extracted by using 2 cm DVB/PDMS/Carboxen solid-phase

52 microextraction (SPME) fiber. A controlled sample with only carpet and subflooring was also exposed  
53 to the SPME fiber similarly as treated carpet material.

### 54 3.2 Data acquisition and analysis

55 All chemicals emitted from the sample vial headspace were extracted using SPME fiber of 2 cm  
56 50/30  $\mu\text{m}$  DVB/PDMS/Carboxen (57299-U, Supelco, Bellefonte, PA, USA). All samples were heated to  
57 37 °C (close to body temperature) using a digital hotplate during extraction to enhance the emissions.  
58 A 60 min extraction time was used for all of the extractions. After the extraction, the SPME fiber  
59 loaded with odorants inserted to the 250 °C GC injector for thermal desorption of samples to the GC  
60 columns and separation and analysis using MS and olfactometer.

61 All carpet, urine, and water treated carpet, urine-microbe and water-microbe treated carpet and  
62 cleaning product treated carpet samples were analyzed and completed using a custom  
63 multidimensional gas chromatograph (Microanalytics, Round Rock, TX, USA) built on Standard  
64 Agilent 6890N (G1530N) (Agilent Technologies, Santa Clara, CA, USA)-mass spectrometer (Agilent  
65 5973N, Agilent Technologies, Santa Clara, CA, USA) olfactometer (GC-MS-O). System Automation  
66 software was Multitrax v. 10.1 (MOCON, INC. Round Rock, TX, USA); the data acquisition software  
67 was Chemstation ver. D.02.00.275 (Agilent Technologies, Santa Clara, CA, USA) and aroma  
68 characterization was done using AromaTrax ver. 10.1 (Microanalytics, Round Rock, TX, USA).

69 The GC oven temperature was programmed at the initial 40 °C for 3 min, followed by ramping  
70 up to 240 °C at a rate 7 °C/min, where it was maintained for 8.43 min. The quadrupole MS was using  
71 electron ionization mode with ionization energy of 70 eV during operation, and the full scan range  
72 was 34 to 350 m/z. The carrier gas used was ultra-high pure (UHP) helium (99.99%, Airgas, Des  
73 Moines, IA, USA). The GC used in this experiment has two columns in series, the first one is a non-  
74 polar column with a fixed restrictor pre-column, and the second one is a polar column. The system  
75 was used in full heart cut mode with a total run time of 40 min. One part of the effluent from the polar  
76 column was simultaneously directed to the single quadrupole mass spectrometer and three parts of  
77 the effluent to the sniff port of the Olfactometry.

78 The peaks were identified using PBM-Benchtop software (Wiley7 library) and the NIST database  
79 library. Aromagrams for odors were generated using AromaTrax software, recorded and generated  
80 by the panelist. Odors recorded/reported by the panelist was verified with published odors [13,14]

## 81 4. User Notes (optional)

82 Table S1, Table S2, Table S3, and Table S4 is presented in the Supplemental Material spreadsheet  
83 has the same layout of columns and column description as Table 1, Table 2, Table 3, and Table 4,  
84 respectively, in the main text.

85 **Supplementary Materials:** The following are available online at [www.mdpi.com/xxx/s1](http://www.mdpi.com/xxx/s1),

86 Table S1: Table S1 contains information of volatile compounds emitted on day 0 data,

87 Table S2: Table S2 contains information on volatile compounds emitted on day 15 data,

88 Table S3: Table S3 contains information of volatile compounds emitted from commercial odor removal product  
89 applied to urine + *M. luteus* contaminated carpet on day 0 data,

90 Table S4: Table S4 contains information of volatile compounds emitted from commercial odor removal product  
91 applied to urine + *M. luteus* contaminated carpet on day 15 data

