FOOD SCIENCE & SENSORY ANALYSIS

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OTTIMMO INTERNATIONAL MASTERGOURMET ACADEMY
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PREFACE

Food Science and Sensory Analysis is one of courses in OTTIMMO International Master Gourmet Academy. This module is intended for student in 3rd semester who take food science and sensory evaluation subject. This is the first edition of "Sensory Evaluation Module". Six different methods are taught for analyzing the sensory of panelist for food product in this module.

This module will explore the fundamentals of sensory evaluation course. In this module, the author has attempted to present an easy way to understand about sensory evaluation method.

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INTRODUCTION

Food is consumed because it can stimulate human sensing organs to consume it. Human sensing organs serve as measuring instrument for detecting whether a food favored or not. We can measure color of food using colorimeter and measure milk temperature to pasteurize using thermometer. However, we can't measure food preference (like or dislike) using any instrument.

Sensory evaluation is an instrument used to measure food preference using human sensing organs. It is used the senses for measuring texture, sighting, the scent and flavor of food product. Humans have five senses: taste, smell, touch, sight, and hearing. All of the senses are important when eating a food. There is no instrument that can replace or replicate the human senses, making the sensory evaluation subject is important to learn.

Sensory evaluation is one of an area that generally well-known and important for food industry. However, many people considered that application of sensory food evaluation only needed to the research and development department in food industry. In fact, sensory evaluation can be used in many areas such as:

- To evaluate or improve quality of food product
- To provide information for decision making (launching a new lamb steak or a new chicken steak in steak restaurant).
- To determine shelf-life of a product
- To test the taste of new recipe to others people
- To test the taste of modified recipe

- To compare our new product to competitor's product
- And so on

Before going to the next chapter, think about eating a potato chip. First you see the chip (maybe you notice if it has any dark/burnt spots?). Next if you touch it (maybe you notice if it's greasy?) or if it's thick?). Then, as you bring the chip to your mouth, you smell it (maybe you smell the seasoning?) or the oil it was fried or baked in?). Then you eat it and hear the crunch of the chip, and you probably also taste the saltiness (maybe you also experience some additional flavor?). Imagine if any one of these experiences was missing — would a chip be the same if you didn't hear it crunch in your mouth?

SENSORY ANALYSIS IS THE IDENTIFICATION, SCIENTIFIC MEASUREMENT, ANALYSIS AND INTERPRETATION OF THE ATTRIBUTES OF A PRODUCT AS THEY ARE PERCEIVED THROUGH THE FIVE SENSES OF SIGHT, SMELL, TASTE, TOUCH AND HEARING (CARPENTER ET AL., 2000).

CHAPTER I
GENERAL RULES OF SENSORY EVALUATION

1.1 Objective

Students will be able to understand the general rules of sensory evaluation

1.2 Sample food (carrier, size and temperature)

All foods presented in sensory evaluation test must be safe to eat. Food that has become moldy or has been treated causes microbiological or chemical contamination, then only the odor and appearance attributes of the food can be evaluated.

Some foods are not easily evaluated on their own, e.g. fat spreads, cereal, jam, sauces, etc. They are requiring an additional product to be presented as a carrier. Some carriers are unsalted cracker, bread, milk, and pasta (Watts, et al., 1989).

Foods presented in sensory evaluation must be in adequate size (adequate but not excessive). The recommendation size for solid sample is 30 grams and for liquid sample is 15 ml (the American Society for Testing and Materials STP 434, 1968).

Technically, based on some recommendations from literature, frozen dessert should be served between -18°C and -10°C, cold beverages served between 5°C and 9°C, hot food should be present on 60°C- 66°C and hot tea and coffee present on 66°C-71°C. While there are many foods can be served in ambient temperature, e.g. snack, cereal, bread, and so on.

1.3 Method

There are 3 types of organoleptic method, namely discriminative test, descriptive test and affective test. Discriminative tests include Triangle Test, Duo Trio Test and Paired Comparison Test. Discriminative test is used to find out if there are differences between the samples presented. Meanwhile, the descriptive test is used to describe the intensity of product differences.

Furthermore, the affective test is divided into 3 methods namely Preference test, Acceptance test, and Hedonic Test. This test is used to measure the preference and/or acceptance of a product (Carpenter, et al., 2000).

1.4 Panelists

People who test the food in sensory evaluation named "Panelists". Panelists can identify the sensory properties that will help to describe the product. The panelists for sensory evaluation **must not people who dislike the food**. For example, if we want to evaluate the taste of our homemade yoghurt, the panelist who test our yoghurt must be people who like the yoghurt.

