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PHYSICOCHEMICAL PROPERTIES OF TOW MANGO CULTIVARS EWAIS AND ZEBDA (*Mangifera indica* L.) IN EGYPT

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ABSTRACT: This study was conducted at Ismailia Governorate, Egypt. The investigation aimed to evaluate physicochemical characteristics of two mango cultivars *i.e.*, Ewais and Zebda (*Mangifera indica* L.). Mango trees, 10 years old (planting distance 7 × 7 m) from each cultivar were selected to be nearly size and being in their off bearing. Leaves at different stages of growth and fruits were investigated. Results revealed that, Ewais leaves have phenolic compounds from 80.36 to 92.82 (mg/ gfw), Cytokinin from 3.60 to 4.41 (ng/gfw), gibberilic acid from 28.58 to 36.61 (µg/gfw), absisic acid from 8.44 to 9.5 (µg/gfw), total protein from 4.38 to 9.13(g/100 gdw), total free amino acids from 23.72 to 36.70 (m mol/100 gdw), total protein from 5.83 to 7.22 (µmol/gfw), total carbohydrate from 18.76 to 21.09 (g/100gdw), total chlorophyll from 1.55 to 2.11 (mg/gfw) and total carotenoid from 0.82 to 0.98 (mg/gfw). Enzymes activities (mmol/gfw) in Ewais leaves were as follow, catalase between 26.23 and 50.31, peroxidase between 1.23 and 2.80, polyphednol oxidase from 101 .29 to 106.62 and amylase from 7.13 to 8.1. These results dependant on growth stages and were superior for Zebda cultivar. Ewais cultivar has higher yield (yield/tree, kg) (92.82) than zebda (89.27). Fruits of Ewais have a higher performance parameters than fruits of Zebda.

Key words: Mango, ewais cultivar, phenolic compounds, protein, carbohydrates, growth regulators, enzymes.

INTRODUCTION

Mango (*Mangifera indica* L.) is belongs to genus *Mangifera* which consists of about 30 species of tropical fruiting trees in the flowering plant family Anacardiaceae. It is cultivated on an area of approximately 3.7 million ha worldwide and conquers the second position as a tropical crop, in terms of production (Tharanathan, 2006; Muchiri *et al.*, 2012). According to Kittiphoom (2012) and Parvez (2016) It's the most widely exploited fruits for food, juice, flavor and fragrance a common ingredient in new functional foods often called super fruits. Antioxidants and enzymes present in mango fruits are believed to play an important role in prevention and in protection of cancer (colon, breast, leukemia and prostate) and heart disease, as revealed by Mathew (1983), Hamdard *et al.* (2004) and Bowden (2007)

Mango is tropical/sub-tropical fruit with a highly significant economic importance, because fruit is rich in antioxidants and recommended to be included in the daily diet due to its health benefits such as reduced risk of cardiac disease, anti-cancer, and anti-viral activities, as reported before by Sivakumar *et al.* (2011).

Mango fruit contains different classes of phytochemicals such as polyphenols, ascorbic acid and carotenoids, revealing health promoting properties mainly due to their antioxidant properties as reported by Talcott (2005) and Kumar *et al.* (2014) who also revealed that the environmental factors played very effective role to induce flowering and fruiting. Shaaban and

