J. Food and Dairy Sci., Mansoura Univ., Vol. 9 (4): 133 - 137 , 2018

Dietary Supplement Drink of Cheese Whey Enriched with Guava Fruit

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ABSTRACT

The aim of the present study is to study the effect of adding mixture of guava fruit and cheese whey in making functional dietary drink. Cheese whey (6.1 % total solids, 5.12 % lactose and 0.54 % ash) was used. Guava fruit was added at different levels(5,10,15and20gm/ml). Guava fruit drinks were chemically, microbiologically and Organoleptically analyzed when fresh and during cold storage.Guava fruit supplemented with cheese whey fruit was found rich in essential electrolytes (calcium, potassium, sodium, manganize, zinc, iron, and phosphorus), together with vitamins B1 , B2 , B3 , B6, B9 , A and C. The drink is also found a good source for fiber and natural antioxidants.

INTRODUCTION

Cheese whey is one of milk by-product resulting from production of cheese. However, further researches of its nutritional and biological value were carried out through the past 25 years. It could be considered as valuable component in various industries of foods, pharmaceuticals and nutraceuticals. Disposed whey results in pollution problems due to its rich content of organic compounds. The biological oxygen demands (B.O.D) of whey is 35-45 Kg m^{-3} (Gannoun *et al*., 2007).

Whey has significant nutritional value as well as containing important components that enhance human physiological function. Many food industries use whey in manufactuting their food products. The presence of branched-chain amino acids (leucine, isoleucine and valine) in whey makes it of nutritional value. leucine is of a vital role in the pathway of protein metabolism, and synthesis of new proteins . (Ha and Zamel, 2003).

Sulfur-containing amino acids (methaionine and cysteine) act as precursors in the formation of the tripeptide, glutathione (GSH), which are of moderate oxidative damage and enhance immune function, which are known as a potential antioxidant.(Tseng *et al*.,2005). (Hoppe *et al*.,2010).

Whey contains β-lacto globulin, α-lactalbumine , glycomacropeptide ,immunoglobulins, serum albumin, lactofrrin, lactoperoxidase, which are of valuable importance due to the abundance essential amino acids (Hulmi *et al*.,2010).

Whey protein has also been found of an antioxidative activity against different inducers of oxidative stress such as carbon tetrachloride, paracetamol and iron overload (Athira *et al*., 2013, and Kim *et al*., 2013).

Conjugated linoleic acid (CLA) is a component in whey and has been reported as potent anticancer agent in studies performed on human malignant breast and colon cancer cell lines. In addition CLA consumption may inhibit the growth and spread of mammary tumors (Nukumi *et al*., 2006).

Guava fruit is a new source of antioxidant and ascorbic acid, which was commonly added to military rations in World War Ⅱ (Jimenez - Escring *et al*., 2001).

Guava is used in treating diarrhea, type 2 diabetes, dysmenorrheal, hyperlipidemia, and hypertension. Photochemical analyses of guava reveal alkaloids, antcocyanins, carotenoids, essential oils, fatty acids, falvonoids (especially quercetin), lectins, phenols, saponins, tannins, triterpenes and vitamin C (80 mg per 100g of guava) (Mewally *et al*., 2010).The essential oil contains alpha pinene, caryophyllene, cineol, D-limonene, eugenol. The major constituents of the volatile acids include cinnamic acid and hexenoic acid (Conde *et al*., 2003). The guava fruit has high water content with lesser amounts of carbohydrates, proteins and fats. The fruit also contains iron, vitamins A and C, thiamine, riboflavin, niacin, manganese and zinc. The characteristic fruit odor is attributed to carbonyl compounds (Gutierrez *et al*., 2008). The addition of 400mg to 1Kg daily of guava fruit for up to 12 weeks resulted in decreased systolic and diastolic blood pressure. Guava is up to 5 times richer in vitamin C than oranges (Rahmat *et al*., 2004).

For the above mentioned reasons the aim of this work was devoted to get use of sweet cheese whey and guava fruit in making dietary supplement drink of cheese whey enriched with guava fruit with high nutrients and good quality besides containing high activity antioxidants.

