Influence of Drying Methods on Physicochemical Constituents of Guava Juice

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Abstract: The present work was conducted to evaluate physical properties and chemical constituents of fresh guava juice, dehydrated guava Juices into powdered by different drying methods (solar energy drying & freeze drying) and guava jam were determined. The result indicated that the a significant reduction in titratable acidity as citric acid and an increase in pH after drying of guava juice indicated that some acids were lost during the drying process. Ascorbic acid was considerably lower in solar energy compared to freeze drying were obtained from the guava juice. However, results showed that the solar dried product was stable and more economical to produce guava powder with good stability. The chromomeric parameters L (lightness), a (redness) and b (yellowness) were found to be affected by drying methods. However, the freeze dried product had superior nutritional value… value. Processing of guava jam by using solar energy improved parameters. Generally, results confirmed that the highest physical and chemical parameters as well as quality characteristics were recorded for solar energy produced guava jam.

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Key words: Guava powder, freeze drying, solar drying, guava jam.

1. Introduction:

There is an increasing demand for healthy products, natural and high quality, among Kingdom of Saudi Arabia consumers. Furthermore, the demand for commercial fruit juice products is growing due to the development in nutrition; biochemical surveying and public awareness towards health.

Guava (*Psidium guajava* L.) is a perennial tree fruit of tropics and subtropics offering great economic potential (***Kosky et al., 2005)***. It's rich source of citric acid, lycopene, vitamins (A, C, niacin and riboflavin), omega-3 and -6 polyunsaturated fatty acids with especially high levels of dietary fiber, dietary minerals (magnesium, and potassium). It contains flavonoids like myricetin and apigenin which required by human body for optimal health ***(Suntornusk et al., 2002; Leite et.al, 2006; Manosroi, 2006; Sidhu, 2006; Adrees et al., 2012 and Usman et al., 2013).***

Guava not only possesses a unique taste, flavor, aroma and texture but also has excellent overall nutritive quality. Hence, guava is often promoted as a health fruit which is equal to or better than most other fruits. Guava is processed in various commercial guava products including puree, paste and canned slices in syrup. Among these products, the guava juice has become economically important in the market. Some recent studies indicated that fruit juices have curative potential due to the presence of anticarcinogenic agents, thereby raising much interest ***(Kordich, 2007 and Akesowan & Choonhahirun 2013).***

Drying refers to a process in which moisture is removed from a solid using heat as the energy input. In many agricultural countries large quantities of food products are dried to improve shelf life, reduce packing costs, lower shipping weights, enhance, retain original flavors and maintain nutritional value. Moreover, removal of moisture during drying resulted in an increase in concentration of nutrients in the remaining mass. Hence, proteins, fats and carbohydrates are present in large amounts per unit weight in the dried food than in the fresh. However, the mechanism of drying is a complex phenomenon involving combined heat and mass transfer, and in most cases, resulting in products with modified properties, depending on the drying conditions, food products may undergo various degrees of browning, shrinkage and loss of nutrients ***(Hawlader et al., 2006).***

Rosenfeld & Nes (2000) reported that, sensory quality is important when assessing cultivars for fresh consumption as well as for the processing industry. Important quality attributes for fresh consumption were found to be color, taste and flavor. The quality of processed fruits differs considerably from that of fresh fruits. On the other side, ***Ricardo-Lopez et al., (2000)*** studied the physic-chemical and microbiological evaluation of three commercial guava Jams (*Psidium guajava L.*). The average physical and chemical values were vacuum = 38.81 Cm Hg; pH = 3.28; titratable acidity (% citric acid) = 0.59%; degrees Brix = 67.24; reducing sugars = 55.28% total sugars = 62.28 and the color parameters "a" = 14.44, "b" = 8.77; and "L" = 17.09. In agreement with variance analysis, there were highly significance differences between the samples and among the shares of each sample for all physical and chemical properties evaluated. On the other hand, the variation of guava juice yield was a function of enzyme hydrolysis pretreatment conditions including enzyme concentration, temperature and incubation time, and other quality parameters such as clarity, TSS and ascorbic acid investigated by ***Kaur et al. (2009) and Usman et al. (2013).***

The objectives of the present study have been carried out to investigate the physical and chemical characteristics of guava fruits, utilize guava in processing different guava products, such as, powders (produce by two methods) and Jam (produce by two methods) and compare between the different processing methods.

2. Materials and Methods

Materials:

Guava Fruit (*Psidium guajava L.*) and sugar were obtained from the local market. All chemicals were obtained from Kingdom of Saudi Arabia, Jeddah.

