

PROCESAREA MINIMALĂ PRIN DESHIDRATARE A MERELOR ECOLOGICE – ACCEPTANȚA CONSUMATORULUI MINIMAL PROCESSING OF ORGANIC APPLES BY DRYING - CONSUMER ACCEPTANCE

Andreea Stan¹, Mihai Frîncu¹, Marian Vintilă², Liliana Bădulescu¹

¹Research Center for Studies of Food Quality and Agricultural Products, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Bucharest, Romania

²Institute of Research and Development for Industrialization and Marketing of Horticultural Products, Bucharest, Romania

Abstract

Sensory attributes like colour, flavour and texture are makers in the consumer's purchasing decision of minimally processed organic apples. Drying using low temperatures represent a simple and easy way for minimally processing of organic fruits, moreover this procedure is accepted in organic agriculture. The aim of this study is to establish the consumer acceptance of organic apples dried using two different temperatures and how they characterize the final product. In order to accomplish the proposed purpose, three organic apples cultivars 'Rubinola', 'Topaz' and 'Gemini' were sliced and dried in a professional dryer with air distribution, using temperatures like 35°C and 50°C. Consumer general impression regarding obtained dried organic apples was based on a questionnaire, which contain several questions about colour, flavour, texture and size, in two sessions organized during two different scientific events. Dried organic apples were tasted and evaluated by consumers of both genders with ages between 22 and 66 years old. The slice size of organic dried apples was preferred by over 50% of consumers for all apple varieties. Consumers preferred more the taste of 'Gemini' cv. apples dried at 50°C compared to those dried at 35°C. The consumer's acceptance of minimally processed organic apples was oriented towards those dried at 50°C. Obtained results suggest that sensory attributes are very important in consumer acceptance of a minimally processed product by drying technology and more studies are required.

Cuvinte cheie: analiză senzorială, temperatură scăzută, aromă, gust.

Key words: sensorial analyses, low temperature, flavour, taste.

1. Introduction

Consumer attitudes and beliefs represent factors that influence the new foods acceptance or rejection (Stan et al., 2017). In today's society, the consumption preferences are varied and deeply changed comparative with the past; consumers are no longer categorized only about income, demographic variables and lifestyle (Popa et al, 2017; Farruggia et al., 2016).

Now, consumer preference is influenced by intrinsic quality attributes discovered before (colour, taste, flavour, and texture) (Sulistyawati et al., 2020). This perception is used to assess other more quality attributes of the product, such as health (nutritional value and vitamins content), and to determine the overall quality of a food product (Sulistyawati et al., 2020; Asioli et al., 2017). Besides product sensory and health properties, a key role in consumers' food choice is played by product familiarity and health consciousness, including for fresh fruit (Pollard et al., 2002) and dried fruits (Asioli et al., 2019). Moreover, healthiness of the product is another reason in consumers' food choice (Grunert, 2013; Milošević et al., 2012; Januszewska et al., 2011) and is often associated with flavour, taste, colour, texture and natural content characteristics (free of additives and with natural ingredients) (Chambers et al., 2018; Puska & Luomala, 2016). Consumer preference studies on dried fruits shown that health-related attributes, such as nutritional content, a positive influence on health, and functional ingredients were among the important intrinsic attributes (Asioli et al., 2019; Jesionkowska, et al., 2009).

The consumers acceptance of a new processing technology depends on their perception of benefits and risk, the impact on taste, convenience, nutritional value, the perceived safety of the process or technology, the magnitude of the risk the technology reduces, and the effect of the technology on the environment. Moreover, the consumer acceptance is crucial to the development of successful food products (Popa & Popa, 2012).

Drying can be mentioned as being one of the most used processing technology over the world, with global market interest since the dried product availability is longer, and can be used in various food

products, including breakfast cereals, fruit bars, and mixed with nuts (Sulistyawati et al., 2020, Sadler et al., 2019). Fruit drying using modern technology allows manufacturers to obtain products with high concentrations of bioactive compounds (Sun & Liang, 2020; Ullah et al., 2018), but not all of them are allowed to be used for organic system. Instead, drying technologies which use low temperatures are accepted also in organic food processing.

