Sesnory qaulioty of dried and other food products

https://www.sensoryvalue.com/

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April 27, 2023
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Sensory evaluation

- Sensory evaluation is a scientific discipline used to evoke, measure, analyze and interpret reactions to those characteristics of foods and materials as they are perceived by the senses of sight, smell, taste, touch, and hearing (Sidel & Stone, 1993).

Human senses

- Human senses have more than 30 senses, but food products can be perceived through these senses including sight, smell, taste, touch, and hearing.
- Human senses have become testing devices, therefore humans or panelists must be trained and understood to sensory techniques.

Source: https://www.foodelphi.com/

Importance of sensory evaluation

- Sensory evaluation is an important approach for testing products together with physical, chemical, and microbiological analyses.
- sensory evaluation in industries, applied in several industrial applications including
  - develop product development process,
  - evaluate developed products against competitors' products,
  - improve existing products,
  - reduce production costs,
  - select new raw and packaging materials,
  - quality control, storage test stored food products,
  - evaluate acceptability or liking by consumers
  - select and train sensory panelist
- It can also be used to measure the success of a product in manufacturing and marketing.

Selection of panellists (subject/acessor/taster)

General principles that should be followed are:

- Never ask anyone to taste food they do not like
- Make sure that the correct panelists are and that they know in advance when they will be required
- Train panelists to be silent while tasting. This prevents panelists from influencing one another.
- Make the tasting session interesting and desirable.
- Use rewards to motivate taters, vary these and choose foods that contrast with those being tasted
- Motivated panelists are more efficient. Give feedback on results whenever possible.
- Avoid giving any unnecessary information to panelists that may influence their scores.

Source: Mason & Nottingham (2002)

Panellists selection and training - taste Identification

- To develop awareness for the basic tastes – sweet, sour, salt and bitter; taste identification exercises were adapted by Institute of Food Technologists.
- Standard basic taste solutions:
  - Sweet Sucrose 20 (g/L)
  - Sour Citric acid 0.25 (g/L)
  - Bitter Caffeine 0.10 (g/L)
  - Salty Sodium chloride 2.0 (g/L)
- These solutions are presented to the trainees, and they were instructed to fill out the scorecard provided.

Scorecard - Taste Identification Test

Tray number ..... **Name.....**

You are presented with 4 samples of solutions which represent the basic taste sensations of sweet, sour, salt and bitter.

Starting in any order, choose a cup, take a sip from it, hold it in your mouth for 10 seconds and note the taste.

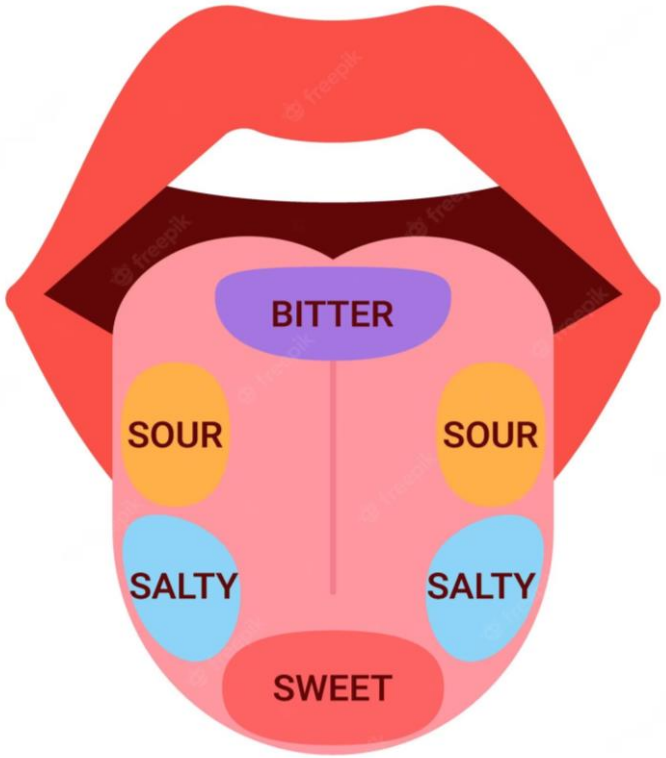
Proceed through the other samples in a similar manner, rinsing your mouth between each.

Fill in the taste identified in each case.

Solution	Taste Identified	Correct ✓ Incorrect ✗
358		
247		
579		
469		

Source: Singh-Ackbarali & Mahara (2014)

- Five types of taste receptors - salt, sweet, sour, bitter and umami
- Different areas of the tongue respond to different sensations
- Substances must be dissolved for taste buds to detect them
- Flavor of the food is a complex interaction of different tastes and odors
- Sensitivity to taste varies between individuals and is affected by their physiological states



https://www.freepik.com/

Sensory characteristics and appropriate vocabulary

- Trainees were trained on which sense(s) can be used to examine which food characteristics.
- They were also trained on definitions of the different descriptive terms and the appropriate use of vocabulary

Table : Senses, characteristics of each sense

Sense	Characteristic
Sight	Appearance – colour, size, shape, transparency, dullness, gloss
Smell	Aroma – flavour, aromatics
Taste	Flavour - odour, mouth feel and taste – sweet, salt, sour, bitter
Hearing	Sound – intensity and quality
Touch	Texture, mouth feel

Source: Singh-Ackbarali & Mahara (2014)

Sensory test methods

Sensory test aims – to provides the following types of information that obtain to the different test aims:

- **Discriminative information** - determination of differences between products/samples.
- **Descriptive information** - focus on the description of products/samples. This information can be correlated with other forms of analysis such as chemical results etc. and
- **Consumer information** - focus on consumer preference, acceptance, liking etc. of one product over another. Ranking of one or more products or rating of products in a range (by consumers), can also be the aim.

