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Physiochemical, microbiological and sensory properties of guava whey blend beverages

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ABSTRACT

Six blends of different ratios composed of sweet whey and guava pulp were prepared to produce new beverage blends. Prepared samples named blend 1 (100% sweet whey), blend 2 (10% guava + 90% sweet whey), blend 3 (20% guava + 80% sweet whey), blend 4 (30% guava + 70% sweet whey) blend 5 (40% guava + 60% sweet whey) and blend 6 (50% guava + 50% sweet whey). Physiochemical, microbiological and sensory properties of whey beverages and guava pulp blend at different mixing ratios were evaluated during storage at room temperature (25±5°C) for 3 months. The acidity of beverage samples were gradually increased during storage periods. Meanwhile, the loss percentage of ascorbic acid contents increased with increasing the storage time. Lactose and calcium content of guava beverages samples slightly decreased. Microbial analysis of prepared beverages revealed that, total bacterial counts, yeast and molds counts gradually decreased with increasing storage period. On the other hand, sensory attributes of guava whey beverages samples during storage for 0 and 3 months indicated that, guava whey beverage blend 5 had the highest organoleptic scores followed by blend 6, blend 4 blend 3, blend 2 and Blend 1.

***Keywords*:** Physiochemical, microbiological, sensory evaluation, guava whey blends, guava pulp, sweet whey.

Introduction

Guava is often marketed as "super-fruits" which has a considerable nutritional importance in terms of vitamins A and C with seeds that are rich in omega-3, omega-6 polyunsaturated fatty acids and especially dietary fiber, riboflavin, as well as in proteins, and mineral salts. The high content of vitamin C (ascorbic acid) in guava makes it a powerhouse in combating free radicals and oxidation that are key enemies that cause many degenerative diseases. The antioxidant virtue in guavas is believed to help reducing the risk of cancers of the stomach, esophagus, larynx, oral cavity and pancreas. The vitamin C in guava makes absorption of vitamin E much more effective in reducing the oxidation of the (bad) LDL cholesterol and increasing the (good) HDL cholesterol. The fibers in guavas promote digestion and ease bowel movements. The high content of vitamin A in guava plays an important role in maintaining the quality and health of eyesight, skin, teeth, bones and the mucus membranes (Dattatreya *et al.,* 2012).

Guava fruit consists of 20% peel, 50% flesh portion and 30% seed core. It also contains 74-84% moisture, 13-26% dry matter, 0.8-1.5%protein, 0.4-0.7% fat and 0.5-1.0% ash and the fruit is considered as an excellent source of vitamin C (299 mg/100 g) and pectin (1.15%) as reported by Wilson, (1980). The fruit has an appreciable amount of minerals such as phosphorus (23 - 37 mg/100 g), calcium (14 - 30 mg/100 g), iron (0.6 - 1.4 mg/100g) as well as vitamins like Niacin, Thiamine, Riboflavin and Vitamin A (Paul and Goo, 1983 and Bose and Mitra, 1999). The fresh guava has a short shelf life (one week), for its high moisture content (Singh *et al*., 1990). The post-harvest losses occur to reach about 22% (Bons and Dhawan, 2006). Guava fruit is normally consumed as fresh as a dessert fruit or in processed form as puree, juice, concentrate, jam, jelly, toffee, fruit flakes, squash, syrup, nectar, powder, wine, vinegar, ready to use snacks, drinks and dehydrated canned products (Lalit *et al.,* 2014).

Over the years, numerous approaches have been taken in an effort to transform a large volume of whey into products suitable for use as food. Whey is one of the major byproducts of the cheese and casein industry (Sienkiewicz and Riedel 1990). Whey is a source of vitamins and minerals as well as a source of high-quality proteins, among which sulfur amino acids are particularly valuable owing to their anticancer activities (Mirjana *et al.,* 2004). Numerous procedures have been developed for improving

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its characteristics aiming to enable its direct utilization by human as (concentrates, juices, syrups pulps and nectars) whey recognized as a genuine thirst quencher, light refreshing healthful and nutritious (Prendergast, 1985). Whey based fruit beverages are more suitable for health as compared to other drinks Sarvana, (2005). Whey and its biological components have proven its effects in treatments of cervical chronic diseases like cancer, cardiovascular, HIV etc. As it is nutritionally too rich, it can also be used in beverages of infant Geriatric and Athletic foods (Devera, 2005).

