



The 6th international- 20th Arabic conference for
Home Economics
Home Economics and Educational quality
assurance December 23rd -24th, 2018

<http://homeEcon.menofia.edu.eg>

**Journal of Home
Economics**

ISSN 1110-2578

Effect of some food processing by-products on obesity complications induced in experimental animals

Omar Emam¹, Ghada ElBasouny¹, Yousif Elhassaneen² and Entsar Ebeed¹

¹Department of Home Economics, Faculty of Specific Education, Benha University, Benha, Egypt and ²Department of Nutrition and Food Science, Faculty of Home Economics, Minoufiya University, Shebin El-Kom, Egypt

Abstract: The present study aims to investigate the effectiveness of some food processing by-products on obesity complications induced in experimental animals. Thirty male albino rats (150-160g per each), were divided into two main groups, the first group (Group 1, 6 rats) still fed on basal diet and the other main group (25 classified into five sub groups as follow: group (2), fed on DIO as a positive control; groups (3-6), fed on DIO containing 5 % potato peel powder (PPP), yellow onion skin powder (ROSP), eggplant peel powder (EPP) and their mixture, respectively. Feeding of rats on diet induced obesity (DIO) leads to increase the BW than the control group. At the end of the experiment (8 weeks), rats of the normal group recorded 188.02% of baseline for the BW while obese group was 231.07% of baseline. Replacement of wheat flour with PPP, YOSP, EPP and their mixture induced significant decreasing on BW of the obese rats which recorded 217.04, 203.03, 209.56 and 193.04% of baseline, respectively. Biochemical analysis data indicated that obesity induced a significant increase in liver functions (AST, 33.88%, ALT, 25.62% and ALP, 26.76%, kidney functions (uric acid, 12.66% and creatinine, 15.69%) and serum glucose (31.54%) compared to normal controls. Feeding on 5% of with PPP, YOSP, EPP and their mixture exhibited a significant improvement ($p \leq 0.05$) in all of these parameters by different rates. The higher amelioration effects were recorded for the by-product mixtures treatment followed by YOSP, EPP and PPP, respectively. In conclusion, these findings provide a basis for the use of the selected food processing by-products in different therapeutic nutrition application such as prevention and early treatment of obesity.

Keywords: eggplant peel, potato peel, onion skin, body weight, liver functions, kidney functions and serum glucose.

Introduction

Obesity is a state of excess adipose tissue mass. Although often viewed as equivalent to increased body weight, this need not be the case—lean but very muscular individuals may be overweight by numerical standards without having increased adiposity. Body weights are distributed continuously in populations, so that choice of a medically meaningful distinction between lean and obese is somewhat arbitrary. Obesity is therefore more effectively defined by assessing its linkage to morbidity or mortality. Although not a direct measure of adiposity, the most widely used method to gauge obesity is the *body mass index* (BMI), which is equal to weight/height^2 (in kg/m^2). Other approaches to quantifying obesity include anthropometry (skin-fold thickness), densitometry (underwater weighing), CT or MRI, and electrical impedance. Using data from the Metropolitan Life Tables, BMIs for the midpoint of all heights and frames among both men and women range from 19–26 kg/m^2 ; at a similar BMI, women have more body fat than men (Elhassaneen and Salem, 2015). Based on data of substantial morbidity, a BMI of 30 is most commonly used as a threshold for obesity in both men and women. Large-scale epidemiologic studies suggest that all-cause, metabolic, cancer, and cardiovascular morbidity begin to rise (albeit at a slow rate) when BMIs are ≥ 25 , suggesting that the cut-off for obesity should be lowered. Most authorities use the term *overweight* (rather than obese) to describe individuals with BMIs between 25 and 30. A BMI between 25 and 30 should be viewed as medically significant and worthy of therapeutic intervention, especially in the presence of risk factors that are influenced by adiposity, such as hypertension and glucose intolerance (Radwan and Bassouny, 2017)

According to the World Health Organization (WHO), there are more than one billion overweight adults in the world. At least 300 million of them are clinically obese (WHO, 2006) and of these about 115 million come from developing countries (WHO and Dini, 2006). Current obesity levels range from under 5% in China, Japan and certain African nations, to over 75% in urban Samoa. But even in countries with relatively low prevalence, such as China, rates are almost 20% in some cities (WHO and Dini, 2006). Furthermore, in the past 20 years, the rates of obesity have tripled in developing countries (Hossain et al., 2007). Egypt, a developing country, is undergoing rapid urbanization

changes. This has a direct impact on its people's dietary habits and physical activity patterns. According to national studies, it is common to skip meals and to replace them with daily snacks, and most of these snacks are high in calories and low in nutrients. So, Egypt appeared in No. 8 ranking among the countries of the world where obesity - adult prevalence rate, 30.3%

(http://www.indexmundi.com/egypt/obesity_adult_prevalence_rate.html).

Increasing in body weight is associated with various diseases, particularly cardiovascular diseases, diabetes mellitus type 2, obstructive sleep apnea, certain types of cancer, osteoarthritis and asthma. As a result, obesity has been found to reduce life expectancy (**Haslam and James, 2005**). It also increases the risk of many physical and mental conditions. These comorbidities are most commonly shown in metabolic syndrome, a combination of medical disorders which includes: diabetes mellitus type 2, high blood pressure, high blood cholesterol, and high triglyceride levels (**Grundy, 2004**). Complications are either directly caused by obesity or indirectly related through mechanisms sharing a common cause such as a poor diet or a sedentary lifestyle. The strength of the link between obesity and specific conditions varies. One of the strongest is the link with type 2 diabetes. Excess body fat underlies 64% of cases of diabetes in men and 77% of cases in women. Health consequences fall into two broad categories: those attributable to the effects of increased fat mass (such as osteoarthritis, obstructive sleep apnea, social stigmatization) and those due to the increased number of fat cells (diabetes, cancer, cardiovascular disease, non-alcoholic fatty liver disease). Increases in body fat alter the body's response to insulin, potentially leading to insulin resistance. Increased fat also creates a proinflammatory state, and a prothrombotic state (**Bray, 2004 and Ahmed, 2014**).

Many studies reported that vegetables processing by-products especially peels and skins of fruits, are rich sources of different categories bioactive compounds (vitamins: C, E and β -carotene, polyphenols, sulphur compounds, dietary fiber etc.). Varied bioactive components at different levels may be responsible for the offered health protection. A number of experiments indicate that vegetables processing by-products powder added to laboratory animals' diet had positive

effects on body weight, serum lipid profile, liver and kidney functions and serum glucose (El-Sadany, 2001; Coskuner *et al.*, 2005; Gorinstein *et al.*, 2006; Taing, *et al.*, 2012; Matsunaga *et al.*, 2014; Sayed Ahmed, 2016 and Salama *et al.*, 2017). In the present study we try to open new avenue for extending the using of three vegetables by-products including potatoes (*Solanum tuberosum* L.) peel, yellow onion (*Allium cepa* L.) skin and eggplant (*Solanum melongena*) peel in therapeutic nutrition applications through studying the effect of such plant by-products consumption on obesity complications induced in experimental animals.

Materials and Methods

Materials

Food by-products: Yellow onion skin (YOS) was obtained from the New BeniSuef company for Preservation, dehydration and Industrialization of Vegetables, BeniSuefElgudida City, Nile East, BeniSuef, Egypt; potato peel (PP) from *SFCO* For Manufacturing & Export Agricultural Products, El Negila, Kom Hamada, Behira Government, Egypt. Eggplant fruits were obtained from a local market of Benha City, during the 2017 harvesting period, Benha Governorate, Egypt and used for eggplant peels preparation. The collected samples was transported to the laboratory and used immediately for peels preparation process.

