Scientia Horticulturae 188 (2015) 106–114

Contents lists available at ScienceDirect

Scientia Horticulturae

journal homepage: www.elsevier.com/locate/scihorti

Review

Impact of preharvest and postharvest factors on changes in volatile compounds of pomegranate fruit and minimally processed arils – Review

Oluwafemi J. Caleb[a,c], Olaniyi A. Fawole[b], Rebogile R. Mphahlele[b], Umezuruike Linus Opara[a,b,*]

[a] Postharvest Technology Research Laboratory, South African Research Chair in Postharvest Technology, Department of Food Science, Faculty of AgriSciences, Stellenbosch University, Private Bag X1, Stellenbosch 7602, South Africa
[b] Postharvest Technology Research Laboratory, South African Research Chair in Postharvest Technology, Department of Horticultural Science, Faculty of AgriSciences, Stellenbosch University, Private Bag X1, Stellenbosch 7602, South Africa
[c] Department of Horticultural Engineering, Leibniz-Institute for Agricultural Engineering (ATB), D-14469 Potsdam, Germany

ARTICLE INFO

Article history:
Received 12 December 2014
Received in revised form 17 March 2015
Accepted 18 March 2015
Available online 10 April 2015

Keywords:
Preharvest management
Postharvest life
Flavour life
Aroma
Volatile compounds
Smart packaging

ABSTRACT

Composition, concentration and combination of volatile fractions in fresh and fresh-cut fruit and vegetables are essential in conferring the unique aroma characteristics of the product. The volatile organic compounds (VOCs) present are directly responsible for the taste and odour and, hence, the unique identities of fresh and fresh-cut produce. Flavour quality plays a crucial role in consumer preference and liking of pomegranate cultivars and products. This review discusses the volatile composition of pomegranate fruit, including a critical evaluation of the role played by various preharvest and postharvest factors on the flavour life of pomegranates. Future prospects and potential application of VOCs in smart/intelligent packaging and storage of horticultural crops are highlighted. This review provides some critical information for the entire role players along pomegranate value chain.

Contents

* Corresponding author at: Postharvest Technology Research Laboratory, South African Research Chair in Postharvest Technology, Department of Horticultural Science, Faculty of AgriSciences, Stellenbosch University, Private Bag X1, Stellenbosch 7602, South Africa. Tel.: +27 021 808 9242; fax: +27 021 808 3743.
E-mail addresses: caleb.oluwafemi@gmail.com (O.J. Caleb), opara@sun.ac.za (U.L. Opara).

http://dx.doi.org/10.1016/j.scienta.2015.03.025
0304-4238/

1. Introduction

Pomegranate (*Punica granatum* L.) fruit has been reported to possess high antioxidant capacity and anti-mutagenic, anti-inflammatory, anti-hypertension and anti-atherosclerotic activities (Fawole and Opara, 2013a; Opara et al., 2009; Viuda-Martos et al., 2010). Bioactive components reported in pomegranate arils in variable proportions are anthocyanins, ascorbic acid and β-carotene (O'Grady et al., 2014). Additionally, pomegranate fruit is a good source of vitamin C, fatty acids, essential micro- and macronutrients and organic acids (Fawole and Opara, 2013a; Opara et al., 2009). While much is known about the micro- and macronutrients, antioxidant capacity and other quality attributes of the fruit, comparatively little is known about the volatile compounds in pomegranate.

On the hand, more than 300 volatile organic compounds (VOCs) have been reported in fresh apples (Dixon and Hewett, 2000). Although the chemical group, total number and concentration VOCs identified is dependent on maturity of the apple and are cultivar specific (Holland et al., 2005; Villatoro et al., 2008). In pear fruit more than 300 VOCs have been characterized, with decadienoate methyl- and hexyl esters identified as the predominant impact-compounds (Rapparini and Predieri, 2003; Kahle et al., 2005). Mango's VOCs have been extensively investigated over the past decades, due to its characteristic aroma. About 270 VOCs have been identified in different mango varieties (Pino and Mesa, 2006; Quijano et al., 2007). Strawberry flavour profile being a complex mixture of VOCs and non-volatiles, have been extensively examined and over 350 VOCs have been identified and described (Bood and Zabetakis, 2002; Wein et al., 2002; Lunkenbein et al., 2006; Klein et al., 2007). Although, a recent review by El Hadi et al. (2013) extensively reported on the advances in fruit aroma volatile research, no information was provided on pomegranate fruit.