Table : Sensory evaluation questions and methods

Questions	Sensory Evaluation Method	Basic Setup
Are products different?	Discrimination/	20-50 panelists
Which sample has greater intensity of an attribute? E.g. which is sweeter?	Difference Tests	Screened for acuity (keenness or sharpness of perception, i.e. can they smell and taste well?)
		Analysis is done using statistical tables which compare results to chance – this analysis ensures that the difference was real and not because people chose the correct sample by luck/chance.
		one-tailed binomial test, two-tailed binomial test and Chi Square test
If products are different, how are they different?	Descriptive Analysis	8-12 panelists or 6 to 10 panelist
		Screened for acuity, Trained
What is the magnitude of these differences?		Asked to rate intensity for all sensory attributes
		Analysis is done using a t-test or ANOVA to determine if means are statistically different.
What is the acceptability of a product? Is the product liked? Is one product preferred over another?	Affective/	75-150 consumers per test
	Preference	Min of 20 for pilot testing
	Hedonic Tests	Screened for product use (Do they buy the product? And how often?)
		Asked degree of liking (how much do they like it) and/or preference questions
		Friedman test, t-test, 2 tailed binomial, ANOVA

Source: Singh-Ackbarali & Mahara (2014)

Difference test

- Difference test is a sensory test used to assess whether two or more products are their differences in terms of sensory characteristics or not.
- Panelists are asked the difference without asking how much they are different and the difference in any characteristics between products.
- There are methods for testing such as triangle test, duo-trio test, Two-out-of-five test and A-not A test. (Lawless & Heymann 1998)

Triangle test

- Triangle test is popular and frequently used.
- Three samples are presented to the panelists at the same time.
- Two of which are produced from the same formulation and one from a different formulation.
- Each panelist must indicate which sample is different (odd sample) or which pair of samples is the most similar (even).

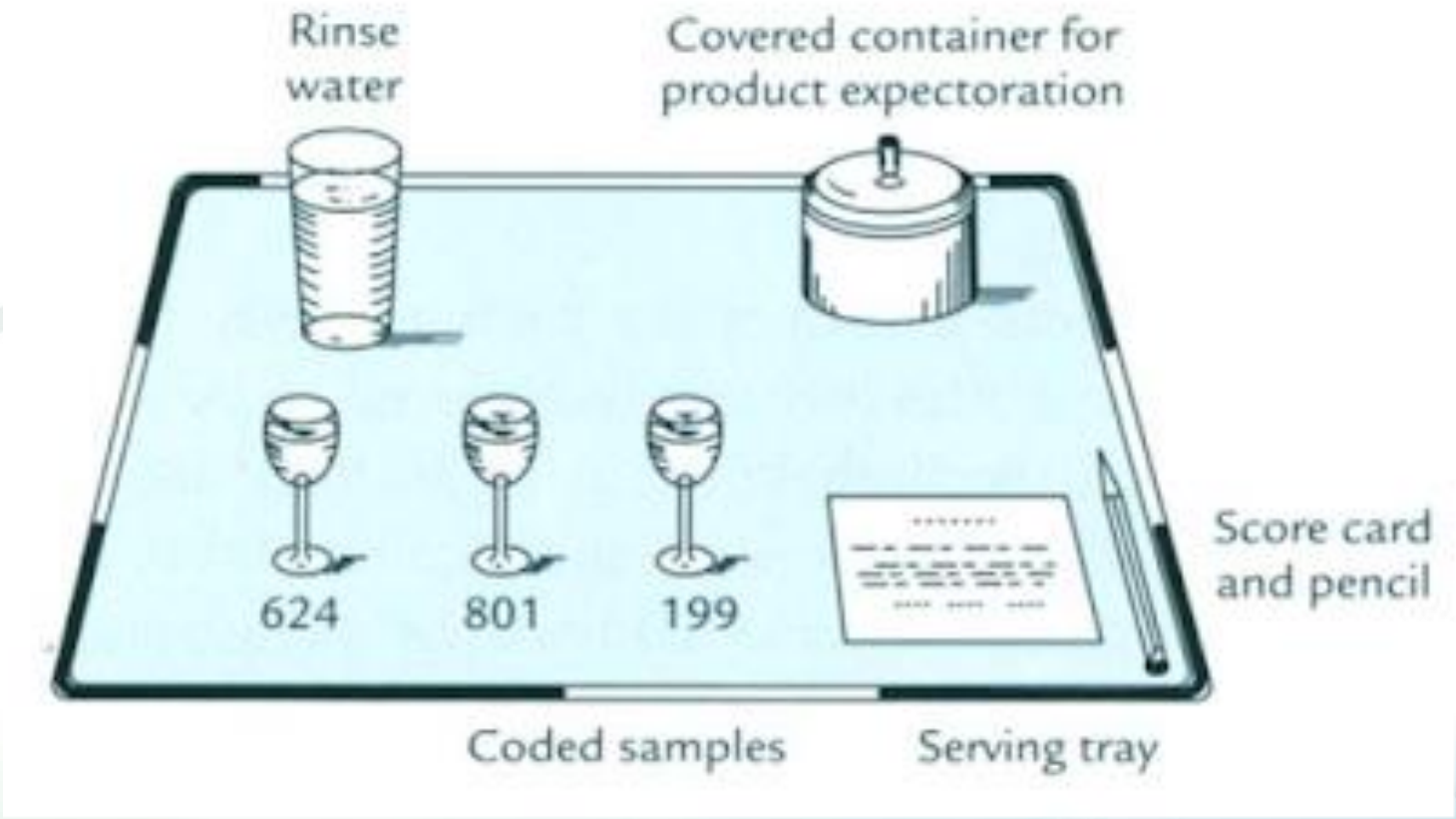


Figure Sample arrangements for triangle test

Source: http://skysky95.blogspot.com

Triangle test report

Product..... Date..... Time.....
Panelist .....

