Utilization of pomegranate and guava seeds in the manufacture of corn chips (*Doritos*) enriched with soybeans

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INTRODUCTION

Fruit seeds are sometimes considered as wastes, which are disposed of during processing or after human consumption. Researchers have sought to assess the nutritional values of many different fruit seeds, as they are rich in nutrients and can be used for medicinal purposes. In addition, their use reduces the problem of wastes disposal in industries (**Raihana *et al*., 2015**).There is a great interest in the residues of vegetables and fruits such as seeds and husks produced during the manufacture of juice and jam, as it contains many important nutrients for human health such as antioxidants (polyphenols, pigments and tocopherol) and omega fatty acids (**Hea *et al*., 2014**). Due to the large amount of pomegranate and guava seeds residues, it has been used in the food industry as animal feed or in commercial cosmetics **(Chaudhary and Tripathi, 2014)**.

Psidium guava (common name for guava) is a well-known to have seeds inside. The size of the seeds is very small and can be easily chewed. They are arranged in regular patterns. Their numbers range from 112 to 535 (**Kumar *et al*., 2011**).Guava seeds make up about 6-12% of the weight of the entire fruit (**Nicanor *et al*., 2000**). Being round in shape and pale yellow structure, seeds were reported to contain about 16% oil, 7.6% protein, and 61.4% crude fibers (**Prasad and Azeemoddin, 1994**). Because of this fact, guava seeds have the potential to become a source of oil that can be used in food products and as a complement to food health (**Zaini *et al*., 2011**).

It is known that most parts of the pomegranate fruit have a great antioxidants activity (**Adhami and Mukhtar, 2006**). Pomegranate seeds, a by-product of pomegranate juice, contain a range of nutritional ingredients such as sterol, tocopherol, punicic acid, and benzoic hydroxyl acids (**Liu *et al*., 2009**).

Corn is one of the most important foods in the world. It is a nutrient rich in many bioactive compounds and has a major role in human health. Consumption of corn and other whole grain products was found to decrease the risk of chronic diseases such as type 2 diabetes (**Montonen *et al*., 2003),** obesity (**Melanson *et al*., 2006**), cardiovascular disease (**Mellen *et al*., 2008**), some cancers (**Mourouti *et al*., 2016**), and the improvement of digestive tract health (**Muir *et al*., 2004**).

Soybean, *Glycine max (L.) Merrill*, is a good source of protein (35-42%), fat (16-27%) and other bioactive compounds, this makes soybean one of the most valuable and common crops (**Kumar *et al*., 2006**). As a result, soybean meal is a valuable and desirable product for human nutrition, because it contains all the essential amino acids at a low cost compared to other high-quality protein sources. Therefore, the study of the formation of amino acid from soybean is important for nutritional purposes and consumer acceptance of soybean food products, as they contribute to the taste of food **(Gao *et al*., 2011).**

Extruded snacks with high calories, fats and low protein content are unhealthy food to most consumers. Today, various techniques have been proposed to improve the quality of snacks. The use of waste's fruit processing products in extruded snacks is one of the most important techniques proposed **(Kakaei *et al*., 2019).** The addition of waste's fruit processing products to extruded snacks improves nutritional values due to the high content of dietary fiber, biologically active compounds and minerals for these by-products **(Yagcl and Gogus, 2008).**

The aim of this study was to prepare high quality healthy corn chips (*Doritos*) with high nutritional value from some fruit wastes (seeds of guava and pomegranate) and using legumes (soybean).

MATERIALS AND METHODS

Materials

Pomegranate, guava, corn and soybean were obtained from Alexandria local market. The fruits were medium in size, and other ingredients including sun flower oil, food salt, spices such as cumin, turmeric were also purchased from Alexandria local market, Egypt.

The pomegranate and guava seeds remained after pulping were removed, washed several times with tap water. The seeds were dried in an ordinary dryer at 50°C for 12 hrs. The dried seeds were ground with a food processor (Kinwood) and stored in glass jars at -18°C until analysis. Corn and soybean flour was prepared according to **Isaac and Koleosho (2012).**

Preparation of corn chips (*Doritos*)

To prepare *Doritos* chips, the dried ingredients were mixed as shown in Table (1) according to **Riaz (2016)**, then the sun flower oil and warm water were gradually added until a smooth dough formed. The dough was spread with a very thin thickness, cut it in to triangles, then baked in a hot oven at 180 ° C until it was roasted and then served. All blends were prepared in different proportions in the same method.

Table (1): Ingredients for different blends of *Doritos* chips

Ingredients	Control corn100%	Corn+ GS (97 + 3%)	Corn+PSR (97 + 3%)	Corn+S+GS (87%+10%+3%)	Corn+ S+PSR (87%+10%+3%)
Corn flour (g)	100	97	97	87	87
Soybean flour (g)	0	0	0	10	10
GS flour (g)	0	3	0	3	0
PSR flour (g)	0	0	3	0	3
Food salt (g)	1	1	1	1	1
Cumin (g)	1	1	1	1	1
Tumeric (g)	3	3	3	3	3
Sunflower oil (ml.)	10	10	10	10	10
Water (ml.)	added as needed	added as needed	added as needed	added as needed	added as needed

GS: guava seeds, **PSR:** pomegranate seeds, **S**: soy bean

Sensory evaluation

The sensory characteristics were evaluated according to **(Hooda and Jood, 2005)**.

Chemical composition

Proximate analysis of PSR, GS, soybean, corn and corn blends including crude fat, crude protein (N×6.25), crude fiber and ash were carried out according to the **AOAC (2007)**.Fat content was extracted by the soxhlet technique **AACC (1995)**. Crude protein determination was performed by the Kjeldahl technique **AOAC (2007)**.The N-free extract content was obtained by subtracting the percent total of the fat, protein, fiber and ash contents from 100%.Caloric values were calculated from the sum of the percentages of crude protein and N-free extract multiplied by a factor of 4 (kcal.g-1) plus the crude fat content multiplied by a factor of 9 (kcal.g-1) according to **Zambrano *et al*. (2004).**

The following mineral elements: Ca, Mg, Zn, and Fe were measured in ash solution using Perkin Elmer atomic absorption spectrophotometer (Model 2380) as outlined in the **AOAC (2007).**whereas Na was determined using Flame Photometer Model PEP7 as described by the **AOAC (2000)**. Total phosphorus was assayed calorimetrically at 630 nm using Carlzeiss Spekol colorimeter **(AOAC, 1990).**

Fatty acids composition

Preparation of fatty acids methyl esters of oils derived from PSR and GS was conducted by using 1% sulphuric acid in absolute methanol according to the **Radwan (1978)** technique.

Total amino acids composition

Amino acids have been determined by a Beckman model 119Cl amino aci d analyzer (USA) using the method described by **Spackman *et al*. (1958)**. Ninhydrin was used as a detective compound.

Bioactive compounds and antioxidant activity

A Jasso V–530 UV–Vis spectrophotometer was used to evaluate the total polyphenols for samples using the Folin– Ciocalteu reagent at 765 nm. The total content of polyphenol was standardized against gallic acid and expressed as (mg of GAE/100 g sample) depending on the method of (**Meyers *et al*., 2003**). According to **Choi *et al*. (2002)**, total carotenoids were determined while flavonoids were determined using the method described by **Gitelson *et al*. (2001**). Isoflavones concentrations were calculated as mg of isoflavones per 100 g of soybean according to **Tsangalis *et al.* (2002**). DPPH assay described by **Fernandez-Pachon *et al*. (2004)** was used for measuring antioxidant activity.

