Beneficial Effects of some beverage consumption and Orlist drug on Diet Induced Obesity in Experimental Rate

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Abstract: Forty two normal male albino rats of Sprague Dawley strain, weighing (170 ± 5 g) strain were fed on high fat diet for six week to induce obesity. The obesity rats were randomly classified into six groups (7 rats each) and treated with orlistat, coffee, green tea, cinnamon and mixture of them for six week.
The results revealed that, obese rat groups which treated with orlistate , green tea, coffee ,cinnamon and mixture of them showed lowered values of final weight , weight gain , gain percent , FER , leptin , glucose ,cholesterol, total lipids , phospholipids ,triglyceride, LDL-$_C$,VDL-$_C$ and cholesterol/HDL-c but a significant increase in the value of serum HDL-$_C$ in comparing with control (+ve). The rat group which treated with orlistat showed non significant difference in the values of serum AST, ALT &ALP but all rat groups treated with green tea, coffee, cinnamon and mixture of them showed a significant decrease in serum AST, ALT &ALP, serum creatinine and urea compared with control (+ve).
The rat groups which treated with green tea, coffee, cinnamon and mixture of them showed a significant decrease in the values of serum creatinine and urea but the rat groups which treated with cinnamon and mixture of green tea, coffee and cinnamon showed a significant decrease in the value of serum uric acid compared with control (+ve).
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1. Introduction:

Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems. Obesity increases the likelihood of various diseases, particularly heart disease, type 2 diabetes, breathing difficulties during sleep, certain types of cancer, and osteoarthritis (Lau et al., 2007).The main treatment for obesity consists of dieting and physical exercise. Diet programs may produce weight loss over the short term, but maintaining this weight loss is frequently difficult and often requires making exercise and a lower calorie diet a permanent part of a person's lifestyle (Strychar 2006).

There are many possible pathophysiological mechanisms involved in the development and maintenance of obesity. Since leptin was discovered, many other hormonal mechanisms have been elucidated that participate in the regulation of appetite and food intake, storage patterns of adipose tissue, and development of insulin resistance. The adipokines are mediators produced by adipose tissue; their action is thought to modify many obesity-related diseases (Flier 2004 and Kushner 2007). There is a little information on drugs affect longer-term complications of obesity. One medication, orlistat (Xenical), is current widely available and approved for long term use for weight loss. Its primary function is preventing the absorption of fats from the human diet, thereby reducing caloric intake (Torgerson et al., 2004).

Coffee is made from the extract of coffee beans, and is available in a remarkable variety of different types throughout the world. Currently, the influence of coffee on the health of people is considered of great significance due to the enormous consumption worldwide. Coffee contains large amounts of antioxidants, such as chlorogenic acids other than caffeine (Gyntelberg et al., 1995).

The consumption of tea is a very ancient habit and legends from China and India indicate that it was initiated about five thousand years ago. Tea is one of the most widely consumed beverages in the world, second only to water, and its medicinal properties have been widely explored. Polyphenols in tea especially the flavonoids possess a high antioxidant power which can protect cells against the adverse effects of reactive oxygen species. Catechins are a group of very active flavonoids found largely in tea (Balentine et al., 1997).

Cinnamon was imported to Egypt as early as 2000 BCE; Cinnamon bark is widely used as a spice. It is principally employed in cookery as a condiment and flavoring material. It is used in the preparation of chocolate, also in many desserts recipes. In the Middle East, it is often used in savory dishes of chicken and lamb. In the United States, cinnamon and sugar are often used to flavor cereals, bread-based dishes, and fruits, especially apples. In medicine, it acts like other volatile oils and once had a reputation as a cure for colds. It has also been used to treat diarrhea and other problems of the digestive system. Cinnamon is high in antioxidant activity. The essential oil of cinnamon also has antimicrobial properties, which can aid in the preservation of certain foods. Cinnamon could have some pharmacological effects in the treatment of type 2 diabetes mellitus and insulin resistance (Singh et al., 2007).

Therefore, we investigated the effect of coffee, green tea and cinnamon intake on body weight in an experimental model of obesity.

