

Physico-chemical Characteristics of Three Mango (*Mangifera indica* L.) Cultivars in Central Sudan

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Abstract- Mango (*Mangifera indica* L) fruits are widely grown in Sudan for local and export utilization. Selected physical and chemical quality attributes of three mango cultivars Kitchener, Abusamaka and Tommy Atkins were evaluated at ripening stage during two seasons (2013-2014). The experiments were arranged in Complete Randomize Design (CRD) with three replications. Results showed that cultivars had significant differences in fruit weight, fruit length, fruit width, pulp weight, pulp thickness, seed weight, seed length, seed width, peel weight in the two seasons. Tommy Atkins obtained the maximum fruit weight, fruit width, pulp weight, pulp thickness, seed weight and seed width values in the two successive seasons and peel weight in the second season. Furthermore, Abusamaka recorded the highest values in fruit and seed length in 2013 and 2014 seasons and peel weight in first season. In the case of chemical characteristics, Tommy Atkins showed the highest Ascorbic Acid and moisture content in the two successive seasons while, Kitchener had the maximum total acidity, TSS, Ash and total sugar content.

Index Terms- Mango, Cultivars, Ripening, Physico-chemical, Characteristics.

I. INTRODUCTION

Mango belongs to the family *Anacardiaceae*, is native to southern Asia [1]. Mango is a popular and economically important tropical fruit throughout the world, due to its excellent eating quality (bright color, sweet taste and luscious flavor) and nutritional composition (vitamins, minerals, fiber, and phytochemicals) [2]. It can play an important role in balancing human diet by providing about 64-86 calories of energy per 100 g [3] and, when consumed regularly, can be a valuable dietary source of many phytochemical compounds [4]. Also, fruit is an excellent source of vitamin C, its content ranging from 32 to 200 mg per 100 g of edible pulp [5].

World production reached 39 million tons in 2009, followed by banana, pineapple, papaya and avocado [6]. Mango is an important horticultural crop in Sudan. It has economic importance and produced almost all around the year in different parts throughout the country. It also has a domestic and international demand in markets, being a popular fruit with high nutritive value and palatable taste [7]. Mango is cultivated in about 67000 feddans in the country, representing 60% of total Sudan export of horticultural crops [8].

There are more than 30 traditional mango cultivars in addition of hundred seedling cultivars in Sudan. Most mangoes

grown in Sudan are mono embryonic cultivars such as Abusamaka. Kitchener is one of the seedling cultivars grown in Sudan. Tommy Atkins is of the newly cultivar introduced from South Africa [9].

The aim of the present study is to evaluate the physico-chemical characteristics of the introduced mango cultivar Tommy Atkins and compare it with Kitchener and Abusamaka cultivars.

II. MATERIALS AND METHODS

This experiment was carried out in the Faculty of Agriculture and Natural Resources, Department of Horticultural Science, El-Deuim – Sudan, during two successive seasons (2013 and 2014). Three mango cultivars (Tommy Atkins, Kitchener and Abusamaka) were collected from a private orchard in Kamlin (15° 04'N-33° 11'E), central Sudan. Fully matured fruits were harvested when so ever ready in each cultivar and were ripened under room temperature. Selected fruits were uniform and undamaged with no visible symptoms of infection. The experiment was laid out in randomized complete design with three replications.

The physical characters included fruit weight (gm), fruit length(cm), fruit width (cm), pulp weight (gm), pulp width (cm), peel weight (gm), peel width (cm), seed weight (gm), seed width (cm), and seed lengths (cm) were recorded.

The chemical characters included TSS, which measured by a hand refractometer, titratable acidity, ascorbic acid, moisture content. Ash (%) and total sugars were estimated following the methods of AOAC [10].

Statistical analysis

Data were subjected to analysis of variance using MStatC computer program. Mean separation was done according to Duncan's Multiple Range Test (DMRT).

III. RESULTS AND DISCUSSION

Physical characteristics

The fruit physical characteristics of the three mango cultivars in central Sudan in 2013 and 2014 seasons are shown in Table (1 and 2, respectively).

Fruit weight

Cultivars showed significant differences in fruit weight in two seasons. Tommy Atkins cultivar showed the highest value of

fruit weight in the two seasons while, the local cultivar Kitchener showed lowest fruit weight values. These findings are in agreement with [11] who reported significant differences in fruit weight between ten mango cultivars. The variability in fruit weight might be due to genotypic and management practices [12].

Fruit size

Cultivars showed significant differences in fruit length and width in two seasons. Abusamaka was obtained the highest fruit length in two successive seasons. It was noted that Kitchener had the smallest fruit length. The highest fruit width value was obtained with Tommy Atkins cultivar. There were no significant differences between Abusamaka and Kitchener in fruit width, and they showed lowest values in successive seasons.

