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Harvest time impacts the fatty acid compositions, phenolic compounds and sensory attributes of Frantoio and Manzanilla olive oil

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ABSTRACT

The effect of harvest time at different ripening stages of fruit influences quality of olive oil. Therefore, the current investigations were conducted during 2013 and 2014 to explore the effects of five different harvesting times (mid- and late-April, mid- and late-May and mid-June) on chemical and sensory attributes of Frantoio and Manzanilla olive oil. The fatty acids of olive oil showed significant increase (palmitic acid, stearic acid, linoleic acid and PUFA) or decrease (oleic acid, MUFA, and MUFA:PUFA ratio) with the delay in harvesting irrespective of the cultivars. A significant gradual decrease was noted in major polyphenol compounds from the first to the fifth harvest. The concentration of phenolic compounds was comparatively higher in the fruit harvested in 2014. The sensory attributes of oil in both cultivars deteriorated with the delay of harvesting, with water stress possibly influencing the bitterness of the fruit in 2014. The harvesting in early part of winter under Mediterranean climate produced olive oil with better chemical and sensory attributes. Higher concentrations of phenolic compounds were observed in 2014 with less rainfall; however, the trend of declining concentration on phenolics from the first to the fifth harvest was comparatively prominent in 2014 than 2013.

1. Introduction

Olive oil consists of fatty acids that contain 16–18 carbon atoms with a carboxyl group (COOH) at one end. The major fatty acid in the olive oil is oleic acid, which is monounsaturated, accounts for 55%–83% of total fatty acids (Beltran, 2000). In addition, olive oil provides many micro-nutrients including vitamin E and beta-carotene. Intake of olive oil reduces harmful cholesterol low density lipoprotein (LDL) without reduction in beneficial high-density lipoprotein (HDL) cholesterol (Psaltopoulou et al., 2004).

Extra virgin olive oil contains numerous phenolic antioxidants which are potent inhibitors of oxidation that reduce cancer risk (Owen et al., 2000). Furthermore, the o-diphenol family is identified as the major source contributing to the overall antioxidant activity and sensorial properties of extra virgin olive oils (Lavelli, 2002). The total phenolic compounds in olive oil ranges between 50–1000 mg L^{-1}. The concentration and antioxidant activity of phenolic compounds in virgin olive oil is significantly affected by numerous factors such as cultivar, fruit maturity stage, location, soil, irrigation systems; environmental factors and production process (Dabbou et al., 2015; El Sohaimy et al., 2016; Köseoğlu et al., 2016).

Quality indices and fatty acid composition are significantly affected by olive fruit maturity (Dabbou et al., 2011; Dabbou et al., 2015; El Sohaimy et al., 2016; Köseoğlu et al., 2016). Maximum oil content is reported to occur between 60^{th} to 75^{th} days after the start of the ripening process (Camposeo et al., 2013). Reduction in various parameters such as peroxide value, pigments, sensory scores, oleic acid and total sterols; and increase in the free acidity and linoleic acid were observed during ripening of fruit of cv. Cornicabra (Salvador et al., 2001).

Australian olive oil from major cultivars does not comply with all the international standards in some cases (Mailer et al., 2010). Some sporadic and inconclusive research work describing the impact of different harvesting times on oil content has been reported from New South Wales (NSW), Australia. Oil content in olive fruit increases with advancement of fruit maturity and also affect total polyphenols,

Abbreviations: cv, cultivar; HDL, high density lipoprotein; LDL, low density lipoprotein; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; WA, Western Australia; NSW, New South Wales

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Table 1
Harvest times and corresponding fruit ripening indices of 'Frantoio' and 'Manzanillo' olives during 2013 and 2014.

Year		Harvest date	Ripening Index	
			Frantoio	Manzanillo
2013	First (H1)	17th April	2.33	3.42
	Second (H2)	30th April	2.79	3.62
	Third (H3)	14th May	3.13	3.79
	Fourth (H4)	28th May	3.35	4.15
	Fifth (H5)	11th June	3.69	4.62
2014	First (H1)	15th April	2.42	3.51
	Second (H2)	29th April	2.94	3.88
	Third (H3)	13th May	3.17	4.14
	Fourth (H4)	29th May	3.43	4.39
	Fifth (H5)	12th June	3.82	4.87

