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Potential Effects of Sage powder, Sesame and Olive Oils on Lipid Profile and Liver Functions of Non-Alcoholic Fatty Liver Rats.

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Abstract

The aim of this study was to investigate the effects of sage, sesame and olive oils alone and in combination with sage on total lipid (TL), total cholesterol (TC), triglyceride (TG), serum lipoprotein fractions (HDL-c, LDL-c and VLDL-c), liver enzymes and antioxidant enzymes, as well as histological changes of liver in obese nonalcoholic fatty liver disease (NAFLD) albino rats. A total of 72 adult male albino rats weighing (200 ± 10g) were used in this study. The rats were divided into two main groups: The first group (8 rats) fed on basal diet (BD) as control negative group (-ve). The second main group (64 rats) fed on high fat diet (HFD) for (8) weeks to induce non-alcoholic fatty liver disease (NLFLD). then rats were divided into (8 subgroups). One (8 rats) fed (HFD), as positive control

group (+ve). The other (7 subgroups) fed on modified (HFD), one of them by adding 5% sage. The other sex subgroups were fed on modified high fat diet (MHFD) by replace 20% sheep tallow (ST) by 20% sesame oil (SO), 20% olive oil (OO) and mixed 10% (SO) with 10% (OO) without or with sage for (8 weeks). Results revealed that, (MHFD) by adding 5% sage or by replacing 20% (ST) to 20% from (SO), (OO) and 20% mixed between them (1:1 W/W) without or with 5% sage induced a significant decrease in serum liver enzymes (Aspartate AminotransferaseAST, Alanin Aminotransferase ALT, and Alkaline phosphates ALP), total cholesterol, triglyceride, LDL-c and VLDL-c, while results revealed a significant increase in HDL-c level. Also results revealed a statistical significant increase in antioxidant enzymes glutathione peroxidase, superoxide dismutase and catalase antioxidants, as compared to the (+ve) control group. Histopathological examination revealed that only (NAFLD) group fed on (MHFD) containing 20% mixed (SO) with (OO) (1:1 W/W) plus 5% sage showed the best ameliorates of fatty liver. In conclusion, replacing 20% from (ST) by 20% from mixed (SO) with (OO) (1:1 W/W) plus 5% sage, ranged somewhere between them rise the effects of either component alone and induced the greatest improvement in case of (NAFLD) fed on (HFD).

Introduction

When we consider the management of Non-Alcoholic Fatty Liver Disease (NAFLD), two aspects should be considered. One is that it

can be a part of the metabolic syndrome. About 80% of patients with metabolic syndrome have NAFLD ***(Antunes and Bhimji., 2017)***. Although the prevalence of NAFLD is 20-40% in the general population, about 70% of type 2 diabetes mellitus ***(Leite et al., 2008),*** and 85% of patients with morbid obesity (BMI ≥ 40) have NLFLD ***(Fabbrini et al., 2009).*** In the general population, 80% of patients with NAFLD are overweight and 20% of NAFLD patients have normal weight as per ultrasonography ***(Bellentani and Tiribelli, 2001).***

As NAFLD is related to insulin resistance, gradual weight loss is extremely important in overweight and obese individuals ***(Harrison and Day, 2007).***About 7-10% of weight loss over one year by lifestyle changes has been associated with histological improvement in simple steatosis and NASH **(Tilg and Moschen, 2010)**. Diet and moderate aerobic exercise the first line measures to reduce weight and improve insulin resistance ***(Wilkins et al., 2013).*** Therefore, study aimed to investigate the effects of sage and sesame & olive oils alone and in combination with sage on some biochemical parameters and histological changes of liver in obese nonalcoholic fatty liver disease (NAFLD) albino rats.

Materials and Methods

Material: Casein, vitamins, minerals, cellulose, and choline chloride were purchased from El- Gomhoria Company, Cairo, Egypt. Soy, sesame and olive oils were obtained from Agricultural Research Center, Giza, Egypt. Sage was obtained from the National market of

Agricultural herbs and medicinal plants, Cairo, Egypt. Kits for biochemical analysis were obtained from Alkan for pharmaceutical and chemical Dokki, Egypt.

Rats: Seventy-two adult male albino rats (Spragu Dawley Strain) were purchased from Helwan farm of experimental animals, Ministry of Health and population, Helwan, Cairo, Egypt.

Methods:

Experimental Design:

A total of 72 adult male albino rats of Sprague-Dauley Strain weighing 200 ± 10g were used in this study. The rats were divided into two main groups: The first main group (n=8) fed on basal diet BD and used as a control negative group (-ve). The second main group (64) rats was fed on high fat diet (HFD) containing 20% sheep tallow for 8 weeks to induce nonalcoholic fatty liver disease (NAFLD) according to ***(Zarghani et al., 2016).***NAFLD rats were divided into (8 subgroups) one of them (8rats) was fed on (HFD), used as a positive control group (+ve). The other (7 subgroups) fed on modified (HFD), one of them by adding 5% sage. The other six subgroups were fed on modified high fat diet (MHFD) by replacing 20% sheep tallow (ST) by 20% sesame oil (SO), 20% olive oil (OO) and mixed 10% (SO) with 10% (OO) (1:1 W/W) without or with 5% sage for 8 weeks'. At the end of the experiment, rats were sacrificed, liver removed and weighed. Blood samples were collected, left to clot, the serum was separated.