Casein was obtained from Morgan Chemical Co., Cairo, Egypt. The rest of chemicals, reagents and solvents were of analytical grade and purchased from El-Ghomhorya for Drugs, Chemicals and Medical Instruments Trading Co. (Cairo, Egypt).

Animals used in this study, adult male albino rats (150-160 g per each) were obtained from Research Institute of Ophthalmology, Medical Analysis Department, Giza, Egypt

Methods

Preparation of food by-products peel powder

Eggplant peel powder (EPP)

Eggplant peel were washed, sliced and dried in two stages at 60 °C for 6 and 40 °C for 6 hours in hot air oven (Microfrost, China). This is

followed by milling with grinder (Al-Araby Co., Egypt) to produce the respective powder types.

Yellow onion skin powder (YOSP) and potato peel powder (PPP)

Yellow onion skin and potato peel were washed and then dried in a hot air oven (Horizontal Forced Air Drier, Proctor and Schwartz Inc., Philadelphia, PA) at 55 °C for 14. The dried peels were ground into a fine powder in high mixer speed (Al-Araby Co., Egypt). The material that passed through an 80 mesh sieve was retained for use.

Cauliflower leaves powder (CLP)

Cauliflower leaves were washed and then dried in a hot air oven (Horizontal Forced Air Drier, Proctor and Schwartz Inc., Philadelphia, PA) at two stages 50 °C for 6 hrs followed by 40 °C for 10 hrs. The dried peels were ground into a fine powder in high mixer speed (Moulinex Egypt, Al-Araby Co., Egypt). The material that passed through an 80 mesh sieve was retained for use.

Basal Diet

The basic diet prepared according to the following formula as mentioned by (AIN, 1993) as follow: protein (10%), corn oil (10%), vitamin mixture (1%), mineral mixture (4%), choline chloride (0.2%), methionine (0.3%), cellulose (5%), and the remained is corn starch (69.5%). The used vitamin mixture component (Table 1) was that recommended by (Campbell, 1963) while the salt mixture (Table 2) used was formulated according to (Hegsted, 1941).

Experimental design

All biological experiments performed a complied with the rulings of the Institute of Laboratory Animal Resources, Commission on life Sciences, National Research Council (NRC, 1996). Rats (n=30 rats), 150-160g per each, were housed individually in wire cages in a room maintained at 25 ± 2 °C and kept under normal healthy conditions. All rats were fed on basal diet for one-week before starting the experiment for acclimatization. After one week period, the rats were divided into two main groups, the first group (Group 1, 5 rats) still fed on basal diet and the other main group (25 rats) was feed with diet-induced obesity

(DIO, product no.D1245, Research Diets, Inc. NJ, See Table 3) for 8 weeks which classified into sex sub groups as follow:

- Group (2), fed on diet-induced obesity (DIO) as a positive control.
- Group (3), fed on DIO containing 5 % potato peel powder (PPP).
- Group (4), fed on DIO containing 5 % yellow onion skin powder (YOSP).
- Group (5), fed on DIO containing 5 % eggplant peel powder (EPP),
- Group (6): fed on DIO containing 5 % mixture, PPP + YOSP + EPP by equal parts.

Body weight gain (as percent of initial weight) was assayed every week in rats.

Blood sampling

At the end of experiment period, 8 weeks, blood samples were collected after 12 hours fasting using the abdominal aorta and rats were scarified under ether anesthetized. Blood samples were received into clean dry centrifuge tubes and left to clot at room temperature, then centrifuged for 10 minutes at 3000 rpm to separate the serum according to Drury and Wallington, (1980). Serum was carefully aspirate, transferred into clean covet tubes and stored frozen at -20°C until analysis.

Hematological analysis

Liver functions

Serum glutamic pyruvic transaminase (SGPT/ALT) and serum glutamic oxaloacetic transaminase (SGOT/AST) activities were measured in serum using the modified kinetic method of Tietz *et al.*, (1976) by using kit supplied by Biocon Company. Alkaline Phosphatase (ALP) activity was determined using modified kinetic method of Vassault *et al.*, (1999).

Kidney functions

Serum creatinine concentration was determined using the modified kinetic method of Young *et al.*, (1975) by using kit supplied by Biocon Company.

Urea

Serum urea concentration was determined by **Chaney *et al.*, (1962)** by using kit supplied by Biocon Company.

Serum glucose

Enzymatic determination of serum glucose was carried out colorimetrically according to Yound, (1975).

Statistical Analysis

All measurements were done in triplicate and recorded as mean \pm SD. Statistical analysis was performed with the Student *t*-test and MINITAB 12 computer program (Minitab Inc., State College, PA).

Results and Discussion

The effect of food processing by-products applied in bread on body weight of obese rats

The effect of vegetables processing by-products applied in bread on body weight (BW, Percent of baseline) of obese rats was shown in Table (1) and Figure (1). From such data it could be noticed that feeding of rats on diet induced obesity (DIO) leads to increase the BW than the control group. At the end of the experiment (8 weeks), rats of the normal group recorded 188.02% of baseline for the BW while obese group was 231.07% of baseline. Replacement of wheat flour with PPP, YOSP, EPP and their mixture induced significant decreasing on BW of the obese rats which recorded 217.04, 203.03, 209.56 and 193.04% of baseline, respectively. The higher effect on weigh decreasing was recorded for the vegetables by-product mixtures followed by ROSP, EPP and PPP, respectively. The effect of different plant parts including PPP, YOSP, EPP and their mixture in the control of obesity is the main subjects of many studies (**El-Nashar, 2007; Bedawy, 2008; Bonet *et al.*, 2015 and Sayed Ahmed, 2016**). The positive effects of such plant parts regarding the control of the obesity could be attributed to their high level content of different classes phytochemical compounds including flavonols, phenolic acids, anthocyanins, alkaloids, carotenoids, phytosterols and organosulfur compounds (**Rodriguez *et al.*, 1994; Velioglu *et al.*, 1998; Beatticet *et al.*, 2005; Sayed Ahmed, 2016 and Mashal, 2016**). Such bioactive compounds and their conversion

products have been shown to impact gene expression and cell (including adipocyte) function through multiple mechanisms, notably by: (a) interacting with several transcription factors of the nuclear receptor superfamily, (b) interfering with the activity of other transcription factors, (c) modulating signaling pathways which are associated with inflammatory and oxidative stress responses; and (d) through extragenomic actions including scavenging of reactive species, retinoylation (**Constance *et al.*, 2003; Bonetet *al.*, 2015; Mashal, 2016 and Sayed Ahmed, 2016**) . All of these mechanisms contribute to their action control of adipocyte function, adiposity and obesity (reviewed in **Bonetet *al.*, 2015**).

The effect of plant by-products applied in bread on liver function enzymes activity in plasma of obese rats

The effect of plant by-products applied in bread on liver function enzymes activity in plasma of obese rats were shown in Table (2) and Figure (2). From such data it could be noticed that obesity induced a significant increased ($p \leq 0.05$) in AST (33.88%), ALT (25.62%) and ALP (26.76%) compared to normal controls. Replacement of wheat flour with PPP, YOSP, EPP and their mixture induced significant decreasing on liver AST, ALT and ALP activities by the ratio of 20.88, 13.73, 18.01 and 9.94; 13.47, 7.05, 11.01 and 4.80; and 17.03, 12.66, 16.31 and 10.22%, respectively. The higher effects in manipulation of the liver enzymes disorders induced by obesity in rats were recorded for the vegetables by-product mixtures followed by ROSP, EPP and PPP, respectively. Such data are in accordance with that reported by Ahmed (2016) who tested the breads blended with different agricultural processing by-products including potato, onion and cauliflower peels powder in obese rats.

