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***Anticancer Activity and Hypolipidimic Effect of Methanolic and Ethanolic Prickly Pear Cactus Peel Extracts.***

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***Abstract***

Prickly pear cactus (*Opuntia ficus-indica*) is an edible cactus plant that grows in the arid and semi-arid regions. Cactus peel makes up about 40% of the whole fruit weight and is subsequently the major by-product. The immense amount of cactus peel waste was the motivation for accomplishing the present work by presenting an informative profile of the nutritional constituents that will serve as a basis for the economical utility of cactus peel. Additionally; it may lead to the elimination of waste in a friendly environmental manner. The obtained data showed that cactus peel is a source of protein (4.75%), carbohydrates (59.25%), calcium (2.04 %), iron (80.35 mg/kg), zinc (37.49 mg/kg), copper (1.92 mg/kg), phosphorous (0.084%), mannan (7.76%), betaglucan (27.25%) and  $\beta$ -carotene (141.4  $\mu$ g/100g). Cactus peel content of hemicellulose, cellulose and lignin was 0.5%, 10.92% and 1.2%, respectively. Amino acid profile ensured the existence of fifteen amino acids, of which seven were essentials: leucine (0.22%), valine (0.19%), lysine (0.11%), phenylalanine (0.14%), threonine (0.14%), isoleucine (0.15%) and

**Egyptian Nutrition Society-Special Issue :**  
**The First International Conference of Nutrition, Hurghada, April 2017**

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histidine (0.09%). The remaining amino acids were aspartic acid (0.28%), arginine (0.15%), alanine (0.19%), proline (0.23%), glutamic acid (0.32%), glycine (0.18%) and serine (0.14%).

Phytochemical screening of the methanolic and ethanolic extracts revealed the presence of total amino acids in a range of 0.35 and 0.3%, respectively. Mannan content 9.89 and 10.48%. While,  $\beta$ -glucan content was 34.74% and 36.79%, respectively. Indols content were 0.052% and 0.021%, respectively. Sucrose level were between 3.3% and 6.05%, respectively. The extraction of these bioactive compounds constitutes a key step in the manufacture of phytochemical-rich products. GC-MS analysis revealed the existence of many common compounds in both extracts as p-coumaric acid,  $\alpha$ -isomethyl ionone, heptadecanoic acid, kaempferol, 6-octadecenoic acid and hexestrol. *In vivo* experiment was carried out to investigate the hypocholesterolemic activity of cactus peel extracts on the biochemical parameters, enzyme activities and lipids profile in rats fed high fat diet. Additionally, significant increase in serum calcium, iron, zinc and copper levels reflected the bioavailability of these extracts.

Moreover, *in vitro* cytotoxic activity of the extracts of cactus peel was assessed against brine shrimp and recorded to be 5.8% and 5.2% for methanolic and ethanolic extracts, respectively. Sulforhodamine B assay was used to evaluate the anti-cancer activity of the extracts against colon carcinoma cell line (Caco-2) and liver cancer cell line (Hep-G2). LC<sub>50</sub> (concentration that kills 50% of the cells) were calculated. Methanolic extract exhibited cytotoxicity against Caco-2 cancer cell line with IC<sub>50</sub> = 47.5  $\mu$ g/ml. Contrarily, ethanolic extract did not record any cytotoxicity. While, IC<sub>50</sub> were found to be 20  $\mu$ g/ml and 22.5  $\mu$ g/ml for liver cancer cell line (Hep-

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

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G2), respectively. In conclusion; cactus peel extracts may successfully be useful in cancer control. Further work is needed to develop a processing to produce it commercially.

### ***Introduction***

Cactus (*Opuntia ficus-indica*) is a member of the plant family Cactaceae within the order Caryophyllales. Cacti are native to the Americas, Canada, widely distributed in Africa, Australia, Sri Lanka, India and in the Mediterranean basin (**Piga, 2004**). It inhibits stomach ulceration and possesses neuroprotective, anti-inflammatory and hypoglycemic effects. It is processed on a small scale in the food industries as a jelly and jam, ready-to serve sauces and liquors (**Sawaya, 1983**). Potentially active nutrients and their multifunctional properties make cactus pear perfect for the production of health-promoting food and food supplements on a nutritional and technological functionality basis (**Sarbojeet Jana, 2012**). Generally, cladodes are rich in pectin, mucilage and minerals, whereas the fruits are good sources of vitamins, amino acids and betalains. The seed endosperm was reported to consist of arabinan rich polysaccharides (**Habibi et al., 2005**) and accumulated proanthocyanidines (**Bittrich and Amaral, 1991**). Plant-derived products contain a great diversity of phytochemicals such as phenolic acids, flavonoids and tannins (**Cowan, 1999**) possessing numerous health-related effects such as antibacterial, antimutagenic, anticarcinogenic, antithrombotic and vasodilatory activities (**Bidlack et al., 2000**).