Panelist divided into two categories, untrained panelist and trained panelist. Trained panelists are usually used for descriptive and discrimination methods. Meanwhile, affective method is held by untrained panelists (Watts, et al., 1989).

Trained panelists are selected through some selections; one of them is sensitivity / threshold method. Panelists are asked to recognize the level of taste (sweet, sour, and so on).

Table 1. Examples of samples and concentrations used for determining recognition levels for taste

Property	Material	Concentration (g/L)
Sour	Citric acid	0.43
Bitter	Caffeine	0.195
Salt	Sodium Chloride	1.19
Sweet	Sucrose	5.76
Umami	Monosodium Glutamate	0.595

Source: ISO 3972:1991

1.5 Environment

In general, based on Watts, et al., (1989), the facilities for sensory analysis must meet the basic requirements. The basic requirements for sensory analysis are:

1. A food preparation area
2. A separate panel discussion area
3. A quiet panel booth area
4. A desk or office for the panel leader
5. Supplies for preparing and serving samples

1.6 Utensils

Utensils used for sensory evaluation method are the vessel and cutlery if needed. The vessel or container for sample should give no additional sensory characteristic to the sample. We can use glass, but it is

more expensive than plastic, and can be hazard. Clear or plain white containers are recommended to use in food sensory evaluation.

1.7 Analysis of Data

Analysis of data is different for each sensory evaluation method. Analysis of data for each method can be seen in the next chapter. Hence, the results of the sensory evaluation are stated clearly and concisely in a written report (explained in the next chapter) that is also completed with a summary of data, sample identity, and other information deemed necessary.

CHAPTER II
PREFERENCE TEST

2.1 Objective

Students will be able to conduct preference test and analyze the test result.

2.2 Fundamental Theory

Sensory evaluation methods may be divided into two broad classes based on the purpose of the test: affective (consumer oriented) and analytical methods (product oriented) (Watts, et al., 1989). Consumer oriented test should be conducted with untrained panelists (see chapter I). Preference is consumer oriented test. Preference test allow the consumer to say **which sample is preferred** between two samples presented.

In preference test, panelists are asked which of two coded samples they prefer. Panelists are instructed to **choose one** between two coded samples; one sample is preferred and the other is no preference. The option either "no preference" for two samples or "dislike both equally" is not recommended for panels with less than 50 panelists. It is due to it will reduces the statistical power of the test.

Name:

Date:

Taste the two product samples in front of you, starting with the samples on the left. Circle the number of the sample that you prefer. You must choose a sample over the other (re-taste sample is allowed).

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Figure 1. Preference Questionnaire Test Sample

The two samples (A and B) presented in preference test are coded **with 3-digit random number**. There are two possible orders of presentation of the samples; A first, then B or B first, then A. The panelists evaluate the samples from left to right.

After the samples tested by panelists, the results of the test are analyzed using Table 3 (See Appendix). In this Table ***X represents the number of panelists preferring a sample and n represents the total number of panelists participating in the test.*** In the Table, the decimal point has been erased to save space; therefore 625 should be read as 0.625.

Look at the Table 3! If 17 of 25 panelist prefer sample A, the probability from Table 3 (X=17, n=25) would be 0.108. If the result is bigger than the probability of 0.05, it would be concluded that sample A was not significantly preferred over sample B. However, if 19 out of panelist prefer sample A, the probability from Table 3 would be 0.015. The

probability of that result is less than 0.05. In that case, it can be concluded that panelist prefer to choose sample A over sample B (sample A significantly preferred over sample B) (Modified from Watts, et al., 1989).

2.3 Instructions

1. Group 1 prepares Bolognese sauces (homemade and shop product) (A and B) in two different containers.
2. Group 1 also prepares carrier (pasta), questionnaires, mineral water and tissue for panelist.
3. The two samples were presented to each panelist simultaneously.
4. Each panelist evaluated the two samples from left to right. Re-tasting is allowed.
5. Groups 1 collect the questionnaire and evaluate the result using Table 3.
6. Group 1 makes a report and submits the report for next week.

2.4 Result

For the result, it should contain:

a. Cover
b. Table of content
c. Chapter I. Introduction
   - 1.1 Background
   - 1.2 Objective
d. Chapter II. Report
   - 2.1 Panelist
   - 2.2 Food test method

- 2.3 Result (summarize the data in Table then analyze those data)

e. Chapter III. Conclusion

f. Appendix (questionnaires of the panelists)

CHAPTER III
ACCEPTANCE TEST

3.1 Objective

Students will be able to conduct acceptance test and analyze the test result.