Drying means product moisture removing using sun or mechanical devices (Chang et al., 2016). This process reduces packaging, shipping and transportation costs for the product due to the weight and mass decrease and reduces the measures needed for product protection (Omolola et al., 2017). Moreover, dried fruits contain higher amounts of antioxidants, fibres and vitamins comparative with fresh fruits (Cinar, 2018; Bennett et al., 2011) due to the dry matter concentration.

Dried fruit regularly consumption and in the right amount can reduce risk for various health factors like glycaemia and cardiovascular diseases (Jeszka-Skowron et al., 2017). Although dried fruits have advantages related to both consumer health and commercial risk, few studies have focused on consumer preferences for these products. Current studies focused on European dried fruit markets (Alphonse et al., 2015) indicated that European consumers are familiar with dried fruit products and their production technologies (Sun & Liang, 2020). In a study conducted by Jesionkowska et al. (2009) it was determined the factors affecting the consumption preferences of Dutch, French and Polish consumers which consumed dried fruit and fruit products at least once a month. More studies have been conducted on Dutch and French (Sijtsema et al., 2012) consumers. In these studies, it was observed that emphasis on health can have an important role in the increasing of dried fruit consumption increasing (Cinar, 2018). Alphonse et al., (2015) evaluated European consumer preference and their willingness to pay more for tropical dried fruit produced in Africa. The organic status of dried fruit and fair trade factors have been shown to influence consumer willingness to pay extra for dried fruit.

Like around the world, the Romanian food market is changing and consumer become more conscious about health and environmental (Popa et al., 2011). Newly, consumers are oriented and prefer organically grown apples, which they consider healthier and safer than conventional ones (Zhu et al., 2018). Apples (*Malus domestica* Borkh.) are considered most consumed fruits in the world (Jaeger et al., 2018) because are rich in vitamins, antioxidant compounds and minerals (Bezdadea-Cătuneanu et al., 2019), and for their accessibility over year. As it is known, fruits quality depends on factors like production area, environmental conditions, producing technology, ripening stage, harvest time, (Asănică, 2018) and also processing technology after harvest. Consumers demand for minimally processed organic fruits with high nutritional quality is growing and for this, organic processing technologies becomes highly relevant.

The size, colour, flavour, texture, and the lack of defects are important indicators and mainly determine consumer's general impression of minimally processed organic apples. The aim of this study is to establish which drying technology of organic apples is easy accepted by consumers and how they characterize the final product.

2. Material and methods

In order to accomplish the purpose of this study, three organic apples cultivars 'Rubinola', 'Topaz' and 'Gemini' were harvested, in September 2019, from the experimental orchard of University of Agronomic Sciences and Veterinary Medicine of Bucharest and stored in cold conditions at 1°C and 95% air relative humidity, in Postharvest Technology Laboratory, for 2 months until were minimally processed and dehydrated. The minimally processing consisted in washing, core removing and slicing, followed by dehydration which were performed at the Institute Research and Development for Industrialization and Marketing of Horticultural Products. Dehydration was realized using a B.MASTER professional dryer with air distribution and it was used two different relatively low temperatures (35°C for 32 hours and 50°C for 20 hours). Dried slices of organic apples were then packed in normal plastic bags and stored at room temperature (approx. 23±1°C) until were sensorial analysed by evaluators.

Consumers general impression was determined in two tasting sessions realised in Romania, in two different social and scientific events, organized in October and November 2019, via INGADRA - USAMV Bucharest Conference, University Research - support of organic farming, Bucharest; respectively Workshop "Modern pomiculture in organic concept" at Research Institute for Fruit Growing Pitesti, Romania.

Methods used in this study in order to observe consumer general impression regarding dehydrated apples was based on offline questionnaire. The questionnaire was composed from 4 questions about sensorial indicators like size, colour, flavour, texture and 2 questions about age and gender. Dehydrated apples were evaluated by 49 consumers with ages between 22 and 66 years old both genders, from rural and urban area.

3. Results and discussions

Dehydrated organic apples were evaluated by consumers represented by 49% women, 41% men and 10% didn't reveal their gender (Figure 1); 6% of them with ages between 18 and 24 years old, 33% with ages between 25 and 34 years old, 19% with ages between 35 and 44 years old, 16% with ages between 45 and 54 years old, 10% with ages between 55 and 64 years old, 4% with ages above 65 years old and 12% of them didn't reveal their age (Figure 2).