2. Materials and Methods:

Materials:

Orlistat drug was marketed as a prescription under the trade name Xenical by Roche in most countries and also known as tetrahydrolipstatin. Orlistat drug was obtained from the pharmacy in Cairo, Egypt. Kits used for biochemical analysis were obtained from Gama tread Company, Cairo, Egypt. The orlistat rat dose was 5 mg / rat. Green tea (Camellia sinensis), coffee (Coffea arabica) and cinnamon (Cinnamomum zillanicum) packets were obtained from local market. Forty two normal male albino rats of Sprague Dawley strain, weighing (170 ± 5 g) were obtained from the Laboratory Animal Colony, Helwan, Cairo, Egypt.

Methods:

The standard diet was prepared from casein (200g/kg), corn starch (497g/kg), sucrose (100g/kg), cellulose (30 g/kg), corn oil (50g/kg), mineral mixture (100g/kg), vitamin mixture (20g/kg) and DL-methionine (3g/kg) according to NRC (1995) . High fat diet was a standard diet in addition to 200 g ghee/kg diet as saturated fat and substituted from the amount of corn starch according to Bhatt et al., (2006).

Green tea, coffee, and cinnamon extract were prepared separately by putting packets in 75 ml boiled water for 4 min according to the method described by Jonathan et al., (2000). Water extracts were prepared freshly every day. The rat dose of these extract was 5 ml / rat three times daily.

Rats were housed in cages under hygienic condition and fed on basal diet for one week for adaptation then fed 6 week on high fat diet to induce obesity. The weight of obese rats reached 255± 5 g and then divided into six groups (n = 7 each) fed also on high fat diet all over the period of the experiment. One group served as a positive control. The other rat groups treated daily with orlistat, green tea, coffee, cinnamon and mixture of them for six week. The food intake was calculated daily and the body weight gain was recorded weekly. Feed efficiency ratio, FER, [weight gain (g)/ feed intake (g)] was calculated according to Chapman et al., (1950)

At the end of the experimental period, all rats were fasted overnight then sacrificed. Blood samples were immediately collected in clean and dried Wiesserman tubes from the portal vein. First part of blood was collected in tubes containing potassium oxalate and sodium fluoride for the estimation of glucose by O-toluidine method (Sasaki et al., 1972). Second part of blood was left to coagulate then centrifuged at 3000 rpm for 15 minutes to obtain serum. Serum insulin and leptin were estimated according to Wilson and Miles (1977) and Palacio et al., (2002), respectively.

Serum cholesterol, triglycerides (TG), high density lipoprotein cholesterol (HDL-$_c$), and total lipids were determined by using enzymatic colorimetric methods (Abell et al., 1952, Buccolo and David (1973), Kostener, 1977 and Folch et al., 1957). Very low density lipoprotein cholesterol (VLDL-c) was calculated as TG/5 but low density lipoprotein cholesterol (LDL-c) was calculated as following [LDL-$_C$= Total cholesterol –HDL-$_C$ –VLDL-$_C$] according to Fruchart, (1982) while phospholipids calculated as following [phospholipids =total lipid – (TG-Tc)] according to Ketes (1972). Atherogenic index (cholesterol /HDL-c) was calculated according to Castelli and levitar, (1977).

Serum alanine and aspartate aminotransferase (ALT&AST), and alkaline phosphatase (AP) activity enzymes were estimated according to Reitman and Frankel (1957) and Kind and King (1954), respectively. In addition, creatinine, urea and uric were estimated according to Bonsens and Taussky, (1984), Patton and Crouch, (1977), and Fossati et al., (1980), respectively. Blood superoxide dismutase (SOD) catalase , glutathione peroxidase (GPX) and nitric oxide (NO) were estimated according to Mc Cord and Fridovich, (1969), Aebi, (1974), Flohe and Gunzler (1984) and Green et al., (1981), respectively.

Collected data were presented as mean ±SD and statistically analyzed using one way analysis of variance (ANOVA).Student "t" test was used for significance according to Artimage and Berry (1987).

3. Results and Discussion:

Results of table (1) indicated that obese rat groups which treated with orlistate , green tea, coffee ,cinnamon and mixture of them showed lowered values of final weight ($p<0.05$&0.01), weight gain ($p<0.01$&0.001), gain percent ($p<0.001$) and FER($p<0.01$) in comparing with control (+ve). The rat groups which treated with orlistate or mixture of the experimental beverage showed a significant decrease in weight gain and gain percent compared with rat groups which treated with green tea, coffee and cinnamon. There were non significant differences in final weight, food intake and FER among treated groups.

