# Bioactive Compounds and Potential Antioxidant Activities of Fruits by-Products in Egypt

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## Abstract:

The present study was aimed for examine the bioactive compounds and antioxidant potential of three fruits by-products (banana peels (BPP), pomegranate (PGPP) and prickly pear PPP) in Egypt. The total dietary fiber content for all fruit by - products PGPP – PPP - BPP was ranged 26.06 - 34.76 $g.100g^{-1}$, total phenolics was 516 -1267 mg GAE.100 $g^{-1}$ and total carotenoids were 146.25- 219.11 $mg.100g^{-1}$. The BPP recorded the highest content of total dietary fiber followed by PPP, mixture and PGPP respectively while PPP the highest in carotenoids and PGPP registered high content in Total phenolic. The fruits by-product PGPP- PPP-BPP extracts indicated that large differences in antioxidant activity (AA, %) was ranged 74.96 - 89.16 %. PGPP showed strong antioxidant activity followed by mixture, BPP and PPP respectively. The results showed that BPP recorded high content of protein, crude fiber and ash 3.64, 28.43 and 3.42 respectively While PGPP recorded high level of Moisture 10.76 and PPP have the highest content of Carbohydrates73.87. In conclusion, result of the current study disclosed that fruits by-products (PGPP-PPP-BPP) can be useful sources of valuable bioactive compounds and antioxidants expand their main uses in nutritional, curative applications and many health benefits.

**Keywords:** prickly pear peel, pomegranate peel, banana peel, phenolics, carotenoids, dietary fiber, antioxidants.

## Introduction:

Food processing by-products have become an important sanitary problem material to be studied. Such efforts have been made for converting these refused materials into valuable products **(Elsayed, 2016).** And could reduce waste disposal problems and serve as a potential new source waste disposal problems and serve as a potential new source of fats and proteins for use in food and feed **(El-Said *et al*., 2011)**.

Processing of fruits, vegetables and oil seeds result in large amounts of waste materials such as peels, seeds and stones. Disposal of these materials usually represents a problem that is further aggravated by legal restriction **(Ali, 2017)**.

Thus, new aspects concerning the use of these wastes as by. Products for further production of food additives or supplements with high nutrition value have gained increasing interest because these bioactive are high-value products and their recovery.

May be economically attractive **(Vasso and Constantina, 2007)** There is an increasing interest in fruits rich in dietary fibre which has been associated with health. Promoting abilities. **(Omogie and Odekunle, 2002)** There is an increasing interest in fruits rich in dietary fiber which has been associated with health. Promoting abilities.

About 50% of the total fruits weight corresponds total peel which as important source of bioactive compounds such as phenols, flavonoids, ellagitannins and proanthocyanidin compounds that acted more dramatically I against oxidation as compared to the pulp extract **(Sayed, 2014).** The peels of a variety of fruits have gained attention as anatural source of antioxidants and phytochemical content which are rich in compounds with free radical scavenging activity **(Baskar *et al.*, 2011).**

Cactus (opuntia ficus – indica), commonly known as prickly pear. It is highly useful in arid and semiarid environments particularly during prolonged dry spells or failure of the monsoon **(Anbar, 2015)**. Prickly pear peels contained essentially glucose, protein starch was found in each of the three parts (pulp, skin and seed) of the fruit. Skin was rich in cellulose and it is remarkable for its content of calcium and potassium. Prickly pear is neglected nutritional. Source which should be more widely used because of its potential nutrient contribution **(Ali, 2013)**. The cladodes and skin fruit of cactus have found to be potential source of useful phytochemicals like ascorbic acids, vitamins, carotenoids, fibers, **(Tilahun and Welegerima, 2018).**

The pomegranate is an ancient fruit that has not changed much throughout the history of man **(Dahham *et al.*, 2010)**. The popularity of pomegranate is mainly due to a protective role in prevention of oxidation of both low-and high density lipoprotein, blood pressure, inflammation, atherosclerosis, prostate cancer and heart disease. **(Zarei *et al.*, 2011)**

Pomegranate peels have been shown to have therapeutic activity and food supplementation as a good source of the above nutrients **(Ali, 2013)**. Pomegranate peel contains substabtial amounts of polyphenols such as ellagic tannins, ellagic acid and gallic acid **(Fatma, 2014)**.

Banana (musa Spp.) is considered as one of the most important favorable and popular fruits in Egypt and all over the world **(Mohammed *et al*., 2015)**. Bananas are the one of the most widely consumed fruits in the world because of its taste, nutritional value and potential health benefits **(Singh, 2017)**. Banana peel has a complete nutrition such as carbohydrates, fats, protein, calcium, phosphorus, iron, vitamin B, vitamin C and water **(Setyawati *et al*., 2015).**

## Materials and Methods:

### Materials:

### Fruits by-products:

- Fresh pomegranate, prickly pear, and banana fruit were purchased from local market of Minia city, Egypt.
- All chemicals and Materials, were in analytical grade and purchased from Al-safa Company for Drugs, Chemicals and Medical Instruments, Minia, Egypt.

### Methods:

- **Preparation of Fruits (PGPP- PPP- BPP) by-products peel powder:**

  Fresh pomegranate (PGPP), prickly pear (PPP), and banana (BPP) were washed in running water to remove latex and dirt. The peels were separated from the pulp and cut into slices using stainless stell knives. Then the slices were derided in an oven at 40 0C- 60 0C. Pomegranate peel (PGP) for (6) hour, prickly pear peel (PPP) for 8 hour, and banana peel (BP) for (4) hour. Then the dried peels were founded using ablade grinder (moulinex type L M 207, 220 – 240 V, 50 – 60 HZ, 500 W – France) at room temperature. Pomegranate peel (PG), Prickly pear peel (PPP), and banana peel (BPP) flour then it was store in glass jar at 18 0C to use.