The pulp of the Cactus fruit constituted 43-57%, peels 33-55% and seeds 2-10% of the whole fruit (**Sarbojeet Jana, 2012**). The nutrients and chemical composition of *Opuntia ficus-indica* fruit have been reported by (**Stintzing et al., 2001**). The lipid content in the

peel fraction was reported to be 2.43% (*El-Kossori et al., 1998*). Natural products have been recognized as valuable sources of nutraceuticals for improving health and prevention of diseases.

The present work involved the chemical characteristics, cytotoxic and anticancer activities of the dried cactus peel, considered as a major source of natural antioxidants and phytochemical compounds, which could be directed for medicinal application and food products.

## ***Materials and Methods***

### **Plant material**

The ripened cactus fruit were collected from local markets of Cairo, Giza and Kalyobia Governorates during summer months July and August, 2013. The fruits were peeled, dried using the solar dryer system in the energy department of National Research Center as described by (*Mohamed et al., 2003*). The dried peel was powdered using mixer grinder, kept in plastic bags and preserved at -20°C.

### **Determination of Aflatoxin and ochratoxin in the dried powder of cactus peels**

Total aflatoxin and ochratoxin standards were purchased from Sigma (St. Louis, MO, USA). Stock solutions were prepared by dissolving the toxin in the appropriate solvent at concentration of 1 mg/mL. Aflatoxin was dissolved in toluene:acetonitrile (99:1) and ochratoxin in toluene:acetic acid (99:1). Extraction of aflatoxins was performed according to the (*AOAC, 1988*). HPLC technique (Agilent 1200) series USA were used according to (*AOAC, 2006*). For aflatoxin determination column C<sub>18</sub>, Lichrospher 100 RP-18, 5µm × 25cm was used. The mobile phase consisted of

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

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water:methanol:acetonitrile (54:29:17, v/v/v) at flow rate of 1ml/min. The excitation and emission wave lengths were 362 and 460 nm (Flouresces detector), respectively, according to **(AOAC, 2006)**. Ochratoxin was determined using column Nova- Pak C<sub>18</sub> 4µm, 3.9 × 150mm. The mobile phase consisted of acetonitril: acetic acid: water (495:10:495 v/v/v) at flow rate of 0.8ml/min. The excitation and emission wave lengths were 333 and 477 nm.

**Preparation of methanolic and ethanolic extracts.**

Five hundred grams of the dried powder peel were extracted with 2 liters methanol or ethanol in a soxhelet apparatus for several hours. The extracts were filtered using Whatman No. 1 filter paper. The methanolic and ethanolic extracts were concentrated at 45°C under reduced pressure using rotary evaporator to give yield of 100 g and 64.8 g of dark brown methanolic extract and light brown ethanolic extract, respectively. The extracts of cactus peel were stored in airtight screw-capped bottles at 4°C and subjected to the upcoming biological and chemical studies.

**Chemical analysis.**

The proximate analysis was carried out to identify the nutritional constituents of the cactus peel. Moisture content, crude protein, crude fiber and fat were determined using the procedures described by **(AOAC, 2000)** and ash according to **(AOAC, 1995)**. Carbohydrate content was calculated by difference **(Sara et al., 2008)**. Iron, zinc, calcium and copper were determined according to **(AOAC, 2002)** and **(Iva et al., 2003)** using inductive coupled plasma analyzer Model optima 2000.

**Determination of Phenolic compounds**

Total Phenols and free phenols "Reducing phenols" were determined by the colorimetric methods described by **(Snell and Snell, 1953)**; the conjugated phenols (Non- reducing phenols) were

determined from the calculated difference between total and free phenols.

#### **Determination of total Tannins**

Tannins content was determined according to the method of *(Yeshajahu and Clifton, 1977)*.

#### **Determination of total Indole**

One gram of sample was extracted with 5 ml methanol (80%), stored in cold conditions for 24h, filtered and analyzed according to *(Larsen et al., 1962)*.

#### **Determination of Sucrose**

Sucrose content in the ethanolic and methanolic extracts of cactus peel was estimated according to *(AOAC, 1998)*.

#### **Determination of amino acid**

Total amino acid was measured according to *(Broderick and Kang, 1980)*.

#### **Determination of mannan**

Mannan was detected according to *(Moreira and Filho, 2008)*.

