4

Revista Geama

2

Physico-Chemical Characterization and Dietary Fiber of Mango (*Mangífera indica L.)* Grown in Northeast of Brazil

Maria R. F. Padilha[1*] Nonete B. Guerra[2], Samara A. C. Andrade[3], Neide K. S. Shinohara[1] and José Machado[1]

[1] Departamento de Tecnologia Rural, Universidade Federal Rural de Pernambuco, Recife – PE, Brazil
[2] Departamento de Nutrição, Universidade Federal de Pernambuco (UFPE), LEAAL, Recife – PE, Brazil.
[3] Departamento de Engenharia Química, Universidade Federal de Pernambuco (UFPE) Recife – PE- Brazil.

Article informations
Received: Novembro 01, 2017
Acepted: Dezembro 21, 2017
Published: Abril, 2018

Todos autores contribuíram de forma igualitária

ABSTRACT

Numerous studies show that eating fruits has been inversely linked with chronic disease, type hypertension and significant reduction in the risk of cardiovascular events. And this balanced natural combination of bioactive compounds present in fruits and vegetables cannot be mimicked by industrialized food. Therefore, it is important to encourage the consumption of natural foods, but for this we must know your existing content in foods. Three mangoes cultivars (*Mangifera indica L.)* were evaluated for physico-chemical characterization and dietary fiber during their development (unripe and ripe) and after post-harvest treatments. The results are in agreement with the evolution of the analyzed parameters between the development stages studied and show that regardless the post-harvest treatment, the fruits didn't lose the ability to ripe. At the ripe stage, the highest total dietary fiber was presented by Espada and Tommy Atkins cvs. From these data, at quantitative level, mangoes can be considered a good source of dietary fiber, thus potentially beneficial to human health.

Keywords: maturation's stage, analyses, dietary nutrient

Introduction

Ingestion of fruits and vegetables has shown to reduce the development of a number of chronic diseases, such as hypertension, cancer and coronary artery disease. These benefits are associated with an intake of fiber - bioactive compound - of at least 30 g / day, as well as a variety of fiber source foods: fruits, vegetables, whole grains and bran (MALTA et al. 2017; BERNAUD; RODRIGUES, 2013).

Brazil produces a great diversity of fruits. The country in 2013 (FAO) was the world food producer and a mango (*Mangifera indica L.*), one of the largest producers of tropical fruits, ranked 7th in world production, among the main fruit crops. The Northeast accounts for 27% of the national fruit production, where the culture of the mango is cultivated and is responsible for 9.0% of the production value of the region's sector with the export type fruits (VIDAL; XIMENES, 2016) .0

Despite this large production of Tommy Atkins, mango for exportation, local consumers preferred to eat native's cultivars as Espada and Rosa. However, very little information regarding their bioactive compounds are available in literature.

Due to the increasing interest in fruits and vegetables consumption and from the knowledge that their composition varies according to the origin, maturation's stage, post-harvest treatment and fruit cultivars, this work aimed at evaluating the total dietary fiber (TDF) content and physico-chemical characteristics of three mangoes cultivars grown in Northeast of Brazil.

Material and Methods

Sampling

Three lots of ripe, each one with 2 kg ± 0,1 and equal number of unripe (4 kg ± 0,1 each) of three mangoes cultivars (cvs.) were randomly collected according to the criteria, described in **table 1**, from small orchards in the metropolitan area of the city of Recife-Brazil and the Tommy Atkins cv. from

commercial plantation, Pérsico Farm, in Santa Maria da Boa Vista in São Francisco's Valley- PE.

Table 1. Criteria of collected of the mangoes cvs.

Cultivares	Development Stages	
	Unripe	Ripe (control)
Espada*	100% dark green	2/3 of the skin was bright green and 1/3 yellow or 100% bright green
Rosa*	2/3 of the skin was green light and 1/3 violet	2/3 of the skin was yellow and 1/3 pink-red or completely yellow
Tommy Atkins**	2/3 of the skin was green and 1/3 purple dark	2/3 of the skin was orange-yellow covered with dark red-purple

*Harvested according to the experience of the producer; ** Harvested at point of harvest 2, for immature fruits, and 3, for mature, according to the classification of Alves et al. (2002).

Sample Treatment

After the harvest, the fruits were selected, washed in chlorinated water and drained. The unripe samples were divided in two sub groups: A) whose fruit were peeled, ground, placed in polyethylene bags and stored in a freezer at -18 °C until analysis; B) whose fruit were submitted to different post-harvest treatment (PHT) for simulating the form in which the unripe mangoes get ripped for commercialization: PHT_1 - room temperature (30° ± 2° C and RH (Relative Humidity) 61 ± 9 %), covered with a plastic canvas, usually applied to Espada and Rosa mangoes and PHT_2 - refrigeration 11° ± 2 °C in 90% RH for 22 days, following transfer to ambient with temperature of 22 °C in RH 56 % to 64 %, for 5 days. At the end, the ripe fruits, regardless of the treatment, were processed as described for the sub group A. Identical procedure as described in A, was also applied to the control – samples harvested ripe.