It is known that orlistat is the saturated derivative of lipstatin, a potent natural inhibitor of pancreatic lipases isolated from the bacterium Streptomyces toxytricini. However, due to simplicity and stability, orlistat rather than lipstatin was developed into an anti-obesity drug (Haslam and James 2005). It is apparent that the tea is a source of a wide range of phytochemicals that are digested, absorbed and metabolized by the body, and that tea constituents exert their effects at the cellular level. Supplementation with tea catechins resulted in a significant reduction of high-fat diet-induced body weight gain, visceral and liver fat accumulation, and the development of hyperinsulinemia and hyperleptinemia in mice (Murase et al., 2002). The thermogenic properties of green tea could reside primarily in an interaction between its high content in catechins and the presence of caffeine with sympathetically released noradrenaline. The increased and prolonged sympathetic stimulation of thermogenesis by the interaction between polyphenols and caffeine could be of value in assisting the management of obesity (Dulloo et al., 2000).Coffee is appreciated for its aroma and flavor, but caffeine plays also a role in its popularity. Coffee is a mixture of thousands different compounds, like carbohydrates, lipids, vitamins, alkaloids, nitrogenous molecules, and phenolic compounds (Mario 2010). *Cinnamon* was mainly focused on its essential oils which included antioxidant, antimicrobial activity and antidiarrhoeal activity. Cinnamon did not decrease the levels of blood glucose, but did lower circulating insulin concentrations (Singh et al., 2007).

Table (1): Body weight gain, food intake and food efficiency ratio (FER) of the experimental rat groups

Groups / Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
weight(g)	255.41± 8.42 ^{a}	257.14± 7.18 ^{a}	258.21± 7.35 ^{a}	255.33± 8.22 ^{a}	256.41± 7.11 ^{a}	257.45± 7.18 ^{a}
Final Weight(g)	430.74± 55.14 ^{a}	292.28± 47.21 ^{b*}	304.38± 48.61 ^{b*}	296.55± 36.71 ^{b*}	299.72± 51.11 ^{b*}	288.86± 45.14 ^{b**}
Weight gain(g)	175.33± 20.23 ^{a}	35.14± 3.16 ^{c***}	46.17± 5.21 ^{b**}	41.22± 5.21 ^{b**}	43.31± 6.01 ^{b**}	31.41± 3.20 ^{c***}
Gain %	49.33± 6.19 ^{a}	9.83± 1.60 ^{c***}	12.88± 1.81 ^{b***}	11.60± 1.65 ^{b***}	12.15± 1.36 ^{b***}	8.78± 1.03 ^{c***}
Food intake (g/w)	39.88± 4.21 ^{a}	35.45± 4.66 ^{a}	36.11± 5.20 ^{a}	35.55± 3.99 ^{a}	36.75± 4.69 ^{a}	36.25± 5.11 ^{a}
FER	0.020± 0.003 ^{a}	0.004± 0.001 ^{b**}	0.005± 0.002 ^{b**}	0.005± 0.001 ^{b**}	0.006± 0.002 ^{b**}	0.004± 0.001 ^{b**}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

It is evident in table 2 that all treated rat groups showed a significant decrease in the values of leptin ($p<0.01$&0.001) and glucose ($p<0.01$) but showed non significant difference in insulin value compared with control (+ve). There were non significant differences in leptin, insulin and glucose among treated groups.

Obesity increase incidence of obesity-related disorders type 2 diabetes and cardiovascular diseases. Obesity is a disorder of energy balance and is associated with hyperinsulinemia, insulin resistance, and abnormalities in lipid metabolism. In addition, hyperinsulinemia and insulin-resistance contribute to vascular dysfunction, because the opposing endothelium-dependent vasodilating and vasoconstrictor effects of insulin are shifted toward a predominant vasoconstriction in patients with obesity .leptin has been shown in many studies to inhibit insulin release (Haslam and James 2005). It has been reported that leptin is produced by adipose tissue to signal fat storage reserves in the body, and mediates long-term appetitive controls (to eat more when fat storages are low and less when fat storages are high). Leptin participates in the modulation of energy

