Kurdistan Journal of Applied Research (KJAR)
Print-ISSN: 2411-7684 | Electronic-ISSN: 2411-7706
Special Issue: 2nd International Conference on the Health & Medical Sciences | DOI: 10.24017/science.2018.2.6

Received: 25 June 2018 | Accepted: 16 July 2018

Effect of Different Dietary Oils and Fat on Body Weight, Food Intake, Some Haematological and Biochemical Parameters in Female Albino Rats

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Abstract: ***The present study investigates the influence of different dietary plant oils included sunflower oil (SO), olive oil (OO) corn oil (CO), and animal (AF) on different parameters in female albino rats. Twenty-two animals were divided equally and randomly into five groups, the treatment was performed by needle gavage. First group fed on basal diet and served as control. Second group fed on a basal diet with 0.3ml/rat animal fat orally. Third group fed on a basal diet with 0.3ml/rat sunflower oil orally. Fourth group fed on a basal diet with 0.3ml/rat olive oil orally. Fifth group fed on a basal diet with 0.3ml/rat corn oil orally. It continued for 28 days. Several parameters were measured during and after the study such as body weight, food intake, organ weight (kidney, liver and spleen) Haematological parameters (Hb, RBC, WBC, PLT, HCT and MCV), lipid profile (Total cholesterol, TG, HDL and LDL). Commonly plant oils and animal fat showed both benefits and harmful effects on the mentioned parameters; the corn oil and olive oil played important role through generating the healthy signs among other oils and animal fat. The present results concluded that both corn oil and olive oil may own positive effect than the other animal fat sunflower oil of people used in their daily diet.***

Keywords: Corn oil, Olive oil, Sunflower oil, Animal oil and Lipid profile.

1. INTRODUCTION

Fats and oils play supplied high energy, taste and desirable flavor of the food preparation. Each gram of oil or fat provides 9 kilo calories (Kcal) energy which is the double of the quantity of energy as is provided by proteins or carbohydrates. They contain more unsaturated fatty acids than the saturated fatty acids are particularly susceptible to oxidation. The food intake containing oxidized lipid increase the concentration of secondary peroxidation products in the liver. Metabolism of these components ultimately affects the activity of different lipogenic enzymes and causes various types of liver injury[1].

Therefore, this study was aimed to investigate the influence of different dietary fats oils included animal fat (AF), sunflower oil (SO), olive oil (OO) and corn oil (CO) on body weight BW, food intake, some haematological and biochemical parameters in female albino rats.

2. LITERATURE REVIEW

Each of cholesterol, saturated fatty acids, trans fatty acids of fats and oils increase the risk of coronary heart diseases by increasing the blood cholesterol [2]. However, CO is a good source of essential fatty acids and their nutritional properties are excellent and the fatty acids found in their structure are palmitic acid, stearic acid, oleic acid, linoleic acid, and linolenic acid [3]. Besides that, it responsible for hyperlipidemia, increase of total lipids, triglycerides (TG) and low-density lipoprotein cholesterol (LDL-c) along with a decrease in high-density lipoprotein cholesterol (HDL-c). Hyperlipidemia is the predictor of coronary artery disease, fatty liver disease and carcinogenesis and is a predominant risk factor for cardiovascular diseases [4]. On the other hand, OO is extensively used in Europe as well as Mediterranean countries as a cooking and seasoning medium for many centuries. This oil is established to have a higher content of unsaturated fatty acids and has been widely recommended to be superior to other oils in maintenance of health, although no detailed comparative study has been reported on its efficacy in humans or animals. Nevertheless, some reports have mentioned the decreased cardio-vascular dysfunction in persons using OO and the relatively decreased incidence of heart related problems in Mediterranean countries [5]. However, others in Western Europe have been attributed to increased use of OO by these populations, in their daily diet both as a cooking and a seasoning medium. The beneficial effects of this oil on cardiovascular system [6] in humans can be attributed to the presence of phenolic compounds reported by some investigators [7] this edible oil has also been reported to have constituents that provide protection against reactive oxygen species (ROS) and lipid peroxidation [8]. Beneficial effects of OO in reducing lipid

