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Microbiological Safety and Selected Chemical Components of Local Sudanese Red and White Guava Cultivars

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Abstract

This study was conducted to evaluate safety and quality of local Sudanese red and white guava cultivars. Different analyses were conducted including the microbiological safety (TVBC, *E. coli, Staphylococcus aureus* and Yeast and mould), physicochemical properties (pH, firmness) and some chemical components (Moisture content, fat, ash, carbohydrates, phosphorus, potassium and vitamin C). The results revealed that, white flesh guava was higher TVBC (1.35 log10cfu/g, than the red flesh one 1.26 log10cfu/g). Moreover, both cultivars were yeast and moulds positive, however they were pathogenic E. *coli* and *Staphylococcus aureus* free. Thus they were safe for human consumption. Physicochemical properties and chemical components were significantly ($P<0.05$) affected by the guava cultivars except for fat content. White guava cultivar recorded higher values of pH, firmness, fiber, carbohydrate and phosphorous than the red one; whereas, the red guava cultivar contained the higher levels of moisture, ash, potassium and vitamin C. Therefore, both guava cultivars were safe but vary in their physicochemical properties and some chemical components.

Key words: Guava, Cultivar, Sudanese, Safety, Chemical components.

Introduction

Sudan has a great potential to produce a good quality fruits and vegetables. This is because of it's large areas of fertile soil, abundant amount of water from rivers, rains and underground source, suitable wide range of climate which allow variability of fruits (Basheer and Imam, 2010). One of the important fruit in Sudan is guava (*Psidium guajava L.*) which belongs to the family *Myrtaceae*. It considered as one of the most important tropical fruit trees in the world and major fruits of the Sudan (Mohammed, 2016). Six thousand hectare produce 112000 tons annually as reported by Elhassan (2016). Nowadays, with consumers' health awareness and the need to intake foods low fats, cholesterol and salt guava is a good choice. The guava fruit is an excellent source of vitamin C and pectin but has low energy (66cal/100g). The fruit is also rich in mineral like phosphorous, potassium, calcium and iron as well as vitamins like niacin, panthotenic acid, thiamin, riboflavin and vitamin A (Mitra and Bose, 2001).The guava includes about 150 species, but only a few have horticultural value. The common guava (*P.guajava*), the most important species is Guava (*P.cattlecianum*), which is also grown commercially. Many guava cultivars exist today, however they can be broadly classified as red or white (Yadava, 1996). In Sudan there are four clones of guava namely: Shendi (white pulp), Pakistani (white pulp), Gunib (red pulp) and Singa (white pulp) (Elhassan, 2016). In fact guava fruits are very perishable due to microbiological contamination and mechanical damages thus safety and quality approve are demanded to protect consumers. Furthermore, no much report on safety and quality of local Sudanese cultivars are available. Therefore, in this study microbiological safety and levels of selected chemical components of two guava cultivars was conducted.

Materials and methods

Raw materials

Fresh guava samples (White and red) were purchased from the central Market for fruits and vegetables at Bahri city (Khartoum State, Sudan), and transferred immediately in sterilized container to the National Food Research Center (NFRC), Agricultural Research, Ministry of Agriculture, Sudan.

Chemical and Reagent

Chemicals and reagents used for analysis were obtained from the Lab Line Company- Khartoum state. All the chemical and reagents were of analytical grades.

Raw materials

Fresh guava (white and red) were washed by clean and sterilized water and were for analysis.

Determination of physicochemical properties and chemical components

Fruit were analyzed for pH, firmness, moisture content, fat, ash, carbohydrates, phosphorus, potassium and vitamin C) according to AOAC (2005) methods.

Microbiological tests

Fruit were analyzed for total viable bacterial counts (TVBC), *E. coli*, *Staphylococcus aureus* and Yeast and mould according to Harrigan, and McCance (1976).

