Physicochemical and Sensorial Quality of Semolina-Defatted Guava Seeds Flour Composite Pasta

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Abstract: Guava seeds flour (≥ 40 mesh) characterized with its higher contents of crude fiber, fat and lowest moisture if compared with semolina flour. Farinograph parameter indicated that, water absorption, arrival time and dough weakening increased and stability decreased by increasing supplementation level of guava seeds flour compared to semolina flour. Supplemented pasta with guava seeds flour (10 & 20%) characterized with its higher volume than control pasta; and cooking loss not affected with replacement of 10% if compared with control pasta. Sensory evaluation showed that, stickiness, appearance, flavor and tenderness not affected with replacing level up to 30%, 20% and 10%, respectively, while color of different replacement level affected. Chemically, supplemented pasta with guava seeds flour caused an acceptable gradual increase in moisture, protein, fat, ash and crude fiber; and decrease in carbohydrates. Guava seeds flour characterized with its higher essential mineral if compared with semolina. FT-IR spectra of guava seeds flour showed two specific bands at 3417 cm^{-1} , 1040 cm^{-1} and 1746 cm^{-1} for stretching (OH), stretching (C-O) and stretching (C=O). While, pasta of 100% semolina was characterized with bending (CH) at 1421 cm^{-1} and stretching (C-C) at 1081 cm^{-1}.

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1. Introduction:

Guava (*Psidium guajava*) is one of the most widely processed fruit in many parts of the world. Guava juice and nectar are the most popular bottled fruit beverages in Egypt. The pulp (88 g/100 g of fruit weight) is used for juice production, but seeds (12 g/100 g of fruit weight) are discarded. One of the most common problems in food processing industry is the disposal of the sub products generated. This ‘‘waste material’’ produces ecological problems related to the proliferation of insects and rodents, and an economical burden because of transportation to repositories. Therefore, strategies for the profitable use of these materials are needed. Kanner *et al*., (2001), Melo *et.al.,* (2008), and Norshazila et al., (2010) found that, Guava wastes have high antioxidant potential, because they are rich in compounds that can delay oxidation; and also, Packer et al., (2010) concluded that Guava peel and seeds extracts are effective in retarding lipid oxidation in processed chicken meat at concentration of 60 mg total phenolic compounds/kg of meat. Opute (1978) and Aly (1981) reported that guava seeds contained 9.0% lipids which consisted almost of neutral compounds (triglycerides). Habib (1986) found that the chloroform methanol extracted lipids amounted to 9.1% on a dry weight basis and contained 12 fatty acids which are similar to that of cotton seed oil. The protein content of guava seeds was 9.73% on dry matter basis and consisted of 15 amino acids of which arginine, glutamic acid, aspartic acid, glycine and leucine presented 67% (Adsule and Kadam, 1995). Several researchers studied the possibility of utilizing guava seeds waste, where Shams El-Din and Yassen (1997) used guava seeds as an additional source of fiber in cookies; they found that, using 9% guava seed meal gave an acceptable, but comparatively inferior product. They found that, increasing the ratio of guava seeds meal caused a decrease in water absorption, dough development time and stability; and increased dough weakening. They found also that, adding guava seed meal to wheat flour improved volume, specific volume, diameter, and thickness of the cookies after baking. While, Abd El-Aal, (1992) studied the optimum conditions for preparing protein isolates from ground, defatted guava seed flour that could be used as a value added products.

Guava seeds gave coarse particle after milling, difficult to be applied at industrial scale. This research is consider as an attempts towards preparing fine ground fractions that could be used to add a nutritive value and cooking quality to pasta.

2. Materials and Methods

Materials:

Guava seeds were washed, dried (air oven at 55ºC), defatted (hexane) and milled using Quadrumat Junior flour mill. Milling process was carried out three times to obtain three fractions by sieving through ≥ 40, < 40 & < 20 meshes. The first fine fraction (≥ 40 mesh) was mixed with semolina at 10, 20 and 30% replacement levels.

Methods:

Pasta samples were prepared according to AACC (2000) using a lab pasta machine (Matic 1000 Simac Machine Corporation, Millano, Italy). Pasta hydrated for 15 min under atmospheric air, dried in a cabinet dryer at 70ºC for 10 hrs (Berglund *et al*., 1987). , then cooled at room temperature, packed in polyethylene bags and kept at room temperature for analysis.