Antinutritional factors

Trypsin inhibitor was extracted according to the method of **Lin and Chen (1989).**Trypsin inhibitor activity was set as the number of trypsin unit inhibited (TUI). Phytic acid was determined according to the method described by **Wheeler and Ferrel (1971).**

In vitro protein digestibility

According to the method described by **Prakash and Prakash(1999),** the digestibility of samples using the proteolytic enzymes pepsin followed by pancreatin was determined. The digestibility in relation to the sample's analyzed protein content was calculated as a percentage of the digested protein.

Statistical analysis

Using IBM SPSS software package version 20.0, data were fed to the co mputer and analyzed (Armonk, NY: IBM Corp) as outlined by **Kirkpatrick and Feeney (2013)**. The Kolmogorov- Smirnov test was used to check the normality of variables distribution; Student t-test was used to compare two groups for normally distributed quantitative variables while ANOVA was used to compare more than two groups followed by Least significant difference (LSD) comparison. The relevance of the results obtained were evaluated at the rate of 0.05 (**Kotz *et al*. 2006)**.

RESULTS AND DISCUSSION

Sensory evaluation for different blends of corn chips (*Doritos*)

The sensory scores of corn chips (*Doritos*) evaluated by 30 persons are shown in Table (2). Five blends were used where the corn, pomegranate seeds, guava seeds, and soybeans were mixed together at (97+3%) and (87/10/3%). These ratios were the best accepted after testing many other concentrations during the pilot study performed before starting the research. The sensory evaluation of *Doritos* incorporated with various levels of corn, pomegranate seeds, guava seeds and soybean is presented in Table (2).

It can be observed that the taste when using *Doritos* with (corn 100%), Corn + PSR (97 + 3%) and Corn/S/PSR (87/10/3%) was significantly higher than the values of *Doritos* with Corn + GS (97 + 3%) and Corn/S/GS (87/10/3%) at 8.93, 8.79, 8.73 vs. 7.60 and 7.28, respectively. On the other hand, no significant ($P \leq 0.05$) differences were observed in odor for all *Doritos* blends. These results revealed that, the highest mean of color was shown in the control *Doritos* and corn + PSR (97 + 3%), while the lowest was in corn/S/GS (87/10/3%) and corn+GS (97+3%) samples.

Overall acceptance score of corn chips (*Doritos*) formulations at corn/S/PSR (87/10/3) ratio had the highest hedonic score (8.36) compared with the other ratios for each (97% corn + 3% GS), (87% corn+10% Soybean + 3% GS) and (97% corn + 3% PSR) which scored significantly ($P \leq 0.05$) less ratio (8.10, 7.42 and 5.58, respectively). Whereas the highest score of overall acceptance for *Doritos* with 100% corn (8.67).

The data showed that there were a significant differences ($P \leq 0.05$) between the corn chips prepared in taste, color, consistency, and overall acceptability. Generally, all formulated samples were significantly ($P \leq 0.05$) accepted for all the sensory properties. The best blend was that contained only corn followed by corn/soybean/pomegranate seeds (87/10/3%), while corn/pomegranate seeds (97+3%) was less acceptable comparing with the other blends. In a similar study, **Abd-El Haleem (2016)** prepared biscuits enriched with guava seeds and pomegranate seeds and the general acceptance of these products was good.

Table (2): Sensory evaluation for different blends of corn chips (*Doritos*)

Samples	Taste	Color	consistency	Odor	Overall acceptability
Control (corn 100%)	8.93± 0.14 [a]	8.90± 0.85 [a]	8.70± 0.07 [a]	8.82± 0.90 [a]	8.67± 0.44 [a]
Corn + PSR (97 + 3%)	8.79± 0.55 [a]	8.71± 0.71 [a]	8.20± 0.71 [ab]	8.43± 0.55 [a]	5.58± 0.02 [c]
Corn + GS (97 + 3%)	7.60± 0.17 [b]	8.12± 0.78 [ab]	7.80± 0.40 [bc]	8.63± 0.01 [a]	8.10± 0.16 [ab]
Corn / S/PSR 87/10/3	8.73± 0.21 [a]	8.56± 0.82 [a]	7.37± 0.68 [bc]	8.26± 0.58 [a]	8.36± 0.29 [a]
Corn /S/GS 87/10/3	7.28± 0.10 [b]	7.18± 0.21 [b]	7.21± 0.25 [c]	7.89 ± 0.88 [a]	7.42± 0.88 [b]

* (PSR) Pomegranate seeds residues, (GS) guava seeds and (S) soybean. Data was expressed using Mean ± SD.

Means in the same **column** with **common letters** are not significant (i.e. Means with **Different letters** are significant)

Proximate analysis for PSR, GS, corn, soybean and different blends of corn chips (*Doritos*)

The proximate analysis and minerals of pomegranate seeds residues (PSR), guava seeds (GS), corn and soybean are tabulated in Table (3-a &3-b&3-c). Data of proximate composition indicated that GS contained a significant ($P \leq 0.05$) lower amount of crude protein, crude fat and ash contents (10.38, 16.94 and 1.71 %, respectively) compared with those of PSR (12.59, 21.39 and 3.17%, respectively). While, GS contained a significant ($P \leq 0.05$) higher amount of moisture, crude fiber and N-free extract contents (2.49, 66.85 and 4.12%,respectively) compared with PSR (0.90, 59.9 and 2.95 %,respectively). The moisture value found in this study for GS are lower than those found by **Fontanari *et al*. (2008)**, who obtained a moisture value of 8.3 g/100g for guava seed powder. The ash value found was 1.71%, This value is less than the results of other authors, such as **Martínez *et al*. (2012)**, who obtained an ash content of 2.4 % for guava.

Table (3-a): Proximate analysis of PSR, GS, corn, soybean

	Components	Moisture %	Crude protein%	Crude fat%	Crude Fiber%	Ash%	N-free extract%	Calories kcal/100g
Raw materials	*PSR	0.90±0.16 [b]	12.59±0.64 [a]	21.39±0.42 [a]	59.9± 0.24 [b]	3.17 ± 0.1 [a]	2.95±0.11 [b]	254.67±0.30 [a]
	GS	2.49±.42 [a]	10.38±0.77 [b]	16.94±0.23 [b]	66.85±0.44 [a]	1.71±0.45 [b]	4.12±0.20 [a]	210.46±0.77 [b]
	**Corn	8.19±0.15 [a]	11.99±0.8 [b]	13.01±0.34 [a]	2.19±0.62 [b]	2.29±0.88 [b]	70.52±0.13 [a]	447.13±0.63 [a]
	Soybean	5.28±0.08 [b]	30.1±0.81 [a]	4.11± 0.88 [b]	9.30±0.52 [a]	6.23±0.23 [a]	50.26±0.11 [b]	358.43±0.60 [b]

Data was expressed using Mean ± SD. (PSR) Pomegranate seeds residues, (GS) guava seeds
*Means in the same column in **PSR** and **GS** are not significant (i.e. Means with **Different letters** are significant)
Means in the same column in **Corn and **Soybean** are not significant (i.e. Means with **Different letters** are significant).

