



EVALUATING THE SAFETY AND EFFICACY OF THE TRADITIONAL USE OF OLIVE LEAVES DECOCTION AS ANTIHYPERTENSIVE AGENT IN ELDERLY PEOPLE

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Abstract

Olive leaves extract (OLE) can be obtained as bio-waste and is extensively used as a food supplement and an over-the-counter drug for its beneficial effects. Dried olive leaves decoction is rich in water-soluble phenolic compounds. A prophylactic blood pressure lowering action of the olive leaves extract has been shown in a preclinical study with rats. The current study aimed at measuring this effect in humans. Prospective, observational study. All subjects were selected from Beni Suef University Hospital. The current study includes hypertensive patients with age above 50 years old classified into 2 groups. Group I: Normal control group consists of healthy volunteers. Group II: Hypertensive group includes hypertensive patients. Each group includes 20 subjects (n=20) divided into (male and female) subjects. In the current study, each group was taken a specific dose of Olive leaves tea for 8 weeks treatment. The present study revealed that a significant reduction in readings of systolic and diastolic blood pressure had happened for patients who took olive leaves tea for two months. As well as a reduction in serum lipid profile including TG, cholesterol, HDL and LDL significantly over a p value of 0.05 or less ($p \leq 0.05$) when compared to healthy group. Our data support previous research, suggesting that olive leaf intake engenders hypotensive and lipid-lowering effects.

Key words: Olive leaves tea, hypertensive patients, lipid profile, phenolic compounds.

Introduction

Olea europaea consider the most ancient trees in the Mediterranean region. Olive leaves, an agricultural by-product waste that obtained at the harvesting process of olive fruits, contain a considerable amount of bio-phenols (Sahin & Bilgin, 2018).

The leaves olive trees are available All the year, they accumulate at the clipping of the olive trees and estimated by (about 25kg of leaves byproducts/tree) each year also found in olive oil industries in large amounts after separate it from fruits before the processing. Several studies report that olive leaves decoction have anti-hypertensive, antioxidant activity, lipid-lowering activity, anti-

proliferative, hypoglycemic and apoptotic effects, Olive Leaf Tea is the solution for us, if we are seeking for green tea alternative, without caffeine and with numerous health benefits (Basuny & Arafat, 2018).

Olive leaves tea is used as a food supplement in the traditional medicine and an over-the-counter drug as it provides a variety of beneficial effects, as anti-inflammatory and anti-atherosclerotic ones (Bulotta *et al.*, 2014; Sahin & Bilgin, 2018). There are recent studies dealing with the potentials effects of olive leaves decoction on blood pressure and plasma lipids (Romero *et al.*, 2016).

The reactive oxygen species (ROS) imbalance produces damage to the other healthy tissue (Bryan *et al.*, 2012; Schreml *et al.*, 2010). The efficient strategy to

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counteract the ROS effects is by using the antioxidant molecules. In several experimental models olive leaves decoctions and extracts are considered antioxidants that provide a protective effect against oxidative stress generated by ROS by scavenging the free radicals, increasing the antioxidant genes expression and preventing lipid peroxidation (Ahmadinejad, Geir Møller, Hashemzadeh-Chaleshtori, Bidkhorji, & Jami, 2017; Kurutas, 2015). Olive leaves decoction contains active components that have a potential antioxidant effect. These properties may be related to the donation of H-atom from the phenolic groups content of the olive leaves decoction or extract.

Dried olive leaves is rich in phenolic compounds which are water-soluble, specifically oleuropein by about 17%, the remaining compounds like apigenine-7-O-glucoside, luteolin-7-O-glucoside, caffeic acid and quercetin are contained in smaller amounts (Susalit *et al.*, 2011). Many studies indicate the polyphenol olive derivatives therapeutic effects such as oleuropein and tyrosol, on vascular and endothelial functions (De la Ossa *et al.*, 2019; Lockyer, Rowland, Spencer, Yaqoob, & Stonehouse, 2017).

Other studies mentioned the polyphenols concentrations in olive leaves by (23.29 mg GAE/g), of which oleuropein concentration accounted for 14.69 ± 0.92 mg/g of olive leaves decoction corresponding to 1.47% (w/w%) and luteolin 7-O-glucoside with a lower concentration of 3.60 ± 0.25 mg/g of olive leaves decoction, corresponding to 0.36% (w/w%) (De la Ossa *et al.*, 2019). Historical doses of olive leaves as a herbal tea according to some sources: 5g of dried leaves or 10g fresh leaves in 150 ml of boiling water as herbal decoction 2 times daily (morning and evening). Decoction time: allow to simmer to reach 100 ml of decoction, also, dried leaves 6-10 g herbal substance as herbal infusion up to 3 times daily. Other references mentioned a daily dose of 6-30 g according to European Medicines Agency; 31 January 2017.