At the question "Size of dehydrated fruit slice", 'Rubinola' organic apple cultivar was evaluated for "very pleasant" note with 20% for slices dried at 35°C (Figure 3) and with 27% for those dried at 50°C (Figure 4). "Pleasant" note was offered by 60% of consumers for slices dried at 35°C, respectively 51% for those dried at 50°C. Only 20% and 22% among consumers evaluate size of dried apples as "unpleasant" or "indifferent". For same questions, 'Topaz' cultivar dried slices at 35°C (Figure 3) were noted with "very pleasant" and "pleasant" by 57% of evaluators and 83% for those dried at 50°C (Figure 4). In this case evaluators preferred more the size of dried slices at 50°C. Similar case was observed also for 'Gemini' cultivar, where slices dried at 50°C (62% "very pleasant" and "pleasant" notes) were more appreciated by consumers than those dried at 35°C (43% "very pleasant" and "pleasant"). When all three organic apple varieties were compared from the dried slice size preferences point of view, 'Rubinola' cv. was more appreciated by consumers. The size of organic dried apples slices was preferred by over 50% of consumers for all apple varieties, with exception of 'Gemini' cultivar dried at 35°C, which obtained 43% as "pleasant".

Colour of dried organic apples was appreciated by evaluators as follow: 100% with "very pleasant" and "pleasant" for 'Rubinola' cultivar dried at 35°C, 92% for 'Rubinola' cultivar dried at 50°C, 71% for 'Topaz' cultivar dried at 35°C, 73% for 'Topaz' cultivar dried at 50°C, 64% for 'Gemini' cultivar dried at 35°C, and 50% for 'Gemini' cultivar dried at 50°C (Figure 5, 6). As it can be observed, 'Rubinola' cultivar obtained also the biggest score according consumers evaluation. Overall, the colour of organic dried apples was also preferred by over 50% of consumers for all apple cultivars.

When consumers evaluated the general taste of organic dried apples, was observed that 'Gemini' cultivar dried at 35°C obtained only 14% notes "very pleasant" and 22% of "pleasant" (Figure 7). Most of consumers appreciate the general taste of 'Gemini' cv. dried at 35°C with "indifferent" (36%), "semi-pleasant" (14%) or "unpleasant" (14%). Meanwhile, general taste of 'Gemini' cv. dried at 50°C was appreciated by 72% of consumers with "very pleasant" and "pleasant" (Figure 8). 'Rubinola' and 'Topaz' cvs. obtained scores of: 86% with "very pleasant" and "pleasant" for 'Rubinola' cv. dried at 35°C, 94% for 'Rubinola' cv. dried at 50°C, 93% for 'Topaz' cv. dried at 35°C, 78% for 'Topaz' cv. dried at 50°C (Figure 7, 8).

At the sensorial indicator "Dried apple slices texture", 'Rubinola' organic apple cv. fruits were evaluated by 87% and 81% of consumers with "very pleasant" and "pleasant" for slices dried at 35°C, respectively for those dried at 50°C. 13% and 19% among consumers evaluated slice texture of dried 'Rubinola' cv. apples with "indifferent", "semi-pleasant" or "unpleasant". Slices texture of 'Gemini' cv. dried at 35°C and 50°C was appreciated only by 42%, respectively 47% of consumers with "very pleasant" and "pleasant" (Figure 9, 10).

When all three organic apple cultivars were compared from the dried slice texture preferences point of view, 'Rubinola' cv. gained again, being the most appreciated by consumers.

4. Conclusions

Apples were evaluated by consumers with ages between 22 and 66 years old.

The "colour" was evaluated as pleasant for the 'Topaz' and 'Gemini' cvs., and very pleasant for 'Rubinola' cv..

Taste was evaluated as "pleasant" and "very pleasant" by 72% of consumers for 'Gemini' apples dehydrated at 50°C, in comparison with 36% for 'Gemini' apples dehydrated at 35°C.

General impression was oriented towards minimally processed organic apples dehydrated at 50°C.

Overall, 'Rubinola' organic apple cv. fruits present best behaviour during drying, maintaining its sensory properties and being the most appreciated by consumers.