Cooking quality of pasta were carried out by measuring the increases in weight, volume and cooking loss after cooking according the methods of AACC (2000).

Analytical methods

Moisture, ash, crude protein, fat and crude fiber contents of semolina, guava seeds mill and pasta were determined according to the methods outlined in AOAC (2000), while carbohydrates were calculated by difference as mentioned by Tadrus (1989).

Minerals contents (calcium, magnesium, sodium, potassium, copper, zinc, Manganese and iron) of guava seeds mill fraction 1, semolina, and their blended pasta products were determined using Perkin Elmer 2380 Atomic Absorption according to the method of AOAC (2000).

The spectra of semolina, guava seeds mill fraction 1 and pasta replaced with 10% guava seeds mill fraction 1 were obtained using FT-IR spectroscopy. The samples of FT-IR (FT-IR-6100 Jasco, Japan) were prepared by using potassium bromide disks.

Rheological properties of the doughs were determined using a Farinograph according to AACC (2000).

Color quality of Processed Products:

The color parameter of semolina, guava seeds mill and pasta were evaluated using Hunter, Lab Scan XE, Reston VA., calibrated with a white standard tile of Hunter Lab color standard (LX No. 16379) x = 77.26, y = 81.94 and z = 88.14 (L^* = 92.43, a^* = -0.88, b^* = 0.21).

Cooked pasta was organoleptically evaluated by ten panelists for its appearance (10), color (10), flavor (10), tenderness (10) and stickiness (10) as described by Hallabo *et al.*, (1985).

The obtained results were evaluated statistically using analysis of variance as reported by McClave & Benson (1991).

3. Results and discussion

Chemical composition of guava seeds and semolina:

Three fractions of guava seeds (≥ 40, < 40 & < 20 mesh) were prepared as a fiber source. Figure (1) showed the percentage of each fraction referred to guava seeds. The obtained guava seed fractions and semolina were evaluated chemically as shown in Table (1). The obtained three fractions of guava seeds contained the highest crude fiber, fat and lowest moisture compared to semolina, where, the crude fibers of fractions (1), (2) and (3) were 17.18, 10.98 and 20.19%, respectively, while it was 0.7% in semolina. These results are in agreement with those reported by Uchoa *et al*., 2009.

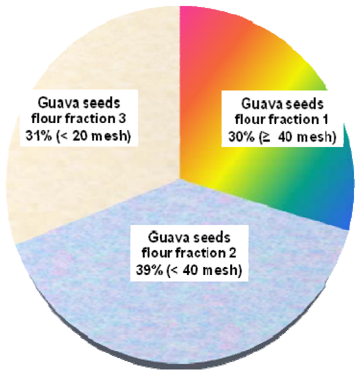
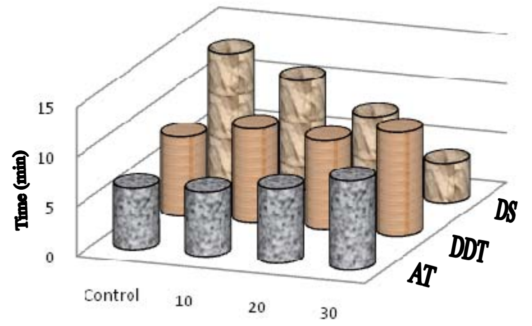


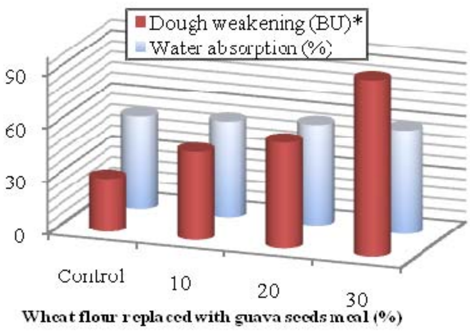
Figure (1): Flour fractions percentage of guava seeds.

Table (1): Chemical composition of semolina and fractions of guava seeds flour (dry weight basis).