Hypertension is one of the most common and important disease caused by the modern lifestyle, in particular by limited physical activity and an unhealthy diets. It may develop without notice and may aggravate other possible fatal diseases such as cardiovascular diseases (CVD) or chronic heart failure (CHF). The CVD risk could increase gradually throughout the blood pressure range, beginning from 115/75 mmHg; levels exceeding 140/90 mm Hg need intervention (Appel *et al.*, 2006). So, hypertension should be totally controlled and treated precociously. However, recommendations to change the life style as first-line treatment alone often fail in early

disease stages and/or asymptomatic period of the disease. On the other hand, most antihypertensive drugs like β -blockers, ACE inhibitors, calcium blockers or diuretics at common doses have significant side effects (Sweetman, 2009), which causes difficulty in their use in mild hypertension forms. A possible alternative treatment of hypertension may consist of food supplementation with active and beneficial ingredients from natural products with better effects on blood pressure. Since ancient times the olive tree and its leaves in particular have been used for the treatment of diabetes, gout, wounds, fever, atherosclerosis and hypertension. *In vivo* assays verify the power of olive leaves to lower the blood pressure. A prophylactic blood pressure lowering effect of olive leaves decoction has been shown in a preclinical study in rats treated with L-NAME (Khayyal *et al.*, 2002). Cholesterol-lowering actions and Antihypertensive effects of the olive leaves decoction have been confirmed in humans (Sahin & Bilgin, 2018).

This current study aimed at measuring and confirming the extent of this effect in humans and evaluating the safety of using olive leaf tea in treating hypertensive patients. So this experiment was designed to examine the effect of olive leaf tea on blood pressure (BP), lipids and a range of related clinical analysis in the designed group of the hypertensive patients.

Materials and Methods

Source of Olive leaves: The ripe olive leaves (*Olea europaea*) Koronkii variety were collected during the pruning process in 2019 year from a farm in 'Beni-Suef' governorate.

Source of chemicals: We use the commercially available enzyme kits for measuring Total Cholesterol, Triglycerides and HDL and other clinical measurements; all chemicals are purchased from (Spectrum Diagnostics, Cairo, Egypt. MDSS GmbH, Schiffgraben 41, 30175 Hannover, Germany).

Olive leaves tea preparation: For the olive leaves tea preparation, green olive leaves were collected, dried and stored until use. Each dose of olive leaves were cut into small pieces and packed in a bag contains 10 gram dried olive leaves. To be ready for use each tea bag was boiled for 5 to 10 minutes in drinking water.

Total polyphenol content: The levels of total polyphenols of fresh crude juice were determined according to the method of Gutfinger (1981). Caffeic acid was a standard compound in the preparation of the calibration curve.

Analytical characterization of the Olive leaves

extract and isolated fractions: The olive-tree leaves extract was analytically characterized by RP-HPLC-ESI-TOF/MS, performed in an Agilent 1200-HPL system (Agilent Technologies, Waldbronn, Germany) of the Series Rapid Resolution equipped with an auto sampler, a binary pump a vacuum degasser and a UV-vis detector. The chromatographic separation was done as reported (Quirantes Piné *et al.*, 2013).

The extract was injected at 1 mg/mL concentration of. The separated compounds were monitored by a mass-spectrometry detector. Mass-spectrometry was done using a micro-TOF (Bruker Daltonik, Bremen, Germany), with an ESI interface (model G1607A, Agilent Technologies, Palo Alto, CA, USA) operating in the negative-ion mode. The optimum source values and transfer parameters were described (Lozano-Sanchez *et al.*, 2010). The software Data Analysis 3.4 (Bruker Daltonik) was used in detecting the accurate mass data for the molecular ions. The phenolic composition of the study product represented in table 1.

Experimental design: This was a prospective, observational study. All subjects were selected from Beni Suef University Hospital suffering from hypertension with age above 50 years old and classified into 2 groups: Group I (gp1): Normal control group consists of healthy volunteers. Group II (gp2): Hypertensive group includes hypertensive patients. Each group includes 20 subjects (n=20) divided into (male and female) subjects. In the current study, each group was taken a specific dose of Olive leaves tea for 8 weeks treatment. In the experiment, **Table 1:** Phenolic contents as caffeic acid of olive (Decoction 1 and Decoction 2).

Oliveleaves	Phenolic contents (ppm)	
Decoction 1 (boiling for 10 min)	510.00	
Decoction 2 (boiling for 5 min)	500.00	
	Decoction1	Decoction2
Quercetin	3.00	2.70
Caffeic acid	7.30	8.00
Gallic acid	5.20	5.51
Apigenin	6.50	5.30
Chlorogenic acid	6.20	5.42
Ferulic acid	5.77	6.50
Cinamic acid	10.32	9.22
P-coumaric acid	9.50	6.30
P- hydroxy benzoic acid	19.07	18.50
Tannic acid	12.11	10.30
Hydroxy tyrosol	27.30	25.60
Vanillic acid	9.30	16.70
Tyrosol	25.50	31.20
Oleurobin	39.01	34.91
Gallic acid	0.07	0.00

the hypertensive group and the healthy control group were given a specific dose of olive leaves tea twice daily with a meal, one in the morning and the other in the evening and advice on how hypertension may be ameliorated by an adequate lifestyle. Blood pressure and heart rate were measured at baseline screening and after each week until the end of the study. Bodyweight, body mass index, abdomen circumference, blood glucose, blood lipids, kidney function tests and liver function tests was also measured at baseline screening and after 8 weeks of treatment. Adverse effects were observed and if present, recorded during the study.