metabolism, neuroendocrine, angiogenesis, reproduction and immune responses, suggesting an important role of leptin in the recovery of functions. Most obese individuals are thought to be leptin resistant and have been found to have high levels of leptin. Leptin is produced peripherally, and control appetite through their actions on the central nervous system thus a deficiency in leptin signaling, either via leptin deficiency or leptin resistance, leads to overfeeding and may account for some genetic and acquired forms of obesity (Hamann and Matthaei 1996 and Faggioni et al., 2000). Consumption of coffee and tea is associated with a reduced risk of several chronic and degenerative diseases including cardiovascular disorders, diabetes, and obesity and neurodegenerative disorders (Mario 2010). *Cinnamon* has insulin-like action and exerts a blood glucose-suppressing effect by improving insulin sensitivity, signaling and synthesis. *Cinnamon* extract has a regulatory role in blood glucose level and lipids (Kim et al., 2006).

Table (2): Mean values ± SD of leptin, insulin and glucose of the experimental rat groups

Groups Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
Leptin	123.20±	59.11±	63.21±	65.71±	70.21±	55.60±
(µ g/1)	15.77 [a]	8.20 [b* **]	9.17 [b**]	8.33 [b* *]	7.20 [b* *]	5.03 [b* **]
Insulin	13.37±	15.88±	15.75±	16.35±	15.02±	16.68±
(µ /ml)	2.11 [a]	2.25 [a]	2.14 [a]	2.66 [a]	2.19 [a]	1.99 [a]
Glucose	175.11±	115.44±	117.45±	110.21±	117.24±	113.39±
(mg/dl)	18.70 [a]	13.28 [b* *]	12.14	9.69 [b* *]	10.22 [b* *]	11.31 [b* *]

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

From results of table (3) it could be noticed that all treated rat groups showed a significant decrease in the values of serum cholesterol (p<0.01&0.001), total lipids (p<0.001), phospholipids (p<0.01) and triglyceride (p<0.01) compared with control (+ve). There were non significant differences in serum cholesterol, total lipids, phospholipids, and triglyceride among treated groups.

Orlistat works by inhibiting gastric and pancreatic lipases, the enzymes that break down triglycerides in the intestine. When lipase activity is blocked, triglycerides from the diet are not hydrolyzed into absorbable free fatty acids, and are excreted undigested instead. Only trace amounts of orlistat are absorbed systemically; the primary effect is local lipase inhibition within the gastrointestinal tract after an oral dose. The primary route of elimination is through the feces (Zhi et al., 1995). Oxidation of LDL induces modification in lipoproteins, stimulates inflammatory reactions, causes monocytes and monocyte-derived macrophages to accumulate in large amounts of oxidized LDL, and forms lipid-laden foam cells and atherosclerotic plaques. The intake of saturated fat accelerates these events. There are several reports indicating that tea inhibits the oxidation of LDL in vitro. A high level of cholesterol is one of the most common problems among overweight or obese people, and this can, over a period of time, cause several other complications, including coronary heart disease and heart attacks (Abd El-Ghany et al .,2004). Tea extracts, catechin and epicatechin exhibit a dose dependant inhibition on the formation of early lipid peroxidation products and late lipid peroxide decomposition products. Green tea reduces significantly serum and liver cholesterol, atherogenic index, and liver weight by lowering lipid deposition in hypercholesterolemic diet-induced rats. Rats fed with 2.5% green tea leaves in the diet for a long time had a reduction in blood triglycerides and total cholesterol contents (Yang and Koo 1997). Green or black tea at a lower level, also improved plasma lipid profiles and reduced LDL and VLDL oxidation in hamsters fed a normal or a high cholesterol diet (Lin et al.,1998). Green tea extract rich in catechins and caffeine has thermogenic properties and promotes fat oxidation beyond than those explained by its caffeine content. The green tea extract may play a role in the control of body composition via sympathetic activation of thermogenesis, fat oxidation, or both (Dulloo et al., 1999). Boiled coffee has been found extensively to be associated with an increase in serum cholesterol, whereas no association has been shown for coffee prepared by the filter process (Hammar et al., 2003). Cinnamon, or its components, has potential lipid lowering properties in people with Type 2 diabetes and cholesterol-fed animals. Acute oral cinnamon treatment inhibits the increase in postprandial triglycerides and the overproduction of apoB48-containing lipoproteins in fructose-fed, insulin-resistant rats (Khan et al., 2003).