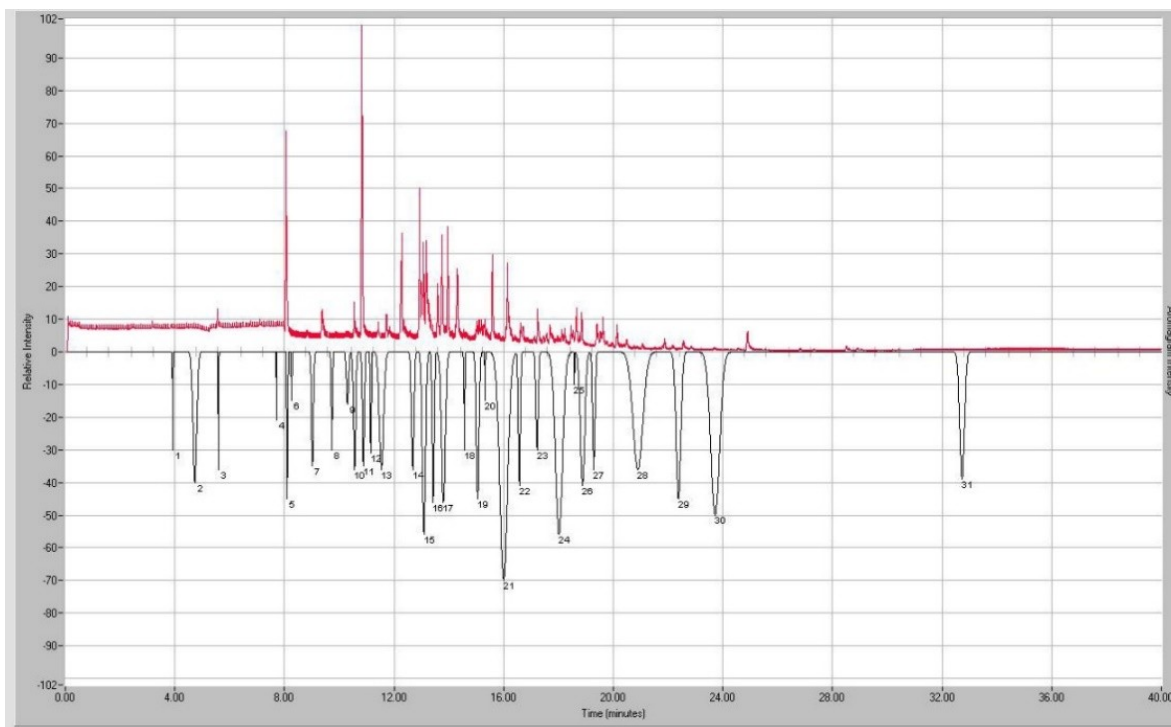
92 **Author Contributions:** Conceptualization, J.K. and C.B.; methodology, C.B. investigation, C.B.; resources, J.K.  
93 and E.F; data curation, C.B.; writing—original draft preparation, C.B; writing—review and editing, J.K and E.F;  
94 visualization, C.B.; supervision, J.K. and E.F; project administration, J.K; funding acquisition, J.K. All authors  
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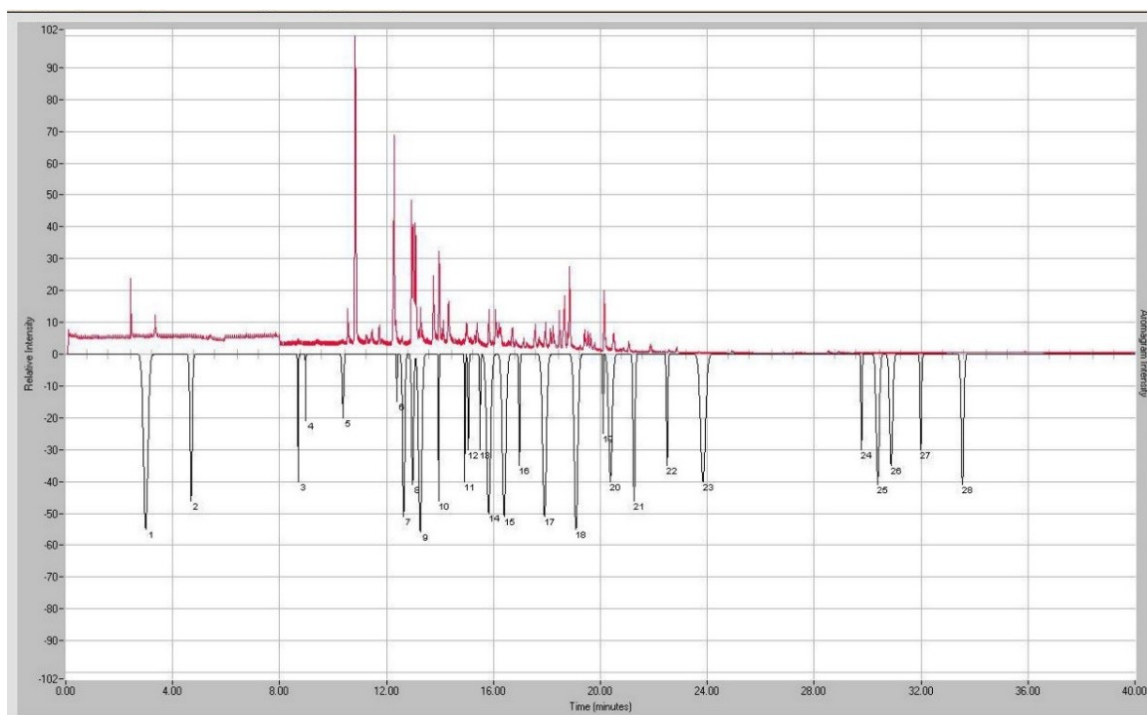
99 **Conflicts of Interest:** The authors declare no conflict of interest. The funders approved the design of the study;  
100 cat urine collection, and microbial inoculant preparation. The funders have no contribution with analyses or  
101 interpretation of data; in the writing of the manuscript, or in the decision to publish the results”.