Study population. The study population consisted of 40 subjects aged between >50 and less than 75 years with an untreated blood pressure. Hypertensive patients' stage II (patients a systolic blood pressure (SBP) \geq 140 mm Hg or diastolic blood pressure (DBP) \geq 90 mm Hg according to new ACC and American Heart Association (AHA) guidelines 2017. All the patients gave written informed consent prior to the inclusion into the study.

Biochemical measures: Blood samples were drawn after a fasting of not less than 12 h. Blood samples for the measurement of liver function tests, kidney function tests and lipid profile concentrations were collected in tubes with no additives and allowed to coagulate at room temperature for 30 min. Blood samples were separated by centrifugation (10 min, 3000 rpm) and kept at -20°C until they were analyzed. Alanine aminotransferase (ALT), Aspartate aminotransferase (AST), UREA, Creatinine, serum total cholesterol (TC), triglyceride (TG) and highdensity lipoprotein (HDL) were measured by a commercially available mentioned enzyme kit. Low density lipoprotein (LDL) was determined using the Friedewald equation: $\text{LDL} = \text{TC} - \text{HDL} - \text{TG}/5$ (Friedewald *et al.*, 1972). Weight was measured for patients with no shoes, light clothing, by a scale up to the nearest of 0.5 kg. Height was measured for all the participants in stocking feet using a ruler at the apex of the head. Blood pressure was measured for all subjects using a cuff and analog sphygmomanometer and the patient comfortably seated for a 10 minutes before the first measurement. Blood pressure was measured for all participants three times and the mean of it were recorded.

Statistical methods: All analyses were done using SPSS statistical software package version 25 (IBM) and graphics utilizing MS Excel. All continuous data were expressed as mean \pm SD, categorical data were expressed as frequency in tables. P-value $<$ 0.05 is considered significant *i.e.* 95% confidence interval is used. All key variables were varied through standard deviations or reasonable ranges. The analyses were performed using

Microsoft Excel 2010 program.

Results and Discussion

Total polyphenol content

Table 1 shows the poly-phenolic content of olive leaves. The concentrations of total phenols as determined by the Folin-Ciocalteu method varied from 500 to 510 ppm as caffeic acid. The highest phenolic content was presented in olive leaf (Oleurobin 39.01 ppm) followed by (Hydroxy tyrosol 27.30 ppm). Fractionation of phenolic compounds by HPLC technique was used to identify the major phenolic compounds in the olive leaves. The fractionation was based on comparisons of the chromatographic retention time and UV absorbance spectra of compounds in olive leaves with of authentic standard. Data of HPLC analysis of the olive leaves were made up of 15 compounds. The main phenolic compounds of olive leaves were found Oleurobin, hydroxytyrosol, tyrosol and p-hydroxyl benzoic acid.

We can use the waste leaves of the olive tree to extract and represent a valid source of polyphenols. Several studies are currently evaluating the possible applications of olive leaves extracts, as a food supplement for nutrition and as a pharmaceutical agent, used for cardiovascular diseases. Also other effects as the cytoprotective and antioxidant effects of olive leaves extract have been discovered at the endothelium level. This has a great importance as tissue damage at the vascular wall will lead to stress in the vascular endothelium and causes complications in the vascular system by the effect of oxidative stress (De la Ossa *et al.*, 2019). Chronic oral administration of olive leaves decoction improved endothelial dysfunction, vascular inflammation, vascular oxidative stress, cardiac and renal hypertrophy and

reduced high BP in genetic hypertension (Romero *et al.*, 2016). In vivo assays verify that olive leaves lowers the blood pressure (Sahin & Bilgin, 2018).

Effect of olive leaves decoction on blood pressure

During the study period, blood pressure changed significantly. The mean systolic (sys.) difference reached up to 3.6 mmHg for the control healthy group and up to 22 mmHg for the hypertensive group after 8 weeks of treatment Fig. 1. Concurrently, the average diastolic (dias.) difference in both groups also reached a maximum, amounting to 1.45 mmHg for the control healthy group and up to 14.5 mmHg for the hypertensive group after 8 weeks of treatment. After 8 weeks of treatment, the mean blood pressure had decreased from baseline in the control healthy group (systolic: 117.75 ± 3.4 vs. 121.3 ± 4.6 , $p < 0.001$; diastolic: 76.75 ± 3.8 vs. 78.2 ± 2.1 , $p < .001$; $n = 20$) and significantly decreased in the hypertensive group (systolic: 132.9 ± 5.2 vs. 155 ± 7.2 , $p < 0.001$; diastolic 81 ± 3.3 vs. 95.5 ± 4.8 , $p < 0.001$; $n = 20$). So there is a significant difference in the blood pressure measurement before and after treatment for the hypertensive group.

This study confirmed the antihypertensive as well as the cholesterol lowering effect of the olive leaves extract EFLA®943 in rats treated with L-NAME (Khayyal *et al.*, 2002). The results also correspond to the results found with an aqueous extract from leaves of *Olea europaea* L. in patients suffering from essential hypertension (Cherif *et al.*, 1996). Moreover, the intake of olive leaves tea twice/day during 8 weeks was shown to be clearly superior to recommendations for lifestyle changes alone in subjects with hypertension.