MATERIALS AND METHODS

Cheese whey (6.1% total solids, 4.8% lactose, 0.86 % protein and 0.54 % ash), and different concentrations of Guava fruit obtained from the local market were used in preparing the guava fruit drink .Sugar (sucrose) was obtained from the local market.

Guava fruit was thoroughly washed, seeds were eliminated, cut into small pieces, mixed with the cheese whey at the rates of 5, 10, 15 and 20gm/ml%. Sugar was added at 3%, and the The mixture was thoroughly blended.

The final mixture was filled into the well cleaned glass bottles, and heat treated (70°C/15 min), cooled to 5°C. The samples were kept in the refrigerator (6-8°C). Cheese whey with added 3% sugar was used as control.

The total solids, fat, ash, total protein and ascorbic acid, minerals, crude fiber (by Weende method) contents were determined according to the methods mentioned in AOAC (2000). Tetratable acidity and pH values were determined according to BSI (2010) and BSI (1985). Carotenoids were determined according to Harvey and Catherine (1982) using Perkin–elmer 2380 Atomic absorption spectrophotometry.

The water-soluble vitamin (B1, B2, B3, B6 and B9) were determined by HPLC analysis according to Albala-Hurtado *et al*. (1997).

Separation of vitamins was carried out by gradient elution with (a) methanol and (b) 1% TFA. Detection wave length for Detection of B1, B2, B3, B6, B9 and pyridoxine were

The resultant fresh control and enriched drink with guava fruit were examined for total bacterial count (TBC), yeasts & moulds, and coliform group as described in Difco Manual(1985).

Guava drinks were sensory examined for color, flavor, texture and overall acceptability by10 panelists from the staff Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture. A hedonic scale of 1 (dislike extremely) to 10 (like extremely) was used. Samples of 2 weeks old were evaluated following the scheme proposed by Saldamli *et al.*, (1991).

Regarding the statistical analysis, all of the determinations were carried out in triplicates. Analysis of variance (ANOVA) was performed using the Duncan's multiple – range test. Significance was set at P≤ 0.05 (Version 9.3, Cary, NC USA, 2013).

RESULTS AND DISCUSSION

Table (1) shows the chemical composition of fresh guava fruit and cheese whey. The highest (P<0.05) contents of total solids, ash, total carbohydrates, fiber and tetratable acidity were detected in guava . Ascorbic acid was not found in cheese that might be due to the applied heat treatment received. Guava was found rich in ascorbic acid contents. The results of chemical composition of guava used for the preparation of the drink were in agreement with those observed by Bahlol *et al.* (2007); Elsayed *et al.* (2007) and Hattem *et al.* (2011). Guava has the highest (P<0.05) values for the examined minerals, compared to cheese whey except for Ca and P. These results are in accordance with those of Elsayed *et al.* (2007). Data presented in Tables (2 and 3) show that the total solids content increased slightly in all treatments during the cold storage up to 10 days Generally, there were significant differences (P<0.05) between TS contents of treatments during the storage. Total solids ranged from 9.09 to 14.18% in the fresh products, and increased from 9.28 to 14.21% after 10 days of storage. Slight increase of TS during storage was attributed to the loss of moisture during the storage. These results came in accordance with those of Aumara (2000) and Hashmi *et al.*, (2011).

Fat and protein contents of the resultant drink increased significantly (P<0.05) during cold storage. The fat content of fresh products varied from 0.10 to 0.30% and 0.32 to 0.43% for protein, with slightly subsequent increase up to the end of the storage period, which came in harmony with those obtained observed by Attalla (2006). The total carbohydrate content decreased significantly during storage at 6°C up to 10 days, and significant differences (P<0.05) between all treatments were established during storage period. The total carbohydrate contents of the freshly treatment varied from 7.59 to 11.33%. These values decreased slightly to 7.45 to 11.04% at the end of the storage period, which might be attributed to the microbial activity, which were confirmed by those reported by Attalla (2006). The ash contents for all treatments significantly increased (P<0.05) during storage, due to the slight increase in the total solids (Aumara 2000).

