

COMPARATIVE STUDY ON FRUIT COMPOSITION OF SEVEN MANGO CULTIVARS AT MATURITY AND RIPE STAGE

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ABSTRACT

In order to determine the nutritional value of Egyptian mango fruits at harvest and at ripe stage, seven cultivars; namely Zebdda, Misk, Alphonso, Tomy Atkins, Mabruka, Compania and Hindy Sinnara; were evaluated. The obtained results showed that total carbohydrates, dry matter, cellulose and lignin percentage declined towards ripening stage. Misk recorded the highest content of crude fiber, total dietary fibers, cellulose, potassium, calcium and zinc. Alphonso recorded the highest magnesium content and the second highest content of potassium and calcium following Misk. Although Mabruka recorded the least percentage of total carbohydrates, fatty acid, calories and zinc among the seven cultivars, it contained the highest percentage of neutral detergent fibers (NDF) and acid detergent fibers (ADF). Zebdda contained the highest percentage of total carbohydrates, fatty acid and calories. Tomy Atkins and Misk attained the highest percentage of iron and copper. Hindy Sinnara had the highest T.S.S. and the least total acidity percentage at ripe stage. Compania attained the least value of soluble and insoluble dietary fibers, potassium and calcium.

keyword: fruit composition dietary fibers mineral content maturity and ripe stage.

INTRODUCTION

Realizing the great importance of nutritional value to health, especially the role that dietary fibers play in reducing cancer cases and the importance of minerals in both children and adults feeding, great efforts were exerted in evaluating contents of fruit, which is considered as the main source of dietary fibers and minerals. However, Ledger (1996) reported that an important problem facing the mango industry was the lack of consistency in fruit quality.

Many researchers described the relationship between minerals and ripening process and physiological disorder. However, fruit Ca may have a stronger influence on mango quality during cold storage than with no storage, since better correlation with fruit Ca and days to ripen after cold storage have been reported in avocado (Hofman *et al.*, 1997). High fruit Ca concentrations have often been associated with extended shelf and storage life in fruits (Witney *et al.*, 1990)

However, lack of information still exists about the nutritional value of the Egyptian Mango (fruit composition especially dietary fibers and mineral elements). Therefore, this work was conducted to find out the nutritional value of the Egyptian mango fruits under local conditions.

MATERIALS AND METHODS

Seven cultivars; namely Zebdda, Misk, Alphonso, Tomy Atkins, Mabruka, Compania and Hindy Sinnara at commercial maturity from Giza Governorate were evaluated in 1999 and 2000. Each cultivar contained 15 fruits and replicated 3 times. Fruits were placed at 22°C and 90% relative humidity for 5 days including 2 days for ripening by acetylene gas (released from calcium carbide 2 g./ kg. fruit according to Kumar et al, 1996). Then fruits contents were analyzed at maturity and ripe stages as follows:

Fruit Composition

Moisture, ash, crude protein, other extract crude fiber were determined according to the methods of AOAC (1998). Titratable Acidity %: Titratable acidity was determined in terms of anhydrous citric acid percentage after titration against 0.1 N. Sodium hydroxide using phenolphthaline as indicator (A.O.A.C.,1998). Total Soluble Solids %: Abbé refractometer was used to determine the percentage of total soluble solids in fruit juice (A.O.A.C.,1998).). Energy Calories: was calculated by multiplying protein and carbohydrates percentages by 4.0 and fat percentage by 9.

Total Dietary Fibers

Soluble insoluble and total dietary fiber were determined according to the methods AOAC (1998). Hemicellulose; cellulose; Lignin, Neutral detergent fiber and acid detergent fiber were determined according to the method described by Goering and Van Soest (1970).

Mineral Contents

Potassium, Calcium, Magnesium, Iron, Zinc were determined using atomic absorption spectro-photometer (AOAC, 1998).