These results also match two previous studies; which resulted in mean reductions in systolic and diastolic blood pressure of 13 and 5 mmHg, respectively, in pre-hypertensive MZ twins (Perrinjaquet Moccetti *et al.*, 2008) and 12 and 5 mmHg, respectively, in hypertensive patients, a magnitude of effect was similar to that of Captopril drug, a common anti-hypertensive used drug (Susalit *et al.*, 2011). In a further study, a dose of 51 mg oleuropein/day induced no significant reductions in BP (de Bock, Derraik, *et al.*, 2013), although this study tested olive leaves extract capsules, which may be less bioavailable than the liquid used in the current study (De Bock, Thorstensen, *et al.*, 2013).

Studies found an evidence for antihypertensive and lipids lowering effects of olive leaves and oil also in man (Psaltopoulou *et al.*, 2004). However, both actions are well-studied in rats (Bennani-Kabchi *et al.*, 2000), for which they were hypothesized to result from a combination of different effects from several active compounds of

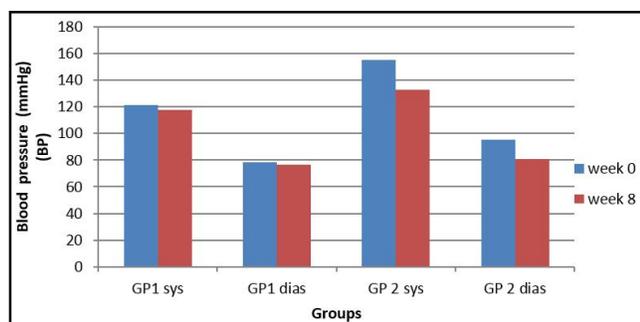


Fig. 1: The change in blood pressure (mmHg) during the study. Week 0: At the beginning of the experiment. Week 8: At the end of experiment.

GP1: Group 1, GP2: group 2.

Sys. : Systolic blood pressure , dias. : Diastolic blood pressure.

olive leaves (Khayyal *et al.*, 2002). To our knowledge this is the first study dealing with olive leaves tea as a treatment of hypertension in humans.

Other bioactives other than polyphenols, such as minerals, squalene and, triterpenoids such as oleanolic, ursolic and maslinic acids (Tsimidou & Papoti, 2010), could have been responsible for the observed blood pressure effects, thus pointing towards a different mechanism of action besides nitric oxide. As for African olive leaves

cultivars which are rich in triterpenoids and poor in polyphenol have been reported that it improve insulin resistance and prevent hypertension and atherosclerosis in Dahl salt-sensitive rats (Somova, Shode, Ramnanan, & Nadar, 2003).

Effect of olive leaves decoction on Lipid profile

Lipid profile levels showed a decrease in its values during the course of the experiment in the two groups Fig. 2. Fig. 2 showed the change in lipid profile (mg/dl)

