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# POMOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF FIG (FICUS CARICA L.) CV. ZIDI IN DIFFERENT AGRO-ECOLOGICAL ZONES OF TUNISIA

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Fig tree (*Ficus carica* L.) is one of the well adapted species to arid and semi-arid conditions. Its cultivation in Tunisia is traditional and local cultivars are numerous. The cultivar *Zidi* (Smyrna type) with absolute need of caprification is well spread in the country for its high commercial value and gustatory good quality which is appreciated by the consumer. This study was focused on the pomological and biochemical characterization of fig cv *Zidi* in various agro-ecological zones of Tunisia (south-east, center-east, north-east and north-west). Results showed significant differences for the studied parameters (fruit size, fruit shape, flesh thickness, ostiole width, total soluble solids) in different cultivation areas. The big size (96.4 g) and large flesh thickness (22.5 mm) of fruits were obtained in north-west (Djebba region); whereas the best taste of fruit was noticed in north-east (Mhamdia region) with a high sugar rate of 19°Brix and an average acidity of 0.18%. These differences reflect large agro-ecological adaptation in cv. Zidi that may be due to intra-varietal genetic variations which necessitate molecular studies in future.
**Keywords**: Fig, *Ficus carica*, Zidi, fruit quality, tunisia

## INTRODUCTION

Fig (*Ficus carica* L.) is among the oldest fruit trees and is known from ancient times. Today, it is an important fruit crop cultivated around the world in subtropical and tropical regions and to some extent in moderate climatic regions of the temperate zones (Aksoy, 1998). In Tunisia, fig tree is widely spread, it is found in the north, the center and in the south of the country. Actually, we have counted more than 2.5 million trees occupying about 33,800 ha. The total annual production is about 27,000 MT (Anonymous, 2010). Figs are mainly consumed as fresh fruits. A small portion is sun dried and little quantities are used for jam and alcoholic beverage production (Mars *et al.*, 2008). Tunisian fig cultivars are numerous and well adapted to local agro-ecological conditions (Mars *et al.*, 2009). Some are of the Common type (parthenocarpic) that produce figs without caprification (pollination). Many others are of Smyrna type that need caprification (Mars *et al.*, 1998). Not all the fig types are equally represented in orchards. Mars (2003) indicated that cultivars of Smyrna type were dominant in south Tunisia, while in the north, cultivars of Common type were equally represented. The utilization of fig germplasm consists of many ecotypes selected either for their fruit traits or their high adaptative potentialities (Mars *et al.*, 2008). The cultivar *Zidi* (Smyrna type) has a large geographical distribution in the country and it is known for its high commercial value and best fruit taste for fresh consumption. The fruit is recognized to be very rich on sugars, most important criterion of quality in figs, compared to many other local fig cultivars (Trad *et al.*, 2012). Present study was designed to evaluate the role of different agro-ecological zones on fruit quality of cv *Zidi* grown in Tunisia.

## MATERIALS AND METHODS

Four major fig production zones located in Tunisia: Tataouine (south-east), Monastir (center-east), Mhamdia (north-east) and Djebba (north-west) (Figure 1) were selected for the present study. Agricultural practices including pruning, irrigation, fertilization and spraying against pests and diseases were done according to standard practices in the area. Two experimental orchards per zone and three adult trees of cv. *Zidi* per orchard were selected. The trees studied were caprified normally to ensure the main crop figs. Observations were made in order to evaluate the quality of fruits collected from these zones. During the harvesting period, morphological measurements and chemical analysis carried out on samples of 20 mature fruits regarding: fruit weight (g), length (mm) and diameter (mm), shape, external color, neck length (mm), ostiole width (mm) and type, skin cracks, internal color, skin thickness (mm), flesh thickness (mm), fruit cavity, total soluble solids TSS (°Brix), pH and titrable acidity (citric acid %). Each fruit shape form received a mark: A (1), B (2), C (3)… J (10). Skin (external) color was determined using the following scale: dark green (1), green (2), light green (3), light yellow (4), greenish brown (5), brown (6), purplish black (7) and

black (8). Another scale ranging from white (1) to dark red (10) was used for internal color. Ostiole types were: closed (1), mid-open (2) and open (3). Skin cracks were evaluated as follows: checked skin (1), scarce cracks (2), minute cracks (3) and not cracked at all (4). Fruit cavity was: very small (3), small (5), medium (7) and large (9) (IPGRI and CIHEAM, 2003). Total soluble solids were determined with a digital refractometer PR-101 ATAGO, Norfolk, VA. Titrable acidity was determined by titrating fig juice with 0.1 M NaOH.