The results obtained in the present study suggest that sensorial analysis plays an active part in choosing the drying technology to be further used, and more studies are necessary.

Acknowledgements

This work was supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI - UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0662, within PNCDI III.

References

1. Alphonse R., Temu A., Almlı V.L., 2015. European consumer preference for African dried fruits. *British Food Journal*. 117(7):1886-1902.
2. Asănică A., 2018. Sensorial evaluation of 26 highbush blueberry varieties in Romania. *Scientific Papers. Series B, Horticulture*. Vol. LXII, 181-186, Online ISSN 2286-1580.
3. Asioli D., Aschemann-Witzel J., Caputo V., Vecchio R., Annunziata A., Næs T., & Varela P., 2017. Making sense of the “clean label” trends: A review of consumer food choice behavior and discussion of industry implications. *Food Research International*, 99(Part 1), 58–71, <https://doi.org/10.1016/j.foodres.2017.07.022>
4. Asioli D., Rocha C., Wongprawmas R., Popa M., Gogus F., Almlı V., 2019. Microwave-dried or air-dried? Consumers' stated preferences and attitudes for organic dried strawberries. A multi-country investigation in Europe. *Food Research International*, 120, 763–775. <https://doi.org/10.1016/j.foodres.2018.11.037>
5. Bennett L.E., Jegasothy H., Konczak I., Frank D., Sudharmarajan S., Clingeleffer P.R., 2011. Total polyphenolics and anti-oxidant properties of selected dried fruits and relationships to drying conditions. *Journal of Functional Foods* 3(2):115-124.
6. Bezdadea-Cătuneanu I., Bădulescu L., Dobrin A., Stan A., Moș A., Hoza D., 2019. A biochemical comparison of apple during postharvest storage in controlled atmosphere conditions. *Scientific Papers. Series B, Horticulture*, LXIII, 115-122, http://horticulturejournal.usamv.ro/pdf/2019/issue_1/Art17.pdf
7. Chambers V.E., Chambers V.E., Castro M., 2018. What is “natural”? Consumer responses to selected ingredients. *Foods*, 7(65). <https://doi.org/10.3390/foods7040065>
8. Chang S.K., Alasalvar C. and Shahidi F., 2016. Review of dried fruits: Phytochemicals, antioxidant efficacies, and health benefits. *Journal of Functional Foods* 21:113-132.
9. Cinar G., 2018. Consumer perspective regarding dried tropical fruits in Turkey. *Italian Journal of Food Science*, vol. 30, 1-19.
10. Farruggiaa D., Crescimanno M., Galatia A., Tinervia S., 2016. The quality perception of fresh berries: an empirical survey in the German market, Florence “Sustainability of Well-Being International Forum”. *Food for Sustainability and not just food*, Florence SWIF 2015, Agriculture and Agricultural Science Procedia 8, 566-575.
11. Grunert K.G. In M. Klopčič A. Kuipers & J. Hocquette (Eds.), 2013. Trends in food choice and nutrition. Consumer attitudes to food quality products. *EAAP Scientific Series*, Vol. 133, pp. 23–30, https://doi.org/10.3920/978-90-8686-762-2_2
12. Jaeger S.R., Antúnez L., Ares G., Swaney-Stueve M., Jin D., Harker F.R., 2018. Quality perceptions regarding external appearance of apples: Insights from experts and consumers in four countries. *Postharvest Biology and Technology*, Volume 146, 99-107, <https://doi.org/10.1016/j.postharvbio.2018.08.014>
13. Januszewska R., Pieniak Z., & Verbeke W., 2011. Food choice questionnaire revisited in four countries. Does it still measure the same? *Appetite*, 57(1), 94–98. <https://doi.org/10.1016/j.appet.2011.03.014>
14. Jesionkowska K., Sijtsema S.J., Konopacka D. & Symoneaux R., 2009. Dried fruit and its functional properties from a consumer's point of view. *Journal of Horticultural Science and Biotechnology*, 84(6), 85–88. <https://doi.org/10.1080/14620316.2009.11512601>
15. Jeszka-Skowron M., Zgoła-Grześkowiak A., Stanisław E. and Waśkiewicz A., 2017. Potential health benefits and quality of dried fruits: Goji fruits, cranberries and raisins. *Food Chemistry* 221:228-236.
16. Milošević J., Žeželj I., Gorton M., & Barjolle D., 2012. Understanding the motives for food choice in Western Balkan Countries. *Appetite*, 58(1), 205–214. <https://doi.org/10.1016/j.appet.2011.09.012>
17. Omolola A.O., Jideani A.I. and Kapila P.F., 2017. Quality properties of fruits as affected by drying operation. *Critical Reviews in Food Science and Nutrition* 57(1):95-108.
18. Pollard J., Kirk S.F.L., Cade J.E., 2002. Factors affecting food choice in relation to fruit and vegetable intake: A review. *Nutrition Research Reviews*, 15(2), 373–387. <https://doi.org/10.1079/NRR200244>.
19. Popa A., Draghici M., Popa M., Niculita P., 2011. Consumer Choice and Food Policy. A Literature Review. *Journal of Environmental Protection and Ecology (Environmental management)*, 12, 2: 708–717.
20. Popa M.E., Geicu-Cristea M., Popa A., Drăghici M., Tănase E.E., Miteluț A., Iorga C.S., Guillaume C., Gontard N., Guillard V., Gogu F., Yanik D.K., 2017. Consumption and attitudes regarding berries-based products – comparative analysis of Romania, France and Turkey. *Romanian Biotechnological Letters*, Vol. 22, No. 3, 12568-12576.
21. Popa M.E., Popa A., 2012. Consumer Behavior: Determinants and Trends in Novel Food Choice. In: McElhatton A., do Amaral Sobral P. (eds). *Novel Technologies in Food Science*. Integrating Food