Statistical analysis:

The obtained data were statistically analyzed using excel micro software (one factor randomized complete block design) according to Senedecor and Cochran (1990) and the L.S.D. test at 5% was applied to compare between the degrees of maturity (treatments).

RESULTS

Dry Matter:

As shown in table (1), at maturity stage in both seasons Zebdda mango fruits recorded the highest value of dry matter followed by Hindy, while Mabruka recorded the least value. The same trend was observed in ripe fruits after 5 days ripening treatment. In all cultivars, progress of mature stage was accompanied by a decrease of this characteristic.

Moisture:

It is clear from table (1) that Mabruka fruits recorded the highest moisture value in both seasons. In spite of the increase of moisture percentage throughout ripening stages, Mabruka mango fruits also recorded the highest value after ripening followed by Alphonso mango fruits. In general, obtained data were in line with those obtained by Singh (1995).

Ash:

A slight decrease of ash percentage after ripening was observed in all cultivars. The highest value was obtained by Zebdda cultivar.

Crude Protein:

Data in table (1) demonstrated that negligible changes of protein occurred, but no significant difference was observed in the second season (at harvest stage) or in the first season (at ripe stage). However, crude protein did not reach 0.3 in all cultivars and was not less than 0.163.

Fatty Acid:

Negligible differences between fatty acid percentage in all cultivars were observed. A slight decrease was detected from maturity stage to ripe stage. However, in both seasons, Zebdda recorded the highest value at harvest stage (0.61-0.7) and at ripe stage (0.57-0.689). Mabruka, as usual recorded the least value (0.41-0.5) at harvest stage and (0.38-0.436) at ripe stage.

Crude Fibers:

At harvest and ripe stages slight differences between cultivars were recorded. The highest crude fibers percentage was recorded by Misk mango fruits in both seasons

Total Acidity %:

In both seasons, titratable acidity in all cultivars declined gradually towards the ripening stage. Although there were no significant differences, the least total acidity was recorded by Hindy Sinnara fruits (0.927-1.01 at harvest and 0.209-0.311 at ripe stage). At ripe stage the highest total acidity obtained by Mabruka (0.613-0.712). These results go in line with those reviewed by Kumar *et al.* (1995), Tandon and Kalra (1997) and Ahmed *et al*, who noted that titratable acidity in mango fruits declined gradually towards the end of ripening period.

Total Soluble Solids

In both seasons, in all cultivars a gradual increase of T.S.S towards the ripening stage was observed. At ripe stage, the highest T.S.S was obtained by Hindy Sinnara fruits (19.0-19.8%) followed by Alphonso (17.30-18.50%) followed by Misk (17.21-18.10%).In this connection, obtained results agreed with those observed by Abdul-Gofur *et al.* (1997), Ahmed *et al.*(1997) and by Tandon and Kalra (1997)who stated that a rapid increase in total soluble solid occurred during the ripening process.

Total Carbohydrates:

Total carbohydrates decreased from maturity stage to ripe stage. The highest percentage of total carbohydrate was recorded by Zebdda fruits, while the least percentage was recorded by Mabruka.

Calories:

In both seasons, the highest significant value was recorded by Zebdda at harvest and ripe stages. However, Hindy, Compania and Tomy Atkins recorded somehow less values, while Mabruka attained the least value.

Total Dietary Fibers:

Data in table (2) described the fraction of total dietary fibers.

(Total dietary fibers = Soluble dietary fiber + Insoluble dietary fibers). The highest value was attained by Misk fruits (1.77-2.74 at harvest time and 1.70-2.173 at ripe stage) followed by Mabruka (1.93-2.71 at harvest time and 1.90-2.601 at ripe stage) in both seasons. However, Compania fruits had the least value in both seasons, at harvest and ripe stages. A noticeable decrease of total dietary fibers was observed between harvest stage and ripe stage.