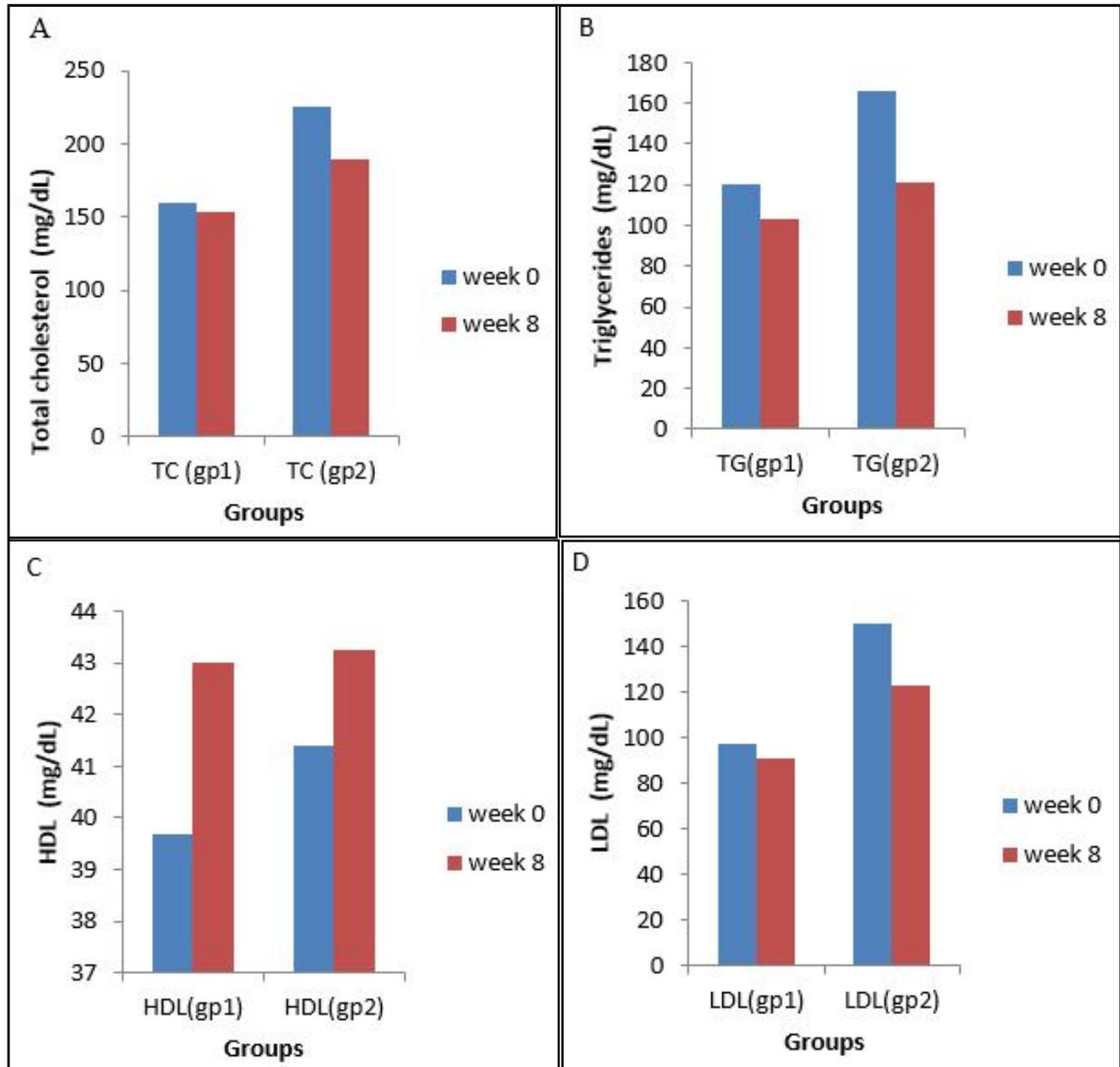


Fig. 2: The change in Lipid profile (mg/dl) during the study.
 A: The change in total cholesterol (TC) (mg/dl) during the study.
 B: The change in triglycerides (TG) (mg/dl) during the study.
 C: The change in high-density lipoprotein (HDL) (mg/dl) during the study.
 D: The change in low-density lipoprotein (LDL) (mg/dl) during the study.

and contains A: The change in total cholesterol (TC) (mg/dl), B: The change in triglycerides (TG) (mg/dl), C: The change in high-density lipoprotein (HDL) (mg/dl) and D: The change in low-density lipoprotein (LDL) (mg/dl) during the study.

With the more pronounced effects than on blood pressure, olive leaves decoction intake was also associated with an improvement in lipid profile with a physiologically significant reductions in total cholesterol (TC), Low-density lipoprotein cholesterol (LDL) and triglycerides (TG).

The mean lipid profile measurement had decreased from baseline in the control healthy group as follow (Total cholesterol 132.95 ± 25.4 vs. 162.75 ± 24.3 , $p < 0.001$; TG: 91.20 ± 8.3 vs. 110.90 ± 10.3 , $p < 0.001$; LDL 71.6 ± 26.1 vs. 100.8 ± 25.4 , $p < 0.001$; $n = 20$) and an increase in HDL by (43.10 ± 4.6 vs. 39.75 ± 5.2 , $p < 0.004$) and significantly decreased in the hypertensive group (Total cholesterol 190 ± 28.3 vs. 224.9 ± 43.9 , $p < 0.001$; TG: 120.8 ± 20.7 vs. 165.85 ± 45 , $p < 0.001$; LDL 122.5 ± 26.3 vs. 150.2 ± 37.5 , $p < 0.001$; $n = 20$) and an increase in HDL by (43.25 ± 3.7 vs. 41.45 ± 5.4 , $p < 0.027$). The average TC, TG, LDL, HDL difference in both groups reached a maximum, amounting to 29.8, 17.9, 29.2, 3.3 mg/dL respectively for the control healthy group and up to 34.9, 45.05, 27.6, 1.8 mg/dL respectively for the hypertensive group after 8 weeks of treatment. So there is a significant difference in the lipid profile measurement before and after treatment for the hypertensive group.

Regarding to the data from a meta-analysis of population based prospective cohort studies report that an increase in TG by 88.5 mg/dL results in a 32 % CHD risk increase (Trialists, 2012). On this basis, consumption of olive leaves decoction at the dose provided in our study may promote a 16 % CHD risk reduction.

Data for the effects of olive leaves extract on lipid profile have been somewhat inconsistent. As, in a study, a 200 mg/day dose of oleuropein intake resulted in a 23.2 mg/dl decrease in TC, a 15.46 mg/dl decrease in LDL and no change in TG relative to healthy lifestyle advice alone after 8 weeks, whilst a 100 mg/day dose resulted in no significant effects on lipid profile (Perrinjaquet Moccetti *et al.*, 2008), whereas a larger study ($n = 148$) found less efficacious changes of 5.8 mg/dl in TC, 3.8 mg/dl in LDL-C and 5.02 mg/dl in TG (Susalit *et al.*, 2011). Another study reported decreases of 26.29, 34.8 and 4.16 mg/dl in TC, LDL-C and TG, respectively (with a non-significant increase in HDL), after twelve months of taking a supplement containing a dose of 100 mg oleuropein (Whitworth, 2003), providing an evidence of

sustained effects over the time. Individual differences in the absorption and metabolism of OLE phenolics could be responsible (De Bock, Thorstensen, *et al.*, 2013).

