

St. Croix Sensory, Inc.



27 July 2006

Mike McGuire
Thornell Corporation
100 James St.
Smithville, MO 64089

Re: Cat Urine Deodorizer Odor Testing Results

Dear Mr. McGuire,

St. Croix Sensory was contracted by Thornell Corporation to compare the deodorizing performance of four cat urine deodorizing products by evaluating human odor perception parameters.

The four cat urine deodorizing products included the following:

1. Urine-off (Bio-Pro Research, LLC)
2. Nature's Miracle (Pets 'N People, Inc.)
3. Hydrocide (Bridgepoint Systems)
4. Odor-off/Odorcide (Thornell Corporation)

The effectiveness at removing cat urine odor was tested by soiling swatches of a carpeting assembly. Carpet samples were first soiled with cat urine. The urine stains were then cleaned 24-hours later. Five days later, the samples were treated with the different deodorizing products and evaluated one hour after treatment and 24-hours after treatment.

The samples were all evaluated by ten assessors trained and experienced at odor evaluation of products and materials.

This report provides the results and interpretation of the odor evaluation test sessions.

Sample Preparation

Cat urine deodorizing products were to be evaluated for their performance at removing cat urine odor from carpeting. Carpet assemblies were constructed containing:

1. 16" x 16" pine ½" plywood as the subfloor,
2. 12" x 12" common carpet padding; and
3. 12" x 12" common shag carpeting of a neutral color;

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These assemblies were secured together with four nails in each corner. The assemblies were individually labeled with randomly generated three digit codes.

One assembly was immediately set aside as the Blank Control sample for the study.

Thornell Corporation supplied cat urine from a local veterinarian. The cat urine was a pooled sample from multiple cats. The urine was shipped on ice to St. Croix Sensory in a cooler and reheated to 100°F in a laboratory oven one hour before application onto the carpet assemblies.

Four ounces (118-mL) of the cat urine was poured out in an approximately 5" diameter circle onto five carpet assemblies. The samples were left to dry for 24-hours in a well ventilated area of the laboratory. After 24-hours, the samples were cleaned with Resolve carpet cleaner. The Resolve carpet cleaner was applied by spraying 1-oz. (16 sprays) of the cleaner onto the urine stain. The cleaner was dabbed and scrubbed following recommended cleaning procedures on the product packaging. This process was repeated with a second application of 1-oz. of the carpet cleaner. After the two applications, the urine stain was completely removed from the carpet.

One of the five soiled and cleaned samples was randomly chosen to be a control sample for evaluation without any deodorizing treatment.

After cleaning, the samples were stored in a well ventilated area of the laboratory for 120-hours to assure the carpet cleaner was completely dry. One hour before the first odor evaluation test session, four carpet test samples were treated separately with four deodorizer products. Following packaging instructions, Hydrocide was diluted in water in a ratio of 8-oz. deodorizer to 1-gallon of cleaner. All other samples were applied at full strength as prescribed in packaging instructions. Eight ounces of the deodorizers were applied to the center of the carpet samples in approximately a 6" diameter wetted circle. The Urine-off product was applied through 300 sprays from the original packaging bottle (1 spray was determined to be equivalent to 0.78-mL, 0.026-oz).

The four samples treated with deodorizing products, the soiled and cleaned control sample (Control), and the blank sample were then evaluated by the trained assessors on 24 July 2006. After this first evaluation, the samples were held in a well ventilated space in the laboratory and presented to the same panel of assessors again on 25 July 2006, 24-hours after application.

Odor Evaluation Results

Samples were presented following a Latin Square design. This design alternates the order of sample presentation so all samples are observed in each presentation order position and samples are not evaluated in the same sequence by multiple assessors. For presentation, the assessors sniffed the carpet samples directly, with their nose ½" to 1" above the center of the carpet surface.