Samples	Moisture	Protein	Fat	Ash	Crude fiber	Carbohydrate
Semolina	11.22± 0.5	13.86± 0.2	0.2± 0.01	0.82± 0.05	0.7± 0.06	76.32± 3
Fraction (1)	6.52± 0.4	16.91± 0.1	5.02± 0.19	1.65± 0.1	17.18± 0.3	59.24± 0.4
Fraction (2)	5.71± 0.3	11.07± 0.1	2.6± 0.08	1.19± 0.1	10.98± 0.2	74.16± 0.5
Fraction (3)	3.75± 0.4	5.2± 0.1	1.02± 0.05	0.64± 0.1	20.19± 0.2	72.95± 0.6

Preliminary study on the palatability of the three fractions of guava seed flours showed that, fraction 2 and 3 were unaccepted for their roughness like sand (< 20 & < 40 mesh), but fraction 1 (≥ 40 mesh) was accepted for its lower granule size. Rheological study was carried out to select the best replacement level of guava seeds flour fraction 1 with semolina to produce high fiber pasta. Farinograph parameters of semolina and different blends of semolina with guava seed flours (10, 20 and 30%) illustrated in Figure (2). The obtained results indicated that, water absorption, arrival time and dough weakening increased and stability decreased by increasing the level of fraction 1 compared to control (semolina 100%). The increasing water absorption is mainly due to the strong water-binding ability of fibers. The longer dough development time and lower dough stability could result from the dilution of gluten and the difficulty of mixing fibers and semolina homogeneously. Such results were in agreement with those obtained by Jinzhou, *et al*., (2002), Gomez, *et al*., (2003) and Yaseen & Shouk (2007).





Wheat flour replaced with guava seeds meal (%)
AT = Arrival time DDT = Dough development time
DS = Dough stability

Figure (2): Farinograph parameters of semolina dough as affected by replacement level of guava seeds meal fraction (1).

Cooking quality of pasta prepared by partial replacement of semolina with deferent levels of fraction 1 is shown in Table (2). Data revealed that, the volume (swelling %) of high fiber pasta (10 & 20%) increased if compared with control pasta (semolina 100%), while weight decreased in all replacement levels of guava seeds fraction 1 if compared with control pasta sample. This result indicated that, increasing fiber level led to decrease weight of cooked pasta. Cooking loss (represent loss of solids in cooking water) was evaluated and presented in Table (2). Results showed that, there was no significant difference in cooking loss of control pasta and replaced pasta with 10% guava seeds flour, while increasing replacing level led to increase cooking loss of pasta. The undesirable effect of guava seed flour on cooking loss may be due to the dilution of gluten, and the interaction between gluten and fiber that allowed starch to be leached out during cooking. Such results were in agreement with those obtained by Yaseen & Shouk (2007)

Table (2): Effect of replacing semolina with guava seed flour on cooking quality of pasta at three levels of replacement.

Pasta Sample	Weight increase (%)	Volume increase (%)	Cooking loss (%)
Control (Semolina 100%)	330	300	8
Replacing level of guava seeds meal fraction (1)			
10 (%)	287.5	350	8
20 (%)	262.5	320	10
30 (%)	250	250	12

Table (3) showed that, there were significant difference in color parameter of uncooked pasta as affected with replacing level of semolina with guava seed flour, where increasing replacing level from 10, 20 and 30% led to a decline in lightness (L*) to 78.22, 72.47 and 68.29; respectively; and at the same time, redness and yellowness were increased. Table (3) showed that, cooking pasta caused significant decrease in lightness (L*) and increase in redness (a*), where uncooked control pasta (100% semolina) were 86.56 (L*) and 1.38 (b*), while cooked control pasta decreased to 66.17 (L*) and 0.237 (a*). Also, increasing replacing levels of guava seeds flour caused significant increase in darkness, where lightness (L*) decreased to 53.64, 49.60 and 49.40; and redness increased to 4.32, 4.71 and 5.02 at replacement levels 10, 20 and 30%, respectively.

Table (3): Effect of replacing semolina with guava seeds meal fraction (1) on color quality of uncooked and cooked pasta.