## Analytical methods

### Chemical composition:

The sample were analyzed for proximate composition Moisture, Protein, ash, crude fibers, fat and carbohydrates. Moisture, protein (T.N. x 6.25, Micro-Kjeldahl method), Fat (Soxhelt apparatus, petrolium ether solvent) and ash contents were determined using the methods described in the **(A.O.A.C, 1990).**

Crude fiber was determined according to the method given by **(Pearson,1971)** samble was digested in boiling 0.128m sulphuric acid for 45 minutes , washed with distilled water for three times then digested with boiling 0.233 m potassium hydroxide, washed by distilled water with (acetone cold extraction) for three times then dried at 150 c0 for one hour and finally weighed.

Carbohydrate value was determined according to **(FAO, 1982)** by difference as follows:

Carbohydrate (%) = 100 – (protein % + fat % + Ash % + fiber %).

### Total phenolics, carotenoids and dietary fiber:-

Total phenolics, carotenoids and total dietary fiber in selected by fruit –products (PGPP-PPP-BPP) samples were analyzed as follow: By fruit –products (PGPP-PPP-BPP) samples were extracted with 80% acetone and centrifuged at 10,000g for 15 min. For samples (PGPP-PPP-BPP), one gram of samples powder was extracted with 20 ml of 80% acetone and centrifuged at 8000g at room temperature. The supernatant obtained from both samples were used for the analysis of total phenolics, antioxidant activity and carotenoids Total phenolics were determined using Folin-Ciocalteu reagent **(Singleton and Rossi, 1965).** 200 milligrams of sample (PGPP-PPP-BPP) was extracted for 2 h with 2 mL of 80% MeOH containing 1% hydrochloric acid at room temperature on an orbital shaker set at Two hundred rpm. The mixture was centrifuged at 1000g for fifteen min and the supernatant decanted into 4 mL vials. The pellets were collected and used for total phenolics assay. 100 microliters of the obtained extract was mixed with 0.75 mL of Folin-Ciocalteu reagent (previously diluted 10-fold with distilled water) and allowed to stand at 22 0C for 5 min; 0.75 ml of sodium bicarbonate (60g/L) solution was added to the mixture after 90 min at 22 0C, absorbance was measured at 725 nm. Results are expressed as ferulic acid equivalents. The total carotenoids in 80% acetone extract were determined by using the method reported by **(Litchenthaler, 1987)**. Total dietary fiber content in the (PGPP-PPP-BPP) was predestined according to the method described by **(Asp et al., 1983).**

**Antioxidant**

Antioxidant activity of tested spices extracts and standards was determined according to the β-carotene bleaching method following a modification of the procedure described by **(Marco, 1968).** For a typical examination, 1mL of β-carotene (Sigma) solution, 0.2 mg/mL in chloroform, was added to round-bottom flasks (50 mL) containing 0.02 mL of linoleic acid (J.T. Baker Chemical Co., Phillipsburg, NJ) and 0.2 mL of Tween 20 (BDH Chemical Co., Toronto, On). Each mixture was then dosed with 0.2 mL of 80% Me OH (as control) or corresponding plant extract or standard. After evaporation to dryness under vacuum at room temperature, oxygenated distilled water (50 ml) was added and the mixture was shaken to form a liposome solution. The samples were then subjected to thermal autoxidation at 50 0C for 2 h. The absorbance of the solution at 470 nm was measured at a spectrophotometer (Beckman DU-50) by taking measurements at 10 min intervals.

And the rate of bleaching of β-carotene was calculated by fitting linear regression to data over time. All samples were assayed in triplicate. Various concentrations of BHT, BHA, and α-tocopherol in 80% methanol was used as the control.

Antioxidant activity was calculated in four different ways. In the first, absorbance was plotted against time, as a knit curve, and the absolute value of slope was expressed as antioxidant value (AOX). The second Antioxidant activity (AA) was all calculated as percent inhibition ralative to control using the following equation **(Al-Saikhan *et al*., 1995).**

AA= (R control - R sample) / R control x 100

Where:

R control and R sample were the bleaching rates of beta-carotene in reactant mixture without antioxidant and with plant extract, respectively.

The third method of expression based on the oxidation rate ratio (ORR) was calculated according to the method of **(Marinova *et al.*, 1994)** using the equation:

ORR = R sample / R control

Where:

R control and R sample are the same in the previous equation.

In the fourth method, the antioxidant activity coefficient (AAC) was calculated as described by **(Mallett *et al.*, 1994).**

(AAC) = (Abs S 120 - Abs C 120) / Abs C 0 - Abs C 120) x 1000

Where:

Abs S 120 was the absorbance of the antioxidant mixture at time 120 min, Abs C 120 was the absorbance of the control at time 120 min, Abs C 0 was the absorbance of the control at zero time.

**Water (WHC) and oil (OHC) holding capacity:**

Water (WHC) and oil (OHC) holding capacity were determined according to the method of **(Larrauri *et al.*, 1996).** 25 ML of distilled water or commercial corn oil were added to 0.5 g of PGPP, PPP and BPP shacked vigorously for 1 min and then centrifuged for 15 min at 10,000g. The residue was weighed and the WHC and OHC were calculated as g water or oil per g of dry sample, respectively.

**Statistical Analysis:**

Data were analyzed with the GLM (General Linear Model) program using statistical analysis system **(SAS, 2003)**. Mean values were compared by **(Duncan 1955).** Multiple range test.

**Results and Discussion:**

- **Chemical composition of selected fruit by-products:-**

The proximate composition of selected fruits by-products (PGPP-PPP-BPP) and their mixture are presented in Table (1) and figure (1)(2). The results Clarified that the total protein in PGPP, BPP, PPP and their mixture are 2.95%, 3.64%, 2.76% and 3.09% respectively, moisture varied from 10.76%, 8.95%, 9.89% and 10.02% for PGPP, BPP, PPP and their mixture respectively, The results in ash for PGPP, BPP, PPP and their mixture were 3.01%, 3.42%, 2.88%, and 3.12% respectively, crude fat and crude fiber were 1.80 %, 2. 11%, 1.49%, 1.84% and 10.94%, 28.43%, 9.11%, 16.45% in PGPP, BPP, PPP and their mixture respectively, And for carbohydrates in PGPP, BPP, PPP and their mixture it were found to contain 70.54, 53.45, 73.87 and 65.48 respectively. The banana peel powder (BPP) followed by the mixture were recorded the highest content of total protein, crud fat, crude fiber and ash while prickly pear peel powder (PPP) recorded the highest values of carbohydrates. The pomegranate peel powder (PGPP) was recorded the highest content of moisture and followed by the mixture.