The mechanisms involved in the lipid-lowering effects of olive leaves decoction are presently unknown. However, animal data studies suggest that the consumption of olive leaves decoction rich in phenolic components appears to decrease the activities of 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA) reductase and acetyl-CoA cholesterol acyltransferase (ACAT) the main key cholesterol-regulatory enzymes, resulting in the decreased biosynthesis of cholesterol (Lee *et al.*, 2001). Another animal studies suggest an impact of olive phenolic compounds on bile flow, increasing biliary cholesterol and bile acid concentrations, leading to their increased faecal excretion (Krzeminski *et al.*, 2003). Interestingly, favourable modification of lipid profiles by olive leaves decoction extracts reported by another paper (Filip *et al.*, 2015) also observed osteoblast stimulation and postulated that as a dipocytes and osteoblasts derive from the same mesenchymal stem cells, this may explain the lipid profiles change. So, there may be an evidence to suggest that there is a role of non-phenolic components in lipid lowering effects (Liu, Rajendram, & Zhang, 2010).

Effect of olive leaves decoction on Liver function tests

Fig. 3 divided into A: The change in ALT (Alanine aminotransferase): (The mean difference was 5.8 and 3.3 U/L for gp1 & gp2 respectively) and B: The change in AST (Aspartate aminotransferase): (The mean difference was 7.5 and 2.7 U/L for gp1 & gp2 respectively). Good improvement in the liver functions had noticed in the two groups, for the control healthy group the measurements of ALT was (19.05 ± 2.7 vs. 24.90 ± 3.9 U/L, $p < 0.001$) and the measurements of AST was (22.75 ± 4.3 vs. 30.25 ± 4.1 U/L, $p < 0.001$). Also for the hypertensive group the measurements was (30.75 ± 7.2 vs. 34.10 ± 10.3 U/L, $p < 0.023$) for ALT and (36.95 ± 5.1 vs. 39.65 ± 9 U/L, $p < 0.073$) for AST respectively. There is a significant decrease in the hypertensive group for the two liver function tests and this verify the results of other studies mentioned that, oleuropein and rutin decreased body weight gain and improved plasma lipid profiles and hepatic steatosis in HFD-fed mice (Kim, Choi & Park, 2010).

The levels of serum ALT, AST were significantly decreased, the mean difference for ALT was 5.8 and 3.3 U/L for gp1 & gp2 respectively and the mean difference for AST was 7.5 and 2.7 U/L for gp1 & gp2 respectively these findings are generally in agreement

with previous experimental diabetes studies(Al-Attar & Alsalmi, 2019).

Effect of olive leaves decoction on Kidney function tests

Fig. 4 consists of A: The change in Urea: (the mean difference was 0.05 and 3.55 mg/dL for group1 & group2

respectively) and B: The change in Creatinine: (the mean difference was 0.1 and 0.035 mg/dL for group1 & group2 respectively) during this study.

There is an improvement in the kidney function tests had noticed in the two groups, for the control healthy group the measurements of Urea was (27.25 ± 5.47 vs. 27.30 ± 5.4 mg/dL , $p < 0.3$) and the measurements of