peroxidation and in enhancing cardio protection have been corroborated by other investigators as well [9]. One of the most reasons for the popularity growing of SO using to its magnificent fatty acid content, oleic acid (omega-9) and linoleic acid (omega-6) which are the predominant monounsaturated and polyunsaturated fats [10]. Both of SO and CO reduce cholesterol synthesis, they are considered as risk factors for the sensitivities to free radical formation because of their high contents of polyunsaturated fatty acids (PUFAs) [11], Another study indicated that corn oil offering health benefits through decreasing of cholesterol, TG, and LDL concentrations [6]. It has been reported that CO administration increased both TGA and phospholipids level which may positively correlated with hepatic lipogenic enzyme activity. In addition, it decreases the activity of mitochondrial carnitine palmitoyl transferase-1 (PTS-1), resulted in impairment in fatty acid oxidation and lipid accumulation in corn oil fed rats [7], while A. F. contain higher proportions of saturated fatty acids (SFA), may increase the risk of vascular system diseases. Numerous studies indicate that butter elevates the level of total cholesterol, LDL-c and TG. It has also been reported that consumption of dietary butter contributes to hypercholesterolemia due to its high content of SFA [12]. A high dietary fat meal is known to induce obesity in animals and humans [2] This is accomplished even without hypercaloric intake, indicating an elevated feeding efficiency induced by high-fat feeding [3] Other research findings have documented that not only quantity, but also fat type used in the diets will affect the amount of weight gained. Saturated fatty acids (SFAs) have been shown to produce higher rates of weight gain compared with other types of fatty acids [4]. As an important constituent of cell membranes, lipids also play specific roles in membrane signaling events. Thus cell development certain lipids are indicators of cellular events, and lipid concentration can represent physiological conditions of cells [5].

3. METHODS AND MATERIALS

Animals and housing

The female of inbred rats *Rattus norvegicus* [6] were bred in the animal house of Biology department, Faculty of Science, Soran University, Soran, Erbil, Iraq. They were acclimatized in an environmentally controlled room at constant temperature 22 ± 2 °C, they were maintained at free access to tap water *ad libitum* and were fed at a standard pelleted feed according to Pico Lab. The pellets contained (wheat 66.6%, soya bean 25.6%, sunflower oil 4.4%, lime stone 1.5%, salt 0.63%, methionine 0.158%, choline chloride 0.062% and trace elements 0.05%). During the experiment the cages were cleaned once a week. Olive, corn, sunflower and animal fats were purchased from local markets in Soran city, Iraq they were mostly used by the people of food cooking.

Experimental design

The present study was performed on 24 female albino rats weighing (132-288) gm were randomly and equally divided into five groups as following:

Group I (control group) (n=4): Rats were given, control diet and tap water *ad libitum.*

Group II (AF group) (n= 5): Rats were given control diet, tap water *ad libitum* and 0.3ml animal fat daily by gavage orally.

Group III (SO group) (n= 5): Rats were given control diet, tap water *ad libitum* and 0.3ml sunflower oil daily by gavage orally.

Group IV (OO group) (n=4): Rats were given control diet, tap water *ad libitum* and 0.3ml olive oil daily by gavage orally.

Group V (CO group) (n=4): Rats were given control diet, tap water *ad libitum* and 0.3ml corn oil daily by gavage orally.

The experiment was performed for four weeks.

Body weight and food intake determination

At the beginning of the experiment and the end of each week, the weight of animals and food intake were recorded.

Collection of blood samples

At the end of experiment, they anesthetized after 24 hours fasting with ketamine hydrochloride (50 mg/kg). Blood samples were taken by cardiac puncture into chilled tubes with or without ethylene diamine tetra acetic acid (EDTA) (4.5mM) as anticoagulant and centrifuged at 3000 rpm for 15 minute.

Absolute organ weight measurements

After animal dissection the weight of liver, spleen and right kidney were recorded by precision electronic balance.

Haematological parameters measurement

Haematological parameters (Hb, RBC, WBC, PLT, HCT and MCV) were measured by coulter counter (Nihon Kohden, MEK-6410K, Japan) for each group[7].

Serum lipid profile determination

Serum total cholesterol (TC), HDL-C and TG were estimated by the enzymatic colorimetric test –CHOD-PAP Method, while LDL was estimated using the formula of Friedewald [8].

Statistical analysis

The data analyzed statistically by one-way analysis of variance (ANOVA) using statistical package for the social sciences (SPSS) version 16.0 with significant level fixed at $p<0.05$. Data were expressed as mean ± standard error (mean ± S.E.).

4. RESULTS

Effect of different dietary oils and fat on food intake

The effect of AF, SO, OO, and CO on food intake of female rats are shown in table 1, non-significant changes was occurred in week1 in AF group as compared to the control group, meanwhile both of S.O and CO were increased significantly $p< 0.05$ as compared to the control. In contrast food intake was decreased

significantly $p< 0.05$ in the OO as compared to the control. In week 2 food intakes significantly $p< 0.05$ increased in AF, SO and CO groups respectively as compared to the control group, whereas it decreased significantly $p< 0.05$ in OO group as compared to the control group, but in week 3 and week 4 the food intake significantly $p< 0.05$ increased in AF, SO and CO groups as compared to control group, while the non-significant change was occurred in OO group.