Table (1): The effect of vegetables processing by-products applied in bread on body weight gain (Percent of baseline) of obese rats*

Groups	Feeding period (weeks)								
	0	1	2	3	4	5	6	7	8
Control (-) Std diet	100.00	108.82	117.82	124.80	141.47	162.45	172.67	179.65	188.02
Control (+) Obese	100.00	118.03	133.65	140.41	163.73	200.93	204.66	216.71	231.07
PPP	100.00	115.79	127.52	133.38	155.54	190.87	198.05	203.40	217.04
YOSP	100.00	109.24	122.40	126.75	147.80	174.96	178.20	186.71	203.03
EPP	100.00	112.89	122.84	129.18	149.36	190.21	196.71	196.98	209.56
Mix	100.00	109.91	118.87	125.85	142.67	163.02	174.86	181.92	193.04

* PPP, potato peel powder, YOSP, yellow onion skin extract; EPP, eggplant peel powder and Mix, mixture powder of PPP, YOSP and EPP by equal parts. Values in the same row with different superscript letters are significantly different at $p \leq 0.05$.

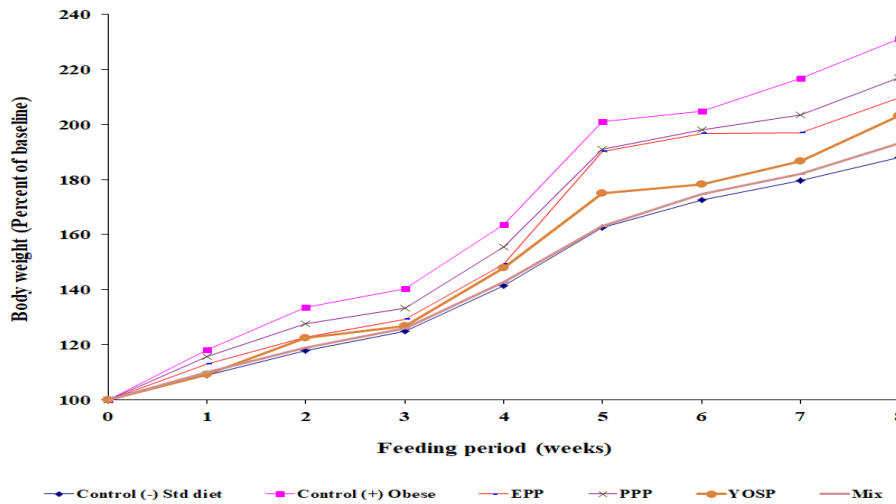


Figure (1): The effect of vegetables processing by-products applied in bread on body weight gain (Percent of baseline) of obese rats*

* PPP, potato peel powder, YOSP, yellow onion skin extract; EPP, eggplant peel powder and Mix, mixture powder of PPP, YOSP and EPP by equal parts.

Table 2. Liver functions enzyme of obese rats feeding some selected food processing by-products applied in bread*

Value	Control (-) Std diet	Control (+) Obese	Vegetables processing by-product powder (5 %, w/w)			
			PPP	YOSP	EPP	Mix
Serum alanine aminotransferase (ALT) activity (U/L)						
Mean	46.69 ^a	58.65 ^d	52.98 ^{bc}	49.98 ^b	51.83 ^{bc}	48.93 ^{bc}
SD	5.23	7.35	8.99	6.98	7.11	5.66
% of Change	0.00	25.62	13.47	7.05	11.01	4.80
Serum Aspartate aminotransferase (AST)activity (U/L)						
Mean	26.15	35.01	31.61	29.74	30.86	28.75
SD	9.98	7.44	6.41	5.23	3.99	5.98
% of Change	0.00	33.88	20.88	13.73	18.01	9.94
Serum alkaline phosphatase (ALP,U/L)						
Mean	93.33	118.31	109.23	105.15	108.55	102.87
SD	10.45	10.92	8.34	9.53	11.67	17.87
% of Change	0.00	26.76	17.03	12.66	16.31	10.22

* PPP, potato peel powder, YOSP, yellow onion skin extract; EPP, eggplant peel powder and Mix, mixture powder of PPP, YOSP and EPP by equal parts. Means in the same row with different superscript letters are significantly different at $p \leq 0.05$.

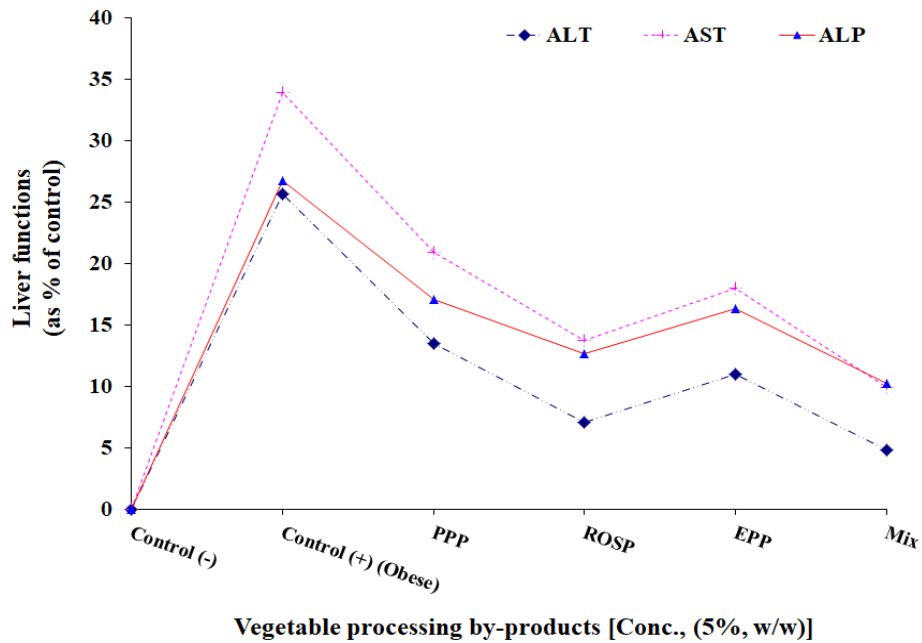


Figure (2): Liver functions enzyme of obese rats feeding some selected food processing by-products applied in bread*

* PPP, potato peel powder, YOSP, yellow onion skin extract; EPP, eggplant peel powder and Mix, mixture powder of PPP, YOSP and EPP by equal parts. Means in the same row with different superscript letters are significantly different at $p \leq 0.05$.