3.2 Fundamental Theory

Acceptance test are classified as consumer oriented test. Acceptance test are used to determine the degree of consumer acceptance for a product. Ranking test, category scales, and the paired-comparison test can all be used for acceptance test.

In ranking test, panelists are asked to rank coded sample for acceptance in order from the least acceptance to the most acceptable. Panelist usually not allowed give equal acceptance ranks. Samples used in these test are three or more, each coded with 3-digit different random number and presented in identical sample container.

Picture source: Travers, 2019

Name:

Date:

Please taste each of the samples of product in the order listed below. Assign the sample with the most acceptable taste a rank value of 1, the sample with the next most acceptable taste a rank value of 2, and the sample with the least acceptable taste a rank value of 3. Do not give the same rank to two samples

Coded sample	Rank Assigned
.....	.....
.....	.....
.....	.....

Figure 2. Ranking Questionnaire Test Example

After testing by panelists, the results are tabulated in Table then analyzed using Friedman Test (Table 4&5) (see Appendix). Example of ranking test used to determine acceptability of bean texture. *"Yoghurt samples were prepared from three varieties of brand. 20 panelists evaluated the samples and give each sample a different rank (the most acceptable texture (1), the next most acceptable (2), least acceptable (3)). The ranked values given to each sample were tabulate as shown in Table 2".*

Table 2 Tabulated Ranking* for Acceptance Test Data

	Yoghurt		
Panelist	**A**	**B**	**C**
1	1	2	3
2	3	2	1
3	1	3	2
4	2	3	1
5	1	2	3
6	1	3	2
7	1	2	3
8	1	2	3
9	2	1	3
10	1	2	3
11	1	3	2
12	2	1	3
13	1	3	2
14	1	2	3
15	1	3	2
16	2	1	3
17	1	3	2
18	1	3	2
19	1	2	3
20	1	3	2
Rank Total	26	46	48

*Highest Rank=1=most acceptable taste, 3 = least acceptable taste

"Based on Table 2, the differences between rank total pairs were:

$$C\text{-}A = 48\text{-}26 = 22$$

$$C\text{-}B = 48\text{-}46 = 2$$

$$B\text{-}A = 46\text{-}26 = 20$$

The tabulated critical value at p=0.05 (Table 4), for 20 panelists and 3 samples is 15. Thus, the taste of yoghurt brand A and C were significantly different and the taste of yoghurt brand A and B were significantly different. However, there was no difference (no difference means the product is less acceptable) in taste of yoghurt brand B and C (2 (from

differences between rank B and C) <15 (from Table 4)). It means that the panelists found the taste of yoghurt from brand B and C less acceptable than the taste of yoghurt brand A".

3.3 Instructions

1. Group 2 prepares Products (Tomato sauces homemade) from three recipes, A, B and C in three different cups.
2. Group 2 also prepares carrier (cracker), questionnaires, mineral water and tissue for panelist.
3. The three samples were presented to each panelist simultaneously.
4. Each panelist evaluated the samples from left to right. Re-tasting is allowed.
5. Each panelist give rank for each samples
6. Groups 2 collect the questionnaire and tabulated each rank for all panelist in Table
7. The result was measure using Table 4 and 5.
8. Group 2 makes a report and submits the report for next week.

3.4 Result

For the result, it should contain:

a. Cover
b. Table of content
c. Chapter I. Introduction
   - 1.1 Background
   - 1.2 Objective

d. Chapter II. Report
   - 2.1 Panelist
   - 2.2 Food test method
   - 2.3 Result (summarize the data in Table then analyze those data)

e. Chapter III. Conclusion

f. Appendix (Questionnaire)

CHAPTER IV
HEDONIC TEST

4.1 Objective

Students will be able to conduct hedonic test and analyze the test result.

4.2 Fundamental Theory

Hedonic test is classified as consumer oriented test. Hedonic test is used to measure degree liking for a product. Category scales in hedonic test ranging from like extremely, neither like nor dislike, dislike extremely, and so on.

In hedonic test, panelists are asked to evaluate coded sample of products for degree of liking. Samples used in these test are coded with 3-digit different random number and presented in identical sample container.

Name:

Date:

In front of you are products from different recipe. Taste the sample and tick (√) how much you like or dislike the sample. You can taste more than once. Remember to clean your mouth with mineral water before taste the other sample.