These results are nearly in accordance with those found by **(Jalal *et al*., 2018)** 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 f pomegranate peel powder. And this agree with the result of banana peel powder peel is nearly agree with **(Waghmare and Arya, 2016)** which found that content of (BPP) from moisture, protein, ash and fat is 10.0, 8.4, 7.6, 4.7 respectively**. (Salim *et al*., 2009)** found the content of Opuntia ficus-indica peel fruit from protein, lipids and ash nearly from our result 1.45, 1.06 and 3.05. **(Vasso and Constantina, 2007)** reported that varieties of plant parts affected well on the chemical composition of peels. Data of the present study with the others confirmed that such tested fruits by-product PGPP, BPP, PPP could be used successfully in food technology and nutritional applications.

**Table 1.** Proximate chemical composition (g.100g$^{-1}$) of fruit by-products PGPP, BPP, PPP:

| Parameters | Pomegranate peel powder (PGPP) | Banana peel powder (BPP) | Prickly pear peel powder (PPP) | Mixture (PGPP + BPP + PPP) |
|---|---|---|---|---|
| Moisture | 10.76 ± 0.23$^{a}$ | 8.95 ± 1.01$^{b}$ | 9.89 ± 0.78$^{a}$ | 10.02 ± 0.76$^{a}$ |
| Total protein | 2.95 ± 1.39$^{a}$ | 3.64 ± 0.09$^{a}$ | 2.76 ± 0.14$^{b}$ | 3.09 ± 0.29$^{a}$ |
| Crude fat | 1.80 ± 0.22$^{ab}$ | 2.11 ± 0.22$^{a}$ | 1.49 ± 0.29$^{c}$ | 1.84 ± 0.19$^{a}$ |
| Crude fiber | 10.94 ± 1.05$^{c}$ | 28.43 ± 2.11$^{a}$ | 9.11 ± 2.11$^{c}$ | 16.45 ± 2.10$^{b}$ |
| Ash | 3.01 ± 0.50$^{a}$ | 3.42 ± 0.29$^{a}$ | 2.88 ± 0.26$^{b}$ | 3.12 ± 0.94$^{a}$ |
| Carbohydrates (by difference) | 70.54± 5.19$^{a}$ | 53.45± 3.45$^{c}$ | 73.87± 4.43$^{a}$ | 65.48± 6.05$^{b}$ |

**[e] Each value represents the mean of three replicates ±SD. [e] Mean values with the different letters in the same raw mean significantly different at level p≤0.05.**