#### **Determination of glucan**

HPLC method for the determination of beta-glucan was conducted according to *(Pérez-Vendrell et al., 1995)*. The beta-glucan was hydrolysed with lichenase [endo-beta-(1-3),(1-4)-D-glucan-4-glucanhydrolase from *Bacillus subtilis*] to oligosaccharides, which were analysed by reversed-phase HPLC using water as the mobile phase at a flow-rate of 0.7 ml/min. The separation of the oligosaccharides was performed in a C18 stainless-steel column (Spherisorb ODS-2) with 5-microns particles in less than 10 min, with refractive index detection.

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

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### **Gas chromatography-mass spectrometry (GC/MS) analysis**

GC/MS determination of the methanolic and aqueous extracts was performed at the Regional Center for Food and Feed (RCFF) using GC (Agilent Technologies 7890A) equipped with a mass-selective detector operating by HP-5ms capillary column (30  $\mu\text{m}$  x 0.25 mm i.d. and 0.25  $\mu\text{m}$  film thickness). The temperature was increased from 80  $^{\circ}\text{C}$  to 230  $^{\circ}\text{C}$  with rate of 3  $^{\circ}\text{C min}^{-1}$ . The carrier gas was helium at a flow rate of 1ml  $\text{min}^{-1}$ . The identification of bioactive compounds was performed by comparing their mass spectra and retention time with those of authentic standards and by computer matching with the database of National Institute Standard and Technique.

### **Bioactivity of cactus peel methanolic and ethanolic extracts**

#### **Brine shrimp toxicity screening**

The method of (*Meyer et al., 1982*) was applied using nauplii of the brine shrimp *Artemia salina*. The test was conducted according to the standard operating procedure ( $25\pm 1^{\circ}\text{C}$ , 35% salinity) with three replicates for each treatment and ten nauplii per replicate. Artificial sea water (ASW) was prepared using the composition reported by (*Kester et al., 1967*). The bioactivity of extracts was determined by the brine shrimp lethality test. To the six-well plate containing 3 mL of ASW, 10-15 nauplii were added using Pasteur pipette. To the wells containing nauplii, aliquots from stock solution of extracts was added to make three different concentrations viz. 100, 500 and 1000  $\mu\text{g/mL}$ . Ten nauplii added in 3 mL of ASW were used as a negative control while potassium dichromate was used as positive control during the experiment. All plates were incubated for 24 h at room temperature. Numbers of dead nauplii were counted after 4 and 24 h with the help of magnifying glass. The percentage mortality of brine shrimp nauplii was determined from the number of dead nauplii.

### **Cytotoxicity studies on colon and liver carcinoma cell lines**

The cytotoxicity study was carried out and documented in the Cancer Biology Department, National Cancer Institute. The SRB assay of **(Skehan et al., 1990)** assessed the antitumor activity of the extracts against colon carcinoma cell line (Caco-2) and liver cancer cell line (Hep-G2). Briefly, cells were seeded at a density of  $1 \times 10^6$  cells/well in 96-well microplates. After 24 h, the cells were exposed to drugs for continuous 3 days. The culture medium was removed and trichloroacetic acid (50%, 100ul) was added for fixation. Then the plates were air-dried and 0.4% SRB (sigma) in 1% acetic acid was added for 30min. Unbound dye was washed out with 1% acetic acid. After air-drying, SRB dye within cells were dissolved with 100  $\mu$ l solution of tris-base 10 mM (pH 10.5). The optical density of the extracted SRB dye was measured with a microplates reader (Platos R 496) at 490 nm. The 50% inhibitory concentration (LC50) of the tested extracts was determined.

### **In vivo biological experiment.**

Assessment of methanolic and ethanolic extracts on minimizing blood cholesterol level through biological experiment lasted for two months using five weeks old male albino rats. The rats were individually housed in stainless steel cages and maintained at 22-24°C with relative humidity 45-55%. Diet and water were provided *ad-libitum*. Adaptation time took three days using barley as the sole diet. Three types of diets (a, b and c) were prepared as follows: Normal diet (a) formulated according to **(NRC, 1995)**. Diet (b) included 20% soya bean oil as fat source to prepare high fat diet. Diet (c) comprised high fat diet (20% soya bean oil) devoid of any calcium, iron, zinc and copper sources. All diets were analyzed for moisture, crude protein, fiber and fat according to **(AOAC, 2000)** and ash **(AOAC, 1995)**. Also, mineral contents of normal diet (a) and high

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

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fat diet (c) devoid of any calcium, iron, zinc and copper sources were determined according to **(AOAC, 2002)**.

**Experimental design**

Twenty four rats were randomly distributed on four groups: **Group 1** served as negative control fed on normal diet (a) and drunk tap water. **Group 2** " positive control" fed on high fat diet (b) and drunk tap water. **Group 3** fed on high fat diet (c) and supplied with 10% aqueous-cactus peel ethanolic extract. **Group 4** fed on high fat diet (c) and supplied with 10% aqueous-cactus peel methanolic extract. At the end of experiment (two months); blood samples were collected centrifuged at 3000 rpm for 15 min.