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Shaaban (2012) illustrated that mango cultivar Zebda had higher tolerate characteristics against unfavorable soil conditions and nutrient deficiencies than Ewais., But Sayed (2015) revealed that physiological and biochemical changes were significantly differed according tested cultivars and sampling time, he added that more effected parameters in dry leaves were Na^{+1}, K^{+1}, total phosphate, Ca^{+2}, N, TSS, TSAA, protein and proline content, in this respect Ewais more tolerate than Zebda. Benjawan *et al.* (2006) and Shaban (2009) reported that foliar application, with growth regulator, on mango tree cultivars improved vegetative growth, length of panicle, fruit set, fruit retention and yield. Abou-Ellail *et al.* (2014) stated that quantification of chlorophyll and carotenoids was important as intriguing tool that can reveal information on plant performance and cultivars relationship. Also they revealed that Ewais cultivar had more content of total soluble carbohydrates (58.5±2.45 µg/100 mg), total chlorophyll (273.2 ± 21.2 µg/g) and total carotenoids (40.9 ± 3.5 µg/g) than those of Zebda cultivar (37.2 ± 3.39 µg/100 mg, 272.9 ± 18.7 µg/g and 30.9 ± 1.51 µg/g, respectively). El-Khawaga and Maklad (2013) stated that, number of panicles/tree of Ewais and Zebda mango cultivars in two seasons were (350,311); (381,396), number of flowers/ panicle (3100,3200); (1500,1700), perfect flower (%) (14,14.5%); (8.5,8.0%), initial fruit setting (0.75%, 0.74%); (3.00%, 3.25%), fruit weight (160,171g); (300,330g). TSS% (22,22%); (14,14.5%); total acidity (%) (0.34,0.35); (0.373, 0.379%), total sugar (%) (8.2,8.4); (4.7,4.6), vitamin C. (mg/100 g.juice) (50.0,51.0); (29.0, 30.0) in respective order. El-Sheshetawy *et al.* (2016) studied physical and chemical properties of Ewais and Zebda cultivars and they detected that the average fruit weight (246.6,338..4 g), fruit length (10.55, 11.95 cm), maximum fruit width (6.84,7.70 cm), minimum width (6.06,6.994 cm), firmness (24.97, 23.80 N), TSS (23.67, 17.33 Brix), total acidity (0,19,0,46%) and TSS/total acidity ratio (124.58,37.67), total phenolic compound (20.95, 26.59 g/100g), fruit elements as ppm Fe (9.20, 0,98), Cu (0.41,0.32), K (313.9,212.8), P (30,10) taste sweet (9.1,5.6), and sour (0.0,3.3), respectively. Masibo and He (2008) revealed that polyphenolic compounds contents in mango fruits correlated with mango-parts (pulp, peel, seed, bark, leaf and flower). They also, revealed that phenolic compounds protected human cell against oxidative stress. Abdualrahman (2013) observed that, mango fruit total carbohydrate ranged from 14.1±0.01 to 15.5 ± 0.01%, TSS from 67% to 66.8%, total sugars from 12.8% to 12.3%, reducing sugars from 4.8% to 4.5%, titratable acidity from 0.37% to 0.34%. Also Ara *et al.* (2014) reported that mango fruit total sugars ranged between 4.72% to 5.48%, reducing sugar ranged from 4.61% to 3.04%. vitamin C ranged between 46.53 mg/100 g and 26.53 mg/100g, potassium ranged from 10.29 mg/100 g and 64.04 mg/100 g and calcium ranged between 6.54 mg/100g and 30.56 mg/100 g. These bio-parameters were depended on mango verity. Ellong *et al.* (2015) revealed that firmness, taste, and pH properties correlated with mango varity, as well as starch, carbohydrates fractions, carotenoids, phenolic compounds, vitamins C and E contents. Wongmetha *et al.* (2015) stated that sucrose metabolism and starch storage in mango were depended on growth stage, development in mango fruits, decrease activity of sucrose phosphate syntheses, acid invartase (AI) and neutral invartase (NI). Faria *et al.* (2016) revealed that the content of N, P, K, Ca, Mg, S, B, Cu, Fe, Mn, Zn and Na concentration in mango leaves as well as total chlorophyll, contents of a and b were depended on treatment strategies, growth stages and time of sampling.

This study was carried out at El-Kassasin, Ismailia Governorate, Egypt to compare physiological and biochemical properties between two mango cultivars *i.e.,* Ewais and Zebda.

MATERIALS AND METHODS

The present investigation has been carried out during 2014/2015 and 2015/2016 seasons on mature Ewais and Zebda trees (*Mangifera indica* L.) grown in privet orchard at El-Kassasin, Ismailia Governorate, Egypt. The tow cultivars were grown in sandy soil and the trees were under float irrigation system, the mean values of both two seasons results were taken.

Before the beginning of each experimental season (three replicates) 9 mature mango trees

10 years old (planting distance 7×7m) from each cultivar Ewais and Zebda were selected to be of nearly similar size and being in their off bearing year.

Experimental trees of both replicates from the same orchard, received a uniform orchard management practices concerning irrigation, soil fertilization, pruning, pest and weed control following the usual management program as recommended by Ministry of Agriculture in Egypt.

Panicle Characteristics

Number of each healthy and malformed panicles per tree as well as malformation percent were determined as follow :

$$\text{Malformation (\%)} = \frac{\text{No. of malformed panicles/tree}}{\text{Total No. of panicles/tree}} \times 100$$

Length of panicles (cm) were measured using 24 detached panicles per tree (by random). The measurements were carried out for both healthy and malformed panicles.