Observing the results of lipid analysis for GS shown in **Table 3-a**, the results presented in this study are more than to those reported by **Silva *et al*. (2009)** who found that crude fat was 11.71 % for the guava seed on a dry basis. **Rowayshed *et al*. (2013)** determined the chemical composition of PSR and found that moisture, crude protein, crude fat, ash, crude fibers and N-free extract contents were 5.82, 13.66, 29.60, 1.49, 39.36 and 13.12 % on dry weight basis, respectively. The difference in content may vary depending on the soil and agriculture environment. The relatively high protein contents in each sample showed that samples could be considered a good source of protein and they may contribute significantly to humans' daily protein requirements.

Values of chemical composition showed that corn has a significant ($P \leq 0.05$) increase in moisture, fats, N-free extract and calories (8.19, 13.01, 70.52 and 447.13%, respectively) compared to the values of soybean (5.28, 4.11, 50.26 and 358.43%, respectively), Whereas corn has a significant ($P \leq 0.05$) reduction in protein, ash and crude fibers (11.99, 2.29 and 2.19%, respectively) compared to those of soybean (30.1, 6.23 and 9.30%, respectively). **Rashwan and Mohamady (2015)** found that corn contains 10.5,4.7,1.6,1.4 and 81.8% for protein, lipids, ash, fibers and carbohydrates, respectively. Also, **Guria (2006)** found the value of moisture, crude protein, crude fat, crude fiber and N-free extract contents for corn were 8.03, 10.29, 5.53, 1.34,73.58,respectively.

The soybean's composition varies with the location,growing season and v ariety (**Bakal *et al*., 2017**). Nonetheless, **Seo *et al*. (2012)** found that the average for the main nutrients in soybean are 8.1% moisture, 18.1% lipid, 35.1 % proteins and 6.0 % ash (g/100 g).

Drought and temperature also affect the chemical composition of soybeans. Many researchers found that there was a difference in moisture content between soybean samples and this may be due to conditions legumes drying after harvest, legumes ability to lose moisture and storage period (**Coradi *et al*., 2016**). In addition, high temperatures during soybean growth were found to be associated with lower fat content. However, this depends on other factors such as water stress, which affects the production of fat by affecting the growth and development of grains **(Thuzar, 2010)**.

The data of the chemical composition of corn chips (*Doritos*) are explained in Tables (3-b). Chemical composition of *Doritos* showed that *Doritos* with 100% corn has a significant ($P \leq 0.05$) lower ratio of moisture, crude protein, fat, crude fiber, and ash contents (7.15, 10.99, 14.01, 2.25 and 2.59%, respectively) compared to other blends. Whereas the *Doritos* enriched with 3% PSR have a significant ($P \leq 0.05$) higher ratio of crude protein, fat and calories compared to *Doritos* with 3% Gs. On the other hand the blends with (87% corn+10% Soybean+3% PSR and 87% corn+ 10% Soybean+3% GS) have a significant ($P \leq 0.05$) higher ratio of moisture, crude protein, crude fiber and ash content when compared with other blends. While N-free extract, in blends (97% corn + 3% PSR and 97% Corn + 3% GS) have a significant ($P \leq 0.05$) higher ratio (65.02 and 66.22, respectively) compared to N-free extract content of 87% corn+10% Soybean+3% PSR and 87% corn+10% Soybean+3% GS (62.11and 63.28, respectively).

Table (3-b): Proximate analysis of different blends of corn chips (*Doritos*)

	Components	Moisture %	Crude protein%	Crude fat%	Crude Fiber%	Ash%	N-free extract%	Calories kcal/100g
****** Doritos* blends**	**Control (Corn100%)**	7.15±0.87 [a]	10.99±0.03 [c]	14.01±0.53 [c]	2.25±0.78 [b]	2.59±0.76 [a]	70.16±0.61 [a]	450.69±0.02 [b]
	Corn+PSR (97 + 3%)	7.18±0.40 [a]	12.01±0.66 [b]	16.04±0.01 [a]	3.9 ± 0.60 [a]	3.02±0.87 [a]	65.02±0.42 [c]	452.48±0.78 [a]
	Corn+GS (97 + 3%)	7.22±0.17 [a]	11.94±0.60 [b]	14.87±0.29 [b]	4.12±0.50 [a]	2.85±0.69 [a]	66.22±0.32 [b]	446.47±0.38 [c]
	Corn/S/PSR (87/10/3)	7.73±0.19 [a]	13.82±0.73 [a]	15.24±0.44 [b]	4.98±0.13 [a]	3.85±0.07 [a]	62.11±0.30 [e]	440.88±0.68 [e]
	Corn/S/GS (87/10/3)	7.95±0.17 [a]	13.75±0.08 [a]	14.98±0.15 [b]	4.53±0.80 [a]	3.46±0.42 [a]	63.28±0.15 [d]	445.28±0.45 [d]

Data was expressed using Mean ± SD. (PSR) Pomegranate seeds residues, (GS) guava seeds
*******Means in the same column in ***Doritos* blends** are not significant (i.e. Means with **Different letters** are significant)

These data explained that blends enriched with soybean included high amount of protein, ash, crude fiber and moisture and low amount of N-free extract. These results are different from **Aly (2019)** whereas he enriched biscuits with GS and the study showed that biscuits enriched with 5% GS has 17.2% fats,1.4% ash and 69.8% N-free extract whereas the data is so close for protein (11.6%).

Minerals content of PSR and GS are presented in Table (3-c). Results showed that PSR contained a significant ($P\leq0.05$) increase of Ca, Na, Mg, Fe and Ph (465.3, 352.6, 232.4,3.45 and 990.09 mg/100g, respectively) compared with the same minerals of GS (257.3, 162.0, 190.0, 1.18 and 752.13 mg/100g, respectively). While the content of zinc in PSR (11.6 mg/100g) less than GS (20.99 mg/100g,respectively). PSR values differ from the result of **Rowayshed *et al*. (2013)** who found that the content of Na, Fe, Zn, Mn, Cu and Se in PSR were 33.03, 10.88, 5.54, 2.26, 3.82 and 0.23 mg/100g on dry matter, respectively. The results confirmed that PSR and GS are a good source of macro and micro elements so it should be used in food fortification and enrichment. The content of these seeds of sodium is considered low according to the **World Health Organization (2013)**, which recommends taking less than 1.7 g / day (1700 mg / day) of this mineral. **Uchôa *et al*. (2008)** assessed magnesium in guava seeds and found that it contained 0.19 mg / 100 g. **Gondim *et al*. (2005)** found that biological reactions are highly dependent on magnesium and sulfur. When compared the iron content of pomegranate seeds, it was found to represent 24.64% of the adult dietary intake (DRI), which is 14 mg / day (**Brasil, 2005**). In estimating the amount of zinc contained in pomegranate and guava seeds in this study, the values found were (11.61 ± 0.63 and 20.99 ± 0.35 mg / 100 g, respectively).When comparing these values with the recommended adult amounts of 15 mg / day, they were found to represent 77.4 and 139.9% of the recommended amount.

Analysis of minerals for corn and soybean in (Table 3-c) showed that soybean has a significant ($P \leq 0.05$) increase in Fe, Ca, Zn, Mg and phosphorus (14.6, 298.32, 2.1, 244.42 and 643.15, respectively) compare with those of corn (1.36, 0.72, 0.21, 39.02 and 30.0, respectively) while the soybean showed significantly ($P \leq 0.05$) decrease in sodium (2.98 mg/100g) compared to corn (198.0 mg/100g). **Rashwan and Mohamady (2015)** determined the minerals content of corn and found the values as follow 360, 120, 128 and 3.60 (mg/100g on dry weight basis) For Ca, P, Mg and Fe, respectively. Also, **Guria (2006)** found the content of iron, copper, manganese and zinc were 1.92, 0.33, 0.18, 1.65 mg, respectively.

