

Smoothies

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The word “smoothie” comes from the English term “smooth” (tender, creamy), and defines a creamy non-alcoholic drink with a thick texture similar to that of milkshakes. Smoothies are beverages containing a blend of fruit pulp, fruit juice, ice, yoghurt, and/or milk. This beverage includes only natural ingredients such as puree fruit with fruit juice, and possibly dairy products or/and crushed ice cubes. Their preparation is based on the use of the entire fruit, which is processed from pulp to puree, with only the seeds and peel being removed.

consumers

polyphenols

fiber

smoothies

fruit

1. Introduction

Nutrition is the most important external factor influencing children's development. Its influence is essential from birth through childhood. Consumption of fruit and vegetables is important as it plays an essential role in preventing childhood obesity, and preventing many diseases, including certain cancers, osteoporosis, diabetes, coronary heart disease, stroke, neuronal degeneration, and type II diabetes. Therefore, the World Health Organization (WHO) recommends eating a minimum of 400 g of fruits and vegetables per day to improve health and prevent the above-mentioned chronic diseases. Because current consumption is lower than the recommended intake, the development of easy-to-eat fruit-based products such as smoothies could be a good option. Despite of the natural sugar content, smoothies could reach the promotion into the children's diet. They are becoming a so popular way to consume fruits, especially among young people. These products are typically purchased freshly prepared from juice bars or as a processed product (mildly pasteurized) from the refrigerated section of retail outlets. Even after the economic crisis of 2007–2008, smoothies remained a popular and convenient way of consuming fruit. Fruit components of smoothies could be considered as natural foods because of their nutrient profile or health-protecting qualities

The smoothies market can be divided into several segments, attending to different criteria (e.g., product type, distribution channel, and geographical location). Based on product type, the market is segmented into fruit-based, vegetal-based, dairy-based, and others. The fruit-based smoothies segment accounts for the largest market and is expected to be the fastest growing segment in the healthy beverage market. The global smoothies market were worth \$12.1 billion in 2020 and is projected to reach a compound annual growth rate (CAGR) of 8% over the next five years, to reach a value of \$17 billion in 2025. North America dominates the smoothie market, while the Asia-Pacific region is expected to be the fastest growing area. It is worth mentioning that, although an increase in smoothies' consumption exists in those areas, people's health have worsened during recent years, basically

increasing overweight problems. On the other hand, despite the health-promoting potential of smoothies, in Spain, it is still a sub-segment. However, consumer interest is growing, driven by health and wellness trends. Therefore, it is essential to test their sensory quality to improve their consumption.

The shelf life of non-pasteurized smoothies is relatively short due to microbial growth as a result of the minimal level of processing associated with these products. These are normally consumed fresh or preserved for short periods (1-3 weeks) by storing them under refrigeration. Besides, storage time can affect the color and polyphenolic composition of the smoothies. Some researchers suggested that it could be worth to use a mild thermal pasteurization or a thermal and high hydrostatic pressure processing to increase their shelf life and for better color retention, polyphenols and other quality attributes, guaranteeing consumers acceptance and food safety.

2. Latest Research

Different research articles have been recently published about smoothies. Please, find some of them in the following links and abstract of them was also included:

2.1. How a Spanish Group of Millennial Generation Perceives the Commercial Novel Smoothies?

Cano-Lamadrid, M.; Tkacz, K.; Turkiewicz, I.P.; Clemente-Villalba, J.; Sánchez-Rodríguez, L.; Lipan, L.; García-García, E.; Carbonell-Barrachina, Á.A.; Wojdyło, A. *Foods* 2020, 9, 1213.

The World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO) constantly emphasize the importance of increasing fruit and vegetable consumption; these natural products help in the prevention of major diseases. Smoothies are a simple and convenient way of doing so; thus, their demand is constantly growing and their market is becoming important for the food industry. Therefore, the objective of this research was to determine Millennial consumer opinion towards novel fruit-and vegetable-smoothies available on the retail market. Napping[®], descriptive sensory analysis, and consumer studies were conducted. Napping[®] results group samples into four clusters of smoothies; the main grouping factor was the type of fruit and the percentage of vegetables. Penalty analysis showed that smoothies need improvement mainly dealing with sweetness, bitterness, and vegetable flavors. Millennial consumers formed a homogeneous sensory group in which the overall liking was negatively correlated with the level of sweetness, and earthy, carrot, beetroot, and pear flavors. The key liking drivers were sourness and notes of mango, banana, and peach flavors. This research is a new insight into the perception of smoothies, provides comprehensive knowledge for the food industry, and can guide the design of new healthy smoothies.

2.2. Volatile Composition and Sensory Attributes of Smoothies Based on Pomegranate Juice and Mediterranean Fruit Purées (Fig, Jujube and Quince).

Issa-Issa, H.; Cano-Lamadrid, M.; Calín-Sánchez, Á.; Wojdyło, A.; Carbonell-Barrachina, Á.A. *Foods* 2020, 9, 926.