Table (3): Serum cholesterol, total lipids, phospholipids and triglyceride of the experimental rat groups

Groups / Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
Cholesterol (mg/g)	371.41± 55.61 [a]	177.31± 20.11 [b***]	182.13± 18.14 [b**]	179.91± 16.21 [b***]	181.19± 20.18 [b***]	175.59± 16.16 [b***]
Total lipids (mg/g)	699.43± 112.13 [a]	388.31± 70.36 [b***]	391.41± 75.12 [b***]	395.54± 74.17 [b***]	401.14± 81.36 [b***]	381.35± 69.16 [b***]
Phospholipids (mg/ l)	136.75± 12.16 [a]	107.65± 9.11 [b**]	102.06± 10.11 [b**]	109.35± 12.17 [b**]	114.64± 13.15 [b**]	106.36± 11.66 [b**]
Triglyceride (mg/g)	191.45± 22.41 [a]	103.35± 9.16 [b**]	107.22± 11.11 [b**]	106.19± 12.21 [b**]	105.31± 11.61 [b**]	99.40± 9.69 [b**]

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

Data in table (4) showed that all treated rat groups showed a significant decrease in the values of serum LDL-$_C$ (p<0.001), VDL-$_C$ (p<0.001) and cholesterol/HDL-c (p<0.01&0.001) but a significant increase in the value of serum HDL-$_C$ (p<0.01) compared with control (+ve). There were non significant differences in the above mentioned parameters among treated groups.

Coffee has been widely investigated for its effects on the cardiovascular system (CHD). Moreover, coffee has been reported to raise inflammatory markers and lipid levels, although the effect on lipids is probably influenced by the brewing method, being higher for the boiled compared to the filtered method (Francesco et al., 2007). In general, coffee consumption is not associated with an increased risk of CHD, whereas a significant association of CHD with high consumption of coffee is reported among case control studies (Hammar et al., 2003). The average flavonol and flavone intake in tea appears to be inversely correlated with mortality rates from coronary heart and play a protective role in the development of CVD (Tijburg et al., 1997). Flavonoids like quercetin, myricetin and kaempferol can also protect LDL from oxidation by regenerating tocopherol, an important endogenous antioxidant in humans (Zhu et al, 2000). Cinnamon has potential lipid lowering properties in animal and human studies. Cinnamon can reduce the level of cholesterol, especially the level of bad LDL cholesterol (Wang, et al., 2008).

Table (4): Serum HDLc, LDLc, VLDLc and cholesterol/HDLc of the experimental rat groups

Groups / Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
HDLc (mg/dl	25.53± 3.21 [b]	45.77± 4.10 [a**]	42.60± 4.27 [a**]	43.69± 4.26 [a**]	41.16± 5.11 [a**]	47.91± 5.31 [a**]
LDLc (mg/dl)	307.58± 91.16 [a]	110.84± 9.69 [b***]	118.09± 10.18 [b***]	114.99± 11.14 [b***]	118.97± 12.16 [b***]	107.80± 9.69 [b***]
VLDLc (mg/dl)	38.30± 7.21 [a]	20.70± 3.61 [b***]	21.44± 3.25 [b***]	21.23± 3.11 [b***]	21.06± 2.99 [b***]	19.88± 1.81 [b***]
Cholesterol /HDLc	12.43± 2.11 [a]	3.87± 0.36 [b**]	4.27± 0.48 [b**]	4.11± 0.77 [b**]	4.40± 0.55 [b**]	3.66± 0.43 [b**]

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

Data presented in table (5) showed that rat group which treated with orlistat showed non significant difference in the values of serum AST, ALT &ALP but all treated rat groups showed a significant decrease in these values (p<0.01& p<0.001) compared with control (+ve). There were non significant differences in the above mentioned parameters among treated groups.

