FAT BURNERS: TECHNOLOGICAL, CHEMICAL AND NUTRITIONAL STUDIES

حارقات الدهون: دراسات تكنولوجية وكيميائية وغذائية

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الملخص

هدفت الدراسة الى فتح افق جديدة لاستخدام بعض النواتج الثانويه لمصانع الصناعات الغذائية وهي قشور المانجووالبصل والطمام في تطبيقات التغذية العلاجيه من خلال دراسة حارقات الدهون دراسه تكنولوجية وكميائية وغذائية

تم تحضير مسحوق قشور المانجو (MPP) وقشور البصل (O SP) وقشور طماطم (TPP) وتحليلها لتكوينها الكيميائي والخصائص الفيزيائية والمركبات النشطة بيولوجيا والأنشطة المضادة للأكسدة.

تكونت العينه الفئران (ن = ٣٦ الفئران)، تم وضعهم فى غرفة فى درجه حراره ٢٥ ± ٢ C٠ للحفاظ عليها في ظل ظروف صحية طبيعية. تم تغذية جميع الفئران على النظام الغذائي القاعدي لمدة أسبوع واحد قبل بدء التجربةوبعد انقضاء اسبوع تم تقسيم العينة إلى مجموعتين رئيسيتين، المجموعة الأولى (٦ الفئران) المجموعه السالبة تتغذى على النظام الغذائي القاعدي.

المجموعة الرئيسية الثانية (٣٠ الفئران) تتغذى على نظام غذائي غنى بالدهون لاصابتها بالسمنه، والتي قسمت الى خمس مجموعات فرعية على النحو التالي:

المجموعة (١)، المجموعه الضابطه، مجموعة (٢)، تغذت على عليقه اساسيه تحتوى على ٥٪ قشور الطماطم؛ مجموعة (٣)، تغذت على عليقه اساسيه تحتوى على قشور البصل٥٪ ؛مجموعه (٤)، تغذت على عليقه اساسيه تحتوى على مسحوق٥٪قشورالمانجو ، مجموعة (٥)، على عليقه اساسيه تحتوى على خليط قشور (المانجو والبصل والطماطم)٥٪ بنسب متساويه.

وبعد انقضاء ٨ أسابيع بعد تغذية كل مجموعة حسب النوع المحدد لها تم جمع عينات الدم بعد ١٢ ساعة الصيام عن طريق الشريان الأورطي وتم تشريح الفئران تحت الأثير تخدير. تم تحليل عينات الدم عن الجلوكوز في الدم، ونسب الدهون في الدم ومضادات الأكسدة البيولوجية.

اشارت النتائج إلى:

١- ارتفاع محتوى المركبات الفينولية الكلية للنباتات المختبرة

٢- إضافة هذه المستخلصات إلى الوجبات الغذائية أدى إلى انخفاض وزن الجسم و دهون الكبد وتحسين مستوى سكر الدم وارتفاع نسبة مضادات الاكسده في الجسم.

الكلمات المفتاحية: حارقات الدهون – مضادات الاكسده –الاحماض االفينوليه – الكاروتينات

Abstract

The purpose of this study is to examine the evidence for a number of the most popular plant parts/ food processing by-products that are proposed to enhance fat burning have some research to support or not. The selected plant parts as fat burners study includes some technological, chemical and nutritional aspects.

Mango peel powder (MPP), onion skin powder (OSP) and tomato pomace powder (TPP) were prepared and analysis for their chemical composition, physical properties, bioactive compounds and antioxidant activities.

Rats (n=36 rats), were housed individually in wire cages in a room maintained at 25 ± 2 ^{0}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 (6 rats) still fed on basal diet and the other main group (30 rats) was feed with diet-induced obesity (DIO, product no.D1245, Research Diets, Inc. NJ, See Table 4) for 8 weeks which classified into five sub groups as follow:

group (1), fed on diet-induced obesity (DIO) as a positive control; group (2), fed on DIO containing 5 % MPP; group (3), fed on DIO containing 5 % OSP; group (4), fed on DIO containing 5 % TPP, group (5), fed on DIO containing 5 % mixture, MPP + OSP+ TPP by equal parts.

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 analyzed for serum glucose, blood lipid profile and biological antioxidants.

present study concluded that: high content of the total phenolic compounds of the different tested plantsKand the addition of these extracts to diets led to decrease in liver fat and improve immunity.