At the end of the experimental period (8 weeks)**.** Animals were fasted overweight, and then sacrificed under very light ether an aesthesia – blood samples were collected from hepatic portal vein of each rat. Serum were carefully separated by centrifugation of blood sample. Then kept frozen at - 20°C until the analysis. Liver, was removed from rats by careful dissection, washed in saline solution (0.9%), dried using filter paper and independently weighed.

Biochemical analysis:

Determination of total lipids according to ***Christopher and Ralph, (1970).*** Triglycerides according to ***Fossati and prencipe (1982)*****.** Total cholesterol***Allain et al., (1974).*** High density lipoprotein cholesterol (HDL-C) ***(Burstein, 1970).***Low and very low density lipoprotein cholesterol (LDL-c and VLDL-c) ***Friedwald et al., (1972).*** Aspartate Aminotransferase(AST) and Alanin Aminotransferase (ALT) ***Henry (1974)*****.** Alkaline phosphates (ALP) ***Belfield and Goldberg (1971).***Liver [catalase (CAT), superoxide dismutase (SOD) and reduced glutathione (GSH) activities] were measured according to the methods described by ***(Aebi, 1984; Beauchamp and Fridovich 1971 and Paglia& Valentine 1967),***respectively**.**

Histopathological Examination:

Specimens from liver tissue was taken immediately after sacrificing animals, and fixed in 10% buffered neutral formalin solution. The fixed specimens were then trimmed, washed and dehydrated imbedded in paraffin, cut in sections of 46 microns' thickness and stained with haematoxylin and eosin stain, according to***(Sheehan and Hrapchak, 1980).***

Statistical Analysis:

Results of biochemical analysis and biological evaluation of each group were statistical analyzed, mean, standard error and one-way ANOVA test using SAS package with level of significant $p<0.05$ ***(SAS,2004).***

Results and Discussion

Effects of Sage, Sesame and Olive Oils on Total Lipids, Cholesterol and Triglycerides in Nonalcoholic Fatty Liver Rats.

Table (1) illustrated the effects of high fat diet (HFD) or modified high fat diet (MHFD) by replacing 20% sheep tallow (ST) to 20% (SO), 20% (OO), 20% mixed (SO) with (OO) (1:1 W/W) without or with 5% sage on serum total lipid (TL), total cholesterol (TC) and triglycerides (TG) in Nonalcoholic Fatty Liver Disease (NAFLD) rats. Statistical analysis showed a significant increase ($p\leq .05$) in (TL), (TC) and (TG) levels in control (+ve) group fed on (HFD), as compared to control (-ve) group fed on basal diet, which agree with ***(Wu et al., 2013)*** suggested that (HFD) induced increase serum (TG) and (TC) levels, as compared to those fed on low fat diet (LFD).

Our results revealed that, all groups fed on (MHFD) induced a significant decrease ($p\leq .05$) in serum (TL), (TC) and (TG). The best decrease recorded for group fed on mixed oils (10% SO with 10% OO) plus 5% sage.

Olive oil and sesame oil contain high amounts of mono unsaturated fatty acids MUFAs, concerning the effects of MUFAs***(Paniagua et al., 2007)*** demonstrated that, consumption of MUFAs decreased blood (TGs) by increasing fatty acid oxidation through activation of peroxisome proliferator – activated receptor (PPAR) or by reducing the activation of sterol regulatory element binding protein (SREBP) and inhibiting lipogenesis.

Concerning the effects of (SO) on TL, TC and TG, our results are at the same line with ***(Taha et al., 2014)*** who reported that, treatment of hyperlipidimic rats with (SO) 5&10% showed hypolipidimic activity as they decreased hepatic level of TG & TC. Concerning sage effects on plasma lipids ***(Eidi and Eidi., 2009)*** reported that, sage ethanolic extract significantly decreased serum glucose, triglycerides and total cholesterol.

In this respect, ***(Ben Khedher et al., 2018)*** suggested that, sage treated animals had a decrease in plasma triglycerides level.

Effects of Sage, Sesame and Olive Oils On Serum Lipoprotein Fraction in Nonalcoholic Fatty Liver Rats.