Odor Intensity

Odor intensity is determined following the ASTM International standard E544-99: *Standard Practice for Referencing Suprathreshold Odor Intensity*. For this method, the odor intensity result is expressed in parts per million (PPM) of n-butanol. A larger value of butanol concentration means a stronger odor. A smaller value of butanol concentration means a weaker odor. Butanol concentrations are used as a referencing scale for purposes of documentation and communication in a reproducible format.

Table 1 presents a summary of the odor intensity results for the test samples during the two odor evaluation testing sessions. All treated samples had higher perceived odor intensity than the control sample. This is due to the chemical and fragrance odors of the samples being more intense than the original cleaned cat urine. Odor-off/Odorcide had the highest odor intensity of all the samples 1-hour after application and the largest reduction in intensity during the 24-hours after application. The sample treated with Urine-off was the highest odor intensity of all the samples 24-hours after application and it was the only sample that increased in odor intensity during the 24-hours after application.

While odor intensity can be a measure of overall odor reduction, it often times is not the best measure of performance if the treatment methods add additional odors to the test sample. For example, an air freshener in a room may cover all the malodor, but the overall perception of odor intensity increases due to the fragrance.

Table 1. Comparison of the odor intensity results (ppm n-butanol equivalent) of the test samples one-hour and 24-hours after application of the deodorizing products.

Sample	1-hr after application	24-hrs after application
Blank	10	9
Control	40	30
Urine-off	80	100
Nature's Miracle	60	40
Hydrocide	60	40
Odor-off/Odorcide	130	80

Hedonic Tone

Hedonic tone is a measure of the pleasantness or unpleasantness of an odor. This is a subjective test parameter where assessors use a scale of -10 (most unpleasant) to +10 (most pleasant) to report their perception of the odor. A score of zero is a neutral odor.

Table 2 presents a summary of the hedonic tone results for the two odor evaluation testing sessions. The Blank sample was near neutral (zero). Odor-off/Odorcide had the least negative value, most pleasant, of the treated samples and it was the only product with a hedonic tone lower than the control for both time periods tested. Nature's Miracle had the most negative, least pleasant, hedonic tone of the treated samples 1-hour after application. Urine-off had the most negative hedonic tone of the treated samples 24-hours after application. Hydrocide had the second most negative hedonic tone 1-hour after application; however, the hedonic tone was slightly better than the control sample after 24-hours.

Table 2. Comparison of Average Hedonic Tone results of the test samples one-hour and 24-hours after application of the deodorizing products.

Sample	1-hr after application	24-hrs after application
Blank	-0.7	-0.3
Control	-3.5	-3.3
Urine-off	-3.8	-4.4
Nature's Miracle	-4.5	-3.9
Hydrocide	-4.2	-3.1
Odor-off/Odorcide	-2.1	-2.1

Note that the hedonic tone values provided by the trained assessors from this project should not be considered to represent the opinions of the general population. The values should be used for comparison of the pleasantness between samples since they were observed by the same panel of assessors. Furthermore, the presence of a negative hedonic tone does not in itself suggest a cat urine odor was present. It is possible for a chemical odor or even a fragrance to be perceived as just as negative as the cat urine, depending on the specifically perceived character and the intensity.

Odor Characterization

Assessors observed the test samples directly and reported the relative strength of odor descriptors observed. Based on results of testing during protocol development, St. Croix Sensory selected a list of 15 descriptor terms from a standard list of over 100 terms. The odor characters included eight main odor categories: floral, fruity, vegetable, earthy, offensive, fishy, chemical, and medicinal, as well as 7 other terms: musty, musky, stale, sour, urine, ammonia, and soapy.

Each odor descriptor was rated in relative intensity on a 1 to 5, faint to strong, scale (0=not present). The odor testing descriptor data is then plotted on a spider plot (radar plot) with the distance along each axis representing the 0-5 scale for each of the categories. The plot creates a "pattern" that can be readily compared to spider plots for other samples.

