Effect of Different Types of Fat on Lipid Metabolism in Rats

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Abstract

The current study was conducted to inquiries and to determine the impact of different edible oils in experimental animals. Sixty albino rats that were randomly divided into 6 groups of 10 animals. The groups were fed on dietary without fat(control) (Group I), corn oil (Group II), butter fat (Group III), refined palm oil(Group IV) sunflower oil (Group V) and frying fat more than one for 8 weeks. After 12 h of diet removal, blood was collected to measure serum lipid profile (T.C., HDL, LDL and T.G.) levels. Rats of Group A were kept as control by feeding rat normal chow diet. Animals (rats) of groups B, C, D, E & F where fed by corn, butter, palm, sunflower and frying fat more than one oils respectively, at the dose of 15% in feed for 8 weeks. The procedures included determination of body weight gain, lipid profiles and histopathological lesions in different organs. All experimental rats declared advance or delay weight gain during the research period relying on type of oil. GC & GF oil treated group show highest significant (P<0.05) body weight gain, while GB, GD& gE show lowest significant (P<0.05, (P<0.05, P<0.03) Respectively than control group. Rats fed on diet include butterfat and frying more than one had the increment levels of TG, TC & LDL, and lower the HDL level than control group. On the other hand, corn, palm, sunflower oils led to the lower levels of TG, TC & LDL, but the same oils or viz (corn, palm, sunflower oils) had incremented the HDL level as compare to control group.

However, dietary intake of vegetable oils improved lipid profile, while butterfat and frying more than one had the contrary impact.

Key words; *Lipid profile, fat, oils, histopathology, body weight*

Introduction

Fat is an essential component of the diet because it is among the major sources of energy that comes second after carbohydrates [1]. Fat is needed by the body to be required for the absorption and transport of fat-soluble vitamins through the bloodstream [2]. As an significant component of cell membranes, lipids also play specific roles in membrane signaling events.

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There are several experimental studies propose that increased cholesterol intake leads to higher serum cholesterol levels, and thus increased the risk of cardiovascular disease [3].

That Changing views concerning the influences of dietary fats and oils can safely affect the consuming of various foods and, eventually health and nutritional status. There is an inclination to increment the use of various kinds of vegetable oils because of public awareness that animal fats contribute to health problems and because of high cost of butterfat. The production of partially hydrogenated vegetable oils increased steadily because of their low cost, long shelf life and suitability for trade frying. Palm stearin has a semisolid texture at room temperature. It represents a cheap highly agreeable source of saturated fat in the food equipping [4].

However, different types of fats (e.g. animal fat, vegetable fats/oils) include various levels of specific fatty acids (saturated fatty acids and unsaturated fatty acids- monounsaturated/ polyunsaturated). The quality and quantity of fat in the diet influence serum lipid concentrations [5]. Serum lipids play an important role in pathogenesis of many diseases. For example, excessive intake of cooking oils over a period can lead to hyperlipidemia and consequently related conditions such as arteriosclerosis, hypertension, and cardiovascular disease (CVD) and certain cancers [6].

Anyway, the n-3 fatty acids or (Omega-3fatty acids) are long-chain polyunsaturated fatty acids Naturally present in some plants in addition to fish oils. The fatty acids of the n-3 family are the following: eicosapentaenoic acid (EPA) (C20: 5n-3), docosahexaenoic acid (DHA) (C22: 6n-3), and a-linolenic acid (aLA) (C18: 3n-3) [6, 7].

The metabolic effects of EPA and DHA are already well known previously, but the evidence of alA metabolic impacts is increasing. Since the fatty acid is derived from plants and is found in different types of vegetable oils. However, after being ingested, aLA may be Unsaturated and changed to other forms of long-chain polyunsaturated fatty acids, as EPA and DHA [8].

However, the incidence of cardiovascular disease is related with diets high in saturated fatty acids (SFA). Animal fats, which contain higher proportions of SFA, increase the risk of vascular system diseases. Numerous studies indicate that butter elevates the level of total cholesterol, low-density lipoprotein (LDL) and triacylglycerols. It has also been reported that consumption of dietary butter contributes to hypercholesterolemia due to its high content of (SFA) [9].