Results presented in Table (2) showed the effects of (HFD) and (MHFD) on lipoprotein cholesterol in nonalcoholic fatty liver disease (NAFLD) albino rats. Results revealed that (+ve) control group fed on (HFD) recorded a significant increase in LDL-c and VLDL-c, as compared to the (-ve) control group, while recorded a significant decrease in (HDL-c) level, as compared to the negative control group (-ve)

Also results in table (2) revealed that, all (+ve) groups fed on tested (MHFD) by adding 5% sage to HFD or replacing (20% ST) to 20% (OO), 20% (SO) and mixed (1:1 W/W) from 10% (SO) with 10% (OO) without or with 5% sage induced a significant decrease ($p \leq 0.05$)in LDL-c and VLDL-c, while recorded a significant increase ($p \leq 0.05$) in (HDL-c). However, rats group fed on diet containing (10% SO and 10% OO) plus 5% sage; After 8 weeks, induced a significant increase in HDL-c, while recorded a significant decrease in LDL-c and VLDL-c.

Our results are in agree with ***(Christensen et al., 2010)*** who reported that, sage extract was able to lower plasma cholesterol, low density lipoprotein LDL-c and TGs, as well as increase the high density lipoprotein (HDL-c) levels in lipidemic rats. On the other side our results are at the same line with **(*Asgary et al., 2013)*** whoreported that dietary supplementation with sesame oil significantly reduce TC and LDL-c concentration in rabbits under a lipogenic diet. In this concern ***(El-Baz et al., 2015)*** reported that supplementation of hypolipidemic rats with (SO) found to have lower circulating concentration of TC, LDL-c and normalized TG.

Concerning (OO) ***(Bopitiy and Madhujith., 2013)*** suggested that olive oil (OO) rich in mono unsaturated fatty acid (MUFA) lower total and LDL-c, triglycerides and increase HDL-c. We suggested that, combination between (SO) with (OO) plus sage maximized the potential effects of each component alone.

Effects of Sage, Sesame and Olive Oils On Liver Enzymes in Nonalcoholic Fatty Liver Rats.

Table (3) showed the effects of (HFD) and (MHFD) on liver enzymes in (NAFLD) albino rats. Results revealed that, serum liver enzymes as spartate amino transferas (AST), Alanin amino transferas (ALT), and alkaline phosphatase (ALP) levels for the control (+ve) group recorded a significant increase (P≤ 0.05), as compared to the control (-ve) group fed on (BD). In this respect***(Tolman et al., 2004)*** reported that, the increased levels of the liver enzymes (ALT), (AST) and γ- glutamyl transferase (GGT) are the markers of (NAFLD).

Concerning (+ve) groups fed on (MHFD) by adding 5% sage or by replacing 20% (ST) to 20% (SO), 20% (OO) and mixed (1:1 W/W) from 10% (SO) with 10% (OO) without or with 5% sage induced a significant decrease (P≤ 0.05) in level of liver enzymes (AST), (ALT) and (ALP). In this respect, ***(Amin and Hamza, 2005)*** suggested that, serum AST, ALT and ALP are the enzymes biomarker to monitor the liver structural integrity and damage and aids in the clinical diagnosis of NAFLD and other liver toxicity conditions. Generally, high fat diet increases these enzymes through the induction of oxidative stress in the liver.

Our results revealed that, consumption of modified (HFD) by adding 5% sage or replacing 20% (ST) to 20% (SO), 20% (OO) or mixed 20% (1:1 W/W) from (SO) and (OO) without or with 5% sage induced a significant decrease in serum liver enzymes (AST, ALT and ALP).

Son et al., (2007)reported that sage leaf extract increased significantly the plasma level of anti-inflammatory cytokines and inhibited an opposite effect on pro inflammatory cytokines by decreasing plasma level of TNF-α, KC/GRO and IL-2. KC/GRO is highly induced by pro inflammatory cytokines such as TNF- α.
In this respect ***(El-saher, 2012)*** reported that, sage and its isolated oils are largely responsible for promoting energy expenditure and fat oxidation, which may led to body weight reduction.

Our results revealed that the best results induced by replacing 20% (ST) to 20% mixed (1:1 W/W) 10% (SO) with 10% (OO) plus 5% sage. High amount of sesamin and sesamol have been identified in sesame and they are reported to increase the hepatic mitochondria and peroxisome fatty oxidation rate, also sesame lignans have antioxidant and healthy promoting activity ***(Uthandi and Ramasamy 2011).*** In this concern ***(Kumar and Singh, 2015)***reported that, sesame oil has a higher concentration of sesamol, the isolated lignans and sesamol is the best antioxidant and free radical scavenging properties, responsible for the protective response.

Concerning olive oil effects ***(Shidfar et al., 2018)***reported that,the consumption of low caloric diet enriched with olive oil, along with slight weight reduction, reinforces the desired effect of weight loss in improving the levels of hepatic enzymes.

Effects of Sage, Sesame and Olive Oils on Antioxidant Enzymes in Nonalcoholic Fatty Liver Rats.