Sex expression the same detached panicles were used to count total number of flowers, number of mal and perfect flowers for each panicle as follow :

$$\text{The sex ratio was then calculated} = \frac{\text{No. of male flowers/panicle}}{\text{No. of perfect flowers/panicle}}$$

Fruit set was determined by labeled 24 healthy panicles on trees of each replicate. The numbers of set fruitlets were first counted on each labeled panicle at first fruit set, and calculated for each replicate as follow:

$$\text{Fruit set (\%)} = \frac{\text{No. of fruit set/panicle}}{\text{No. of total flowers/panicle}} \times 100$$

Yield and Fruit Quality

The total number of fruits/tree and average weight of fruit at each replicate were recorded. Then the yield/tree was calculated as follow:

Yield/tree=No. of fruits /tree × average weight /fruit

Fruit characteristics

Samples of 15 mature fruits per tree were randomly taken and kept in laboratory till the ripe stage. The following physical and chemical properties were determined and fruit dimensions, length, and diameter (cm) were measured also, the pulp juice was obtained using a blender for physio-chemical analyses.

Determination of physico-chemical parameters

Total soluble solids (TSS) percentage was determined using a hand refractometer according to. Gofur *et al*. (1998)

Juice acidity

(as citric acid g/100 ml juice) was determined according to AOAC (1980).

Ascorbic acid (Vitam. C) content, was determined as mg/100g of fresh juice using 2, 6-dichlorophenolindophenol according to Bessey and King (1933) and Mahadevan (1982).

Carbohydrate fractions determination

a- Total carbohydrates were determined according to Cherry (1973).

b- Total soluble sugars

1- Total reducing sugar contents were determined according to Miller (1959).

2- Total non-reducing sugars were determined as follow :

non-reducing sugars = total soluble sugars- total reducing sugars

C- Total of non-soluble sugars: were determined as follow:

Non-soluble sugars = Total of carbohydrates - Total soluble sugars

Leaves

Samples of leaves were taken from the middle position of the tagged leaves starting from the third leaf from each replicate of treatment at three times every season at different stages, *i.e.,* full blooming stage and fruit set stage, each sample comprised 36 leaves. The samples were cut into small pieces, then weighed, crushed with 80% methyl alcohol at 0˚C in a porcelain mortar and extracted for 72 hours as described by Daniel and George (1972).

Carbohydrate Fractions Determination

Total carbohydrate was estimated calorimetrically by the Nelson´s reagent as reported by Cherry (1973).

The concentration of both total soluble sugars, and reducing sugars, were determined according to Miller (1959).

Total non-reducing sugars were determined as follow:

Non-reducing sugars = total soluble sugars- total reducing sugars

Total of non-soluble sugars were determined as follow:

Non-soluble sugars= Total of carbohydrates - Total soluble sugars

Determination of leaves total nitrogen

Total nitrogen was determined using the MicroKheldahl method as described by Bremner and Mulvaney (1982).

Determination of Protein Fractions

Total protein

Total protein was calculated by multiplying the total nitrogen by 6.25 (leaves) according to AOAC (1985).

Total soluble protein

The method adapted by Lowry *et al.* (1951) was applied.

Total non-soluble protein

The non-soluble protein was calculated by subtracting the amount of soluble protein from the total protein contents.

Determination of Total Free Amino Acid Content

The total of free amino acid was determined colorimetrically according to Nassar and El-Abbassi (1973).

Determination of free proline

Free proline was determined according to Bates *et al.* (1973).

Determination of total phenolic compounds

Total phenolic compound, in mango leaves and fruits was estimated by the method proposed by Malic and Singh (1980).

Determination of enzyme activities

Polyphenol oxidase activity

Was determined according to the method of Bauer *et al.* (1980) and Zoecklein *et al.* (1999).

Catalase activity (CAT)

Catalase activity was assayed using the method of Luck (1974).

Peroxidase (POD) activity

The method proposed by Reddy *et al.* (1995) was adopted for assaying the activity of peroxidase.

α-Amylase activity

Was determined according to OCME (1995).

Determination of growth regulators

The growth regulators, such as, Abscisic acid, Gibberellic acid and Cytokinin were determined as follow:

Abscisic acid (ABA) determination

Abscisic acid (ABA) was determined according to method which was modified by Campbell *et al.* (2008).

Cytokinin determination

Cytokinin was determined according to Hussain and Hasnain (2009) and Palet *et al.* (2012).

Gibberellic acid (GA3) content

Was determined according to Takahashi *et al.* (1991) and Deno (1993).

