



## Enzyme activity and biochemical changes of three date palm cultivars with different softening pattern during ripening

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### ABSTRACT

The physicochemical composition changes during palm ripening were studied. The activities of invertase and cell wall-modifying enzymes, namely pectin methylesterase (PME),  $\beta$ -galactosidase ( $\beta$ -Gal), endo-1,4- $\beta$ -D-glucanase (EGase), and cellulase were monitored during growth and ripening of Shahani, Piarom and Deiry cultivars with different textures. Also, we estimated the concentrations of six organic acids by HPLC. Reducing sugars, most of organic acid, pH and TSS increased up to the full-ripe stage of all date types. On the contrary, moisture, macro and microelements and proteins decreased during the same period. Despite a considerable rise in invertase activity (200 units) during ripening of Shahani, no significant trend could be discerned in Deiry cultivar (8 units) at different stages. Our results also showed that cell wall enzymes were increased in activity during ripening and these increases were coincident with fruit softening. Furthermore, our results showed that the composition and the variation of the chemical compositions mainly depended on the cultivar and maturity stage.

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### 1. Introduction

Although Iran with an annual production of more than 1,000,000 tonnes (15% of total world production) is the second largest producer of dates in the world, little is known concerning the composition of different varieties and the physicochemical changes of fruit during development. The fruit of most date palm cultivars passes through five distinct stages of development and ripening. These stages are designated by Arabic terms and used universally. Hababouk, kimri, khalal, rutab and tamar are used to represent, respectively, the cell division, cell elongation or the immature green, the mature firm full coloured the soft brown and the hard raisin-like stages of date palm development. Generally, whole dates are harvested and marketed at three stages of their development mainly khalal, rutab and tamar depending on cultivar characteristics, especially soluble tannin level, climatological conditions and market demand (Awad, Adel, Al-Qurashi, & Mohamed, 2011). Date cultivars are classified on the basis of the texture of the ripe fruit into three generally accepted categories a soft, semi-dry and dry types. These categories are generally, but not exclusively, associated with particular moisture and sucrose contents. Soft dates usually possess moisture content in excess of 30% and no sucrose. Semi-dry types have moisture content of

between 20% and 30% and a higher sucrose level, whilst dry varieties contain less than 20% moisture and approximately equal quantities of sucrose and reducing sugars. Shahani, Piarom and Deiry are soft, semi-dry and dry date palm, respectively. These types are well known because of their common preference, popularity and price.

Fruit softening is a major factor that determines fruit quality and is thought to be the result of cell wall degradation by enzymes. It is generally accepted that the degradation of the polysaccharide components of the cell wall and reduction of cell to cell adhesion, as a result of middle lamella degradation, are the main factors causing softening of the fruit. Different researches have been performed on the activities of the cell wall degrading enzymes in some fruits, such as polygalacturonase (PG) in tomato and avocado (Huber & O'Donoghue, 1993) and cellulase or glucanase in avocado (Awad & Young, 1979), and xylanase in papaya (Chen & Paull, 2003).

Most of the research work on date palm is mainly concerned with changes in physical and chemical parameters during development and ripening related to the marketing quality of fruit. Al-Hooti, Sidhu, and Qabazard (1995) reported that on maturity from kimri to tamar stage sugar content increased, but moisture, crude protein, ash, tannins and pectin decreased.

Sugars in date flesh mainly consist of fructose, glucose and sucrose. They are found as predominant sugars in dates from different cultivars at maturation, but with significant differences in proportions between the cultivars. The majority of date cultivars

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