The Pharma Innovation Journal 2018; 7(4): 1127-1131

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2018; 7(4): 1127-1131

www.thepharmajournal.com
Received: 05-02-2018
Accepted: 07-03-2018

Heena Jalal
Division of Livestock Products Technology Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Science and Technology (SKUAST-K), Shuhama Ganderbal, Jammu and Kashmir India

Mohammad Ashraf Pal
Division of Livestock Products Technology Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Science and Technology (SKUAST-K), Shuhama Ganderbal, Jammu and Kashmir India

Sheikh Rafeh Ahmad
Division of Livestock Products Technology Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Science and Technology (SKUAST-K), Shuhama Ganderbal, Jammu and Kashmir India

Mudasir Rather
Division of Veterinary Public Health Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Science and Technology (SKUAST-K), Shuhama Ganderbal, Jammu and Kashmir India

Mudasir Andrabi
Division of Veterinary Biotechnology Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Science and Technology (SKUAST-K), Shuhama Ganderbal Jammu and Kashmir India

Shabeer Hamdani
Division of Veterinary Animal Extension
Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Science and Technology (SKUAST-K), Shuhama Ganderbal Jammu and Kashmir India

Correspondence
Heena Jalal
Division of Livestock Products Technology Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Science and Technology (SKUAST-K), Shuhama Ganderbal, Jammu and Kashmir India

Physico-chemical and functional properties of pomegranate peel and seed powder

Heena Jalal, Mohammad Ashraf Pal, Sheikh Rafeh Ahmad, Mudasir Rather, Mudasir Andrabi and Shabeer Hamdani

Abstract
The aim of the present study was to determine the physico-chemical and functional properties of pomegranate peel powder (PPP) and pomegranate seed powder (PSP). The proximate composition analysis showed higher protein and fat content in seed powder samples than peel powder samples. Pomegranate peel powder showed a significantly higher ($P<0.05$) pH than that of pomegranate seed powder samples. Significant differences ($P<0.05$) were shown between the water holding capacity (WHC) of pomegranate peel and seed powder samples. Oil holding capacity (OHC) values were statistically similar ($P>0.05$). Emulsifying capacity (EC) and emulsion stability (ES) values of pomegranate peel powder samples were significantly higher ($P<0.05$) than pomegranate seed powder samples. Thus it was concluded that pomegranate by-products could be used as substrate for the production of nutritionally valuable components that could find several applications as functional food ingredients, food additives and nutraceuticals

Keywords: Functional, ingredients, pomegranate, peel, powder, seed.

1. Introduction
Pomegranate fruit is berry like with a leathery rind (husk or peel) enclosing many seeds surrounded by juicy arils. The husk is composed of two parts: pericarp and mesocarp (albedo). The edible part of the pomegranate fruit (50%) consists of 40% arils and 10% seeds. Arils contain 85% water, 10% total sugars and bioactive compounds such as phenolics and flavonoids, principally anthocyanins (Rafraf *et al.*, 2017) [18]. Pomegranate peel comprises about 50% of the total fruit weight and is an important source of minerals especially potassium, calcium, phosphorus, magnesium, and sodium; complex polysaccharides and high levels of diverse range of bioactive compounds such as phenolics, flavonoids, proanthocyanidin compounds and ellagitannin (ETs), such as punicalagins and its isomers, as well as lesser amounts of punicalin, gallagic acid, ellagic acid, and ellagic acid glycosides. Pomegranate seed oil (PSO) contains an exceptional conjugated fatty acid called punicic acid (trienoic acid) that makes up approximately 65% to 80% of the oil from pomegranate seeds. Punicic acid is also referred as a super conjugated linolenic acid whose effect is even more potent than that of an ordinary conjugated linolenic acid. Seeds also contain protein, crude fibers, vitamins, minerals, pectin, sugars, polyphenols, isoflavones, the phytoestrogens, coumestrol and the sex steroid, estrone (Aruna *et al.*, 2016) [2]. Recently, it has been revealed that PP powder contains much higher content of lysine, leucine, aromatic fatty acids (phenylalanine and tyrosine), threonine and valine, while having less concentration of sulphur containing amino acids (methionine and cysteine), than the reference protein pattern of FAO/WHO (FAO/WHO, 1973) [6]. Also, pomegranate seed powder contains sulfur containing amino acids (methionine and cysteine), aromatic fatty acids (phenylalanine and tyrosine), leucine and isoleucine were much higher than the corresponding mentioned in reference protein pattern of FAO/ WHO (Syed *et al.*, 2007) [6]. Several scientific studies have confirmed pomegranate biological activities and medicinal effects of the edible part of the fruit, but very few data exist about the bioactivity of pomegranate peel, seed, powder and extracts. Therefore, more research has to be done in that field.
The industrial transformation of vegetables and fruits generates large quantities of co-products rich in bioactive compounds that may well be suitable for other purposes. The importance of natural food additives are increasing due to a more extensive use of natural compounds in food, cosmetics and pharmaceuticals industries rather than synthetic compounds. The vast majority of by-product streams generated throughout industrial processes give rise to immense