Table (4) showed the levels of antioxidant enzymes in (NAFLD) fed on (HFD) and (+ve) group fed on (MHFD). Results revealed that, the (+ve) control group recorded a significant decrease (P≤ 0.05) in levels of glutathione peroxidase (GSH-PX), Superoxide dismutase (SOD) and Catalase (CAT) as compared to the control (-ve) group.

On the other hand, results revealed that all (+ve) groups fed on tested (MHFD) by adding 5% sage to HFD, or replacing 20% (ST) to (20% SO or 20% OO) and mixed 20% (1:1 W/W) from 10% (SO) with 10% (OO) without or with 5% sage, statistically showed a significant increase (P≤ 0.05) in (GSH-PX), (SOD) and (CAT) levels as compared to the (+ve) control group.

The best results induced greatest increase in (GSH-PX), (SOD) & (CAT) by (+ve) group (NAFLD) fed on (MHFD) by replacing 20% (ST) to 20% mixed (1:1 W/W) from 10% (SO) with 10% (OO) plus 5% sage.

Our results revealed that, in (NAFLD) replacing 20% (ST) to mixed combination from 10% (SO) with 10% (OO) plus 5% sage, this combination maximized the potential effects of (OO), (SO), and sage than the potential effect of each component only.

In this concern our results are at a harmony with ***(Gorinstein et al., 2002)*** who suggested that, olive oil maintained the plasma lipid pool by regulating the lipid peroxidation and antioxidant parameters. Our results are at the same line with ***(Hassanein, 2010)*** who reported that sesame oil contained powerful antioxidant lignans, when mixed with individual sunflower and olive oil generally, the antioxidative stability of oil mixtures was increased.

In this respect ***Kumar and Singh (2015)*** suggested that, sesame seeds are rich in phytochemical called lignans, which are methylene dioxyphenyl compounds.

In this concern also our results are at a harmony with ***(Alshubaily and Jambi, 2018)***who reported that, sage water extract could be used as a natural antioxidant supplement due to the presence of essential oil, phenolic contents and other antioxidant components in sage.

Effects of Sage, Sesame and Olive Oils on Liver Histopathological Changes in Nonalcoholic Fatty Liver Rats.

Histopathological examination of liver of rats from control (-ve) group fed on (BD) revealed that normal histology of hepatic lobule as shown in Photo (1&2). On the other side. In rats from (+ve) control group fed on (HFD), showed a macrovesicular steatosis of hepatocytes (Photo 3&4).

Concerning (+ve) groups (NAFLD) fed on (MHFD) for 8 weeks by adding 5% sage to HFD, showed vacuolar degeneration of

hepatocytes as shown in Photo (5&6). Some Sections from (+ve) group fed on (MHFD) by replacing 20% (ST) to 20% (OO) revealed cytoplasmic vacuolization of hepatocytes as shown in Photo (7&8).

Meanwhile examination of liver from (+ve) group fed on (MHFD) by replacing 20% (ST) to 20% sesame oil (SO), microscopically sections of liver revealed hydropic degeneration of hepatocytes as shown in Photo (9&10). Meanwhile liver sections examination of rats from (+ve) group fed on (MHFD) by replacing 20% (ST) to 20% from mixed (1:1 W/W) 10% (SO) plus 10% (OO), revealed cytoplasmic vacuolization of hepatocytes and slight hydropic degeneration as shown in Photo (11&12).

On the other hand, our histopathological results of liver sections examination from (+ve) group fed on modified (HFD) by replacing 20% (ST) to mixed (1:1 W/W) from 10% (SO) with 10% (OO) plus 5% sage showed slight hydropic degeneration of hepatocytes as shown in Photo (13 &14).

Results of the histopathological examination of liver of (NAFLD) fed on (MHFD) by adding 5% sage or replacing 20% (ST) to 20% (SO), (OO) and 20% from mixed (1:1 W/W) without or with 5% sage different (MHFD) dose revealed a dose dependent reduction of steatosis degenerative changes caused by (HFD). This histological finding may confirm the various biochemical changes in lipid profile, TC, TG and lipid fraction. These findings at a harmony with ***(Szende et al., 1994)*** who suggested that olive oil, in contrast to polyunsaturated oils, could protect the liver against the development of fibrosis.

In respect to the effect of sesame oil ***(Bopitiy and Madhujith, 2013)*** suggested that (SO) possessed a strong antioxidant activity. On the other side ***(Alves Rodrigies et al., 2011)*** cleared that hydroalcoholic extract and active compound isolated from sage such as carnosol, oleanolic and ursolic acids reduces the nociception and oedema induced by different chemicals.

