Using complexes to shorten descriptive analysis training time in an industrial setting

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INTRODUCTION

Descriptive analysis uses lexicons developed by panelist consensus to describe and understand differences between products[1-2]. Lexicons vary in the number of attributes included; some studies use upwards of 35 attributes for certain products. With longer lexicons, attributes are very specific in an attempt to capture small nuances in product differences. However, in an industrial setting, it may not be feasible or necessary to use longer and highly specific lexicons. Training time increases with a greater number of attributes to ensure all panelists are aligned, and sensory analysts that manage industrial descriptive analysis panels using coworkers as panelists may not have the time required to adequately train panelists. Aroma complexes are often used in lexicons to help categorize attributes into broader groups; panelists scale both the complex and individual attributes within it[1].

In an effort to lessen the number of attributes and thus shorten training time, this research examined data from panelists scaling individual attributes and complexes versus solely complexes.

MATERIALS & METHODS

A group of 23 trained internal panelists (M=16, F=7) used a modified Spectrum™ method to develop a lexicon for hard ciders[3]. Hard ciders were a new product category for panelists, though all panelists had between one and three years' experience on a descriptive analysis beer panel. The lexicon below included both specific aroma attributes and broad aroma complexes, and panelists were aligned with references for most attributes. Complexes are indicated by bold headings; the attributes within each complex are listed below the heading.

Nineteen ciders were evaluated for visual, aroma, taste, and mouthfeel; the data presented only include aroma, as these were the attributes for which complexes were used.

Apple	**Sweet Aromatics**
Apple flesh	Caramel
Apple skin	Honey
Bruised apple	**Candy**
Floral	Fun Dip™/Pixie Sticks™
Honeysuckle	Green Jolly Rancher™
Perfume	Pink Bubble Gum
Other Fruit	**Woodsy**
Melon	Oak
Pear	Dried Leaves
White Grape	**White wine**
Citrus	**Medicinal**
Tropical Fruit	**Phenolic**
Guava	**Catty**
Passion Fruit	

Table 1. Complexes and specific attributes used for the cider lexicon. Four attributes (white wine, medicinal, phenolic, and catty) are not a part of any complex.

RESULTS

Two indicators were used to determine if complexes performed as well as the combination of complexes and specific attributes (all aromas): 1) equal or greater amount of variance explained in PC 1 and 2 and 2) similar orientation and distribution of products.

In this study, complexes were able to explain more of the variance than the use of all aromas (Table 2). Therefore, the complexes allow more of the data set to be represented in the PCA, giving a more robust model.

	Variance Explained	
	PC1	PC2
All Aromas PCA	42%	18%
Complexes PCA	50%*	23%*

Table 2. Variance explained by PCs 1 & 2 for All Aromas PCA and Complexes PCA (Figures 1 & 2). The higher variance for each PC is marked with an asterisk.

Comparison of the PCAs of product distributions for all aromas and complexes indicates the distributions are quite similar (Figures 1 & 2). Outliers like samples 10, 11, 12, and 16 retain their positions, as do many of the more clustered samples (see ellipses for comparison in Figures 1 & 2).

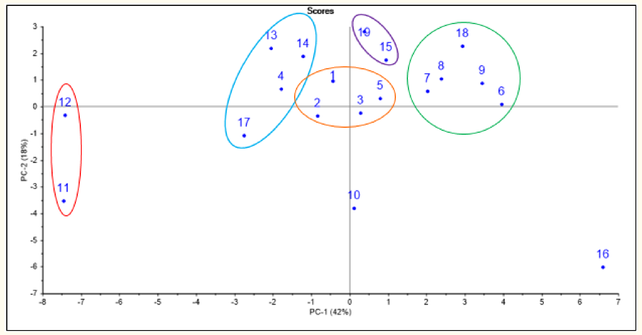

Figure 1. Distribution of products using all aromas. Ellipses group similar products

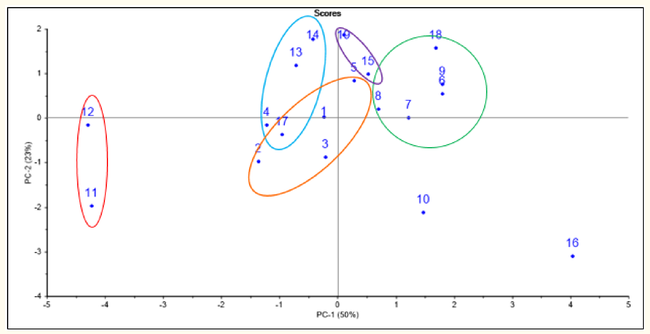

Figure 2. Distribution of products using complexes only. Ellipses are the same groupings as Figure 1.

DISCUSSION

The largest benefit of using complexes is that panelists require less training to understand concepts. Though most Coloradoan panelists cannot distinguish passion fruit from guava without extensive training, it is quite easy for them to separate tropical fruit from citrus due to their everyday experiences. In an industrial setting where training time is limited, it was useful to rely on panelists' everyday knowledge to expedite understanding of the complexes.

There is a tradeoff to solely using complexes. Smaller nuances between products are not captured. Figure 3 shows apple complex in the upper right hand corner, but the specific attributes within that category are widely spread in the PCA. Apple skin is closer to woodsy aromas, whereas apple flesh and bruised apple are more similar to sweeter fruit aromas. Without the inclusion of apple skin, it would have been difficult to characterize the ciders at the top of the y axis.

This issue could be mitigated by more specific complexes. For example, apple complex could be further separated into sweet apple and tart apple complexes. A hybrid lexicon can be used as well, which is what this study did; use complexes where appropriate, but also include specific attributes such as phenolic, and white wine that didn't fit under a complex. By considering the needs of the product category and training time limitations, sensory scientists can leverage the use of complexes to get equally actionable data as if they were to use many specific attributes.

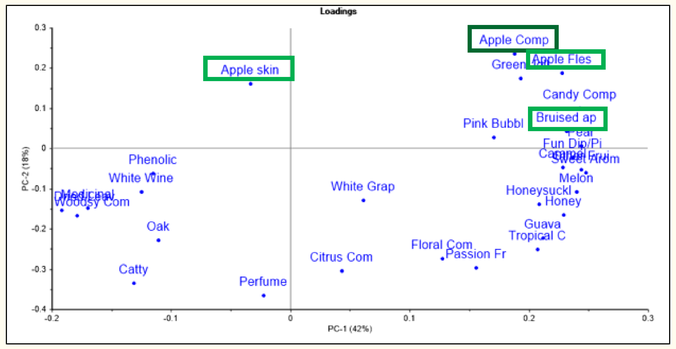

Figure 3. Attribute PCA including all aromas. Apple complex is indicated in dark green; the attributes within that complex are indicated in light green.

CONCLUSIONS

This research demonstrates how a shorter lexicon using only complexes provides data that is equally discriminating and actionable as that of a longer lexicon. The flexible format of the lexicon would even allow both complexes and more specific attributes that do not fall under any complex in the same lexicon should the need arise. With this in mind, it's possible these findings could be applicable to any descriptive analysis panel based on the product and data usage.

References: 1. Lawless, L. J. R.; Civille, G. V. Developing Lexicons: A Review. *J. Sens. Stud.* **2013,** *28* (4), 270-281. 2.Drake, M. A.; Civille, G. V. Flavor Lexicons. *Comprehensive Reviews in Food Science and Food Safety* **2002,** *2*, 33-40. 3. Meilgaard, M. C.; Civille, G. V.; Carr, B. T. *Sensory Evaluation Techniques*; 4th ed.; CRC Press: Boca Raton, Florida, 2007.