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Physico- Chemical Evaluation of By-Products of Some Fruits Resulting From Food Processing

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Abstract

The aim of this study was to investigate the possibility of benefiting from both pomegranate seed pomace PSP (the remaining part after pomegranate seed juice) and the date press DP (the residual part after extracting the fleshy part of the date), which are unused by-products of the pomegranate and date fruits at cheap prices. It is easy to obtain as it is generated in large quantities from food factories, and by evaluating the aforementioned raw materials physio-chemical. The obtained resulted showed that PSP had the higher content of crude protein (11.31%), ether extract (3.50%), ash (1.82%) and crude fiber (11.66%) compared with the DP,which recorded 9.87, 2.58, 1.69 and 8.58%, respectively. Meanwhile, DP had the higher content of available carbohydrate (77.29%) compared with PSP (71.70%). PSP had the higher content of K, Ca, Mg, Mn, Zn and Cu (858.66, 248.48, 685.07, 1.54, 2.85 and 2.66 mg/100g, respectively). While, DP had the higher content of Na and Fe (43.23 and 4.61 mg/100g, respectively). Total dietary fiber and insoluble dietary fiber were higher in DP powder (41.50 and 38.7%, respectively), while soluble dietary fibers were higher for PSP (3.8 %). PSP had the higher content in both of total phenols and antioxidant activity than DP. While, DP had the higher content in total flavonoids than PSP. So, results indicated that PSP and DP by-products can serve as a good source of dietary fibers, minerals and bioactive components. It could be recommended that incorporation of the mentioned raw materials with food product to obtain healthy food products (especially bakery products) have a high biological value.

KEYWORDS: Pomegranate seed pomace, Date pomace, Physico-chemical properties

Introduction

Agricultural by-products originated from food processing factories represented one of the permanent environmental problems. Nowadays, trends were raised to utilize these valuable wastes full of nutraceuticals and phytochemicals **(Schieber *et al.*, 2001)**.

Kumar *et al*. (2017) declared that huge amount of fruit and vegetable residues by-products from food sector industry increased continuously. **Liu (2004), Kiokias *et al.* (2016) and Varzakas *et al*. (2016)** pointed to the usefulness of plant residues containing bioactive phytochemicals related to health management, reduced risk of chronic diseases, and could be directed to food-related industries.

The pomegranate seeds (*Punica granatum* L.) a by-product of pomegranate process, contain approximately 3% of total fruit weight, which contains typically oil in the range of 12–20%. Conjugated fatty acids are present in many plant oils with varying concentrations including pomegranate seed oil. The pomegranate seed oil contains higher concentration (>70%) of conjugated fatty acids in the form of punicic acid (9 cis, 11 trans, 13 cis-conjugated linolenic acid) **(Mahesar *et al.*, 2019)**. Recent studies have shown that pomegranate seeds might be a potential source of antioxidants and nutrients. Furthermore, it has been suggested that food supplementation with pomegranate seeds may prevent DNA damage, reduce the risk of cancer, and also reduce the symptoms of menopause. The advantageous of pomegranate seeds are related to the presence of biologically active components especially polyphenols, which their antioxidant effects have been studied. In addition, significant amounts of compounds with polyphenolic structures were detected in pomegranate seeds **(Jing *et al.*, 2012)**. Seeds also contain protein, crude fibers, vitamins, minerals, pectin, sugars, polyphenols, isoflavones, the phytoestrogens, coumestrol and the sex steroid, estrone **(Aruna *et al*., 2016)**.

Dietary fiber (DF) may be divided into two parts when it is dispersed in water: a soluble and an insoluble fraction **(Perigo *et al*., 1993).** Each fraction has different physiological effects. The insoluble part is related to both water absorption and intestinal regulation, whereas the soluble fraction is associated with the reduction of cholesterol in blood and the diminution in the intestinal absorption of glucose. Insoluble fiber include lignin, cellulose, and hemicelluloses; soluble fibers include pectin, beta-glucans, galactomanan, gums, and a large range of non-digestible oligosaccharides including inulin **(Meyer, 2004)**.