environmental, societal and economic related issues. The development of strategies for the valorization of these industrial residues will not only address these problems but also promote bioeconomy, satisfying sustainable development principles. Pomegranate peel (PP) and pomegranate seed (PS) are valuable sources of bioactive phytochemicals, the vast majority of which hold a great potential through appropriate processes to be converted into value added products. So, pomegranate by-products could be used as substrate for the production of nutritionally valuable and biologically active components that could find several applications as functional food ingredients, food additives, nutraceuticals and supplements and in phenolic-rich diets. To date, there has been limited assessment about the potential of converting non-edible pomegranate production process residues, through the development of novel efficient systems, to value added products such as antioxidants, dietary fibers, industrial enzymes and single cell protein. Up-grading of this by-product to value-added products is therefore, of interest to the pomegranate juice industry. The aim of the present study was to determine the chemical, physicochemical and functional properties of pomegranate peel and seed powder as a potential source for food enrichment.

2. Materials and methods

Fresh ripened pomegranate fruits shall be procured from the local market and used as per experimental requirements.

2.1. Preparation of pomegranate peel powder (PPP)

Pomegranate fruits shall be washed with distilled water and cut manually to separate the arils and peel. The rind (peel) thus obtained shall be cut into small pieces using a sharp knife and dried in an air circulatory tray drier at 60 ± 5ºC for ~12 hrs or till a moisture content of ~12-14% is reached. Dried pieces shall be cooled, powdered to be able to pass through a 20 mesh sieve, packed in high density polyethylene bags and stored at room temperature (25 ± 5ºC) until use.

2.2. Preparation of pomegranate seed powder (PSP)

Pomegranate fruits shall be washed with distilled water and cut manually to separate the arils and peel. The pomegranate arils shall be pressed manually to extract pomegranate juice. Pomegranate seeds (PS) thus obtained shall be washed with distilled water to remove any adhering pomegranate flesh and dried in an air circulatory tray drier at 60 ± 5ºC for 6 hrs or till its moisture content reaches ~5-6 %. Dried seeds shall be cooled, powdered to be able to pass through 40 mesh screen, packed in high density polyethylene bags and stored at room temperature (25 ± 5ºC) until use.

2.3 Chemical analysis

Moisture, protein, fat and ash content were determined by AOAC methods (AOAC, 2000) [1]. Ash was performed at 550°C for 2 h (g ash/100 g sample). Protein (g protein/100 g sample) was analyzed according to the Kjeldahl method. Fat (g fat/100 g sample) was calculated by weight loss after a 6-cycle extraction with petroleum ether in a Soxhlet apparatus.