Table (3-c): Minerals content of PSR, GS, corn, soybean and different blends of corn chips (*Doritos*)

	Components	Minerals (mg/100g DM)					
		Calcium	Sodium	Magnesium	Iron	Zinc	Phosphorus
Raw materials	*PSR	465.3±0.18 [a]	352.6±0.24 [a]	232.4±0.33 [a]	3.45±0.71 [a]	11.61±0.63 [b]	990.09±0.58 [a]
	GS	257.3±0.30 [b]	162.0±0.71 [b]	190.0± 0.67 [b]	1.18±0.09 [b]	20.99±0.35 [a]	752.13±0.41 [b]
	**Corn	0.72 ± 0.71 [b]	198.0±0.32 [a]	39.02± 0.07 [b]	1.36±0.02 [b]	0.21±0.88 [b]	30.0±0.17 [b]
	Soybean	298.32±0.3 [a]	2.98 ± 0.01 [b]	244.42± 0.4 [a]	14.6±0.2 [a]	2.1±0.10 [a]	643.15±0.05 [a]
****Doritos* blends**	Control (Corn100%)	0.78± 0.54 [e]	202.0±0.24 [b]	41.52± 0.69 [e]	1.37±0.72 [b]	0.19± 0.01 [b]	32.01±0.35 [e]
	Corn+PSR (97 + 3%)	14.64±0.65 [c]	207.63±0.57 [a]	44.81± 0.13 [c]	1.43±0.37 [b]	0.50± 0.31 [a]	59.80±0.36 [c]
	Corn+GS (97 + 3%)	8.40± 0.26 [d]	196.92±0.69 [c]	43.54± 0.39 [d]	1.37±0.87 [b]	0.81± 0.22 [a]	53.66±0.40 [d]
	Corn/S/PSR (87/10/3)	44.40±0.55 [a]	183.13±0.45 [d]	65.35± 0.05 [a]	2.78±0.02 [a]	0.70±0.18 [a]	122.11±0.68 [a]
	Corn/S/GS (87/10/3)	38.16±0.61 [b]	177.42±0.24 [e]	64.08± 0.59 [b]	2.70±0.25 [a]	0.97±0.42 [a]	114.97±0.77 [b]

Data was expressed using Mean ± SD. (PSR) Pomegranate seeds residues, (GS) guava seeds.
*Means in the same column in **PSR** and **GS** are not significant (i.e. Means with **Different letters** are significant)
Means in the same column in **Corn and **Soybean** are not significant (i.e. Means with **Different letters** are significant)
Means in the same column in ***Doritos **blends** are not significant (i.e. Means with **Different letters** are significant)

Soybeans contain a significant amounts of iron and calcium (**Miller, 2008**). The bioavailability of certain minerals, such as zinc, may be adversely affected by phytic acid (**Dahdouha *et al*., 2019). Zhang *et al*. (2010)** found that there was a significant difference in the mineral content of the soybean due to different environment and genotype. From the previous discussion of the results, it can be concluded that guava, pomegranate seeds, corn and soybean are a good source of many nutrients.

Minerals content for corn chips blends (*Doritos*) are presented in Table (3-c). The results indicated that the use of a mixture of corn, guava seeds, pomegranate seeds and soybeans in various proportions increased the mineral content. Magnesium content increased slightly, but significantly, after preparation of *Doritos* with different blends, This is in agreement with **Suri and Tanumihardjo (2016)**, which found that the magnesium content increases in the dough after preparation from 165 to 180 mg/100 g. Increases in phosphorous and iron in all blends may be due to a decrease in the phytic acid content, as will be explained later. This result is consistent with (**Hambidge *et al*., 2005**), which found that food preparation processes that reduce phytic acid lead to increased availability of phosphorous and iron. The low zinc content in the prepared *Doritos* from corn only may be caused by the maillard reaction that occurred during heat treatment, This result is consistent with **Prasanthi *et al*. (2017)**, who estimated the zinc content in corn flakes and corn grits, and found that the grits contained a higher percentage of zinc compared to the corn flakes that were exposed to this reaction, which made zinc less available. The results showed that this percentage increases in the other *Doritos* mixtures, depending on the ingredients used that contain zinc.

Fatty acids composition for PSR and GS oils

Fatty acid composition of oils extracted from PSR and GS are illustrated in Table (4). It is obvious that the fatty acid of GS include higher amount of capric, hendecanoic, palmitic, heptadecanoic, stearic and behenic (0.69, 0.32, 5.31, 0.08,6.42 and 0.20%, respectively) compared with fatty acid of PSR (0.28, 0.19, 3.49, 0.06, 2.29 and 0.19%, respectively). Whereas GS has insignificant ($P \leq 0.05$) decrease in caproic,myrsitic, pentodecanoic and arachidic (0.39, 0.16, 0.07 and 0.16%, respectively) compared to PSR (0.79, 0.18, 0.36 and 0.32%, respectively).

Table (4): Fatty acids composition for PSR and GS oils

Fatty acids (%)	* PSR	**GS
Caproic	0.79 ± 0.22 [a]	0.39 ± 0.16 [a]
Caprylic	1.08 ± 0.20	-
Capric	0.28 ± 0.65 [a]	0.69 ± 0.26 [a]
Hendecanoic	0.19 ± 0.14 [a]	0.32 ± 0.81 [a]
Lauric	0.09 ± 0.79 [a]	0.09 ± 0.10 [a]
Myrsitic	0.18 ± 0.42 [a]	0.16 ± 0.85 [a]
Pentodecanoic	0.36 ± 0.22 [a]	0.07 ± 0.28 [a]
Palmitic	3.49 ± 0.48 [b]	5.31 ± 0.67 [a]
Heptadecanoic	0.06 ± 0.34 [a]	0.08 ± 0.24 [a]
Stearic	2.29 ± 0.56 [b]	6.42 ± 0.23 [a]
Arachidic	0.32 ± 0.40 [a]	0.16 ± 0.71 [a]
Behenic	0.19 ± 0.43 [a]	0.20 ± 0.49 [a]
Total saturated fatty acids	9.32 ± 0.49 [b]	13.89±0.77 [a]
Myristoleic	0.61±0.60 [a]	0.35±0.37 [a]
Margaroleic	0.16 ± 0.86 [a]	0.28±0.84 [a]
Palmitoleic	3.01± 0.08 [a]	1.11 ± 0.77 [b]
Oleic	9.36±0.14 [a]	6.10±0.61 [b]
Linoleic	13.85±0.36 [b]	72.32±0.32 [a]
Linolenic	60.48 ±0.47 [a]	7.02±0.05 [b]
Eicosenic	0.95 ±0.32 [a]	0.38±0.35 [a]
Docosadienoic	1.22 ±0.42 [a]	0.09±0.29 [b]
Total unsaturated fatty acids	89.64±0.09 [a]	87.65±0.24 [b]

Data was expressed using Mean ± SD. Values followed by the same letter in a row are not significantly (i.e. Means with Different letters are significant)
Pairwise comparison bet. each 2 groups was done using student t-test
different at $P \leq 0.05$.* (PSR) Pomegranate seeds residues and **(GS) guava seeds.