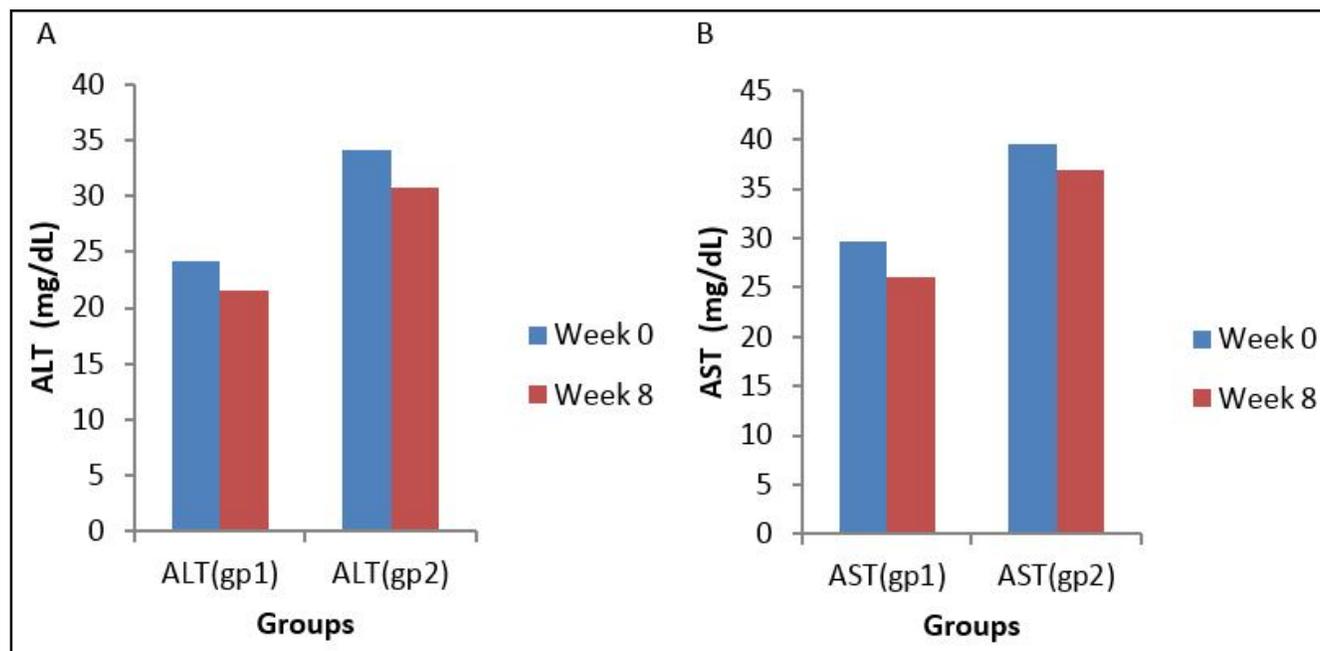


Fig. 3: The change in liver function tests during the study.
 A: The change in ALT (Alanine aminotransferase) for group 1& group2.
 B: The change in AST(Aspartate aminotransferase) for group 1& group2.

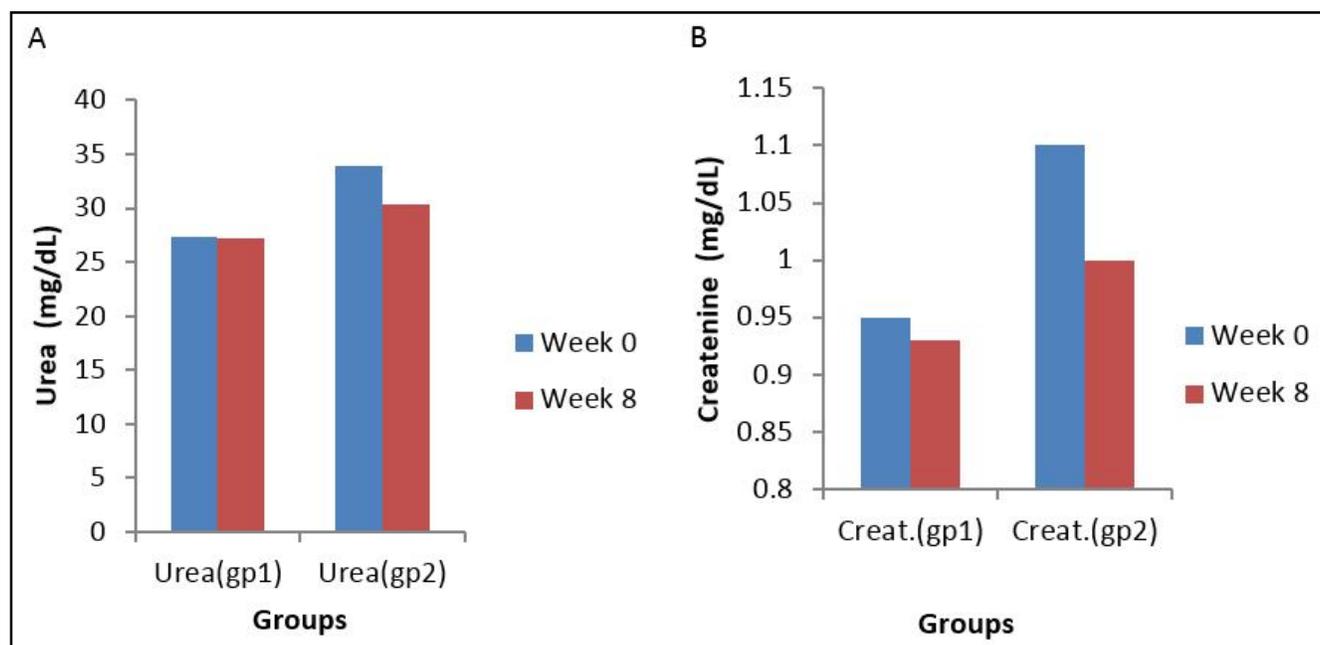


Fig. 4: The change in kidney function tests during the study
 A: The change in Urea for group 1& group2.
 B: The change in Creatinine for group 1& group2.

Creatinine was (0.905 ± 0.11 vs. 1 ± 0.13 mg/dL, $p < 0.001$). Also for the hypertensive group the measurements was (30.40 ± 5.7 vs. 33.95 ± 9.7 mg/dL, $p < 0.01$) for Urea and (1.07 ± 0.16 vs. 1.11 ± 0.19 mg/dL, $p < 0.09$) for Creatinine respectively.

There is a significant decrease in the levels of serum creatinine and urea, these findings are generally in agreement with previous experimental diabetes studies (Al-Attar & Alsalmi, 2019).