Statistical analysis

All the experimentally obtained data were analyzed using Minitab Statistical Software for windows (MINITAB, 2012).

Results and Discussion

1-Microbiological safety of white and red guava cultivars

Table 1, showed that, TVBC of fresh guava was significantly ($P<0.05$) affected by cultivars. White flesh reported the higher TVBC, while, the red flesh one was lower (Table 1). Matching result was reported by Ahmed (2006) who found that; white guava had higher TVBC of 1.37 $\log_{10}$ cfu/g, than red flesh 1.23 $\log_{10}$cfu/g. Similarly, Joshi (2017) found that, white guava had higher TVBC of 1.40 $\log_{10}$cfu/g, whereas, red one contained TVBC of 1.31 $\log_{10}$cfu/g. This could be attributed to the presence of higher vitamin C level in red guava as compared to white pulp as stated by Deshmukh *et al.* (20103).

As presented in Table 1, all guava samples under investigation were *E.coli* free as recommended by Sudanese Standardization and Meteorology Organization (SSMO) (2003). Similar finding was stated by Mourad (2017) who found that, white guava fruit was *E.coli* free. In contrast, Joshi (2017) and Ahmed (2006) found that, white and red guava fruit were contaminated with *E.coli*. Harris and Savill (2005) mentioned that *E. coli* is the best indicator for fecal contamination or state of un-hygiene. That is because this bacterium is a natural habitat in intestines of human and vertebrate animals (FAO, 1992).

Referring to the result in Table 1, both white and red guava cultivars were *Staphylococcus aureus* free. Similar results were reported by Joshi (2017). Deshmukh *et al.* (2017) and Mourad (2017). They all found that tested white and red guava were *Staphylococcus aureus* free. In

addition, FAO (1992) reported that, the presence of Staphylococci in food products indicates contamination from skin, mouth and nose of the person.

On the other hand, both white and red guava cultivars were yeast and moulds free (Table 1). Mohammed (2017) and Ahmed (2006) found that, white guava was yeast and moulds free; whereas, red one had contained yeast and moulds. Joshi (2017) also found yeast and moulds in raw white and red guava. The present of sugar in guava pulp could great suitable condition for yeast and mould growth.

Table 1: Microbiological safety of white and red guava cultivars

	Guava cultivars	
Type of microorganism (log_{10}cfu/g)	**White**	**Red**
TVBC	1.35^{a} (± 0.35)	1.26^{b} (± 0.02)
E.coli	Nil	Nil
Staphylococcus aureus	Nil	Nil
Yeast and mould	Nil	Nil

*Values are mean ± SD for replicate independent analysis

*Values that carry different subscript letters in same raw are significant different at ($P<0.05$)

2- Physicochemical properties of fresh white and red flesh guava cultivars

Table 2, illustrated that, pH value of guava was significantly ($P<0.05$) different between the two guava cultivars. White guava was higher in pH value than the red one recording values of 5.89 and 5.01, respectively. Similarly, Joshi (2017) found that, white guava pH was higher (5.07), than red flesh 5.00. Also comparable pH-value for red guava (5.0) was reported by Mohammed (2016). Byrne *et al.* (2000) stated that, pH influences fruit quality since it determines the traits that responsible for the processing suitability and effects shelf life and quality characteristics. The variation in pH between different types of guava could be attributed to different environmental factor such as: Soil, variety of guava, irrigation and stages of harvesting.

Referring to the result in Table 2, significant ($P<0.05$) differences in firmness between the two types of guava were declared. Clearly, white guava cultivar was more firm (1.2inch) than the red cultivar (0.9inch). Similar results were reported by Joshi (2017) who found that the firmness of

white and red guava cultivars were 1.4 and 1.1inch, respectively. Mohammed (2016) also found that, white guava cultivar was 1.2 inch firmness exactly similar to the result in Table 2. However, the result on firmness of guava reported by joshi (2017) was lower comparing to those displayed in Table 2. Lower firmness of 0.7 inch was also found by Mourad (2017). This variation in guava firmness could be attributed to fruit varieties, maturing degree and chemical composition.