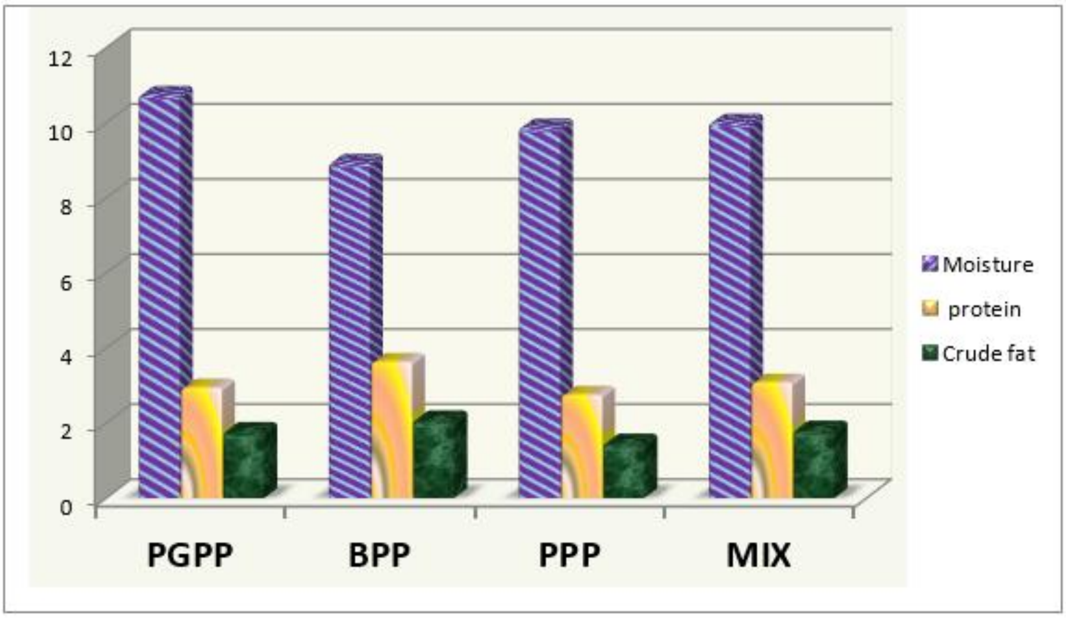


**Figure (1):** chemical compositionof fruit by-products PGPP, BPP, PPP in moinster, protein and crude fat.

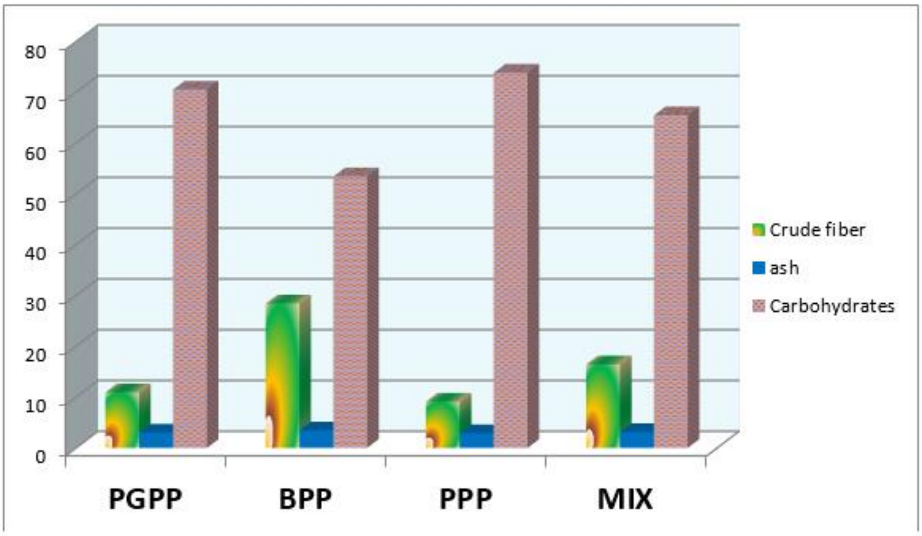


**Figure (2):** chemical composition of fruit by-products PGPP, BPP, PPP in Crude fiber, Ash and Carbohydrates

## Antioxidant activities of selected fruits by-products:

The antioxidant activities and total phenolics of three fruits by-products (PGPP-PPP-BPP) and their mixture are shown in Figures (3) and Table (2). From such data it could be noticed that Pomegranate peel powder (PGPP), banana peel powder (BPP), prickly pear powder (PPP) and mixture (PGPP + BPP + PPP) in antioxidant activity (AA) 89.16%, 80.67%, 74.96% and 87.52% respectively. The selected fruits by-product (PGPP-PPP-BPP) extracts showed great differences in antioxidant activity (AA= 74.96-89.16%) when it was calculated by the four different methods used in this study. Pomegranate peel powder (PGPP), mixture (PGPP + BPP + PPP) of the selected fruits by products and banana peel powder (BPP) showed strong activity because of its high phenolic content (1267.24, 840.68 and 771.78 mg GAE/100 g Dry matter, respectively) Table (2) and Figure (4) while prickly pear powder (PPP) showed relatively low content in both antioxidant activity and the total phenolics 516.23 mg GAE/100 g Dry matter.

Several comparable studies indicated that big differentiations have been recorded amongst different fruits/vegetables by-products. For example, **(Sonia *et al*., 2016)** reported that Total phenolic content (TPC) and total flavonoid content (TFC) values of banana peel were higher than those of banana pulp, potato peel provides an excellent source for the recovery of phenolic compounds. **(Martinez et al., 2011)** found that peels of cactus pear extracts had the highest value for antiradical activity amongst samples, which was similar to that of BHT. And this agree with **(Manasathien *et al*., 2012)** which showed that pomegranate peel extracting possessed higher phenolics, flavonoids and antioxidant activity its demonstrated highest free radical scavenging activity with value of ethanolic and water extracts 121. 65± 2.66 and 151.78±2.70 mg/ml.