Whey is the aqueous fraction produced in large amounts as a sub-product of the cheese-making process, being produced at the rate of about 10.1 per Kg of cheese (Adam *et al.,* 2004). The world production of whey cheese is estimated as 118 million tons. This amount is equivalent to approximately 7 million tons of solids, of which 10% are proteins (Wit, 1998 and Adriano *et al.,* 2009).

The environmental problem and the various health benefits of whey cheese proteins for humans (immunomodulation, antimicrobial, antiviral, anti-carcinogenic, and antiulcer activities as well as protection of the cardiovascular system) and the presence of essential sulfur amino acids that had both nutritive value and antioxidant activity, make the use of this compound as an ingredient in food products a question of priority, and thus it is being more used by the food manufacturers (Sgarbjieri, 2004).

The present research aimed to optimizing mixing ratio of whey with guava to produce guava and whey beverage blends. Therefore, physicochemical, microbiological and sensory properties of the obtained product of different mixing ratio were evaluated during storage for 3 months at the room temperature.

Materials and Methods

Materials:

Guava fruits (*Psidium guajava*) were bought from Horticultural Research, Institute, Agricultural Research Center at Giza Governorate. Fruits were harvested at the ripening stage in September 2017. Fresh sweet whey was obtained from Animal Production Research, Agricultural Research Center at Giza Governorate.

Preparation of guava juice:

Guava fruits were washed, then mixed in a blender and filtered through a cheese cloth. The mixed pulp was heated in a stainless steel container at 90°C for 3 min. to inactivate pectin enzymes, rapidly cooled to 20°C then filled into polyethylene bags. The fruit juices were stored at -18°C until used.

Preparation of Whey Beverage:

Homogenized guava pulp and sweet whey were used to prepare different blends at different mixing ratios as presented in Table (1). Each sample were mixed with 0.2 % carboxyl methyl cellulose (CMC), 0.2% citric acid and 0.1% sodium sorbate. All the obtained juice blend samples were adjusted to 18% total soluble solids by using sucrose. The beverages were filled in white glass bottles, tightly closed, pasteurized at 85°C for 20 min., then cooled and stored for three months at room temperature (25°C ± 2°C).

Table 1: Mixing level of guava pulp and sweet whey blends.

Materials	Blend 1	Blend 2	Blend 3	Blend 4	Blend 5	Blend 6
Guava pulp	0%	10%	20%	30%	40%	50%
Sweet whey	100%	90%	80%	70%	60%	50%

Methods:

Moisture content %, Total solids (TS) and fat content were determined according to Ling, (1963). While ascorbic acid, pH, titratable acidity, ash, calcium, protein and total soluble solids (TSS%) were determined according to (AOAC 2010). The total bacterial counts were estimated using the appropriate media as recommended by the APHA, (1978).

Sabouraud agar media was used for enumeration total count of mold and yeast according to APHA (1992).

Sensory Evaluation:

All juice blend samples were sensorial evaluated for flavor (60 points), appearance (30 points) and color (10 points) by 10 well trained panelists as recommended by Deka *et al.* (1984).

Statistical Analysis:

The results of the sensory analysis were submitted to the analysis of variance followed by Tukey test, using the SAS System Version 6 Program SAS, (1996). Probabilities of ($P < 0.05$) were considered significant.

Results and Discussion

Chemical composition of guava pulp and sweet whey are presented in Table (2). It could be noticed that fresh guava pulp contains 85.82% moisture 0.96% ash, 0.14% fat and 0.61% protein, while sweet whey contained 93.7% water, 0.50% ash, 0.50% fat and 0.80% protein. On the other hand, total soluble solids and acidity were 9.70 % and 0.44% in guava pulp and 5.46% and 0.32% in sweet whey, respectively. While the ascorbic acid and calcium in guava pulp was 230.0 mg/100 g and 21 mg/100g respectively. However, the corresponding values in sweet whey were 18.0 mg/100 g and 40 mg/ 100 g. Therefore, guava pulp characterized with its higher content of ascorbic acid. On the other hand, sweet whey characterized with its higher percentage of protein, fat and calcium. These results are agreement with Dattatreya *et al.* (2012) and Bose and Mitra, (1999).

Table 2: Chemical composition of guava pulp and sweet whey.