Preparation and Drying of Guava Juice:-

The white fleshed guava was washed, sorted and trimmed; the juice was extracted, strained pasteurized at 90˚C for 3 min., and directly cooled to 25˚C. Two grams of ascorbic acid and one gram citric acid were added to each kilogram of guava juice and stirred till being dissolved. The juice was divided into two portions:-

(a) The first portion was dried by using the solar energy dryer, the temperature ranged between 50 - 55˚C for about 50 hours.

(b) The second portion was dried by using freeze-dryer at 40˚C for 72 hours.

Preparation of Guava Jam:-

One kilogram of guava fruit juice was thoroughly mixed with 1.25 kilogram of sugar. Three grams of citric acid was added to the above mentioned mixture to adjust pH value to (3.3). The mixture (TSS 48%) was concentrated to 73% TSS by two methods: (1) cooking in stainless steel pan using direct heat as described by ***Tressler & Woodroof (1976),*** (2) solar concentration in solar drier at 40 - 55˚C. Each was divided into two portions. The first portion was processed by adding 0.05% sodium benzoate and 0.05% sodium sorbet. The second portion was processed without any additives. After complete processing, Jam was packed in clear glass jars, tightly closed and pasteurized at 60˚C for 30 min.

Methods of Analysis:-

- Moisture content, total soluble solids, total titratable acidity, pH values, fiber and ash were determined according to ***A.O.A.C. (2005).*** Ascorbic acid was determined as described in methods of vitamin assay ***(Anonymous, 1986).*** Total sugars were determined according to ***Smogy, (1952) and Nelson, (1974).***

- Color values: Color values were measured with Minolta Chroma Meter (CM 3600d, Minolta, and Ramsey, NJ) (**Ruiz,** *et al.,* 2005). The measurements were displayed in "L", "a" and "b" values. Chroma "C" and hue angle "h" were calculated by using the following equation:

- Chroma = $\sqrt{a^2 + b^2}$ hue = arc tan (b/a)

Determination of color index: Color index was determined according to ***Ranganna (1979).***

Viscosity of Jam: Viscosity of guava jam was measured at 25˚C using Brookfield Viscometer model DV – III Rheometer using spindle No.7. The viscosity was expressed as centipoises according to ***Ranganana (1979).***

3. Results and Discussion

Physical and chemical characteristics of fresh Guava Juice:

In the present study physical properties and chemical compositions of fresh guava juice were determined and the results presented in Table (1). It could be noticed that, guava Juice contained 52.64% total sugar, 14.20% fiber, pH value 4.21% and 495 mg/100 gm vitamin C (dry weight basis).

Our data was agreement with **Ashaye *et. al.* (2005),** studied the chemical and organoleptic characterization of pawpaw and leathery guava. Guava was significantly higher crude fiber (2.67%), carbohydrates (74.50%), ash (2.87%) and vitamin C (237 mg / 100 g). on the other hand, **Carbral *et al.* (2007)** reported that, the guava pulp contained 5.22 g / 100 fibers, total sugars and ash were (7.85 & 0.59 g/100 gm), while, total ascorbic acid was 218.4 mg/100g, and moisture content was 84g / 100g respectively.

In fact, our results in Table (1) indicated that the guava juice was also high in titratable acidity, TSS and ascorbic acid, but low in pH and absorbance values. This can be explained that pectinase, which include pectin methyl esterase and polygalacturonase, assist in pectin hydrolysis. Their reactions cause a release of carboxylic acids and galacturonic acids. This leads to a decrease in puree viscosity and pH of juice, but a significant increase in titratable acidity and juice yield published by **Tadakittisarn *et al.* (2007)** and **Akesowan & Choonhahirun (2013).**

Effect of Drying Technique on Physicochemical Constituents of Guava Juice:-

The effect of dehydration methods on the physicochemical constituents is presented in Table (2). From this table, it could be observed that, reducing sugars content showed no significant decrease during the using any of the drying methods. On the other hand, there was slight increase in non-reducing sugars. As for total sugars, their values of increasing were negligible. On the other hand, **Mahendran (2010)** revealed that there was a reduction in total sugars in the guava powder, which may be due to non-enzymic browning reactions during drying of guava juice

Moreover, concerning acidity, it was quite affected by using solar drying method. The lowest decrease in acidity content was found in the freeze-dried guava juice. Confirmed by **Mahendran (2010)** published that during drying, a significant reduction in titratable acidity of 0.22% as citric acid and increase in pH of 0.44 after drying of guava juice indicated that some acids were lost due to evaporation during drying.

It is clear also from Table (2), that ascorbic acid content of the guava juices was more affected by using solar drying method than using freeze-drying method. The difference should be attributed to the higher temperature, used in solar drying method compared to that used in Freeze-drying method. According to **Askar *et al.* (1992)** showed that ascorbic acid was lost during drying as a result of high temperature and oxidation, while, **Mahendran (2010)** reported a 15% loss of ascorbic acid in freeze dried guava pulp.