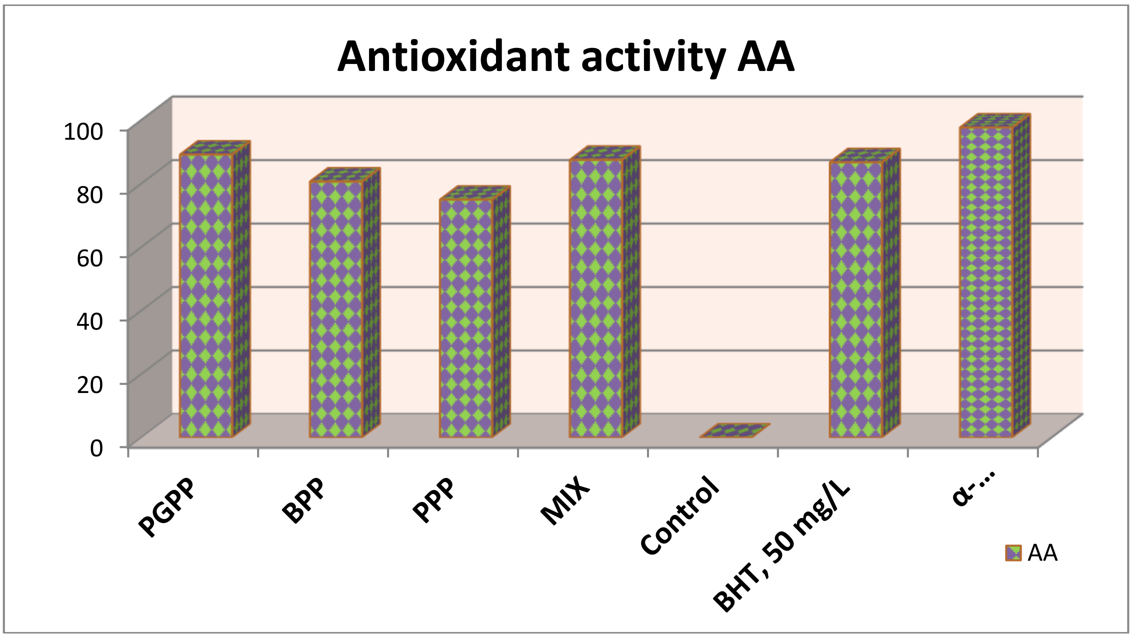


**Figure (3):** Antioxidant activity (AA) of selected fruits by- products (PGPP-PPP-BPP) and their mixture

**Table 2.** Antioxidant activity and total phenolics of selected fruits by-product samples:

| Samples | Antioxidant value[a] AOX (A/h) | Antioxidant activity[b] AA (%) | Oxidation rate ratio[c] (ORR) | Antioxidant activity coefficient[d] (AAC) | Total phenolics (mgGAE.100 $g^{-1}$) |
|---|---|---|---|---|---|
| Pomegranate peel powder (PGPP) | 0.061± 0.011 | 89.16± 5.87 | 0.108± 0.011 | 722.32± 45.67 | 1267.24± 75.7 |
| Banana peel powder (BPP) | 0.109± 0.019 | 80.67± 10.01 | 0.193± 0.029 | 574.72± 22.89 | 771.78± 42.17 |
| Prickly pear peel powder (PPP) | 0.141± 0.034 | 74.96± 2.89 | 0.250± 0.101 | 475.46± 23.61 | 516.23± 65.89 |
| Mixture (PGPP + BPP + PPP) | 0.071± 0.026 | 87.52± 4.21 | 0.124± 0.021 | 693.81± 12.90 | 840.68± 107.89 |
| Control | 0.581± 0.058 | 0.00± 0.00 | 1.000± 0.207 | 0.00± 0.000 | |
| BHT, 50 mg/L | 0.075± 0.01 | 86.75± 6.89 | 0.132± 0.012 | 680.42± 46.78 | |
| BHT, 200 mg/L | 0.019± 0.006 | 96.58± 5.09 | 0.034± 0.005 | 851.31± 36.90 | |
| α-tocopherol, 50 mg/L | 0.013± 0.001 | 97.70± 5.09 | 0.023± 0.003 | 870.78± 31.68 | |

[a] Antioxidant value (AOX, A/h) = The absolute value of slope (Abs was plotted against time).
[b] Antioxidant activity (AA, %) = (R control - R sample) / R control x 100 where: R control and R sample were the bleaching rates of beta-carotene in reactant mixture without antioxidant and with plant extract, respectively
[c] Oxidation rate ratio (ORR ) = R sample / R control
[d] Antioxidant activity coefficient (AAC) = (Abs S 120 - Abs C 120) / Abs C 0 - Abs C 120) x 1000 where: .Abs S 120 was the absorbance of the antioxidant mixture at time 120 min, Abs C 120 was the absorbance of the control at time 120 min, Abs C 0 was the absorbance of the control at zero time.
[e] Each value represents mean ±SD.

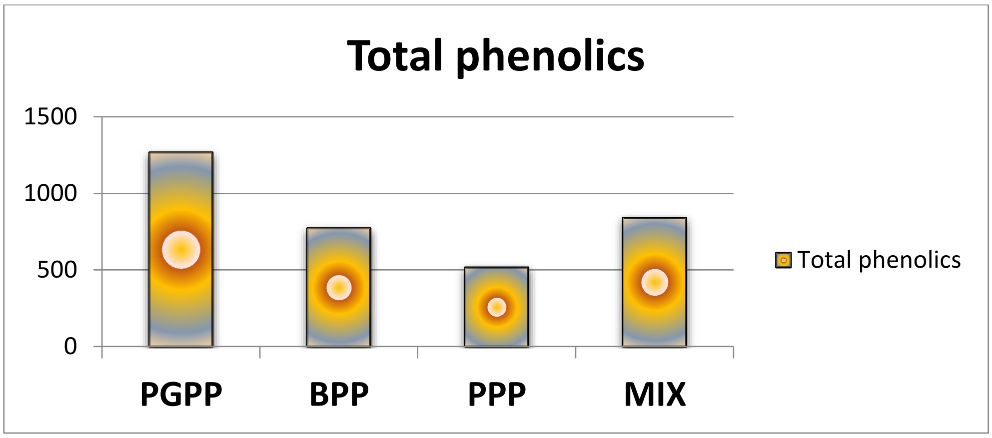


**Figure (4):** phenolic content of fruits by- products ((PGPP-PPP-BPP) and their mixture

## Total dietary fiber, carotenoids and phenolics:

Total dietary fiber, carotenoids and phenolics contents of fruits by-products PGPP, BPP, PPP and their mixture are shown in Table (3) and figure (5). The results showed that the total dietary fiber content was ranged 26.06 - 34.76 g.100g-1, total carotenoids was 146.25 - 219.11 mg.100g-1 and total phenolics was 516-1267 mg EGA.100 g-1.The BPP recorded the highest content of total dietary fiber followed by PPP, mixture and PGPP respectively while the PPP recorded the highest content of carotenoids followed by the mixture, BPP and PGPP. And PGPP recorded the highest content of total phenolics followed by mixture, BPP and PPP respectively**. (Alcantara et al., 201)** reported that the highest fiber content was detected in carrot bagasse, followed by banana peel and apple peel (52.01%, 46.63% and 35.22%, respectively). While higher polyphenols content was found in apple peel, followed by carrot bagasse and banana peel. **(Khojah and Hafez, 2018)** determined that the pomegranate fruits peel powder had the highest amounted from total dietary fiber; soluble and insoluble dietary fibers were 56.23, 43.54 and 12.69%, respectively. The pomegranate fruits peel powder had higher amounted from total phenolic compounds was 58.63 mg/g GAE. **(De Wit *et al*., 2015)** indicated that cactus pears are high in dietary fiber, minerals, phenol contents; it shows greater technological potential for water binding capacity and fat absorption. **Hallabo *et al*., (2018)** reviewed that phytochemicals such as carotenoids, polyphenols and dietary fiber are gaining increased attention because of their antioxidant, anticancer and antimutagenic activities as well as other health benefit properties.

**Table 3.** Total dietary fiber, carotenoids and phenolics contents of fruit by-products samples:

| Parameters | Pomegranate peel powder (PGPP) | Banana peel powder (BPP) | Prickly pear peel powder (PPP) | Mixture (PGPP + BPP + PPP) |
|---|---|---|---|---|
| Total dietary fiber ($g.100g^{-1}$) | 26.06 ± 3.18 [ab] | 34.76 ± 1.77 [a] | 31.01 ± 2.15 [a] | 29.02.71 ± 2.23 [ab] |
| Total carotenoids ($mg.100g^{-1}$) | 146.25 ± 8.80 [d] | 162.12 ± 6.41 [c] | 219.11 ± 14.76 [a] | 170.89 ± 12.09 [b] |
| Total phenolics (mg EGA.100 $g^{-1}$) | 1267 ± 130 [a] | 771 ± 142 [c] | 516 ± 59 [d] | 840 ± 67 [b] |

[e] **Each value represents the mean of three replicates ±SD. Mean values with the different letters in the same raw mean significantly different at level p≤0.05.**