Table 1. Chemical composition of raw materials used in producing cheese whey guava drink

Items	Guava fruit	cheese whey
Total solids %	15. 82^{a}	6.1^{c}
Ash %	0.71^{a}	0.45^{c}
Fat %	0.25^{b}	0.22^{c}
Protein %	0.35^{b}	0.86c
Total sugars %	11.85^{a}	4.8c
Fiber %	2.23^{a}	———
Titrat0ble acidity %*	0.43^{a}	0.39^{c}
pH values	4.06^{c}	5.05^{a}
Ascorbic acid (mg / 100 g)	78.32^{b}	———
Carotenoids (mg / kg)	6.02^{b}	———
K (mg / 100 g)	16.34^{b}	6.17^{c}
Ca (mg / 100 g)	15.00^{c}	27.0^{a}
P (mg / 100 g)	22.00^{b}	28.0^{a}
Na (mg / 100 g)	18.44^{a}	10.05^{a}
Z (mg / 100 g)	0,04^{b}	0.01^{b}
Cu (mg / 100 g)	0.03^{b}	0.04^{b}
Fe (mg / 100 g)	0.34^{b}	0.20^{c}
Mang (mg / 100 g)	2.27^{c}	-

Table 2. The chemical composition of the cheese whey guava drink during the storage periods at 6 –8° C (g / 100g)

Treatments	Total solids %	Fat %	Protein %	Total carbohydrates	Ash%
			Fresh		
Control	9.22^{ca}	0.14^{ca}	0.38^{cb}	7.72^{da}	0.26d^{c}
T1*	14.02^{ba}	0.31^{ba}	0.41^{bb}	10.55^{ca}	0.29^{cc}
T2	14.55^{aa}	0.34^{aa}	0,44^{ab}	10.89^{ba}	0.32^{bc}
T3	14.69^{aa}	0.36^{aa}	0.46^{ab}	11.00^{aa}	0.35^{bc}
T4	14.85^{aa}	0.38^{aa}	0.47^{ab}	11.33b^{a}	0.37^{ac}
			5 days		
Control	9.35^{ca}	0.14^{ca}	0.38^{ca}	7.55^{eb}	0.31^{db}
T1	14.65^{ba}	0.31^{ba}	0.41^{aa}	10.23^{cb}	0.35^{cb}
T2	15.02^{aa}	0.34^{aa}	0.44^{da}	10.45^{bb}	0.38^{bb}
T3	15.25^{aa}	0.36^{aa}	0.46^{aa}	10.65^{ab}	0.40^{bb}
T4	15.55^{aa}	0.38^{aa}	0.47^{aa}	10.92^{bb}	0.43^{ab}
			10 days		
Control	9.55^{ca}	0.14^{ca}	0.38^{ca}	7.25^{ec}	0.36^{da}
T1	14.72^{ba}	0.31^{ba}	0.41^{aa}	9.98^{cc}	0.39^{ca}
T2	15.12^{aa}	0.34^{aa}	0,44^{da}	10.12^{bc}	0.41^{ba}
T3	15.32^{aa}	0.36aa	0.46^{aa}	10.29ca	0.45^{ba}
T4	15.63^{aa}	0.38^{aa}	0.47^{aa}	10.75^{bc}	0.48^{aa}
			15 days		
Control	9.65^{ca}	0.14^{ca}	0.38^{ba}	7.05^{dd}	0.39^{da}
T1	14.75^{ba}	0.31^{ba}	0.41^{aa}	9.65^{cd}	0.43^{ca}
T2	15.18^{aa}	0.34^{aa}	0.44^{da}	9.98^{bd}	0.46^{ba}
T3	15.36^{aa}	0.36^{aa}	0.46^{aa}	10.05^{ad}	0.48^{ba}
T4	15.65^{aa}	0.38^{aa}	0.47^{aa}	10.35^{bd}	0.51^{aa}

Control: cheese whey with 3% sugar
T1: cheese whey with 5% guava fruit +3% sugar. **T2: cheese whey with 10% guava fruit +3% sugar.**
T3: cheese whey with 15% guava fruit +3% sugar. **T4: cheese whey with 20% guava fruit +3% sugar.**