Physico–chemical Characterization

Frozen fruits samples, from each lot, were thawed at room temperature, separately, homogenized in a mixer and submitted to the following assays: moisture and starch content, according Association of the Analytical Chemistry (AOAC, 2002); pH of diluted pulp by a pH – Metter; titratable acidity (TTA) was determined by titration with a 0,1 N NaOH solution, to pink coloration, using phenolphthalein as indicator, and expressed as % citric acid and total soluble solids (TSS) determined using a handheld refractometer and TSS/TTA ration for calculation.

Total Dietary Fiber Determinations

Total Dietary Fiber (TDF) was performed by the enzymatic gravimetric method of the Association of the Analytical Chemistry (AOAC, 2002) nº 991.43.

Statistical Analyzes

All samples were analyzed in triplicate and the results were subjected to statistical analysis of variance. Treatments mean were separated using the Duncan's test (p< 0, 05). In order to find the main variation trends between mango fruits from different cultivars, maturation stages and post-harvest treatment, data were processed according to principal component analysis (PCA) using Statistic Windows 7.0.

Results and Discussion

Physico-chemical characteristics of the three mango cultivars analyzed are described in **Table 2**. Moisture content was around 80%, with differences among cultivars, maturation stages and after PHT, being lower 3%. The Tommy Atkins which had the highest values, presented also significant (p>0,05) difference between maturation stages - ripe Tommy Atkins had lower value than the immature one. Differences were also detected after the PHT_2 in this cultivar and also with Espada. The pH except the Tommy Atkins after PTH_2 was < 4.5, very acid. This characteristic is desirable for industrial purposes, which gives the fruit, a higher resistance to microbial contamination (FORSYTHE, 2002). These results agree with the findings by Maia et al. (1986) for native's mangoes and with Andrade et al. (2016) for Tommy Atkins, both in ripe fruits. In terms of total soluble solids (°Brix), Rosa and Espada had the highest values regardless the maturation stage and PHT, while the Tommy Atkins, the lowest one, except when the fruits were harvested in the ripe stage. The considerable decrease in titratable acidity observed in theses fruits and in those submitted to the PHT_2, resulted in high TSS/TTA ration (60.63 and 80.73, respectively), when compared to the means TSS/TTA rations obtained for natives cultivars, mainly Espada (**Table 1**). According Morais et al. (2002), this tendency to reduce the TTA in function of the maturation stage and storage time, always result in higher TSS/TTA. This ration has been used to determining the maturation stage and the flavor's attributes of the fruit by producers and consumers, respectively.

Table 2. Physical-chemical and chemical characterization of mangoes harvested at different stages of development under different treatments Post-harvest.

Determinations	Manga Rosa			Manga Espada			Manga Atkins		
	Immature	Maduro		Immature	Mature	I	Immature	Mature	
	PC_1*			PC_1*			PC_2**		
	(at once)	(control)		(at once)	(control)		(at once)	(control)	
Humidity (%)	80,5±0,17^{Ba}	80,28±0,17^{Ba}	80,96±1,78^{Ba}	79,70±0,07^{Cb}	79,78±0,15^{Cb}	84,03±0,17^{Aa}	84,23±0,06^{Aa}	83,23±0,25^{Ab}	84,58±0,59^{Aa}
pH (%)	3,62±0,21^{Ab}	4,15±0,15^{Ba}	4,18±0,31^{Aa}	3,75±0,12^{Ab}	4,46±0,03^{Aa}	4,38±0,27^{Aa}	3,64±0,25^{Ab}	4,34±0,25^{ABa}	4,59±0,03^{Aa}
TTA (%)	0,68±0,03^{Ba}	0,44±0,10^{Ab}	0,39±0,07^{Bb}	0,81±0,03^{Aa}	0,40±0,01^{ABc}	0,67±0,05^{Ab}	0,78±0,01^{Aa}	0,32±0,02^{Bb}	0,20±0,01^{Cc}
TSS (%)	12,67±0,58^{Ab}	19,67±0,58^{Aa}	18,67±0,58^{Aa}	13,0±1^{Ab}	19,33±0,58^{Aa}	18,33±0,58^{Aa}	9,33±0,58^{Bc}	19,33±0,58^{Aa}	16,33±0,58^{Bb}
Starch (%)	7,79±0,62^{Aa}	1,01±0,22^{Bb}	0,70±0,05^{Cb}	6,71±0,02^{Ba}	1,14±0,09^{Bb}	1,33±0,08^{Bb}	8,22±0,20^{Aa}	3,76±0,20^{Ab}	1,52±0,11^{Ac}
Relação TSS/TTA	18,76±1,64^{Ab}	46,14±9,96^{Ba}	49,34±9,19^{Ba}	16,08±1,75^{Ac}	48,37±2,58^{ABa}	27,59±2,09^{Cb}	11,95±0,60^{Bc}	60,63±5,5^{Ab}	80,73±8,39^{Aa}