Instructions:
Rinse your mouth before testing. You will be given 3 samples, two of which are identical, and one is different. Test the samples in the order presented from left to right. Circle the answers that you think are different. Always rinse your mouth with water before testing the next sample and rinse the mouth with water and the sample is discarded in a bowl provided.

293 594 862

Thank you for your cooperation

Table Critical values table for Triangle tests

- Minimum numbers of correct responses to reject the null hypothesis of no difference at selected significance levels with a total number of assessors 'n' .

n	Significant (%)			n	Significant (%)		
	5	1	0.1		5	1	0.1
5	4	5	-	21	12	13	15
6	5	6	-	22	12	14	15
7	5	6	7	23	12	14	16
8	6	7	8	24	13	15	16
9	6	7	8	25	13	15	17
10	7	8	9	26	14	15	17
11	7	8	10	27	14	16	18
12	8	9	10	28	15	16	18
13	8	9	11	29	15	17	19
14	9	10	11	30	15	17	19
15	9	10	12	31	16	18	20
16	9	11	12	32	16	18	20
17	10	11	13	33	17	18	21
18	10	12	13	34	17	19	21
19	11	12	14	35	17	19	22
20	11	13	14	36	18	20	22

Duo-trio test

- For this test, the subject is first presented with a reference sample (“R”; reference), then the “R” was evaluated before testing the remaining 2 samples which gives a 3-digit random code.

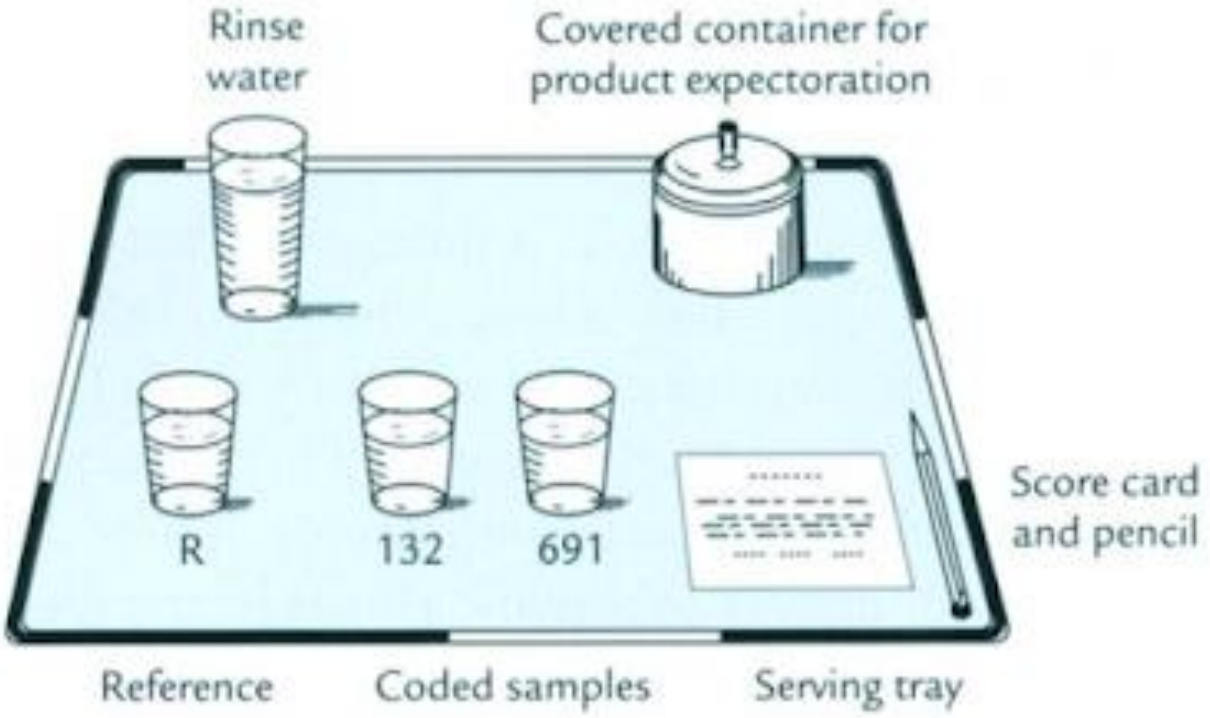


Figure Sample arrangements for Duo-trio test.

Source: http://skysky95.blogspot.com

Duo-trio test report sheet

Product..... Code.....Date..... Time.....
Panelists.....

Instruction:
Please taste the reference sample (R) first and taste the other 2 samples from left to right and circle the sample that you feel is the same as the reference sample.

Reference (R) Code 434 Code 102

Thank you for your cooperation

Table Critical values table for duo-trio test and paired comparison test for difference (one tailed)

- Minimum numbers of correct responses to reject the null hypothesis of no difference at selected significance levels with a total number of assessors 'n' .

n	Significant (%)			n	Significant (%)		
	5	1	0.1		5	1	0.1
5	5	-	-	21	15	17	18
6	6	-	-	22	16	17	19
7	7	7	-	23	16	18	20
8	7	8	-	24	17	19	20
9	8	9	-	25	18	19	21
10	9	10	10	26	18	20	22
11	9	10	11	27	19	20	22
12	10	11	12	28	19	21	23
13	10	12	13	29	20	22	24
14	11	12	13	30	20	22	24
15	12	13	14	31	21	23	25
16	12	14	15	32	22	24	26
17	13	14	16	33	22	24	26
18	13	15	16	34	23	25	27
19	14	15	17	35	23	25	27
20	15	16	18	36	24	26	28

Descriptive test

- Descriptive analysis is the most complex method and requires the most training.
- This allows the operator to know all the sensory characteristics of the product by identifying which factors in the production process and ingredients influence on the sensory quality of the product and/or analyzing the sensory characteristics are most important for acceptance of a particular product.
- Moreover, it was to check competitor's product attributes, study product shelf life, develop product development, and analyze problems requiring detailed investigation in food quality assurance.