Minerals contents of raw materials constitute a very important food components however, mixtures calcium, iron, magnesium and zinc are the most important minerals for physiological requirements of children, for example, calcium is combined as the salts give hardness to bones and teeth, iron is required for an expanding blood volume and increasing amounts of hemoglobin in grown children, magnesium is essential for all living cell, it is a catalyst in numerous metabolic reaction and zinc as an integral part of least 20 enzymes that belong to a large group known as metabloenzymes **(Martínez *et al.,* 2010 and Nieder *et al*., 2018)**. Fruits are considered as a good source of dietary minerals **(Ismail *et al.,* 2011)**.

Date press cake (*Phoenix dactylifera* L.) as by-product during syrup (Debis) preparation are large amounts available. Depending on the method used for extraction, date flesh with remaining sugar with or without date pit is left. Since date press cake (DP) is wet (about 70% moisture), bulky (it forms 30% of date weight), and easily deteriorated, it causes a disposal problem **(Al-Farsi *et al.,* 2007)**. Currently, the sole use of DP for animals feeding and also microbial conversions **(Al-Farsi *et al.,* 2007 and Ashraf and Hamidi-Esfahani, 2011).** And it’s a good source of dietary fiber and rich in mineral potassium, magnesium, phosphorus, calcium and iron (**Kerkadi, 2006; Hashim and Khalil, 2015 and Hamoda, 2018)**. Also, **Elleuch *et al.* (2014)** found that, date fiber is good sources of dietary fiber, protein and ash (86.4, 10.56 and 2.54% in dry matter, respectively). **Rahman and Al-Farsi (2005)** measured neutral detergent fiber (NDF) and acid detergent fiber (ADF) of date flesh. Neutral detergent fiber (NDF) contains hemicellulose, cellulose, lignin, cutin, silica and some cell wall protein, while ADF contains cellulose, lignin, cutin and silica. Date also contains a special type of fiber known as β-D-glucan. Isolated glucans from date have high anticancer activity (**Ishurd *et al*., 2002 and Ishurd and Kennedy, 2005).** These polysaccharides have a main chain of (1→3)-β-D-glucopyranosyl residues with (1→6)-linked branched saccharide residues (**Ishurd and Kennedy, 2005)**. Date fruit residues has hypolipidemic effects **(Kerkadi, 2006).**

Phenolic compounds are widely distributed in foods, such as fruits, vegetables and cereals **(Liyana-Pathirana and Shahidi, 2006 and Dykes and Rooney, 2007)**. As naturally occurring antioxidants, phenolic compounds have been reported to possess diverse beneficial bioactivities, including anti-allergic, antiviral, anti-inflammatory and antimutagenic properties **(Yao *et al.,* 2004)**.

Flavonoids are a group of phenolic compounds with antioxidant activity that have been connected to reducing the risk of major chronic diseases **(Boots *et al*., 2011 and Gawlik-Dziki *et al*., 2011)**.

Nowadays, the food and agricultural product processing industries generate substantial quantities of phenolic-rich by-products, which could be valuable natural sources of antioxidants to be employed as ingredients. Phytochemicals, including phenolic compounds, are suggested to be the major bioactive compounds contributing to the health benefits of fruits, vegetables and grains **(Roldan *et al*., 2008 and Mateo-Anson *et al*., 2010)**. Phenolic compounds showed a wide range of cumulative biological affects including antiinflammatory, antibacterial, vasodilator actions, anticarcinogenic, antiviral, antithrombotic, antiallergic, and hepatoprotective affects **(Haggag *et al.,* 2011)**. The biochemical, chemical, epidemiological and clinical evidences support the chemo protective effects of phenolic substances against oxidative stress facilitated disorders **(Turner *et al.,* 2005; Del-Bano *et al.,* 2006 and Jayaram and Dharmesh, 2011)**. Recent awareness regarding their anti-cancer potential built up a pressure on food and pharmaceutical industries to explore more and more phenolic resource and innovates efficient to utilization from the natural sources of phenolic compounds especially agro wastes by adding extracts or whole dried waste which was rich with phenolic compounds to food as natural sources. In recent decades, flavonoids have been the focus of much research, due to their potential as health promoting phytochemicals. Flavonoids exhibit antioxidant and antimicrobial properties and have been investigated extensively regarding their ability to lower the risk of cardiovascular diseases **(Volden *et al.,* 2009)**.