The composition and concentration of volatile compounds in fresh and fresh-cut fruit and vegetables (FFVs) is essential for the characteristic flavour of the produce and this has a direct influence on consumer perception of freshness and purchase decision (Kader, 2008; Belitz et al., 2009). In various types of FFVs, the class of volatiles representing characteristic flavour include alcohols, aldehydes, terpenes, esters and their derivatives (Bicas et al., 2011). Flavour quality is described based on the class of volatile compounds or combinations with the highest concentration/odour threshold that contributes to the global aroma of a given produce (Alonso et al., 2009; Belitz et al., 2009; Caleb et al., 2013a). In some type of produce, a single class of volatiles, often referred to as the "impact compound", could reflect the global flavour of the product (Bicas et al., 2011). Hence, understanding the flavour life of each type of fruit or vegetable is essential towards maintaining or enhancing unique sensory quality attributes. Fig. 1 summarizes the different factors that could influence the flavour development and defect in fresh and fresh-cut (FC) produce.

The flavour composition and volatile constituents of different exotic fruits have been described such as Brazilian cherry, acerola, jackfruit and starfruit (Bicas et al., 2011), and other tropical fruits (Maróstica and Pastore, 2007). During the last decade, there has been a drastic increase in global production and consumption of pomegranates, due mainly to the reported health benefits and enriched bioactive phytochemicals of this fruit (Caleb et al., 2012; Opara et al., 2009). Understanding the impacts of preharvest and postharvest management practices on flavour and consumer acceptability is important in future growth of this market.

Research on aroma and flavour of pomegranate fruit has focused on the identification of unique volatiles produced by fully ripened whole fruit (Calín-Sánchez et al., 2011; Melgarejo et al., 2011; Mayuoni-Kirshinbaum et al., 2012; Fawole and Opara, 2013b). Using headspace solid-phase micro-extraction (HS-SPME) and gas chromatography–mass spectrometry (GC–MS) techniques Calín-Sánchez et al. (2011) and Melgarejo et al. (2011) identified 18 and 21 VOCs, respectively, in juice of nine different Spanish pomegranate cultivars. The effects of modified atmosphere packaging (MAP) and storage temperature on composition of VOCs in minimally processed pomegranate arils (cv. 'Acco' and 'Herskawitz') were investigated by Caleb et al. (2013a). The authors identified a total of 17 and 18 VOCs in the headspace of pomegranate juice of cv. 'Acco' and 'Herskawitz', respectively. Mayuoni-Kirshinbaum and Porat (2014) provided a detailed recent review on the sensory quality and biochemical compounds associated with flavour attributes of pomegranate arils; however, this article did not discuss the role of preharvest and postharvest factors on the development of flavour attributes in pomegranate fruit. Similarly, Mphahlele et al. (2014)

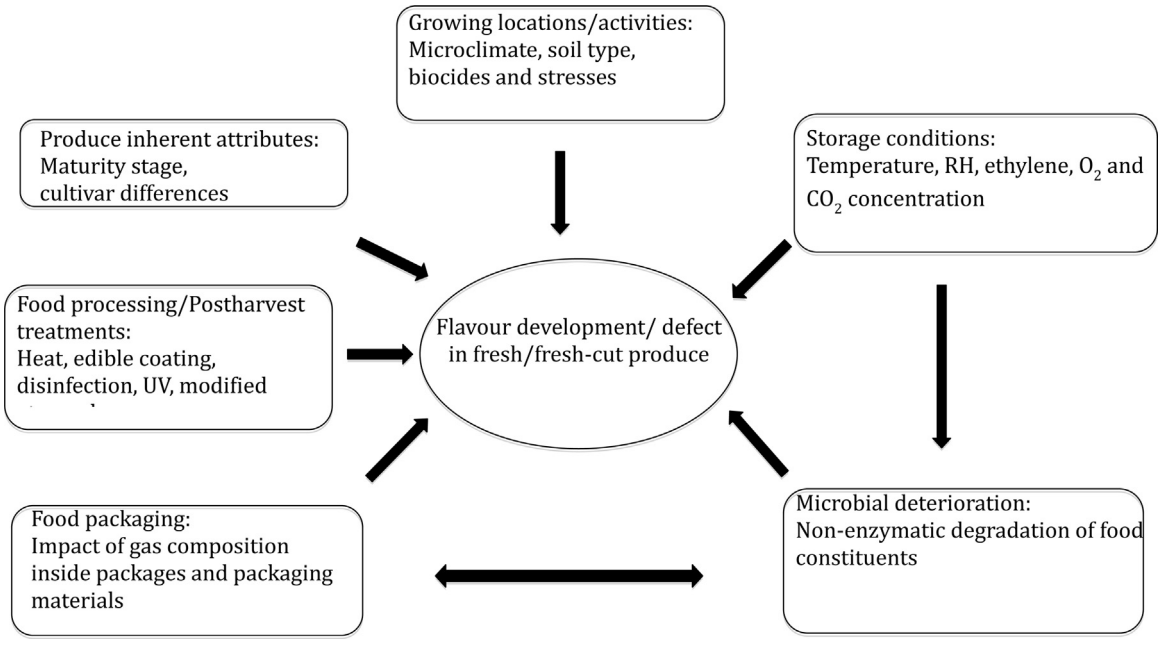

Fig. 1. Factors influencing the successful development/defect of flavour quality in fresh/fresh-cut fruit and vegetables.