Descriptive test

- Flavour profile method ®
- Texture profile method ®
- Quantitative descriptive analysis, QDA®

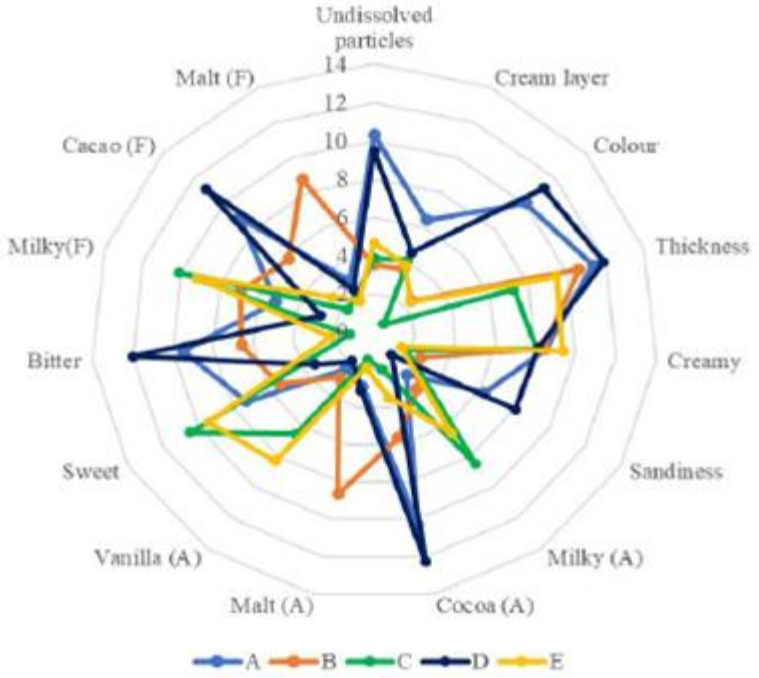


Figure Spider web of chocolate drinks

Source: Muktiningrum et at (2022)

Acceptance test

- Sensory acceptance testing of food products is a process to find out the preference or acceptance that consumers have towards food products. This can be a test for a single product or for multiple comparisons.
- Affective test (later more commonly referred to as the hedonic test) is used to assess the effect of food on human response (liking/acceptance). This response can be caused by both physical and psychological factors. There are two related terms:
  - Preference is the preference of one product over another. This may be one of the features or overall preference.
  - Acceptance is the acceptance to purchase of the product or the use of the product.

Panellists

1. Panel selection

Selection of people to be panelists is considered from age, religion, gender, product to be tested or random selection.

2. Panel training

It is not necessary to train the panelist in technical or proficiency; however, it is advisable to advise the tester on the test method, questionnaire, clarification, and number of samples.

3. Number of panelists

Typically, affective tests are taken with 20–100 people. However, if a test carried out with general consumers, a hundred panelists is suggested.

Paired preference test

- It's a preference test by asking consumers' preferences for two samples.
- This technique is used when trying to determine whether a consumer prefers one product over another, for example product improvement study or comparative analysis with competitor products.
- This technique also works well if the consumers are not very skilled in testing.
- This will only measure whether the tester likes one product over another, but it did not say whether the consumers accepted the product.
- There are 2 samples including a control sample and a testing sample. Both samples will be presented at the same time. The consumers evaluate which sample he or she likes more.

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Paired preference test

Tester code ..... date ..... time.....

Instructions:
Please rinse your mouth with water before taking the test.
Test the samples in the order presented, from left to right, and circle the number of the samples you like more. One sample must be selected.
You may drink as much as you think is sufficient. At least half of the amount of the sample is suggested to drink.

Code 238 Code 799

Thank you for your cooperation

Table Critical values table for duo-trio test and paired comparison test for difference (one tailed)

- Minimum numbers of correct responses to reject the null hypothesis of no difference at selected significance levels with a total number of assessors 'n' .

n	Significant (%)			n	Significant (%)		
	5	1	0.1		5	1	0.1
5	5	-	-	21	15	17	18
6	6	-	-	22	16	17	19
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8	7	8	-	24	17	19	20
9	8	9	-	25	18	19	21
10	9	10	10	26	18	20	22
11	9	10	11	27	19	20	22
12	10	11	12	28	19	21	23
13	10	12	13	29	20	22	24
14	11	12	13	30	20	22	24
15	12	13	14	31	21	23	25
16	12	14	15	32	22	24	26
17	13	14	16	33	22	24	26
18	13	15	16	34	23	25	27
19	14	15	17	35	23	25	27
20	15	16	18	36	24	26	28

Rating for preference

- The most popular method of testing liking is a 9-point hedonic scale, also known as the degree of liking scale.
- This consumer preference can be classified by the response value (likes and dislikes) that occur.
- The 9-point hedonic scale is very easy to use and interpretation is also easy to do.
- Consumers are asked to evaluate one or more samples by indicating the degree of liking in any feature or overall product feature based on human feeling which have quite a lot of variances.
- Therefore, it should be used with many consumers to obtain reliable statistical results. In general, approximately 20-30 consumers are included.

