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Sensory quality of pomegranate products

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Abstract. Pomegranate has become very popular in the last years because of its healthy properties (high antioxidant activity and phenolic compounds content). However, do consumers really know how a fresh pomegranate fruit/juice tastes? In our opinion the answer is clear: no, they do not. Thus, our first task is to explain consumers the main characteristics describing fresh pomegranate fruits; then, they will be able to assess whether the products they are buying/consuming come from natural sources. It is evident that the *appearance* of pomegranate fruits is very appealing and this is the main reason why intense garnet arils are always shown in advertisement. Pomegranate products can be manufactured using fruits from sweet, sour-sweet or sour cultivars, determining the relative intensities of the *basic tastes*. However, pomegranate has a big drawback, the low intensity of volatile compounds (*aroma*). The arils can be described by their basic tastes but not by their aroma; this makes very difficult to judge whether a pomegranate product is natural. In contrast, the rind has strong intensities of attributes such as astringency and toothetch mouthfeel. Without these notes a product will not have any healthy activity because polyphenols are mainly located in the rind. If a pomegranate juice can be described as having high intensities of candy-like and sweet overall, it can be a high success among consumers but it cannot be considered as a natural pomegranate product, and besides it will not have any healthy activity.

Keywords. Consumer studies – Descriptive analysis – Lexicon – New products – Sensory evaluation.

I – Introduction

Until a couple of years ago and despite the huge popularity and well-documented health benefits of pomegranate fruits, pomegranate based products and even pomegranate co-products, little research on the descriptive sensory attributes of pomegranate products was found, apart from that conducted by POM Wonderful, LLC (Los Angeles, CA, USA) on pomegranate juices (Koppel and Chambers IV, 2010).

Initially, researchers were only focused in studying the consumers' opinion on pomegranate products. For instance, consumer acceptability was important for the studies of Hayaloglu and Vardin (2001) and Riaz and Elahi (1992) in the research of fruit punch with watermelon/pomegranate juice mixtures and carbonated pomegranate drink, respectively.

Data showing differences in morphological, chemical and biochemical characteristics among pomegranate cultivars suggests that pomegranates may also vary in their sensory properties (appearance, flavor and texture). However most of the sensory research has been focused on pomegranate based products and not on fresh fruits, perhaps because fresh fruits were locally marketed and consumers in the producing areas were well-aware on how high-quality fruits looked like. In this way, Vardin and Fenercioglu (2003) studied the clarification of *pomegranate juices* and evaluated attributes like color, turbidity, overall appearance, bitterness and overall quality. López-Rubira *et al.* (2005) studied the aroma, taste, firmness, visual appearance, color, browning and dehydration of *pomegranates arils* during their shelf life. Singh and Sethi (2003) conducted a screening of pomegranate genotypes for the preparation of high quality anardana (*dried pomegranate seeds* original from India) and evaluated mouthfeel, color and flavor. Later,

Martinez *et al.* (2006) characterized the seeds of five new pomegranate varieties using sensory attributes such as seed hardness, visual color, taste, and overall quality appreciation. These authors tried to correlate their sensory data with physico-chemical parameters and to recommend a commercial destination for each of their varieties. Pomegranate varieties were classified into three categories based on the maturity index (MI) of the seeds: (i) sweet: MI = 31-98, (ii) sour-sweet: MI = 17-24, and (iii) sour: MI = 5-7. Finally varieties PTO2 and CRO1 were very interesting for the juice industry because of their high juice contents, while varieties ME14 and ME15 were more appropriate for the fresh fruit market because of the large fruit size and excellent seed organoleptic characteristics.

Until the work by Koppel and Chambers IV (2010), none of the research studies previously described included or use a detailed lexicon for the classification of the flavor attributes of pomegranate juices. A similar situation is still true and valid for the appearance, texture and flavor of fresh pomegranate fruits or the texture of other products.

Nowadays it seems crucial to "fully" characterize, using appropriate lexicons, fresh fruits from different pomegranate varieties and clones to obtain high quality products and to classify varieties and clones according to their suitability to manufacture different products, such as juices, dried arils, jams, etc. To properly characterize and classify commercially pomegranate varieties and clones there is an urgent need of properly develop appearance, flavor and texture lexicons and consumers studies linking products attributes with high consumers' liking and acceptability.