* PC1 - treatment applied to native cultivars (30 + 20 C and UR 61 + 9%); ** PC2 - treatment cooled to Tommy Atkins (11 + 20 C at 90% RH, for 22 days; set transfer to room temperature from 220 C in RH 56% to 64%, for 5 days); TSS- Total soluble solids; TTA- Titratable acidity; Equal farming, lower case letters the same as they are not, at 5% level by the Duncan Test; at the same maturation stage, in cultivars of equal capital letters which are not different, at the 5% level by the Duncan Test.

During their development the mango accumulated starch, nutritional reserves which during the ripening process, were transformed, until reaching insignificants levels or even completely disappearing, giving place to the accumulation of sugars especially sucrose (Moraes et al. 2000). These changes derive from phosphorolytic and hydrolytic reactions, whose mechanism is still not completely elucidated (TAIZ; ZEIGER, 2004). According the **Table 1**, Rosa, Espada and Tommy Atkins presented, after PHTs, a considerable decreased 91.01%, 80.18% and 81.51% in their starch content, respectively. Similar results were registered by Dutra (2004) for Tommy Atkins cultivated in the same region.

Dietary Fiber content was determined for estimate possible mango's linkage to human health. According the results, described in **Table 3**, the TDF content ranged from 1.49 (Rosa after TPH) to 2.63 g/ 100g (immature Tommy Atkins). In quantitative terms, this results are comparable with those obtained by Mendez et al. (1995) and Ramulo and Rao (2003), for ripe harvest mango's fruits. Among the cultivar, the lowest TDF content were presented by Rosa. Ripe fruits, regardless the cultivar and PHT presented a reduction in their TDF content due to chemical and enzymatic changes of the structural components of cellular walls (Souza et al. 2002). Research upon the influence of the PHT_2 on Tommy Atkins demonstrated one acceleration in the loss of firmness with the fruit transference to ambient temperature (Morais et al. 2002). According to Sauco and Galvan (1990) mangoes contain different quantities and kinds of fiber, capable to reduce postprandial glycaemic response and a potential effect on the control of blood glucose.

Table 3 – Dietary fiber content of three mangos cultivars, in different stages of maturation and post-harvest treatment.

Determination	Rosa mango			Espada mango			Atkins mango		
	Unripe	Ripe		Unripe	Ripe	PHT_1*	I Unripe	Ripe	
		PHT_1* (control)			(control)		PHT_2** (control)		
TDF	1,71± 0,05^{Ba}	1,51± 0,03^{Bb}	1,49± 0,0^{Bb}	2,60± 0,0^{Aa}	2,11± 0,06^{Ab}	2,04± 0,01^{Ab}	2,63± 0,01^{Aa}	2,17± 0,02^{Ab}	2,12± 0,0^{Ac}

TDF – Total dietary fiber; PHT_1 – Room temperature (30 ± 2^0 C and RH 61± 9 %); PHT_2 – (11 ± 2^0 C in 90% RH, for 22 days) followed by transference to ambient with temperature of 22^0C, in RH 56% to 64%, for 5 days. In the same cultivar, in the same analysis, equal lower case letters indicate that they don´t differ, at level 5%, by Duncan's test; in the same maturation stage, in different cultivars, in the same analysis, higher case letters indicate that they don´t differ, at level 5%, by Duncan's test.

An acceptable solution for the principal component analysis was reached when two dimensions of the model were found to be significant and explained 78,36 % of the total variance of original variables set (**Tables 2 and 3**). The first component (PC_1), accounting for 52 34%, of the total variance, is dominated positively by mangos characters namely which pH, °Brix,

ºBrix/acidity ration and negatively by starch and acidity. The second component (PC_2) which explain 26,02% of the total variance is characterized by positive loading, of moisture and total dietary fiber.association

The mango Espada demonstrated greater differentiation according to stage of maturation and post-harvest treatment: in stage immature reflected greater intensity of starch and acidity in the post-harvest by moisture and mature ºBrix, pH and ºBrix / acidity, which Tommy Atkins also describes this same stadium. Moreover, this cultivar in the immature stage as a group, the left upper quadrant, characterized by the TDF.