Consumption of coffee and especially caffeine was associated with lower risk of elevated ALT activity. The coffee oils (kahweol and cafestol) and aromatic extracts isolated from coffee beans were associated with lower levels of liver enzymes, mainly serum alanine aminotransferase (ALT) and glutamyltransferase. Caffeine may have antioxidant effects that could be beneficial if oxidative stress

plays a role in liver injury (Honjo et al., 2001 and Constance and James 2005). Coffee consumption has been found to be associated with a reduced risk of chronic liver disease (Ruhl and Everhart 2005). Diterpenes (non triglyceride lipid components of coffee oils), cafestol and kahweol in coffee beans are found to induce synthesis of glutathione, an important mediator against hepatocellular injury.Cinnamon is responsible for brain function, memory, stomach benign, reducing fat level in the body by lowering the cholesterol level and insulin level (Singh et al., 2007).

Table (5): Serum ALT, AST and ALP of the experimental rat groups

Groups / Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
ALT	55.99±	57.31±	40.33±	35.14±	42.31±	40.11±
(µ /ml)	6.44 [a]	6.96 [a]	5.88 [b**]	5.68 [b***]	5.24 [b**]	4.77 [b**]
AST	101.31±	112.31±	66.81±	60.61±	67.18±	55.38±
(µ /ml)	9.60 [a]	11.29 [a]	7.11 [b**]	6.12 [b**]	7.30 [b**]	5.41 [b***]
ALP	110.31±	120.31±	75.38±	61.18±	65.61±	71.31±
(µ /ml)	11.14 [a]	12.15 [a]	8.21 [b**]	7.10 [b**]	6.45 [b**]	8.24 [b**]

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

Data presented in table (6) showed that rat group treated with orlistat showed non significant difference in values of serum creatinine, urea and uric acid compared with control (+ve). Rat groups which treated with green tea, coffee, cinnamon and mixture of them showed a significant decrease in values of serum creatinine and urea (p<0.01&p<0.001) but rat groups which treated with cinnamon and mixture of green tea, coffee and cinnamon showed a significant decrease in value of serum uric acid (p<0.05) compared with control (+ve).

The rat groups which treated with green tea or cinnamon showed a significant difference in the value of serum creatinine compared with the rat groups which treated with coffee or mixture. There was non significant difference in the value of serum urea among rat groups which treated with green tea, coffee, cinnamon and mixture of them. There was non significant difference in the value of serum uric among rat groups which treated with coffee, cinnamon and mixture of them.

Rats receiving green tea prior to induce nephropathy have decreased blood levels of urea nitrogen and creatinine, and lower urinary levels of protein and glucose indicating a reduction in the effects of the damaged kidney. By its direct action at the kidney level, tea can improve overall renal function (Yokozawa et al., 1999).Uric acid have antioxidant properties due to uric acid being activated as a defense mechanism against oxidative stress, but instead acting as a pro-oxidant in cases where metabolic derangements shift its production well outside of normal levels (Glantzounis et al., 2005). Coffee consumption has been related with reduction of various chronic diseases (Higdon and Frei 2006). Cinnamon increases body heat, and thereby speeds up metabolism in order to burn the extra calories or fats deposited in the body. Cinnamon has a marked antioxidant potential and may be beneficial in alleviating the complications of many illnesses related to oxidative stress in humans (Wondrak et al., 2010). The volatile oil from cinnamon contains more than 98 % cinnamaldehyde and that it confers dose-dependent, significant protection against alloxan-induced renal damage (Awanish et al., 2010).

Table (6): Serum Creatinine, urea and uric acid of the experimental rat groups

Groups / Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
Creatinine	0.99±	1.02±	0.68±	0.55±	o.71±	0.56±
(mg/dl)	0.13 [a]	0.36 [a]	0.19 [b**]	0.15 [c***]	0.19 [b**]	0.22 [c***]
Urea	51.14±	48.65±	38.50±	35.51±	36.21±	34.39±
(mg/dl	7.30 [a]	5.17 [a]	4.14 [b**]	5.21 [b**]	6.01 [b**]	4.66 [b**]
Uric acid	4.99±	4.55±	4.75±	4.11±	3.21±	3.31±
(µ /ml)	1.11 [a]	1.21 [a]	1.03 [a]	1.19 [ab]	0.87 [b*]	0.76 [b*]

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

Data presented in table (7) showed that rat group treated with orlistat showed non significant difference in the values of serum SOD, GPX, and catalase compared with control (+ve). The rat groups which treated with green tea, coffee, cinnamon and mixture of them showed a significant increase in the values of serum SOD, GPX and catalase ($p<0.05$, $0.01\&p<0.001$) and a significant decrease in the values of serum NO($p<0.05$, $0.01\&p<0.001$) compared with control (+ve). There was non significant increase in serum SOD and catalase among rat groups treated with green tea, coffee, cinnamon and mixture of them. The rat groups which treated with green tea and cinnamon showed a significant decrease in the value of serum GPX compared with rat groups treated with coffee and mixture of them. There was non significant difference in the value of serum NO among rat groups which treated with green tea, coffee and cinnamon.