Constituents	Guava pulp	Sweet whey
Moisture content %	85.82	93.70
Total solids %	14.18	6.30
Total soluble solids (TSS%)	9.70	5.46
Protein %	0.61	0.80
Fat %	0.14	0.50
Ash %	0.96	0.50
Ascorbic acid mg/100 g	230.0	18.0
Titratable acidity %	0.44	0.32
pH values	4.21	5.30
Calcium mg/100 g	21.0	40.0
Lactose mg/100 g	-	4.69

All analyses were carried out in triplicate

Effect of storage period on chemical composition of guava whey beverages blends:

Changes in chemical constituents of guava whey beverage blends stored at room temperature (25°C ± 5°C) for 3 months are presented in Table (3). The obtained results showed that total soluble solids (TSS) of all fresh guava whey beverage blends (0 time) which were adjusted to 18.0, were slightly decreased during storage to reach 17.60% after 6 months.

Furthermore, acidity of guava whey beverage blends were slightly affected during storage, but increased as increasing the ratios of guava pulp. The same trend was observed in pH values of guava whey beverage samples. This noticeable decrease of pH values could be attributed to the acid production during storage. The increase in acidity was due to conversion of lactose to lactic acid and formation of organic acids. These results are in agreement with the findings reported by Sikder *et al.* (2001) and Ritika *et al.* (2010).

Table (3) showed also the effect of storage periods on ascorbic acid content of guava whey beverage blends. The obtained data indicated that the ascorbic acid content was increased by increasing the ratio guava pulp. On the other hand, the loss of ascorbic acid content was increased with increasing storage periods. The loss of ascorbic acid could be due to the oxidation process during storage. Similar results were reported by EL-Gharably *et al.* (2004).

Table (3), also showed the effect of storage period on lactose content in guava whey beverage blends. It could be noticed that a slight reduction in lactose were occurred among all tested samples during storage at room temperature. Whereas, lactose levels of the guava beverage blend 1 (100%

guava) declined from 4.23 to 3.10 mg/g during zero time and 3 months, respectively. While, blend 6 slightly decreased from 2.80 mg/100g at zero time to 2.35 mg/100g after 3 months. These results are in agreement with the findings reported by Rizk *et al.* (2012).

A slight reduction in calcium content among all tested samples were also noticed during storage. Whereas, calcium content of blend 6 was 36.0 mg/100g at zero time then declined to 21.80 mg/100g after 3 months. These results are in agreement with the findings reported by Rizk *et al.* (2012).

Table 3: Effect of storage periods for 3 months at room temperature (25º± 5 º C) on chemical characteristics of guava whey blends.

Samples	TSS %	Acidity %	Ascorbic acid mg/100g	pH values	Ca mg/100g	Lactose mg/100g	Ash %
			Storage period (0 Time)				
Blend 1	18.00	0.32	2-.0	5.30	39.0	4.23	0.51
Blend 2	17.90	0.36	15.00	5.27	39.0	4.05	0.51
Blend 3	17.80	0.38	10.20	5.11	38.90	3.95	0.51
Blend 4	18.0	0.41	7.40	4.90	38.80	3.00	0.46
Blend 5	17.95	0.34	40.0	5.20	36.0	2.90	0.46
Blend 6	17.90	0.37	25.0	5.0	36.0	2.80	0.45
			Stored for 1 Month				
Blend 1	17.70	0.39	20.0	4.75	36.0	3.80	0.50
Blend 2	18.0	0.42	10.50	4.50	35.8	3.60	0.50
Blend 3	18.0	0.36	80.0	5.00	31.0	3.50	0.50
Blend 4	17.80	0.39	60.50	4.76	31.0	2.70	0.44
Blend 5	18.00	0.42	40.0	4.40	30.9	2.82	0.44
Blend 6	17.90	0.45	20.50	4.10	30.9	2.75	0.44
			Stored for 2 Months				
Blend 1	17.90	0.38	140.50	4.90	29.0	3.40	0.49
Blend 2	17.80	0.40	100.90	4.60	29.0	3.30	0.49
Blend 3	18.0	0.44	70.80	4.24	28.9	3.20	0.48
Blend 4	17.80	0.46	50.40	4.00	28.8	2.70	0.43
Blend 5	17.70	0.40	190.30	4.80	25.5	2.60	0.42
Blend 6	18.00	0.43	150.22	4.50	25.5	2.60	0.42
			Stored for 3 Months				
Blend 1	17.90	0.47	110.88	4.20	24.40	3.10	0.48
Blend 2	17.80	0.49	80.99	3.90	25.3	3.0	0.47
Blend 3	17.75	0.44	220.30	4.75	22.0	2.2.90	0.47
Blend 4	17.80	0.47	170.44	4.32	22.0	2.50	0.42
Blend 5	17.70	0.49	130.77	4.10	21.80	2.40	0.41
Blend 6	17.60	0.52	100.22	3.65	21.80	2.35	0.41