In general, aminotransferases are normally intracellular enzymes. Thus, the presence of elevated levels of aminotransferase in the plasma indicates damage to cells rich in these enzymes. For example, physical trauma or a disease process can cause cell lysis, resulting release of intracellular enzymes into the blood. Two amino transferases were found in plasma are of particular diagnostic value AST and ALT. AST enzyme is one of the enzymes tested in the cardiac enzyme series. This enzyme is found in very high concentration within the heart muscles, skeletal muscle cells, and to a lesser degree in the kidney and pancreas. ALT is found predominately in the liver lesser quantities are found in the kidneys, heart and skeletal muscles (Veot and Veot, 1990). These enzymes are elevated in nearly all liver diseases, but are particularly high in conditions that the causes extensive cell necrosis, such as severe

viral hepatitis and prolonged circulatory collapse. Serial enzyme measurements are often useful in determining the course of liver damage (**Pagana and pagana, 1997, Hong et al., 2002 and Elhassaneenet al., 2016**). Also, aminotransferases may be elevated in nonhepatic disease, such as myocardial infarction and muscle disorders; however, these disorders can usually be distinguished clinically from liver disease (**Champe and Harvey, 1994**). Data of the present study with the other reported that aminotransferases may be elevated significantly in additionally nonhepatic disease such as obesity in human and experimental animals (**Elhassaneen and Salem, 2014 and Sayed Ahmed, 2016**). Alkaline phosphatase (ALP) is an enzyme which catalyzes the hydrolysis of phosphate esters at an alkaline pH to give phosphate and the corresponding alcohol, phenol or sugar. Although ALP is found in many tissues, the highest concentrations are found in the liver, biliary tract, epithelium and bone. The intestinal mucosa and placenta also contain ALP (**Pagana and pagana, 1997**). However, practically every body tissue contains at least a small amount of ALP. Because of this wide distribution limited information can be obtained from a total AP assay. Elevated serum and leukocytic AP levels in patients with Hodgkin's and non-Hodgkin's lymphoma were reported by several investigators (**Thysset al., 1985**). Also, **Pagana and pagana, (1997)** reviewed that the elevated leukocyte AP in patients who have hairy cell leukemia was inversely correlated to absolute number of neutrophils in the peripheral blood, *i.e.* the patients who had high leukocyte AP scores have low or normal peripheral blood neutrophil counts. Abnormal leukocyte AP scores are characteristic of certain myeloproliferative and lymphoproliferative disorders. **Gobbiet al., (1982)** found that among liver function tests that have been investigated in Hodgkin's disease, serum AP activity was elevated in 20 out of 133 patients while it was elevated in 10 out of 20 patients with initial bone disease. The liver inflammation and functions-improving effects were evaluated according to ALT, AST (serum biochemical indicators for liver inflammation), albumin, total protein (liver cell regeneration indicators).

Such as reviewed in several studies plant parts including PPP, YOSP, EPP and their mixture are a rich source of different classes of phytochemicals such as flavonols, phenolic acids, anthocyanins, alkaloids, carotenoids, phytosterols and organosulfur compounds (**Harborne,**

1998; Harborne and Mabry, 1982, Rodriguez *et al.*, 1994a; Velioglu *et al.*, 1998; Singh *et al.*, 2002; Beatticet *et al.*, 2005; Mohamed, 2012; Sayed Ahmed, 2016 and Elhassaneen *et al.*, 2016). The present study with others reported that the effect of many plant parts on decreasing the serum liver function enzymes activity could be attributed to their high level content of that phytochemicals. For example, El-Nashar, (2007) found that different doses of cinnamon extract (rich in bioactive compounds such as reported on the tested vegetables by-products) showed slight-decreased in serum AST, GLT and AP after 12 week of feeding when compared with control group. The same observation was reported in rats injected with nitrosamine and treated with apricot kernel extracts (Hassan, 2011). Active ingredients in sweet violet (*Viola odorata* L.) blossom powder prevented partially the rise of mean serum ALT, AST and AP activities induced by CCl₄ injection (Abd El-Fatah, 2013 and Elhassaneen *et al.*, 2013).

The possible mode of action of liver serum enzymes-lowering activity of the tested bread supplemented with by-products including ROSP, MPP, PPP and CLP, as individually or mixture, could be explained by one or more of the following process. Flavonoids found in all the tested by-products are known to block the hepatocellular uptake of bile acids (Dawson, (1998). Flavonoids pretreatment improved the antioxidant capacity of the liver, diminished the bilirubin concentration compared with the groups without treatment (Beatticet *et al.*, 2005). They also reported that flavonol glycosides reduced the elevated levels of the following serum enzymes, AST, ALT and ALP. Als, pre-treatment with flavonoids were not only able to suppress the elevation of AST and ALT but also reduce the damage of hepatocytes *in vitro* was reported by El-Nashar, (2007). It was found that flavonoids have exhibited strong antioxidant activity against reactive oxygen species (ROS) *in vitro*. The hepatoprotective activity of flavonoids was possibly due to its antioxidant properties, acting as scavengers of reactive oxygen species (ROS). Pre-treatment with apricot kernel extract rich in phytochemicals were able to reduce the damage of liver i.e. suppresses the elevation of AST, ALT and ALP through the improvement of antioxidant defense system in red blood cells (Hassan, 2011). Recently, Mahran *et al.*, (2018) found that food processing by-products extracts (rich in bioactive compounds such as reported on the tested vegetables by-products)

showed high decreased in serum AST, GLT and AP after eight week of feeding in rats treated with benzo(a)pyrene. Take in our consideration all of these mechanism of actions, the higher improvement in liver function parameters recorded in rats feeding vegetables by-products mixture bread samples could be attributed to the antagonism effects induced by their content of different categories of bioactive compounds.

The effect of vegetables by-products applied in bread on kidney functions in plasma of obese rats

Kidney functions (urea and creatinine concentrations) in serum of obese rats consumed vegetables by-products applied in bread were shown in Table (3) and Figure (3). From such data it could be noticed that obesity induced a significant increased ($p \leq 0.05$) in uric acid (12.66%) and creatinine (15.69%) compared to normal controls. Supplementation of the rat diets with 5% w/w by PPP, YOSP, EPP and their mixture induced significant decreasing on serum uric acid and creatinine levels by the ratio of 5.90, 4.89, 6.68 and 3.90%; and 11.76, 7.84, 11.76 and 5.88%, respectively. The higher amelioration effects in kidney disorders induced by obesity in rats were recorded for the vegetables by-products mixtures treatment followed by YOSP, PPP and EPP, respectively.

Urea is formed in the liver as the end product of protein metabolism. During ingestion, protein is broke down into amino acids. These amino acids are catabolized and free ammonia is formed. The ammonia is combined to form urea (**Pagana and pagana, 1997**). Urea, the major product of protein catabolism measuring urea is the most popular laboratory procedure for assessing renal function (**Bennett et al., 1995**

Table 3. Kidney functions of obese rats feeding some selected food processing by-products applied in bread*

Value	Control (-) Std diet	Control (+) Obese	Vegetables processing by-product powder (5 %, w/w)			
			PPP	YOSP	EPP	Mix
Serum urea concentration (mg/dl)						
Mean	49.57	55.84	52.49	51.99	52.88	51.50
SD	2.78	4.22	5.17	6.98	5.63	4.40
% of Change	0.00	12.66	5.90	4.89	6.68	3.90
Serum creatinine concentration (g/dl)						
Mean	0.51	0.59	0.57	0.55	0.57	0.54
SD	0.12	0.09	0.13	0.20	0.10	0.11
% of Change	0.00	15.69	11.76	7.84	11.76	5.88

* PPP, potato peel powder, YOSP, yellow onion skin extract; EPP, eggplant peel powder and Mix, mixture powder of PPP, YOSP and EPP by equal parts. Means in the same row with different superscript letters are significantly different at $p \leq 0.05$.