Code	Dislike Extremely (1)	Dislike (2)	Neither dislike nor like (3)	Like (4)	Like extremely (5)

Figure 3. Hedonic Questionnaire Test Example

After testing by panelists, the results of the test are tabulated in Table then analyzed using Microsoft Excel.

Hedonic Scale Sample	Dislike Very Much	Dislike	Neither Like or Dislike	Like	Like Very Much	Total Answer
319	0	0	0	0	0	0
592	0	0	0	0	0	0
871	0	0	0	0	0	0
How many people are tasting your food?		0				
Scores						
319	0	out of a possible	0			
592	0	out of a possible	0			
871	0	out of a possible	0			
	0					
Maximim score =	0	(This is the highest score possible for this test.)				
Minimum score =	0	(This is the lowest score possible for this test.)				
Percentages						
319	#DIV/0!	%	#DIV/0!			
592	#DIV/0!	%	#DIV/0!	The Best Product can be conclude here		
871	#DIV/0!	%	#DIV/0!			

Figure 4. Hedonic Test Measurement Using Microsoft Excel

4.3 Instructions

1. Group 3 prepares Products (Pesto homemade) from three recipes, A, B and C in three different cups.
2. Group 3 also prepares carrier (pasta), questionnaires, mineral water and tissue for panelist.
3. The three samples were presented to each panelist simultaneously.
4. Each panelist evaluated the samples from left to right. Re-tasting is allowed.
5. Each panelist gives degree of liking to each product.

6. Tabulated each rank for all panelists in Table.
7. The result was measure using Microsoft Excel.

4.4 Result

For the result, it should contain:

a. Cover
b. Table of content
c. Chapter I. Introduction
   - 1.1 Background
   - 1.2 Objective
d. Chapter II. Report
   - 2.1 Panelist
   - 2.2 Food test method
   - 2.3 Result (summarize the data in Table then analyze those data)
e. Chapter III. Conclusion
f. Appendix (Questionnaire from the panelists)

CHAPTER V
TRIANGLE TEST

5.1 Objective

Students will be able to conduct triangle test and analyze the test result.

5.2 Fundamental Theory

Triangle test are classified as product oriented test. Product oriented test usually carried out by trained panelists. Triangle test are used to determine whether there are perceptible differences (most difference) between three samples.

In triangle test, panelists are asked to evaluate coded sample of products. Samples used in these test are coded with 3-digit different random number and presented in identical sample container.

Name :

Date :

You have been given three samples of products. Two of these samples are identical, the third is different. Tastes the samples in the order indicated and identify the sample that is different

Code	Check the sample that is different
…….	……
…….	……
……	……

Figure 5. Triangle Questionnaire Test Example

After testing by the panelists, the correct answers from panelists will be summarized. Based on the correct answers, then the data is analyzed in Table 6 (Appendix). Table 6 showed the minimum correct number required (at different significance levels required). The smaller the level of significance the more accurate the data is.

5.3 Instructions

1. Group 4 prepares Products (Bolognese homemade and shop product) in three different cups.
2. Group 4 also prepares carrier (pasta), questionnaires, mineral water and tissue for panelist.
3. The three samples were presented to each panelist simultaneously.
4. Each panelist evaluated the samples from left to right. Re-tasting is allowed.
5. Each panelist determines the most different sample.
6. Tabulated each rank for all panelist in Table
7. The result was measure using Table 6 (appendix).

5.4 Result

For the result, it should contain:

a. Cover

b. Table of content

c. Chapter I. Introduction

- 1.1 Background
- 1.2 Objective

d. Chapter II. Report
   - 2.1 Panelist
   - 2.2 Food test method
   - 2.3 Result (summarize the data in Table then analyze those data)

e. Chapter III. Conclusion

f. Appendix

CHAPTER VI
DUO TRIO TEST

6.1 Objective

Students will be able to conduct duo trio test and analyze the test result.

6.2 Fundamental Theory

Duo trio test are classified as product oriented test. Product oriented test usually carried out by trained panelists. Duo trio test are used in food industry when changes are made to products that are currently available.

In duo trio test, panelists are asked to evaluate coded sample of products. Samples used in these test are three samples, two samples are coded and one is identified as the reference. Panelists are asked to decide which is the most different to the reference sample. The reference is normally the product currently being produced. The samples are presented in identical sample container (PDST, 2017).