As for color index, clear differences were observed in the color of the two dried products under investigation as shown also in Table (2). The guava powder prepared by solar drying was markedly darker than those obtained by Freeze-drying method; hence their color index was 0.095 and 0.016, respectively. This could be attributed to that a part of reducing sugars could be involved in a Millard reaction forming dark compounds, which resulted in a darker color of the products prepared by solar drying method than that obtained by Freeze-drying method. **Hawlader, *et al.* (2006)** reported that, removal of moisture content during drying resulted in an increase in concentration of nutrients in the remaining mass. However, the mechanism of drying is a complex phenomenon involving combined heat and mass transfer, and in most cases, resulting in products with modified properties, depending on the drying conditions, food products may undergo various degrees of browning, shrinkage and loss of nutrients.

Data in Table (3) show the color measurements by Hunter lab as "L". "a" and "b" Factors for guava pulp, results were 76.90, -1.70 and 20.20 for these values, respectively. Also, the same table shows the effect of solar energy drying and Freeze-drying process of guava juice.

The Hunter color difference meter (L) recorded lower values for the sample processed by solar drying (59.90) compared with fresh guava juice. The same trend was noticed for chroma and hue values concerning, "b" values; the less darkness was noticed for Freeze-drying process compared with fresh guava juice. These results agree with **Ginat (2000)** and **Okilya *et al.* (2010)** they found that the solar dried had the lowest values for (L), (b) and hue. The various drying methods were found to have a significant effect on the colour parameters of the guava powder. Also, this is in agreement with the results of **Tashtoush *et al.* (2007)** and **Mahendran (2010)** they showed that an increase in Hunter L* (lightness) values and b* (yellowness) values following production of guava powder was probably the result of non-enzymic browning during freeze drying which produced a light yellow product. Our results confirmed that there were several methods may be used for production of guava powder, but in fact, the most successful methods include freeze drying.

Changes in Physical and Chemical Parameters of Guava Juice as Affected by Concentration:

Guava Juice after addition for sugar was processed into Jam by concentrated using heat. The used heat was supplied either by direct heating and solar energy drying. The physical and chemical parameters of the produced Jam were evaluated as presented in Table (4). Results showed that the produced guava Jam characteristics were affected by the method of processing solar energy produced jam having higher TSS, total sugars, ascorbic acid, viscosity and color index with less darkness effect compared to that produced by direct heat. Total acidity and pH values and color index values were increased in direct heat compared to other method.

This indicated that processing of guava jam by using solar energy improved parameters. Generally, results showed that the highest physical and chemical parameters as well as quality characteristics were recorded for solar energy produced guava jam. These results were agreement with **Aziza (2009).**

Table (1): Physical and Chemical Characteristics of Fresh Guava Juice

Component (%)	Fresh Weight basis	Dry Weight basis
TS.	14. 18	100.00
TSS	8.70	61.35
Reducing sugars	2.68	18.93
Non-reducing sugars	4.78	33.71
Total sugars	7.84	52.64
Ash	0.96	6.77
Fiber	2.01	14.20
pH Value	4.21	4.21
T. acidity (as citric acid)	0.44	3.10
Ascorbic acid (mg/100gm)	70.00	495.00
Moisture Content	85.82	---

Table (2) Effect of Drying Methods on Physico-chemical Constituents of Guava Juice (dry weight basis)

Component (%)	Fresh Juice	Solar Energy Drying	Freeze-drying
Reducing sugars	18.93	18.63	18.92
Non-reducing sugars	33.71	34.01	33.74
Total Sugars	52.64	52.62	52.66
pH- Value	4.21	4.18	4.23
Total acidity	3.10	2.70	3.08
Ascorbic acid (mg / 100g)	495	240	405
Color index	0.010	0.095	0.016
Rehydration time (min.)	---	6.5	3
Moisture Content	85.82	8.54	6.18

Table (3): Color Parameters of Fresh Guava Juice and Dehydrated Guava Juices

Color	Fresh Guava Juice	Solar Drying	Freeze-Drying
L	76.90	59.90	68.50
a	-1.70	-3.90	- 0.80
b	20.20	10.90	13.90
Chroma	20.70	11.57	13.92
Hue	-0.084	-0.36	- 0.058

Table (4): Changes in Physico-chemical Parameters of Guava Jam

Component (%)	Jam without additives		Jam with Sorbe and Benzoat	
	Direct heat	Solar energy		
TSS	69.00	69.00	73.00	73.00
Total sugars (mg/100gm)	59.21	63.14	59.32	63.21
Total acidity	4.11	3.29	4.29	3.77
pH value	3.02	3.69	3.00	3.03
Ascorbic acid (mg/100gm)	11.90	20.96	12.13	21.87
Color index	0.501	0.092	0.312	0.083
Viscosity (cintpose)	16200	135000	130000	270000

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