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Comparison of Tetrad and Degree of Difference Sensory Testing Methods in Evaluating the Quality of Flour Tortillas

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Introduction

Discrimination sensory tests are methods used in sensory analysis to determine whether two samples are perceptibly different (Lawless and Heymann 2010). One of these tests is the Tetrad that has recently gained popularity in the sensory evaluation of foods. It has demonstrated superiority over the triangle test in both theory and practice with its proven relatively large statistical power (Christensen and Ennis 2014). In this test, panelists are presented four samples – two samples from one group and two samples from another. Panelists are asked to group the samples into two groups of two based on similarity. Recent studies have shown that Tetrad has the potential to detect differences more reliably and with a smaller sample size than many other discrimination tests including the 2-AFC, 3-AFC and triangle methodologies (Christensen and Ennis 2014; Ennis 2012). Although, Tetrad can possess a drawback of sensory fatigue with the addition of its fourth stimulus (Ennis 2012).

Another discrimination test utilized is the degree of difference (DOD) methodology. Two products (A and B) are presented to panelists in one of the following ways: A/A, B/B, A/B and B/A. Panelists are then asked to rate the degree of difference for a given sample pair on a scale (Bi 2002). There have been numerous studies comparing the precision and power of the Tetrad test vs. other discrimination tests, however there has been little research comparing the Tetrad vs. the DOD test. This project compared the precision and power of the Tetrad and DOD tests by measuring the flour tortilla quality from two different manufacturing lines in one commercial plant to determine if a sensory difference exists.

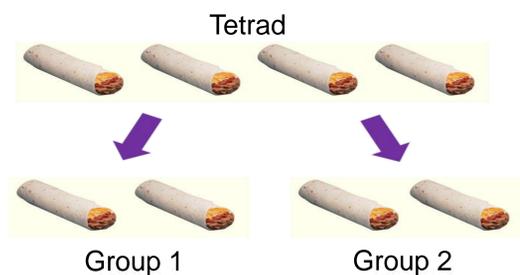
Research Objectives

- Compare the Degree of Difference and Tetrad discrimination testing methods when measuring the sensory quality between flour tortillas made from two different processing lines
- Determine which of the two methodologies will provide greater precision, power and efficiency, while being financially wise

Material and Methods

- **Tortilla samples**
 - Samples of 10.25" tortilla were obtained from two different manufacturing lines in one commercial plant and stored at room temperature
- **Subjects**
 - The same 48 panelist were used in both methodologies consisting of 22 women and 26 men
- **Sample prep**
 - Tortillas were heated on a tortilla grill and filled with refried beans, red sauce, white onions and cheddar cheese. The product was folded like a burrito and served in paper wraps

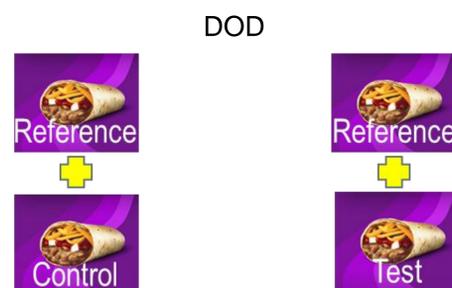
Experimental overview



You have been given 4 samples of bean burritos, each with a 3 digit code on them.
Please try them from left to right.
Then group the samples into 2 groups of 2 based on similarity.

Write your answers here for Group 1:

Write your answers here for Group 2:



You will be served a REFERENCE sample

All questions are based on how DIFFERENT your other samples are from the Reference sample

You may or may not be getting a sample that is different from the Reference (i.e. the Sample(s) could be the same as the Reference Sample)

You do not have to eat all the products, just enough to answer the questions.

Take your REFERENCE sample FIRST

No Difference	Very Slight Difference	Slight Difference	Moderate Difference	Large Difference

Please press the NEXT SAMPLE / END button on your touch screen to receive your next sample and when you are finished. Also press the silver call button when you are ready for your next sample and when you are finished. Thank you.

Key Findings

Table 1 - Degree of Difference % correct answers

Line A	# Correct Answers	Total Panelists	%
1	17	48	35.41%
2	16	48	33.33%
3	11	48	22.91%
4	4	48	8.33%
5	0	48	0%
Line B			
1	15	48	31.25%
2	14	48	29.17%
3	10	48	20.83%
4	6	48	12.5%
5	0	48	0%

Note: 1 = No difference, 2 = Very Slight Difference, 3 = Slight Difference, 4 = Moderate Difference, 5 = Large Difference

Table 2 - Percent Correct Answers in Tetrad

Tetrad	# Correct Answers	Total # Panelists	%
	19	48	39.58%

Table 3 – d', Variance of d', Power and P-value of Tetrad and DOD

	d'	Variance of d'	Power	p-value
Tetrad	0.598	0.13	22%	0.22
DOD	0.695	0.28	18.5%	0.92

Conclusions

- Results showed that the statistical power of Tetrad was higher than DOD at 22% and 18.5% respectively. This higher power as well as lack of significance between the two tests d' indicate that Tetrad may be substituted for DOD to achieve its same power using fewer panelists.
- Tetrad has a smaller variance of d' than that of DOD suggesting that Tetrad was more precise.
- P-values indicated the panels in both methodologies did not detect a difference between the two tortilla samples
- Tetrad is a viable alternative to DOD in determining differences in flour tortilla quality by improving the precision and accuracy of sensory results. The subsequent reduction in the number of panelist required will also reduce the cost of product testing.

References

- Bi J. 2002. Statistical models for the degree of difference test. Food Quality and Preference. 13:31-37.
 Christensen R, Ennis J. 2014. Precision measurement in Tetrad testing. Food Quality and Preference. 32: 98-106.
 Ennis J, Rousseau B. 2012. Reducing Costs with Tetrad Testing. IFPress. 15: 3-4p.
 Lawless H, Heymann H. 2010. Sensory Evaluation of Food. 2nd ed. New York: Chapman and Hall. 116-138 p.

To determine if the d prime value (d') from Tetrad is significantly different then the d' prime value of DOD we've performed a two tailed test based on the data. Results show that the test statistic is 0.1535 with the p-value of .88.

To figure out if our z-values are significantly different, we use the formula below.

$$Z = \frac{|d'_A - d'_B|}{\sqrt{S_A^2 + S_B^2}}$$

The formula of two d' values, d'_A and d'_B each with its variance value s²_A and s²_B. In this instance, DOD is A and Tetrad is B.

Observations

- Table 3 shows that the power of the Tetrad test was higher than the DOD test at 22% and 18.5% respectively. It also shows that the d' of Tetrad was 0.598 while the d' of the DOD was higher at 0.695. It also shows the variance of d' was 0.13 for Tetrad which was lower than the 0.28 for DOD. Finally it shows the p-value of Tetrad was 0.22 and DOD was 0.92. The p-value comparing the d' of Tetrad and DOD is 0.88.
- With the calculation of Z-value, the d' of both tests were not found to be significantly different.