## 102 Appendix A



103

104 **Figure A1.** An overlay of aromagram and total ion chromatogram of the carpet subflooring urine  
105 microbe exposed to DVB/CAR/PDMS Stableflex (2 cm) SPME fiber for 60 min at 37 °C on day 0. An  
106 increase in black signal height represents an intensity increase of odor and, the responsible volatiles  
107 are in the red TIC signal. Several unpleasant odor events were recorded during analysis, and few of  
108 them were medium to strong unpleasant odor events.



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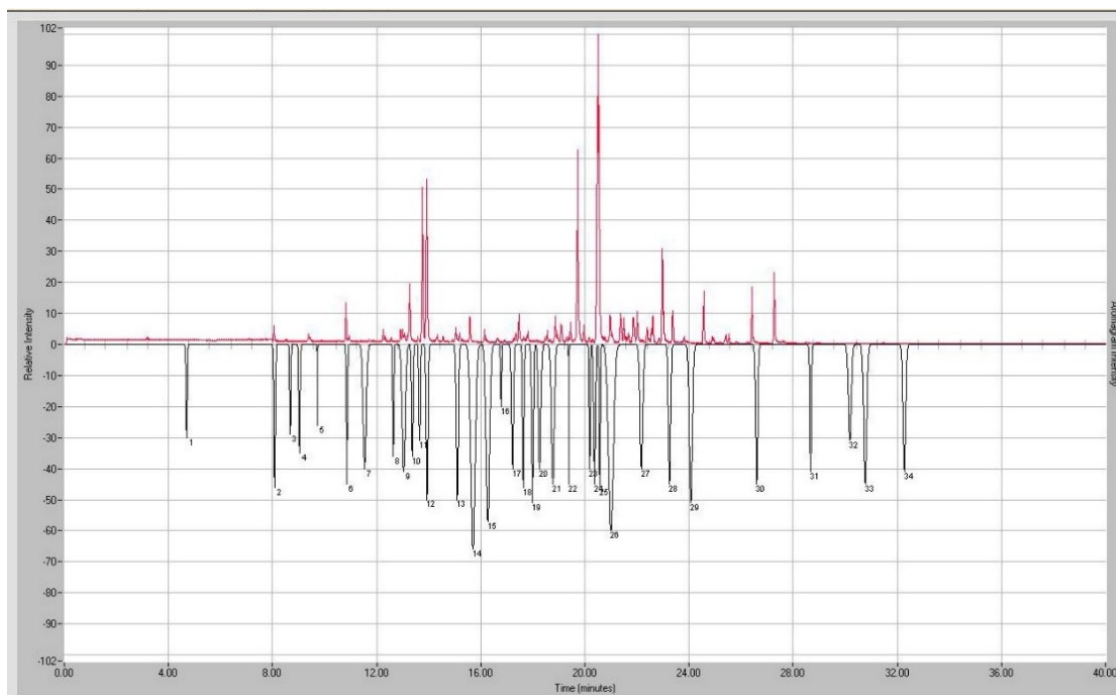
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**Figure A2.** An overlay of aromagram and total ion chromatogram of the carpet subflooring cat urine microbe exposed to DVB/CAR/PDMS Stableflex (2 cm) SPME fiber for 60 min at 37 °C on day 15. An increase in black signal height represents an intensity increase of odor and, the responsible volatiles are in the red TIC signal. Several unpleasant odor events were recorded during analysis, and few of them were medium-strong unpleasant odor events.