Table (2): The Percentage of Total Dietary Fibers, Cellulose, Hemi-Cellulose, Lignin, NDF and ADF of Seven Mango Cultivars at Maturity and Ripe Stage

Mango Cultivars	Total Dietary Fibers%		Soluble Dietary Fibers%	Insoluble Dietary Fibers%		Cellulose %		Hemicellulose %		Lignin%		NDF% *		ADF% *		
	1 st	2 nd		1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	
At Harvest																
Zebdda	2.293	1.62	1.316	1.01	.977	0.61	.778	0.59	.223	0.35	.115	0.09	11.16	14.25	8.93	6.59
Misk	2.784	1.77	1.424	0.97	1.360	0.80	.867	0.78	.418	0.38	.161	0.14	14.46	13.66	10.28	8.81
AlPhonso	2.600	1.71	1.488	0.89	1.112	0.82	.846	0.93	.435	0.21	.104	0.17	13.85	15.88	9.50	10.23
Tomy Atkins	2.185	1.95	1.319	0.93	.766	0.52	.778	0.71	.212	0.19	0.139	0.09	10.29	12.11	8.17	9.41
Mabruka	2.710	1.93	1.678	1.11	1.032	0.82	.813	0.79	.334	0.28	.271	0.14	14.18	15.55	10.84	12.31
Compania	1.889	1.31	1.092	0.82	.797	0.49	.400	0.51	.242	0.23	.195	0.22	8.37	12.34	5.95	5.24
Hindy sinnara	2.100	1.54	1.215	0.95	.885	0.59	.571	0.53	.294	0.31	.116	0.11	9.81	17.88	6.87	5.52
L.S.D at 5%	0.731	N.S	N.S	0.073	0.50	N.S	0.066	N.S	0.047	N.S	0.056	N.S	0.619	0.090	0.953	0.515
After 5 Days From Ripening Treatment																
Zebdda	1.638	1.53	.921	0.91	.717	0.62	.625	0.53	.253	0.36	0.056	0.08	9.34	12.56	6.81	7.54
Misk	2.173	1.70	1.349	0.99	.824	0.71	.750	0.71	.225	0.31	0.058	0.09	10.33	12.00	8.08	9.05
AlPhonso	2.500	1.69	1.474	0.85	1.026	0.84	.756	0.79	.301	0.27	0.033	0.07	19.10	14.01	16.00	11.58
Tomy Atkins	2.353	1.51	1.349	0.88	1.004	0.63	.818	0.70	.364	0.16	0.139	0.09	12.44	11.51	8.80	9.11
Mabruka	2.601	1.90	1.421	1.13	1.180	0.77	.751	0.82	.356	0.21	0.150	0.18	18.88	14.01	15.32	12.40
Compania	2.484	1.43	1.485	0.78	0.999	0.56	.369	0.55	.245	0.27	.270	0.20	12.84	11.41	10.39	9.88
Hindy sinnara	2.085	1.41	1.348	0.90	.737	0.51	.500	0.44	.344	0.29	.120	0.14	9.64	12.66	6.20	8.78
L.S.D at 5%	0.675	0.275	0.056	N.S	0.05	N.S	N.S	N.S	N.S	N.S	N.S	N.S	0.551	0.755	0.596	0.521

* NDF & ADF calculated as percentage of the total dietary fibers

Soluble and Insoluble Fibers: It was noticeable that percentage of soluble dietary fibers percentage of the seven cultivars was greater than insoluble dietary fibers either at harvest or at ripe stages. Both of them declined towards ripe stage, but Mabruka attained the highest values of soluble and insoluble dietary fibers at harvest stage, followed by Alphonso mango fruits. However, Compania and Hindy had the least values of both soluble and insoluble dietary fibers.

Cellulose:

It was obvious that mango fruits contains a great amount of cellulose percentage, approximately 2 or 3 times more than hemi-cellulose. Cellulose percentage declined towards ripening stage. Misk, Alphonso and Mabruka mango fruits recorded the highest values., while Compania and Hindy attained the least ones.

