Introduction

- "Marijuana’s bad, and it also has a very distinct smell, m’kay?" (MacKay, 1998).
- The aroma character of dried flowers varies markedly across different strains of Cannabis (Gilbert & DiVerdi, 2018).
- Consumer perception of product quality (potency, price, and interest in smoking) varies with strain-specific aroma.


- An empirically-based olfactory lexicon for cannabis would benefit consumers, growers, and retailers.

- Gilbert & DiVerdi (2018) had observers sniff and rate samples using a check-all-apply (CAA) ballot.

- Here we extend those findings using quantitative sensory rating scales.

Objectives

- Use quantitative ratings scales to characterize the aroma profiles of multiple cannabis strains.
- Compare results to those obtained by Gilbert & DiVerdi (2018) using CATA ballots.

Methods

- Cannabis purchased at local dispensaries licensed for retail recreational sale in Colorado (Sorrel Beds, Infinita Wellness Center, Organic Alternatives).


- Each stimulus (1 g dried cannabis flower) presented in wide mouth 118 ml (4 oz) amber glass bottle labeled with a three-letter code. Samples stored at -2°C, thawed at room temperature 2 hours prior to testing.

- Fifty-two people tested (26♂; 26♀; mean age 28.5 ± 7.4 years). All 21+ years old. Colorado residents, self-reported normal sense of smell. Paid $20

- Forty odor descriptors selected from the 48 used by Gilbert & DiVerdi (2016).
- Apple, blueberry, pear, plum, strawberry, tea, tree fruit, and vanilla eliminated due to low frequency of endorsement and random assignment across strains.

- Eleven point scales (0 = “not at all”; 10 = “extremely like”) presented on a touch-screen device (Apple iPad).

- Most participants had purchased (94.2%) and used (92.3%) marijuana since it became legal on January 1, 2014.
- 17% (32.7%) took part in the original CATA study.

- There was wide variation in strain-specific aroma profiles (Fig 3).
- Master Kush was characterized as Earthy, Herbal, Pungent, Tea, and Woody.
- It also had distinct notes of Cheese, Blue cheese, Butter, Chestnut, Nutty, Tea, and Tobacco.
- Golden Goat was described as Citrus, Lemon, Pungent, Sweet, Herbal, Lime and Orange.
- It also had notes of Mango, Peach, and Tropical Fruit.

- There were only 3 strains in common among the odor stimuli.

- Despite different cannabis strains as stimuli, descriptor use with each method appeared to converge.

- Cluster analysis (Fig 4) produced a solution with two main groups (Clusters A and B) and a possible intermediate group (A/B).
- The Lamb’s Breath, G13, and Jilly Bean strains were also tested in the original study (Fig 5).
- In both studies, Lamb’s Breath and G13 sorted into one group and Jilly Bean into the other.

- Clusters A and B (Fig 4) have distinctive aroma profiles based on top rated descriptors for their respective strains (Table 1).

- An intermediate group (Fig 4) consisting of Sour Diesel and Jack Flash shares descriptors with the two main clusters.

- Compared to the original study, there is a consistent pattern of results, even though the original study used CATA ballots and this study used numerical rating scales.

- There were only 3 strains in common among the odor stimuli.

Figure 1. Mean ratings across all 10 cannabis samples

Figure 2. Comparison with CATA results

Figure 3. Aroma profiles of two strains compared

Table 1. Five highest scoring descriptors for each strain

<table>
<thead>
<tr>
<th>Cluster A</th>
<th>Cluster B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Master Kush</strong></td>
<td><strong>Golden Goat</strong></td>
</tr>
<tr>
<td>Herbal</td>
<td>Herbal</td>
</tr>
<tr>
<td>Pungent</td>
<td>Pungent</td>
</tr>
<tr>
<td>Tea</td>
<td>Tea</td>
</tr>
<tr>
<td>Woody</td>
<td>Woody</td>
</tr>
<tr>
<td>Sweet</td>
<td>Sweet</td>
</tr>
<tr>
<td>Citrus</td>
<td>Citrus</td>
</tr>
</tbody>
</table>

Figure 4. Hierarchical cluster analysis of the 10 cannabis strains

Figure 5. Hierarchical cluster analysis of the 13 cannabis samples from Gilbert & DiVerdi (2018)

Conclusions

- The Earthy/Herbal/Pungent/Woody and Citrus/Pungent/Sweet aroma profiles are confirmed.

- These profiles represent a basic divide in the dried cannabis flower odor space.

- An intermediate aroma profile may also exist.

- Quantitative rating scale results and CATA ballots produce similar results.

- Participants tend to endorse more odor descriptors when using rating scales.

- A reduced set of 40 descriptors is adequate to specify cannabis aroma.

- Blunt and Diesel are valid descriptors.

- Strain-specific aroma profiles are potentially useful in quality control, plant breeding, identification of consumer preferences, and development of ancillary products.

References

1. Mackey South Park 1998; 2:4
5. Strong & England 2016; Style Guidelines; Beer Style Guidelines; Beer Judge Certification Program.

Ethics Statement

This study was approved by the Western Institutional Review Board (Puyallup, WA) (#RBM Protocol #2017016). All participants provided informed written consent. At no time did participants come into direct contact with each other. All participants were adults 21 years of age and older who were legal in the state of Colorado since January 1, 2014.

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