Fruit size (length and width) major quality indices play a main role for the success of any fruit cultivars. These results are in agreement with previous research finding of [13 and 14], who reported that, the range of fruit length from 6.35 to 12 cm and fruit width from 4.26 to 7.90 cm. Furthermore, several workers have studied the fruit size of mango and stated that mango cultivars differed in fruit length and width according to their genetic makeup [11].

Pulp weight

Our results showed significant differences between cultivars in the pulp weight in the two seasons. The highest pulp weight was obtained in Tommy Atkins cultivar, and the lowest value was obtained in Kitchener cultivar. This variation may be due to varietal differences [12].

Pulp thickness

Cultivars showed significant differences in pulp thickness in 2013 and 2014 seasons. Tommy Atkins was obtained the highest pulp thickness values in two seasons.

Seed weight

There were significant differences among cultivars in seed weight in the two seasons. Tommy Atkins had the heaviest seed weight. These findings are similar to those found by [15] who reported that as the fruit weight and size in different cultivars varied, seed weight also differed within the cultivars.

Seed length

There are significant differences between cultivars in seed length in the two successive seasons. The longest seed was obtained in Abusamaka cultivar, while Kitchener obtained shortest seed length. These findings are in agreement with those reported by [16] who worked in three cultivars of mango and found significant differences between cultivars in seed length.

Seed width

Cultivars showed significant differences in seed width in the two successive seasons. The highest seed width values were obtained in Abusamaka and Tommy Atkins in seasons 2013 and 2014, respectively.

Peel weight

Peel weight varied significantly among mango cultivars in the two successive seasons. The heaviest peel weight values were obtained in Tommy Atkins and Abusamaka in seasons 2013 and 2014, respectively. These findings are similar to those found by [17] who reported significant difference in peel weight in nineteen mango cultivars.

Peel thickness

There were no significant differences among mango cultivars in peel thickness in the two seasons.

Chemical characteristics:

The fruit chemical characteristics of the three mango cultivars in central Sudan during 2013 and 2014 seasons are shown in Table (3 and 4), respectively.

Total acidity (TA)

There were no significant differences on TA among the three cultivars in the first season. There were significant differences on TA among three cultivars in the second seasons. Kitchener showed the highest TA values in the two successive seasons. These findings are in line with those reported by [18] who worked in four mango cultivars and found significant differences on TA among the mango cultivars. Along the same lines, [12], who worked on five mango cultivars in India, found that TA varied among mango cultivars.

Ascorbic Acid (Vitamin C)

There were significant differences on ascorbic acid content between the three cultivars in the two successive seasons. Our results showed that the ascorbic acid content was ranges from 123.6 mg/100g in Tommy Atkins in 2013 to 98.67 mg/100g in Kitchener in 2014 season. Tommy Atkins obtained the highest vitamin C content in the two successive seasons. These findings are in line with those reported by [16] who worked in three mango cultivars and found that Tommy Atkins have the maximum vitamin C content. Furthermore, [19] and [20] reported that the great variation in vitamin C content varied according to mango cultivar.

Total Soluble Solids (^oBrix)

TSS content is considered as a measure of quality for most of the fruits. There were significant differences between cultivars in the two successive seasons in TSS of fruit. The maximum TSS contents were detected in the pulp of the local mango cultivar Kitchener, which was consistent with the higher content of total sugar. Tommy Atkins cultivar had the lowest content of total soluble solids. These results are in line with those reported by [12 and 18] who found significant differences between cultivars in TSS content.

TSS has a strong implication on the choice of fruit for processing as well as fresh consumption, TSS of 15° Brix and above at ripe stage is recommendable for products like fruit juices, nectar and jam products [21].

Moisture percentage

Moisture content percentage varied significantly according to mango cultivars during the two successive seasons. Tommy Atkins cultivar had the highest moisture content percentage in

the two seasons (80.89% in 2013 season and 85.04% in 2014 season), followed by Abusamaka cultivar (77.29% in 2013 season and 84.51% in 2014 season) while, Kitchener cultivar had the lowest moisture content percentage (45.57% in 2013 season and 83.44% in 2014 season).

These results are in full agreement with those found by [16] they found that the Tommy Atkins mango cultivar fruits recorded the highest moisture percentage in two seasons. Along the same lines, [22] reported that the great variation in moisture percentage differed according to mango cultivar.

Ash contents

Cultivars showed significant differences in Ash contents. Maximum ash contents were noticed in Kitchener cultivar in two seasons, while the minimum ash contents were found in Tommy Atkins and Abusamaka cultivar in seasons 2013 and 2014, respectively. The present results for ash contents are in line with the results obtained by [23] who reported significant differences between three Sudanese mango cultivars in ash contents.