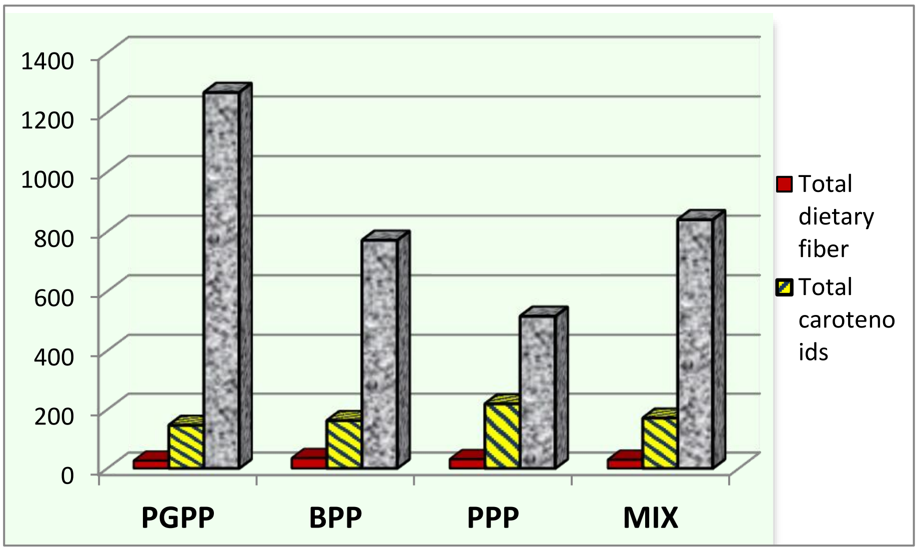


**Figure (5):** Total dietary fiber, carotenoids and phenolics contents of fruits by-products PGPP, BPP, PPP and their mixture.

## Physical properties:

The water (WHC) and oil (OHC) holding capacity of fruits by-products PGPP, BPP, PPP and their mixture were arranged in Table (4) and figures (6) From such data it could be noticed that Banana peel powder (BPP) recorded the highest WHC and OHC followed by Mixture (PGPP + BPP + PPP), Pomegranate peel powder (PGPP) and Prickly pear peel powder (PPP) being 9.51, 8.12 , 7.89 and 6.01 g water.g-1,and 3.11, 4.65, 2.41 and 3.87 water.g-1 respectively, indicating that the higher fiber content in BPP hold more water compared to rest fruits by-products. This accordance with **(Bandal, *et al.*, 2014)** reported that the WHC of banana peel flour was higher as compared to the wheat and pomegranate flour as the banana having higher fiber content. In similar study of fruits by-products. **Mashal (2016)** who reported that Potato peel powder recorded the higher WHC than prickly pear powder being 8.01and 5.33 g H2O.g-1, respectively, indicating that the higher fiber content in Potato peel powder hold more water compared to the prickly pear powder**. (Eshak, 2016)** which found WHC and OHC of Egyptian balady bread with concentration of banana peels which were increased than the control bread. Our data confirmed that a good positive correlation was observed by the values of WHC and OHC

**Table 4.** Physical properties of fruit by-products (**PGPP** – **BPP** - **PPP**)

| Parameters | Pomegranate peel powder (PGPP) | Banana peel powder (BPP) | Prickly pear peel powder (PPP) | Mixture (PGPP + BPP + PPP) |
|---|---|---|---|---|
| Water holding capacity (WHC, g $H_2O.g^{-1}$) | 7.89 ± 0.34 [ab] | 9.51 ± 2.11 [a] | 6.01 ± 1.14 [c] | 8.12 ± 0.13 [ab] |
| Oil holding capacity (OHC, g $oil.g^{-1}$) | 3.11 ± 0.21[b] | 4.65 ± 0.68 [a] | 2.41 ± 0.19 [c] | 3.87 ± 0.47 [a] |

[e] **Each value represents the mean of three replicates ±SD. [e] Mean values with the different letters in the same raw mean significantly different at level p≤0.05.**

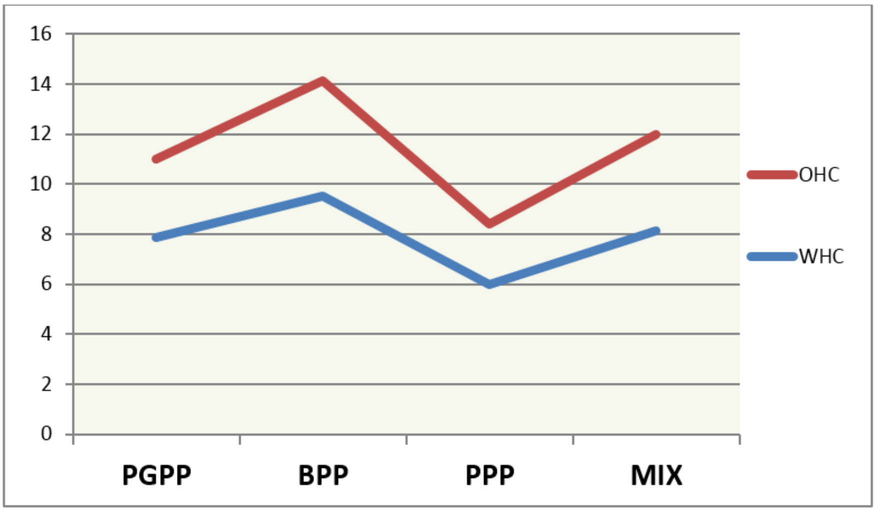


**Figure (6):** WHC and OHC content of fruits by-products PGPP, BPP, PPP

**In conclusion:**

Data of the current study detected that Products made from the peel of fruits can be perfect sources of antioxidants and valuable bioactive compounds thereafter expand their main uses as natural antioxidants and therapeutic applications. These extracts noticed the peel of banana, pomegranate and prickly pear fruit have a high values of polyphenolic content, antioxidant, carotenoids and dietary fiber which possess many health benefits.