Data were expressed as mean of two harvesting season crops and were subjected to analysis of variance (one way ANOVA) of Statistical Package for the Social Sciences (SPSS) version 13.0. The mean values were compared using Duncan's multiple range test ($P \leq 0.05$).

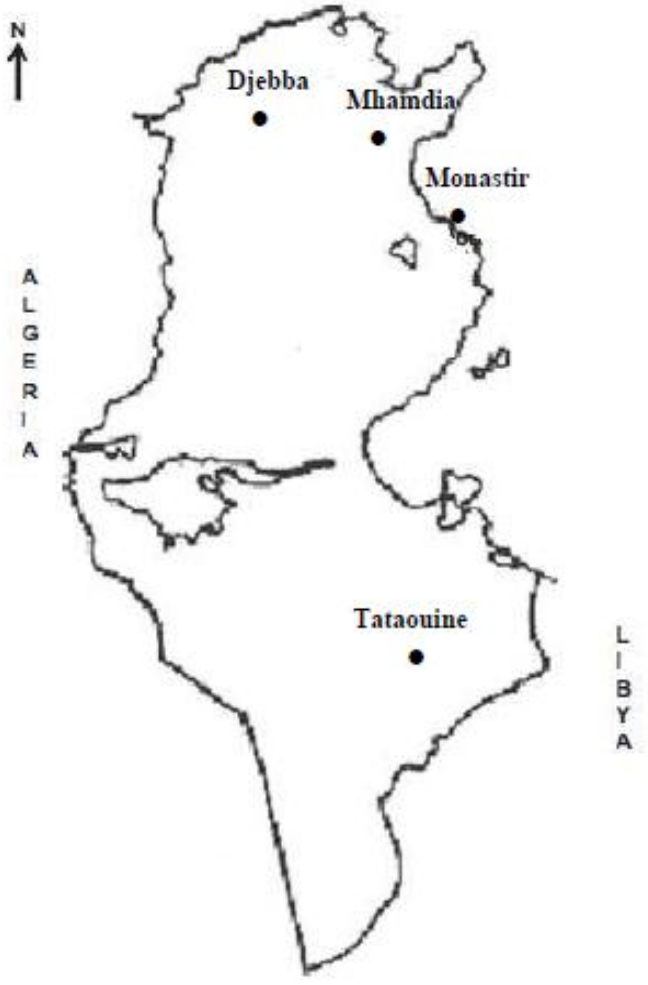


**Figure 1. Geographical localization of the prospected areas**

## RESULTS AND DISCUSSION

Most of the parameters of fruit quality studied were affected significantly ($P \leq 0.01$) by the cultivation area except for external color, skin cracks, skin thickness and pH (Tables 1 and 2). Mean fruit weight varied between 56.1 g (center-east, region of Monastir) and 94.6 g (north-west, region of Djebba). Fruit shortest length was recorded at 42.4 mm and the tallest at 60.2 mm in the center-east and north-west, respectively. Fruit diameter ranged between 47.4 mm (north-east, region of Mhamdia) and 60.5 mm (north-west) (Table 1). Results obtained on fruit dimensions are in agreement with some previous studies (Bostan *et al.*, 1998; Karadeniz, 2008). With respect to neck length, *Zidi* fruit from Tataouine and Mhamdia regions had the highest values. Short neck length is not a desirable characteristic in terms of harvest, because damages may occur due to difficulties in harvest (Ozeker and Isfendiyaroglu, 1998). Ostiole width ranged between 5.9 mm (south-east) and 12.7 mm (north-west) (Table 1) and it was narrower or similar than values reported in other studies (Aksoy *et al.*, 2003; Messaoudi and Boughida, 2008) and the smaller the ostiole width is, the better is the fruit stored and preserved from infectious agent (Michailides *et al.*, 2008). It is important to note that a large ostiole on the fig is an undesirable characteristic as pests and pathogens enter the fruit. Fruit shape differed among the localities and varied from oblate (north-west) to pyriform (south-east) (Table 2). Aksoy *et al.* (2003) indicated that fruit shape index is of great importance in packaging and transportation. Fruit internal color changed from rosy (region of Mhamdia) to dark-red (region of Djebba). Fruit internal cavity varied from small (Monastir) to large (Djebba) (Table 2). Flesh thickness ranged between 15 mm (Monastir) and 22.5 mm (Djebba). For the total soluble solids, the lowest value was recorded in Tataouine (12.5°Brix), whereas the highest value was observed in Mhamdia (19°Brix). The most acidic fruit (0.27 %) were recorded in the north-west while the fruit obtained from the south-east were least acidic (0.15 %) (Table 1). These results are in accordance with other reports (Küden *et al.*, 2008; Messaoudi and Haddadi, 2008; Crisosto *et al.*, 2010).