Total sugars percentage

Total sugars percentage differed significantly according to mango cultivars. Kitchener cultivar had the highest total sugars percentage in the two seasons (43.10% in 2013 season and

71.70% in 2014 season), followed by Abusamaka cultivar (41.78% in 2013 season and 59.75 % in 2014 season) while, Tommy Atkins cultivar had the lowest total sugars percentage (36.50% in 2013 season and 48.2% in 2014season, respectively). These results are in agreement with the findings of [24, 19 and 16] they found that the great variation in total sugars percentage differed according to mango cultivar. The variation in sugar contents between different mango varieties may be attributed to physiological changes and polysaccharides metabolism during ripening process that contribute to accumulation of sugars [25].

IV. CONCLUSIONS

The present study revealed that different mango cultivars presented different physic-chemical characteristics, which are important factors for evaluating the characterization of mango cultivars with regard to their nutritional value and potential use for different products. The introduced cultivar Tommy Atkins showed the highest value in weight and less TSS value so it can be used for fresh consumption or export while, local cultivar can be used for products like fruit juices, nectar and jam due to its highest TSS values.

Table (1): Fruit physical characteristics of the three mango cultivars in central Sudan during season 2013

Cultivars Characters	Fruit weight (gm)	fruit length (cm)	fruit width (cm)	pulp weight (gm)	pulp thickness (cm)	seed weight (gm)	seed length (cm)	seed width (cm)	peel weight (gm)	peel thickness (cm)
Kitchiner	166.43c	8.08c	6.21b	115.8 c	1.412b	31.91a	6.80c	4.01a	21.89c	0.2811
Abu samaka	261.50b	11.98a	6.46b	213.8b	2.283a	25.37b	10.43a	1.76b	31.7b	0.7800
Tommy Atkins	354.17a	9.84b	7.82a	291.1a	2.732a	31.62a	8.36b	1.84b	39.67a	0.2022
Sig.	**	**	**	**	**	*	**	**	**	NS
C.V (%)	28.03	10.26	7.46	25.04	10.78	23.69	9.15	10.96	18.95	26.89

Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.

*, ** and NS indicate significance at P≤0.05, 0.01 and not significant, respectively.

Table (2) Fruit physical characteristics of the three mango cultivars in central Sudan during season 2014

Characters Cultivars	fruit weight (gm)	fruit length (cm)	fruit width (cm)	pulp weight (gm)	pulp thickness (cm)	seed weight (gm)	seed length (cm)	seed width (cm)	peel weight (gm)	peel thickness (cm)
Kitchener	141.3c	8.39c	6.178b	98.93c	2.086b	25.37b	6.546c	3.906b	19.63c	0.1111
Abu samaka	235.8b	12.17a	6.022b	178.0b	2.081b	24.74 b	10.23a	3.616b	34.28a	0.1333
Tommy Atkins	275.5a	9.04b	7.611a	216.1a	3.080a	27.81 a	7.611b	4.174a	28.90b	0.1000
Sig.	**	**	**	**	**	*	**	*	**	NS

C.V (%)	15.73	5.39	7.51	12.53	12.72	11.40	6.41	8.87	13.82	29.03
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Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.

*, ** and NS indicate significance at P≤0.05, 0.01 and not significant, respectively.

Table (3): Fruit chemical characteristics of the three mango cultivars in central Sudan during season 2013

Characters Cultivars	Total acidity (citric acid %)	Ascorbic Acid (mg/100g)	TSS (° Brix)	Moisture (%)	Ash (%)	Total Sugars (%)
Kitchener	0.7333	108.3b	16.03a	45.57c	0.64 a	43.10a
Abu samaka	0.5867	122.8a	16.00a	77.29b	0.51b	41.78a
Tommy Atkins	0.2722	123.6a	11.29b	80.89a	0.422c	36.50b
Sig.	NS	**	**	**	*	**
C.V (%)	3.88	4.86	11.17	8.28	18.35	3.88

Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.

*, ** and NS indicate significance at P≤0.05, 0.01 and not significant, respectively

Table (4) Fruit chemical characteristics of the three mango cultivars in central Sudan during season 2014

Characters Cultivars	Total acidity (Citric acid %)	Ascorbic Acid (mg/100g)	TSS (Brix)	Moisture (%)	Ash (%)	Total Sugars (%)
Kitchener	0.501a	98.67b	16.06a	83.44b	0.56a	71.70a
Abu samaka	0.351b	101.7ab	9.813b	84.51ab	0.36 c	59.75b
Tommy Atkins	0.400b	103.0a	9.551b	85.04a	0.43 b	48.24 c
Sig.	**	**	**	**	*	**
C.V (%)	8.03	7.97	10.80	2.94	19.68	0.39

Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.

* and ** indicate significance at P≤0.05, 0.01, respectively

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