- **lactic acid %**

Data presented in Tables (2 and 3) summarizes the physicochemical properties of the prepared drink during storage up to 10 days at 6-80C. The total solids content increased slightly in all treatments during the storage periods. Significant differences (P<0.05) between TS contents of treatments were detected during the storage. TS ranged from 9.22 to 014.85% in the fresh products, and increased to 9.55 -15.65% after 10 days of storage. Slight increase of TS during storage might be attributed to the loss of moisture during storage, which agree with Hashmi *et al*.,

Fat and protein content of the resultant drink increased significantly (P<0.05) during cold storage. The fat content of fresh products varied from 0.14 to 0.38%, and 0.38 to 0.47% for protein, with consequent slight increase up to the end of the storage period, that agree with those obtained by Attalla (2006).

Total carbohydrate contents of the resultant drink decreased significantly during storage up to 10 days. Significant differences (P<0.05) were found between all treatments during storage period. The total carbohydrate contents of freshly product varied from 7.72 to 11.33%, followed by slight decrease from7.05 to 10.35% at the end of storage period. The decrease in the total carbohydrate content during the storage periods might be due to the microbial activity.

Ash contents for all treatments significantly increased (P<0.05) during storage, which might be due to the slight increase in the total solids. These findings are in accordance with Aumara (2000).

Table (4) revealed that the highest (P<0.05) contents of minerals were found in the drink containing guava due to the presence of high content of these minerals in guava fruit. The Ca content was significantly different (P<0.05) among all treatments, as it ranged between 35.55 to 61.00 mg/100g. The P contents (P<0.05) varied between 24.03 to 30.15 mg/100g. Cheese whey was responsible for the relatively high Ca and P. The trace elements Manganize, Fe, Cu and Zn contents differed significantly (P<0.05) in the treatments as they ranged from 2.24 to 6.74, 0.50 to 1.88, 0.07 to 1.05 and 0.05 to 0.99 mg/100g, respectively, due to the variable contents of these elements in the treatment with guava fruit .

Table 3. Acidity, pH, fiber, ascorbic acid and carotenoids of whey guava drink during storage

Treatments	Acidity (%)	PH	Fiber (g / 100 g)	Ascorbic acid (mg / 100g)	Carotenoids (mg / kg)
			Fresh		
Control	0.75^{bc}	4.49^{ac}	0.00ea	0.00ea	0.00da
T1	0.85^{ac}	3.90^{aa}	0.74da	31.12aa	27.32aa
T2	0.95^{ac}	3,80^{aa}	0.82^{ba}	19.95ba	17.55ca
T3	0.97^{bc}	3.80^{aa}	0.85^{ca}	14.50ca	13.22ba
T4	0.98^{dc}	3.79^{aa}	0.88^{aa}	12.65da	10.01ca
			5 days		
Control	0.78^{bb}	4.30^{cb}	0.00^{ea}	0.00^{eb}	0.00^{db}
T1	0.91^{ab}	3.70^{eb}	0.74^{da}	28.00^{ab}	27.30^{ab}
T2	0.94^{ab}	3.62^{bb}	0.82^{ba}	16.11^{bb}	17.55^{cb}
T3	0.99^{cb}	3.60^{db}	0.85^{ca}	12.11^{cb}	13.25^{bb}
T4	1.01^{cb}	3.55^{ab}	0.88^{aa}	12.35^{db}	10.02^{cb}
			10 days		
Control	0.86^{ba}	4.15^{cc}	0.00^{ea}	0.00^{ec}	0.00^{dc}
T1	0.95^{aa}	3.60^{ec}	0.74^{da}	26.11ac	27.05^{ac}
T2	0.98^{aa}	3.55^{bc}	0.82^{ba}	10.45^{bc}	15.90^{cc}
T3	1.05^{ca}	3.55^{dc}	0.85^{ca}	9.12cc	11.95^{bc}
T4	1.08^{ca}	3.45^{ac}	0.88^{aa}	8.88^{dc}	9.52^{cc}
			15 days		
Control	0.97^{da}	4.05^{ad}	0.00^{ea}	0.00^{ed}	0.00^{dc}
T1	1,09^{aa}	3.45^{ed}	0.74^{da}	25.88^{ad}	27.00^{ac}
T2	1.18^{aa}	3.35^{bd}	0.82^{ba}	10.11^{bd}	15.85^{cc}
T3	1.25^{ba}	3.25^{cd}	0.85^{ca}	9.08^{cd}	25.90^{bc}
T4	1.28^{ca}	3.15^{dd}	0.88^{aa}	8.78^{dd}	14.50^{cc}