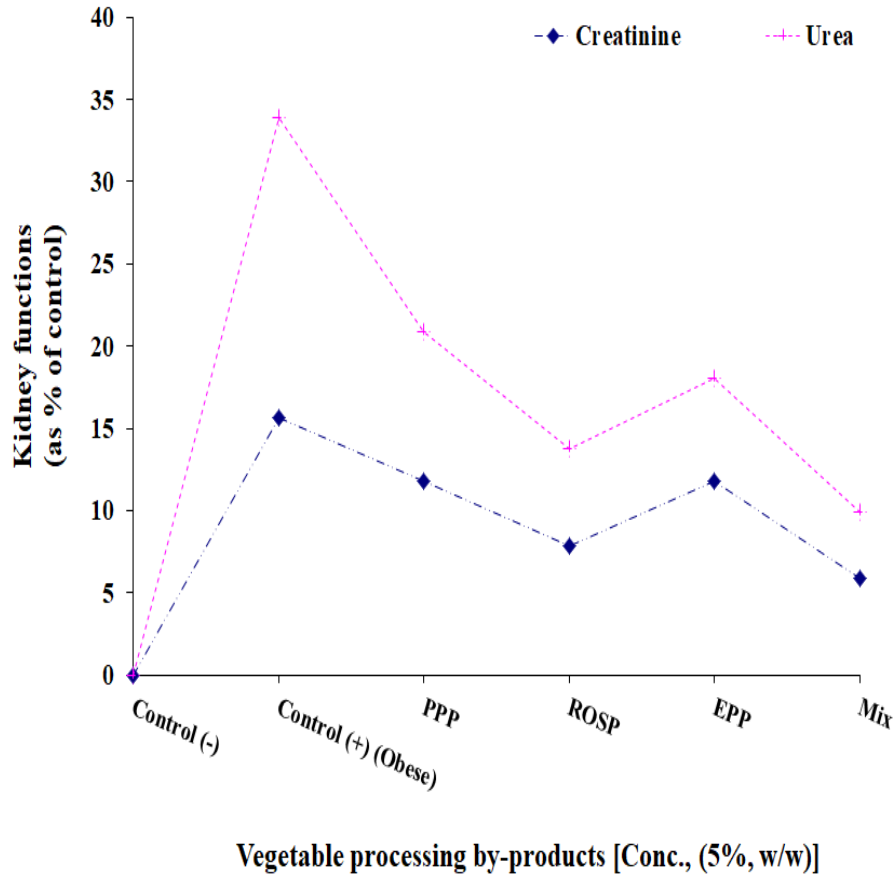


Figure (3): Kidney functions of obese rats feeding some selected food processing by-products applied in bread*

* PPP, potato peel powder, YOSP, yellow onion skin extract; EPP, eggplant peel powder and Mix, mixture powder of PPP, YOSP and EPP by equal parts. Means in the same row with different superscript letters are significantly different at $p \leq 0.05$.

and Pagana and pagana, 1997). Creatinine is a catabolic product of creatine phosphate, which is used in skeletal muscle concentration (Pagana and pagana, 1997).

In the skeletal muscle serum creatinine levels are elevated by renal disease and dehydration.

The decreasing in serum uric acid and creatinine as the result of feeding vegetables parts including PPP, YOSP, EPP and their mixture

could be attributed to their higher content of bioactive compounds such flavonols, phenolic acids, anthocyanins, alkaloids, carotenoids, phytosterols and organosulfur compounds (**Harborne, 1998; Onyeneho and Hettiarachchy, 1993; Rodriguez et al., 1994; Singh et al., 2002; Mohamed, 2012; Elhassaneenet al., 2013 and Mahranet al., 2018**). In similar studies, (**Bedawy, 2008**) reported that the decreasing in serum uric acid and creatinine as the result of feeding onion, garlic and cabbage could be attributed to their higher content of phenolic compounds. Also, **El-Sayed et al., (2012)** found that the addition of plant parts such Henada (*Jasonia Montana*), lemon balm leaves (*Melissa officinalis*), hawthorn leaves (*Crataegusazorolus*), rose of jericho (*Anastaticahierochuntica*) and corn cob silk (*zeamayz*) by 5 and 10% of the diet intake in the presence of CCl₄ induced significant improvements in all kidney functions including the serum urea and creatinine levels. Furthermore, active ingredients in sweet violet (*Viola odorata* L.) blossom powder prevented partially the rise of mean serum urea and creatinine levels induced by CCl₄ injection (**Elhassaneenet al., 2013**).

The possible mode of action of kidney serum parameters-lowering level of the tested by-products could be explained by one or more of the following process. Polyphenols found in such plant by-products improved the kidney weight and serum levels of urea nitrogen, creatinine and creatinine clearance as well as increased the activity of superoxide dismutase in the kidney (reviewed in **El-Nashar, 2007**). Also, flavanone produced significant protection of renal function by significant reduction in serum urea and creatinine concentrations, decreased polyuria and reduction in body weight loss, marked reduction in urinary fractional sodium excretion as well as protected kidney tissues (**Badary et al., 2005 and Mohamed et al., 2005**). Finally, flavonoids lowered plasma creatinine and urea concentration, both indicating a better postoperative kidney functions (**Van Hoorn et al., 2006**). Such mechanisms of action indicated that a combination of different vegetables by-products may be more efficient for reducing serum level of urea and creatine, the biomarkers of kidney functions stress, because the interactive effects occurred by different categories of bioactive compounds of the tested vegetables by-products.

The effect of vegetables by-products applied in bread on serum glucose of obese rats

Glucose concentration in serum of obese rats consumed vegetables by-products applied in bread was shown in Table (4) and Figure (4). From such data it could be noticed that obesity induced a significant ($p \leq 0.05$) increased in serum glucose (31.54%) compared to normal controls. Supplementation of the rat diets with 5% w/w by PPP, YOSP, EPP and their mixture induced significant ($p \leq 0.05$) decreasing on serum glucose concentrations by the ratio of 12.36, 7.98, 10.62 and 4.96%, respectively. The higher amelioration effect in serum glucose rising induced by obesity in rats was recorded for the vegetables by-products mixtures treatment followed by YOSP, PPP and EPP, respectively.

In similar studies, in patients with type II diabetes, weight loss of around 5 kg is associated with a reduction in fasting blood glucose of between 0.17 mmol/L to 0.24 mmol/L at 12 months (Avenellet *al.*, 2004 and Vettoret *al.*, 2005). The decreasing in serum glucose as the result of feeding plant parts and by-products including PPP, CLP, ROSP and MPP was the subject of many studies. For example, significant research has been done on the effect of onion consumption on diabetic conditions.

Table 4. Plasma glucose concentration in obese rats feeding some selected food processing by-products applied in bread*

Value	Control (-) Std diet	Control (+) Obese	Vegetables processing by-product powder (5 %, w/w)			
			PPP	YOSP	EPP	Mix
Mean	101.66	133.73	114.22	109.77	112.46	106.70
SD	12.93	10.76	12.98	5.56	9.81	7.88
% of Change	0.00	31.54	12.36	7.98	10.62	4.96

* PPP, potato peel powder, YOSP, yellow onion skin extract; EPP, eggplant peel powder and Mix, mixture powder of PPP, YOSP and EPP by equal parts. Means in the same row with different superscript letters are significantly different at $p \leq 0.05$.