Keywords: Fat Burners - Antioxidants - Avinoic acids – Carotenoids

INTRODUCTION

Obesity is a complex disease that results from the inappropriate control of the body's energy balance due to overfeeding and/or a sedentary way of life. In this context,both hypocaloric diets (decreased energy intake) and increased physical activity (increased energy output) result in loss of body weight and body fat. With these traditional approaches to weight loss, potential therapeutic agents could be important tools in preventing and/or treating obesity and associated metabolic diseases. Although a number of pharmacological approaches have been investigated in recent years, few therapeutically effective and safe products have been developed (Jandacek Woods, 2004).&

In more recent history, the use of plants as medicines has involved the isolation of bioactive compounds, beginning with the isolation of morphine from opium in the early 19th century. For example, (Itokawa *et al.*, 2008) reported that many important bioactive compounds have been discovered from natural sources using bioactivity-directed fractionation and isolation. These bioactive compounds are mostly secondary plant metabolites, and many naturally occurring pure compounds have become medicine, dietary supplements, and other useful commercial products.

One of the most popular categories of nutrition supplements is often referred to as 'fat burners'. The reasons for the popularity of these supplements generally include the proposed improvements in health, improvements in performance, weight loss or a combination of these factors. The term 'fat burner' is used to describe nutrition supplements that are claimed to acutely increase fat metabolism or energy expenditure, impair fat absorption, increase weight loss, increase fat oxidation during exercise, or somehow cause long-term adaptations that promote fat metabolism (Venuto, 2013).

Scientists have identified thousands of phytochemicals, including flavonoids, glucosinolates (isothiocyanates and indoles), phenolic acids, phytates, and phytoestrogens (isoflavones and lignans), in vegetables, fruits, grains, legumes, and other plant sources. A vast variety of phytochemicals that are present in the daily human diet have been found to possess substantial antimutagenic and anticarcinogenic properties (Surh, 2002). The chemopreventive effects of the majority of edible phytochemicals are often attributed to their antioxidative or anti-inflammatory activities (Surh *et al.*, 2001).

Phenolic acids exhibit acidic properties due to the presence of the carboxylic acid group. Phenolic acids are aromatic econdary plant metabolites that are widely spread throughout the plant kingdom (Hsu and

Yen, 2008). Phenolic acids are present in plant-based foods such as fruits, vegetables, grains, tea, coffee, and spices, and are consumed by most humans every day. Hydroxybenzoic acids (C6–C1) and hydroxycinnamic acids (C6–C3) are phenolic acids that are predominantly found in plants. The estimated daily consumption of phenolic acids ranges from 25 mg to 1 g, depending on the diet. Most phenolic acids have shown excellent scavenging activity with respect to active oxygens such as superoxide anion radicals, hydroxyl radicals, and singlet oxygen. They have also been reported to exert antiinflammatory, antimutagenic, and anticarcinogenic activities (Crozier et al., 2009). Phenolic acids are currently being investigated for their potential anti-obesity activities. Some of them (gallic acid, capsaicin, curcumin, and coumaric acid) have anti-obesity properties.

Mango (Mangifera indica L.) is one of the major tropical fruits and the world's annual production is 25 MMT (FAO, 2004). As mango is a seasonal fruit, mango fruits are processed into various products such as puree, nectar, leather, pickles, canned slices, etc., which have worldwide popularity (Loelillet, 1994). Mango peel considered as a waste by-product which obtained it during processing of mango, huge amount of peel is generated, and its disposal is a major problem and causes environmental pollution. Peel constitutes about 15–20% of mango fruit.

Onions (Allium cepa L.) are the second most important horticultural crop worldwide, after tomatoes, with current annual production around 66 million tonnes. Over the past 10 years, onion production has increased by more than 25% (FAO, 2008). The main onion waste include onion skins, two outer fleshy scales and roots generated during industrial peeling and undersized malformed or damaged bulbs (Benitez et al., 2011).

Tomato juice represents one of the most important vegetable juice with respect to per capita consumption. Such as reported by (Otto and Sulc, 2001), about 3-7% of the raw material is lost as waste during tomato juice processing. Tomato pomace consists of the dried and crushed skins and seeds of the fruit (Avelino et al., 1997).