- Science and Engineering Knowledge into the Food Chain, vol 7. Springer, New York, NY. https://doi.org/10.1007/978-1-4419-7880-6_6.
22. Puska P., Luomala H.T., 2016. Capturing qualitatively different healthfulness images of food products. *Marketing Intelligence and Planning*, 34(5), 605–622. <https://doi.org/10.1108/MIP-06-2015-0119>.
 23. Sadler M. J., Gibson S., Whelan K., Ha M.A., Lovegrove J., Higgs J., 2019. Dried fruit and public health—What does the evidence tell us? *International Journal of Food Sciences and Nutrition*, 70(6), 675–687. <https://doi.org/10.1080/09637486.2019.1568398>.
 24. Sijtsema S.J., Jesionkowska K., Symoneaux R., Konopacka D., Snoek H., 2012. Perceptions of the health and convenience characteristics of fresh and dried fruits. *Food Science and Technology* 49(2):275-281.
 25. Stan A., Dobrin A., Zugravu M., Bezdadea-Catuneanu I., Iancu A., Lagunovschi-Luchian V., Badulescu L., 2017. Perception and preference of the Romanian consumers regarding organic vs. conventional products quality – survey study. *Journal of Horticulture, Forestry and Biotechnology*, Volume 21(3), 1- 7.
 26. Sulistyawati I., Dekker M., Verkerk R., Steenbekkers B., 2020. Consumer preference for dried mango attributes: A conjoint study among Dutch, Chinese, and Indonesian consumers. *Journal of Food Science*, Vol. 85, Iss. 10, 3527- 3535, doi: 10.1111/1750-3841.15439.
 27. Sun Y., Liang C. 2020. Factors Determining Consumers' Purchase Intentions Towards Dried Fruits. *International Journal of Fruit Science*, 1-25, DOI:10.1080/15538362.2020.1774477.
 28. Ullah F.K., Min M.K., Khattak S., Wahab N., Wahab M., Ameen N., Li X., Wang S., Soomro A., Yousaf K., 2018. Effects of different drying methods on some physical and chemical properties of Loquat (*Eriobotrya japonica*) fruits. *Int. J. Fruit Sci.* 18(4):345–354. doi:10.1080/15538362.2018.1435330.
 29. Zhu Z., Jia Z., Peng L., Chen Q., He L., Jiang Y., Ge S., 2018. Life cycle assessment of conventional and organic apple production systems in China. *Journal of Cleaner Production*, Volume 201, 156-168, <https://doi.org/10.1016/j.jclepro.2018.08.032>.