Determination of leaves phosphorus, potassium and calcium content

Such elements were determined using method as described by John (1970) but potassium and calcium were determined by using Flame photometer according to Murthy and Rhea (1967).

Determination of leaves elements

Cupper, Iron, zinc, boron were determined using method of AOAC (1990).

Determination of photosynthetic pigments

The photosynthetic pigments were extracted from fresh leaves using 85% acetone solution

according to Fadeel,s method (1962). The optical densities were measured spectrophotometrically using Pharamicia LKB Novasspec at 622, 644 and 440nm.

The pigments concentration were calculated using Wettstain,s formula (Wettstain, 1957).

Chlorophyll a (mg/l) = 9.784 × E662 – 0.99 × E644

Chlorophyll b (mg/l)=21.426 × E644– 4.65 × E662

Carotenoids (mg/l) = 4.695 × E440 – 0.268 (Chlorophyll a+b)

Where:

E = optical density at the wavelength indicated.

The concentration of pigments was then expressed in mg/g fresh weight of leaves according to the following formula; mg/g = (mg/l × dilution) / (sample weight × 1000)

Panel test

Was determined according to Alnagar (1996) and Akhtar *et al.* (2009)

RESULTS AND DISCUSSION

Table 1 stated status of biochemical compounds, growth regulators and enzyme activities in both studied mango varieties, Ewais and Zebda at different stages of growth (differentiation, full bloom and fruit set). It can be noticed that Zebda variety leaves had a higher content of phenolic compounds (95.75 ± 0.65, 117.44 ± 0.82 and 86.21 ± 1.00 mg/gfw) than Ewais variety leaves 92.82 ± I.9, 115.44 ± 0.88 and 80.63 ± 0.63 at three growth stages, respectively. This may be explain why Zebda considered, sometimes, more tolerate, than Ewais against some stress factors as reported by Shaaban and Shaaban (2012). In the opposite direction Ewais leaves were superior in its contents of growth regulators, cytokinin (3.65 ± 0.21, 3.60 ± 0.36 and 4.91 ± 0.36 ng/gfw), Gibberellic acid (36.81 ± 4.07, 28.58 ± 0.88 and 31.15 ± 0.89 mg/gfw), Abscisic acid (8.43 ± 0.30, 9.93 ± 0.30 and 9.5 ± 0.30 µg/gfw) whereas enzyme activities (n.mol/ gfw) were as follows, catalase (32.88 ± 1.03, 26.23 ± 1.03 and 50.31 ± 1.12), peroxidase (2.80 ± 0.12, 1.33 ± 0.01 and 2.58 ± 0.16), polyphenol oxidase (106.62 ± 0.0.69, 105.36 ± 0.71 and 101.29 ± 1.21), α-Amylase (8.1 ± 0.37, 7.39 ± 0.37 and 7.13 ± 0.57); Proteins fractions (g/100 gdw) were (6.57 ± 0.25, 4.38 ± 0.25 and 9.13 ± 0.97) for total protein. While soluble protein were (2.61 ± 0.28, 2.23 ± 0.20 and 4.65 ± 0.21), insoluble protein (3.97 ± 0.03, 2.15 ± 0.05 and 4.48 ± 0.77). Total free amino acids (n.mol/ 100 gdw), 23.72 ± 0.56, 28.68 ± 0.56, 36.70 ± 0.5 and proline acid (µmol/gfw) were 5.83 ± 0.25, 5.98 ± 0.25 and 7.22 ± 0.30 at different stages of growth. Growth regulators can be used to control reproductive and vegetative of growth, differentiation, full bloom and fruit set and fruit set percentage of Ewais mango (Chen, 1983; Davenport, 2007) mostly more tolerate than Zebda against unfavorable condition as respected by Sayed (2015). These results are in harmony with those reported by Benjawan *et al.* (2006) and Shaban (2009).