Hemicellulose

Negligible differences between the seven cultivars of hemicellulose contents were observed. However, some cultivars increased after ripening (Zebdda, Tomy Atkins and Mabruka) in the first season. Hemicellulose

percentage declined in most cultivars in the second season.

Lignin:

A small amount of Lignin was detected at harvest stage in all cultivars and declined towards ripe stage. Mabruka recorded the highest content in the first season, but Alphonso recorded the highest in the second.

Neutral Detergent Fibers (NDF):

NDF percentage (as percentage of total dietary fibers). NDF percentage of all cultivars was higher than acid detergent fibers either at harvest or at ripe stage. However, the percentage of NDF might have decreased or increased after ripening, but Mabruka cultivars recorded the highest value.

Acid Detergent Fibers:

In most cultivars ADF increase accompanied the ripening process. Mabruka, Misk and Alphonso mango fruits nearly had the highest amount of ADF.

Mineral Elements:

Concentration of Potassium, Calcium, Magnesium, Iron, Copper and Zinc in the seven cultivars were demonstrated in table (3), however mineral concentration decreased from maturity stage towards ripe stage. This might be due to the role which minerals played in metabolism and catabolism after harvest and till fruits reached senescence. At harvest time in both seasons, Misk recorded the highest concentration of Potassium (268.57-292 mg./100g.), while Compania attained the least value (130.66-144.80 mg./100g.). At ripening stage, Hindy Sinara recorded the least value (125.50-137.50 mg./100g.)

Concerning Calcium concentration, Misk (19.92-21.83 mg./100g. at harvest and 16.30-24.77 mg./100g. at ripe stage) followed by Alphonso had the highest content, while Compania had the least (10.99-11.02 mg./100g. at harvest and 7.10-10.53 mg./100g. at ripe stage).

Magnesium concentration did not exceed 19.28 mg./100g. and was not less than 9.34 mg./100g. at harvest time, While at ripe stage concentration did not exceed (13.86 mg./100g.) and was not less than (6.50 mg./100g.). In general, Alphonso followed by Misk recorded the highest value of Magnesium content and Mabruka followed by Hindy had the least content percentage.

Regarding Iron content, all cultivars did not exceed (3.38 mg./100g.) at harvest and (2.67 mg./100g.) at ripe stage, while iron content was not less than (1.47 mg./100g.) at harvest and (1.34 mg./100g.) at ripe stage. In general, Tomy Atkins followed by Misk attained the highest percentage of Iron, while Zebdda and Hindy recorded the least percentage.

At harvest, Tomy Atkins recorded the highest value of Copper content (0.628 mg./100g.) in the first season, while Misk had the highest value (0.468 mg./100g.) in the second season.

Misk recorded the highest value of Zinc content at harvest (1.40-1.68 mg./100g.), while Mabruka recorded the least one (0.48-0.91 mg./100g.).

However, regarding mineral contents results obtained here nearly agreed with those obtained by Burdon *et al.* (1991), Singh, (1995), Raymond *et al.* (1998) and Simmons *et al.* (1998). In general, Burdon *et al.* (1991), stated that Potassium contents of Kent mango fruits ranged between 157.9-236.8 mg./100g, Calcium content ranged between 4.23-11.70 mg./100g., and Magnesium ranged between 8.01-12.60 mg./100g

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دراسة مقارنة على تركيب ثمار سبعة أصناف من المانجو في مرحلة اكتمال النمو ومرحلة النضج