**Reference:**

A.O.A.C. (1990). “Official Methods of the Association of Official analytical Chemists” 15 th Ed. Published by the Association of Official Analytical Chemists. Washington, D.C, USA.

Alcantara, A. M. H.; Totosaus, A. and Chabela, L. P. (2016): Evaluation of agro – industrial co – products as source of bioactive compounds: fiber, antioxidants and prebiotic. Food Technology. 2 (2): 3 – 16.

Ali, A. E. H. H. (2013): Technological studies on some vegetables and fruits peel and their utilization on raising the nutritional values of child foods, “PH-D. Thesis in nutrition and food faculty of Home Economucs, Menoufia University, Egypt.

Ali, H. M. M. (2017): Increasing of frying oils stability by using vegetable and fruit wastes. M. Sc. Thesis in nutrition and food science, faculty of Home Economics, Menoufia University, Egypt.

Al-Saikhan, M.; Howard, L. and Miller, J. (1995). Antioxidant activity and total phenolics in different genotypes of potato (Solanumtuberosum, L.). J. Food Sci., 60 (2): 341-343.

Anbar, S.A (2015): Nutrional and Biochemical studies on uses of opuntia ficus – Indica Juice, and Aqueous extract of carica papaya leaves on rats suffered from hepatotoxicity – M.Sc. Thesis in nutrition and food science, faculty of Home Economics, Menoufia University, Egypt.

Asp, N. G.; Johnson, C.G.; Hallomer, H. and Siljestrom, H (1983). Rapid enzymatic assay of insoluble dietary fiber. Journal of Agricultural and Food Chemistry, 31, 476-482.

Bandal, S.; Talib, M. and Parate, V. (2014): Utilization of Banana and Pomogranate Peel Flour in Fortification of Bread. International Journal of Engineering Research & Technology (IJERT). 3(7):1100-1105.

Baskar, R.; Shrisakthi, S.; Sathyapriya, B.; Shyampriya, R.; Nithya, R. and Poongodi, P. (2011): Antioxidant potential of peel Extracts of Banana varieties (musa sapientum). Food and Nutrition Sciences. 2 (1): 1128 – 1133.

Dahham, S.S.; Ali, M. N.; Tabassum, H. and Khan, M. (2010): Studies on antibacterial and antifungal activity of pomegranate (punica granatum L.); American-Eurasian. J. Agric & Environ. Sci., 9 (3): 273 – 281.

De wit, M.; Bothma, C.; Hugo, A.; Sithole, T.; Absalom, C. and van den, B. C. (2015): physico-chemical and sensory evaluation of cactus pear (opuntia ficus – indica L. mill and opunt robusta wendi) cladode flour in different baked. Products. JPACD. 17, 89 – 106.

Duncan, D. B., (1955): Multiple ranges and multiple F-test. Biometric, 11: 1042.

El-said, N. M.; Nagib, A.I; Rahman, Z. A. and Deraz, S. F. (2011): prickly pear [opuntia ficus – indica (L.) mill] peels: chemical composition, Nutitional value and protective effects on liver and kidney functions and cholesterol in rats. Functional plant science and. Biotechnology. Global science Books. 5 (1): 30 – 35.

Elsayed, H.E.H. (2016): Effect of pomegranate (leaves & peels) and its extracts on biological, biochemical and histopatological changes of induced obese rats. M.Sc. Thesis is in Nutrition and food science, faculty of home Economics, Menoufia University, Egypt.

Eshak, N. S. (2016): Sensory evaluation and nutritional value of balady falt bread supplemented with banana peels as a natural source of dietary fiber, Annals of Agricultural science. 61 (2): 229 – 235.

FAO (1982): food composition tables for the near east, FAO. Food and nutrition, paper, 26.

Fatma, M. E. (2014): protective effect of pomegranate (peel and molasses) incorporated into roasted meat balls on renal failure in rats., J. food and Dairy Sci., Mansoura Univ., 5 ( 6 ) : 435 – 449 .

Hallabo, S. A. S.; Helmy, S. A.; Elhassaneen, Y. and Shaaban, M. (2018): utilization of Mango, onion and potato peels as sources of bioactive compounds in biscuits processing, Bioscience research, 15 (4) 3647 – 3657.

Jalal, H.; Pal, M. A.; Ahmad, S. R.; Rather, M.; Andrabi, M. and Hamdani, S. (2018): physicochemical and functional properties of pomegranate peel and seed powder, the pharma Innovation Journal, 7 (4): 1127 – 1131.

Khojah, E. Y. and Hafez, D. A. (2018): fortification of macaroni with pomegranate peels as dietary fiber and natural antioxidant for the treatment of obesity and high cholesterol in rats, Australian Journal of Basic and applied sciences, 12 (2): 31 – 35.

Larrauri, J.; Ruperez, P.; Borroto, B. and Saura-Calixto, F. (1996): Mango peels as anew tropical fiber: preparation and characterization lebensmittle- wissenschaft – food science and technology, 29 (8): 729 – 733.

Litchenthaler, H. K. (1987): Chlorophylls and carotenoids: pigments of photosynthetic biomembranes. Methods in Enzymology 148, 350-383.

Mallett, J.; Cerrati, C.; Ucciani, E.; Gamisana, J. and Gruber, M. (1994). Antioxidant activity of plant leaves in relation to their a-tocopherolcontent.Jornal of Food Chem., 49: 61-65.

Manasathien, J.; Indeapichate, K., and Intarapichet, K. O. (2012): Antioxidant activity and bioefficacy of pomegranate punica granatum linn. Peel and seed extracts, Global Journal of pharmacology, 6 (2): 131 – 141.

Marco, G. (1968): A rapid method for evaluation of antioxidants. J. Am. Oil Chem. Soc., 45: 594-598.

Marinova, E.; Yanishlieva, N. and Kostova, I. (1994): Antioxidative action of the ethanolic extract and some hydroxycoumarins of Fraxinusornus bark. Food Chem., 51: 125-132.

Martinez, A. C.; Martinez, C. J. and Sandoval, J. (2011): Revalorization of cactus pear (opuntia SPP) waste as a source of antioxidants, ciencia e Tecnologia de Alimentos., campians, 31 (3): 782 – 788.