Tables and Figures

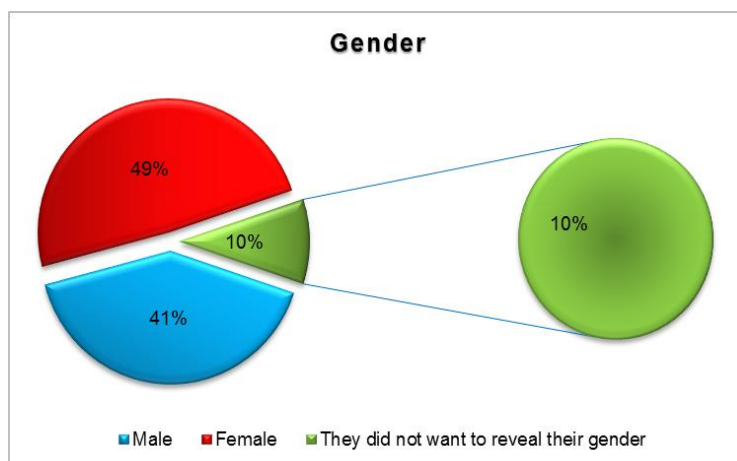


Fig. 1. Graphical representation of respondent's gender

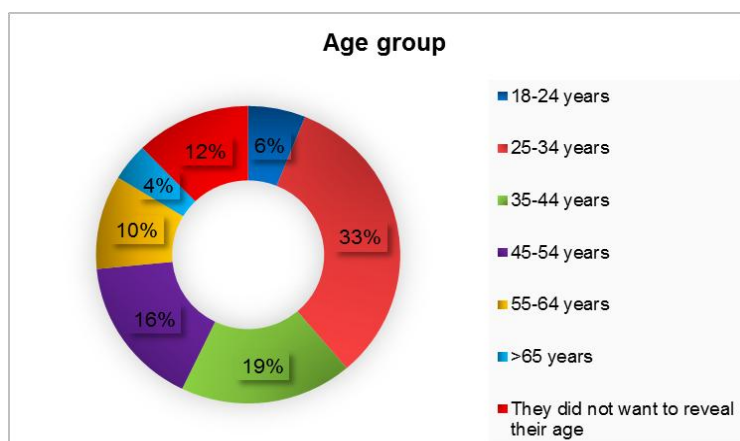


Fig. 2. Graphical representation of respondent's age

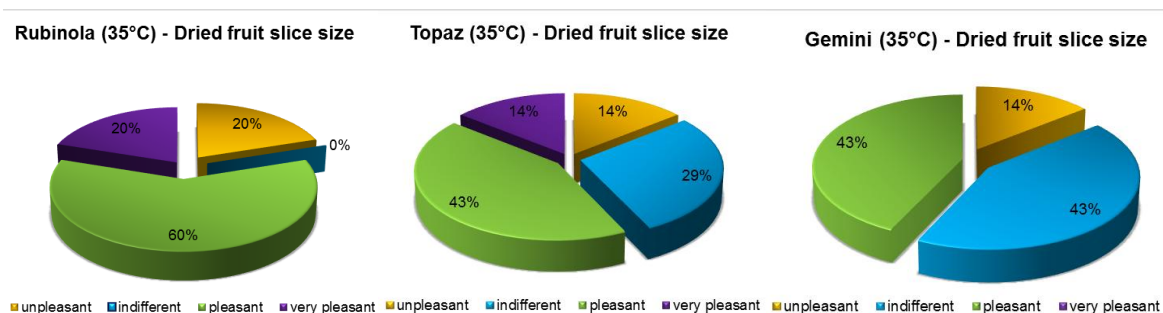


Fig. 3. Slice size results for 'Rubinola', 'Topaz' and 'Gemini' cvs. organic apples dried at 35°C