Figure 1 presents the odor character profile results of all samples 1-hour after treatment. The Odor-off/Odorcide product had the lowest relative strength of urine, offensive, and ammonia odor reported. Odor-off/Odorcide also had the highest relative strength of floral and soapy odor characters. The other three deodorizing products had relative strengths of urine, offensive, and ammonia characters that were similar or greater than the control. Table 3 summarizes the relative strength results for the urine, offensive and ammonia characters for all samples.

Figure 1. Comparison of the odor character profiling of the test samples 1-hour after application of the deodorizing products.

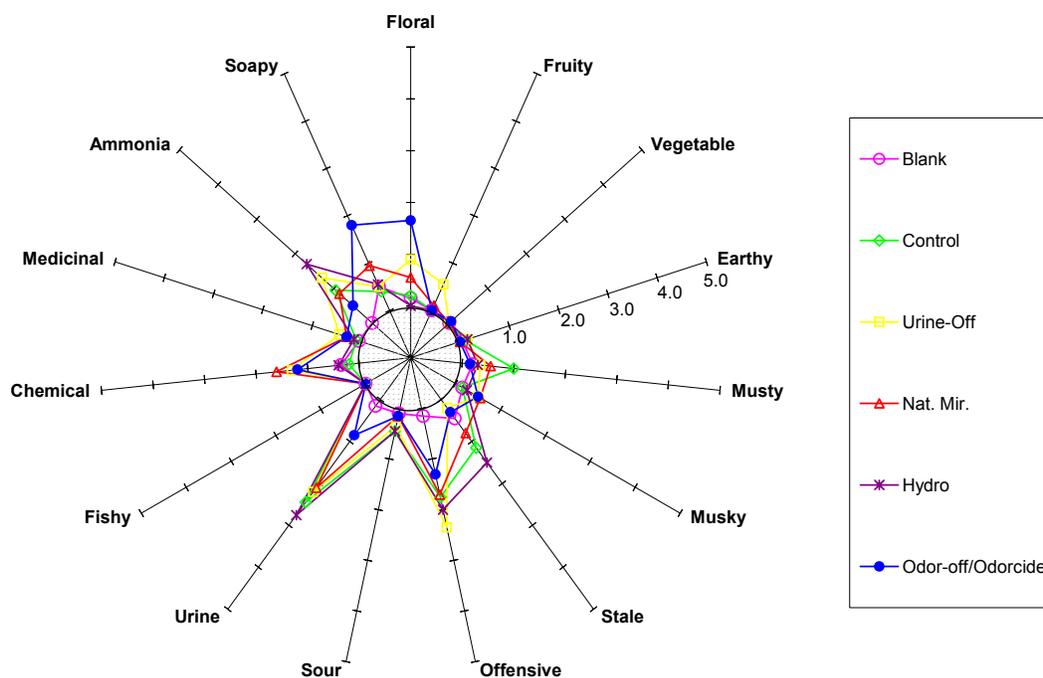


Table 3. Comparison of average relative strength results for urine, offensive and ammonia characters of the test samples one-hour after application of the deodorizing products.

Sample	Urine	Offensive	Ammonia
Blank	0.1	0.1	0.0
Control	2.5	1.8	0.9
Urine-off	2.2	2.4	1.3
Nature’s Miracle	2.1	1.7	0.9
Hydrocide	2.8	2.0	1.7
Odor-off/Odorcide	0.9	1.3	0.5

Figure 2 presents the odor character profile results of all samples 24-hours after treatment. The Odor-off/Odorcide product again had the lowest relative strength of urine and offensive character reported. Odor-off/Odorcide also had the highest relative strength of floral, chemical and soapy odor characters. The other three deodorizing products had relative strengths of urine character that were similar or greater than the control. Table 4 summarizes the relative strength results for the urine, offensive and ammonia characters for all samples 24-hours after treatment.

Figure 2. Comparison of the odor character profiling of the test samples 24-hours after application of the deodorizing products.