Pasta	Uncooked Pasta Sample			Cooked Pasta Sample		
	L^*	a^*	b^*	L^*	a^*	b^*
Control	86.56[a]	1.83[b]	18.68[d]	66.17[a]	0.237[d]	12.51[c]
10 %	78.22[b]	2.46[b]	21.36[c]	53.64[b]	4.32[c]	15.19[ab]
20 %	72.47[c]	5.06[a]	23.02[b]	49.60[c]	4.71[b]	14.95[b]
30 %	68.29[d]	5.96[a]	23.97[a]	49.40[c]	5.02[a]	15.59[a]
LSD at 5%	2.807	2.084	0.599	2.196	0.2	0.581

Influence of replacing semolina with different levels of guava seeds flour to pasta was also evaluated sensorial. Table (4) revealed that, appearance of control pasta not affected significantly with increasing replacing levels of guava seeds flour up to 10 or 20%; while flavor and tenderness not affected significantly with replacement level 10%. But, color of different replacement level affected significantly if compared with pasta of control sample, this result is confirmed with the previous color parameter (L, a & b) of Table (3), where darkness was increased with increasing replacement of guava seeds flour. Also, the obtained color result agreed with Kordonowy & Young (1985), who stated that color of control spaghetti ranked higher than those of replaced bran spaghetti. Stickiness is one of the most important characteristics in judging pasta quality. The obtained sensorial results indicated that, stickiness not affected significantly, where control pasta was 8.3, while replaced pasta with different levels of guava seeds flour ranged between 8.4 - 7.6.

Table (4): Effect of replacing semolina with guava seeds meal fraction (1) on Sensory quality of pasta.

Cooked pasta Sample	Appearance (10)	Color (10)	Flavor (10)	Tenderness (10)	Stickiness (10)
Control (Wheat flour 100%)	8.5[a]	9.2[a]	8.3[a]	8.4[a]	8.3[a]
Replacing level of guava seeds meal fraction (1)					
10	7.8[a]	7.7[b]	7.7[ab]	8.6[a]	8.4[a]
20	7.1[ab]	6.4[c]	6.4[bc]	7.3[b]	8.2[a]
30	6.2[b]	5.3[c]	5.9[c]	7.7[ab]	7.6[a]
LSD at 5%	1.234	1.181	1.335	0.998	1.124

LSD = least significant differences at 5% level.
There is no significant difference between two means (within the same property) designed by the same letter.

Table (5) indicated that, pasta containing guava seeds flour caused an acceptable gradual increase in moisture, protein, fat, ash and crude fiber; and decrease in carbohydrates as a replacement of guava seeds flour level increased.

Table (5): Effect of replacing semolina with guava seeds meal fraction (1) on gross chemical composition pasta.

Pasta Samples	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Crude fiber (%)	Carbohydrate (%)
Control	11.0	12.5	0.5	0.82	0.76	85.42
Replacing level of guava seeds meal fraction (1)						
10	11.50	12.90	1.05	1.02	2.26	82.77
20	11.70	13.22	1.52	1.12	3.65	80.49
30	12.00	13.50	1.95	1.22	4.86	78.47

Moreover, chemical active groups that represent the fingerprints of the studied semolina, guava seeds flour and their blends were identified using FT-IR. Table (6) and figure (3) contained the FT-IR spectral bands of the previously mentioned samples. The broad band around 3417-3351 cm^{-1} is the characteristic absorption peak of hydroxyl group of lipid in guava seeds at 3417 cm^{-1} and stretching (OH and NH) in wheat flour and their blends with guava seeds flour. Stretching (CH_2) asymmetric vibration was identified as weak absorption peak at 2926-2928 cm^{-1}.

Stretching (CH_2) symmetric vibration (2856 cm^{-1}), stretching carbonyl group (1746), Bending (CH_2 at 1375 cm^{-1}) and stretching (C-O) of ester (1040 cm^{-1}) peaks were identified in guava seeds powder only and that attributed to its lipid content. The absorption spectral bands at 1654-1652 cm^{-1} and 1541-1540 cm^{-1} that corresponding to the carbonyl group of amide I and amide II (stretching C-N with bending N-H), respectively (Chen *et al*, 2008 and Goormaghtigh *et al*, 1996). The major peaks corresponding to carbohydrate content were located in the range 1157—1159 cm^{-1}(stretching C-O-C) , 1019 cm^{-1}(stretching C-O) and 860 cm^{-1} (stretching C-O-C-O) these results in agreement with Kacura´kova´ *et al.*, (2001).

