beverages

Editorial

Fruit Juices: Technology, Chemistry, and Nutrition 2.0

Alessandro Attanzio [1,*], Guadalupe Garcia-Llatas [2,*] and Antonio Cilla [2,*]

[1] Department of Biological, Chemical and Pharmaceutical Sciences and Technologies (STEBICEF), University of Palermo, Via Archirafi 28, 90123 Palermo, Italy
[2] Nutrition and Food Science Area, Faculty of Pharmacy, University of Valencia, Avda. Vicente Andrés Estellés s/n, Burjassot, 46100 Valencia, Spain
* Correspondence: alessandro.attanzio@unipa.it (A.A.); guadalupe.garcia@uv.es (G.G.-L.); antonio.cilla@uv.es (A.C.)

In recent years, the food industry has increased its interest in the development of functional foods, including fruit juices, due to the increased demand among consumers for foods and beverages that benefit and improve our health. Fruit juices, a type of natural functional foods (without the addition, removal or modification of specific components), in addition to their intrinsic nutritional value, can supply other compounds with potential health benefits, e.g., ascorbic acid, α-tocopherol, carotenoids and polyphenols, with the potential ability to lower the risk of chronic degenerative diseases such as cancer and cardiovascular disorders through the combined action of its bioactive compounds [1,2].

The manufacture and development of fruit juices comprises technological and operational pathways. Considering engineering and technological perspectives, fruit juice production techniques range from traditional methods such as blending, formulation, and fermentation, to advanced techniques designed to protect bioactive compounds, such as microencapsulation, edible films, coatings, and nonthermal processing technologies to avoid the degradation of bioactive compounds and increase their bioaccessibility/bioavailability (and hence, their potential bioactivity) without compromising sensory attributes [3].

In addition to these previous aspects, fruit juices are primarily spoiled due to the proliferation of acid-tolerant and osmophilic microflora; thus, thermal pasteurization is commercially used for the preservation of industrially produced fruit juices, but results in losses of essential nutrients and changes in physicochemical and organoleptic properties [4]. Currently, to preserve food products such as fruit juices, non-thermal methods, as alternatives to pasteurization, are often combined with different techniques, such as antimicrobial additives, thermal treatments, and ultraviolet or pulsed light, to achieve synergistic effects and overall sensory, nutritional and microbiological quality improvements in functional juices [5].

In this regard, the first research article of this Special Issue by Bizuayehu et al. [6] addresses the impact of 1-methylcyclopropene (1-MCP) (a potent ethylene action inhibitor intended to extend the storage and shelf life of apples), storage atmosphere (controlled or regular) and juice processing (clear or cloudy) on the volatile aroma compounds from McIntosh and Honeycrisp apples following 4 months of storage. In the former juices, a noticeable reduction in all types of esters, aldehydes, most alcohols, and total volatile compounds was found when juices were prepared with 1-MCP-treated apples. On the contrary, for Honeycrisp juices, significant differences in the levels of esters and the total volatile aroma were caused by the storage atmosphere and juice processing techniques, but not for 1-MCP treatment, indicating that cloudy samples from the latter juices preserved a higher content of volatiles and aroma. These results suggest that the content and composition of volatile aroma compounds in apple juice could be strongly influenced by fruit quality and juice processing techniques.

Another study performed by Sokolowska et al. [7] evaluated and identified the off-odor compounds in samples of strawberry-flavored water preserved with potassium sorbate and

check for updates

Citation: Attanzio, A.; Garcia-Llatas, G.; Cilla, A. Fruit Juices: Technology, Chemistry, and Nutrition 2.0. *Beverages* **2022**, *8*, 26. https://doi.org/10.3390/beverages8020026

Received: 1 April 2022
Accepted: 12 April 2022
Published: 26 April 2022

sodium benzoate due to the action of a mold isolated in this drink, *Penicillium corylophilum*. It was shown that the *P. corylophilum* strain produced both 1,4-pentadiene and benzaldehyde within 5 days of incubation in the presence of both preservatives. It is notable that these volatile compounds were produced only in the presence of preservatives and were not synthesized de novo under the test conditions.

Aside from the sensory properties of fruit juices, the effect of applied treatments on nutritional and/or the stability of bioactive compounds is one of the most crucial issues that has gained widespread interest in recent years. This problem is studied in the research conducted by Bassama et al. [8]. In their study, the impact of temperature (60–90 °C) on betacyanins degradation (bioactive compounds typically used as natural colorants) was evaluated in cactus pear juice following three models: Arrhenius, Eyring and Ball. The data showed that the thermal degradation of these compounds could be described using first-order reaction kinetics; the Ball model is the best model for predicting time/temperature combinations to ensure both the safety of the product and the preservation of betacyanins. In fact, it was concluded that pasteurization at 90 °C for 36 s should be enough to guarantee the safety of the end product, and storage at temperatures under 20 °C should be prioritized to ensure the stability of the product for at least 2 months.

Another study included in this Special Issue, carried out by Sauceda-Gálvez et al. [9], reported the effect of turbidity as a UV-C interference factor against the inactivation of bacterial spores of *Bacillus subtilis* and *Alicyclobacillus acidoterrestris* in model solutions and cloudy apple juice. Their main findings found that, while higher UV-C doses increased the inactivation rates of spores, these doses were reduced when turbidity values increased as the spores of *B. subtilis* were more resistant than those of *A. acidoterrestris*. In the case of cloudy apple juice processed by UV-C in a single pass or with a recirculation of the matrix, it was found that the inactivation significantly increased with recirculation, thus, highlighting that the degree of turbidity could impact the effectiveness of UV-C to inactivate resistant spores in fruit juices.