chlorophyll concentration, palmitic acid and linoleic acid in olive oil depending upon a cultivar, cultivation year and harvesting time (Ayton et al., 2007; Zeleke et al., 2012). Qualitative effects of harvesting time on polyphenol profile in olives grown in NSW conditions were also reported by Obied et al. (2008). Although, the effects of different harvest times on olive oil quality have been reported earlier by other researchers, yet to be confirmed in south Western Australia. As a prelude, growing olives at different locations around the Mediterranean influence olive fruit and oil quality. Recently, Alowaiesh et al. (2016) reported that harvest time affects fruit removal force, oil content, free fatty acids and peroxide in the oil of Frantoio and Manzanilla olive cultivars grown in Western Australia (WA). There is a little information available on chemical composition and properties of the olives and extracted oil according to the ripening stages of the fruit grown under south-western Australian conditions. Therefore, the effects of harvest time at various fruit ripening stages on the changes in the level of different fatty acids, total and individual polyphenols and sensory attributes such as fruitiness, bitterness and pungency of olive oil in cvs. Frantoio and Manzanilla were investigated.

2. Materials and methods

2.1. Location and plant material

The experiments were conducted for two consecutive years at York

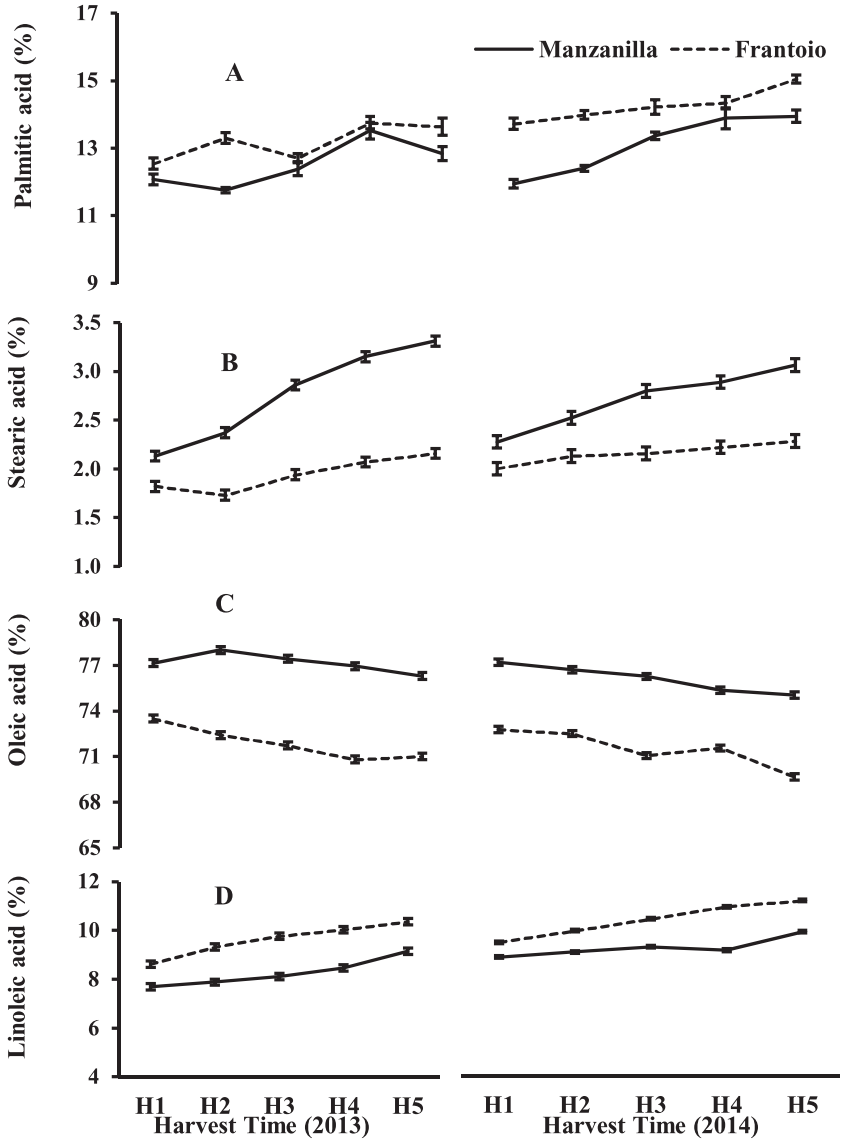

Fig. 1. Effects of different harvest time on the level (%) of palmitic acid (C 16:0) (A), stearic acid (C 18:0) (B), oleic acid (C18:1) (C) and linoleic acid (C18:2) (D) in the virgin olive oil of cvs. Frantoio and Manzanilla olives during 2013 and 2014. Vertical bars represent LSD ($P \leq 0.05$).