Effect of different dietary oils and fat on body weight

The effect of AF, SO, OO, and CO on BW are shown in table 2. The non-significant change was occurred in A.O., SO and OO groups in week 1 as compared to the control group, while it decreased significantly $p< 0.05$ in CO group as compared to control group. Furthermore, the non-significant change was occurred in week 2, week 3 and week 4 in all experimental groups as compared to the control group.

Effect of different dietary oils and fat on liver, kidney and spleen absolute weight

The effect of AF, SO, OO, and CO on liver, kidney and spleen are shown in table 3. The liver weight was significantly $p< 0.05$ increased in all experimental groups as compared to control group. On the other hand, kidney weight of AF was significantly $p< 0.05$ decreased as compared to the control group; in addition, the non-significant change was occurred of kidney weight of SO, OO and CO groups as compared to control group. Conversely the weight of spleen in both SO and OO groups were significantly $p< 0.05$, increased as compared the control group, instead that non-significant changes were occurred of AF and CO groups as compared the control group.

Effect of different dietary oils and fat on some haematological parameters

The effect of AF, SO, OO, and CO on some haematological parameters are shown in table 4. Non-significant changes were occurred of WBCs parameter in all experimental groups in comparison with control group. Also, the non-significant change was occurred of RBCs in all experimental groups except in AF group which was significantly $p< 0.05$ increased as compared to the control group. In addition, the Hb level of all experimental groups changed non-significantly as compared to the control group. In contrast the HCT level in AF and OO groups were significantly $p< 0.05$ decreased as compared to control group. In contrast, HCT of SO and CO groups changed non-significantly as compared to control group. The platelets in A. F. and OO groups were decreased significantly $p< 0.05$ as compared to control group, while it changed non-significantly in SO and CO groups as compared to control groups. Furthermore, the non-significant changed was occurred of MCV parameter in AF, SO and OO groups as compared to control group, but MCV in CO group was decreased significantly $p< 0.05$ as compared to control group.

Effect of different dietary oils and fat on lipid profile parameters

The effect of AF, SO, OO, and CO on lipid profile parameters are shown in table 5. TC in AF and SO groups changed non-significantly as compared to control group; meanwhile it decreased significantly $p< 0.05$ in OO and C. O. groups as compared to control group. On the other hand, the non-significant change was occurred HDL parameter in all experimental groups as compared to control group, in addition the non-significant change was occurred of LDL in AF and CO groups as compared to control group, whereas the LDL level in SO and CO groups were decreased significantly $p< 0.05$ as compared to control group, but TG was changed non-significantly in all experimental groups as compared to control group.

5. DISCUSSION

The different dietary oils and fat used in the current study affected food intake during the four weeks feeding period. Rats were fed CO (table 1) in their diet increased their food intake in agreement with previous study [9] who suggested that rats fed the CO diet increased their food intake and also agreed with finding of [10] at the same manner, similarly the elevation of food intake in SO group (table 1) during 4 weeks is agreed with the finding of [11] who reported that rats fed SO during 90 days treatment consumed more food. On one hand, our food intake data disagreed with finding of [12] who reported that rats administered 10 mg/kg CO in diets significantly lowered it. On the other hand, our previous work [13] suggested that oral administration of male rats with CO (0.3 ml/rat) by gavage for four weeks didn't change rat's food consumption significantly. The increased food intake by CO may it attributed for providing the appetite stimulation. On the other hand, our results disagreed with finding of [14] who showed that the OO administration significantly decreased food intake. The significant increase in AF is supported by [15] who demonstrated that the 'high-fat diet' to induce obesity by a nutritional intervention.

The significant decrease in BW in CO group (week 1) (table 2) is supported by the findings of [16] who investigated that the female rats given CO by gavage had 3-7% lowered BW, also these differences in BW are similar with observed in an earlier finding [17]. On the other hand, the non-significant decrease in BW of rats treated with different oils AF, SO, OO, and CO (table 2) in other three weeks may return to their high activity of female rats during day. Therefore, female rat's activity during day may decline BW (table 2).