In this concern ***Oniga et al, (2007)*** demonstrated that sage leaf extract increased significantly the plasma level of anti-inflammatory cytokines and exhibited an opposite effect on pro-inflammatory cytokines by decreasing the plasma level of TNF-X, KC/ GRO and IL-12, KC/GRO is highly induced by pro-inflammatory cytokines such as TNF-α***(Son et al., 2007).***

Conclusion

our results revealed that modified high fat diet (MHFD) by replacing 20% (ST) to 20% from a combination between mixed (1:1 W/W) 10% (SO) with 10% (OO) plus 5% sage induced a clear raise in the protective effects of either component alone in the amelioration of liver (NAFLD) and prevent fibrosis or cirrhosis. This results confirmed by histopathological examination.

Table (1): Effects of Sage, Sesame and Olive Oils on Total Lipids, Cholesterol and Triglycerides in Nonalcoholic Fatty Liver Rats**.**

Parameters / Groups		Lipid	Cholesterol	Triglycerides
		mg/dl		
Control (-ve) group		303.628[h] ± 5.328	88.556 [h] ± 3.216	56.030 [g] ± 3.420
Control (+ve) group, fed on high fat diet (HFD).		518.758[a] ± 6.948	166.433 [a] ± 8.742	107.645 [a] ± 8.400
Fed on modified high fat diet (MHFD) containing	5% sage	471.367[b] ± 6.859	149.612 [b] ± 5.547	98.225 [b] ± 8.872
	20% olive oil "OO"	401.539[d] ± 9.552	142.915 [c] ± 5.547	92.121 [b c] ± 5.152
	20% sesame oil "SO"	440.104[c] ± 5.810	139.536 [cd] ± 4.516	86.163 [c d] ± 3.4534
	10% OO plus 10% SO	393.939[d] ± 9.470	135.015 [d] ± 3.748	83.660 [d] ± 3.243
	20% OO plus 5% sage	361.245 [f] ± 10.604	128.208 [e] ± 3.472	79.324 [d e] ± 3.517
	20% SO plus 5% sage	378.286[e] ± 7.732	119.539 [f] ± 3.553	73.576 [e] ± 3.067
	10% OO plus 10% SO plus 5% sage	348.039[g] ± 6.320	111.500 [g] ± 3.086	66.357 [f] ± 3.725

OO: Olive Oil **SO:** Sesame Oil

Mean values in each column with same letters are not significantly different.

LSD: Least significant differences (P<0.05)

Table (2): Effects of Sage, Sesame and Olive Oils on Serum Lipoprotein Cholesterol in Nonalcoholic Fatty Liver Rats.

Groups \ Parameters		HDL-c mg/dl	LDL-c mg/dl	VLDL-c mg/dl
Control (-ve) group		51.849 [a] ± 1.938	25.500 [i] ± 0.780	11.205 [g] ± 0.684
Control (+ve) group, fed on high fat diet (HFD).		25.876 [h] ± 3.890	119.029 [a] ± 3.263	21.528 [a] ± 1.679
Fed on modified high fat diet (MHFD) containing	5% sage	29.160 [g] ± 3.214	100.986 [b] ± 1.753	19.644 [b] ± 1.774
	20% olive oil "OO"	32.491 [f] ± 1.945	92.000 [c] ± 3.068	18.424 [bc] ± 1.030
	20% sesame oil "SO"	34.899 [e f] ± 1.535	87.403 [d] ± 3.195	17.232 [cd] ± 0.690
	with 10% OO plus 10% SO	37.062 [e] ± 1.526	81.221 [e] ± 3.041	16.731 [d] ± 0.648
	20% OO plus 5% sage	40.703 [d] ± 1.094	71.639 [f] ± 2.930	15.864 [de] ± 0.703
	20% SO plus 5% sage	43.624 [c] ± 1.237	61.199 [g] ± 3.724	14.715 [e] ± 0.613
	10% OO plus 10% SO plus 5% sage	47.795 [b] ± 0.842	50.433 [h] ± 3.169	13.271 [f] ± 0.745

OO: Olive Oil **SO:** Sesame Oil

Mean values in each column with same letters are not significantly different.

LSD: Least significant differences (P<0.05)

Table (3): Effects of Sage, Sesame and Olive Oils On Liver Enzymes in Nonalcoholic Fatty Liver Rats.

Groups \ Parameters		AST U/l	ALT U/l	ALP U/l
Control (-ve) group		74.614 $^{f g}$ ± 2.893	25.468 ^{h} ± 1.535	101.694 ^{g} ± 6.469
Control (+ve) group, fed on high fat diet (HFD).		116.056^{a} ± 4.682	81.323 ^{a} ± 3.243	277.225^{a} ± 13.360
Fed on modified high fat diet containing	5% sage	103.252^{b} ± 4.262	72.971 ^{b} ± 3.221	223.805^{b} ± 7.245
	20% olive oil "OO"	96.822 ^{c} ± 4.214	67.180 ^{c} ± 3.045	218.792^{bc} ± 6.677
	20% sesame oil "SO"	92.741 ^{c} ± 2.918	62.334 ^{d} ± 2.057	215.644^{bc} ± 4.218
	10% OO plus 10% SO	86.399 ^{d} ± 3.555	59.306 ^{d} ± 2.452	210.032 ^{c} ± 4.640
	20% OO plus 5% sage	79.922 ^{e} ± 2.919	54.060 ^{e} ± 2.824	196.865 ^{d} ± 4.389
	20% SO plus 5% sage	75.331 $^{e f}$ ± 3.369	48.590 ^{f} ± 3.146	183.951 ^{e} ± 5.160
	10% OO plus 10% SO plus 5% sage	70.224 $^{g f}$ ± 3.548	42.686 ^{g} ± 2.333	174.608 ^{f} ± 4.628