Table 2: Physicochemical properties of fresh white and red flesh guava

	Guava cultivars	
Physical properties	White	Red
pH	5.89^{a} (±0.09)	5.01^{b} (±0.98)
Firmness	1.2^{a} (±0.06)	0.9^{b} (±0.05)

*Values are mean ± SD for replicate independent analysis

*Values that carry different subscript letters in same raw are significant different at ($P<0.05$)

3- Chemical composition of fresh white and red guava cultivars

Table 3, showed that, moisture content between guava fruit cultivars was significant ($P<0.05$). Red guava contained higher moisture level as compared to white one. Similar observation was reported by Joshi (2017) who reported that moisture content of red guava cultivar was higher than white one. Comparable moisture level to that presented in Table 3 amounting 79.84% was also reported by Mohammed (2016). However, lower moisture content for white guava flesh (64.80%) was also reported by Mourad (2017). A previous study by Ghosh and Chattopadhyay (1996) reported that, ripe guava generally contain 77.90% moisture. These variations in moisture could be attributed to different factor such as fruit varieties and cultivars variation and also to the maturity stage of fruit.

Table 3, illustrated that, there was no significant ($P<0.05$) differences in fat between the two guava cultivars. However, red flesh contained higher fat content of 0.68% as compared to white one (0.61%). Joshi (2017) stated that, fat content of guava fruit influenced by guava varieties. On the other hand, higher fat content in red guava (0.80%) was reported by Mohammed (2016). Comparable fat level for white guava (0.60%) was reported by Mourad (2017) as in Table 3.

Crude fat in range of 0.10-0.70% was reported for guava cultivars by Ghosh and Chattopadhyay (1996).

Table 3 showed significant ($P<0.05$) different in ash of guava cultivars. White and red flesh guava contained 0.87 and 0.97% ash, respectively. Mohammed (2016) found higher levels in white and red guava recording values of 0.97 and 0.99%, respectively. Whereas, lower ash amount in white flesh guava of 0.60%, was reported by Mohammed (2016). While Kumar (2015) found 0.86% ash in red guava flesh. The current result in Table for ash was outside the range reported by Morton (1987) which was 0.43- 0.70%.

As shown in Table 3 fiber content of guava significantly ($P<0.05$) influenced by the guava cultivars. These values of fiber (Table 3) were higher than the range of 2.8 - 5.5% observed by Morton (1987). Mohammed (2016) reported lower value of 9.1% in crude fiber for white flesh guava in comparison the result in Table 3. While Kumar (2015) reported lower value of 8.13% of crude fiber for red flesh guava. As stated by Joshi (2017) fruit varieties, soil type, climatic condition, genetic factors that can influence the chemical composition of the guava fruit.

Carbohydrate content was significantly ($P<0.05$) different between the two guava cultivars (Table 3). Carbohydrate content of guava cultivars ranged from 10.02% in red cultivar to 11.40% in white one. This variation could be attributed to the amount of sugar between the two guava types or cultivars as stated by Joshi (2017). Similarly, Morton (1987) and Ahmed (2006) reported that total carbohydrate in white flesh guava was higher than in the red one. Furthermore, Mourad (2017) stated that, at maturity state, starch is converted into sugar revealed by the sweet and soft at ripening stage.