The significant increase of liver weight in CO group (table 3) is supported by the finding of [18], and disagreed with previous finding [13]. On the other hand, the significant increase in liver weight negatively matched with BW insignificancy (table 1). Conversely , the liver weight also in rats treated with AF diet may attributed to insulin action supported by both [2] who showed that high fat feeding is known to induce insulin resistance. Furthermore, the fatty acid profile of the diet also influences insulin action. Also in the SO group the significant increase in liver weight is disagreed with previous data [19]. Besides that, liver weight increased is disagreed with finding of [20] who demonstrated that rats fed 20% saturated fatty acid combined with different oil included OO Kidney weight in SO group also disagreed [19]. Meanwhile the increased weight of

spleen in OO group was disagreed with the finding of [21] who demonstrated that Wister rats treated with 1ml/kg BW lead to decrease spleen weight, besides that, it needs additional investigations in order to explain the effect of OO on rats' spleen. Nevertheless, sunflower oil also increased spleen weight may it attributed that this oil contains fibers (26.7%) ratio in their seeds structure.

In the AF group each parameters included RBC, PLT and Hct (table 4) are decreased in rats treated with AF is supported by the finding of [22] indicate that AF plays a differential role in modulation of the RBCs. On the other hand, OO decreased Hct and PLT significantly, whereas previous findings showed any harmful effect of OO on haematological parameters [23]. Besides that, the significant decrease in rats treated with OO is supported by the findings of [24] who showed that rats treated with unheated cooking OO (0.10 mL) via oral gavage for 28 days lead to reduce their MCV.

Non-significant change in TC (table 5) in SO was supported with the study of [25]. On the other hand, the significant decrease of TC in OO group is supported by the attempt of [26] who showed that OO administration provoke their effect by their oleic acid. However, the significant decrease of TC level in rats treated with CO is supported by the finding of [27] who suggested that CO is highly effective in decreasing serum cholesterol. Besides that, cholesterol and LDL significantly declination is supported by the finding of [13] who demonstrated that CO offering health benefits through decreasing both parameters. Also previous study investigated that OO is one of richest sources of monounsaturated fatty acids (MUFA), whose effect on glycemic status and lipid profile [28]. Therefore, our result is agreed with findings of [29] who showed that rats treated with supplemented diet containing OO for six weeks lead to decrease both TC and LDL level. [19]. Sun flower oil decreased LDL-C in our result and it disagreed with previous works [30, 31], we believe that the significant reduction of LDL-C may return to delay of absorption of fatty acids from digestive tract.

5.1. Tables

Table 1: Effect of different dietary oils and fat on food intake

Groups / Parameters	Control	Animal fat (AF)	Sunflower oil (SO)	Olive oil (OO)	Corn oil (CO)
Week1 (gm) *	68.920 ± 1.078^{a}	67.240± 0.331^{a}	96.840± 0.312^{b}	63.600 ± 0.748^{c}	82.000± 1.414^{d}
Week2 (gm)*	72.800 ± 0.200^{a}	77.1200 ± 0.280^{b}	100.0152± 0.1200^{c}	62.600 ± 1.326^{d}	83.7000 ± 1.003^{e}
Week3 (gm)*	76.660 ± 0.213^{a}	96.3600 ± 0.348^{b}	100.030± 0.233^{b}	76.680 1.148^{a}	94.680± 0.527^{c}
Week4 (gm)*	80.580 ± 0.516^{a}	86.660± 0.446^{b}	94.520± 3.096^{c}	78.200 ± 1.019^{a}	88.480± 0.886^{b}

Data presented as mean ± S.E the same letters mean non-significant differences while the different letters mean significant differences *= p< 0.05

Table 2: Effect of different dietary oils and fat on body weight

Groups / Parameters	Control	Animal fat (AF)	Sunflower oil (SO)	Olive oil (OO)	Corn oil (CO)
Before treatment (gm)	202.75 ± 8.498^{a}	205.25 ± 5.437^{a}	234.80± 3.157^{b}	241.50 ± 15.256^{b}	198.20 ± 4.737^{a}
Week1 (gm)*	225.75 ± 11.198^{a}	214.25 ± 9.830^{ab}	220.60± 8.686^{ab}	211.50 ± 13.592^{a}	187.00 ± 12.633^{b}
Week2 (gm)	241.50 ± 14.885^{a}	224.50 ± 12.278^{a}	222.80± 14.619^{a}	216.50 ± 16.291^{a}	192.60 ± 18.131^{a}
Week3 (gm)	249.50 ± 14.002^{a}	234.00 ± 11.423^{a}	231.00± 11.991^{a}	230.75 ± 186.164^{a}	206.80 ± 20.177^{a}
Week4 (gm)	253.75 ± 15.450^{a}	240.75 ± 11.898^{a}	240.40± 11.578^{a}	237.50 ± 13.799^{a}	211.20 ± 21.055^{a}