2.4 Physico-chemical analysis

The pH was measured in a suspension resulting from blending 10 g sample with 10 mL of distilled water for 2 min, using a pH meter ((Model CP 901, Century Instruments Ltd., India). The colour was measured using a Colorflex colorimeter supplied by Hunterlab (Hunter Associates Laboratory, Inc., Reston, VA, USA) along with the software (version 4.10) and the results were expressed in term of CIELAB system. Before the test, the instrument was calibrated with standard black and white tiles as specified by the manufacturer. The light source was dual beam xenon flash lamp. Data was received through the software in terms of L^* (lightness), ranging from 0 (black) to 100 (white), a^* (redness), ranging from +60 (red) to -60 (green) and b^* (yellowness), ranging from +60 (yellow) to -60 (blue) values. Readings were taken in triplicate for each sample

2.5 Functional properties

The water-holding capacity (WHC) and oil holding capacity (OHC) were determined according to Robertson *et al*. (2000) [19] with some modifications. Twenty-five millilitres of distilled water or sunflower oil were added to 250 mg of dry sample, stirred and left at room temperature for 1 h. After centrifugation, the residue was weighed. The WHC was expressed as g of water held per g of sample, while the OHC was expressed as g of oil held per g of sample.

Emulsifying activity (EA) and emulsion stability (ES) were evaluated according to Chau *et al.* (1997) [3] with some modifications. One hundred millilitres of 2% (w/v) sample suspension in water was homogenised at 11,000 rpm for 30 s using an Ultra Turrax tissue homogenizer (T-25, Germany). One hundred millilitres of sunflower oil was then added and homogenised for another 1 min. The emulsions were centrifuged in 10 mL graduated centrifuge tubes at 1200 g for 5 min, and the volume of the emulsion left was measured. The EA was calculated as the volume of emulsified layer/volume of whole layer in the centrifuge tube × 100. To determine the ES, emulsions prepared by the above procedures were heated at 80°C for 30 min, cooled to room temperature, and centrifuged at 1200 g for 5 min. The ES was calculated as the volume of remaining emulsified layer/original emulsion volume × 100.

2.6 Statistical analysis

The data generated from various trials under each experiment shall be pooled and subjected to statistical analysis using the software of Statistical Package for Social Sciences (SPSS-Base 20).

3. Results and discussion

3.1 Chemical analysis

The results have indicated that the percent moisture, protein, fat and ash content was, respectively, 12.48 ± 0.07, 3.26 ± 0.14, 1.73 ± 0.08 and 3.31 ± 0.05 for PPP and 5.81 ± 0.01, 13.67 ± 0.08, 29.61 ± 0.07 and 1.46 ± 0.01 for PSP (Fig 1 and Fig. 2). These results are nearly in accordance with those found by Rowayshed *et al.* (2013) [20], Fadavi *et al*. (2006) [5] and Kingsly *et al*. (2006) [14]. The pomegranate fruits peel powder is considered a good source of crude fiber, ash and carbohydrates, while pomegranate seed powder is considered a good source of crude protein, crude fat and crude fibers (Rowayshed *et al.*, 2013) [20]. These findings are in agreement with our results. Ozgul-Yucel, (2005) reported that the pomegranate seeds are a rich source of total lipids; pomegranate seed oil comprises 12–20% of total seed weight. The oil is characterised by a high content of polyunsaturated (n-3) fatty acids such as linolenic, linoleic, and other lipids such as punicic acid, oleic acid, stearic acid, and palmitic acid (Fadavi *et al.*, 2006) [5]. An important parameter in a fruit or vegetable powder extract is its lipid content. Viuda-Martos *et*

al. (2012) [26] reported that the pomegranate aril bagasse (AB) and pomegranate whole fruit bagasse (WFB) had a lipid content of 24.3 and 20.9 g/100 g (dry sample) respectively, which are higher than that reported in grapefruit dietary fibre (3.2 g/100 g dry sample) or banana fibres (5.8 g/100 g dry sample) (Figuerola *et al.*, 2005; Emaga *et al.*, 2007) [9, 4].