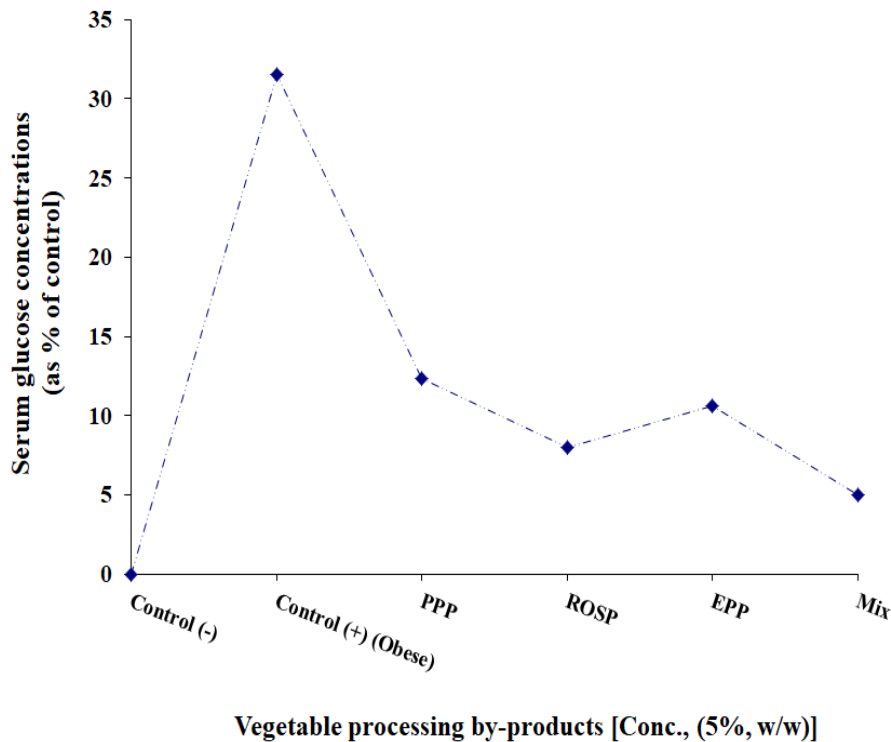


Figure (4):Plasma glucose concentration in obese rats feeding some selected food processing by-products applied in bread*

* PPP, potato peel powder, YOSP, yellow onion skin extract; EPP, eggplant peel powder and Mix, mixture powder of PPP, YOSP and EPP by equal parts.Means in the same row with different superscript letters are significantly different at $p \leq 0.05$.

The organosulfur compounds S-methylcysteinesulfoxide (SMCS) and S-allylcysteinesulfoxide (SACS) were linked to significant amelioration of weight loss, hyperglycemia, low liver protein and glycogen, and other characteristics of diabetes mellitus in rats (Sheela *et al.*, 1995). They found that the use of SMCS and SACS ($200 \text{ mg.kg}^{-1}.\text{day}^{-1}$) gave results comparable to treatment with insulin or glibenclamide but without the negative side effect of cholesterol synthesis stimulation. Onion peel extract (OPE) might improve glucose response and insulin resistance

associated with type 2 diabetes by alleviating metabolic dysregulation of free fatty acids, suppressing oxidative stress, up-regulating glucose uptake at peripheral tissues, and/or down-regulating inflammatory gene expression in liver which was reported by **Jung et al., (2011)**. Moreover, in most cases, OPE showed greater potency than pure quercetin equivalent. These findings provide a basis for the use of onion peel to improve insulin insensitivity in type 2 diabetes. OPE might improve glucose response and insulin resistance associated with type 2 diabetes by alleviating metabolic dysregulation of free fatty acids, suppressing oxidative stress, up-regulating glucose uptake at peripheral tissues, and/or down-regulating inflammatory gene expression in liver. Moreover, in most cases, OPE showed greater potency than pure quercetin equivalent. These findings provide a basis for the use of onion peel to improve insulin insensitivity in type 2 diabetes. PPP and pomegranate peel powder (PGPP) displays potent hypoglycemic action in alloxane-induced diabetic rats. Such activity may be related to diverse phenolic compounds present in PGPP and PPP including punicalagin isomers, ellagic acid derivatives and anthocyanins (delphinidin, cyanidin and pelargonidin 3-glucosides and 3,5-diglucosides) chlorogenic, gallic, protocatechuic and caffeic acids (**Onyeneho and Hettiarachchy, 1993 and Rodriguez et al., 1994**). These compounds are known for their properties in scavenging free radicals, inhibiting lipid oxidation *in vitro* and improve glucose response and insulin resistance associated with type 2 diabetes (**Gil et al., 2000; Noda et al., 2002; Jung et al., 2011; and Elmaadawy, 2016**). Additionally, the mixture treatment gave maximum hypoglycemic yield when compared with the tested vegetables by-products separated. It could be mean that a combination of different vegetables by-products may be more efficient for reducing the serum glucose level because the interactive effects occurred by different categories of bioactive compounds of the tested vegetables by-products.

In conclusion, the present study has demonstrated the potency of the selected food processing by-products including PPP, YOSP, EPP and their mixture to ameliorate liver, kidney disorders and hyperglycemia in obese rats. These findings provide a basis for the use of PPP, YOSP, EPP and their mixture and also have important implications for the prevention and early treatment of obesity. Furthermore, more research must be done on the future in the area of food processing by-products

with the high content of different categories bioactive compounds and extended their applications in human diets, industrial and medical applications instead of the synthetic antioxidants/chemicals used which have induced health hazards and side effects for the human being.

References

- Abd El-Fatah, A. (2013):** Active ingredients in sweet violet and their relation with liver diseases in experimental animals: Biochemical, therapeutic and histopathological studies. Ph.D. Thesis in Nutrition and Food Science, Faculty of Home Economics, Minoufiya University, Egypt.
- Ahmad, L. (2014):** Renoprotective effect of Egyptian cape gooseberry fruit (*Physalis peruviana*) against acute renal injuries in rats. *The Scientific World Journal*, 10(1):39-48.
- AIN.American Institute of Nutrition. (1993):** Purified diet for laboratory Rodent, Final report. *J. Nutrition*. 123:1939-1951.
- Avenell, A.; Broom, J.; Brown, T.J.; Poobalan, A.; Aucott, L. and Stearns, S.C. (2004):** Systematic review of the long-term effects and economic consequences of treatments for obesity and implications for health improvement. *Health Technology Assess*, 8 : (21).
- Badary, O. A.; Abdel-Maksoud, S.; Ahmed, W. A. and Owieda, G. H. (2005):** Naringenin attenuates cisplatin nephrotoxicity in rats. *Life Sci.*, 76(18): 2125-35.
- Beattic, J.; Crozier, A. and Duthie, G. (2005):** Potential Health Benefits of berries. *Current Nutrition & Food Science*. 1: 71-86.
- Bedawy, O. E. (2008):** Relationship between phyto-sulphur compounds and lipid of blood in experimental animals M.Sc. Thesis, Faculty of Home Economics, Minoufiya University, Shebin El-Kom, Egypt.
- Bennett, P. H.; Mogensen, C. E. and Keane, W. F. (1995):** Prevention of diabetic renal disease with special reference to microalbuminuria. *Lancet*. 346:1080-4.
- Bonet, M.; Jose A.; Joan R. and Andreu P. (2015):** Carotenoids and their conversion products in the control of adipocyte function, adiposity and obesity. *Archives of Biochemistry and Biophysics*, 572: 112-125.
- Bray, G.A. (2004):** Medical consequences of obesity. *J. Clin. Endocrinol. Metab.* 89 (6): 2583-9.