Table (6): FT-IR spectra and assignments of Semolina, guava seeds flour fraction 1 and semolina replaced with 10% guava seeds flour fraction 1.

Assignments	FT-IR spectra (cm^{-1})		
	Guava seeds flour	Pasta of 100% Semolina	Pasta of 10% Guava seeds flour
Stretching (OH) vibration	3417	- - -	- - -
Stretching (OH and NH)	- - -	3351	3383
Stretching (CH2) asymmetrical	2926	2928	2926
CH2 stretching symmetrical	2856	- - -	- - -
C=O stretching of ester	1746	- - -	---
Amide I (C=O amide)	1653	1652	1654
Amide II (C-N stretching with NH bending mode)	- - -	1541	1540
CH bending of lipids	- - -	1421	- - -
Bending (CH2)	1375	- - -	---
stretching (C-O) of ester	1238	- - -	- - -
stretching (C-O-C) of carbohydrate	1159	1157	1158
stretching (C-C) of carbohydrate	- - -	1081	- - -
C-O stretching of ester	1040	- - -	- - -
c-o of carbohydrate stretching	- - -	1019	1019
C-O-C stretching	- - -	860	860

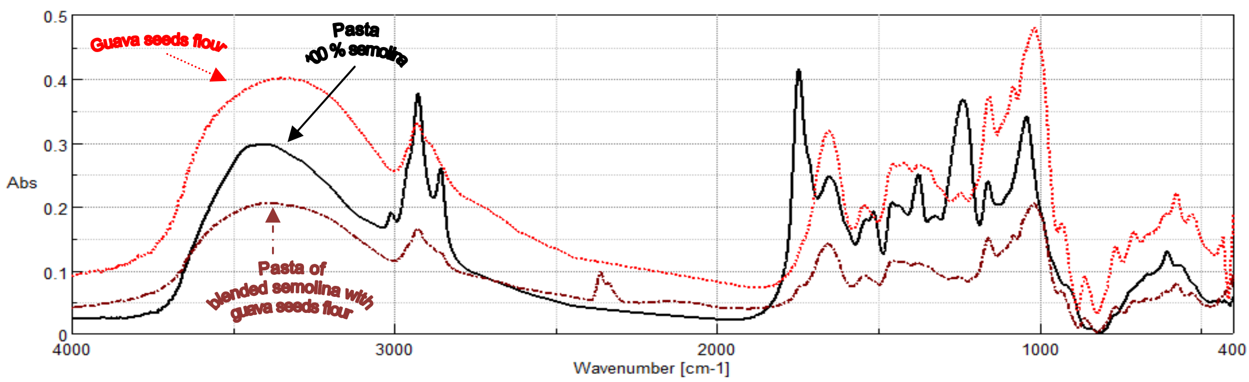


Figure (3): FT-IR spectra of guava seeds flour, control pasta sample (100% semolina) and pasta of 10% guava seeds flour.

Magnesium, calcium, potassium, iron, copper and zinc are considered as essential elements to human being. Table (7) showed that, guava seeds flour fraction 1 characterized with its higher mineral contents if compared with semolina. So, replacing guava seeds flour improved the minerals content of the blended flour, especially at a higher replacement level.

Table (7): Effect of replacing semolina with guava seeds meal fraction (1) on minerals content of pasta (dry weight basis).

Minerals (mg/100g)	Guava seeds Fraction 1	Control (Semolina 100%)	Replacing level of guava seeds meal fraction (1)		
			10 %	20 %	30 %
Magnesium	158.65	104.61	122.19	128.62	148.35
Calcium	172.36	53.00	83.55	111.32	128.43
Potassium	895.0	102.0	202.32	268.34	326.49
Iron	11.71	1.31	2.03	3.37	6.19
Copper	1.379	0.11	0.18	0.26	702.74
Sodium	750.86	630.18	650.76	680.26	702.74
Manganese	1.38	0.53	0.66	0.75	0.91
Znic	1.84	0.33	0.46	0.62	0.81

Conclusion

From the previous results, it could be concluded to use guava seeds flour fraction 1 (≥ 40 mesh) to produce pasta characterized with its lower content of carbohydrate and at the same time increasing its availability with essential minerals, crude fiber and protein. FT-IR spectroscopy was used as beneficial instrument to detect the chemical composition of food matrix.

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