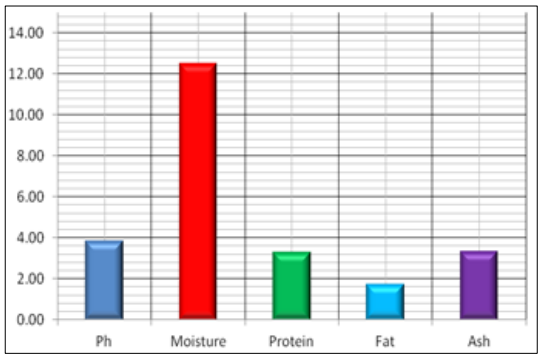

Fig 1: Physico-chemical analysis of Pomegranate Peel Powder (PPP)

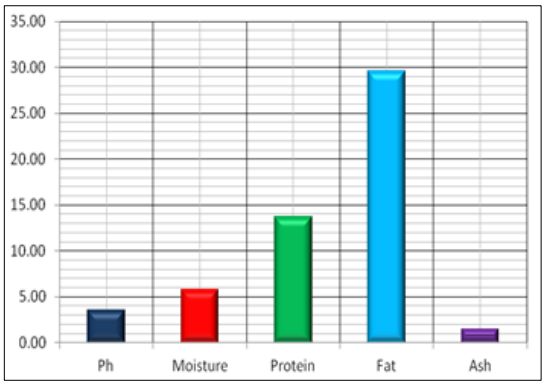

Fig 2: Physico-chemical analysis of Pomegranate Seed Powder (PSP)

3.2 Physico-chemical analysis

The results have indicated that the pH of pomegranate peel powder was 4.83 while pomegranate seed powder showed a pH of 4.55 (P>0.05) (Fig. 1 and Fig. 2). These pH values were higher than those obtained by Viuda-Martos *et al.* (2012) [26] for pomegrante aril bagasse (4.40) and pomegranate whole fruit bagasse (4.50); orange dietary fibre (4.06) or lemon albedo (3.96) (Lario *et al*., 2004; Garau *et al*., 2007) [15] [10]. The low pH of PSP and PPP, highly related to product deterioration, indicate that the risk of deterioration (by microorganism, enzymes or nonenzymatic reactions) is minimal.

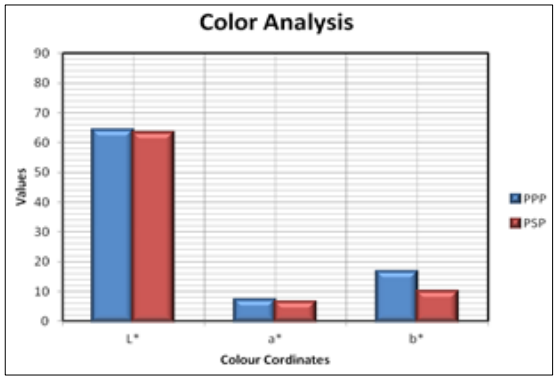

Fig 3: Instrumental colour analysis of pomegranate peel powder (PPP) and pomegranate seed powder (PSP