Data presented as mean ± S.E the same letters mean non-significant differences while the different letters mean significant differences *= p< 0.05

Table 3: Effect of different dietary oils and fat on liver, kidney and spleen weight

Groups / Parameters	Control	Animal fat (AF)	Sunflower oil (SO)	Olive oil (OO)	Corn oil (CO)
Liver (gm)*	21.020 ± 4.597^{a}	28.340 ± 0.782^{b}	33.140± 0.723^{b}	27.340 ± 0.515^{b}	33.220 ± 0.487^{b}
Kidney (gm)*	4.400± 0.109^{b}	3.540± 0.092^{a}	4.700± 0.054^{b}	4.500± 0.130^{b}	4.508± 0.133^{b}
Spleen (gm)*	3.180± 0.115^{a}	3.320± 0.139^{a}	4.024± 0.134^{b}	4.186± 0.193^{b}	3.520± 0.142^{a}

Data presented as mean ± S.E the same letters mean non-significant differences while the different letters mean significant differences *= p< 0.05

Table 4: Effect of different dietary oils and fat on some haematological parameters

Groups / Parameters	Control	Animal fat (AF)	Sunflower oil (SO)	Olive oil (OO)	Corn oil (CO)
WBC (10^3/µL)	7.650± 0.064^{ab}	5.425± 0.596^{a}	10.500± 0.371^{b}	9.875± 1.024^{b}	7.340± 1.979^{ab}
RBC (10^6/µL) *	7.700± 0.111^{a}	5.770± 0.825^{b}	6.812± 0.144^{ab}	6.665± 0.678^{ab}	7.378± 0.426^{a}
Hb (g/dL)	14.600 ± 0.108^{a}	12.550 ± 0.377^{a}	12.340± 0.515^{a}	12.500 ± 1.447^{a}	13.320 ± 0.421^{a}
HCT (%)*	43.325 ± 0.458^{a}	36.250 ± 1.493^{b}	38.620± 1.124^{ab}	35.900 ± 4.314^{b}	38.040 ± 1.480^{ab}
PLT	747.252	436.002	605.202±	280.502	620.402

(10^3/µL)*	± 24.658[a]	± 53.214[bc]	56.824[ab]	± 1.098[c]	± 49.639[ab]
MCV (fL)*	56.275 ± 0.432[a]	54.400 ± 0.481[ab]	52.820± 0.757[ab]	53.500 ± 1.326[ab]	52.060 ± 1.634[b]

Data presented as mean ± S.E the same letters mean non-significant differences while the different letters mean significant differences *= p< 0.05

Table 5: Effect of different dietary oils and fat on lipid profile parameters

Groups / Parameters	Control	Animal fat (AF)	Sunflower oil (SO)	Olive oil (OO)	Corn oil (CO)
TC (mg/dL)*	66.250 ± 4.643[a]	58.000 ± 2.738[ab]	46.200± 4.211[ab]	49.000 ± 3.488[b]	53.000 ± 6.603[b]
HDL-C (mg/dL)	37.000 ± 2.483[ab]	42.250 ± 3.350[b]	37.000± 2.073[ab]	30.500 ± 4.974[a]	31.200 ± 3.800[ab]
LDL-C (mg/dL)*	24.250 ± 2.462[a]	20.000 ± 1.779[ab]	14.880± 1.433[b]	16.250 ± 1.750[b]	19.800 ± 2.835[ab]
TG (mg/dL)	48.500 ± 5.751[a]	42.000 ± 3.696[a]	43.000± 7.245[a]	33.750 ± 6.625[a]	46.000 ± 6.082[a]

Data presented as mean ± S.E the same letters mean non-significant differences while the different letters mean significant differences *= p< 0.05

6. CONCLUSION

In view of the results of the present study and their interpretations we concluded that the effects of dietary oils and fat on food intake and BW showed some controversy may it attributed to some physiological changes related with female reproductive system. On the other hand, each of AF, SO, CO increased food intake in all weeks. Whereas kidney is decreased with AF and liver is increased with all treatments. Nevertheless RBC, HCT and PLT are declined with AF may return to the AF role in modulating RBCs. Finally, TC declination is observed in both OO and CO treatment, while LDL-C declination is observed in SO and OO treatment may it attributed that corn oil contain high fiber because it belongs to whole grains. Besides that, OO due to its high concentration of monounsaturated fat, it can significantly aid to decline LDL-C. Sunflower oil contains a substantial amount of linoleic acid (an omega-6 fatty acid) could reduce cholesterol content in the body.

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