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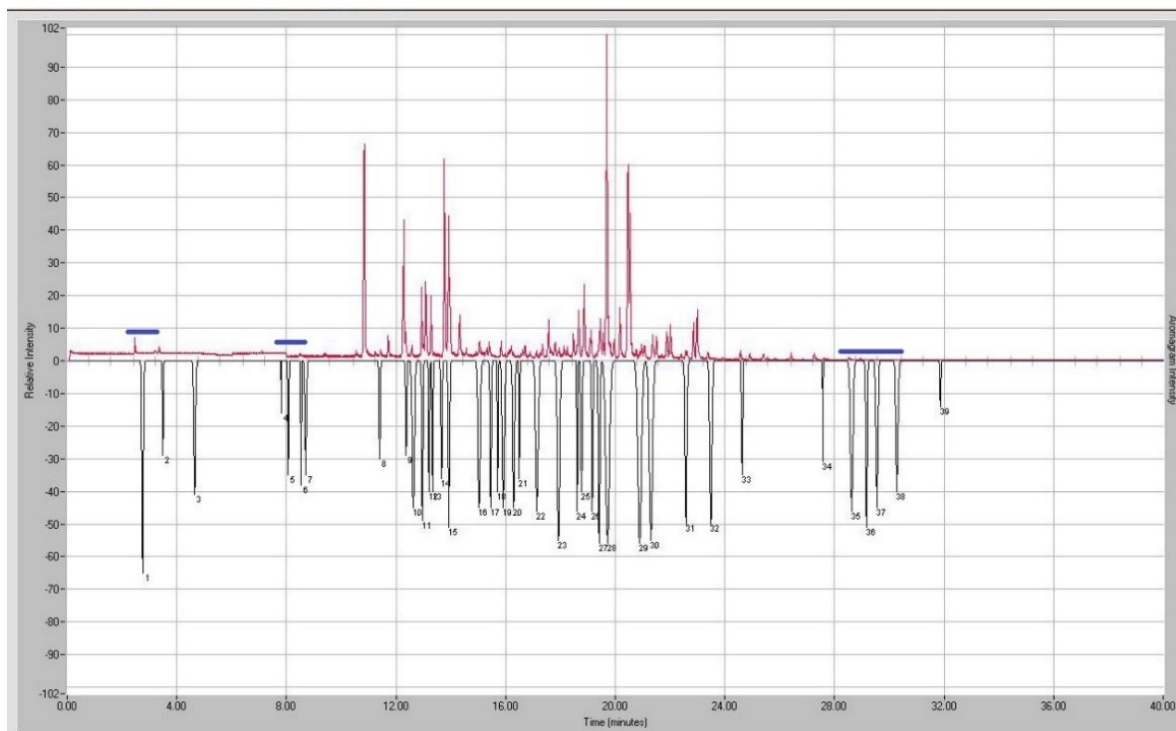
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**Figure A3.** An overlay of aromagram and total ion chromatogram of the carpet subflooring cat urine microbe Product 3 exposed to DVB/CAR/PDMS Stableflex (2 cm) SPME fiber for 60 min at 37 °C on day 0. An increase in black signal height represents an intensity increase of odor and, the responsible volatiles are in the red TIC signal. Several unpleasant odor events were recorded during analysis, and few of them were medium odor events.