Total saturated fatty acids for PSR and GS were 9.32 and 13.9%, respectively. Also, the fatty acids pattern revealed that the total unsaturated content were (89.64%) and (87.65%) for PSR and GS oils, respectively. Linolenic acid was found to be the dominant unsaturated fatty acid (60.48 %) in PSR oil, while linoleic acid was the major one (72.32%) in GS oil.

These results are consistent with **Opute (2008)** which found that linoleic acid is found in a very large proportion in guava seeds, accounting for about 51% of total fatty acids. Also, **Uchôa-thomaz *et al*. (2014)** found that guava seeds are rich in unsaturated fatty acids (87.06%), especially oleic acid and linoleic acid. The presence of unsaturated fatty acids in foods has a significant role in lowering blood cholesterol levels and within the treatment of atherosclerosis (**Ander *et al*., 2003**).**Wu and Tian (2017)** analyzed the fatty acids in pomegranate seed oil, where it was found that punicic is the most abundant fatty acid with 60% of the fatty acids, followed by oleic acid, linoleic acid, and palmitic acid. The seeds of mature pomegranate fruits in the local Egyptian markets were studied by **El-Nemr *et al*. (1990**) where it was found that the total fat content was 27.2% and the percentage of saturated fatty acids was 83.6% of the total fatty acids. caprylic acid was the most present (36.3%), followed by stearic acid, oleic and linoleic acids out of 11 estimated fatty acids, But no results were reported for punicic acid or linolenic acid.

Total amino acids composition of PSR, GS, soybean, corn and different blends of corn chips (*Doritos*)

The amino acids composition of PSR, GS, soybean, corn and different blends of corn chips (*Doritos*) are showed in Table (5-a, 5-b). It was obvious that PSR contains higher amounts of lysine, leucine and histadine (2.08, 7.59 and 2.99, respectively) compared with GS amino acids (1.75, 7.19 and 2.82, respectively); the opposite was noticed for the other essential amino acids, since GS had a higher content of methionine, isoleucine, phenylalanine, cysteine, threonine, tyrosine and valine compared with amino acids of PSR. It could be noted that both PSR and GS exhibited much higher content of methionine, isoleucine, phenylalanine, tyrosine, valine and histidine, than the reference protein pattern of **FAO/WHO (2002).** The results of non-essential amino acids showed that PSR has a higher amount of glycine, aspartic, proline and glutamic (7.60, 6.40, 6.22 and 23.49, respectively) compared to GS (4.92, 2.81, 3.55 and 16.72, respectively). Whereas PSR has a low amount of alanine, arginine and serine (5.48, 6.69 and 3.49, respectively) compared with data of GS (7.72, 9.89 and 5.55, respectively).

Amino acids were studied in two varieties of pomegranate seeds found in Tunisia by **Elfalleh *et al.* (2011)**, also been studied in Egypt by **Rowayshed *et al*. (2013).** Both recorded high levels of aspartate (1.9 and 1.21 g/100 g, arginine 1.9 and 1.47 g/100 g, respectively) and glutamate (3.5 g/100 g), respectively) in dry seeds.

Table (5-a): Amino acids composition of PSR, GS, soybean and corn

Amino acid g/100 g protein	*PSR	**GS	Soybean	Corn	FAO /WHO Pattern (2002)
Essential A.A.					
Phenylalanine	3.42	4.01	4.85	3.59	2.8
Histidin	2.99	2.82	4.67	6.32	1.8
Isoleucin	5.35	6.05	5.87	3.45	4.2
Leucine	7.59	7.19	5.69	7.60	6.3
Lysine	2.08	1.75	5.91	2.01	5.2
Methionine	2.98	3.90	2.81	4.05	2.2
Threonine	3.39	3.99	1.32	2.50	2.7
Valine	4.88	6.39	5.89	5.12	4.2
Tryptophan	N.D	N.D	N.D	N.D	
Total –essential A.A.	**32.68**	**36.10**	**37.01**	**34.64**	**29.4**
Non-essential					
Alanine	5.48	7.72	6.40	4.42	
Aspartic acid	6.40	2.81	8.32	7.08	
Cysteine	0.51	0.69	2.05	4.21	
Glutamic acid	23.49	16.72	8.40	7.65	
Glycine	7.60	4.92	7.60	5.09	
Proline	6.22	3.55	5.30	5.57	
Serine	3.49	5.55	6.73	5.76	
Tyrosine	3.68	3.96	5.20	4.86	
Arginine	6.69	9.89	5.75	3.64	
Total non-essential a. a.	63.56	55.81	55.75	48.28	
Total (TEAA + TNEAA)	96.24	91.91	92.76	82.92	
Ar EAA (Phe + Tyr)	7.10	7.97	10.05	8.45	
TSAA(Meth+Cys)	3.49	4.59	4.86	8.26	

*(PSR): Pomegranate seeds residues and **(GS) guava seeds.
N.D: Not Determined

These values depended on climate, genotype and growth conditions. They also found that the seeds content of amino acids was similar in composition to the peels in the sample estimated in Egypt. When comparing the essential amino acids content of pomegranate seeds to the requirements of FAO / WHO by **Elfalleh *et al*. (2011)** they were found to be significantly higher than these requirements for adults. As a result of the lack of these essential amino acids in most foods, it is recommended to use these seeds as food supplements. **El Anany (2015)** pointed out that guava seeds have a large percentage of essential amino acids and account for 35.19% of the total amino acids content. The protein of guava seeds was rich in essential amino acids such as threonine, isoleucine, total aromatic amino acids, tryptophan and total sulfur amino acids compared with the **FAO/WHO (1991)** reference. Total amount of non-essential amino acids represented 64.81 % of the total amino acids content. Glycine, arginine and glutamic acids were found to be the major non-essential amino acids in guava seeds protein 18.75, 8.52 and 9.06 %, respectively.

The values of amino acids for soybean and corn are showed in (Table 5-a). The results indicated that lysine content was (5.91 g/100 g protein), while threonine was the lowest essential amino acid presented in the soybean and it was (1.32 g/100 g protein), but the highest percentage for essential amino acids was lysine (5.91±0.18) followed by valine (5.89 g/100 g protein). cysteine % was the lowest non-essential amino acid presented in the soybean and it was (2.05 g/100 g protein), but the highest percentage for non-essential amino acids was glutamic acid (8.40 g/100 g protein) followed by aspartic acid (8.32 g/100 g protein).

These results were consistent with **Sharma *et al*. (2014)** who reported that soybean seeds contain a large amount of all the essential amino acids, so it is a rich source of protein but lacks others such as methionine and cysteine. These seeds of different genotypes contain different amounts of amino acids where the proportions of methionine, sulfur and cysteine differed between different species. The results indicated that leucine was higher essential amino acid presented in the corn (7.60 g/100 g protein), while lysine was the lowest essential amino acid and it was (2.01 g/100 g protein).The non-essential amino acids were found in a wide range. Glutamic acid was the most predominant non-essential amino acid found and it was (7.65 g/100 g protein), followed by aspartic acid which was (7.08 g/100 g protein) However, the arginine was the lowest non-essential amino acid presented in the corn and it was (3.64 g/100 g protein).These results are consistent with **Okaka (2005)** who found that corn are deficient in sulphur amino acids such as lysine.