Microbial examination:

Total bacterial and yeast and mould counts of guava whey beverages samples were determined before and during storage for three months at room temperature. It could be observed from Table (4) that both bacterial as well as yeast and mould counts decreased with increasing storage period. Whereas bacterial counts of blends from 1 to 6 at zero timed were 6.33, 6.11, 5.44, 5.21, 4.88 and 4.52 x 10^{4}, then decreased after three month of storage to 1.95, 1.84, 1.60, 1.55, 0.99 and 0. 0.44 x 10^{4}, respectively. These results are agreement with Mirjana *et al.* (2004).

Table (4) showed that yeast and mold counts were slightly decreased during storage periods. Whereas, mold and yeast counts at zero time in all blends (from blend 1 to 6) reached to 5.40, 5.80, 5.90, 6.20, 6.49 and 6.58 x 10^{2}, respectively then they were declined in the same blends to 1.40, 1.66, 1.75, 1.84, 1.90 and 1.97 x 10^{2}, respectively. It could be concluded that both bacterial and yeast and mold counts were gradually decreased during storage.

Sensory evaluation:

Sensory evaluation of guava whey beverage blends were evaluated at zero time and after storage for 3 months at room temperature. Table (5) showed that guava whey beverages that prepared with 40% guava pulp and 60% sweet whey (blend 5) gained the highest score for color, appearance and flavor at

zero time and after 3 months of storage. Therefore, these samples came in the first order on comparison with other prepared beverages up to 3 months of storage. This treatment was the most acceptable blend followed with blend 6, while blend 1 and blend 2 were unacceptable blends since they had been given the lowest scores. Therefore, it could be concludes that guava whey beverages that prepared with 40% guava pulp and 60% sweet whey (blend 5) could be applied in preparing a favorite blend of such issue.

Table 4. Effect of storage period at room temperature for 3 months on total bacterial and yeast and molds counts of guava whey beverage blends.

Guava Whey beverage blends	Total bacterial counts ($X 10^4$/g) Storage period (months)				Yeast and molds counts ($X 10^2$ /g) Storage period (months)			
	0	1	2	3	0	1	2	3
Blend 1	6.33	5.60	3.22	1.95	5.40	4.83	2.90	1.40
Blend 2	6.11	5.40	2.96	1.84	5.80	4.97	2.97	1.66
Blend 3	5.44	5.30	2.56	1.60	5.90	5.11	3.33	1.75
Blend 4	5.21	4.22	2.30	1.55	6.20	5.32	3.72	1.84
Blend 5	4.88	3.57	1.26	0.99	6.49	5.49	3.85	1.90
Blend 6	4.52	3.11	1.15	0.44	6.58	5.66	3.94	1.97

Table 5: Effect of stored guava whey beverage blends at room temperature for three month on its sensory properties.

Guava whey beverage samples	Attributes values at zero time of storage				Attributes values after three months storage at room temperature			
Blended	Color (10)	Appearance (30)	Flavor (60)	Total (100)	Color (10)	Appearance (30)	Flavor (60)	Total (100)
Blend1	4.90^{e}	11.80^{d}	22.00^{e}	38.70^{e}	4.40^{e}	10.00^{e}	18.00^{0e}	32.40^{e}
Blend2	6.40^{c}	13.00^{d}	28.00^{d}	47.40^{e}	6.00^{d}	11.00^{d}	25.00^{e}	42.00^{e}
Blend3	7.60^{b}	19.00^{c}	38.00^{c}	64.60^{d}	7.00^{c}	16.00^{c}	30.0^{cd}	53.00^{d}
Blend4	8.60^{b}	27.00^{b}	54.00^{b}	89.60^{b}	8.00^{b}	23.00^{b}	46.0^{d}	77.00^{b}
Blend5	9.70^{a}	29.50^{a}	59.50^{a}	98.70^{a}	9.50^{a}	27.50^{a}	56.00^{a}	93.00^{a}
Blend6	9.60^{a}	29.00^{a}	58.00^{a}	96.60^{a}	9.20^{a}	26.00^{a}	54.00^{a}	89.50^{a}

Different letters in the same column denote statistical significance at $P<0.05$.

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