

Fruit physical and chemical characteristics at maturity stage of Tommy Atkins, Keitt and Kent mango cultivars grown under Nubariya conditions

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Abstract: The present study was conducted at orchard located at the side of Alexandria desert road (Cairo - Alexandria, Km. 140), at Nubariya region during 2007 and 2008 seasons. The three experimented mango cultivars were Tommy Atkins, Kent and Keitt. The trees of the three studied cultivars are grafted on seeded rootstocks, attained nine years old and grown in sandy Soil .Trees of all mango cvs. Were planted at 3×5 meter apart and subjected to the same horticultural practices .The objective of the present study is evaluating some fruit physical and chemical characteristics at maturity stage of Tommy Atkins, Kent and Keitt mango cultivars grown under Nubariya conditions. The obtained results can be summarized as follows: The observation besides the analysing of some physical and chemical characteristics of the fruits indicated that the physiological maturity was attained in Tommy Atkins cvs. at fruit age 113 day, Kent and Keitt cvs. at fruit age 122 day. Keitt cv. had the highest values of pulp percentage of weight followed by Kent cv. while, Tommy Atkins cv. had the lowest values of pulp percentage of weight. Meanwhile Tommy Atkins cv. had the highest percentage of peel of weight followed by Kent cv., while Keitt cv. had the lowest percentage of peel of weight. Tommy Atkins cv. had the highest percentage of seed of weight followed by Kent cv. while, Keitt cv. had the lowest percentage of seed of weight. Keitt cv. had the highest seed length, followed by Tommy Atkins cv. while, Kent cv. had the lowest values in the two seasons. The highest seed width was Tommy Atkins cv., followed by Kent cv. meanwhile; Keitt cv. had lowest values in the two seasons. Ascorbic acid (vitamin c) percentage was lowest in Kent cv. compared to Tommy Atkins cv. which had the highest value; Keitt cv. had intermediate values in the two seasons. Moisture percentage was almost the same with no significant difference among cvs. Tommy Atkins cv. had the highest moisture percentage, followed by Keitt cv. while, Kent cv. had the lowest moisture percentage in the two seasons. Kent cv. had the highest dry matter content percentage, followed by Tommy Atkins cv. while, Keitt cv. had the lowest value in the two seasons. Total sugars percentage was highest in Kent cv., followed by Keitt cv. while, Tommy Atkins cv. had the lowest total sugars percentage in the two seasons. Tommy Atkins cv. had the highest crude fiber percentage, followed by Keitt cv. while, Kent cv. had the lowest crude fiber percentage in the two seasons.

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1. Introduction

Mango belongs to the family “Anacardiaceae” and is consumed mainly as a fresh fruit or as a juice. Its nutritional value is great and is considered one of the richest sources of vitamins and mineral salts. Besides it contains enough amounts of carbohydrates and proteins.

There are many factors that influence yield, maturity and quality of fruits the, same cultivar can attains different characteristics in different growing conditions. Even in the same region, different environmental conditions at different years can affect maturity and quality of the fruit. (Devilliers, (1998)).

There were great variations in growth, yield as well as physical and chemical properties of the fruits of various mango cultivars grown in different climatic conditions. Abou - El-Az, (1988); Hussein *et al* (1989); Salem (1993); Abd-El Hameed (1996);

Ahmed *et al* (1998) and El-Masry and Galila Said (1998).

The objective of the present study is evaluating some Fruit physical and chemical characteristics at maturity stage of Tommy Atkins, Ket and Keitt mango cultivars grown under Nubariya conditions.

2. Material and Methods

This study was carried out during two successive seasons (2007 and 2008) on three mango cultivars namely Tommy Atkins, Kent, and Keitt at a private orchard located in Nubariya at Alexandria at desert road (km. 140 Cairo – Alex), Beheira governorate, Egypt. The selected trees were about nine years old, budded on seedling rootstocks and planted at 3×5 meters apart, in sandy soil and irrigated by drip irrigation system. Samples of 9 fruits per replicate (9×3 = 27 fruits for each cultivar) were

collected every two weeks. The first fruit sample was collected at fruit age at 77 days in all cultivars. The fruits were collected then washed with tap water, let to dry then put in small plastic boxes in single layer under temperature (25 ± 2 c) and relative humidity (80-85 %) to follow their shrinking. The time of maturity stage was determined by testing some physical and chemical fruit characteristics according to Hussein and Youssef (1972), Subramnyan *et al.* (1975), Mann and Singh (1976), Singh *et al.* (1978), Singh *et al.* (1979) and Roy and Biswas (1985).

1. The physical fruit characteristics

1. Fruit weight (g.)
2. Fruit volume (cm.³)
3. Specific gravity (g/cm.³)
4. Flesh firmness (lb/inch²)
5. Fruit length (cm.)
6. Fruit width (cm.)
7. Peel colour by using colour chart.
8. Pulp colour by using colour chart.