Results of amino acids composition for different blends of *Doritos* are shown in Table (5-b). From the obtained results, it could be illustrated that *Doritos* with corn/ S/PSR and corn /S/GS by 87/10/3% contained a higher amount from all essential and non-essential amino acids than the blends of *Doritos* with corn only, Total essential amino acids in the *Doritos* blends ranged from 32.64 to 40.29 g/100 g protein and non essential ranged from 46.33 to 54.56 g/100 g protein, because the addition of soybean has increased the amount of amino acids. It is noticeable that the mixture of *Doritos* prepared from corn only is poor in the content of lysine, because the corn is poor in the content of sulfur amino acids such as lysine, therefore it was found that when making mixtures of corn with soybeans led to a high proportion of lysine as the legumes are rich in sulfur amino acids, These observation are in agreement with **Okaka (2005)**.

Table (5-b): Amino acids composition for different blends of corn chips (*Doritos*)

Amino acid g/100 g protein	Control (Corn100%)	Corn + PSR* (97 + 3%)	Corn + GS** (97 + 3%)	Corn / S/PSR 87/10/3	Corn /S/GS 87/10/3	FAO /WHO Pattern (2002)
Essential A.A.						
Phenylalanine	3.26	3.61	3.56	4.41	4.31	2.8
Histidin	5.99	6.19	6.05	6.92	6.91	1.8
Isoleucin	3.45	3.51	3.77	4.45	4.23	4.2
Leucine	6.60	7.41	7.40	8.30	8.29	6.3
Lysine	2.01	2.02	2.39	3.10	2.70	5.2
Methionine	3.72	4.02	3.79	4.59	4.75	2.2
Threonine	2.50	2.53	2.43	3.11	3.24	2.7
Valine	5.12	5.11	4.27	5.89	5.86	4.2
Tryptophan	N.D.	N.D.	N.D.	N.D.	N.D.	
Total-essential A.A.	**32.64**	**34.40**	**33.66**	**40.77**	**40.29**	**29.4**
Non-essential						
Alanine	4.42	4.38	4.51	5.35	5.22	
Aspartic Acid	6.41	6.94	6.74	7.88	7.65	
Cysteine	3.88	4.04	3.89	4.95	4.76	
Glutamic Acid	7.65	7.79	7.73	8.90	8.62	
Glycine	4.89	5.16	5.33	6.12	5.78	
Proline	5.24	5.41	5.52	6.26	6.01	
Serine	5.67	5.69	5.52	6.49	6.45	
Tyrosine	4.52	4.75	4.55	5.76	5.54	
Arginine	3.64	3.73	4.04	4.64	4.53	
Total non-essential a. a.	**46.33**	**47.89**	**47.83**	**56.35**	**54.56**	
Total (TEAA + TNEAA)	**78.96**	**82.27**	**81.48**	**97.12**	**94.86**	
Ar EAA (Phe + Tyrosine)	**7.78**	**8.36**	**8.11**	**10.17**	**9.85**	
TSAA(Methionine +Cysteine)	**7.59**	**8.06**	**7.68**	**9.54**	**9.51**	

*(PSR): Pomegranate seeds residues and **(GS) guava seeds
N.D: Not Determined

Also, **Jezierny *et al.* (2010)** noted that when mixing grains with legumes, this leads to a balance in the amino acids content of these mixtures. **Hess *et al.* (2016)** reported that snacks are not highly nutritious and do not give the body nutrients. Therefore, this study aimed to make snacks containing many nutrients and acceptable. Leucine is the most concentrated essential amino acid, increased in both corn+PSR and corn+GS (7.41 and 7.40 g/100 g protein, respectively) than *Doritos* with 100% corn (6.60 g/100 g protein). While lysine was the lowest essential amino acid presented and varied from 2.01 to 3.10, the highest percentage of lysine was in *Doritos* with (Corn/S/PSR)(3.10 g/100 g protein). Glutamic is the most concentrated non – essential amino acid. The highest was observed in corn/S/PSR (8.90 g/100 g protein) followed by Corn/S/GS (8.62 g/100 g protein), but the lowest value was found in the *Doritos* with 100% corn (7.65 g/100 g protein). As also shown in Table (5-b), it could be noted that *Doritos* with PSR, GS, soybean contained a much higher contents of phenylalanine, histidin, isoleucin, leucine, methionine, threonine, valine than the corresponding contents in the reference protein pattern of **FAO/WHO (2002)**. On the other hand, the blends was found to be deficient in lysine and threonine. However, there has been an increase in soybean blends. Therefore, it is necessary to make different mixes to take advantage of different nutrients.

Bioactive compounds and antioxidant activity for PSR,GS and soybean

Bioactive compounds and antioxidant activity of PSR and GS are showed in Table (6-a). Our finding indicated that PSR has a significantly ($P \leq 0.05$) higher amounts of polyphenols and total flavonoids (419.32 mg GAE/100 g and 93.12 mg Rutin/100g, respectively) than GS (102.03 mg GAE/100 g and 53.99 mg Rutin/100g, respectively). On the other hand, GS contained a significantly ($P \leq 0.05$) higher amounts of total carotenoids (220.05 µg/g) than PSR (110.04 µg/g).The results interpreted that antioxidants activity (DPPH) in PSR (75.12**%**) were significantly ($P \leq 0.05$) higher than GS (50.14**%**). These results are in accordance with those reported by (**Opute, 2008; EL-Safey *et al*. 2012** and **Mekni *et al*. 2014)**. **El Anany (2015)** found that total flavonoids of guava seeds were 290.30 mg/100 g DW, phenolic content was 973.80 mg/100 g DW and DPPH radical-scavenging activity expressed in % inhibition was 63.74 %. **Jain *et al*. (2014**) found that pomegranate seeds are rich in flavonoids, total phenols, total carotenoids. The results shows that the seeds can be used in more beneficial applications in food due to its rich content of unsaturated fatty acids, phenolic content and its antioxidant properties.

Table (6-a): Bioactive compounds and antioxidant activity for PSR and GS

Component	*PSR	**GS
Polyphenols (mg of GAE/100 g)	**419.32 ± 0.67 [a]**	**102.03 ± 0.40 [b]**
Total carotenoids (µg/g as beta-carotene)	**110.04 ± 0.37 [b]**	**220.05 ± 0.16 [a]**
Total flavonoids (mg of Rutin/100g)	**93.12 ± 0.88 [a]**	**53.99 ± 0.90 [b]**
DPPH scavaning activity (%)	**75.12 ± 0.61 [a]**	**50.14 ± 0.51 [b]**

Data was expressed using Mean ± SD. The same letter in a row are not significantly different at $P \leq 0.05$.
Pairwise comparison bet. each 2 groups was done using Least significant difference (LSD)
* (PSR) Pomegranate seeds residues ** (GS) guava seeds.

The average of DPPH and total phenolic content for soybean were (63.90 **%** and 576.0 mg GAE/100 g) as shown in Table (6-b). The antioxidant activity of soybeans was in correlation with total phenols content (**Kumar *et al*., 2010a)**. **Sharma *et al*. (2014)** found that the content of total phenols, ortho-dihydroxy phenols and flavonols in different genotypes ranged from 1.0–1.5, 0.10–0.21 and 0.20–0.34 mg g−1, respectively. Soybean content of phenolic compounds varies from place to place and from region to region. This is confirmed by the study carried out by **Chung *et al*. (2011)** who found that the total phenolic content in Korean soybean was 366 mg/100 g, while **Malenčić *et al*. (2007)** found a different ratio in Serbia where total phenolic content ranged from 270 to 488 mg/100 g.