Colour is one of the most important quality parameters in food products. Possible colour changes caused by dietary fibres would limit their potential application in food. Colour is influenced by many factors including fruit variety and ripeness, but particularly, by the drying process of the pulp. During pulp dehydration, it undergoes high temperatures which cause enzymatic and non enzymatic browning (Maillard reactions) which darken the product (Monsalve-Gonzalez *et al*., 1994). Lightness (L^*) in food is related with many factors, including the concentration and type of pigments present, the water content and surface water availability. PPP and PSP presented a value for this coordinate (P>0.05) of 64.14 and 63.21 respectively. As regards the red–green coordinate, redness, (a^*), PPP showed a value of 7.23 while PSP showed a value of 6.73 (P>0.05); this coordinate is affected by the structural integrity of the fibre and the pigment content and disposition (water or lipid-soluble) (Fernandez- Lopez *et al*., 2005) [8]. The yellow–blue coordinate, yellowness, (b^*) presented a value of 16.86 for PPP samples while for PSP showed a value of 10.25 (P<0.05), which is lower than other fruit fibres such as lemon fibre which present a b^* coordinate of 25.89 (Lario *et al*., 2004) or orange fibre which present a b^* coordinate of 38.8 (Grigelmo-Miguel and Martín-Belloso, 1999) [12]. This high b^* value could be due to the carotenoids present in the pomegranate peel fibre, which were not eliminated by washing. Colour properties of PSP and PPP samples show their suitability as an ingredient in a large variety of food products, especially in meat and fish products, which may mask PSP and PPP colour.

3.3 Functional properties

The water-holding capacity 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) [25]. 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) [22]. The results indicated that PPP and PSP exhibited a Water Holding Capacity (P<0.05) 4.84 and 4.45 times its own weight (Fig.4) respectively which is higher than that reported for fibrous residues such as date paste (1.3 g water/g product) (Sanchez-Zapata *et al*., 2010) [21] but lower than other dietary fibre products such as bambangans peel (11.6 g water/g product) or apple pomace (8.4 g water/g product) (Sudha *et al*., 2007; Hassan *et al*., 2010) [13, 23]. Our results are in agreement with the findings of Viuda-Martos *et al.* (2012) [26]. 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; Fernandez-Lopez *et al*., 2009) [9, 7]. The results indicated that the PPP and PSP showed an OHC (P>0.05) of 5.83 and 5.81 g oil/g dry fibre respectively (Fig.4). This is lower than the OHC of lemon by-products (6.60 g oil/g fibre) or tiger nut by product (6.90 g oil/g fibre) (Lario *et al*., 2004; Sanchez-Zapata *et al*., 2009) [15, 22] but similar to those reported by Viuda-Martos *et al.* (2012) [26] For this reason, foods added with PPP or PSP will not retain high amounts of oil, both in the case that it will be added as ingredient in the food product, or in the case that it will be used for frying processes.

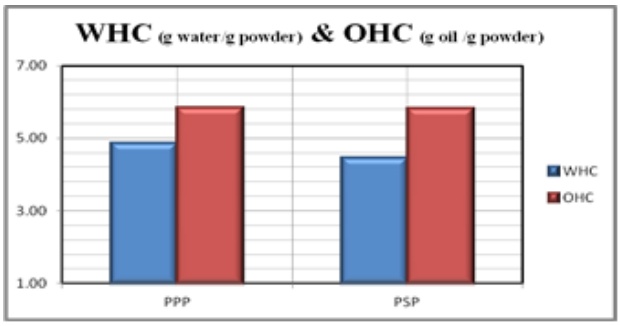

Fig.4: Water Holding Capacity (WHC) and Oil Holding Capacity (OHC) of Pomegranate Peel Powder (PPP) and Pomegranate Seed Powder (PSP)

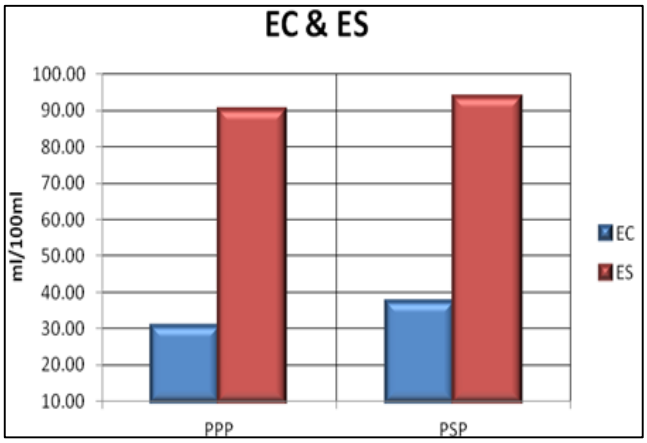

Fig.5: Emulsifying Capacity (EC) and Emulsion Stability (ES) of Pomegranate Peel Powder (PPP) and Pomegranate Seed Powder (PSP)