Effect of olive leaves decoction on body measurements

A significant improvement in the body measurements occurred after the treatment course Fig. 5 which contains; A: The change in body weight (the mean difference was 4.85 and 6.75 mg/dL for gp1 & gp2 respectively), B: The change in the abdomen circumference (the mean difference was 3.70 and 5.95 mg/dL for gp1 & gp2 respectively) and C: The change in body mass index (BMI) (the mean difference was 1.73 and 2.40 mg/dL for gp1 & gp2 respectively) during the study.

We detect a decrease in the abdomen circumference after the treatment course. Also body weight decreased so the BMI was improved significantly. The mean decrease in body weight, abdomen and BMI from baseline in the control healthy group was (78.25 ± 9.7 vs. 83.10 ± 9.3 , $p < 0.001$; 87.75 ± 4.7 vs. 91.45 ± 4.8 , $p < 0.001$; 27.26 ± 1.9 vs. 28.99 ± 2.1 , $p < 0.001$; $n = 20$), respectively, also a significant decrease in the hypertensive group was (90.20 ± 13.7 vs. 96.95 ± 16 , $p < 0.001$; 99.15 ± 4.9 vs. 105.10 ± 7.8 , $p < 0.001$; 32.26 ± 5.3 vs. 34.66 ± 6.1 , $p < 0.001$; $n = 20$) for body weight, abdomen and BMI respectively from the measurements at baseline. So there is a significant difference in the body measurements before and after treatment for the hypertensive group.

Several olive leaf constituents have been reported to exert beneficial effects against obesity both *in vitro* and *in vivo* (Kim *et al.*, 2010), Caffeic acid also exhibited anti-obesity effects by reducing body and visceral fat-pad weights, plasma levels of lipids and obesity-related hormones such as leptin and insulin in HFD-fed mice (Cho *et al.*, 2010). From the collected results of these studies, we appraise that the weight-lowering effects of olive leaves decoction can be caused by a combination of various weight-suppressing components.

There were no significant differences of demographic data and levels of efficacy parameters among groups at baseline, the other clinical blood analysis showed good improvement during the experiment. No adverse effects were observed to the subjects involved in the experiment throughout this study.

Conclusion

Olive leaves phenolic compounds, as oleuropein, have many interesting effects on the human body systems such as, antihypertensive, hypo-cholesterolemic and hypoglycemic effects. The present study may strengthen the evidences that olive leaves decoction has the ability to favorably modify blood pressure and lipid profiles. The dietary factors and modifying our life style had a good impact in this study towards the primary prevention of hypertension and raised cholesterol. In the next few years, there may be a clear evidence for this advice to be extended to include foods rich in phenolic compounds. Daily consumption of olive leaves decoction can result in lowering blood pressure and serum lipid profiles and also in favorable improvements in several CVD risk factors, making it a preferable addition to a healthy diet and lifestyle.

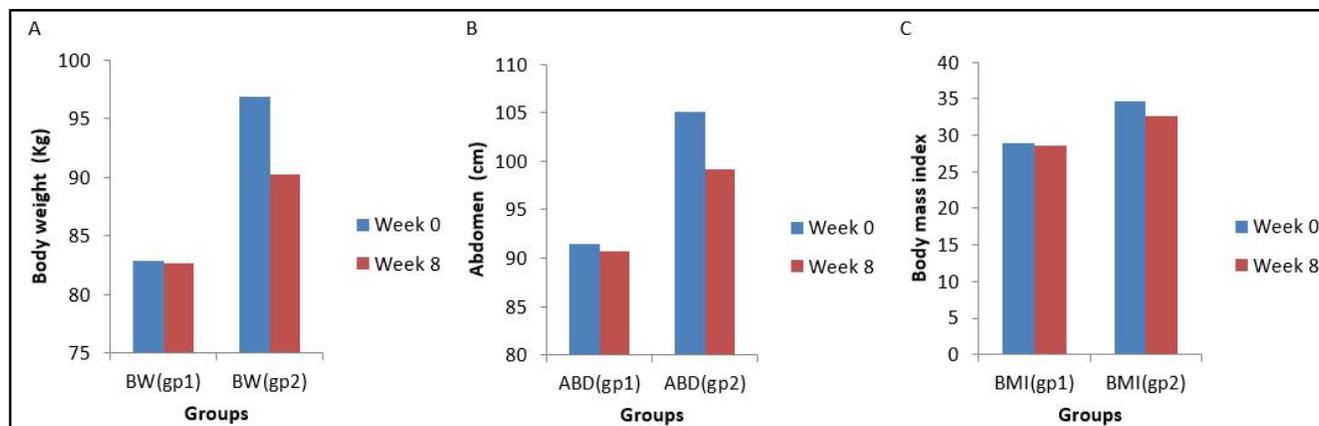


Fig. 5: The change in body parameters during the study:
 A: The change in body weight (BW)/ kg, during the study.
 B: The change in abdomen circumference (ABD)/ cm, during the study.
 C: The change in body mass index (BMI), during the study.

Ethical Approval: Ethical approval was granted by the Research Ethical Committee at Faculty of Medicine, Beni-Suef University, (FWA#: FWA00015574). The consent forms were obtained from all groups participants.

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