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لتقدير القيمة الغذائية لثمار المانجو المصرية في مرحلة اكتمال النمو ومرحلة النضج تم تقييم سبعة أصناف من ثمار المانجو هي: زبدة، مسك، الفونس، تومي اتكنز، مبروكة، كوبانية، وهندي بسنارة. وقد أشارت النتائج المتحصل عليها إلى انخفاض نسبة الكربوهيدرات، والمادة الجافة، والسليلوز، والليجنين في جميع ثمار المانجو مع اقتراب الوصول إلى مرحلة النضج. كما سجلت ثمار المسك أعلى محتوى من الألياف الخام، والألياف الغذائية الكلية، والسليلوز، واليوتاسيوم، والكالسيوم، والزنك. أما ثمار المانجو الفونس فقد سجلت أعلى نسبة محتوى من المغنسيوم، وثاني أعلى نسبة بوتاسيوم وكالسيوم بعد ثمار المسك. بالرغم من أن ثمار المبروكة سجلت أقل نسبة كربوهيدرات، وأحماض دهنية، وسعرات، وزنك بالمقارنة بالأصناف السبعة الأخرى، إلا أنها احتوت على أعلى نسبة ألياف تهضم طبيعياً، والألياف التي تهضم بالأحماض. ثمار الزبدة احتوت على أعلى نسبة كربوهيدرات ودهون حمضية وسعرات. كل من التومي اتكنز والمسك فقد حققا أعلى محتوى من الحديد والنحاس. الهندي بسنارة فقد احتوت على أعلى نسبة من المواد الصلبة الذائبة الكلية وأقل نسبة حموضة. كانت ثمار الكوبانية هي أقل ثمار من حيث نسبة الألياف الغذائية ذائبة وغير ذائبة، وبوتاسيوم، وكالسيوم.

Table (1): Fruit Composition of Seven Mango Cultivars at Maturity and Ripe Stage

Mango Cultivars	Dry Matter %		Moisture %		Ash %		Crude Protein %		Ether Extract (fatty acid) %		Crude Fibers %		Total Acidity %		T.S.S. %		Total Carbohydrate %		K-Calorie (100gm.)		
	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	
At Harvest																					
Zebdda	23.20	21.48	76.80	78.60	0.579	0.495	0.21	0.23	0.70	0.61	.148	1.36	1.45	1.62	8.0	7.3	21.136	19.0	91.68	82.41	
Misk	19.34	18.78	79.76	81.22	0.710	0.66	0.226	0.21	0.619	0.54	.255	1.49	1.12	1.32	8.1	9.3	17.62	17.81	76.955	76.94	
AlPhonso	19.26	19.26	80.74	81.50	0.676	0.511	0.209	0.21	0.621	0.52	.1681	1.23	1.34	1.54	7.5	9.5	17.94	17.63	78.185	76.04	
Tomy Atkins	19.94	21.40	80.055	78.59	0.420	0.44	0.213	0.22	0.639	0.53	.127	1.13	1.56	1.70	6.0	6.8	18.69	19.99	81.36	80.61	
Mabruka	15.47	17.03	84.525	82.97	0.438	0.481	0.205	0.20	0.500	0.41	.164	1.35	1.38	1.93	6.3	6.0	13.87	15.63	60.800	67.01	
Compania	19.68	20.00	80.315	80.00	0.493	0.411	0.269	0.22	0.629	0.53	.187	1.01	1.20	1.080	7.7	6.8	18.43	18.63	80.45	80.17	
Hindy sinnara	19.92	19.41	80.075	80.59	0.430	0.351	0.294	0.24	0.649	0.50	.121	1.31	0.927	1.01	8.2	7.5	18.55	18.22	81.217	78.34	
L.S.D at 5%	N.S	0.457	N.S	0.232	0.076	0.056	N.S	N.S	N.S	N.S	N.S	0.159	N.s	N.s	N.s	.872	N.S	0.525	0.801	0.534	
After 5 Days From Ripening Treatment																					
Zebdda	22.84	20.82	77.16	79.18	0.530	0.401	0.21	0.19	0.689	0.57	0.177	1.44	0.401	0.532	13.3	14.1	21.627	19.33	93.548	83.21	
Misk	19.20	17.49	80.80	82.51	0.457	0.523	0.275	0.20	0.657	0.49	.257	1.51	0.325	0.333	17.2	18.1	18.84	16.21	82.373	70.05	
AlPhonso	15.44	15.95	84.56	84.05	0.521	0.50	0.163	0.23	0.511	0.48	.255	1.21	.333	0.333	17.3	18.5	14.08	14.65	61.571	63.84	
Tomy Atkins	17.51	19.73	82.49	80.27	0.400	0.41	0.213	0.21	0.565	0.48	.139	1.16	0.526	0.612	17.2	14.5	16.33	18.55	71.257	79.36	
Mabruka	14.59	15.30	85.41	84.70	0.412	0.38	0.179	0.24	0.436	0.38	.195	1.43	0.613	0.712	13.5	14.0	13.52	14.29	58.963	61.54	
Compania	18.26	17.26	81.74	82.74	0.349	0.381	0.270	0.21	0.585	0.46	.176	1.21	0.413	0.512	14.5	15.23	16.9	15.81	73.94	68.22	
Hindy sinnara	18.52	16.94	81.48	83.06	0.416	0.291	0.283	0.23	0.593	0.41	.144	1.33	0.290	0.311	19.8	19.0	17.225	15.81	75.369	67.85	
L.S.D at 5%	N.S	0.533	0.725	0.386	N.S	0.056	N.S	0.056	N.S	N.S	N.S	0.991	N.s	N.s	.854	.844	N.S	0.389	N.S	0.497	