The emulsifying capacity (EC) is a molecule's ability to act as an agent that facilitates solubilisation or the dispersion of two immiscible liquids, and emulsifying stability (ES) is the ability to maintain the integrity of an emulsion. The results indicated that PPP and PSP showed EC and ES ($P<0.05$) of 30.78 and 37.40 mL/ 100 mL, and 90.16 and 93.50 mL/100 mL (Fig.5). The low protein content of PSP and PPP samples would explain its low EC and ES, since most proteins are strong emulsifying agents. Similar results were obtained by Viuda-Martos *et al.* (2012) [26] for pomegranate aril bagasse (AB) and whole fruit bagasse (WFB).

4. Conclusion

Our findings suggest that pomegranate peel and seed powder could be considered as a potential functional ingredient in food products improving their technological properties. Pomegranate peel powder (PPP) and Pomegranate seed powder (PSP) is of great interest not only as a means of improving the functionality of food products, but also as a means to create functional foods with health benefits.

5. References

1. AOAC Official method of analysis, Association of Official Analytical Chemists, 20th edition. Washington, USA, 2000.
2. Aruna P, Venkataramanamma D, Singh KA, Health Benefits of Punicic Acid: A Review. Comprehensive Reviews in Food Science and Food Safety. 2016; 15:16-27.
3. Chau CF, Cheung PCK, Wong YS, Functional properties of protein concentrate from three Chinese indigenous legume seeds. Journal of Agricultural and Food Chemistry. 1997; 45:2500-2503.
4. Emaga TH, Andrianaivo RH, Wathelet B, Tchango JT, Paquot M. Effects of the stage of maturation and varieties on the chemical composition of banana and plantain peels. Food Chemistry. 2007; 103:590-600.
5. Fadavi A, Barzegar M, Azizi HM. Determination of fatty acids and total lipid content in oilseed of 25 pomegranates varieties grown in Iran. Journal of Food Composition and Analysis. 2006; 19:676-680.
6. FAO/WHO Energy and Protein Requirements. Report of a Joint FAO/WHO Expert Committee. WHO Tech. Report Series 522, FAO Nutrition Meetings Report Series. 1973; 52:57-62.
7. Fernandez-Lopez J, Sayas-Barbera ME, Navarro C, Sendra E, Perez-Alvarez JA. Antioxidant and antibacterial activities of natural extracts: application on cooked meat balls. Meat Science. 2000; 5 69:371-380.
8. Fernandez-Lopez J, Sendra-Nadal E, Navarro C, Sayas E, Viuda-Martos M, Perez-Alvarez JA. Storage stability of a high dietary fibre powder from orange by-products. International Journal of Food Science and Technology. 2009; 44:748-756.
9. Figuerola F, Hurtado ML, Estevez AM, Chiffelle I, Asenjo F Fibre concentrates from apple pomace and citrus peel as potential fibre sources for food enrichment. Food Chemistry. 2005; 91:395-401.
10. Garau MC, Simal S, Rossello C, Femenia A. Effect of air-drying temperature on physico-chemical properties of dietary fibre and antioxidant capacity of orange (Citrus aurantium v. Canoneta) by-products. Food Chemistry. 2007; 104:1014-1024.
11. García ML, Caceres E, Selgas MD. Utilization of fruit fibres in conventional and reduced-fat cooked-meat sausages. Journal of the Science and Food Agricultural. 2007; 87:624-631.
12. Grigelmo-Miguel N, Martín-Belloso O. Characterization of dietary fiber from orange juice extraction. Food Research International. 1990; 31(5):355-361.
13. Hassan FA, Ismail A, Hamid AA, Azlan A, Al-sheraji, SH. Characterisation of fibre-rich powder and antioxidant capacity of Mangifera pajang K. fruit peels. Food Chemistry. doi:10.1016/j foodchem.2010.11.019.
14. Kingsly ARP, Singh DB, Manikantan MR, Jain RK. Moisture dependent physical properties of dried pomegranate seeds (Anardana). J Food Engin. 2006; 75(4):492-496.
15. Lario Y, Sendra E, García-Perez J, Fuentes C, Sayas-Barbera E, Fernandez-Lopez J *et al*. Preparation of high dietary fibre powder from lemon juice by-products. Innovative Food Science and Emerging Technology. 2006; 5:113-117.
16. Marín FR, Soler-Rivas C, Benavente-García O, Castillo J, Perez-Alvarez JA. By-products from different citrus processes as a source of customized functional fibres. Food Chemistry. 2007; 100:736-741.
17. Ozgul-Yucel S. Determination of conjugated linolenic acid content of selected oil seeds grown in Turkey. Journal of the American Oil Chemists Society. 2005:82 (12):893-897.
18. Rafraf M, Hemmati S, Jafarabadi AM, Moghaddam A, Haghighian KM. Pomegranate (*Punica Granatum L.)* Peel Hydroalcoholic Extract Supplementation Reduces Pain and Improves Clinical Symptoms of Knee