Conclusions

The results are in agreement with the evolution of the parameters analyzed between the stages of development studied and show that, independently of the post-harvest treatment, the fruits did not lose the capacity to mature. In addition to the physical-chemical characteristics suitable for the consumption of nature. These data confirm the general assertion that regular intake of mango fruit can contribute to a substantial intake of dietary fiber, especially soluble dietary fiber.

References

ALVES, R.E. et al. Colheita e pós-colheita. In: GENÚ, P.J. de C.; PINTO, A.C. de Q.(Ed.). Acultura da mangueira. Brasília: Embrapa, 2002. P. 381-405.

ANDRADE, F.A. et al. Efeito da injúria mecânica por impacto na qualidade físico-química da manga Tommy Atkins. Tecnologia & Ciência Agropecuária, v.10, n.1, p.69-73, 2016.

BERNAUD, F.S.R.; RODRIGUES, T.C. Fibra alimentar – Ingestão adequada e efeitos sobre a saúde do metabolismo. Arq Bras Endocrinol Metab. v.57, n.6, 2013.

ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTRY. (2002). Official methods of analysis of Association of Official Analytical Chemistry Internacional. Food Composition; Additives; Natural Contaminantes. (17th. ed.); (4th rev.). Maryland: AOAC Internacional.

DUTRA. P.R.S. (2004). Amido e sua inter-relação com o desenvolvimento e ponto de colheita de mangas (Mangífera indica, L.) cultivar Tommy Atkins. PhD Thesis, Universidade Federal de Pernambuco, Recife-Brasil.

FAO. Organização das Nações Unidas para a Agricultura e Alimentação. FAOSTAT. Divisão de estatística. 2013. Disponível em: <http://faostat3.fao.org/download/Q/ QC/E>. Acesso em: 02.03.2018.

FORSYTHE, S. J. Microbiologia da segurança alimentar. Tradução de Maria Carolina Minardi Guimarães; Cristina Leonhardt. Porto Alegre: Artmed, 2002. 424 p.

MAIA, G.A., SILVA, M.F.A, HOLANDA, L.F.F., MONTEIRO, J.C.S., ORIÁ, H.F., FIGUEIREDO, R.W. (1986). Estudo da maturação de algumas variedades de manga (*Mangifera indica* L.). Revista Brasileira de Fruticultura, 8, 2, 67-74.

MALTA, D.C.; BERNAL, R.T.I.; Andrade, S.S.C.A.; SILVA, M.M.A.; VELASQUEZ-MELENDEZ, G. Prevalência e fatores associados com hipertensão arterial autorreferida em adultos brasileiros. Rev. Saúde Pública v.51 supl.1 Epub June 01, 2017.

MENDEZ, M. H. M. , DERIVI, S.C.N. , RODRIGUEZ, M.C.R. , FERNANDES, M.L. (1995). Tabela de composição de alimentos. Niterói: Editora da UFF.

MORAES, D.M., PUSCHMAN, R., LOPES, N.F. (2000). Respiração e desenvolvimento de fruto de mangueira cv. Ubá. Revista Brasileira de Fruticultura, 22 (Esp.), 37-41.

MORAIS, P.L.D. de, FILGUEIRAS, H.A.C., PINHO, J.L.N. de, ALVES, R.E. (2002). Ponto de colheita ideal de mangas "Tommy Atkins" destinadas ao mercado europeu. Revista Brasileira de Fruticultura, 24, 3, 671-675.

RAMULO, P. & RAO, P.U.(2003). Total, insoluble and soluble dietary fiber contents of Indian fruits. Journal of Food Composition and Analysis, 16, 677-685.

SAUCO, V.G. & GAUVAN, D.I. (1990). Differnes between mango cultivars regarding their facility to be halved and spoon-eaten, and association witte fiber. Fruits, 45, 381-385.

SOUZA, J.P.de, PRAÇA, E.F., ALVES, R.E. , BELKIAN NETO, F. , DANTAS, F.F. (2002). Influência do armazenamento refrigerado em associação com atmosfera modificada por filmes plásticos na qualidade de mangas "Tommy Atkins". Revista Brasileira de Fruticultura, 24, 3, 665-668.

TAIZ, L. ZEIGER, E.(2004). Fisiologia vegetal, 3 ed. Porto Alegre: Artmed.

VIDAL, M.F.; XIMENES, L.J.F. Comportamento recente da fruticultura nordestina: área, valor da produção e comercialização. Caderno Setorial ETENE. ano 1, n. 2, outubro, 2016.