WHC is the ability of a moist material to retain water when subjected to an external centrifugal gravity force or compression. It consists of the sum of bound water, hydrodynamic water and, mainly, physically trapped water **(Vazquez-Ovando *et al*., 2009)**. It is an important property of dietary fiber from both a physiological and technological point of view. Dietary fibre holds water by adsorption and absorption phenomena and some water is also retained outside the fibre matrix (free water) **(Sanchez-Zapata *et al*., 2009)**.

The aim of this work was to evaluated chemically and physically analysis of pomegranate seed pomace and date press cake co-product as a potential dietary fibers, minerals and bioactive components for food enrichment.

Materials and Methods

Materials:

Pomegranate fruit (*Punica granatum* L.) was obtained from local market Inshas Al-Raml City, El-Sharkia Governorate, Egypt.

Date press (date fiber) (*Phoenix dactylifera* L.) date by-product, namely Sewi date collection at the tamr stage (full ripeness), a by-product of date syrup (Debis) was obtained from El-Tahhan Dates Company, Obour City, Cairo, Egypt.

Chemicals used in this study were purchased from El-Gomhoria and El-Shark El-Aost Companies, Cairo, Egypt.

Methods:

Preparation of pomegranate seeds powder:

Pomegranate fruits were washed with clean running water to remove dust particles and to reduce the microbial load on the surface of the fruits. Pomegranate fruits were cut into four pieces then peeled off and the arils were separated manually.

These arils were passed through the juicer for extraction the juice. The residual distance juice extraction (seeds) dried in a ventilated oven at 120°C/30 min to inhibit the oxidative and pectin enzymes, increase the water evaporation and decrease the microbial load. The seeds were dried in a ventilated oven at 60°C until complete dryness. The dried seeds were grounded and the fine powder was sieved through a 60 mesh sieve, then it was stored at -18°C until used.

Preparation of date press powder:

Date press (the residual distance date juice extraction) was obtained from Al-Tahhan Dates Company, Obour City, Cairo, Egypt. dried in a ventilated oven at 120°C/30 min to inhibit the oxidative and pectin enzymes, increase the water evaporation and decrease the microbial load. The date press was dried in a ventilated oven at 60°C until complete dryness. The dried seeds were grounded and the fine powder was sieved through a 300 mesh sieve, then it was stored at -18°C until used.

Chemical analysis:

Moisture, protein, ash, crude fiber and ether extract contents were determined according to the methods described by **A.O.A.C. (2012)** Available carbohydrates (A.C) were calculated by difference according to the following equation:

A.C =100- % (moisture + protein + total lipids+ ash+ crude fiber).

Minerals content, i.e., Ca, K, Mg, Na, Fe, Zn, Cu and Mn were determined by atomic absorption spectrophotometer (3300 Perkin-Elmer) as described in **A.O.A.C. (2012)**.

Determination of total dietary fibers:

Total dietary fibers (TDF) was determined according to the method described by **Prosky *et al.* (1984)**.

Determination of insoluble dietary fiber:

Insoluble dietary fiber (IDF) was determined as mentioned before the total dietary fiber (TDF) but after digestion with termamyl protease and amyloglucosidase, no alcohol was added as recommended by **Prosky *et al.* (1988)**.

Calculation of soluble dietary fiber:

Soluble dietary fiber (SDF) was calculated by subtraction IDF from TDF.

SDF = TDF – IDF

Water and oil absorption capacity (WAC & OAC):

The water and oil absorption capacities of flour were determined by the method of **Sosulski *et al.* (1976)**.

pH value:

The pH value was measured by using a pH meter Model Consort pH meter P107.

Determination of total phenolis content:

Total phenolic content was determined using a Folin Ciocalteu assay according to the method by **Singleton and Rossi (1965)**.

Determination of total flavonoids content:

Total flavonoids content was measured by AlCl3 colorimetric assay according to the method described by **Tacouri *et al.* (2013)**.

Identification of phenolic compounds:

Identification of phenolic compounds by high performance liquid chromatograph (HPLC) according to the method of **Goupy *et al.* (1999)**.