Furthermore, another influences edible oil were Margarine made from corn or sunflower oils are much lower in SFA than butter, which contains high amount of linoleic acid polyunsaturated fatty acids (PUFA). It is a mixture of oleic acid and stearic acid as major monounsaturated fatty acids (MUFA) and SFA, respectively [10]. Substitution of margarine for dietary butter reduces total cholesterol and LDL level [11]. By reducing serum cholesterol levels without any effect on high-density lipoprotein (HDL) cholesterol levels.

However, some workers were reported that; the possible effects of the intake of n-3 fatty acids on lipid metabolism: (1) inhibition of VLDL synthesis, (2) decrease in Apo lipoprotein B synthesis, (3) increase in VLDL catabolism, (4) decrease in LDL synthesis, and (5) decrease in postprandial lipemia [12].

Lipoproteins are closely related to the risk of cardiovascular diseases, as follows: low-density lipoproteins (LDL) indicate an increased risk, and high-density lipoproteins (HDL) are considered a protective factor [13, 14]. When the risk of cardiovascular diseases was considered a function of HDL-C and LDL-C, the incidence of cardiovascular diseases increased with the increase in the concentration of LDL-C and the decrease in the concentration of HDL-C [14]. Both LDL-C and HDL-C are independent risk factors for cardiovascular diseases [15]. This is important in establishing the conditions that influence the changes in LDL and HDL levels throughout life.

Hence, this study was carried out to evaluate compare the probable effects of selected edible dietary oils (corn, sunflower, refined palm and butterfats) which commonly available in the local market in body weight gain and changing on lipid profiles in rats. Moreover, examine the pathological changes of vital organs in rat at different time intervals.

Materials and Methods

Experimental Animals; Sixty Waster albino adult rats (*Rattusnorvegicous*) of both sexes were used in this study, they were obtained from the laboratory animal house, College of Science, Thi-qar University. All animals were kept under normal healthy conditions and fed on a basal diet for one week before starting the experiment, and were housed in cages of polypropylene boxes, in a climate-controlled room for one week before the beginning of the study. Allowed free diet and water ad libitum. At temperature $(22\pm1c^0)$ and the environment underwent lightness-darkness cycles of 12-hours.

Fats and oils

Five types of oils and fats were chose for this study. The samples were collected from obtainable brands found in the local market. Corn oil, sunflower oil, refined palm oil, butter fat and frying fat more than once were

purchased from local market/ Karbala / republic of Iraq.

Kits: for biochemical of analysis of serum lipid profile, were obtained from Medical Supplies Office in Karbala \ Iraq.

Preparation the blackberry (basal diet)

Concentrated blackberry ingredients were obtained from the college of Agriculture outlined in Table1, was

formulated without any source of oil or fat. All types of vegetable and animal oils used in this study were mixed with fodder by 15% for each. However, the total weight of the blackberry was 133kg and the weight of the oil or fat used for each type, which was added to the total weight of the diet, was 20 kg, so it was the percentage of the species used in the study for the diet 15%.

Table 1: Composition of concentrated blackberry ingredients used to feed rats [4].

Ingredients	Content (kg / 133kg)	Percentage %
Wheat,	36.ooo	27.06
barley	25.000	18.79
corn	18.000	13.53
maize	17.000	12.78
Table salt	0.650	0.48
Animal protein	6.500	4.88
Animal fat	1.200	0.90
Minerals	6.650	5
Casein	6.500	4.88
sucrose	15.500	11.65

Experimental design

After acclimatization period, the study animals were divided into six groups of three animals each, and placed in separate agency cages. Animal weights were also monitored during the period Feeding by taking animal weights before feeding and after two months (end of experiment).

Group (A): Control group(normal chow diet), that were fed a typical blackberry.

Group (B): First treatment group; Rats fed a typical blackberry and blended With 15% corn oil.

Group (C): The second treatment group rats fed a typical blackberry and blended With 15% butter fat.

Group (D): third treatment group rats fed a typical

blackberry and blended With 15% refined palm oil.

Group(E): Treatment Group IV rats fed a typical blackberry and blended With 15% sun flower oil.