OO: Olive Oil **SO:** Sesame Oil

Mean values in each column with same letters are not significantly different.

LSD: Least significant differences (P<0.05)

Table (4): Effects of Sage, Sesame and Olive Oils on Antioxidant Enzymes in Nonalcoholic Fatty Liver Rats.

Groups \ Parameters		Glutathione peroxidase (GSH-Px) ng/g Liver	Superoxide dismutase (SOD) U/g liver	Catalase (CAT) mmol/g liver
Control (-ve) group		0.560 [a] ± 0.012	0.392 [a] ± 0.0251	0.413 [a] ± 0.016
Control (+ve) group, fed on high fat diet (HFD).		0.252 [f] ± 0.011	0.258 [g] ± 0.011	0.210 [f] ± 0.015
Fed on modified high fat diet (MHFD) containing	5% sage	0.325 [e] ± 0.014	0.303 [f] ± 0.009	0.265 [e] ± 0.011
	20% olive oil "OO"	0.372 [d] ± 0.014	0.326 [e] ± 0.009	0.290 [d] ± 0.014
	20% sesame oil "SO"	0.364 [d] ± 0.006	0.326 [d e] ± 0.008	0.283 [de] ± 0.010
	10% OO plus 10% SO	0.378 [d] ± 0.008	0.332 [cde] ± 0.009	0.299 [d] ± 0.024
	20% OO plus 5% sage	0.439 [c] ± 0.011	0.347 [c] ± 0.009	0.332 [c] ± 0.008
	20% SO plus 5% sage	0.429 [c] ± 0.009	0.342 [c d] ± 0.005	0.324 [c] ± 0.006
	10% OO plus 10% SO plus 5% sage	0.476 [b] ± 0.012	0.366 [b] ± 0.008	0.354 [b] ± 0.008

OO: Olive Oil **SO:** Sesame Oil

Mean values in each column with same letters are not significantly different.

LSD: Least significant differences (P<0.05)

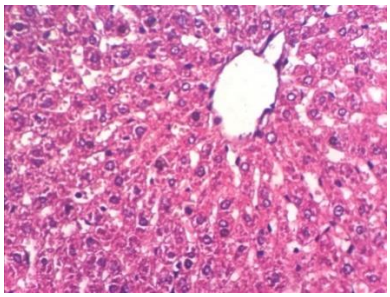

Photo (1):

Liver of rat from group 1showing the normal histological structure of hepatic parenchyma (H & E X 400).

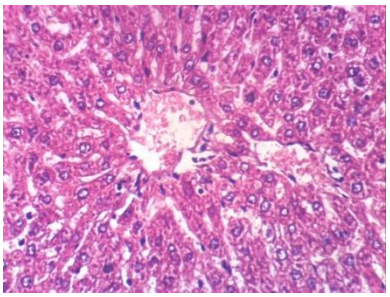

Photo (2):

Liver of rat from group 1 showing the normal histological structure of hepatic parenchyma (H & E X 400).

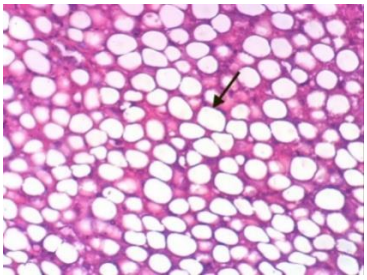

Photo (3):

Liver of rat from group 2showing macrovesicular steatosis of hepatocytes (arrow) (H & E X 400)

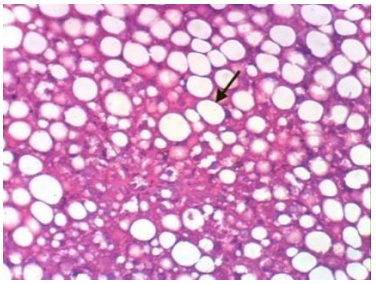

Photo (4):

Liver of rat from group 2 showingmacrovesicular steatosis of hepatocytes (arrow) (H & E X 400).

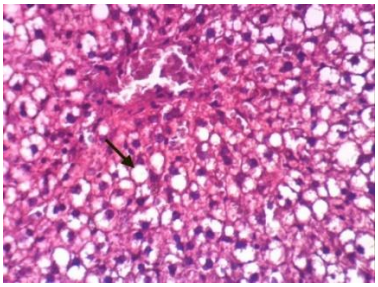

Photo (5):

Liver of rat from group 3 showing vacuolar degeneration of hepatocytes (H & E X 400).