The obesity-dependent vascular damage appears to derive from a variety of changes in the adipose tissue, leading to a chronic inflammatory state and to dysregulation of adipocyte-derived factors produce unbalance between the protective effects of the nitric oxide (NO) pathway (Rucker et al., 2007).Cells have different antioxidant systems such as glutathione and various antioxidant enzymes to protect various tissues from free radicals attacks. Apart from glutathione, the antioxidant enzymes including SOD, CAT and GSH dependent enzymes such as glutathione peroxidase (GPX), and glutathione transferase (GST) may minimize or remove the oxygen radical cascade and reduce cytotoxic oxidative damage in cells (Kaynar et al., 2005 and Meister 1988). Nitric oxide (NO) is a paracrine factor that controls vascular tone, inhibits platelet function, prevents adhesion of leukocytes, and reduces proliferation of the intima. An enhanced inactivation and/or reduced synthesis of NO are seen in conjunction with risk factors for cardiovascular disease (Forstermann 2010).Nitric oxide (NO) plays an important role in inflammatory process. Macrophages may greatly produce both levels of NO and superoxide, which rapidly react with each other to form peroxynitrite which oxidizes LDL, a key process in atherosclerosis. Tea can directly scavenge NO radicals (Duh et al., 2004).

Table (7): Serum SOD, GPX, catalase and NO of the experimental rat groups

Groups / Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
SOD	14.22±	16.35±	18.61±	22.11±	19.61±	21.18±
(µ /ml)	2.17 ^{b}	2.15 ^{ab}	1.98 ^{a*}	2.49 ^{a**}	2.66 ^{a*}	2.44 ^{a**}
GPX	31.24±	38.66±	57.10±	69.30±	59.11±	71.14±
(µ /ml)	4.76 ^{c}	5.87 ^{c}	7.24 ^{b**}	8.42 ^{a***}	7.60 ^{b**}	9.11 ^{a***}
Catalase	95.77±	105.66±	135.65±	151.14±	141.36±	155.33±
(µ /ml)	10.28 ^{b}	11.87 ^{b}	12.13 ^{a**}	15.16 ^{a***}	16.14 ^{a**}	13.23 ^{a***}
NO	8.13±	6.01±	5.33±	4.11±	4.22±	3.66±
(µ mOl/l)	1.69 ^{a}	1.29 ^{b*}	1.36 ^{b*}	1.11 ^{bc**}	0.89 ^{bc**}	0.88 ^{c**}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

Rats fed with 2.5% green tea leaves in the diet for a long time had enhancement in the superoxide dismutase and phase II enzyme activities in the liver without any liver or kidney damage (lin et al .,1998). Both coffee and tea are rich sources of bioactive phytochemicals including methylxanthines, amino acids, phenolic acids and polyphenols. methylxantine in both beverages is well known for its stimulatory and metabolic effects. The phenolic and polyphenolic constituents of coffee and tea have been reported biological activities including: antioxidant activities (Mario 2010). Cinnamon increases body heat, and thereby speeds up metabolism in order to burn the extra calories or fats deposited in the body. Cinnamon have cinnamic aldehyde or cinnamaldehyde (about 60 % of the bark oil) and other chemical components of the essential oil include ethyl cinnamate, eugenol, beta-caryophyllene, linalool, and methyl chavicol (Wondrak et al., 2010).Cinnamon increased total antioxidant power and total thiols but a decrease in lipid peroxidation levels in individuals who received regular or cinnamon tea compared with controls. The extent of increase in total antioxidant power and decrease in lipid peroxidation levels were more evident in individuals who received cinnamon compared with those who received regular tea (Akram et al., 2006).

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