AIM OF STUDY

The purpose of this study is to examine the evidence for a number of the most popular plant parts/ food processing by-products that are proposed to enhance fat burning in some way and/or the supplements that have some research to support or not support their use. The selected plant parts as fat burners study includes some technological, chemical and nutritional aspects.

Materials and Methods

Biological Experiments

Material

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

Animals used in this study, adult male albino rats (140-160 g per each) were obtained from Research Institute of Ophthalmology, Medical Analysis Department, Giza, Egypt.

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 was that recommended by (Campbell, 1963) while the salt mixture used was formulated according to (Hegsted and Perkins 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=36 rats), were housed individually in wire cages in a room maintained at 25 ± 2 0C 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 6 rats) still fed on basal diet and the other main group (30 rats) was feed with diet-induced obesity (DIO, product no.D1245, Research Diets, Inc. NJfor 8 weeks which classified into five sub groups as follow: group (1), fed on diet-induced obesity (DIO) as a positive control; group (2, fed on DIO containing 5 % MPP; group (3), fed on DIO containing 5 % OSP; group (4), fed on DIO containing 5 % TPP, group (5), fed on DIO containing 5 % mixture, MPP + OSP+ TPP by equal parts.

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 -20oC until analysis.

Hematological analysis

Serum glucose

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

Blood lipids profile

Triglycerides (TG), Total cholesterol (TC) and HDL-Cholesterol were determined in serum using specific kits purchased from El-Nasr Pharmaceutical Chemicals Company, Cairo, Egypt. Low density lipoprotein cholesterol (LDL-c) and very low density lipoprotein cholesterol (VLDL-c) were assayed according to the equations of Fniedewald et al., (1972) as follow:

Very low density lipoprotein (VLDL cholesterol) = TG/5

LDL cholesterol = Total cholesterol – HDL cholesterol – V LDL cholesterol

Glutathione fractions

GSH and GSSG were determined by HPLC according to the method of McFarris and Reed (1987). In brief, 100 □l of aliquot were placed in 2 ml of 10% perchloric acid containing 1 mM bathophenanthroline disulfonic acid and homogenized. The homogenate was cold centrifuged at 10000 rpm for 5 min and the internal standard (γ-glutamyl glutamate) was added to the supernatant. A 250 □l aliquot of acidic extract was mixed with 100 □l of 100 mM iodoacetic acid in 0.2 mM cresol purple solution. The acid solution was brought to pH 8.9 by the addition of 0.4 ml of KOH (2 M) – KHCO3 (2.4 M) and allowed to incubate in the dark at room temperature for 1 hr to obtain S-carbooxymethyl derivatives. The N-nitrophenol derivatization of the samples were taken overnight at 4 0C in the presence of 0.2 ml of 1% 1-fluoro-2,4-dinitrobenzene and injected onto the HPLC system.

Statistical Analysis

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

RESULTS AND DISCUSSION

Technological, chemical and nutritional data

Proximate chemical composition of selected plant parts

***Table 1 Pro*ximate chemical composition (g.100g^{-1}) of selected plant parts**

Parameters	Onion skin powder (OSP)	Tomato pomace powder (TPP)	Mango peel powder MPP	Mixture (Mix)
Moisture	7.08 ± 1.55 ^{ab}	8.15 ± 1.15^{a}	7.91 ± 0.83 ^{a}	7.62 ± 1.76 ^{ab}
Total protein	4.11 ± 1.11 ^{b}	5.16 ± 0.96 ^{a}	3.52 ± 1.05 ^{b}	4.43 ± 0.85 ^{ab}
Crude fat	9.74 ± 1.43 ^{a}	1.92 ± 0.56 ^{c}	2.26 ± 0.43 ^{c}	4.64 ± 0.87 ^{b}
Crude fiber	20.42 ± 2.87 ^{c}	21.98 ± 2.65 ^{c}	33.17 ± 5.22 ^{a}	24.98 ± 4.36 ^{b}
Ash	5.43 ± 0.98 ^{a}	2.99 ± 0.87 ^{c}	3.87 ± 0.80 ^{ab}	4.65 ± 1.03 ^{a}
Carbohydrates (by difference)	53.22 ± 5.02 ^{b}	59.80 ± 4.11 ^{a}	49.27 ± 3.66 ^{c}	53.68 ± 4.01 ^{b}

Each value represents the mean of ten replicates ±SD. Mean values with the different superscript letters in the same raw mean significantly different at level p≤0.05. Mix, mixture of OSP, TPP and MPP by equal parts.