Panelist Hedonic Rating	Liking Score
Like Extremely	9
Like Very Much	8
Like Moderately	7
Like Slightly	6
Neither Like Nor Dislike	5
Dislike Slightly	4
Dislike Moderately	3
Dislike Very Much	2
Dislike Extremely	1

Source: Singh-Ackbarali & Mahara (2014)

Figure Smiling face/ facial hedonic scales

Source: Swaney-Stueve, Jepsen, & Deubler (2018)

Example of hedonic scales that are unclear in balance

Nine-point wonderful	Nine-point quartermaster (unbal.)	Six-point wonderful (unbal.)
Think it's wonderful	Like extremely	Wonderful, think it's great
Like it very much	Like strongly	I like it very much
Like it quite a bit	Like very well	I like it somewhat
Like it slightly	Like fairly well	So-so, it's just fair
Dislike it slightly	Like moderately	I don't particularly like it
Dislike it quite a bit	Like slightly	I don't like it at all
Dislike it very much	Dislike slightly	
Think it's terrible	Dislike moderately	
	Dislike intensely	
Seven-point excellent	**Five-point excellent**	**Six-point (unbal.)**
Excellent	Excellent	Excellent
Very good	Good	Extremely good
Good	Fair	Very good
Fair	Poor	Good
Poor	Terrible	Fair
Very poor		Poor
Terrible		

Source: Mailgarrd et al 1999

- Dried dragon fruits were evaluated by 24 consumers to assess acceptance in terms of appearance, smell, taste, texture, and overall acceptance by scoring 9 points; the results are shown in Table.

Table 9.1 Average score for Dried dragon fruits

	Code 379	130	830
Appearance	7.8 ± 0.24	8.5 ± 0.44	7.3 ± 0.32
Flavor	6.9 ± 0.14	6.4 ± 0.02	6.2 ± 0.09
Texture	7.4 ± 0.19	7.6 ± 0.61	7.1 ± 0.11
Acceptability	7.3 ± 0.78	7.8 ± 0.64	7.2 ± 0.55

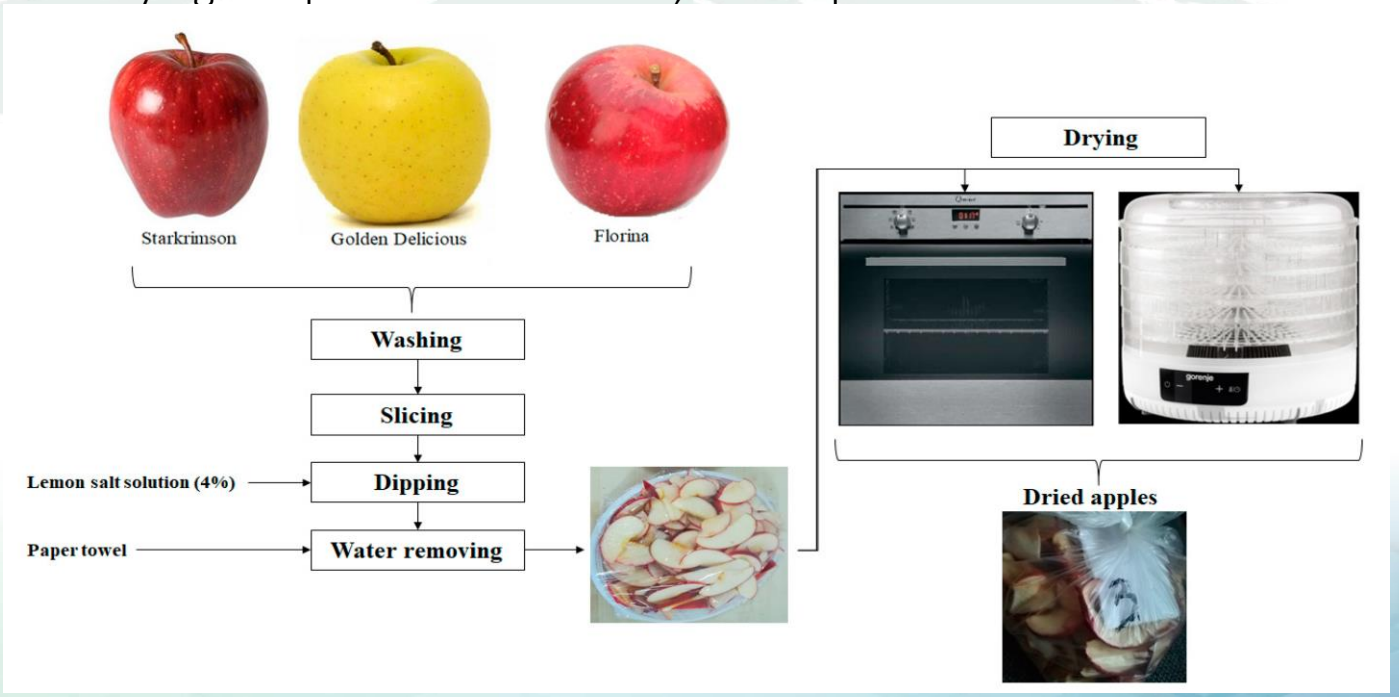
Results are expressed as mean ± SD. (n=30)

Physico-Chemical and Sensory Quality of Oven-Dried and Dehydrator-Dried Apples of the Starkrimson, Golden Delicious and Florina Cultivars

- Apple fruits are high in phenolic compounds, sugar and dietary fiber content and are rich in malic acid and vitamins, with a significant impact on the organoleptic quality and its health promoting properties.
- They can be turned out in value-added product such as apple chips due to the low cost of raw material.
- The aim of the study was to obtain apple chips, fat-free, healthy, traditionally dried and without added sugar, which can be easily obtained and capitalized economically, as well as the evaluation of their physico-chemical and sensory qualities

Sources: Ghinea, Prisacaru & Leahu (2022)

- Drying was performed by using two types of dryers: oven (Indesit on gas) and dehydrator (Gorenje, electric).
- The dehydrator controls and keeps the internal temperature constant, while the oven tends to fluctuate the temperature.
- The oven door was kept slightly open (1 to 2 inches) during drying, and a thermometer was used to check the oven temperature.
- The drying temperature was 65 ◦C; all samples were dried to constant weight.