Identification of flavonoid compounds:

Identification of flavonoids compounds by high performance liquid chromatograph (HPLC) according to the method of **Mattila *et al.* (2000)**.

Determination of antioxidant activity by using 2,2-diphenyl-1-picrylhydrozyl (DPPH):

Radical scavenging activity by donation capacity of samples extracts was determined spectrophotometrically based on bleaching of the purple-colored solution of the DPPH radicals according to the modified method by **Lu *et al.* (2007)**.

Statistical Analysis:

The statistical analysis was carried out using one-way ANOVA using SPSS, ver. 25 **(IBM Corp. Released 2013)**. Data were treated as a complete randomization design according to **Steel *et al.* (1997)**. Multiple comparisons were carried out applying **Duncun test** The significance level was set at < 0.05.

Results and Discussion

1. **proximate chemical composition of raw materials:**

The proximate chemical composition of raw materials under investigation is presented in Table (1). The obtained results revealed that, Pomegranate seeds powder (PSP) had significantly higher contents from moisture (9.62%), crude protein (11.31%), ether extract (3.50%) and crude fiber (11.66%) compared with the date press powder (DP) which recorded 4.80, 9.87, 2.58 and 8.58%, respectively for the same previous compositions. Meanwhile, DP had significantly higher contents from available carbohydrate, total, reducing and non reducing sugars (77.29), 28.19, 22.67 and 5.24% , respectively compared with PS (71.70), 23.22, 21.16 and 1.96%, respectively These data are similar with those reported by **Dadashi *et al*. (2013)** who found crude protein ranged from 8.5 to 11.3% for seeds obtained from four Iranian commercial pomegranate varieties.

The richness in reducing sugar suggests the existence of a more pronounced invertase activity, which would considerably reduce its content in sucrose **(Elleuch *et al.,* 2008)**.

Table 1. Proximate chemical composition of pomegranate seeds powder and date press powder (mean±SE). g/100g

Components (%)	Pomegranate seeds powder	Date press powder
Moisture	**9.62±0.24^{A}**	**4.80±0.18^{B}**
Crude protein*	**11.31±0.22^{A}**	**9.87±0.09^{B}**
Ether extract*	**3.50±0.34^{A}**	**2.58±0.27^{B}**
Ash*	**1.82±0.06^{A}**	**1.69±0.04^{A}**
Crude fiber*	**11.66±0.35^{A}**	**8.58±0.13^{B}**
Available carbohydrate*@	**71.70±0.1 2^{B}**	**77.29±0.37^{A}**
Total sugars	**23.22±0.18^{B}**	**28.19±0.30^{A}**
Reducing sugars	**21.16±0.36^{B}**	**22.67±0.14^{A}**
Non-reducing sugars	**1.96±0.27^{B}**	**5.24±0.16^{A}**

* on dry weight basis. @ Available carbohydrate calculated by difference.
A & B: There is no significant difference (p≥0.05) between any two means, within the same row have the same superscript letter.

2. Minerals content :

Data presented in Table (2) demonstrate that PSP contain the higher concentration from K, Ca, Mg, Mn, Zn and Cu. It was recorded 858.66, 248.48, 685.07, 1.54, 2.85 and 2.66 (mg/100g on dry weight), respectively. While, DP contain the higher concentration from Na and Fe (43.23 and 4.61 mg/100 g on dry weight, respectively).

Table 2. Minerals content of pomegranate seeds and date press powders (mg/100g on dry weight bases).

Minerals	Pomegranate seeds powder	Date press powder	RDA* (mg/day)	
			Child	Adult
K	**858.66**	**430.75**	----	----
Ca	**248.48**	**156.14**	**800**	**800-1200**
Mg	**685.07**	**467.54**	**----**	**----**
Na	**23.61**	**43.23**	**808**	**800-1200**
Fe	**3.45**	**4.61**	**10**	**12-15**
Zn	**2.85**	**2.02**	**10**	**12-15**
Cu	**2.66**	**2.49**	----	----
Mn	**1.54**	**1.46**	**80-170**	**280-350**

*RDA= Recommended dietary allowances from minerals reported by Food and Nutrition Board (1989).