Physical properties of selected plant parts

Table 2. Physical properties of selected plant parts

arameters	Onion skin powder (OSP)	Tomato pomace powder (TPP)	Mango peel powder MPP	Mixture (Mix)
Water holding capacity (WHC, g $H_2O.g^{-1}$)	8.15 ± 2.09 ^{c}	9.95 ± 0.98 ^{b}	11.65 ± 0.63 ^{a}	8.95 ± 1.04 ^{c}
Oil holding capacity (OHC, g oil.g^{-1})	2.81 ± 0.43 ^{ab}	2.97 ± 0.19 ^{a}	2.90 ± 0.42 ^{a}	2.88 ± 0.40 ^{a}

Each value represents the mean of ten replicates ±SD. Mean values with the different superscript letters in the same raw mean significantly different at level p≤0.05. Mix, mixture of OSP, TPP and MPP by equal parts.

Total carotenoids and phenolics contents of selected plant parts

Table 3. Total carotenoids and phenolics contents of selected plant parts

Each value represents the mean of ten replicates ±SD. Mean values with the different superscript letters in the same raw mean significantly different at level p≤0.05. Mix, mixture of OSP, TPP and MPP by equal parts.

Parameters	Onion skin powder (OSP)	Tomato pomace powder (TPP)	Mango peel powder MPP	Mixture (Mix)
Total carotenoids (mg.100g^{-1})	101.65± 11.65 [d]	149.45± 5.76 [c]	397.65 ± 14.97 [a]	218.40 ± 10.65 [b]
Total phenolics (mg GAE.100 g^{-1})	5332 ± 198 [a]	2413 ± 201 [c]	3752 ± 321 [b]	3298 ± 129 [b]

Antioxidant activities of selected plant parts

Table 4. Antioxidant activity of selected plant parts

Samples	Antioxidant value[a] AOX (A/h)	Antioxidant activity[b] AA (%)	Oxidation rate ratio[c] (ORR)	Antioxidant activity coefficient[d] (AAC)
Onion skin powder (OSP)	0.029 ± 0.017	94.95±5.99	0.050±0.036	822.98±88.55
Tomato pomace powder (TPP)	0.041± 0.012	92.68±7.45	0.073±0.027	783.51± 84.31
Mango peel powder (MPP)	0.044 ± 0.019	90.93±3.64	0.078±0.13	774.65±43.76
Mixture (Mix) [F]	0.020 ± 0.016	96.45±13.30	0.035±0.029	849.05±91.39
Control	0.565±0.0723	0.00±0.00	1.000±0.116	0.00±0.00
a-toc, 50 mg/L	0.006±0.002	98.90±13.64	0.011±0.001	891.65±95.94
BHT, 50 mg/L	0.35±0.012	93.86±12.94	0.061±0.017	804.03±70.45

[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.**

[F] **Mix, mixture of OSP, TPP and MPP by equal parts.**

The decrease in absorbance of β-carotene in the presence of different methanolic selected plant parts extracts (and well-known antioxidants used as standards) with the oxidation of β-carotene and linoleic acid is shown in Table (4) Such data indicated that mixture of the selected plant parts (Mix) recorded the lowest decreasing followed by OSP, TPP and MPP. The values of Mix and OSP absorbances throught 120 min are coming well i.e. closing the line of 50 mg α-tocopherol and up to the line of 50 mg /L of butyhydroxy toluene (BHT) followed by the rest of the selected plant parts. These data proved the high stability of the all selected plant parts when comparing with that more common standards α-tocopherol and BHT. The present data are in accordance with the obtained by Ghaly, (2004), Elhassaneen & Abd Elhady, (2014)& Sayed-Ahmed, (2016) who studied the AA stability of many plant parts extracts commonly distributed in the Egyptian local markets.