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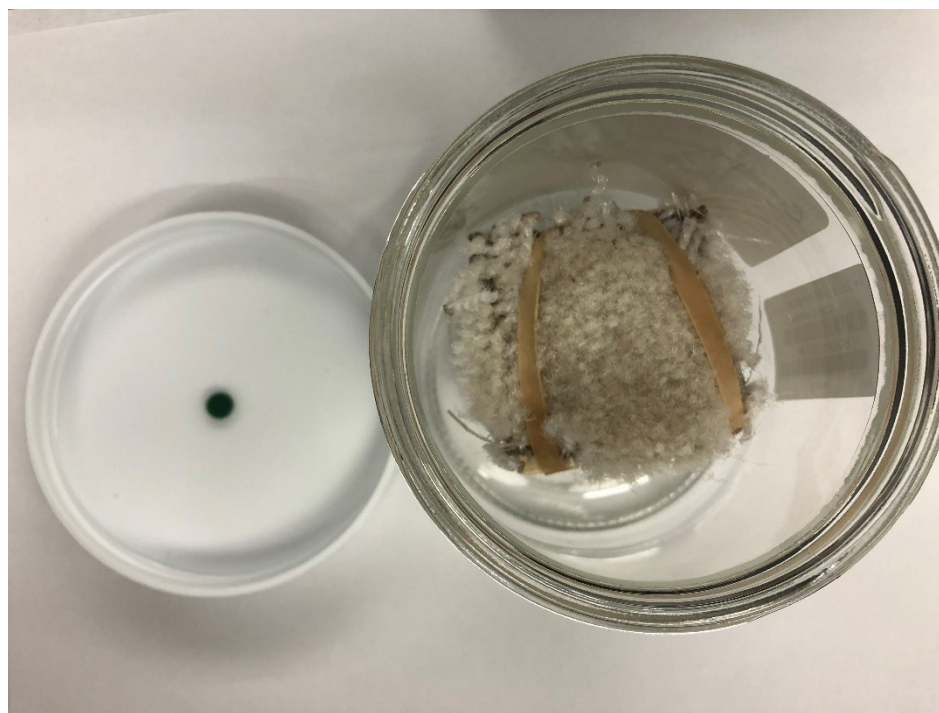
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**Figure A4.** An overlay of aromagram and total ion chromatogram of the carpet subflooring cat urine microbe Product 3 exposed to DVB/CAR/PDMS Stableflex (2 cm) SPME fiber for 60 min at 37 °C on day 15. An increase in black signal height represents an intensity increase of odor and, the responsible volatile chemicals are in the red TIC signal. Several unpleasant odor events were recorded during analysis, and only a few of them were medium-strong unpleasant odor events.



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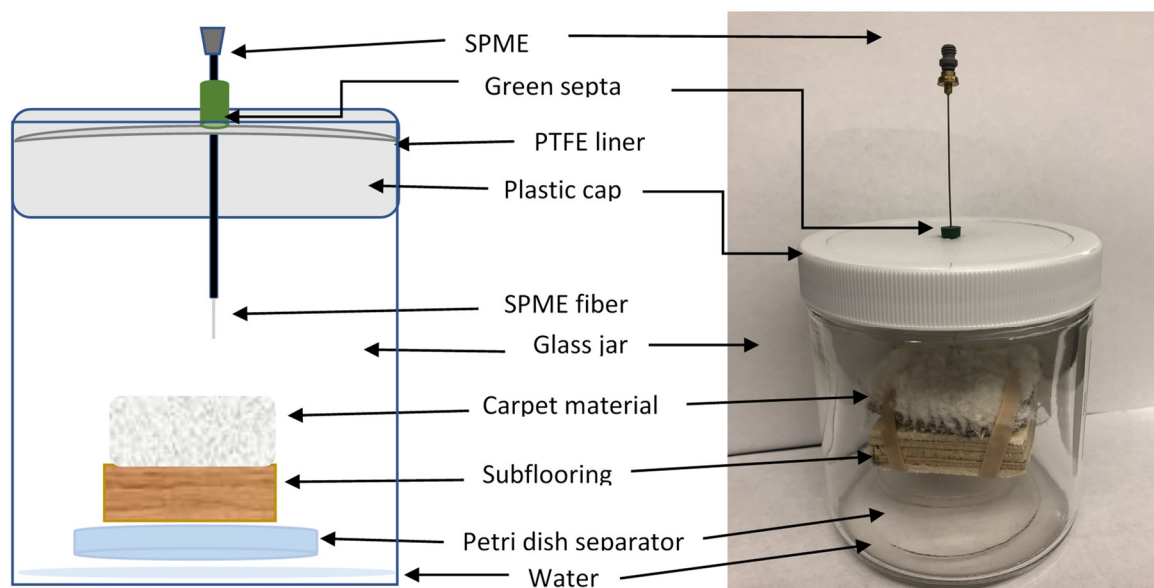
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**Figure A5.** The picture shows the test carpet and subflooring specimen with or without treatment inside the 500 mL glass jar. The carpet specimen was tied with the specimen subflooring using a latex rubberband. Thermogreen half-hole septum in the white plastic screw top was used to insert SPME probes inside the headspace. The inside of the white plastic screw top was lined with PTFE.

132



133 **Figure A6.** The test carpet with or without treatment inside the 500 mL glass jar. Volatiles emitted  
 134 from carpet with subflooring were sampled by a DVB/CAR/PDMS Stableflex (2 cm) SPME fiber for  
 135 60 min at 37 °C. Petri dish separator was on the bottom of the jar. 10 mL of water was added Day 1  
 136 to the bottom of the jar to maintain humidity in the headspace.

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