In general, it could be concluded that pomegranate fruits were characterized with their richness with the most determined nutritious minerals and they are considered a good source of macro and micro elements. Therefore, they should be utilized in food fortification. Such results are nearly in according with **Choi *et al.* (2003), Kushwaha *et al.* (2013) and Khojah and Hafez (2018)**. The variation could originate from the pomegranate variety, and agro-climatic as well as environmental conditions **(Al-Maiman and Ahmad, 2002)**.

3. Dietary fibers and its fractions:

The results of dietary fiber and its fractions of the raw materials are presented in Table (3). The results indicated that the values of total dietary fibers (TDF), insoluble dietary fiber (ISDF) and ISDF / TDF (%) were higher for DP powder (41.50, 38.70 and 93.25%, respectively), while, soluble dietary fibers (SDF) and SDF/TDF (%) were higher for PSP (3.80 and 9.55%, respectively).

DF value of DP was higher than those obtained by **Al-Farsi et al., (2007)** for the Omani press cakes which had total dietary fibers ranging from 25.39 to 33.81%.

Table 3. Dietary fibers and its fractions of pomegranate seeds and date Press powders (g/100g on dry weight basis).

Dietary fibers	Pomegranate seeds powder	Date press powder
Total dietary fibers (TDF)	39.80	41.50
Soluble dietary fibers (SDF)	3.80	2.80
Insoluble dietary fibers (ISDF)	36.00	38.70
SDF / TDF (%)	9.55	6.75
ISDF / TDF (%)	90.45	93.25

4. Total phenols (TP), Total flavonoids (TF) and antioxidant activity of pomegranate seeds(PSP) and date press powders (DP):

TP and TF were expressed as mg gallic acid/gm and mg quercetin/gm of dry weight, respectively, while DPPH% was expressed as inhibition percent. From the data presented in Table (4) it could be noticed that, the PSP and DP are a good source of total phenols content, total flavonoids and free radical scavenging activity. But the PSP had the higher content in both of TP (5.86 mg GAE/gm) and DPPH% (92.50%) than DP (5.44 mg GAE/gm) and 82.33% for TP and DPPH%, respectively. While DP had the higher content in TF (2.495 mg Que/g) than PSP (1.450 mg Que/g).

Table 4. Total phenols (TP), total flavonoids (TF) and antioxidant activity of pomegranate seeds and date press powders.

Materials	Total phenols (mg GAE/g**)	Total flavonoids (mg Que/g*)	Antioxidant activity (%)
Pomegranate seeds powder (PSP)	5.86	1.450	92.50
Date press powder (DP)	5.44	2.495	82.33

*Que= Quercetin equivalents. **GAE= Gallic acid equivalents.

The phenolic and flavonoids contents depend on the cultivar, growing region, climate, maturity, cultivation practice, storage conditions and method used to obtain the juice.

5. Identification of phenolic compounds of pomegranate seed pomace and date press powders:

Data in Table (5) indicated that, the main phenolic acids isolated from PSP and DP by HPLC including pyrogallol, gallic acid, 3-oh-tyrosol, catechol, 4-aminobenzoic, catechin, chlorogenic, benzoic acid, p-oh-benzoic, vanillic, caffeic, caffeine, ferulic, salycilic, oleoropin, ellagic acid and coumarin. From the same Table, it could be seen that the major phenolic acid fraction in PSP were Catechol, 3-OH-Tyrosol, pyrogallol and catechin which amounted 152.15, 96.06, 87.71 and 36.64 mg/100 g, respectively, and the mediated compounds were oleoropin, ellagic acid, chlorogenic, vanillic and caffeic which amounted 10.69, 9.55, 7.16, 6.57 and 5.02 mg/100 g, respectively. While major phenolic acid fraction in DP were 3-OH-Tyrosol, pyrogallol, catechol, gallic and catechin which amounted 272.14, 190.44, 104.20, 29.40 and 28.08 mg/100g, respectively, and the mediated compounds were oleoropin, chlorogenic and ellagic acid (10.19, 7.89 and 5.79 mg/100 g, respectively). In addition, the PSP and DP also contained adequate amounts of 4-aminobenzoic, chlorogenic, benzoic acid, p-OH-benzoic, vanillic, caffeic, caffeine, ferulic, salycilic, ellagic acid and coumarin.