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R

923

Name :

Date :

You have been given three samples of products. One is labeled as reference; two are labeled with random coded. One of these samples are identical with reference, the other is different. Taste the reference first and then taste the other sample in the order indicated and identify which is the most different to the reference. Cleanse your palate with water after each sample.

Code	Most Different to reference
…….	……
…….	……

Figure 6. Duo Trio Questionnaire Test Example

After testing by the panelists, the correct answers from panelists will be counted. Based on the correct answers, then the data is analyzed in Table 7 (Appendix). Table 6 showed the minimum correct number required (at different significance levels required). The smaller level of significance the more accurate the data is.

6.3 Instructions

1. Group 5 prepares Products (Mayonnaise homemade and shop product) in three different cups. One sample is labeled as reference; two are labeled with random code.
2. Group 5 also prepares carrier (crackers), questionnaires, mineral water and tissue for panelist.
3. The three samples were presented to each panelist simultaneously, two samples are identical, and one sample is different.

4. Each panelist evaluated the samples from reference first. Re-tasting is allowed.
5. Each panelist determines the most different sample to the reference.
6. Tabulated each rank for all panelist in Table
7. The result was measure using Table 7 (appendix).

6.4 Result

For the result, it should contain:

a. Cover
b. Table of content
c. Chapter I. Introduction
   - 1.1 Background
   - 1.2 Objective
d. Chapter II. Report
   - 2.1 Panelist
   - 2.2 Food test method
   - 2.3 Result (summarize the data in Table then analyze those data)
e. Chapter III. Conclusion
f. Appendix

CHAPTER VII
PAIRED COMPARISON TEST

7.1 Objective

Students will be able to conduct paired comparison test and analyze the test result.

7.2 Fundamental Theory

Paired comparison test is classified as product oriented test. This test is useful when comparing two types of the same food. There are two types of paired comparison test, namely:

a. **Simple difference paired comparison test (Unilateral)**- are the samples different?
b. **Directional paired comparison test (Bilateral)** - Which sample is saltier?

Name :

Date :

You are presented with two coded sample. Please taste the samples in the order given. Can you detect a difference between the samples?

Yes…… No…….

Figure 7. Simple Difference Paired Comparison Test Example

Name :

Date :

You are presented with two coded sample. Please taste the samples in the order given and circle the sample that is sweater. Re-taste is allowed for panelists.

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Figure 8. Directional Paired Comparison Test Example

7.3 Instructions

1. Carbonara sauces from two recipes, A and B in two different containers, were prepared for panelists (use pasta as carrier)
2. The samples were presented to each panelist simultaneously.
3. Each panelist evaluated the samples.
4. Each panelist gives choices which one is milkier.
5. Tabulated each rank for all panelist in Table
6. The result was measure using Table 7 (appendix).

7.4 Result

For the result, it should contain:

a. Cover
b. Table of content
c. Chapter I. Introduction

- 1.1 Background
- 1.2 Objective

d. Chapter II. Report

- 2.1 Panelist
- 2.2 Food test method
- 2.3 Result (summarize the data in Table then analyze those data)

e. Chapter III. Conclusion

f. Appendix

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APPENDIX

Table 3. Two Tailed Binomial Test (Table for Preference Test)

n \ x	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
5	625	312	062																																
6		688	219	031																															
7			453	125	016																														
8			727	289	070	008																													
9				508	180	039	004																												
10				754	344	109	021	002																											
11					549	227	065	011	001																										
12					774	388	146	039	006																										
13						581	267	092	022	003																									
14						791	424	180	067	013	002																								
15							607	302	118	036	007	001																							
16							804	454	210	077	021	004	001																						
17								629	332	143	049	013	002																						
18								815	481	238	096	031	008	001																					
19									648	350	167	064	019	004	001																				
20									824	503	263	115	041	012	003																				
21										664	383	189	078	027	007	001																		
22										832	523	286	134	062	017	004	001																	
23											678	405	210	093	035	011	003																	
24											839	541	307	152	064	023	007	002																
25												690	424	230	108	043	015	004	001															
26												845	667	327	169	076	029	009	002	001														
27													701	442	248	122	052	019	006	002														
28													851	572	345	185	087	036	013	004	001													
29														711	458	265	136	061	024	008	002	001												
30														856	585	362	209	099	043	016	005	001												
31															720	473	281	150	071	030	011	003	001											
32															880	597	377	215	100	050	020	007	002	001										
33																728	487	296	163	080	035	014	005	001										
34																864	608	392	229	121	058	024	009	003	001									
35																	736	500	310	175	090	041	017	006	002									
36																	868	681	405	243	132	065	029	011	004	001								
37																		743	511	324	188	099	047	020	008	003	001							
38																		871	627	418	256	143	073	034	014	005	002							
39																			749	522	337	200	108	053	024	009	003	001						
40																			875	636	430	268	154	081	038	017	006	002	001					
41																				755	533	349	211	117	060	028	012	004	001					
42																				878	644	441	280	164	088	044	020	008	003	001				
43																					761	542	360	222	126	068	032	014	005	002	001			
44																					880	652	451	291	174	096	049	023	010	004	001			
45																						766	551	371	233	135	072	036	016	007	002	001		
46																						883	659	461	302	184	104	054	026	011	005	002	001	
47																							771	560	382	243	144	079	040	019	008	003	001		
48																							885	665	471	312	193	111	059	029	013	006	002	001	
49																								775	568	392	253	152	085	044	021	009	004	001	
50																								888	672	480	322	203	119	065	033	015	007	003	001