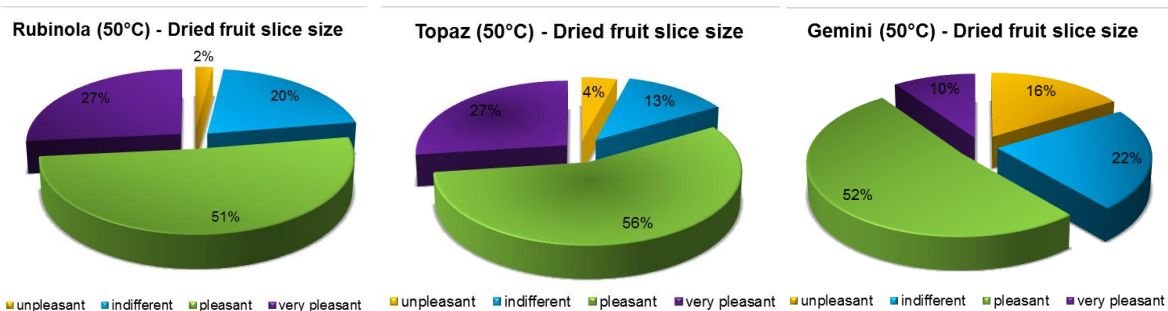


Fig. 4. Slice size results for 'Rubinola', 'Topaz' and 'Gemini' cvs. organic apples dried at 50°C

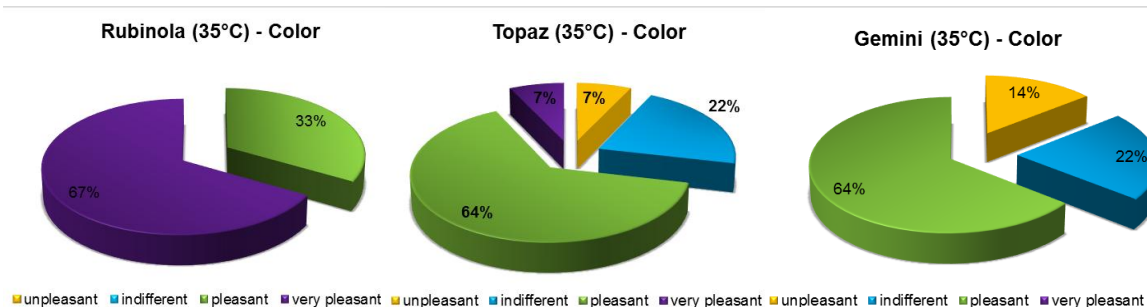


Fig. 5. Color attribute results for 'Rubinola', 'Topaz' and 'Gemini' cvs. organic apples dried at 35°C

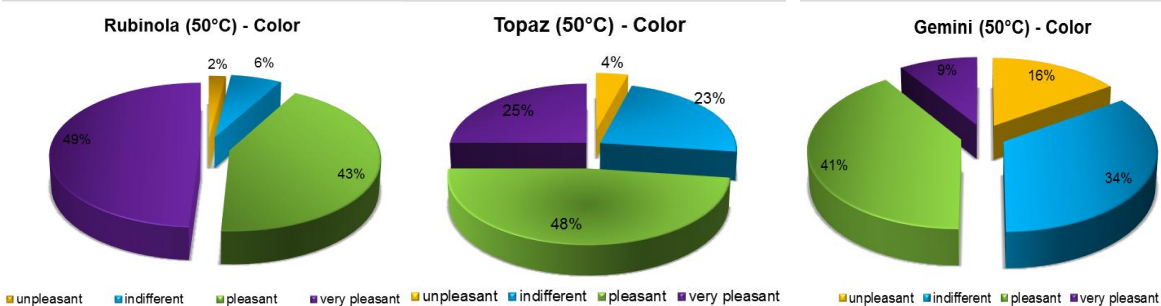


Fig. 6. Color attribute results for 'Rubinola', 'Topaz' and 'Gemini' cvs. organic apples dried at 50°C

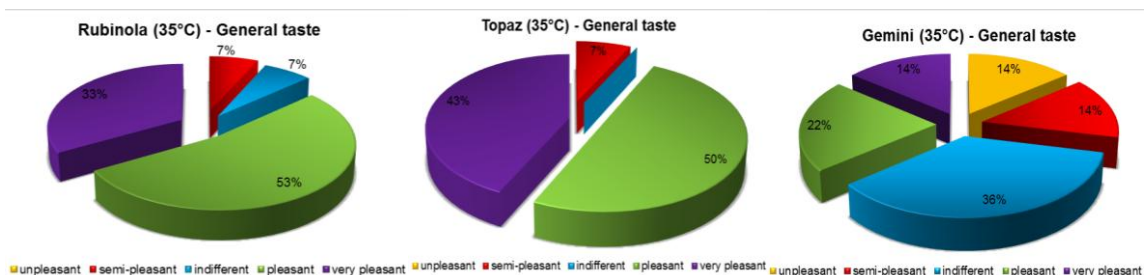


Fig. 7. General taste results for 'Rubinola', 'Topaz' and 'Gemini' cvs. organic apples dried at 35°C