Biological data

The effect of selected plant parts on body weight of obese rats

Table 5. The effect of food processing by-products applied in bread on body weight gain (g) of obese rats*

Groups	Feeding period (weeks)								
	0	1	2	3	4	5	6	7	8
Control (-) Std diet	151.56	167.14	179.04	195.48	221.60	254.46	270.47	281.40	289.00
Control (+) Obese	151.56	202.76	229.59	255.70	281.28	330.68	354.01	372.29	383.66
MPP	151.56	193.90	206.93	223.64	257.99	300.29	313.45	333.87	342.03
OSP	151.56	177.81	199.23	206.30	240.57	284.78	296.56	308.19	323.44
TPP	151.56	184.66	203.07	216.86	255.85	289.52	305.22	320.29	336.31
Mix	151.56	177.14	190.65	205.34	232.80	260.50	285.31	296.85	311.42

***MPP, mango peels powder; OSE, Onion skin powder; TPP, Tomato pomace powder and Mix, mixture extract of MPP, OSE and TPP by equal parts.**

Effect of selected plant parts on serum glucose concentration of obese rats.

Table 6. Effect of selected plant parts on serum glucose concentration (mg/dL) of obese rats*

Value	Control (-) Std diet	Control (+) Obese diet	Plant parts powder (5%, w/w)			
			MPP	OSP	TPP	Mix
Mean	92.67 ^{e}	113.55^{a}	107.56 ^{b}	101.54 ^{bc}	105.03 ^{bc}	96.52 ^{d}
SD	3.23	5.09	5.11	6,87	4.21	5.32
% of Change	0.00	22.53	16.07	9.57	13.34	4.15

*** MPP, mango peel powder; OSE, Onion skin powder; TPP, Tomato pomace powder and Mix, mixture extract of MPP, OSE and TPP by equal parts. Means in the same row with different superscript letters are significantly different at p≤ 0.05.**

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, onion peel extract 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. Onion peel extract 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. These findings provide a basis for the use of onion peel to improve insulin insensitivity in type 2 diabetes. The same behaviors were recorded for MPP which rich by phenolic compounds and carotenoids (Sayed Ahmed, 2016).

Effect of selected plant parts on plasma glutathione fractions concentration of obese rats

Table 7. Effect of selected plant parts on blood lipids profile concentration of obese rats[*]

Value	Control (-) Std diet	Control (+) Obese diet	Plant parts powder (5%, w/w)			
			MPP	OSP	TPP	Mix
Triglycerides (TG, mg/dL)						
Mean	54.41 ^{c}	75.19 ^{a}	66.9 ^{a}	59.23 ^{b}	61.65 ^{b}	58.68 ^{b}
SD	3.11	7.95	6.04	5.76	5.11	4.87
% of Change	0.00	38.19	22.96	8.86	13.31	7.85
Total cholesterol (TC, mg/dL)						
Mean	115.19 ^{d}	150.73 ^{a}	141.78	128.55 ^{c}	136.11	125.26 ^{c}

			b		b	
SD	8.54	12.34	7.78	7.09	6.98	7.91
% of Change	0.00	30.85	23.08	11.60	18.16	8.74
High density lipoprotein (HDL, mg/dL)						
Mean	48.73 a	27.01 d	33.26 c	38.98 b	35.49bc	41.30 b
SD	5.11	3.23	3.65	2.88	5.18	5.87
% of Change	0.00	-44.57	-31.75	-20.01	-27.17	-15.25
Low density lipoprotein (LDL, mg/dL)						
Mean	55.58 d	108.68 a	95.14 b	77.72	88.29 c	72.22 d
SD	6.09	6.00	5.63	7.14	4.87	6.21
% of Change	0.00	95.55	71.18	39.85	58.86	29.95
Very low density lipoprotein (VHDL, mg/dL)						
Mean	10.88 abc	15.04 a	13.38 a	11.85 ab	12.33 ab	11.74 ab
SD	3.09	2.83	1.14	4.11	2.17	3.05
% of Change	0.00	38.19	22.96	8.86	13.31	7.85

***MPP, mango peel powder; OSE, Onion skin powder; TPP, Tomato pomace powder and Mix, mixture extract of MPP, OSE and TPP by equal parts. Means in the same row with different superscript letters are significantly different at p≤ 0.05.**

In recent years, however, the possible hypocholesrerolemic effects of several dietary components, such as found in our selected plant parts (OSP, TPP and MPP) including, flavonols, phenolic acids, anthocyanins, alkaloids, carotenoids, phytosterols and organosulfur compounds etc have attracted much interest. Also, phenolic compounds found in such plant parts exerts its beneficial effects on cardiovascular health by antioxidant and anti-inflammatory activities (Anonymous, 1998; Kuhlmann *et al.*, 1998, & Sayed Ahmed, 2016).