Group (F): Treatment group rats fed a typical blackberry and blended with 15% fat frying more than once.

Furthermore, Animal weights were also monitored during the period Feeding by taking animal weights before feeding And after to end experiment, animal weights were also monitored during the period Feeding by taking animal weights before feeding and to end experiment or after 60 days.

Blood samples

At the expected time, the animals were euthanized

after they had fasted from 12 PM of the previous evening.

The rats were anesthetized lightly by chloroform inhalation. Then killed by neck dislocation then their thorax was opened and a blood sample was collected from the right atrium by heart puncture. The blood of non-heparinized tubes was abandoned at room temperature for30 minutes then was centrifuged at 3000 rpm for 15 minutes, and the sera were kept in deep freeze (-20 C^0) until carrying out the biochemical assay.

Statistical Analysis

To analyze the results and find a T-Test, a test was used Moral differences and relationships between groups.

Results

The results as show in table 2 that the variations in body weight, at the end of experiment(2 month), was significantly difference occurred in the groups (B, D & E) led to significantly decrease (P<0.05, P<0.05, P<0.03) respectively, in comparison to beginning of the experiment(1st week). On the other hand, the results was showed that rats fed on diets supplemented with butter and frying fat more than one had significantly increases in body weight (P<0.05) of both, in comparison to beginning of the experiment(1st week)table 2.

Table 2: Results of rat weights at beginning and end of experiment fed diets supplemented with different types of lipids. The values was expressed as (mean± SD)

Groups weight	GA Control	GB Corn oil	GC Butter fat	GD refined palm oil	GE sun flower oil	GF fat Used more than once
First week*	245.78±41.08	218.33±8.08	233.66±8.11	231.66±	220.23±10.06	225.52±16.06
Eight week**	246.66± 10.91	206.06±4.09	265.66±21.20	223.9.09±10.09	201.33±7.08	251.66±9.89
P-Value	NS	<0.05	<0.05	<0.05	<0.03	<0.05

* The values are expressed as mean± SD. NS; Non significance

 Beginning of the experiment, ** End of the experiment

Conversely, serum lipid levels and Glucose are shown in table 3. At the age of 8weeks, differences in TG, TC, LDL, and HDL were observed. Differences were significant among the following groups: regarding, TG, the results shows that the rats fed on diets accomplished with butter and frying more than one had significant increases in its serum levels, whereas groups fed on diets supplemented with corn oil, palm oil, sunflower oil had significant lower in serum TG levels than in control group. However, fed on diets containing butter, frying more than one caused a significant increment levels in TC, whilst fed on diets containing corn oil and palm oil

caused a significant decreased as compared to fed on diet without fats(control group). There is not significant differences for group fed on diet containing sunflower oil in compared to control group. The serum HDL level displayed to be more significantly lower of rats fed on diet containing butter and frying more than one, however, there were significantly increase of rats fed on diet supplemented with corn oil, palm oil as compared to control group. Otherwise, the serum HDL levels showed that the rats fed on diets supplemented with sunflower oil strong significant increase in comparison to control, moreover, the study was appeared decrease in levels of

LDL in rats that intake diet containing corn and palm oil, but those augmentation not significant, however, butter and frying more than one causing significantly lower as compared to control. Moreover, The lowest glucose level was in the corn oil group, and the strong lowest in the sunflower oil group. While there were not significant differences for groups fed on diet containing palm, butter and frying more than one in as compared with control group.

Table 3: Effect of some types of dietary oil and fats on serum lipid profile(TG, TC, LDL ,HDL in rats. The values was expressed as (mean± SD)

Groups	TG (mg/dl)	Cholesterol (TC) (mmol/l)	LDL (mg/dl)	HDL(mg/dl
GA(normal chow diet)	234±16.23	15.3± 0.65	201±12.09	142.33±9.04
GB corn oil	135.33±12.88	10.89±0.55	198±19.23	146.66±6.05*
GC butter	263.33±19.08*	20.02±0.46*	245±13.04**	116.33±3.33
GD palm oil	147±61.09	12.33±0.31	197.33±1.34	151.03±o.98*
GE sunflower	112.66±21.87	14.29±0.11	187.09±8.09	227. 02±8.71***
GF frying more than one	241.33±11.23*	23.19±0.76*	243.51±18.34**	121.42 ±5.61

*Significantly different from normal control (*P*<0.05)

* P< 0.05, **P< 0.01, ***P< 0.001; control (Rats fed with normal chow diet versus rats fed with normal chow diet + different oils).