Table 5. Identification of phenolic compounds of pomegranate seeds and date press powders by HPLC (mg/100 g).

phenolic compounds	Pomegranate seeds powder	Date press powder
Pyrogallol	**87.71**	**190.44**
Gallic	**3.52**	**29.40**
3-OH-Tyrosol	**96.06**	**272.14**
Catechol	**152.15**	**104.20**
4-Aminobenzoic	**3.13**	**1.72**
Catechin	**36.64**	**28.08**
Chlorogenic	**7.16**	**7.89**
Benzoic acid	**2.12**	**1.55**
P-OH-benzoic	**2.25**	**2.16**
Vanillic	**6.57**	**4.39**
Caffeic	**5.02**	**3.36**
Caffeine	**2.02**	**0.91**
Ferulic	**2.44**	**1.36**
Salycilic	**1.72**	**3.24**
Oleoropin	**10.69**	**10.19**
Ellagic acid	**9.55**	**5.79**
Coumarin	**1.57**	**2.54**

6. Flavonoid fractions content of pomegranate seeds and date press powders:

From data presented in Table (6) it could be noticed that, the major flavonoids fraction in DP were hesperdin and qurectrin which amounted 32.76 and 10.19 mg/100 g, respectively. While the mediated compounds were rosmarinic, rutin which amounted 2.23 and 1.41mg/100g, respectively. The minor compounds were naringin, qurcetin, naringenin, kamferol and apigenin which amounted 0.55, 0.75 and 0.50 mg/100g, respectively.

From the same table, it could be seen that, the major flavonoids fraction in PS were hesperdin, rutin and qurcetin which amounted 9.13, 2.53 and 1.12 mg/100g, respectively. While the mediated compounds were rosmarinic, qurectrin, naringin, naringenin 0.19, 0.48, 0.92 and 0.84 mg/100 g, respectively. The minor compounds were kamferol and apigenin which amounted 0.09 and 0.046 mg/100 g, respectively.

Table 6. Flavonoid fractions content of pomegranate seeds and date press powders by HPLC (mg/100g).

Flavonoid compounds	Pomegranate seeds powder	Date press powder
Hesperdin	**9.13**	**32.76**
Rosmarinic	**0.19**	**2.23**
Rutin	**2.53**	**1.41**
Qurectrin	**0.48**	**10.19**
Naringin	**0.92**	**0.55**
Qurcetin	**1.12**	**0.75**
Naringenin	**0.84**	**0.50**
Kamferol	**0.09**	**0.80**
Apigenin	**0.046**	**0.32**

7. Iso-flavon fractions content of pomegranate seeds powder and date press powders:

Data in Table (7) indicated that DP had the higher concentration of some iso-flavon compounds which contained from biochainin and isoformentin (245.67 and 277.34 mg/100g, respectively than PSP (20.85 and 172.12 mg/100g, respectively). While, PSP had the higher concentration from of iso-flavon compounds which contained genistein, isorhamentin and daidazein (2.13, 738.01 and 4.65 mg/100g, respectively than DP (1.64, 539.86 and 2.24 mg/100g, respectively.

Table 7. Iso-Flavon fractions content of pomegranate seeds and date press powders by HPLC (mg/100g**) .**

Iso-flavon fractions	Pomegranate seeds powder	Date press powder
Biochainin	**20.85**	**245.67**
Isoformentin	**172.12**	**277.34**
Genistein	**2.13**	**1.64**
Isorhamentin	**738.01**	**539.86**
Daidazein	**4.65**	**2.24**

Functional properties of pomegranate seeds and date press powders:

Results in Table (8) showed that DP had the higher value of WHC (241.66%) than PS (158.33%). This might suggest that DP and PSP would be useful in baked products that require hydration to improve handling characteristics.