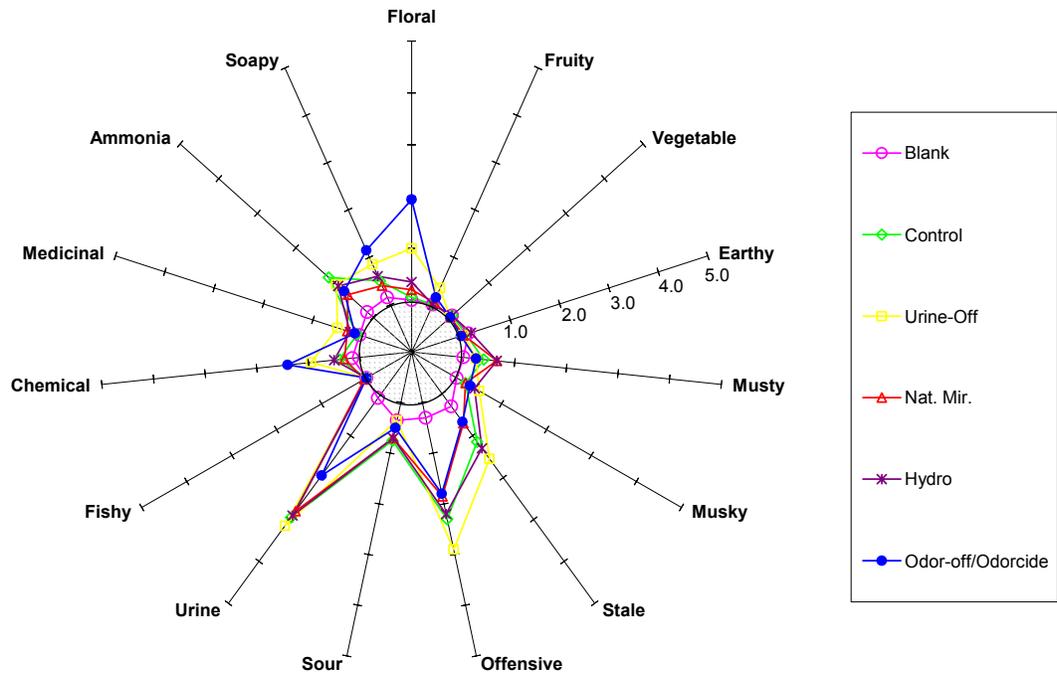


Table 4. Comparison of average relative strength results for urine, offensive and ammonia characters of the test samples 24-hours after application of the deodorizing products.

Sample	Urine	Offensive	Ammonia
Blank	0.1	0.3	0.2
Control	2.9	2.3	1.15
Urine-off	3.1	2.9	0.9
Nature's Miracle	2.8	1.9	0.7
Hydrocide	2.9	2.2	0.9
Odor-off/Odoricide	1.9	1.8	0.8

Discussion and Conclusions

The perceived odor intensity was not a representative odor parameter for evaluating effectiveness of the products to reduce the cat urine odor since the product chemical and fragrance odors were more intense than the original cat urine. This is not unusual for deodorizer products.

The hedonic tone and odor characterization results show that the Odor-off/Odorcide product reduced the urine, and other unpleasant odors related to the cat urine, more than the Urine-off, Nature's Miracle, and Hydrocide products. The group of trained assessors determined the Odor-off/Odorcide treated sample was the most pleasant of the soiled samples tested.

This letter is intended to provide results and interpretation of the odor evaluation work performed by St. Croix Sensory on 24-25 July 2006. We appreciate the opportunity to provide this report. Please review the results presented. I am available for a conference call to discuss this data and discuss future testing plans. Please feel free to call with any additional questions or comments.

Yours truly,

A handwritten signature in black ink, appearing to read "Michael McGinley". The signature is fluid and cursive, with a large loop at the end.

Michael McGinley, P.E.
Laboratory Director