Discussion

The choice of healthy dietary fat has become a critical subject because of the association with several disorders. The continuous modernization and technological advancement of the developing world has brought rapid lifestyle changes which has led to the consumption of high fat diets, fast-food, caloric-dense diets coupled with sedentary lifestyle, which are known to have a major impact on the development of cardiovascular and other chronic diseases [16].

However, some researchers were mentioned that eating food rich in fats Saturated and cholesterol increases the risk of infection Many diseases, as fat works on Induce oxidative stress and root production Free [8,17]. Thus lipid peroxidation occurs Which represents the dissolution of unsaturated fatty acids In cell membranes by a chain of reactions Self-stimulation of free radicals [18] and the resulting The final process of lipid peroxidation is malaldehyde (MDA). It is increasingly concentrated in cases of oxidative stress Which can be removed or reduced by systems Defensive antioxidants, thereby protecting the body [5]. Oxidative stress is defined as a disorder of Balance between oxidizing substances and systems Defensive antioxidants [6,12] have been concerned Recent studies the role of antioxidants in prevention of oxidative stress.

However, present study was observed that the diets supplemented with different dietary lipids impacted serum lipid levels. The empirical diets in our study included six times the amount of lipids recommended for the normal diet of rats [19], which were required for determining alterations in the lipoproteins of rats, which

are animals resistant to hyperlipidemia [16].

The present study was appeared that the variations in body weight, at the end of experiment(2 month), was significantly difference occurred in the groups (B, D& E) led to significantly decrease (P<0.05, P<0.05, P<0.03) respectively, in comparison to control group. On the other hand, the results was showed that rats fed on diets supplemented with butter and frying fat more than one had significantly increases in body weight (P<0.05) of both, in comparison with control group table (2).

However, the experimental animals gained weight which was significant (p<0.05 and p<0.03) compared to the control. The significant increase in weight of the animals may have been caused by using of the all types of dietary oil used in our study. Those oils is rich in polyunsaturated fatty acids, including the two essential fatty acids, linoleic and linolenic, that are not produced in the body. Linoleic and linolenic acids aid the body's absorption of vital nutrients and are required for human health. These two essential acids are also precursors to hormones that regulate smooth muscle contraction, blood pressure and the growth of healthy cells [20].

The body weight gain in different groups are shown in Table (1). However, all the edible oil treated rat groups The observed findings supported by the experimental studies where edible oil especially butter fat and fat used more than one was effective in increasing body weight gain [21,22] in different animals had significantly (p<0.05 and p<0.03).

Table 3 appear the comparative analysis of lipid constitutes of experimental edible oils treated rat groups and control group in various time periods. The changes of lipid profiles value were considerable in eaten oil treated rat group in comparison to control group. The serum TG level of two treatments (butter and frying more than one groups) were significantly (p<0.05) highest than control group. Conversely, serum level of TG of three treatments (corn, sunflower and palm oil group) lower than control. This findings match with the results of other empirical studies [23, 24].

On the other hand, the results was appeared that serum level of TC of GC and GF caused increased significantly (P<0.05) than control group, but the treatments of and Gb, GD and GE caused decrease TC serum level than control group. However, the present study displayed that a sever dissimilarity in between the results of both treatment groups and control group but it Match with the observations of other researchers [25, 26]. However, the animals which received Butter (GC) caused strong significant (P<0.01) increased of LDL level than control group. The study results of [6, 7], having similar results of this present experiment. Moreover, intake of corn and palm oil by rats led to significant (P<0.05) increased of HDL level. Whilst, noticed sever significant (P<0.001) increased of HDL than normal chow diet group (group A) than control group, and this is agree with other workers [19, 21].

Conclusion

Ultimately The results revealed that all species of lipid which used in this research shows an effect on the body weight gain and serum level of lipid profile on the experimental animals. Whether that effect is an increase or decrease.

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