Mashal, E.M.M. (2016)**:** Technological and nutrition studies on the fortification of some Bakery products with phytochemlcals. “Ph.D. Thesis in nitrition and food science, faculty of home Economics, Menoufia University, Egypt.

Mohammad, S. G.; Ahmed, S. M.; Badawi, A. F. and El-Desouki, D.S. (2015): Activated carbon derived from Egyptian Banana peels for removal of cadmium for water. Journal of Applied life sciences International, 3 (2): 77 – 88.

Omogie, H. N. and Odekunle, O. Y. (2002): substituting wheat flour with Banana flour: effects on the quality attributes of doughnut and cookies, a publication of the school of Agriculture Technology, The Federal University of Technology. Akure, Nigeria 134 – 142.

Pearson,D.(1971): the chemical analysis of food, nation college of food technology. Universition of reading .weybridge, surry, J.8A.churchill.

Salim, N.; Abdelwaheb, C.; Rabah, C. and Ahcene, B. (2009): Chemical composition of opuntia ficus-indica (L.) fruit, African Journal of Biotechnology., 8 (8): 1623 – 1624.

SAS. (2003): SAS user’s Guide: statistics. SAS Institute cary, NC.

Sayed, A. E. F. (2014): Evaluation of pomegranate peel fortified pan bread on body weight loss, International Journal of Nutrition and food sciences, 3 (5): 411 – 420.

Setyawati, Y.D.; Khalifah, Z.; Atiyah, F.U. and saputra, F. Y. (2015): Antidiabetic activity of banana peel extract: effect on hyperglycemia, hyperlipidemia and Augmented oxidative stress in diabetes mellitus, Journal of health, Medicine and nursing, 17 (1): 3 – 5.

Singh, S. (2017): Banana blossom – An understated food with high functional benefits, International Journal of current research, 9 (1): 44516 – 44519.

Singleton, V. and Rossi, J. (1965): Colorimetry of total phenolics with phosphomolybdic- phosphotungstic acid reagents. Am. J. Enol. Vitic, 16: 144-158.

Sonia, N. S.; Mini, C. and Geethalekshmi, P. R. (2016): Vegetable peels as natural antioxidant for processed foods – A review, Agricultural Reviews, 37 (1): 35 – 41.

Tilahun, Y. and welegerima, G. (2018): Pharmacological potential of cactus pear (Opuntia ficus Indica): A review, Journal of pharmacognosy and phytochemistry 7 (3): 1360 – 1363.

Vass, O and Constantina, T. (2007): Utilization of plant by – products for the recovery of proteins, dietary fibers, antioxidants, and colorants. In utilization of by. Products and treatment of waste in the food industry. Ed. By: vasso oreopoulou and win fried Russ. Springer science Business media, LLC, 209 – 232.

Waghmare, A. G. and Arya, S. S. (2016): Utilization of unripe banana peel waste as feed stock for ethano production, Biothanol., DE Gruyter open 2: 146 – 156.

Zarie, M.; Azizi, M. and sadr, Z.B. (2011): Evaluation of physicochemical and characteristics of pomegranate (punica granatum L.) fruit during ripening, Journal of fruits 66 (2): 121 – 129.

# المركبات النشطة بيولوجيا والأنشطة المضادة للأكسدة المحتملة لمنتجات الفاكهة في مصر

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**المستخلص:**

هدفت الدراسة الحالية إلى فحص المركبات النشطة حيويًا ومضادات الأكسدة للمنتجات الفرعية لقشور فاكهة الموز والرمان والتين الشوكي في مصر حيث سجل محتوى مسحوق قشور الموز والرمان والتين الشوكي من الألياف الغذائية بين ٢٦,٠٦ إلى ٣٤,٧٦ جرام/١٠٠جرام والفينولات بين ٥١٦ إلى ١٢٦٧ ملجم حامض جاليك مكافئ/١٠٠جم أما بالنسبة للكاروتينات ما بين ١٤٦,٢٥ إلى ٢١٩,١١ ملليجرام/١٠٠ جرام لذلك سجل مسحوق قشر الموز أعلى محتوى من الألياف الغذائية يليه مسحوق التين الشوكي ثم الخليط من هذه القشور ثم مسحوق قشر الرمان على التوالي بينما سجل مسحوق قشر التين الشوكي أعلى نسبة في محتواه من الكاروتينات ومسحوق قشر الرمان من حيث محتواها من الفينولات.

أظهرت مستخلصات مساحيق قشور الموز والرمان والتين الشوكي اختلافات كبيرة في محتواها من النشاط المضاد للأكسدة حيث أمتدت النسب ما بين ٧٤,٩٦% إلى ٨٩,١٦% وأظهر مسحوق قشر الرمان نشاطًا قويًا لمضادات الأكسدة يليه الخليط من هذه المساحيق الثلاثة لقشور الموز والرمان والتين الشوكي على التوالي وسجلت نتائج التحليل الكميائي لقشور الفاكهة محل الدراسة أن مسحوق قشر الموز يحتوي على أعلى نسبة من البروتين والألياف والرماد ٣,٦٤ و٢٨,٤٣ و٣,٤٢ على التوالي بينما يحتوي مسحوق قشر الرمان على نسبة مرتفعة من الرطوبة ١٠,٧٦ ويحتوي مسحوق قشر التين الشوكي على أعلى نسبة من الكربوهيدرات ٧٣,٨٧.

الإستنتاج: كشفت نتيجة الدراسة الحالية أن المنتجات الثانوية لقشور الموز والرمان والتين الشوكي يمكن أن تكون مصادر مفيدة للمركبات النشطة بيولوجيا ومضادات الأكسدة واستخداماتها الرئيسة في التطبيقات الغذائية والعلاجية وعديد من الفوائد الصحية.

**الكلمات المفتاحية:** قشر التين الشوكي، قشر الرمان، قشر الموز، الفينول، الكاروتينات، الألياف الغذائية، مضادات الأكسدة.