Lastly, the paper by Alderees et al. [10] outlines the antimicrobial activity of an oil-in-water-encapsulated nanoemulsion containing either an individual oil or a combination of three essential oils of Tasmanian pepper leaf (*Tasmania lanceolate*), lemon myrtle (*Backhousia citriodora*), and anise myrtle (*Syzygium anisatum*) against weak-acid-resistant *Zygosaccharomyces bailii* in clear apple juice. The results of this study clearly indicated that essential oils of lemon myrtle and Tasmanian pepper leaf as individual oils, as well as the combination of anise myrtle and Tasmanian pepper leaf, were effective for controlling the growth of the yeast in clear apple juice within the studied storage period (28 days) and temperature (25 °C), highlighting the great potential of native Australian herbs in controlling one of the most resistant yeasts to the action of weak-acid preservatives in clear apple juice.

We are pleased to present this Special Issue—which includes five papers written by scientists operating in Canada, Poland, Senegal, Spain and Australia—as it highlights the most important research activities in the field of fruit juices technology, chemistry and nutrition. With these studies, it is hoped that our knowledge of how different technological and preservation techniques impact bioactive compounds, as well as the sensory and microbiology spoilage of fruit juices, will be advanced. We are very grateful to the authors who have shared their scientific knowledge and experience through their contributions to this Special Issue. We sincerely hope that readers will find this Special Issue interesting and informative.

Author Contributions: Conceptualization, A.A., G.G.-L. and A.C.; writing—original draft preparation, A.A., G.G.-L. and A.C.; writing—review and editing A.A., G.G.-L. and A.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: All the authors who kindly contributed to this Special Issue are gratefully acknowledged.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Cilla, A.; De Palma, G.; Lagarda, M.J.; Barberá, R.; Farré, R.; Clemente, G.; Romero, F. Impact of fruit beverage consumption on the antioxidant status in healthy women. *Ann. Nutr. Metab.* **2009**, *54*, 35–42. [CrossRef] [PubMed]
2. Cilla, A.; Garcia-Llatas, G.; Lagarda, M.J. Impact of fruit juices consumption on non-enzymatic antioxidant capacity in humans: An updated review. In *Fruit Juices: Types, Composition and Health Benefits*, 1st ed.; Elder, K.E., Ed.; Nova Publishers: New York, NY, USA, 2014; Chapter 7; pp. 125–142.
3. Cilla, A.; Garcia-Llatas, G.; Lagarda, M.J.; Barberá, R.; Alegría, A. Development of functional beverages: The case of plant sterol-enriched milk-based fruit beverages. In *Functional and Medicinal Beverages*, 1st ed.; Grumezescu, A., Holban, A.M., Eds.; Elsevier: Amsterdam, The Netherlands, 2019; Volume 11, Chapter 8; pp. 285–312.
4. Aneja, K.M.; Dhiman, R.; Aggarwal, N.K.; Anejay, A. Emerging preservation techniques for controlling spoilage and pathogenic microorganisms in fruit juices. *Int. J. Microbiol.* **2014**, *2014*, 758942. [CrossRef] [PubMed]
5. Putnik, P.; Pavlić, B.; Šojić, B.; Zavadlav, S.; Žuntar, I.; Kao, L.; Kitonić, D.; Kovačević, D.B. Innovative hurdle technologies for the preservation of functional fruit juices. *Foods* **2020**, *9*, 699. [CrossRef] [PubMed]
6. Bizuayehu, M.M.; Jordan, M.; Forney, C.F.; Speers, C.F.; Vasantha Rupasinghe, H.P. Effect of 1-methylcyclopropene (1-MCP) and storage atmosphere on the volatile aroma composition of cloudy and clear apple juices. *Beverages* **2020**, *6*, 59. [CrossRef]
7. Sokolowska, B.; Polaska, M.; Dekowska, A.; Wozniak, L.; Roszko, M. Degradation of preservatives with the formation of oof-odro volatile compounds – the case of strawberry-flavored bottled water. *Beverages* **2020**, *6*, 67. [CrossRef]
8. Bassama, J.; Tamba, A.; Ndong, M.; Donnée Sarr, K.D.; Cissé, M. Degradation kinetics of betacuanins during pasterurization and storage of cactus pear (*Opuntia dillenni* Haw.) juice using the Arrhenius, Eyring, and Ball models. *Beverages* **2021**, *7*, 2. [CrossRef]
9. Sauceda-Gálvez, J.N.; Martinez-Garcia, M.; Hernández-Herrero, M.M.; Gervilla, R.; Roig-Sagués, A.R. Short wave ultraviolet light (UV-C) effectiveness in the inactivation of bacterial spores inoculated in turbid suspensions and in cloudy apple juice. *Beverages* **2021**, *7*, 11. [CrossRef]
10. Alderees, F.; Akter, S.; Mereddy, R.; Sultanbawa, Y. Antimicrobial activity of nanoencapsulated oils of *Tasmani lanceolate*, *Backhousia citridora* and *Syzygium anisatum* against weak-acid resistant *Zygosaccharomyces bailii* in clear apple juice. *Beverages* **2021**, *7*, 67. [CrossRef]