Sources: Ghinea, Prisacaru & Leahu (2022)

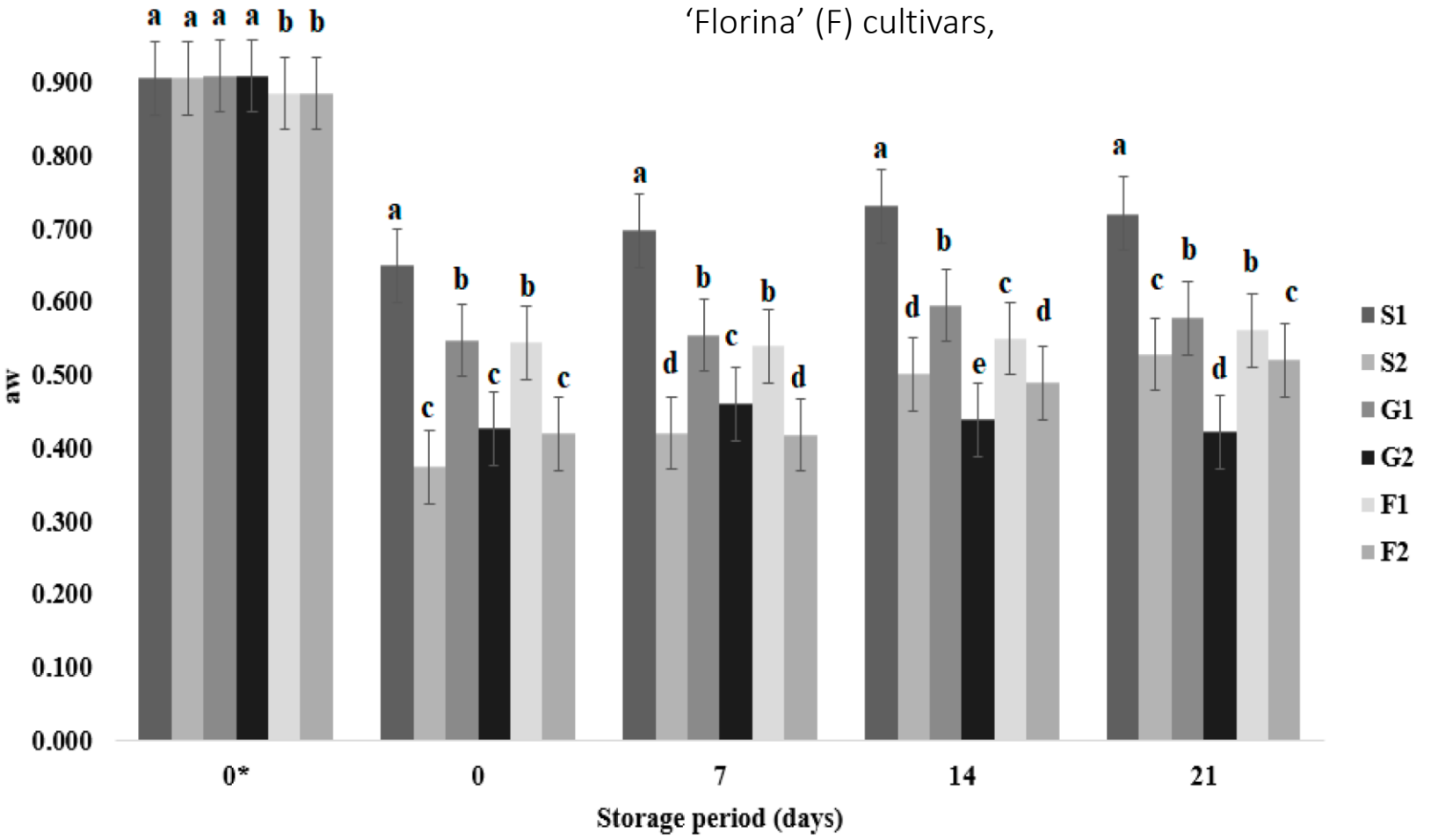
Physico-Chemical analysis

- Moisture
- Water activity
- Active acidity
- Titratable acidity
- Total soluble solids contents
- Total sugar contents
- Electrical conductivity
- Color analysis
- Browning index

- **Sensory evaluation** was performed in laboratory conditions by a panel of 11 engineers from food industry, with experience and familiarity with sensory assessment method.
- Each of the panelists evaluated the appearance, color, aroma, taste and overall acceptability of the dried apple chip samples.
- The scoring was based on the nine points of the standard hedonic scale, where 9 denoted ‘like extremely’, 5 ‘neither like nor dislike’, and 1 indicated ‘dislike extremely’ .
- The sensory evaluation experiment was repeated three times.

Water activity

Apples ('Starkrimson' (S), 'Golden Delicious' (G) and 'Florina' (F) cultivars,



Sources: Ghinea, Prisacaru & Leahu (2022)