* NOTE Initial decimal point has been omitted.

Table 4. Critical Absolute Rank Sum Differences for "All Treatment" Comparisons at 5% level of significance (For Ranking Test) (Table for Acceptance Test)

	Number of samples									
Panelists	3	4	5	6	7	8	9	10	11	12
3	6	8	11	13	15	18	20	23	25	28
4	7	10	13	15	18	21	24	27	30	33
5	8	11	14	17	21	24	27	30	34	37
6	9	12	15	19	22	26	30	34	37	42
7	10	13	17	20	24	28	32	36	40	44
8	10	14	18	22	26	30	34	39	43	47
9	10	15	19	23	27	32	36	41	46	50
10	11	15	20	24	29	34	38	43	48	53
11	11	16	21	26	30	35	40	45	51	56
12	12	17	22	27	32	37	42	48	53	58
13	12	18	23	28	33	39	44	50	55	61
14	13	18	24	29	34	40	46	52	57	63
15	13	19	24	30	36	42	47	53	59	66
16	14	19	25	31	37	42	49	55	61	67
17	14	20	26	32	38	44	50	56	63	69
18	15	20	26	32	39	45	51	58	65	71
19	15	21	27	33	40	46	53	60	66	73
20	15	21	28	34	41	47	54	61	68	75
21	16	22	28	35	42	49	56	63	70	77
22	16	22	29	36	43	50	57	64	71	79
23	16	23	30	37	44	51	58	65	73	80
24	17	23	30	37	45	52	59	67	74	82
25	17	24	31	38	46	53	61	68	76	84
26	17	24	32	39	46	54	62	70	77	85
27	18	25	32	40	47	55	63	71	79	87
28	18	25	33	40	48	56	64	72	80	89
29	18	26	33	41	49	57	65	73	82	90
30	19	26	34	42	50	58	66	75	83	92
31	19	27	34	42	51	59	67	76	85	93
32	19	27	35	43	51	60	68	77	86	95
33	20	27	36	44	52	61	70	78	87	96
34	20	28	36	44	53	62	71	79	89	98
35	20	28	37	45	54	63	72	81	90	99
36	20	29	37	46	55	63	73	82	91	100
37	21	29	38	46	55	64	74	83	92	102
38	21	29	38	47	56	65	75	84	94	103
39	21	30	39	48	57	66	76	85	95	105
40	21	30	39	48	57	67	76	86	96	106
41	22	31	40	49	58	68	77	87	97	107
42	22	31	40	49	59	69	78	88	98	109
43	22	31	41	50	60	69	79	89	99	110
44	22	32	41	51	60	70	80	90	101	111
45	23	32	41	51	61	71	81	91	102	112
46	23	32	42	52	62	72	82	92	103	114
47	23	33	42	52	62	72	83	93	104	115
48	23	33	43	53	63	73	84	94	105	116
49	24	33	43	53	64	74	85	95	106	117
50	24	34	44	54	64	75	85	96	107	118
55	25	35	46	56	67	78	90	101	112	124
60	26	37	48	59	70	82	94	105	117	130
65	27	38	50	61	73	85	97	110	122	135
70	28	40	52	64	76	88	101	114	127	140
75	29	41	53	66	79	91	105	118	131	145
80	30	42	55	68	81	94	108	122	136	150
85	31	44	57	70	84	97	111	125	140	154
90	32	45	58	72	86	100	114	129	144	159
95	33	46	60	74	88	103	118	133	148	163
100	34	47	61	76	91	105	121	136	151	167

[a]Exact values adapted from Hollander and Wolfe (1973) are used for up to 15 panelists.