Serum was separated and kept at 4°C until biochemical analysis of AST, ALT and creatinin **(Friedman and Young, 1997)**, urea **(Newman and Price, 1999)**, Alkaline phosphatase **(Moss and Henderson, 1999)**, triglycerides and cholesterol **(Guder and Zawta, 2001)**, HDL **(Friedewald et al., 1972)** and LDL **(Levy, 1981)**. Calcium, iron, zinc and copper levels in serum were estimated according to **(AOAC, 2002)**.

**Statistical analysis.**

M-STATC program was used for the statistical analysis. Results were expressed as mean±SD. Student t-test was used to test for significance. P values of ≤ 0.05 were considered as significant and P values of ≤ 0.01 were considered as highly significant.

## ***Results***

Aflatoxin and Okratoxin determinations revealed that the dried cactus peel was free of toxins, making it suitable for the preparation of extracts for further analysis.

Chemical composition of cactus dried peel is presented in tables (1,2) and ensured high fiber and carbohydrate contents. Also, phytochemical screening revealed the presence of mannan,  $\beta$ -glucan,  $\beta$ -carotene. Cactus peel is a reservoir of iron and zinc as shown in table (3).

### **Amino acid profile**

Amino acid profile (Table 4) demonstrated the existence of fourteen amino acids, of which seven were essentials: leucine, valine, lysine, phenylalanine, threonine, isoleucine and histidine.

### **GC-MS analysis of ethanolic and methanolic extracts**

The chromatograms of ethanolic and methanolic extracts are shown in Figs (1,2). The bioactive compounds, area (%) and retention time (RT) are presented in Tables (5,6). GC-MS analysis revealed the existence of many common compounds in both extracts as p-coumaric acid,  $\alpha$ -isomethyl ionone,

### **Estimation of bioactive compounds**

The quantitative analysis of bioactive compounds in the extracts is shown in Table (7). It was evident that methanolic and ethanolic extract of cactus peel is a source of amino acid, mannan,  $\beta$ -glucan, indoles and sucrose.

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

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### **Antitumor activities of cactus peel extracts**

Figs. (3-6) demonstrated the antitumor activities of cactus peel extracts against colon carcinoma cell line (Caco-2) and liver cancer cell line (Hep-G2). LC50 (concentration that kills 50% of the cells) were calculated. The surviving fraction decreased by increasing the extract's concentration, reflecting the potential of peel as anti-cancer agent. Methanolic extract exhibited cytotoxicity against Caco-2 cancer cell line with  $IC_{50} = 47.5\mu\text{g/ml}$ . On the contrary; ethanolic extract did not record any cytotoxicity. While,  $IC_{50}$  were reported to be  $20\mu\text{g/ml}$  and  $22.5\mu\text{g/ml}$  for liver cancer cell line (Hep-G2), respectively. The brine shrimp lethality assay evaluated the cytotoxicity of the extracts (Table 8) and recorded to be 5.8% and 5.2% for methanolic and ethanolic extracts, respectively.

### **Biological experiment.**

Results in tables (9-11) demonstrated that high fat diet increased cholesterol, triglycerides, LDL, AST and ALT levels ( $p \leq 0.05$ ). Moreover, a significant decrease ( $p \leq 0.05$ ) in HDL level was noticed, when compared to negative control. Ethanolic and methanolic extracts of cactus peel led to a variation in blood indices, monitoring its abilities to minimize hyperlipidemic condition. Administration of extracts increased HDL level ( $p \leq 0.05$ ) and simultaneously, decreased cholesterol, triglycerides and LDL levels in comparison to positive control. Both extracts showed significant increase ( $p \leq 0.05$ ) in serum calcium, iron, copper and zinc, as well as, a significant diminution in AST and ALP levels in comparison to positive control.

## ***Discussion***

Our results indicated that cactus peel extract's possessed both antitumor activity and hypolipidemic effects. The bioactive

**Egyptian Nutrition Society-Special Issue :**  
**The First International Conference of Nutrition, Hurghada, April 2017**

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compounds of the extracts demonstrated their health promoting properties (**Kris and Hecker, 2002**).

Antitumor activity of methanolic and ethanolic extracts could be attributed to their contents of  $\beta$ -glucan and indoles. These data were supported by the findings of (**Dalia et al., 2007**) who reported that  $\beta$ -glucan, naturally occurring polysaccharides, acted as powerful immune stimulant and antagonist to benign and malignant tumors.  $\beta$ -glucan is a safe and very potent biological response modifier (BRM) (**Gardiner, 2000**).