In respect to mango leaves carbohydrates fractions, chlorophyll fractions and carotenoids of two mangos varieties, Ewais and Zebda at different stages of growth, the results were illustrated in Table 2. These results showed that mostly, Ewais has a higher content of each of carbohydrate fractions, total carbohydrates (18.76 ± 0.50, 19.91 ± 0.45 and 21.42 ± 0.45 g/100 gdw), total soluble sugars (8.56 ± 0.56, 10.06 ± 0.31, 10.37 ± 0.56 g/100gdw), reducing sugar (4.99 ± 0.11, 7.79 ± 0.10, 5.75 ± 0.11 g/100 gdw); non-reducing sugar (3.62±0.45, 2.27 ± 0.21 and 4.62 ± 0.45 g/100 gdw). The chlorophyll fractions (mg/gfw) referred to, total chlorophyll (1.55 ± 0.12, 1.81 ± 0.08 and 2.11 ± 0.08), chlorophyll a (0.61 ± 0.10, 0.71 ± 0.09 and 0.86 ± 0.89); chlorophyll b (0.94 ± 0.02, 1.11 ± 0.17 and 1.26 ± 0.17). The carotenoid were (0.84 ± 0.02, 0.90 ± 0.02, 0.98 ± 0.02 mg/ gfw). While values of Zebda variety, were as follows for carbohydrate fractions were (g/100 gdw), total carbohydrates (16.45 ± 0.21, 17.56 ± 0.30, and 19.07 ± 0.30), total soluble sugars (5.56 ± 0.18, 9.37 ± 0.66 and 6.83 ± 0.10); reducing sugars (2.06 ± 0.05, 7.09 ± 0.36 and 2.92 ± 0.18); non-reducing sugars (2.96 ± 0.13, 2.49 ± 0.06 and 3.96 ± 0.13). Chlorophyll fraction (mg/gfw) gave the following values, total chlorophyll (1.45 ± 0.12, 1.45 ± 0.12, 1.75 ± 0.12); chlorophyll a (0.52 ± 1.2, 0.61 ± 0.87 and 0.62 ± 0.09); chlorophyll b (0.93 ± 0.03, 0.84 ± 0.03 and 0.99 ± 0.03). For carotenoids their values were (0.79 ± 0.07, 0.85 ± 0.26 and 0.93 ± 0.1). These results revealed that, Ewais variety contains high concentrations of

Table 1. Mean values of leaves phenolic compounds, growth regulators, enzyme activities, protein fractions, free amino acids and proline acid contents of Ewais and Zebda at different stages of growth (average of two seasons)

Cultivars	Phenolic compound mg/gfw	Cytokinin ng/gfw	Gibberelic acid mg/gfw	Abscisic acid µg/gfw	Catalase activity n.mol/gfw	Peroxidase activity n.mol/gfw	Polyphenol oxidase activity n.mol/gfw	α-amylase activity n.mol/gfw
Differentiation stage(D)								
Ewais	92.82±0.22	3.65±0.21	36.81±4.07	8.43±0.30	32.88±1.03	2.80±0.12	106.62±0.69	8.1±0.37
Zebda	95.75±0.65	2.08±0.24	24.54±0.73	6.23±0.35	29.98±1.78	0.76±0.26	37.85±10.65	4.24±0.53
Full bloom stage(FB)								
Ewais	115.31±0.70	3.60±0.36	28.58±0.88	9.93±0.30	26.23±1.03	1.23±0.01	105.36±0.71	7.39±0.37
Zebda	117.44±0.82	2.18±0.09	18.84±0.88	9.27±0.25	22.88±1.28	0.46±0.1	36.35±10.62	3.53±0.53
Fruit set stage(FS)								
Ewais	80.63±0.63	4.91±0.36	31.15±0.89	9.5±0.30	50.31±1.12	2.58±0.16	101.29±1.21	7.13±0.57
Zebda	86.21±1.00	3.46±0.11	21.35±0.88	7.34±0.35	17.68±2.55	0.6±0.01	33.1±7.06	3.27±0.72

Cultivars	Total protein g/100gdw	Soluble protein g/100gdw	Insoluble protein g/100gdw	Total free amino acid n.mol/100gdw	Proline acid µmol/gfw
Differentiation stage(D)					
Ewais	6.57±0.25	2.61±0.28	3.97±0.03	23.72±0.56	5.83±0.25
Zebda	5.96±0.20	2.16±0.11	3.80±0.09	21.16±1.07	5.19±0.11
Full bloom stage(FB)					
Ewais	4.38±0.25	2.23±0.20	2.15±0.05	28.68±0.56	5.98±0.25
Zebda	3.74±0.20	2.05±0.04	1.84±0.07	25.57±0.45	5.34±0.11
Fruit set stage(FS)					
Ewais	9.13±0.97	4.65±0.21	4.48±0.77	36.70±0.5	7.22±0.30
Zebda	6.58±0.48	4.37±0.28	2.23±0.21	31.12±1	6.44±0.11

Table 2. Mean values of leaves carbohydrate fractions, chlorophyll fractions, and carotenoid content of Ewais and Zebda at different stages of growth (average of two seasons)