Table 4. Average minerals contents of cheese whey guava drink (mg/100 g)

Minerals	Control	T1	T2	T3	T4
Ca	59.00^{a}	61.00^{a}	49.01^{c}	35.55^{e}	43.01^{d}
P	30.01^{a}	30.03^{a}	30.05^{a}	30.15^{c}	24.03^{b}
Na	18.62^{a}	19.01a	32.65^{a}	31.22^{a}	28.92^{a}
K	11.44^{e}	11.65^{d}	21.02^{ab}	19.55^{c}	18.23^{b}
Mang		2.25^{d}	6.74^{a}	4.10^{c}	4.77^{b}
Fe	0.50^{e}	0.55^{d}	0.92^{b}	1.03^{b}	1.80^{a}
Cu	0.07^{c}	0.09^{b}	0.09^{b}	1.00^{b}	1.05^{a}
Z	0.05^{d}	0.06^{d}	0.21^{b}	0.24^{d}	0.99^{c}

From the results of minerals, it could be concluded that the prepared drink could be considered as a good source for these minerals. Trace elements are essential for growth, activating immunity system and other physiological processes. These results are closely similar with those reported by Kansal (2002).

Results presented in Table (5) indicated that supplementation of guava drink in all treatments did not remarkably affect the total bacterial count.

Table 5. Vitamins content of cheese whey treatments drink containing different levels of guava fruit:

Treatment	B1	B2	B3	B6	B9
Control	0.141^{B}	1.276^{B}	0.079^{A}	0.015^{A}	0.0023^{A}
T1	0.144^{A}	1.298^{A}	0.067^{B}	0.015^{A}	0.0024^{A}
T2	0.106^{C}	1.196^{C}	0.053^{C}	0.012^{B}	0.0019^{B}
T3	0.096^{D}	0.905^{D}	0.052^{C}	0.011^{B}	0.0018^{B}
T4	0.084^{E}	0.851^{E}	0.044^{D}	0.011^{B}	0.0016^{C}

Table 6. showed that the vitamins content of cheese whey drink increased by increasing the addition level of guava fruit. Thus, these vitamins in the products could be a good source of vitamin (B).

Table (7) showed the changes in sensory evaluation of functional drink manufactured with guava fruits and cheese whey during storage period at ~6-8 ºC for10 days. Significant differences ($P<0.05$) were found in the scores gained by different sensory attributes between all treatments during the storage period. The obtained results revealed that all the treatments recorded higher scores than the control when fresh and throughout the storage period.

Table 6. Microbiological quality of cheese whey guava drink during storage periods (cfu /g):

Treatments*	Total bacterial count (cfu / g)	Mould and yeast (cfu / g)	Coliform Group (cfu / g)
	Fresh		
Control	8855^{ab}	ND^{a}	ND^{a}**
T1	8900^{b}	ND^{a}	ND^{a}
T2	9125^{a}	ND^{a}	ND^{a}
T3	9255^{bc}	ND^{a}	ND^{a}
T4	9310^{c}	ND^{a}	ND^{a}
	15 days		
Control	7560^{c}	ND^{a}	ND^{a}
T1	6420^{bc}	ND^{a}	ND^{a}
T2	6211^{b}	ND^{a}	ND^{a}
T3	5740^{ab}	ND^{a}	ND^{a}
T4	5225^{a}	ND^{a}	ND^{a}

Table 7. Sensory evaluation of cheese whey fortified with guava fruit during the storage periods a(~6-8°C):