The total isoflavones content of soybean was 372.0 mg/100 g. The highest average value of glycitein was found at (170.4 mg/100 g) while, genistein had the lowest value at (60.10 mg/100 g). Soybeans are a major source of isoflavones in human nutrition where they are found in large quantities, while in cereals and legumes in a small amount (**Fletcher, 2003**). Some studies found that plasma genistein and daidzein concentrations were very high after about six hours of taking isoflavones. These compounds also appeared, but less frequently after one hour of eating a soy-rich meal (**Franke *et al*., 2014**). **Mujić *et al*. (2011)** found that total isoflavones content ranging from 80.7 to 213.6 mg/100 g in various soybean cultivars. **Carrão-Panizzi and Kitamura (1995)** reported that some researchers found isoflavones in different soybean varieties and their concentration ranged between 126.1 and 409.2 mg/100 g. Isoflavones are good ingredients for human health as they prevent many diseases such as osteoporosis, menopausal symptoms and heart diseases (**Zaheer and Humayoun, 2017**).

Table (6-b): Bioactive compounds and antioxidant activity for soybean

Soybean	Values
DPPH (%)	63.90 ± 0.42
TPC mg GAE/100 g	576.0 ± 0.32
Content of isoflavone (mg/100 g of soybean)	
Daidzein	141.5 ± 0.14
Glycitein	170.4 ± 0.19
Genistein	60.10 ± 0.84
Total	372.0 ± 1.18

Values represent means of triplicates. Data was expressed using Mean ± SD.

Anti-nutritional factors and protein digestibility of PSR, GS, corn, soybean and different blends of corn chips (*Doritos*)

Anti-nutritional factors and protein digestibility of PSR,GS, corn and soybean are illustrated in Table (7). The significantly (P≤0.05) higher amount of trypsin inhibitors and phytic acid were found in GS (41.98 and 72.02, respectively) compared to PSR (22.02 and 14.01, respectively). On the other hand, protein digestibility in PSR were significantly (P≤0.05) higher (90.08%) than GS (80.99%).The reduction of anti-nutrients may have a role in protein digestibility improvement **(Laminu *et al*., 2011).** Anti-nutrients are a doubleedged sword as they have both adverse effects and health benefits, such as phytic acid, which binds with calcium, copper, iron and zinc and forms insoluble complexes. Flavonoids are widespread forms of anti-nutrients and a group of polyphenols that include phenolic compounds (tannins), saponins and enzyme inhibitors (proteases and amylase) (**Reyden and Selvendran 1993**). **El Anany (2015)** determined the content of phytic acid and tannins from guava seeds and found the results were as follows: (273.63 and 325.67 mg/100 g, respectively) on dry weight basis.

Table (7): Anti-nutritional factors and protein digestibility of PSR, GS, corn, soybean and different cooked blends of corn chips (*Doritos*)

	Components	Trypsin inhibitor (TIU/mg)	Phytic acid (mg/100 g)	Protein digestibility (%)
Raw materials	***PSR**	22.02±0.23 [b]	14.01±0.56 [b]	90.08±0.46 [a]
	GS	41.98±0.003 [a]	72.02±0.07 [a]	80.99±0.21 [b]
	****Soybean**	0.63±0.43 [a]	9.26±0.37 [a]	85.46±0.32 [a]
	Corn	0.52±0.10 [b]	4.96±0.73 [b]	79.02±0.53 [b]
	Control (corn % 100)	1.80±0.37 [a]	7.41±0.61 [a]	78.87±0.68 [d]
*****Doritos* blends**	**Corn + PSR (97 + 3%)**	1.16±0.39 [b]	5.67±0.71 [b]	80.35±0.34 [c]
	Corn + GS (97 + 3%)	1.76±0.10 [a]	6.97±0.13 [a]	79.08±0.33 [d]
	Corn / S/PSR 87/10/3	0.48±0.35 [c]	4.25±0.26 [c]	90.15±0.40 [a]
	Corn /S/GS 87/10/3	1.13±0.19 [b]	5.23±0.27 [b]	83.03±0.78 [b]

Data was expressed using Mean ± SD. (PSR) Pomegranate seeds residues, (GS) guava seeds.
Pairwise comparison bet. each 2 groups was done using Least significant difference (LSD).
*Means in the same column in **PSR** and **GS** are not significant (i.e. Means with **Different letters** are significant)
Means in the same column in **Corn and **Soybean** are not significant (i.e. Means with **Different letters** are significant)
***Means in the same column in ***Doritos* blends** are not significant (i.e. Means with **Different letters** are significant)

Results of anti-nutritional factors of phytic acid and trypsin inhibitors showed that soybean contained a significant ($P \leq 0.05$) increase of phytic acid, trypsin and protein digestibility (9.26, 0.63 and 85.46, respectively) compared to those of corn (4.96, 0.52 and 79.02, respectively). Phytic acid is a form of phosphorus stored in plants. It is also an anti-nutrient because it is strongly linked to starch, protein and minerals, which leads to reduce the bioavailability (**Weaver and Kannan, 2002**). The soybean genotypes ' phytic acid content ranged from 2.3 to 5.6 mg g−1 (**Sharma *et al*., 2014**). The range of anti-nutritional factors for phytic acid and phenols was stated to be 1.6–3.1 and 18.3–35 mg g−1, respectively in soybean (**El-Emery and Amin 2010**). **Guillamon *et al*. (2008)** found that trypsin inhibitor among legume seeds can be found in very small quantities as in Lupinus spp, on the contrary, it may be found in other types in large quantities such as glycine max cultivars. On the other hand, **Kumar *et al.* (2003)** found that the amount of trypsin inhibitors in defatted soy flour ranged between 42 and 113 mg g-1, and trypsin inhibitors activity did not change due to location change. Cereal seeds contain about 1-2%

by weight of phytic acid and may increase this percentage to 3-6% (**Gupta *et al.*, 2015**).

Anti-nutrition factors including phytic acid and trypsin inhibitor for different blends are presented in Table (7). Concentrations of phytic acid and trypsin inhibitor among the *Doritos* blends were significantly different ($P \leq 0.05$). Phytic acid in the formulated *Doritos* ranged from 4.25 to 7.41 mg/100g. The *Doritos* with 100% corn had the highest value (7.41mg/100g). The lowest value of phytic acid in the *Doritos* with Corn/S/PSR (87/10/3%) with value 4.25 mg/100g. These results are in agreement with **Sade (2009**) who found that preparation methods can reduce the phytic acid content in food**.**

The value of trypsin inhibitor in the formulated *Doritos* blends is varied between 0.48 to 1.80 TIU/mg, these low values are mainly due to cooking and roasting processes as trypsin inhibitor can partially change their nature when exposed to high temperature. This is in agreement with **Leeson and Summers (2008**) who found that the time of exposure to heat directly affects the trypsin inhibitors that are found in raw soybeans where they are destroyed, and they also found that high heat for a shorter period of time have the same effect when exposed to low temperatures for longer periods. Also, **Hefnawy (2011)** reported that microwave cooking destroyed trypsin inhibitors to a degree similar to those observed in six legumes cooked using the traditional methods.