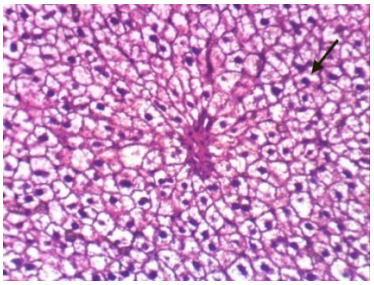

Photo (6):

Liver of rat from group 3 showing hydropic degeneration of hepatocytes (H & E X 400)

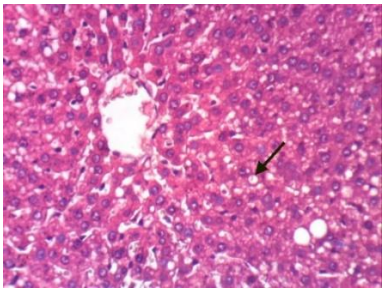

Photo (7):

Liver of rat from group 4 showing cytoplasmic vacuolization of hepatocytes (H & E X 400).

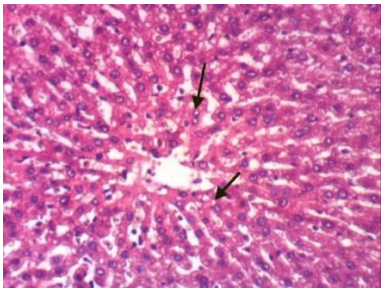

Photo (8):

Liver of rat from group 4 showing cytoplasmic vacuolization of hepatocytes (H & E X 400).

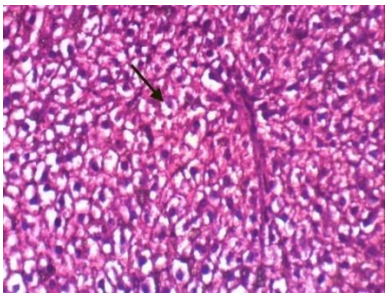

Photo (9):

Liver of rat from group 5 showing hydropic degeneration of hepatocytes
(H & E X 400).

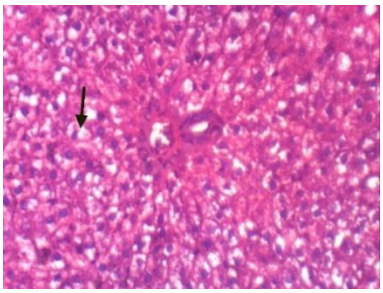

Photo (10):

Liver of rat from group 5 showing hydropic degeneration of hepatocytes
(H & E X 400).

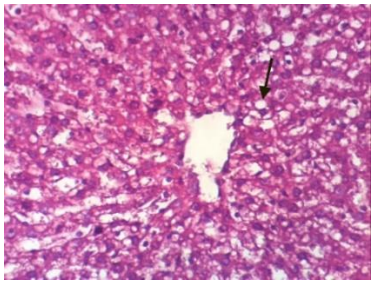

Photo (11):

Liver of rat from group 6 showing cytoplasmic vacuolization of hepatocytes
(H & E X 400).

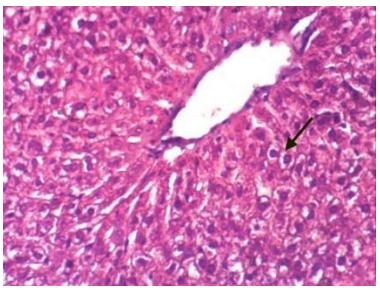

Photo (12):

Liver of rat from group 6 showing slight hydropic degeneration of hepatocytes
(H & E X 400).

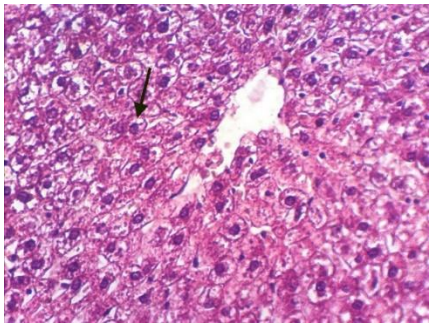

Photo (13):

Liver of rat from group 9 showing slight hydropic degeneration of hepatocytes (H & E X 400).

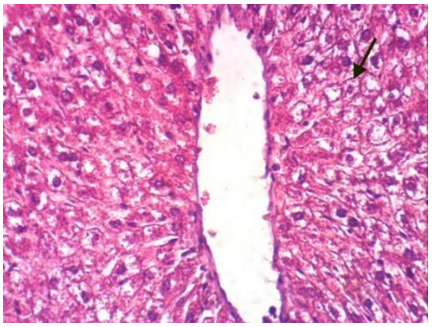

Photo (14):

Liver of rat from group 9 showing slight hydropic degeneration of hepatocytes (H & E X 400).