Osteoarthritis: A Randomized Double-Blind Placebo Controlled Study. Iranian Red Crescent Medical Journal. 2017; 19(1):377-385.
19. Robertson JA, Monredon de FD, Dysseler P, Guillon F, Amado R, Thibault JF. Hydratation properties of dietary fibre and resistant starch: a European collaborative study. Lebensmittel-Wissenschaft und-Technologie. 2000; 33: 72-79.
20. Rowayshed G, Salama A, Abul-Fadl M, Akila-Hamza S, Emad A Mohamed. Nutritional and chemical evaluation for pomegranate (*Punica granatum* L.) fruit peel and seeds powders by products. Middle East Journal of Applied Sciences. 2013; 3(4):169-179.
21. Sanchez-Zapata E, Fernandez-Lopez J, Penaranda M, Fuentes-Zaragoza E, Sendra E, Sayas E *et al*. Technological properties of date paste obtained from date by-products and its effect on the quality of a cooked meat product. Food Research International. doi:10.1016/j foodres,2010, 04-034.
22. Sanchez-Zapata E, Fuentes-Zaragoza E, Fernandez-Lopez J, Sendra E, Sayas E, Navarro C *et al*. Preparation of dietary fibre powder from tiger nut (Cyperus esculentus) milk (horchata) byproducts and its physicochemical properties. Journal of Agricultural and Food Chemistry. 2009; 57:7719-7725.
23. Sudha ML, Baskaran V, Leelavathi K. Apple pomace as a source of dietary fibre and polyphenols and its effect on the rheological characteristics and cake making. Food Chemistry. 2007; 104:686-692.
24. Syed DN, Afaq F, Mukhtar H. Pomegranate derived products for cancer chemoprevention. Semin Cancer Biolol. 2007; 17(5):377-85.
25. Vazquez-Ovando A, Rosado-Rubio G, Chel-Guerrero L, Betancur-Ancona D. Physicochemical properties of a fibrous fraction from chia (Salvia hispanica L.). Food Science and Technology. 2009; 42:168-173.
26. Viuda-Martos M, Ruiz-Navajas Y, Martin-Sanchez A, Sanchez-Zapata E, Fernandez-Lopez J, Sendra E *et al* Chemical, physico-chemical and functional properties of pomegranate (*Punica granatum* L.) bagasse powder co-product. Journal of Food Engineering. 2013; 110:220-224.