2. The chemical fruit characteristics

1. Total soluble solids (T.S.S) by using a hand refractometer.
2. Total Acidity (%) (A.O.A.C, 1985).
3. T.S.S /Acid ratio.

Fruit characteristics at maturity stage

Nine mango fruits of each mango cultivar at maturity stage were used.

a. The physical characteristics

1. Pulp weight (%)
2. Seed weight (%)
3. Peel weight (%)
4. Seed length (cm.)
5. Seed width (cm.)

b. The chemical characteristics

1. Ascorbic acid content (mg / 100 g. fresh weight) (A.O.A.C,1985).
2. Total sugars content was determined colorimetrically in fruit dry weight according to the method of Smith *et al.* (1956).
3. Fruit crude fibers content was determined using the method described in the Official Analytical Chemistry (A.O.A.C, 1985).
4. Moisture and Fruit dry matter content .The flesh of fruit samples was cut into small pieces and dried at (60 - 65 c) for 48 h. the moisture and dry matter percentage were calculated using the following equations :

a. Moisture (%)

$$\frac{\text{Weight before drying} - \text{Weight after drying}}{\text{Weight before drying}} \times 100$$

b. Fruit dry matter content (%)

$$\frac{\text{Average dry weight (g.)}}{\text{Average fresh weight (g.)}} \times 100$$

Statistical analysis and comparison among means were made using L.S.D. test at 5 % level according to Steel and Torrie (1980).

3. Results and Discussion

Data illustrated in (Table 1)show from the reliable indicators for determining fruit maturity in the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons that the physiological maturity was attained in Tommy Atkins cvs. at fruit age 113 day, Kent and Keitt cvs. at fruit age 122 day.

Keitt cv. had the highest fruit weight and volume, followed by Kent cv., while Tommy Atkins cv. had the lowest fruit weight and volume. The highest value of specific gravity was found in Keitt cv., while Tommy Atkins cv. had the lowest specific gravity in the two seasons. Keitt cv. had the highest fruit length, followed by Tommy Atkins cv., while Kent cv. had the lowest fruit length. Keitt cv. had the highest fruit width, followed by Kent cv., while Tommy Atkins cv. had the lowest fruit width in the two seasons.

Peel colour of Tommy Atkins at maturity stage was "Moderate yellow green" + one side colour "dark red" in the two seasons. While, peel colour of Kent fruits was "Moderate yellow green" and peel colour of Keitt fruits was "Moderate yellow green". Pulp colour of Tommy Atkins at maturity stage was "Vivid yellow" While, pulp colour of Kent fruits was "Strong yellow." and pulp colour of Keitt fruits was "Vivid yellow" in the two seasons.

Total soluble solids percentage was the best in Kent cv. followed by Keitt cv. while, it was relatively low in Tommy Atkins cv. in the two seasons. Kent cv. had the lowest total acidity value followed by Keitt cv. Tommy Atkins cv. had the highest value in the two seasons. Kent cv. had the highest T.S.S / Acid ratio, followed by Keitt cv. while, Tommy Atkins cv. had the lowest value in the two seasons.

1. Physical characteristics at maturity stage

a. Percentage of pulp, peel and seed of fruit fresh weight

Data in Table (2) show percentage of pulp, peel and seed of fruit fresh weight of the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons. Percentage of pulp, peel and seed of fruit fresh weight varied significantly according to mango cvs. in two studied seasons.

Keitt cv. had the highest percentage of pulp of fruit fresh weight (81.60 % in 2007 season and 82.68 % in 2008 season) followed by Kent cv. (77.47 % in 2007 season and 76.27 % in 2008 season) while,

Tommy Atkins cv. had the lowest percentage of pulp (71.70 % in 2007 season and 71.49 % in 2008 season). Meanwhile Tommy Atkins cv. had the highest percentage of peel of fruit fresh weight (15.82 % in 2007 season and 16.11 % in 2008 season) followed by Kent cv. (11.86 % in 2007 season and 12.24 % in 2008 season), while Keitt cv. had the lowest percentage of peel of fruit fresh weight (8.68 % in 2007 season and 7.47 % in 2008 season).

Tommy Atkins cv. had the highest percentage of seed weight (12.48 % in 2007 season and 12.40 % in 2008 season) followed by Kent cv. (10.67 % in 2007 season and 10.30 % in 2008 season), while, Keitt cv. had the lowest percentage of seed weight (9.72 % in 2007 season and 9.85 % in 2008 season).