Cultivar	Total carbohydrate g/100 gdw	Total insoluble sugar g/100 gdw	Total soluble sugar g/100 gdw	Reducing sugar g/100 gdw	Non-reducing sugar g/100 gdw	Total chlorophyll mg/gfw	Chlorophyll a mg/gfw	Chlorophyll b mg/gfw	Carotenoid mg/gfw
Differentiation stage (D)									
Ewais	18.76±0.5	10.20±0.06	8.56±0.56	4.99±0.11	3.62±0.45	1.55±0.12	0.61±0.10	0.94±0.02	0.84± 0.02
Zebda	16.45.±0.30	10.44±0.36	5.56±0.66	2.06±0.05	2.96±0.13	1.45±0.12	0.52±1.20	0.93±0.03	0.79±0.07
Full bloom stage (FB)									
Ewais	19.91±0.45	9.85±0.14	10.06±0.31	7.79±0.10	2.27±0.21	1.81±0.08	0.71±0.09	1.11±0.17	0.9±0.02
Zebda	17.56±0.30	8.19±0.26	9.37±0.66	7.09±0.36	2.49±0.06	1.45±0.12	0.61±0.87	0.84±0.03	0.85±0.26
Fruit set stage (FS)									
Ewais	21.42±0.45	10.76±0.43	10.37±0.56	5.75±0.11	4.62±0.45	2.11±0.08	0.86±0.89	1.26±0.17	0.98±0.02
Zebda	19.07±0.30	12.24±0.20	6.83±0.10	2.92±0.18	3.96±0.13	1.75±0.12	0.62±0.09	0.99±0.03	0.93±0.01

carbohydrates fractions, which considered osmotically-active compounds, therefor Ewais tree become further tolerate against drought and salinity stress as noticed before by Abosaif (2017). Also Ewais leaves contain high levels of carotenoids, which play an important role as antioxidant defense of plant as revealed before by Abou-Ellail *et al.* (2014). These results were in accordance with those stated by Sayed (2015).

Status of element content concentrations in leaves of two mangos varieties, Ewais and Zebda, at different stages of growth are demonstrated in Table 3. These results showed that mango Ewais leaves have, mostly, higher contents of determined elements than those of mango Zebda leaves. These cations have high osmotically active properties, therefore Ewais variety considered more tolerate than Zebda variety, specially, Cu and Fe which play an important role as antioxidants, as well as, have a pesticide effect against land snail and fungi (Saleh, 2016). Also, B, Ca and Zn cations considered metabolite regulators (Faria *et al.*, 2016).

Plant performance of two mango varieties, Ewais and Zebda was illustrated in Table 4, since it can be noticed that Ewais had higher performance (262.5 ± 3.5 panicle/tree, 34.18 ± 2.11 malformed panicles (%) (1^{*}), 3480.5 ± 38.5 flower/panicle, 3301.5 ± 37.5 male flower/ panicle, 94.88 ± 0.01% mal flower (%) (2^{*}), 179.0 ± 1.00 perfect flower/panicle, 5.14 ± 0.01 perfect flower (%) (2*) and 18.45±0.1 sexual (%) than those of Zebda variety (160.5±25.5 panicle/ tree, 15.16 ± 0.89% malformed), 1994.5 ± 14.5 flower/ panicle, 93.05 ± 0.03 male flower (%), 137.0 ± 2.00 perfect flower/panicle, 6.87 ± 0.05 perfect flower (%) and 13.56 ± 0.11 sexual (%). It can be noticed that malformed pancil tree (%) those of Ewais (34.18 ± 2.11), this may be due to high content of phenolic compounds in Zebda leaves, since that in agreement with those respected before by El-Khawaga and Maklad (2013). So perfect flower (%) of Zebda was higher (6.87 ± 0.05) than those of Ewais (5.14 ± 0.01) meanwhile perfect flower/panicle of Ewais was higher than those of Zebda variety (137.0 ± 2.0). These results were in harmony with those stated by El-Khawaga and Maklad (2013). Malformed panicle/tree (%) of zebda lesser (15.16±0.89) than those of Ewais (34.18 ± 2.11), but the perfect flower/panicle of Ewais was higher (179.0 ± 1.0) than those of Zebda variety (137.0 ± 2.0), therefore the productivity of Ewais was higher (92.33 ± 0.68 Kg/tree) than that of Zebda (89.27 ± 38.21) as shown in Table 5.