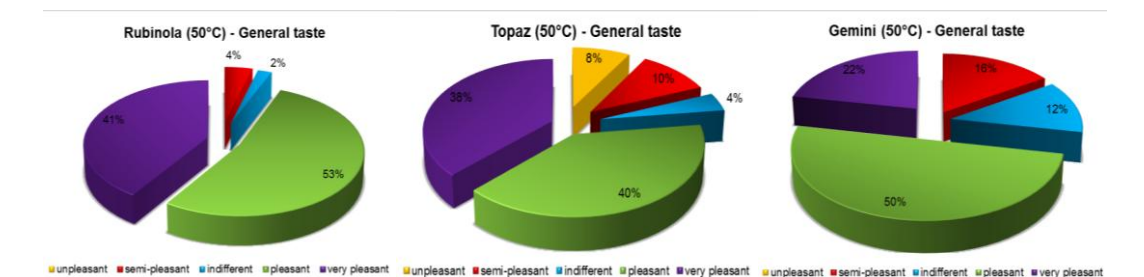


Fig. 8. General taste results for 'Rubinola', 'Topaz' and 'Gemini' cvs. organic apples dried at 50°C

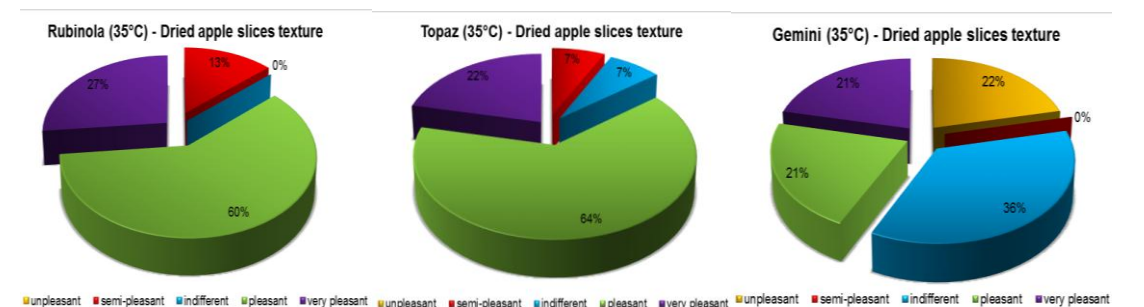


Fig. 9. Slice texture results for 'Rubinola', 'Topaz' and 'Gemini' cvs. organic apples dried at 35°C

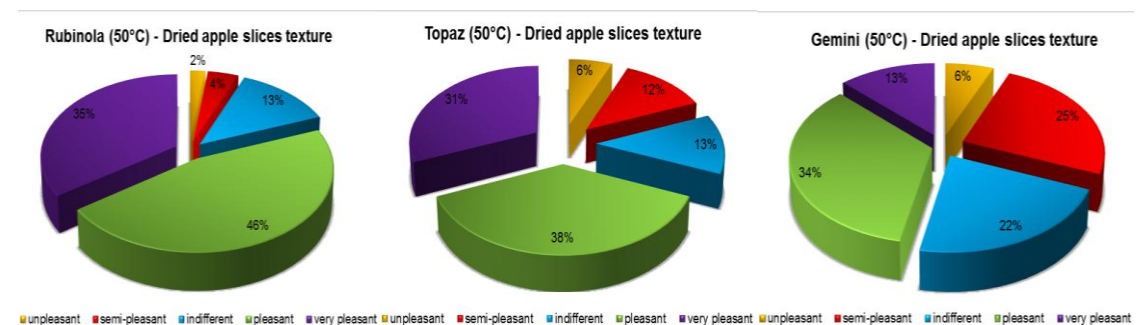


Fig. 10. Slice texture results for 'Rubinola', 'Topaz' and 'Gemini' cvs. organic apples dried at 50°C