Fig cultivation in Tunisia has an old history and has a promising future. Superior quality figs for the same genotype change from one region to another. Figs are first appreciated for their size, lucid colour and sweetness. *Zidi* fig's quality is enormously depending on agro-ecological conditions. The organoleptic fruit quality is crucial to meet consumer requirements. However the market context of these last decades privileged quality criteria having a strong impact on the market value: fruit size, visual aspect and storage potential of fruits (Plénet *et al.*, 2010). Results of the present investigation can help fig breeders and growers to decide about most suitable fig genotypes for every

**Table 1. Quantitative parameters of fruit quality of cv. *Zidi* in the different localities**

| Localities | Fruit characteristics | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Fruit weight (g)** | **Fruit length (mm)** | **Fruit diameter (mm)** | **Neck length (mm)** | **Ostiole width (mm)** | **Skin thickness (mm)** | **Flesh thickness (mm)** | **TSS (°Brix)** | **pH** | **Titrable acidity (%)** |
| South-east (Tataouine) | 67.7b | 58.0a | 49.6b | 11.3a | 5.9c | 1.90 | 17.7c | 12.5b | 5.0 | 0.15d |
| Center-east (Monastir) | 56.1d | 42.4b | 51.2b | 3.6c | 6.4c | 1.73 | 15.0d | 14.3b | 4.9 | 0.22b |
| North-east (Mhamdia) | 62.0c | 56.5a | 47.4b | 9.5b | 11.0b | 1.82 | 20.2b | 19.0a | 5.0 | 0.18c |
| North-west (Djebba) | 96.4a | 60.2a | 60.5a | 5.3c | 12.7a | 1.77 | 22.5a | 13.2b | 4.8 | 0.27a |
| *F-value* | 88.8** | 22.3** | 13.0** | 38.5** | 48.8** | 0.26NS | 16.9** | 25.3** | 0.32NS | 30.4** |

*Mean in each column followed by the same letters are not significantly different at P < 0.05 according to Duncan's multiple range test.* Significant at P < 0.05; ** Significant at P < 0.01; NS: non significant.*

**Table 2. Qualitative parameters of fruit quality of cv *Zidi* in the different localities.**

| Localities | Fruit characteristics | | | | | |
|---|---|---|---|---|---|---|
| | **Ostiole type** | **Fruit shape** | **External color** | **Skin cracks** | **Internal color** | **Fruit cavity** |
| South-east (Tataouine) | 2.1bc | 7.2a | 7.7 | 3.9 | 9.0ab | 7.9a |
| Center-east (Monastir) | 1.8c | 6.8a | 7.6 | 3.8 | 8.4b | 5.2b |
| North-east (Mhamdia) | 3.0a | 4.1b | 7.6 | 4.0 | 7.0c | 8.0a |
| North-west (Djebba) | 2.6ab | 3.8b | 7.5 | 4.0 | 9.8a | 8.8a |
| *F-value* | 6.68** | 15.7** | 0.06NS | 1.3NS | 11.4** | 17.5** |

*Mean in each column followed by the same letters are not significantly different at P < 0.05 according to Duncan's multiple range test.* Significant at P < 0.05; ** Significant at P < 0.01; NS: non significant.*

cultivation area while quality should be a prime target for plant breeders. In addition, present study also demonstrated that the fruit quality is highly dependent on agro-geographical cultivation areas. The best fruit size and quality of cv *Zidi* found in the north-west (region of Djebba) can be explained by the agricultural practices including tillage, irrigation and pruning. Whereas, the sweeter taste registered in the north-east (region of Mhamdia) may be attributed to caprification adequate technique (Gaaliche *et al.*, 2011) and fertilization. The quality in these regions is dependent on cultural operations and better pollination. By contrast, in the center-east fig trees are mainly cultivated in rain-fed conditions and little cultural practices are made, which influenced the quality of figs *Zidi*. The quality in this region is affected by shortage of water and poor cultural operations.

***Conclusion*:** We finally highlighted that these differences in terms of fruit quality for cv *Zidi* observed between the different areas reflect a large agro-ecological adaptation of this cultivar. They could be due to the intra-varietal genetic variations and climatic conditions between distinct growing areas. Molecular marker studies are required to complete this study for better characterizing this cultivar. Such studies may be undertaken for many other cultivars in order to define those well adapted to specific groves and environment of Tunisian rural areas.

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