[b]Interpolation may be used for unspecified table values involving more than 50 panelists.

Source : Newell and MacFarlane, 1987

Table 5. Critical Absolute Rank Sum Differences for "All Treatment" Comparisons at 1% level of significance (For Ranking Test) (Table for Acceptance Test)

	Number of samples									
Panelists	3	4	5	6	7	8	9	10	11	12
3	—	9	12	14	17	19	22	24	27	30
4	8	11	14	17	20	23	26	29	32	36
5	9	13	16	19	23	26	30	33	37	41
6	10	14	18	21	25	29	33	37	41	45
7	11	15	19	23	28	32	36	40	45	49
8	12	16	21	25	30	34	39	43	48	53
9	13	17	22	27	32	36	41	46	51	56
10	13	18	23	28	33	38	44	49	54	59
11	14	19	24	30	35	40	46	51	57	63
12	15	20	26	31	37	42	48	54	60	66
13	15	21	27	32	38	44	50	56	62	68
14	16	22	28	34	40	46	52	58	65	71
15	16	22	28	35	41	48	54	60	67	74
16	17	23	30	36	43	49	56	63	70	77
17	17	24	31	37	44	51	58	65	72	79
18	18	25	31	38	45	52	60	67	74	81
19	18	25	32	39	46	54	61	69	76	84
20	19	26	33	40	48	55	63	70	78	86
21	19	27	34	41	49	56	64	72	80	88
22	20	27	35	42	50	58	66	74	82	90
23	20	28	35	43	51	59	67	75	84	92
24	21	28	36	44	52	60	69	77	85	94
25	21	29	37	45	53	62	70	79	87	96
26	22	29	38	46	54	63	71	80	89	98
27	22	30	38	47	55	64	73	82	91	100
28	22	31	39	48	56	65	74	83	92	101
29	23	31	40	48	57	66	75	85	94	103
30	23	32	40	49	58	67	77	86	95	105
31	23	32	41	50	59	69	78	87	97	107
32	24	33	42	51	60	70	79	89	99	108
33	24	33	42	52	61	71	80	90	100	110
34	25	34	43	52	62	72	82	92	102	112
35	25	34	44	53	63	73	83	93	103	113
36	25	35	44	54	64	74	84	94	105	115
37	26	35	45	55	65	75	85	95	106	117
38	26	36	45	55	66	76	86	97	107	118
39	26	36	46	56	66	77	87	98	109	120
40	27	36	47	57	67	78	88	99	110	121
41	27	37	47	57	68	79	90	100	112	123
42	27	37	48	58	69	80	91	102	113	124
43	28	38	48	59	70	81	92	103	114	126
44	28	38	49	60	70	82	93	104	115	127
45	28	39	49	60	71	82	94	105	117	128
46	28	39	50	61	72	83	95	106	118	130
47	29	39	50	62	73	84	96	108	119	131
48	29	40	51	62	74	85	97	109	121	133
49	29	40	51	63	74	86	98	110	122	134
50	30	41	52	63	75	87	99	111	123	135
55	31	43	54	66	79	91	104	116	129	142
60	32	45	57	69	82	95	108	121	135	148
65	34	46	59	72	86	99	113	126	140	154
70	35	48	61	75	89	103	117	131	146	160
75	36	50	64	78	92	106	121	136	151	166
80	37	51	66	80	95	110	125	140	156	171
85	38	53	68	83	98	113	129	144	160	176
90	40	54	70	85	101	116	132	149	165	181
95	41	56	71	87	103	120	136	153	169	186
100	42	57	73	89	106	123	140	157	174	191

[a]Exact values adapted from Hollander and Wolfe (1973) are used for up to 15 panelists.

[b]Interpolation may be used for unspecified table values involving more than 50 panelists.