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التأثيرات المحتملة لمسحوق المرمرية وزيوت السمسم والزيتون علي صورة الدهون ووظائف الكبد لفئران الكبد الدهنى غير الكحولي

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الملخص العربى

الهدف من هذه الدراسة هو معرفة تأثيرات المرمرية ، وزيوت (السمسم و الزيتون مفردا) ومختلطا مع المريمية على الدهون الكلية (TL) والكوليسترول الكلي (TC) والجلسريدات الثلاثية (TG) وجزيئات البروتين الدهني في الدم (HDL-c, LDL-c and VLDL-c) وإنزيمات الكبد والإنزيمات المضادة للأكسدة ، وكذلك التغيرات النسيجية للكبد في فئران الالبينو البدينة التي تعاني من مرض الكبد الدهني غير الكحولي (NAFLD). تم استخدام عدد ٧٢ فأرا بالغا من نوع الالبينو من فصيلة الاسبراج داولي اوزانهم ٢٠٠ ± ١٠ جم في هذه الدراسة.تم تقسيم الفئران الي مجموعتين رئيسيتين. المجموعة الرئيسية الأولي (٨ فئران) تم تغذيتها علي غذاء اساسي واستخدمت كمجموعة ضابطة سالبة.المجموعة الرئيسية الثانية (٦٤ فأرا) تم تغذيتها علي غذاء عالي الدهن لمدة ثمانية اسابيع لإحداث مرض الكبد الدهنى غير الكحولي. تم تقسيم الفئران المصابة بتدهن الكبد غير الكحولي الي (٨ مجموعات فرعية).مجموعة منهم (٨ فئران) تم تغذيتها علي غذاء عالي الدهن واستخدمت كمجموعة ضابطة ايجابية "مصابة".المجموعات السبع الفرعية الاخري تم تغذيتها علي نظام غذائي معدل عالي الدهن. مجموعة منهم تم تغذيتها علي غذاء عالي الدهن تحتوى علي ٥% مرمرية.المجموعات الفرعية الست الاخري تم تغذيتها عليغذاء عالي الدهن معدل عن طريق إستبدال ٢٠% دهن الغنم بـ ٢٠% زيت سمسم، ٢٠% زيت زيتون و

خليط " ١٠% زيت سمسم مع ١٠% زيت زيتون "بدون أو بإضافة المرمرية لمدة (٨ اسابيع). أشارت النتائج الي أن الغذاء عالي الدهن المعدل بإضافة ٥% مرمرية أو بإحلال ٢٠% دهن الغنم بـ ٢٠% زيت السمسم، ٢٠% زيت زيتون و خليط منهما (١:١ وزن / وزن) مع أو بدون ٥% مرمرية أحدثت تناقصا معنويا في انزيمات الكبد في السيرم (AST, ALT and ALP) ، الكولسترول الكلي، الجلسريدات الثلاثية، كولسترول الليبوبروتينات منخفضة الكثافة والمنخفضة جدا، في حين أشارت النتائج الي حدوث ارتفاع معنوي في مستوى كولسترول الليبوبروتينات عالية الكثافة. أشارت النتائج أيضا الي حدوث ارتفاع معنوى احصائي في الانزيمات المضادة للأكسدة "انزيمات الجلوتاثيون بيروكسيديز، وسوبراكسيد ديسميوتيز والكاتاليز"، مقارنة بالمجموعة الضابطة المصابة. الفحص النسيجى للكبد في مجموعة الفئران المصابة بتدهن الكبد غير الكحولي والتى تم تغذيتها علي غذاء عالي الدهن (معدل) والذي يحتوى علي ٢٠%خليط زيت سمسم و زيت زيتون بنسب (١:١ وزن / وزن) بإضافة ٥% مرمرية ربما يكون قد ادى الي زيادة فاعلية المكونات مع بعضها البعض عما لو كانت منفرده وقد ادى ذلك الي افضل تحسن في تدهن الكبد. وخلاصة نتائجنا أشارت إلى أن استبدال ٢٠٪ من دهن الغنم بنسبة ٢٠٪ من خليط (زيت السمسم) مع (زيت الزيتون) بنسب (١:١ وزن / وزن) وبإضافة ٥% مرمرية ، أحدثت أكبر تحسن في الفئران المصابة بمرض الكبد الدهنى غير الكحولي التي تم تغذيتها على غذاء عالي الدهن. أظهر البحث الحالي أن التحاليل الكيميائي للمرمرية وزيوت السمسم و الزيتون أظهر وجود مركبات الفلافونويد والمركبات الفينولية وهذه المركبات لها قيمة علاجية ويمكن أن تعدل دهون الكبد لمرضى السمنة المصابيين بتدهن الكبد.