Indoles are natural compounds that are found in many plants but particularly associated with cruciferous vegetables such as broccoli, cauliflower, cabbage and brussels sprouts. High dietary intake of fruits and vegetables inhibited carcinogenesis process (**Heber and Bowerman, 2001**).

(**Sarkar et al., 2009**) postulated that indoles inhibited proliferation, expansion and invasion of cancer cells. Our results demonstrated that extracts contained indoles that acted as mediators against cancer lines, presenting the antitumor activity of cactus peel. The present data were supported by (**Ahmad et al., 2011**) who reported that indoles induced apoptosis of cancer cell lines.

Beta-carotene and  $\beta$ -glucan modulated the hypolipidemic effects of cactus extracts. These results were in accordance with (**Pavia and Russell, 1999**) who stated that beta-carotene had antioxidant properties, neutralized free radicals implemented in lipids damaging that led to the development of cardiovascular disease and cancer. Also, beta-carotene is essential for normal growth and immune system function (**Food and Nutrition Board,**

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

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**2000**). In vitro studies indicated that carotenoids inhibited the oxidation of fats (**Young and Lowe, 2001**).

(**EFSA, 2009**) assessed that beta-glucans maintained normal blood cholesterol and triglyceride levels. GC-MS analysis of ethanolic and methanolic extracts revealed the existence of many common compounds in both extracts as p-coumaric acid,  $\alpha$ -isomethyl ionone, heptadecanoic acid, kaempferol, 6-octadecenoic acid and hexestrol. p-Coumaric acid has antioxidant properties and reduces the risk of stomach cancer (**Ferguson et al., 2005**) by reducing the formation of carcinogenic nitrosamines (**Kikugawa et al., 1983**). Chemical analysis of cactus peel emphasized its high mineral content of calcium, iron, copper and zinc, which reflected the ability of methanolic and ethanolic extracts to increase rats' serum calcium, iron, copper and zinc.

Finally, the peel extracts exhibited their therapeutic effects as hypolipidemic and antitumor depressing agents as atypical natural source. These data strongly proved the possible inclusion of cactus peel extracts in cancer-treated remedies.

### **Conclusion**

In conclusion, the present results elucidated that extracts improved clinical blood parameters due to lipid lowering and antioxidant properties, as well as increased serum levels of iron, zinc, copper and calcium monitored the mineral bioavailability of cactus peel. Phytochemical and antitumor compounds of cactus peel will lead to the formulation of pharmaceutically effective compounds. Subsequent studies on animal model should be carried out to evaluate the effectiveness of cactus peel as feed additive .

**Egyptian Nutrition Society-Special Issue :**  
**The First International Conference of Nutrition, Hurghada, April 2017**

**Table (1):** The proximate analysis of dried cactus peel (g/100gm dry peel powder).

Composition	Protein (%)	Fiber (%)	Fat (%)	Moisture (%)	Ash (%)	Carbohydrate (%)
Value	4.75	8.15	3.55	13.3	11.0	59.25

**Table (2):** Functional ingredients in dried cactus peels.

Ingredients	Mannan (%)	$\beta$ -glucan (%)	$\beta$ -Carotene ( $\mu$ g/100g)	Lignin (%)	Hemicellulose (%)	Vit. C (ppm)	Cellulose (%)
Value	7.76	27.25	141.4	1.2	0.5	ND	10.92

**Table (3):** Mineral profile of cactus peel dried powder.

Element	Calcium (%)	Phosphorus (%)	Iron (mg/Kg)	Zinc (mg/Kg)	Copper (mg/Kg)
Value	2.04	0.08	80.35	37.49	1.92

**Table (4):** Amino acid profile of dried peels.

Amino acid	Percentage
Leucine	0.22
Valine	0.19
Lysine	0.11
Phenylalanine	0.14
Threonine	0.14
Isoleucine	0.15
Histidine	0.09
Aspartic acid	0.28
Arginine	0.15
Alanine	0.19
Proline	0.23
Glutamic acid	0.32
Glycine	0.18
Serine	0.14

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

**Table (5):** GC-MS of ethanolic extract of cactus peel

RT (min)	Identified compounds	Area (%)
5.38	p-Coumaric acid	3.61
13.3	$\alpha$ Isomethyl ionone	5.9
14.9	trans-2,3-Dimethoxycinnamic acid	2.73
17.58	3',4',7-Trimethylquercetin	5.03
18.4	4H-1-Benzopyran-4-one, 2-[4-[(6-deoxy- $\alpha$ -l-mannopyranosyl)oxy]phenyl]-8-( $\beta$ -d-glucopyranosyloxy)-5,7-dihydroxy-	0.7
18.6	Hexadecanoic acid	1.23
19.036	Retinol	0.62
19.96	Heptadecanoic acid	1.19
20.232	trans-13-Octadecenoic acid	1.62
20.4	Pentadecanoic acid	14.02
20.6	Kaempferol	10.68
21.3	Glycitein	0.94
21.5	(+)- $\alpha$ -Tocopherol	0.79
21.61	Elaidic acid	0.74
22.03	6-Octadecenoic acid	16.97
22.22	Hexestrol	29.53
22.4	Arachidic acid	3.18
23.4	Isohumulone	0.52