Results in Table 5 show productive characteristics of two mango varieties, Ewaise and Zebda. It can be noticed that Ewais has a higher values, in all parameters, than those of Zebda.

Mango fruits consumption is correlating with it's physical parameters such as size, shape, color, external detects/blemishes, taste, shelf life, total soluble solids (TSS), acidity, nutrition values and firmness. These reported before by Lechaudel and Joas (2007) and Jha *et al.* (2013). Therefore fruits total phenolic compounds, fruit's firmness, fruit's TSS, fruit's acidity, TSS/ acid ratios, fruit's size, fruit's carbohydrates fractions and fruit's vitamin C were determined for both Ewais and Zebda cultivars and mean values of two seasons are tabulating in Table 6. It can be noticed that Ewais cultivar was superior than Zebda cultivar, generally, all fruits quality values of Ewais was higher than those of Zebda, except acidity percentage which was lower than acidity percentage of Zebda (0.48 ± 0.02 and 0.55 ± 0.02, respectively). Shelf life of Ewais may be longer than of Zebda cultivar due to higher content of TSS (48.82 ± 1.68) than TSS of Zebda (30.89), higher value of firmness in Ewais (21.31±0.31) than firmness of Zebda (18.28 ± 0.29), phenolic compounds content, which was higher of Ewais (43.77 ± 0.87) than value of Zebda (41.3 ± 1.2), while these compounds play an important role as antimicrobial and antioxidant agents and vitamin C. which was higher of Ewais (19.91 ± 1.11) than of Zebda (19.62 ± 0.10) because it considered as preservative agent . Also it can be noticed that Ewais is more sweetness and more nutritive due to its high content of reducing sugars (7.03 ± 0.12), non-reducing sugars (9.36 ± 0.04), antioxidant phenolic compounds (43.77 ± 0.97). These results were in harmony with those revealed by Ara *et al.* (2014), Naz *et al*. (2014), Kittur *et al.* (2001), Sajib *et al.* (2014), Rajwana *et al.* (2010) and Wongmetha *et al.* (2015), who studied mango fruits quality and its correlation with physico-chemical parameter of fruits.

Table 3. Mean values of leaves element contents of Ewais and Zebda mango at different stages of growth (average of two seasons)

Cultivar	N g/100gdw	K g/100 gdw	Ca g/100 gdw	P g/100 gdw	B ppm	Cu ppm	Zn ppm	Fe ppm
				Differentiation stage(D)				
Ewais	1.05±0.04	0.85±0.89	0.47±0.04	0.115±0.006	12.55±1.35	9.45±1.25	15.00±1.00	122.75±0.75
Zebda	0.95±0.08	0.76±0.80	0.38±0.02	0.107±0.001	10.85±0.55	10.15±0.45	14.25±0.55	120.47±0.28
				Full bloom stage(FB)				
Ewais	0.70±0.04	0.52±0.74	0.52±0.04	0.099±0.001	20.25±0.46	13.75±0.55	14.14±1.16	119.95±0.95
Zebda	0.60±0.02	0.43±0.77	0.43±0.02	0.095±0.001	18.65±0.45	12.35±0.35	12.45±0.25	118.95±0.27
				Fruit set stage(FS)				
Ewais	1.46±0.16	1.28±0.88	0.57±0.05	0.175±0.16	21.13±0.60	11.25±0.45	23.00±0.12	204.35±0.35
Zebda	1.05±0.08	1.19±0.87	0.47±0.02	0.167±0.001	19.75±0.45	9.95±0.35	22.07±0.15	154.57±4.75

Table 4. Mean value of panicle malformation, flower and sexual measurements of Ewais and Zebda mango cultivars (average of two seasons)

Cultivar	No of panicles/ tree	No of malformed panicles/ tree	Malformed panicles (%)/ tree	No. of flowers/ panicle	No. of male flowers/ panicle	No. of perfect flowers/ panicle	Male flowers/ panicle (%)	Perfect flowers/ panicle (%)	Sexual (%)
Ewais	262.5±3.5	89.49±4.49	34.18±2.11	3480.5±38.5	3301.5±37.5	179±1	94.88±0.01	5.14±0.01	18.45±0.1
Zebda	160.5±25.5	24.33±5	15.16±0.89	1994.5±14.5	1857.5±12.5	137.0±2.00	93.05±0.03	6.87±0.05	13.56±0.11

Table 5. Mean value of productivity measurements of Ewais and Zebda mango cultivars (average of two season)