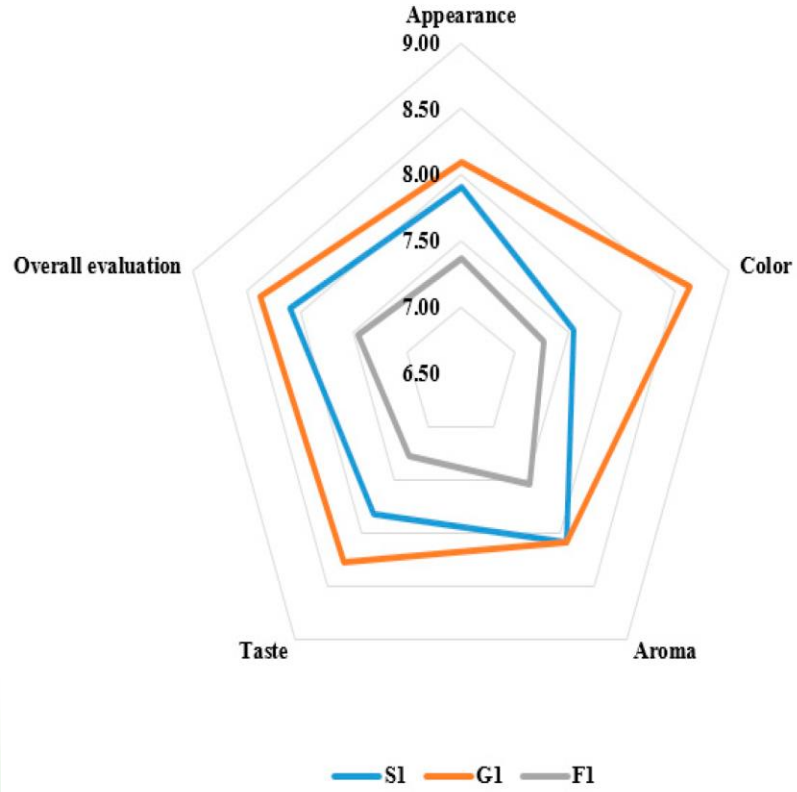
Table 2. Color parameters of fresh and dried apple chips during storage under ambient conditions.