The above results agree with that obtained by Hussein and Youssef (1972), Hassan *et al.* (2004) and Kudachikar *et al.* (2003) they found that the great

variation in percentage of pulp, peel and seed of fruit fresh weight differed according to mango cultivar.

b. Seed length and width

Data in Table (2) show seed length and width. of the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons. Seed length and width varied significantly according to mango cvs. in two studied seasons. Keitt cv. had the greatest seed length (10.72 cm. in 2007 season and 10.42 cm. in 2008 season) followed by Tommy Atkins cv. (9.77 cm. in 2007 season and 9.48 cm. in 2008 season) while, Kent cv. had the lowest seed length (8.79 cm. in 2007 season and 8.73 cm. in 2008 season).

The highest seed width was recorded in Tommy Atkins cv. (4.41 cm. in 2007 season and 4.35 cm. in 2008 season) followed by Kent cv. (4.26 cm. in 2007 season and 4.20 cm. in 2008 season) meanwhile, Keitt cv. had the lowest seed width (4.13 cm. in 2007 season and 4.12 cm. in 2008 season).

Table 2 . Fruit physical characteristics in maturity stage of the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons.

Cultivars	characteristics				
	Pulp weight (%)	Peel weight (%)	Seed weight (%)	Seed length (%)	Seed width (cm.)
2007 season					
Tommy Atkins	71.70 c	15.82 a	12.48 a	9.77 b	4.41 a
Kent	77.47 b	11.86 b	10.67 b	8.79 c	4.26 ab
Keitt	81.6 a	8.68 b	9.72 c	10.72 a	4.13 b
2008 season					
Tommy Atkins	71.49 c	16.11 a	12.40 a	9.48 b	4.35 a
Kent	79.27 b	12.24 b	10.30 b	8.73 c	4.20 ab
Keitt	82.68 a	7.47 c	9.85 c	10.42 a	4.12 b

Means followed by the same letter (s) in each column are insignificantly at 5% level.

2. Chemical characteristics

a. Ascorbic acid (v.c.)

Data in Table (3) show ascorbic acid (vitamin c) percentage in fruit juice of the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons. Ascorbic acid (vitamin c) percentage varied significantly according to mango cvs. The maximum value was detected in the pulp of mango cv. Tommy Atkins (44.89 % in 2007 season and 40.80 % in 2008 season) in the two seasons, followed by Keitt cv. (41.42 % in 2007 season and 38.60 % in 2008 season) while, Kent cv. had the lowest ascorbic acid content (vitamin c) percentage (37.70 % in 2007 season and 35.99 % in 2008 season).

The results are in full agreement with those of others, who found that vitamin c percentage in fruits of some mango cvs. increased up to maturity, thereafter decreased at ripe stage. Ibrahim *et al.* (1985) reported that the vitamin c fruit content was higher in the fruits of Zebda, Misk and Taimour mango cvs. (at ripe stage) compared with that in fruits of Dabsha, Mabrouka, Alphonso, Bullock's Heart, Hindy Sennara and Baladi varieties. Tawfik (2003) found that the vitamin c content of Tommy Atkins mango cv. was the highest at maturity stage (58.53 mg. / 100 g.fr.w) followed by Keitt mango cv. (48.13 mg /100 g.fr.w) and Ewais mango cv. (45.40 mg. /100g.fr.w), while the lowest vitamin c content was found in Sediek mango cv. (32.60 mg. / 100 g.fr.w). Many works such as Said and El-Masry

(1992), Sharma *et al.* (1999), Mitra *et al.* (2000) and Tawfik (2003) reported that the great variation in

vitamin c content differed according to mango cultivar.

Table 3. Fruit chemical characteristics in maturity stage of the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons.

Cultivars	characteristics				
	Ascorbic acid (mg. /g. F.wt.)	Total sugars (%)	Fiber (%)	Moistue (%)	Fruit Dry Matter (%)
2007 season					
Tommy Atkins	44.89 a	6.70 c	1.18 a	79.78	19.89 b
Kent	37.70 c	9.23 a	0.75 c	77.55	22.45 a
Keitt	41.42 b	8.16 b	0.86 b	79.00	21.00 ab
2008 season					
Tommy Atkins	4.80 a	7.38 c	1.13 a	80.11 a	19.89 b
Kent	35.99 b	9.50 a	0.71 c	75.00 b	25.00 a
Keitt	38.60 ab	8.77 b	0.88 b	79.55 a	20.45 b

Means followed by the same letter (s) in each column are insignificantly at 5% level.

b. Pulp moisture percentage

Data in Table (3) show pulp moisture percentage of the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons. Moisture content percentage varied significantly according to mango cvs. Tommy Atkins cv. had the highest moisture content percentage (79.78 % in 2007 season and 80.11 % in 2008 season) in the two seasons, followed by Keitt cv. (79.00 % in 2007 season and 79.55 % in 2008 season) while, Kent cv. had the lowest moisture content percentage (77.55 % in 2007 season and 75.00 % in 2008 season).