**Egyptian Nutrition Society-Special Issue :**  
**The First International Conference of Nutrition, Hurghada, April 2017**

**Table (6):** GC-MS of methanolic extract of cactus peel.

RT (min)	Identified compounds	Area (%)
5.38	p-Coumaric acid	8.17
13.3	$\alpha$ Isomethyl ionone	4.21
14.9	trans-2,3-Dimethoxycinnamic acid	0.35
17.58	3',4',7-Trimethylquercetin	2.54
18.4	4H-1-Benzopyran-4-one, 2-[4-[(6-deoxy- $\alpha$ -l-mannopyranosyl)oxy]phenyl]-8-( $\beta$ -d-glucopyranosyloxy)-5,7-dihydroxy-	0.58
19.036	Retinol	0.21
19.96	Heptadecanoic acid	8.55
20.232	trans-13-Octadecenoic acid	1.48
20.4	Pentadecanoic acid	16.62
20.6	Kaempferol	1.13
21.3	Glycitein	0.89
21.5	(+)- $\alpha$ -Tocopherol	10.78
21.61	Elaidic acid	17.78
22.03	6-Octadecenoic acid	20.05
22.22	Hexestrol	5.75
22.4	Arachidic acid	0.26
23.4	Isohumulone	0.65

**Table (7):** Active compounds of the methanolic and ethanolic cactus peel extracts.

Tested parameters	Total amino acids (%)	Mannan (%)	$\beta$ -glucan (%)	Indols (%)	Total phenols	Tannins	Sucrose (%)
Ethanolic extract	0.30	10.48	36.79	0.021	ND	ND	6.05
Methanolic extract	0.35	09.89	34.74	0.052	ND	ND	3.30

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

**Table (8):** Cytotoxic activities of ethanolic and methanolic extracts against brine shrimp

Tested extract	concentration	% mortality
Methanolic extract	1mg/1ml	5.8%
Ethanolic extract	1mg/1ml	5.2%

**Table (9):** Serum levels of zinc, copper, iron and calcium in treated groups.

Groups Element	Group 1 (negative control)	Group 2 (HFD) (positive control)	Group 3 (ethanoli cextract)	Group 4 (methanoli cextract)
Zinc (µg/l)	10.18±1.29	8.78±0.25	14.49±0.55 <sup>ab</sup>	12.93±0.77 <sup>ab</sup>
Copper (µg/l)	4.13±0.77	3.8±0.31	8.65±0.24 <sup>ab</sup>	7.33±0.82 <sup>ab</sup>
Iron (µg/l)	47.31±1.61	48.67±1.7 <sup>a</sup>	53.57±1.82 <sup>ab</sup>	52.58±1.67 <sup>ab</sup>
Calcium (mg/l)	124.83±4.5	130.7±4.68 <sup>a</sup>	164.54±4.18 <sup>ab</sup>	154.66±3.12 <sup>ab</sup>

Results are expressed as mean±SD

a significant difference in comparison to negative control (p≤0.05)

b significant difference in comparison to positive control (p≤0.05)

**Table (10):** Kidney and liver functions of treated groups.

Groups	Group 1	Group 2	Group 3	Group 4
AST (mg/dl)	90.0±1.41	102.0±2.88 <sup>a</sup>	83.67±1.63 <sup>ab</sup>	87.17±3.19 <sup>ab</sup>
ALT (mg/dl)	26.94±0.33	29.84±0.42 <sup>a</sup>	25.0±0.13 <sup>ab</sup>	26.0±0.06 <sup>ab</sup>
ALP (unite/l)	288.17±4.21	289.0±4.94	480.0±15.65 <sup>ab</sup>	415.5±7.74 <sup>ab</sup>
Creatinine (mg/dl)	0.60±0.004	0.86±0.05 <sup>a</sup>	0.51±0.04 <sup>ab</sup>	0.60±0.004 <sup>b</sup>

Results are expressed as mean±SD

a significant difference in comparison to negative control (p≤0.05)

b significant difference in comparison to positive control (p≤0.05)

**Egyptian Nutrition Society-Special Issue :**  
**The First International Conference of Nutrition, Hurghada, April 2017**

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**Table (11):** Lipids profile of treated groups.