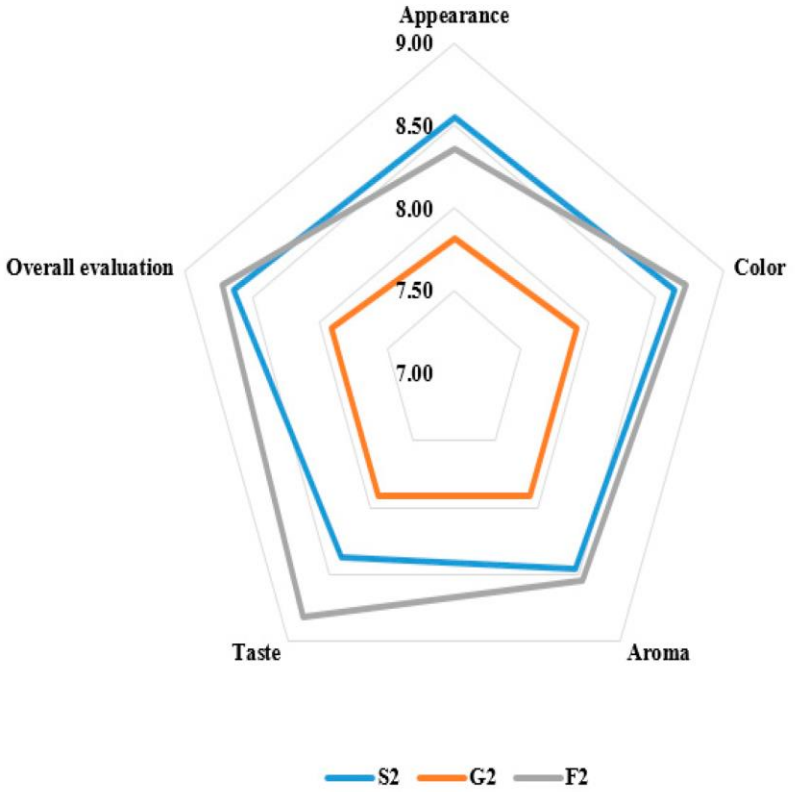
Types	Sample	L*	a*	b*	ΔE	BI	WI
Fresh apple samples	S0	51.93 ^{a} ± 1.13	−1.42 ^{a} ± 0.14	18.36 ^{b} ± 0.45	-	40.27 ^{b} ± 1.23	48.52 ^{a} ± 1.14
	G0	64.28 ^{a} ± 4.86	−2.29 ^{a} ± 0.55	27.30 ^{a} ± 1.64	-	50.63 ^{a} ± 0.94	54.85 ^{a} ± 2.94
	F0	57.7 ^{a} ± 7.03	−3.47 ^{b} ± 0.33	19.83 ^{b} ± 1.51	-	36.29 ^{b} ± 1.09	53.02 ^{a} ± 5.73
Dried apple chip samples	S1	57.69 ^{e} ± 2.42	10.62 ^{a} ± 0.93	20.56 ^{c} ± 0.40	40.17 ^{a} ± 2.32	57.02 ^{a} ± 2.28	51.76 ^{d} ± 2.28
	S2	67.39 ^{c} ± 0.93	5.09 ^{c} ± 0.19	24.41 ^{b} ± 0.62	32.81 ^{c} ± 1.08	49.63 ^{b} ± 1.27	58.94 ^{c} ± 1.09
	G1	71.83 ^{b} ± 0.43	3.02 ^{d} ± 0.33	24.77 ^{b} ± 0.81	29.47 ^{de} ± 0.40	44.42 ^{b} ± 0.67	62.36 ^{ab} ± 0.38
	G2	76.10 ^{a} ± 1.05	2.09 ^{d} ± 0.37	27.56 ^{a} ± 0.47	28.76 ^{e} ± 0.26	45.86 ^{b} ± 0.13	63.44 ^{a} ± 0.36
	F1	65.85 ^{cd} ± 0.94	12.08 ^{a} ± 0.32	17.59 ^{d} ± 0.29	32.49 ^{cd} ± 0.93	44.05 ^{b} ± 0.84	59.73 ^{bc} ± 0.95
	F2	63.65 ^{d} ± 1.01	7.10 ^{b} ± 0.80	25.53 ^{b} ± 0.29	36.78 ^{b} ± 1.08	58.42 ^{a} ± 1.54	55.01 ^{d} ± 1.06
Dried apple chip samples (7th day)	S1	47.39 ^{c} ± 1.17	9.31 ^{a} ± 0.65	18.39 ^{d} ± 0.76	48.41 ^{a} ± 0.95	62.73 ^{ab} ± 1.51	43.48 ^{c} ± 0.97
	S2	71.51 ^{a} ± 3.01	3.98 ^{b} ± 1.12	25.44 ^{ab} ± 1.42	30.32 ^{c} ± 3.27	47.39 ^{cd} ± 3.93	61.58 ^{a} ± 3.29
	G1	61.63 ^{b} ± 1.01	9.14 ^{a} ± 0.91	25.96 ^{ab} ± 0.31	39.09 ^{b} ± 0.78	64.44 ^{a} ± 0.93	52.77 ^{b} ± 0.77
	G2	70.31 ^{a} ± 0.40	3.73 ^{b} ± 0.22	26.94 ^{a} ± 0.73	32.22 ^{c} ± 0.64	51.09 ^{cd} ± 1.10	59.72 ^{a} ± 0.63
	F1	58.09 ^{b} ± 1.26	8.21 ^{a} ± 0.03	21.13 ^{c} ± 0.48	39.43 ^{b} ± 0.90	54.84 ^{bc} ± 0.20	52.34 ^{b} ± 0.90
	F2	73.57 ^{a} ± 2.86	4.05 ^{b} ± 0.78	24.52 ^{b} ± 0.99	28.33 ^{c} ± 1.37	43.76 ^{d} ± 0.42	63.65 ^{a} ± 1.53
Dried apple chip samples (14th day)	S1	52.22 ^{d} ± 2.20	11.16 ^{a} ± 0.55	22.43 ^{c} ± 1.34	45.87 ^{a} ± 1.53	70.72 ^{a} ± 0.28	46.01 ^{d} ± 1.49
	S2	75.96 ^{a} ± 0.13	3.23 ^{d} ± 0.30	27.11 ^{a} ± 0.17	28.59 ^{c} ± 0.19	46.24 ^{c} ± 0.33	63.62 ^{b} ± 0.18
	G1	69.91 ^{b} ± 0.27	4.47 ^{c} ± 0.41	25.72 ^{ab} ± 0.45	31.69 ^{b} ± 0.37	49.58 ^{b} ± 0.80	60.16 ^{c} ± 0.34
	G2	77.17 ^{a} ± 0.80	0.64 ^{e} ± 0.15	24.28 ^{b} ± 0.29	25.37 ^{d} ± 0.67	37.46 ^{d} ± 0.60	66.66 ^{a} ± 0.71
	F1	64.49 ^{c} ± 1.13	8.09 ^{b} ± 0.17	20.52 ^{d} ± 0.34	33.65 ^{b} ± 0.75	46.93 ^{c} ± 0.17	58.19 ^{c} ± 0.77
	F2	63.78 ^{c} ± 0.87	2.77 ^{d} ± 0.20	19.90 ^{d} ± 0.11	32.98 ^{b} ± 0.84	39.82 ^{d} ± 0.66	58.57 ^{c} ± 0.83
Dried apple chip samples (21st day)	S1	52.26 ^{e} ± 1.03	9.84 ^{b} ± 0.75	20.02 ^{e} ± 0.42	44.57 ^{a} ± 0.98	61.34 ^{a} ± 1.42	47.29 ^{e} ± 0.95
	S2	69.63 ^{b} ± 1.09	5.97 ^{c} ± 0.10	26.31 ^{a} ± 0.60	32.58 ^{d} ± 0.54	52.78 ^{b} ± 0.48	59.36 ^{b} ± 0.59
	G1	64.76 ^{c} ± 0.78	6.19 ^{c} ± 0.24	23.70 ^{bc} ± 0.19	34.67 ^{c} ± 0.58	51.72 ^{b} ± 0.40	57.07 ^{c} ± 0.58
	G2	72.39 ^{a} ± 0.08	3.31 ^{d} ± 0.03	24.75 ^{b} ± 0.03	29.09 ^{e} ± 0.07	44.27 ^{c} ± 0.07	62.77 ^{a} ± 0.07
	F1	58.65 ^{d} ± 0.57	12.42 ^{a} ± 0.53	21.44 ^{d} ± 0.25	40.23 ^{b} ± 0.69	60.30 ^{a} ± 0.96	51.77 ^{d} ± 0.68
	F2	68.56 ^{b} ± 1.03	3.75 ^{d} ± 0.51	23.30 ^{c} ± 0.72	31.03 ^{d} ± 0.69	44.69 ^{c} ± 1.06	60.67 ^{b} ± 0.70

Sources: Ghinea, Prisacaru & Leahu (2022)

Sensory evaluation

Apples ('Starkrimson' (S), 'Golden Delicious' (G) and 'Florina' (F) cultivars,





Sources: Ghinea, Prisacaru & Leahu (2022)

Conclusions

- Apple quality is influenced by color, sugar content and acid composition. A ready-to-eat product, apple chips were produced from three different apple cultivars by drying.
- Apple chips preserved the good color, and it can be concluded, after analyzing the color parameters, that samples F1, G1 and S1 are closer to the color of fresh apple samples, followed by samples S2, G2 and F2.
- The drying of the apple chip samples in the dehydrator leads to a decrease in the values of water activity, which varied between 50 and 60% compared to the aw of the fresh samples, while for the samples obtained in the oven, the aw values decreased and varied between 28 and 30%.
- During storage, samples of apple chips dried in the oven are less influenced in terms of water activity, and the increase in aw values is smaller compared to the values obtained for samples from the dehydrator, except for the samples of the ‘Golden Delicious’ cultivar.

Conclusions

- Apple chips obtained by drying in a dehydrator on the first day are the most appreciated in the following order: S2, F2 and G2, followed by F1, G1 and S1.

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