To increase the intake of fruits and vegetables—especially among young people—the food industry is trying to develop new, easy-to-eat and long-shelf-life products, such as smoothies. Nowadays, consumers are choosing their foods based not only on nutritional/functional properties (content of polyphenols, vitamins, minerals, among others), but also on sensory attributes. The aim of this study was to investigate the volatile composition by HS-SPME and the sensory profile by descriptive sensory analysis of novel smoothies prepared by blending fig, jujube or quince purée with pomegranate juices (cv. *Mollar de Elche* or *Wonderful*) at two ratios purée:juice (40:60 or 60:40). Twenty-three volatile compounds were identified by GC-MS and classified as alcohols, aldehydes, esters, furans, ketones, terpenes and terpenoids. Among volatile compounds, the five predominant ones in the studied smoothies were: (i) 5-HMF (30.6%); (ii) 3-hexen-1-ol (9.87%); (iii) hexanal (9.43%); (iv) 1-hexanol (8.54%); and (v) 3-octanone (7.67%). Fig smoothies were sweet and had flavor and volatiles related to fig, pomegranate, and grape. While jujube products were bitter and had jujube and pear notes. Finally, quince smoothies were consistent, sour and had quince, apple and floral notes. Thus, the type of fruit purée used clearly determined the flavor of the final product. The smoothies prepared with *Mollar de Elche* pomegranate juice were characterized by having high intensity of pear odor/aroma and consistency, and the *Wonderful* smoothies were characterized by lower consistency and more intense pomegranate aroma and sourness.

2.3. Formulation and storage effects on pomegranate smoothie phenolic composition, antioxidant capacity and color.

M. Cano-Lamadrid, F. Hernández, P. Nowicka, A.A. Carbonell-Barrachina, A. Wojdyło, LWT, Volume 96, 2018, 322-328, <https://doi.org/10.1016/j.lwt.2018.05.047>.

Smoothies are an increasingly popular way of consuming fruits and the industry is focusing on the increment of shelf life and the maintenance original color and the content of bioactive compounds. The aim of the present study was to evaluate how formulation and storage conditions (6 months at 4 or 20 °C) of different pomegranate smoothies affected on functional compounds. Phenolic compounds, antioxidant capacity (ABTS, FRAP) and color of 12 different smoothies were studied. The study was completed evaluating the effect of ratio purée:juice (60:40 or 40:60), pomegranate cultivar (*Mollar de Elche* or *Wonderful*) and fruit purée (quince, jujube, or fig) on studied smoothies. The smoothies before storage presented high values of total polyphenolic content (TPC): 247–314 mg/100 g fresh weight (fw), 2939–3920 mg/100 g fw, and 3809–5324 mg/100 g fw, in fig, jujube and quinces pomegranate smoothies, respectively. A positive effect of the 40:60 ratio purée:juice, the *Wonderful* pomegranate juice storing at 4 °C was found on total polyphenolic content [sum of anthocyanins, flavanols, flavan-3-ols (as monomeric and dimeric), polymeric procyanidins and phenolic acids] and quality of smoothies (a^* coordinate) being only a reduction of 30.1%, 13.1% and 9.5% in fig, jujube and quinces smoothies, respectively.

2.4. Phytochemical composition of smoothies combining pomegranate juice (*Punica granatum* L) and Mediterranean minor crop purées (*Ficus carica*, *Cydonia oblonga*, and *Ziziphus jujube*).

Cano-Lamadrid M, Nowicka P, Hernández F, Carbonell-Barrachina AA, Wojdyło A. *J Sci Food Agric*. 2018;98(15):5731-5741. doi:10.1002/jsfa.9120

Background: Daily intake of fruits and vegetables as suggested by the World Health Organization is lower than the recommended dietary intake (RDI). A good option to increase the intake of fruit and vegetables is the consumption of smoothies. This work evaluated the effect of adding fig, jujube or quince purée to pomegranate juice (cultivars 'Wonderful' and 'Mollar de Elche') in preparing smoothies at two ratios of purée:juice (40:60 and 60:40) on the composition of minerals, sugars, organic acids, vitamin C, antioxidant activity and polyphenols.

Results: Smoothies composition was mainly affected by the addition of the fruit purée. Twenty-eight polyphenolic compounds were found in the pomegranate smoothies (quadrupole time-of-flight liquid chromatography-mass spectrometry). The highest total content of polyphenolic compounds (ultra-performance liquid chromatography with photodiode array and fluorescence detection) was found in smoothies with quince purée, 501 mg 100 g⁻¹ fresh weight (FW), followed by jujube and figs, with 374 and 320 mg 100 g⁻¹ FW, respectively. Fig smoothies were rich in anthocyanins, while the jujube ones had high content of flavonols and vitamin C; finally, the quince smoothies were rich in hydroxycinnamic acids.

Conclusion: A positive effect of the addition of minor crops (fig, jujube and quince) was observed on the nutritional and functionality of the novel pomegranate smoothies. Moreover, the addition of jujube contributed to an enrichment of the final smoothies in vitamin C and organic acids, while an increase of pectin content was found in fig and quince pomegranate based smoothies. Therefore, the blend of minor Mediterranean crop purées with pomegranate juice to produce smoothies is a good strategy to promote the consumption of these healthy but underutilized fruits.

2.5. Others

Other articles are included in the followed table:

Carrot	Phenolics compounds, technology (High presure), biocompounds, shelf-life	Formica et al 2017; Castillejo et al 2016
Sour cherry	Sensory attributes, physico-chemical parameters, biocompounds content, and shelf-life	Nowicka et al 2016
Apple	Effect of the termal technologies on the quality and microorganisms	Markowski et al 2017

<i>Prunus</i> fruits	Sensory attributes, physico-chemical parameters, biocompounds content, shelf-life and biological activity	Nowicka et al 2016
Berries	Organoleptic assessment, analysis of polyphenols and vitamin C content and antioxidant activity	Teleszko et al 2014
Tomato and pumpkin (Red smoothies)	The effect of a pasteurization conditions (microwave, time) on bioactive compounds and microbiology during storage (Listeria)	Arjmandi et al 2016
Cucumber, broccoli and spinach (Green smoothies)	Effect of themal conditions (HTST) on the preservation of bioactive compounds	Castillejo et al 2017 Castillejo et al 2018

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