Groups Tests (mg/dl)	Group 1	Group 2	Group 3	Group 4
Cholesterol	97.0±1.41	132.0±7.64 <sup>a</sup>	109.0±3.4 <sup>ab</sup>	111.0±5.66 <sup>ab</sup>
Triglyceride	79.0±0.56	107.7±0.75 <sup>a</sup>	92.3±0.76 <sup>ab</sup>	91.0±0.34 <sup>ab</sup>
HDL	76.9±0.90	55.4±0.90 <sup>a</sup>	91.3±1.69 <sup>ab</sup>	90.7±1.7 <sup>ab</sup>
LDL	67.0±2.82	98.0±4.81 <sup>a</sup>	56.0±4.24 <sup>ab</sup>	57.0±2.8 <sup>ab</sup>

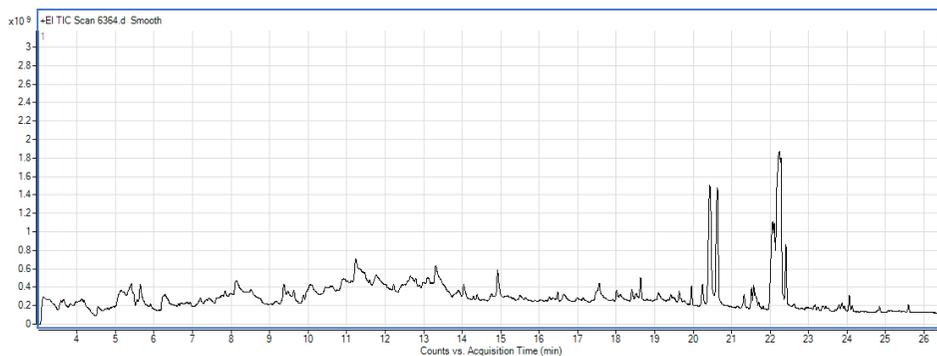
Results are expressed as mean±SD

a significant difference in comparison to negative control (p≤0.05)

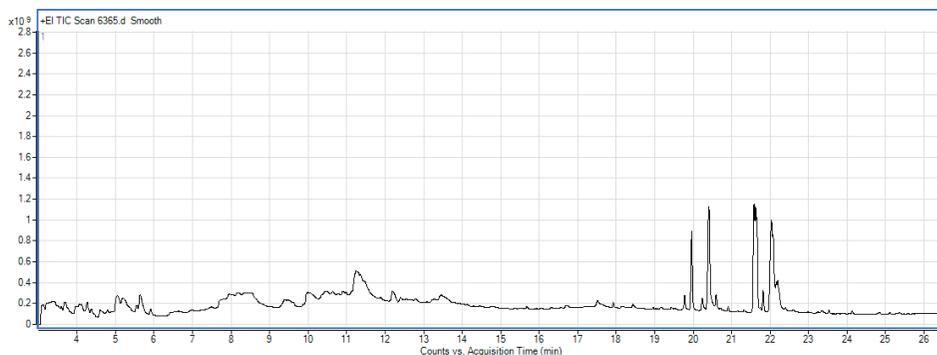
b significant difference in comparison to positive control (p≤0.05)

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

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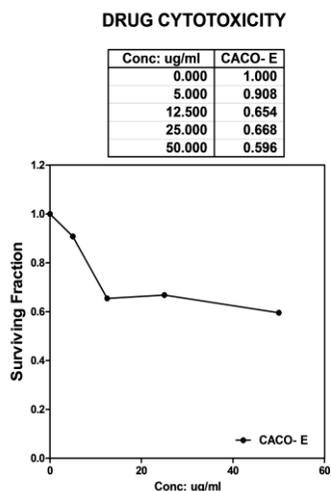
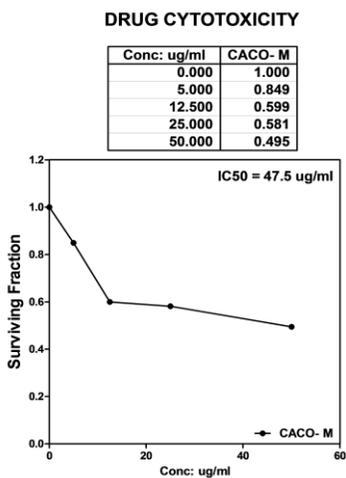
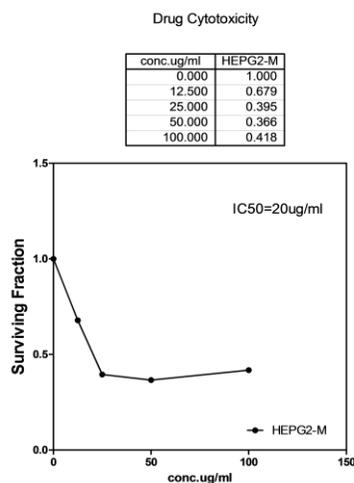
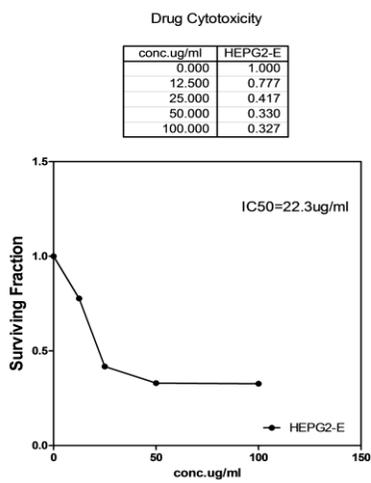