Effect of selected plant parts on plasma glutathione fractions concentration of obese rats

Table 8 Effect of selected plant parts on plasma glutathione fractions concentration of obese rats*

Value	Control (-) Std diet	Control (+) Obese diet	Plant parts powder (5%, w/w)			
			MPP	OSP	TPP	Mix
Reduced glutathione concentration (GSH, µmol /L)						
Mean	11.87 a	7.38 c	8.59 b	10.11 a	9.35 ab	10.54 a
SD	1.02	1.14	0.76	0.93	0.69	1.11
% of Change	0.00	-37.83	-27.63	-14.83	-21.23	-11.20
Oxidized glutathione concentration (GSSG, µmol /L)						
Mean	1.01 a	0.80 b	0.86 b	0.89 a	0.84 ab	0.92 a
SD	0.65	0.49	0.17	0.32	0.28	0.36
% of Change	0.00	-20.79	-14.85	-11.88	-16.83	-8.91

GSH/GSSG ratio						
Mean	**11.75 [a]**	**9.23 [b]**	**9.99 [b]**	**11.36 [a]**	**11.13 [a]**	**11.46 [a]**
SD	**0.58**	**0.98**	**1.15**	**1.09**	**1.11**	**0.73**
% of Change	**0.00**	**-21.51**	**-15.01**	**-3.34**	**-5.29**	**-2.52**

*** MPP, mango peel powder; OSE, Onion skin powder; TPP, Tomato pomace powder and Mix, mixture extract of MPP, OSE and TPP by equal parts. Means in the same row with different superscript letters are significantly different at p≤ 0.05.**

A fall in glutathione fractions observed in obese rats group generally accompanied by a concomitant decreased in the ratio of GSH/GSSG. Di Giulio (1991) mentioned that a more fundamental effect of oxyradical-generating compounds as the obesity development, however, is their effect on what can be referred to as the redox status (GSH/GSSG) of cells or tissues. Few studies have been addressed directly the issue of effects of pro-oxidants on redox status. Elhassaneen *et al*., (2004) mentioned that increased fluxes of oxyradicals might be decreased in the GSH/GSSG ratio, due either to direct radical scavenging or to increased peroxidase activity. This effect could also occur indirectly due to reduced NADPH availability [necessary for glutathione reductase (GSH-Rd) activity] resulting, for example, from oxidations in the first step of the redox cycle (Champe and Harvey, 1994 and Bedard, & Krause, 2007).

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Summary

The study was conducted to investigate the effect of some secondary products of plant parts on body fat and was used in the experiment (tomato pomace, onion skin, mango peel and mixture of them) at a concentration of 5%

The experiments were designed as follow:

Mango peel powder (MPP), onion skin powder (OSP) and tomato pomace powder (TPP) were prepared and analysis for their chemical composition, physical properties, bioactive compounds and antioxidant activities.

Rats (n=36 rats), were housed individually in wire cages in a room maintained at 25 ± 2 ^{0}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 (6 rats) still fed on basal diet and the other main group (30 rats) was feed with diet-induced obesity (DIO, product no.D1245, Research Diets, Inc. NJ, See Table 4) for 8 weeks which classified into five sub groups as follow:

group (1), fed on diet-induced obesity (DIO) as a positive control; group (2), fed on DIO containing 5 % MPP; group (3), fed on DIO containing 5 % OSP; group (4), fed on DIO containing 5 % TPP, group (5), fed on DIO containing 5 % mixture, MPP + OSP+ TPP by equal parts.

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 analyzed for serum glucose, blood lipid profile and biological antioxidants.

Results indicated that;

The results showed the high content of the total phenolic compounds of the different tested plants, which ranged from 189.81: 51.66, the highest of which was the content of the onion peel extract and the lowest in tomato flour.

.Extracts were proven to inhibit the oxidation of low density lipoproteins

Biological experiments The results showed that the addition of these extracts to diets led to a decrease in liver fat and improve immunity and therefore recommends the study to benefit from those parts.