- Campbell, J. A. (1963):** Methodology of Protein Evaluation. RGA Nutr. Document R. Led. 37 .June meeting, New York.
- Champe, C.P. and Harvey, A.R. (1994):** Biochemistry. 2nd edition, J.B.Lippincott Company, Philadelphia, USA.
- Constance, F.; John, A.; Brian D.; Theodore, M. and Timothy J. (2003):** Meal Pattern Analysis of Diet-Induced Obesity in Susceptible and Resistant Rats. Obesity Research, 11(7): 845-851.
- Coskun, O.; Kanter, M.; Korkmaz, A. and Oter, S. (2005):** Quercetin, a flavonoid antioxidant, prevents and protects streptozotocin-induced oxidative stress and beta-cell damage in rat pancreas. Pharmacol Res, 51:11
- Dawson, R. M. (1998):** The toxicology of microcystins. Toxicol., 36: 953-962.
- Drury, R.A. and Wallington, E.A. (1980):** Carleton's Histological Technique. 5th Edition, Oxford University Press, New York.
- Elhassaneen, Y. and Salem, A. (2015):** Biochemical/Nutritional Studies on some Obesity Cases in Egypt. Journal of Home Economics, 24(1): 121-137.
- Elhassaneen, Y.; Ragab, S.; El-Beltagi, A. and Emad, A. (2013):** Mango peel powder: A potential source of phenolics, carotenoids and dietary fiber in Biscuits preparations 2nd International-16th Arab Conference of Home Economics "Home Economics in the Service of Industry"10-11 September, Faculty of Home Economics, Minoufiya University, Shebin El-Kom, Egypt.
- Elhassaneen, Y.; SherifRagab and RaghdaMashal. (2016):** Improvement of Bioactive Compounds Content and Antioxidant Properties in Crackers with the Incorporation of Prickly Pear and Potato Peels Powder. International Journal of Nutrition and Food Sciences, 5 (1): 53-61.
- Elhassaneen, Y.; SherifRagab and RaghdaMashal. (2016):** Improvement of Bioactive Compounds Content and Antioxidant Properties in Crackers with the Incorporation of Prickly Pear and Potato Peels Powder. International Journal of Nutrition and Food Sciences, 5 (1): 53-61.
- Elmaadawy, A. (2016).**Phyto-extracts applied in beef meatballs ameliorates hyperglycemia and its complications in alloxan-induced diabetic rats. Journal of Home Economics, 26 (3): 1-16.

- El-Nashar, N. G. (2007):** Development of primary liver cell culture from fish as a valuable tool in nutrition and biotechnology research. Ph.D. Thesis, Faculty of Home Economics, Minoufiya University, Egypt.
- El-Saadany, M.A. (2001):** The effect of dietary phytochemicals on the prevention of liver cancer initiation induced by some chemical carcinogenesis. M.Sc. Thesis, Fac. of Home Economics, Minoufiya University, Shebin El-Kom, Egypt.
- El-Sayed, M.; El- Sherif. F.; Elhassaneen, Y. and Abd El-Rahman, A. (2012):** Potential Therapeutic Effects of some Egyptian Plant Parts on Hepatic Toxicity Induced by Carbon Tetrachloride in Rats. *Life Sci. J.*, 9(4): 3747-3755.
- Gil, M. I., Tomas-Barberan, F. A., Hess-Pierce, B., Holcroft, D. M., & Kader, A. A. (2000):** Antioxidant activity of pomegranate juice and its relationship with phenolic composition and processing. *Journal of Agricultural and Food Chemistry*, 48, 4581–4589.
- Gobbi ,P. G.; Parrinello, G. A. and Diprisco, U. (1982):** *Eur. J. Cancer Clin. Oncol.*,18,1243.
- Gorinstein, S.; Leontowicz, H.; Leontowicz, M.; Drzewiecki, J.; Najman, K.; Katrich, E. and Barasch D. (2006):** Raw and boiled garlic enhances plasma antioxidant activity and improves plasma lipid metabolism in cholesterol-fed rats. *Life Sci.*, 78, 655-663.
- Grundy, S.M. (2004):** Obesity, metabolic syndrome, and cardiovascular disease. *J. Clin. Endocrinol.Metab.* 89 (6): 2595–600.
- Harborne, J.B. (1998):** *Phytochemical methods: A guige to modern techniques of plant analysis.* The 3rd Ed., Chapman & Hall, London.
- Harborne, J.B.; and Mabry, T.J. (1982):** *The Flavonoids: Advances in Research.* Chapman and Hall, London.
- Haslam, D.W. and James, W.P. (2005):** Obesity. *Lancet* 366 (9492): 1197–209.
- Hassan, A. (2011):** The effect of phytochemicals on prevention and/or treatment of liver cancer induced by some food pollutants" Ph.D. Thesis in Nutrition and Food Science, Faculty of Home Economics, Minoufiya University, Egypt.
- Hegested, D.M.; Mills, R.C.; Elvehjen, C.A. & Hart, E.B. (1941):** Salt mixture. *J. Biol. Chem.*, 138:459.

- Hong, C. H.; Hur, S. K.; Oh, O. J.; Kim, S. S.; Nam, K. A. and Lee, S. K. (2002):** Evaluation of natural products on inhibition of inducible cyclooxygenase (COX-2) and nitric oxide synthase (iNOS) in cultured mouse macrophage cells. *Journal of Ethnopharmacology*, 83: 153–159.
- Hossain, P. Kwar, B, and El Nahas. M. (2007):** Obesity and Diabetes in the Developing World – A Growing Challenge. *N Engl J Med* 356: 213–215.
- Jung, Y. Yeni Lim, Min Sun Moon, JiYeon Kim and Oran Kwon (2011):** Onion peel extracts ameliorate hyperglycemia and insulin resistance in high fat diet/ streptozotocin-induced diabetic rats. *Nutrition & Metabolism* 8 (18) : 1-8.
- Mahran, M.; Ghada M. Elbassyouny and Elhassaneen, Y. (2018):** Preventive effects of onion skin powder against hepatotoxicity in rats treated with benzo(a)pyrene. *Proceeding of the Annual Conference (13th Arab; 10th International), 11-12 April, Faculty of Specific Education, Mansoura University, " Higher Education in Egypt and the Arab World in the Light of Sustainable Development Strategies", Mansoura, Egypt.*
- Mashal, R. (2016):** Technological and chemical studies on the fortification of bakery products with phytochemicals" Ph.D. Thesis in Nutrition and Food Science, Faculty of Home Economics, Minoufiya University, Egypt.
- Matsunaga, S., Azuma, K., Watanabe, M., Tsuka, T., Imagawa, T., Osaki, T. and Okamoto, Y. (2014):** Onion Peel Tea Ameliorates Obesity and Affects Blood Parameters in a Mouse Model of High-Fat-Diet-Induced Obesity. *Experimental and Therapeutic Medicine*, 7, 379-382.
- Mohamed, A. F.; Ali Hasan, A. G.; Hamamy, M. I. and Abdel-Sattar, E. (2005):** Antioxidant and hepatoprotective effects of *Eucalyptus maculata*. *Med. Sci. Monit.*, 11(11): BR426-31.
- Mohammed, N. H. (2012):** Chemical and technological studies on some food products supplemented with gum arabic" M.Sc. Thesis in Nutrition and Food Science, Faculty of Home Economics, Minoufiya University, Egypt.
- Noda, Y., Kaneyuki, T., Mori, A. and Packer, L. (2002):** Antioxidant activities of pomegranate fruit extract and its anthocyanidins:

delphinidin, cyanidin, and pelargonidin. *Journal of Agricultural and Food Chemistry*, 50, 166–171.

Noda, Y.; T. Kaneyuki, K. Igarashi, A. Moriand and L. Pacer. (1998): Antioxidant Activity of Nasunin, an Anthocyanin in Eggplant. *Research Communications in Molecular Pathology and Pharmacology*, 102, 2, 175-187.

NRC, National Research Council. (1996): Guide for the Care and Use of Laboratory Animals, 7th edition. Washington, D.C.: National Academy Press: Washington DC, 1–7.

Onyeneho, S. N., and Hettiarachchy, N. S. (1993): Antioxidant activity, fatty acids and phenolic acids composition of potato peels. *Journal of the Science of Food and Agriculture*, 62: 345–350.

Pagana, K.D. and Pagana, T.J. (1997): Mosby's diagnostic and laboratory test references. 3 rd ed., Mosby-year Book, Inc., New York.