These results are in full agreement with those found by Sobeih and El-Helaly (2002a), they found that the Mabrouka mango cv. fruits recorded the highest moisture percentage in two seasons at harvest stage. Tawfik (2003) reported that the fruit moisture percentage in Tommy Atkins mango cv. was higher than in Keitt cv. at maturity stage (78.3 % and 76.7 % respectively) followed by Sediek cv. (76.44 %), while Ewais mango cv. showed the least value (75.46 %). Sobeih and El-Helaly (2002a) and Tawfik (2003) reported that the great variation in moisture percentage differed according to mango cultivar.

c. Fruit dry matter content percentage.

Data in Table (3) show fruit dry matter content percentage of the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons.

Fruit dry matter content percentage varied significantly according to mango cvs. Kent cv. had the highest dry matter content percentage (22.45 % in 2007 season and 25.00 % in 2008 season) in the two

seasons, followed by Tommy Atkins cv. (19.89 % in two seasons) while, Keitt cv. had the lowest dry matter content percentage in the two seasons (21.00 % in 2007 season and 20.45 % in 2008 season). These results are in full agreement with those found by Sobeih and El-Helaly (2002b) they found that Zebdda fruits recorded the highest value of dry matter at maturity stage followed by Hindy Besinnara cv. while Mabrouka cv. recorded the least value. The same sequence was observed in ripe fruits, 5 days after maturity. Tawfik (2003) found that the dry matter was the highest in Ewais mango cv. (24.54 %) at maturity followed by Sediek cv. (23.56 %) and Keitt cv. (23.23 %) while, the lowest was found in Tommy Atkins cv. (21.67 %).

d. Total sugars percentage

Data in Table (3) show total sugars percentage of the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons. Total sugars percentage varied significantly according to mango cvs. Kent cv. had the highest total sugars percentage in the two seasons (9.23 % in 2007 season and 9.50 % in 2008 season), followed by Keitt cv. (8.16 % in 2007 season and 8.77 % in 2008 season) while, Tommy Atkins cv. had the lowest total sugars percentage (6.70 % in 2007 season and 7.38 % in 2008 season).

These results are in agreement with the findings of Ibrahim *et al.* (1985) Sharma *et al.* (1999) they found that the great variation in total sugars percentage differed according to mango cultivar.

e. Crude fiber percentage

Data in Table (3) show crude fiber percentage of the three mango cultivars grown under

Nubariya region conditions in 2007 and 2008 seasons.

Crude fiber percentage varied significantly according to mango cvs. Tommy Atkins cv. had the highest crude fiber percentage in the two seasons (1.18 % in 2007 season and 1.13 % in 2008 season), followed by Keitt cv. (0.86 % in 2007 season and 0.88 % in 2008 season) while, Kent cv. had the lowest crude fiber percentage (0.75 % in 2007 season and 0.71 % in 2008 season).

The results confirmed the finding of El-Masry (2001) who reported that the percentage of crude fiber of mango fruits was high in some seeded clones and low in other. Sobeih and El-Helaly (2002b) found differences in fruit content of crude fiber percentage among the studied mango cultivars. The highest crude fibers percentage was recorded in Misk mango fruits.

Table 1. Reliable indicators for determining the fruit maturity in the three mango cultivars grown under Nubariya region conditions in 2007 and 2008 seasons.

Cultivars	Characteristics											
	Fruit age (days)	Fruit weight (g)	Fruit volume (cm ³)	Specific gravity (g/cm. ³)	Flesh firmness (Lb/inch ²)	Fruit length (cm.)	Fruit width (cm.)	Peel colour	Pulp colour	T.S.S. %	Total Acidity (%)	T.S.S./Asid ratio
2007 season												
Tommy Atkins	113	443.86	437.75	1.013	33.19	12.48	7.42	Moderate yellow green + dark red	Vivid yellow	8.97	1.31	6.89
Kent	122	478.43	468.27	1.021	26.28	10.22	9.12	Moderate yellow green	Strong yellow	10.23	1.01	10.14
Keitt	122	586.65	573.58	1.022	35.97	12.82	10.41	Moderate yellow green	Vivid yellow	9.85	1.14	8.65
2008 season												
Tommy Atkins	113	433.65	427.34	1.014	33.3	12.32	8.27	Moderate yellow green + dark red	Vivid yellow	8.71	1.37	6.34
Kent	122	45.65	450.65	1.021	26.73	10.10	9.01	Moderate yellow green	Strong yellow	10.14	1.00	10.11
Keitt	122	565.14	565.14	1.022	35.95	12.98	10.43	Moderate yellow green	Vivid yellow	9.70	1.09	8.95

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