Cultivar	No of fruits/tree	Fruit average weight (g)	Yield/tree (kg)	Fruit set (%)/ panicle
Ewais	384.5± 2.5	241.44±1.07	92.82±0.68	1.06±0.17
Zebda	157± 35	568.59±40.02	89.27±38.21	0.77±0.06

Table 6. Mean values of physico-chemical properties of Ewais and Zebda fruits (average of two seasons)

Cultivar	Ewais	Zebda
Fruit total phenolic compound as mg/g.f.w.	43.77±0.87	41.30±1.20
Fruit firmness as pound/inch	21.31±0.31	18.28±0.29
Fruit TSS (%)	23.15±0.07	16.99±0.01
TSS / acid ratio	48.82±1.68	30.89±1.99
Fruit length (cm)	4.00±0.02	10.57±0.04
Fruit width (cm)	6.81±0.06	7.56±0.11
Fruit size (cm^3)	122.3±0.60	279.3±3.12
Fruit total carbohydrate mg/100 gdw	39.01±0.17	41.69±0.51
Fruit total -insoluble sugars mg/100 gdw	22.62±0.13	29.34±0.36
Fruit total soluble sugar mg/100gdw	16.39±0.08	12.35±0.2
Fruit reducing sugar mg/100gdw	7.03±0.12	4.12±0.05
Fruit non-reducing sugar mg/100gdw	9.36±0.04	8.23±0.16
Panel test	3.67±0.34	1.17±0.17
Fruit vitam. C as mg/100gfw	19.91±1.11	19.62±0.1
Fruit acidity (%)	0.48±0.02	0.55±0.02

TSS:Total soluble solids., Vitam. C.: Vitamien C

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الخصائص الكيموفيزيائية لصنفى المانجو العويس والزبدة (*Mangifera indica* L.) فى مصر

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تمت هذه الدراسة في محافظة الإسماعيلية - مصر بغرض تقييم الصفات الطبيعية والكيماوية لصنفين من المانجو هما الصنف عويس والزبدة لذلك تم اختيار أشجار عمر ١٠ سنوات بحيث تكون تقريبا متماثلة في الحجم وفي الصفات الوراثية وأخذت منها الأوراق عند مراحل نمو مختلفة وكذلك الثمار لفحصها ودراستها، توضح النتائج أن الصنف عويس تحتوى أوراقه طبقا لمراحل النمو المختلفة على مركبات فينولية ما بين ٨٠.١٦ و٨٣.٩٢ ملليجرام/جرام وزن طازج وسيتوكينين ما بين ٣.٦٠ و ٤.٤١ نانوجرام/جرام وزن طازج وحمض جبريلك ما بين ٢٨.٥٨ و ٣٦.٦١ ملليجرام/جرام وزن طازج وحمض ابسيسيك ما بين ٨.٤٣ و٩.٥ ميكروجرام/جرام وزن طازج وبروتين كلي ما بين ٤.٣٨ و ٩.١٣ جم/١٠٠ جم وزن جاف وأحماض أمينية حرة ما بين ٢٣.٧٢ و ٣٦.٧٠ ميللي مول/ ١٠٠ جم وزن جاف وبرولين ما بين ٥.٨٣ و٧.٢٢ ميكرو مول/جم وزن طازج كما تحتوى على كربوهيدرات كليه ما بين ٧٦.١٨ و٩٠.٢١ جم/١٠٠ جم وزن جاف، كلوروفيل كلي ما بين ١.٥٥ و ٢.١١ ملليجرام/جم وزن طازج وكاروتينات كليه ما بين ٠.٨٢ و ٠.٩٨ ملليجرام/جم وزن طازج كما تميزت اوراق الصنف عويس بنشاط انزيمي على النحو التالي إنزيم الكاتاليز مابين ٢٦.٢٣ و ٥٠.٣١ البيروكسيداز ما بين ١.٢٣ و ٢.٨٠ والبولي فينول اوكسيداز ما بين ١٠١.٢٩ و١٠٦.٦١ وإنزيم الاميليز ما بين ٧.٣١ و٨.١٠ نانومول/جم وزن طازج، الصنف عويس تميز بإنتاجية عالية عن الصنف زبدة حيث كان الإنتاج بالكيلو جرام لكل شجرة في الصنف عويس ٩٢.٨٢كجم بينما الصنف زبدة كانت إنتاجيته ٨٩.٢٧ كجم كما أن ثمار الصنف عويس أعطت مقاييس وصفية وكيماوية أعلى من ثمار الصنف زبدة.

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