In the present study, it was found that roasting reduced anti-nutritional factors, which is consistent with the results of the study by **Adeyemo (2013)** who found that roasting reduces the content of trypsin inhibitor from 1.20 to 0.025 mg/gm, phytates content from 1.6 to 0.25 mg/g. Also, he reported that cooking reduced, but not as much as roasting, the anti-nutritional factors. This shows that the amount of anti-nutritional present after preparation and cooking in *Doritos* blends was safe for human nutrition and was found in a proportion that does not cause any side effects, according to **Kumar *et al.* (2010b)**.

The protein digestibility of the formulated *Doritos* blends was varied between 78.87 % for *Doritos* with 100% corn to 90.15% for corn/soybean/ PSR (87/10/3) blend. The studied formulated *Doritos* blends have good digestibility because their values were higher than 75%.

It is noticeable that protein digestibility in soybean blends was higher than only seeds blends. In addition, the reduced amount of anti-nutritional factors has led to an improvement in protein digestion. This is consistent with **Gilani *et al*. (2005)** who observed that high levels of dietary trypsin inhibitors from grain and legumes caused decreases in amino acids digestibility and protein in living systems of up to 50 percent.

CONCLUSION

Based on the results obtained, it can conclude that guava and pomegranate seeds powder contain many nutrients such as protein, fiber, minerals, fatty acids and various antioxidants, in addition to low caloric content. Also, they can be used in food enrichment to compensate the shortage of amino acids, decreasing of anti-nutritional factors and improvement of protein digestibility. Therefore, it can be used as one of the ingredients to produce new food products that are suitable for human nutrition, have good acceptance and help in reducing many diseases, and it also helps in preserving the environment as a result of benefiting from these wastes. However, it is suggested that further studies be conducted to see how these wastes are used.

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ABSTRACT

Utilization of pomegranate and guava seeds in the manufacture of corn chips (*Doritos*) enriched with soybeans

There is an increase interest in the modern era by individuals, dietitians and researchers on the utilization of fruit wastes which contain many health-beneficial nutrients and how to incorporate them into some acceptable products for use in overcoming modern-day diseases. This study aims to prepare high quality functional corn chips (*Doritos*) from some unused fruit wastes with the addition of soybeans, at low cost and high nutritional value. Corn chips were produced from the mixture of corn flour with some seeds powder (guava and pomegranate seeds) and one type of legumes (soybean). Blends were prepared in a different ratios corn100%, corn+ GS (97 + 3%), corn+PSR (97 + 3%), corn+S+GS (87+10+3%) and corn+ S+PSR (87+10+3%) using traditional techniques like drying, milling and roasting. Then, sensory evaluation, chemical composition, fatty acids, amino acids, antioxidant activity, anti-nutritional factors and protein digestibility were determined in samples. The results of the sensory evaluation showed that the best acceptance was for the blend containing corn / soybean / pomegranate seeds and the following corn / guava seeds blend, however the control sample prepared with (100% corn) remained more acceptable compared to the other blends. Also, The results showed that guava seeds, pomegranate seeds, corn and soybean were rich in many nutrients such as protein, minerals, fatty acids, fibers and antioxidant components. As a result, the protein content, crude fiber and minerals content of the corn chips "*Doritos*" showed a significantly improvement with the addition of seeds and soybean flour compared to the control sample. The amino acids content of corn chips ‘*Doritos*’, increased especially with the addition of soybean. Also, the addition of seeds and soybean flour with heat treatment reduced the amount of anti-nutritional factors, while there was an increase in protein digestibility in blends compared to control *Doritos*. In conclusion, seeds powder of guava, pomegranate and soybean can be used as one of the ingredients to prepare new food products that are suitable for human nutrition, have good acceptance, help in reducing many diseases and they also help in preserving the environment as a result of using these wastes.

Keywords: Corn flour, guava seeds, pomegranate seeds, soybean, sensory evaluation, chemical composition, amino acids, anti-nutritional factors and protein digestibility.

ملخص البحث

الاستفادة من بذور الرمان والجوافة في صناعة رقائق ذرة (دوريتوس) معزز بفول الصويا

هناك اهتمام متزايد فى العصر الحديث من قبل الأفراد وأخصائيي التغذية والباحثين حول استخدام مخلفات الفاكهة التي تحتوي على العديد من العناصر الغذائية الصحية المفيدة وكيفية دمجها في بعض المنتجات المقبولة لاستخدامها في التغلب على أمراض العصر الحديث. تهدف هذه الدراسة إلى تحضير رقائق الذرة الوظيفية عالية الجودة (الدوريتوس) من بعض مخلفات الفاكهة الغير مستخدمة مع إضافة فول الصويا بتكلفة منخفضة وقيمة غذائية عالية. تم إنتاج رقائق الذرة من مزيج دقيق الذرة مع مسحوق بعض البذور (بذور الجوافة والرمان) ونوع واحد من البقوليات (فول الصويا). تم تحضير الخلاطات بنسب مختلفة ١٠٠% ذرة، ذرة+ بذور جوافة (٩٧+٣%)، ذرة+بذور رمان (٩٧+٣%)، ذرة+ فول صويا+ بذور جوافة (٨٧+١٠+٣%) و ذرة+ فول صويا+ بذور رمان (٨٧+١٠+٣%) باستخدام التقنيات التقليدية مثل التجفيف والطحن والتحميص .بعد ذلك تم تقدير التقييم الحسي ، التركيب الكيميائي ، الأحماض الدهنية ، الأحماض الأمينية ، نشاط مضادات الأكسدة ، العوامل المضادة للتغذية وهضم البروتين في العينات. أظهرت نتائج التقييم الحسي أن أفضل قبول كان للخليط الذي يحتوي على بذور الذرة / فول الصويا / الرمان و يلية خليط الذرة / بذور الجوافة ، ومع ذلك ظلت العينة الكنترول المحضرة من (ذرة ١٠٠ ٪) أكثر قبولا مقارنة بالخلاطات الأخرى. كما أظهرت النتائج أن بذور الجوافة وبذور الرمان والذرة وفول الصويا كانت غنية بالعديد من العناصر الغذائية مثل البروتين والمعادن والأحماض الدهنية والألياف والمكونات المضادة للاكسدة. نتيجة لذلك ، أظهر محتوى البروتين والألياف الخام والمحتوى المعدني لرقائق الذرة "الدوريتوس" تحسنا ملحوظا مع إضافة البذور ودقيق فول الصويا مقارنة بالعينة الكنترول. زاد محتوى الأحماض الأمينية لرقائق الذرة "الدوريتوس" خاصة مع إضافة فول الصويا.و ايضا أدت إضافة البذور ودقيق فول الصويا مع المعالجة الحرارية إلى تقليل كمية العوامل المضادة للتغذية، في حين كانت هناك زيادة في هضم البروتين في الخلطات مقارنة بالدوريتوس فى المجموعة الكنترول. في الختام، يمكن استخدام مسحوق بذور الجوافة والرمان وفول الصويا كأحد المكونات لإعداد منتجات غذائية جديدة مناسبة للتغذية البشرية، ولديها قبول جيد ، والمساعدة في الحد من العديد من الأمراض وتساعد أيضًا في الحفاظ على البيئة نتيجة لاستخدام هذه المخلفات.

الكلمات المفتاحية: دقيق الذرة؛ بذور الجوافة، بذور الرمان، فول الصويا،التقييم الحسى، التركيب الكيميائي، الاحماض الامينية، العوامل المضادة للتغذية، هضم البروتين؛.