Rdwan, H. and Elbassyouny, G. (2016). Nutritional and biochemical studies on obesity and its complications in population of Sharkia and Qalyubia governorates, Egypt. *Journal of Home Economics*, 26 (4): 1-31.

Rodriguez, D. S.; Hadley, M. and Holm, E. T. (1994): Potato peel waste: Stability and antioxidant activity of a freeze-dried extract. *Journal of Food Science*. 59(5): 1031–1033.

Salama, A.; Ghada M. Elbassyouny and Elhassaneen, Y. (2017): Studies on the antioxidant properties of vegetables processing by-products extract and their roles in the alleviation of health complications caused by diabetes in rats. *Proceeding of the 1st International Conference of the Faculty of Specific Education, Kafrelsheikh University, “Specific Sciences, their Developmental Role and Challenges of Labor Market”* PP 1-24, 24-27 October, 2017, SharmElSheikh, Egypt.

Sayed Ahmed, S. (2016): Nutritional and technological studies on the effect of phytochemicals on obesity injuries and their related diseases by using experimental animals Ph.D. Thesis in Home Economics (Nutrition and Food Science), Faculty of Specific Education, Port Said University, Egypt.

Sheela, C.; Kumud, K.; and Augusti, K., (1995): Anti-diabetic effects of onion and garlic sulfoxide amino acids in rats. *Planta Med.* 61: 356-357.

- Singh, R. P., Murthy, K. N.C. and Jayaprakasha, G. K. (2002):** Studies on the antioxidant activity of pomegranate peel and seed extracts using in vitro models. *Journal of Agricultural and Food Chemistry*, 50, 81–86.
- Taing, M.W.; Pierson, J.T.; Hoang, V.L.; Shaw, P.N., Dietzgen, R.G.; Gidley, M.J.; Roberts-Thomson, S.J. and Monteith, G.R., (2012) :** Mango Fruit Peel and Flesh Extracts Affect Adipogenesis in 3T3-L1 Cells. *Food & Function*, 3: 828-836
- Thyss, A.; Schneider, M.; Caldani, C.; Viot, M. and Bourry, J. (1985).***Br.J.Cancer*,52,183.
- Tietz, N.W. (1976):** *Fundamental of Clinical Chemistry*. Philadelphia, W.B. Saunders,P. 243.
- Van Hoorn, D. E.; Nijveldt, R. J. and Boelens, P. G. (2006):** Effects of preoperative flavonoid supplementation on different organ functions in rats. *J Parenter Enteral Nutr.*, 30(4):302-8.
- Vassault, A.; Grafmeyer, D.; Graeve, J.; Cohen, R.; Beaudonnet, A.; and Bienvenu, J. (1999):** Quality specifications and allowable standards for validation of methods used in clinical biochemistry. *Ann BiolClin (Paris)*. 57(6): 685-95.
- Velioglu, Y.S.; Mazza, G.; Gao, L. and Oomah, B.D. (1998):** Antioxidant activity and total phenolics in selected fruits, vegetables and grain products. *J. Agric. Food Chem.*, 46 (10): 4113-4117.
- Vettor, R.; Serra, R.; Fabris, R.; Pagano, C. and Federspil, G. (2005):** Effect of sibutramine on weight management and metabolic control in type 2 diabetes: a meta-analysis of clinical studies. *Diabetes Care*; 28(4):942-9.
- Voet, D. and Voet, J.G. (1990):** *Biochemistry*. John Wiley and Sons, Inc., New York.
- WHO (2006):** Report. Puska, P. Nishida, C. Porter, D .Obesity and overweight. Rome, Italy.
- WHO and Dini, L. (2006):** Strategic directions for improving nutritional status of populations using the lifecycle approach. Assignment Report.SEA-NUT-167.
- Young, L. Swinburn, B.(2002):** Impact of the Pick the Tick food information programme on the salt content of food in New Zealand. *Health PromotInt*, 17:13-19.



تأثير بعض النواتج الثانوية للصناعات الغذائية على مضاعفات مرض السمنة
المستحث في حيوانات التجارب

عمر امام^١، غادة البسيوني^١، يوسف الحسانين^٢، انتصار عبيد^١
^١ قسم الاقتصاد المنزلي، كلية التربية النوعية، جامعة بنها، بنها، مصر
^٢ قسم التغذية وعلوم الأطعمة، كلية الاقتصاد المنزلي، جامعة المنوفية، شبين الكوم، مصر

الملخص العربي:

تهدف الدراسة الى إستكشاف تأثير بعض النواتج الثانوية للصناعات الغذائية على مضاعفات مرض السمنة المستحث في حيوانات التجارب. تم تقسيم ثلاثون فأر (١٥٠-١٦٠ جم) إلى مجموعتين رئيسيتين، المجموعة الأولى (مجموعة ١، ٥ فئران) تم تغذيتها على الغذاء الأساسي (مجموعة ضابطة سالبة) والمجموعة الرئيسية الأخرى (٢٥ فأر) تم تغذيتها على نظام غذائي يسبب السمنة (DIO) لمدة ٨ أسابيع، تم تقسيمها فيما بعد إلى خمسة مجموعات فرعية على النحو التالي: المجموعة (٢) تم تغذيتها على غذاء (DIO) كمجموعة ضابطة موجبة، اما المجموعات (٣ - ٦) تم تغذيتها على غذاء DIO يحتوي على ٥٪ من مسحوق قشر البطاطس (PPP)، مسحوق قشر البصل الأصفر (YOSP)، مسحوق قشر الباذنجان (EPP) ومسحوق مخلوطهم، على التوالي. تغذية الفئران على نظام غذائي يسبب السمنة لمدة ثمانية أسابيع ادي إلى زيادة وزن الجسم عند مقارنتها بالمجموعة الضابطة وقد سجلت المجموعة الضابطة السالبة زيادة في الوزن مقدارها 188.02% ، في حين سجلت المجموعة الضابطة الموجبة زيادة في الوزن مقدارها 231.07% مقارنة بلحظة بداية التجربة. بينما استبدال دقيق القمح بنسبة ٥٪ من PPP, YOSP, EPP ومخلوطهم ادي الي انخفاض كبير في اوزان الفئران التي تعاني السمنة ، وذلك بنسب 193.04% and 209.56, 203.03, 217.04 على التوالي. أشارت النتائج أن السمنة ادت الي زيادة معنوية في كل من وظائف الكبد (AST بنسبة 33.88% ، 25.62% بنسبة ALT، ALP بنسبة 26.76% وظائف الكلى (حامض البوليك بنسبة 12.66% والكرياتينين بنسبة 15.69% والجلوكوز في مصل الدم بنسبة 31.54% مقارنة بالمجموعة الضابطة السالبة كما وجد ان التغذية على ٥٪ من PPP, YOSP, EPP ومسحوق مخلوطهم ادي الي تحسن ملحوظ في كل التقديرات السابقة وبنسب مختلفة. وقد سجلت افضل التأثيرات لمخلوط النواتج ثم مسحوق قشر البصل الاحمر، مسحوق قشر الباذنجان ومسحوق قشر البطاطس على التوالي. وخلصت الدراسة ان النواتج الثانوية لمصانع تصنيع الأغذية (الخضروات) لها انعكاسات مهمة للوقاية والعلاج المبكر من مضاعفات السمنة.

الكلمات المفتاحية: قشر الباذنجان - قشو البصل - قشر البطاطس - وزن الجسم - وظائف الكبد - وظائف الكلى مستوي الجلوكوز.

Journal of Home Economics, Volume 28, December (4), 2018