Table (3): Fruit Mineral Elements of Seven Mango Cultivars at Maturity and Ripening Stage

Mango Cultivars	Potassium		Calcium		Magnesium		Iron		Copper		Zinc	
	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd
At Harvest												
Zebdda	190.91	220.11	14.62	17.32	11.39	18.24	2.73	1.52	0.489	0.373	1.36	1.22
Misk	292.43	268.57	24.77	19.92	11.98	17.35	2.48	1.77	0.583	0.468	1.40	1.68
AlPhonso	265.66	201.24	20.91	18.20	11.99	19.28	3.38	2.58	0.247	0.222	1.29	1.20
Tomy Atkins	182.07	165.00	13.90	13.00	9.51	13.50	2.69	1.97	0.628	0.436	1.12	1.01
Mabruka	248.28	187.30	12.87	13.65	6.18	9.34	2.96	1.90	0.340	0.218	0.84	0.91
Compania	144.80	130.66	11.02	10.99	10.30	14.22	3.30	2.00	0.397	0.373	1.00	1.10
Hindy sinnara	181.26	145.32	12.87	11.58	6.65	9.98	2.19	1.79	0.353	0.332	1.08	1.01
L S D	0.684	0.467	0.528	0.470	0.651	0.245	0.436	0.168	0.056	0.112	0.050	0.019
After 5 Days From Ripening Treatment												
Zebdda	128.64	184.30	11.69	12.50	7.73	12.21	1.91	1.11	0.319	0.291	0.98	0.99
Misk	128.15	217.91	21.83	16.30	11.85	12.54	1.75	1.34	0.346	0.379	1.01	1.23
AlPhonso	216.32	181.01	20.01	15.33	11.20	14.31	2.67	2.05	0.357	0.201	1.22	0.98
Tomy Atkins	144.84	134.72	23.32	9.80	13.86	9.21	2.47	1.37	0.641	0.318	1.12	0.77
Mabruka	172.57	125.63	18.42	10.21	13.38	6.50	2.68	1.66	0.402	0.198	1.24	0.85
Compania	145.51	130.30	10.53	7.10	8.29	10.21	2.22	1.78	0.333	0.253	0.98	0.86
Hindy sinnara	137.50	125.55	11.70	8.73	3.79	6.51	1.67	1.61	0.232	0.311	0.79	0.73
	0.579	0.238	0.497	0.125	0.450	0.186	0.470	0.079	0.056	N S	0.056	0.070