	Guava cultivars	
Components	**White**	**Red**
Moisture	76.96^{b} (±0.86)	78.90^{a} (±0.2 6)
Fat	0.61^{a} (±0.36)	0.68^{a} (±0.54)
Ash	0.87^{b} (±0.46)	0.97^{a} (±0.26)
Fiber	9.67^{a} (±0.58)	8.96^{b} (±0.68)
Carbohydrate	11.40^{a} (±0.47)	10.02^{b} (±0.12)

Table 3: Chemical composition of fresh white and red guava cultivars

*Values are mean ± SD for replicate independent analysis

*Values that carry different subscript letters in same raw are significant different at (P<0.05)

3- Phosphorus and Potassium content of fresh white and red guava

Furthermore, guava fruit has also been reported to contain appreciable amounts of minerals such as K, P, and Ca (Joshi, 2017) which could significantly contribute towards meeting a person's daily dietary requirements. Mohammed (2014) stated that, phosphorus plays a vital role in the structure of cell membranes and virtually all metabolic processes. As in Table 4, White guava revealed higher phosphorus content (3.62mg/100g) than the red one (2.60mg/100g). Similar findings were reported by Ahmed (2006) who found that, white flesh guava contained higher amount of phosphorus (3.60mg/100g) as compared to red flesh one (2.89mg/100g). In contrast, Joshi (2017) found that, red flesh guava and white one had phosphorus content of 3.94 and 3.30mg/100g, respectively. Different factors affect phosphorus content of guava including soil composition, varieties and cultivars. In fact, Phosphorus plays a vital role in the structure of cell membranes and virtually contributes all metabolic processes (Mohammed, 2016).

Potassium is an essential mineral for maintaining normal blood pressure and heart function (Mohammed, 2016). Table 4, illustrated that, potassium content of different guava cultivars. As presented in Table 4, white and red flesh guava cultivars had potassium content of 97.00 and 101.00mg/100g, respectively. This result was in agreement with the findings by Joshi (2017). Who found that, red and white flesh guava contained potassium amount of 101 and 99.44mg/100g, respectively. In contrast, Paull and Goo (1983) found that white flesh guava had higher potassium content than the red one.Further, Ahmed (2006) reported that, potassium content was insignificant effect by guava variety.

Table 4: Mineral content of fresh white and red guava cultivars

	Guava cultivars	
Element (mg/100g)	White	Red
Phosphorus	3.62^{a} (±0.46)	2.60^{b} (±0.68)
Potassium	97.00^{b} (±0.93)	101.00^{a} (±0.97)

*Values are mean ± SD for replicate independent analysis

*Values that carry different subscript letters in same raw are significant different at (P<0.05)

4- Vitamin C content of fresh white and red guava cultivars

As stated by Deshmukh *et al.* (2013) guava is a rich source of vitamin C. Refereeing to the result in Table 5 showed that vitamin C varied significantly (P<0.05) by the guava cultivars. Obviously, the red guava cultivar contained higher vitamin C level of 260.46mg/100g than the white flesh one (236.00mg/100g). Similar noticed was establish by Ahmed (2006) who reported that, red guava had higher vitamin C (239.46mg/100g) when compare to the white one (232.46mg/100g). While, Ahmed (2006) found that vitamin C concentration for red fleshed guava was higher than the white- fresh one. Mowlah and Itoo (1983) stated that, vitamin C of guava fruit depends on the guava variety, genetic factor, soli composition, post-harvest treatments. In fact, vitamin C is commonly used to boost our immune system to fight colds and flu, it works as an antioxidant, destroying free radicals that can cause cancer and other diseases in body (ETFN, 2010).

Table 5: Vitamin C content of fresh white and red guava cultivars

	Types of guava	
Item	**White**	**Red**
Vitamin C	236.00^{b} (±0.86)	260.46^{a} (±0.86)

*Values are mean ± SD for replicate independent analysis**.**

*Values that carry different subscript letters in same raw are significant different at (P<0.05)

Conclusion

Based on the results obtained in the present study, the following conclusions can be drawn: TVBC of fresh guava was significantly (P<0.05) affected by the guava types. All guava were safe free of *E.coli* and *Staphylococcus aurues*. Whie guava was more firmness with high pH than the red one. While red guava was less firm having better moisture, vitamin C and potassium contents. Generally both guava cultivars were safe but their components differ significantly.

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