**Fig.1: GC-MS of ethanolic extract of cactus peel**



**Fig.(2) : GC-MS of methanolic extract of cactus peel**

**Egyptian Nutrition Society-Special Issue :**  
**The First International Conference of Nutrition, Hurghada, April 2017**



Figs. (3-6): Anti-tumor activity of cactus extracts

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

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## النشاط المضاد للسرطان والتأثير الخافض للدهون للمستخلصات الأيثانولية والميثانولية لقشر التين الشوكى

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### الملخص العربي

نبات التين الشوكى من نباتات الصبار المثمرة التى تنمو فى المناطق شديدة الجفاف . تمثل قشرة التين الشوكى 40% من وزن الثمرة و يشكل تراكم أطنان مخلفات تقشير الثمار مشكلة بيئية.

يلقى البحث الضوء على التركيب الكيميائى والمكونات الغذائية لقشر ثمار التين الشوكى ودراسة بعض التأثيرات البيولوجية للمستخلصات الميثانولية و الأيثنولية للقشر ومن النتائج التى توصلت إليها الدراسة أن قشر التين الشوكى يحتوى على كل من :- 4,75% بروتين, 59,25% كربوهيدرات, 27,25% بيتا جلوكان, 7,76% منان, 0,084% فوسفور, 2,04% كالسيوم بالإضافة لوجود كل من الحديد والزنك والنحاس بتركيزات 80,35 و 37,49 و 1,92 جزء فى المليون نسبيا إلى جانب الألياف التى تتمثل فى الهيميسيليلوز والسيليلوز والليجنين بنسب 0,5% و 10,92% و 1,2% على التوالى هذا إلى دراسة محتوى قشر التين الشوكى من الأحماض الأمينية الأساسية والغير أساسية. وقد تم عمل مستخلص ميثانولى و إيثنولى لقشر التين الشوكى والتعرف على محتواهما من:- الأحماض الأمينية الكلية 0,35% و 0,30% نسبيا وكان المنان 9,89% و 10,48% نسبيا أما البيتتا جلوكان فكان 34,74% و 36,79% نسبيا وقد كان محتوى الإندول فى المستخلصين الميثانولى والإيثنولى 0,052% و 0,021% نسبيا أما محتوى السكرز فكان 3,3% و 6,05% نسبيا.

وقد تم إجراء تجربة بيولوجى على فئران التجارب تم تغذيتها على وجبات عالية الكوليسترول وأستخدم محلول مستخلص ميثانولى و إيثنولى لقشر التين الشوكى كمصدر لمياه شرب الفئران وإستغرقت التجربة ثمانية أسابيع وجد أن المستخلصين لهما تأثير إيجابى على

**Sherif El-Sayed Aly Badr, Adel Ahmed Bakr, Gihan Mohamed El Moghazy and Ola Aly Wahdan.**

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إنخفاض نسبة الكوليسترول فى الدم إلى كما أنهما مصادر حقيقية لعناصر الكالسيوم و الفوسفور و الحديد والزنك والنحاس.

بالإضافة إلى دراسة تأثير المستخلصات الإيجابية على يرقات الجمبرى البحرى بنسبة 5,8% و 5,2%. وتأكيدا لذلك فقد أظهرت نتائج الأختبارات التى أجريت بالمعهد القومى للأورام بأن المستخلص الميثانولى لقشر التين الشوكى له تأثير إيجابى على كل من الخلايا السرطانية الكبدية والقولون بينما كان المستخلص الإيثانولى له تأثير إيجابى على الخلايا السرطانية الكبدية فقط.

وأخيرا نستخلص من الدراسة بأنه يمكن إستخدام قشر التين الشوكى فى أعراض طبية وتغذوية بدلا من تسببه فى مشاكل بيئية.