The oil-holding capacity (OHC) is also a technological property related to the chemical structure of the plant polysaccharides and depends on surface properties, overall charge density, thickness, and hydrophobic nature of the fibre particle **(Figuerola *et al*., 2005 and Fernandez-Lopez *et al*., 2009)**. From Table (8) results indicated that, the OHC was higher value in DP (90.66%) than PSP (64.33%). The OHC of DP and PSP would find useful application in ground beef products such as patties and sausages. The pH in PSP and DP were 4.01 and 4.47, respectively. These pH values were lower than those obtained by **Jalal *et al*. (2018)** for DP (4.55). Lower pH due to the strong acidic nature of DP and PSP. The low pH of PSP and DP, highly related to product deterioration, indicate that the risk of deterioration (by microorganism, enzymes or non-enzymatic reactions) is minimal.

Table 8. Functional properties of pomegranate seeds and date press powders.

Parameters	Pomegranate seeds powder		Date press powder	
	g/g	%	g/g	%
Water holding capacity (WHC)	**1.58**	**158.33**	**2.42**	**241.66**
Oil holding capacity (OHC)	**0.64**	**64.33**	**0.91**	**90.66**
pH	**4.01**		**4.47**	

Conclusion

From the obtained results, it could be that concluded PSP and DP waste is a good source of phenolic compounds and dietary fiber, it could be recommended that, the technology of using PSP or DP waste should be encouraged among food industries to make economic use of local raw materials to incorporate into food product (especially bakery product) and provide healthy product with more functional components and more effective antioxidant activity.

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التقييم الكيميائي والطبيعي للمنتجات الثانوية الناتجة من التصنيع الغذائي لبعض ثمارالفاكهة

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تهدف هذه الدراسة الي إمكانية الاستفادة بكل من تفل بذور الرمان (الجزءالمتبقي بعد عصر بذور الرمان) وتفل البلح (الجزء المتبقي بعد استخلاص الجزء اللحمي للبلح) والتى تعتبر نواتج ثانوية غير مستخدمه رخيصة الثمن، والتي يسهل الحصول عليها حيث تنتج بكميات كبيرة من مصانع الاغذية. وتم تقييم المواد الخام المذكورة سابقا كيميائيًا وفيزيائيًا. أظهرت النتائج أن تفل بذور الرمان يحتوي على أعلى محتوي لكل من البروتين (11.31%)، المستخلص الأثيري (3.50%), الرماد (1.82%) والألياف الخام (11.66%) مقارنة بتفل البلح والتي سجلت9.87 ،2.58، 1.69 % 8.58 علي التوالي لنفس المكونات السابقة. وسجل تفل البلح أعلى محتوي للكربوهيدرات المتاحة (77.29%) والسكريات الكلية (28.19%) والسكريات المختزلة (22.67%) والسكريات الغيرمختزلة (5.24%) مقارنة مع تفل بذور الرمان حيث سجل (71.70، 23.22 ، 21.16 و2.06% علي التوالي). وسجل تفل بذور الرمان أعلى محتوي من عناصر البوتاسيوم، الكالسيوم، الماغنسيوم، المنجنيز، الزنك والنحاس (858.66، 248.48، 685.07، 54، 1.54، 2.85 و2.66 مجم/100جم، على التوالي). بينما احتوى تفل البلح على أعلى محتوى من الصوديوم والحديد (43.23 و4.61 مجم / 100 جم على التوالي). وكان تفل البلح أعلي في محتوي الألياف الغذائية الكلية والألياف الغذائية الغير قابلة للذوبان (% 41.50 و 38.7% علي التوالي) ، بينما الألياف الغذائية القابلة للذوبان كانت أعلى بالنسبة لتفل بذور الرمان (3.8%). وكان تفل بذور الرمان أعلى في قيم كل من الفينولات الكلية ونشاط مضادات الاكسده عن تفل البلح، بينما كان تفل البلح أعلى في محتوى الفلافونات الكلية. مما سبق يمكن إضافه كل من تفل بذور الرمان وتفل البلح كمصدر للألياف الغذائية والمعادن والمركبات النشطة حيويا مع بعض المواد الخام للحصول على منتجات غذائية صحية مرتفعة القيمة الحيوية (خاصة منتجات المخابز).

الكلمات الدالة: تفل بذور الرمان ، تفل البلح ، الخصائص الفيزيائية والكيميائية.