Treatments	Taste (40)	Odour (20)	sweetness (10)	Acidity (20)	Color (10)	Total (100)
			Fresh			
Control	20^{cb}	13^{ba}	5^{aa}	14^{ac}	6.0^{cb}	58^{fc}
T1	35^{bb}	18^{aa}	9.0^{aa}	17^{ac}	8.0^{ba}	87^{dc}
T2	35^{bb}	18^{aa}	9.0^{aa}	18^{ac}	9.0^{aa}	89^{ac}
T3	38^{ab}	18^{aa}	9.0^{aa}	18^{ac}	9.0^{aa}	92^{cc}
T4	39^{ab}	18^{aa}	9.0^{aa}	18^{ac}	9.0^{aa}	93^{bc}
			5 dyes			
Control	23^{ca}	8^{ea}	2.0^{ba}	5.0^{bb}	5.0^{ba}	43^{fb}
T1	34^{aa}	18^{aa}	9.0^{ab}	7.0^{cb} *1*	9.0^{aa}	87^{bb}
T2	34^{aa}	18^{aa}	9.0^{ab}	7.0^{cb} *1*	9.0^{aa}	87^{bb}
T3	34^{aa}	18^{aa}	9.0^{ab}	7.0^{cb} *1*	9.0^{aa}	87^{bb}
T4	34^{aa}	18^{aa}	9.0^{ab}	7.0^{cb} *1*	9.0^{aa}	87^{bb}
			10 days			
Control	20^{ca}	5^{ba}	5.0^{dc}	2.0^{ba}	6.0^{ba}	38^{ea}
T1	34^{aa}	17^{aa}	8.0^{ac}	14.0^{aa}	8.0^{aa}	81^{aa}
T2	34^{aa}	17^{aa}	8.0^{ac}	14.0^{aa}	8.0^{aa}	81^{aa}
T3	34^{aa}	17^{aa}	8.0^{ac}	14.0^{aa}	8.0^{aa}	81^{aa}
T4	34^{aa}	17^{aa}	8.0^{ac}	14.0^{aa}	8.0^{aa}	81^{aa}
			15 days			
Control	10^{db}	9^{db}	2^{dc}	1.0^{aa}	5.0^{ca}	27^{fa}
T1	38^{ba}	12^{ba}	7.0^{ba}	5.0^{ba}	7.0^{aa}	69^{da}
T2	38^{ba}	12^{aa}	7.0^{ba}	5.0^{ba}	7.0^{aa}	69^{ca}
T3	38^{aa}	12^{aa}	7.0^{aa}	5.0^{ba}	7.0^{aa}	69^{ba}
T4	38^{aa}	12^{aa}	7.0^{aa}	5.0^{ba}	7.0^{aa}	69^{aa}

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مشروب مكمل غذائي من الشرش المدعم بثمرة الجوافة

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تم فى هذة الدراسة استخدام الشرش الحلو الناتج من تصنيع الجبن الجاف فى تصنيع مشروب مكمل غذائي من الشرش المدعم بثمرة الجوافه والاستفادة من مكونات كلا من الشرش والجوافة حيث يحتوى الشرش على 6.1 % من اجمالى المواد الصلبة و4.8 % من اللاكتوز و45. 0% من الرماد وقد تم عمل المشروب باضافة قطع الجوافه الى الشرش بتركيزات مختلفة5: 10: 15 : 20% (جم /حجم) وكذلك تم اضاف السكر بنسبة 3 % الى المشروب وتم تحليل عينات المشروب الطازجة وبعد 5 و10 و15 يوم من التخزين فى الثلاجة على درجه حراره 6.8°م وقد تبين من النتائج المتحصل عليها ان المشرب كان مصدر جيد لكل من العناصر الاساسية مثل الكالسيوم والبوتاسيوم والصوديوم والماغنسيوم والفوسفور والمنجنيزوالحديد و الزنك وكذلك العديد من الفيتامينات الهامه لجسم الانسان مثل فيتامين C,A,B9,B6, B3, B2,B1 وكان هناك فروق معنوية بين الكنترول والمعاملات.