Here are some comments on the main attributes that can be used to describe the appearance, flavor and texture of pomegranate products; the attributes list can be completed by readers according to their experience with different products and their main commercial targets. Researchers participating in the session "Industrialization, Products and Sensory Quality" will give further details on the sensory characterization of different pomegranate based products.

II – Appearance

The appearance of pomegranate arils is very appealing for consumers (Fig. 1) and are always included in the labels of all pomegranate products, even though in some cases, the percentage of pomegranate in the products is extremely low (sometimes just 1%). However, it is well-known that the intense garnet color of pomegranate arils will disappear during pasteurization of juices and the addition of natural or artificial coloring substances will be required. Fresh fruits are marketed mainly according to their size and external color. Some of the main defects are low intensity of color, excessive presence of spots or cracks, etc. Regarding the inner appearance of fruits important attributes could be: amount of carpel membranes and rind compared to seeds, color intensity, ratio between whole seed/woody portion, dehydration degree, etc.



Fig. 1. Appearance of fresh pomegranate fruits, seeds and juices.

III – Flavor

Up to date, flavor is the only complex sensory property that can be fully described using the lexicon developed by Koppel and Chambers IV for pomegranate juices. The attributes included in this lexicon can be divided into three main categories: (i) aromatic notes: apple, beet, berry, brown spice, brown sweet, carrot, candy-like, cranberry, cherry, fermented, floral, sweet overall, vinegar, wine-like, woody, (ii) basic tastes: sweet, sour and bitter, and (iii) chemical feeling factors: astringent, toothetch, metallic, chalky, tongue tingle, tongue numbing, and throat burn.

IV – Texture

Probably this property is the less studied in pomegranate products. However, attributes such as firmness, hardness, elasticity, crunchiness, sound, moisture release, mouth drying, tooth-packing, pulpiness, particulates, etc. could also be of interest.

Using their flavor lexicon Koppel and Chambers IV (2010) were able to evaluate 34 pomegranate juices marketed in the USA and including concentrated products, products from concentrate, pasteurized and freshly squeezed products. Juices were clustered into five categories characterized by: (i) berry, dark fruity, toothetch mouthfeel and sweet overall, (ii) grape, cranberry, wine-like and of red or purple color, (iii) fermented and toothetch mouthfeel, (iv) brown color and musty/earthy, and (v) candy-like and sweet overall. According to these authors "it is clear that pomegranate juices are sweet, sour, bitter, astringent, and have toothetch. Although the flavors can be complex, the major components are grape, cranberry, berry, fruity-dark, musty/earthy and beet". Other aromatics can be added to this lexicon such as "citrus notes" and it can be discussed whether "candy-like" juices could come from authentic pomegranates or from artificial flavorings but there is no doubt that this is the only way to properly describe pomegranate products.

Finally it must be mentioned that publications from both the Universidad Miguel Hernández (Calín-Sánchez *et al.*, 2011; Carbonell-Barrachina *et al.*, 2011; Melgarejo *et al.*, 2011) and Kansas State University (Vázquez-Araújo *et al.*, 2011a,b,c) have tried to characterize using both instrumental [chemical composition (polyphenols, punicalagins, sugars, organic acids, volatile compounds), biochemical activity (antioxidant capacity)] and sensory (descriptive and affective tests) tools fresh pomegranate fruits (from different clones/genotypes and countries), juices (mixtures with other berries and fruits, with the addition of dried and milled rind) and dried products (arils and rind).

V – Conclusions

Even though a lot of work is been done on sensory characterization and consumers' behavior on pomegranate fruits, pomegranate based products and pomegranate products in the last three years, many more studies are needed to corrected allocate each variety to a proper commercial sector (fresh fruit, juice, jam, etc.) and to have all the information needed to easily explain consumers how to: (i) distinguish true/authentic products from imitations/low quality products and (ii) fully appreciate and enjoy the uniqueness of authentic pomegranate products.

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