Source : Newell and MacFarlane, 1987

Table 6. The number of panelists in a triangle test required to give correct judgments, at three different significance levels (triangle test)

n	Significance (%)						*n*	Significance (%)					
	30	**20**	**10**	**5**	**1**	**0.1**		**30**	**20**	**10**	**5**	**1**	**0.1**
5	3	4	4	4	5	–	**42**	17	18	19	20	22	25
6	3	4	5	5	6	–	**48**	19	20	21	22	25	27
7	4	4	5	5	6	7	**54**	21	22	23	25	27	30
8	4	5	5	6	7	8	**60**	23	24	26	27	30	33
9	4	5	6	6	7	8	**66**	25	26	28	29	32	35
10	5	6	6	7	8	9	**72**	27	28	30	32	34	38
11	5	6	7	7	8	10	**78**	29	30	32	34	37	40
12	5	6	7	8	9	10	**84**	31	33	35	36	39	43
13	6	7	8	8	9	11	**90**	33	35	37	38	42	45
14	6	7	8	9	10	11	**96**	35	37	39	41	44	48
15	6	8	8	9	10	12	**102**	37	39	41	43	46	50
16	7	8	9	9	11	12	**108**	40	41	43	45	49	53
17	7	8	9	10	11	13	**114**	42	43	45	47	51	55
18	7	9	10	10	12	13	**120**	44	45	48	50	53	57
19	8	9	10	11	12	14	**126**	46	47	50	52	56	60
20	8	9	10	11	13	14	**132**	48	50	52	54	58	62
21	8	10	11	12	13	15	**138**	50	52	54	56	60	64
22	9	10	11	12	14	15	**144**	52	54	56	58	62	67
23	9	11	12	12	14	16	**150**	54	56	58	61	65	69
24	10	11	12	13	15	16	**156**	56	58	61	63	67	72
25	10	11	12	13	15	17	**162**	58	60	63	65	69	74
26	10	12	13	14	15	17	**168**	60	62	65	67	71	76
27	11	12	13	14	16	18	**174**	62	64	67	69	74	79
28	11	12	14	15	16	18	**180**	64	66	69	71	76	81
29	11	13	14	15	17	19							
30	12	13	14	15	17	19							
31	12	14	15	16	18	20							
32	12	14	15	16	18	20							
33	13	14	15	17	18	21							
34	13	15	16	17	19	21							
35	13	15	16	17	19	22							
36	14	15	17	18	20	22							

Source : Kemp *et al.,* 2009

Table 7. Minimum Numbers of Correct Judgments to Establish Significance at Various Probability Levels for Paired – Comparison and Duo-Trio Tests (one-tailed, p=1/2)

	Probability levels						
No of trials (N)	0.05	0.04	0.03	0.02	0.01	0.005	0.001
7	7	7	7	7	7		
8	7	7	8	8	8	8	
9	8	8	8	8	9	9	
10	9	9	9	9	10	10	10
11	9	9	10	10	10	11	11
12	10	10	10	10	11	11	12
13	10	11	11	11	12	12	13
14	11	11	11	12	12	13	13
15	12	12	12	12	13	13	14
16	12	12	13	13	14	14	15
17	13	13	13	14	14	15	16
18	13	14	14	14	15	15	16
19	14	14	15	15	15	16	17
20	15	15	15	16	16	17	18
21	15	15	16	16	17	17	18
22	16	16	16	17	17	15	19
23	16	17	17	17	18	19	20
24	17	17	18	18	19	19	20
25	18	15	18	19	19	20	21
26	18	18	19	19	20	20	22
27	19	19	19	20	20	21	22
28	19	20	20	20	21	22	23
29	20	20	21	21	22	22	24
30	20	21	21	22	22	23	24
31	21	21	22	22	23	24	25
32	22	22	22	23	24	24	26
33	22	23	23	23	24	25	26
34	23	23	23	24	25	25	27
35	23	24	24	25	25	26	27
36	24	24	25	25	26	27	28
37	24	25	25	26	26	27	29
38	25	25	26	26	27	28	29
39	26	26	26	27	28	28	30
40	26	27	27	27	28	29	30
41	27	27	27	28	29	30	31
42	27	28	28	29	29	30	32
43	28	28	29	29	30	31	32
44	28	29	29	30	31	31	33
45	29	29	30	30	31	32	34
46	30	30	30	31	32	33	34
47	30	30	31	31	32	33	35
48	31	31	31	32	33	34	36
49	31	32	32	33	34	34	36
50	32	32	33	33	34	35	37
60	37	38	38	39	40	41	43
70	43	43	44	45	46	47	49

Sources: Mason and Nottingham, 2002

Sensory evaluation is an instrument used to measure food preference using human sensing organs. It is used the senses for measuring texture, sighting, the scent and flavor of food product. Humans have five senses: taste, smell, touch, sight, and hearing. All of the senses are important when eating a food. There is no instrument that can replace or replicate the human senses, making the sensory evaluation subject is important to learn.

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