JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH

How to cite this article:
DINESH KUMAR B, MUKHERJEE S, PRADHAN R, MITRA A, CHAKRABORTY C. EFFECTS OF EDIBLE OILS IN TYPE 2 DIABETES MELLITUS. Journal of Clinical and Diagnostic Research [serial online] 2009 April [cited: 2009 April 6]; 3: 1389-1394.
Available from
http://www.jcdr.net/back_issues.asp?issn=0973-709x&year=2009&month= April &volume=3&issue=2&page= 1389-1394 &id=388

ORIGINAL ARTICLE

Effects Of Edible Oils In Type 2 Diabetes Mellitus

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ABSTRACT

The prevalence of Type 2 diabetes along with dyslipidaemia is increasing alarmingly in India and in some parts of South-East Asia. The causes of this malady are yet to be known though urban life-style and diet are considered to be the two most important factors. Indians are mostly lacto-vegetarians. The intake of fats and oils are less in the Indian diet. Edible oils act as important dietary sources of fats and oils. Some oilseeds are cultivated in India, while a portion is imported to satisfy the need of the population. Indians have a predilection towards fried items and a large portion of fat requirements are fulfilled through this habit. Oils have different biological effects in different conditions, especially in patients suffering from Type 2 Diabetes with dyslipidaemia. Hence, there is a need to have a comprehensive study of all these edible fats and oils in human beings, both in normal and in disease conditions. Our study highlighted the effect of different edible oils such as Sunflower oil, soyabean oil, sesame oil, groundnut oil, mustard oil, coconut oil, ghee and palm oil on humans and the results indicated that sesame oil has the most benefit, followed by mustard oil.

Key Words: Type 2 Diabetes Mellitus, Oilseeds, Edible, Fats and Oils.

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Introduction

Diabetes mellitus is a common metabolic disorder characterized by increase in the blood sugar along with alterations in carbohydrate, fat and protein metabolism, associated with defects in insulin secretion and/or insulin action, or both [1],[2]. Diabetes mellitus is of two main types – Type1 and Type 2. The prevalence of Type 2 Diabetes is increasing at epidemic proportions worldwide and in the recent years, it has become a major global health problem in economically developed countries as well as in countries undergoing rapid economic expansion [3]. According to WHO (1997), there is a marked increase in the number of people affected with diabetes and this trend is expected to grow in geometric proportions in the next couple of decades. In the developed countries, there will be a 42% increase from 51 to72 million and in the developing countries, there will be a 170% increase from 84 to 228 million.

This disease may be consequence of nature and nurture [4]. The presence of a genetic factor (nature) and environmental causes (nurture), faulty dietary intake in excess, proneness to infections, poverty and malnutrition, improper concepts of hygiene and health and reduced physical activities etc, may lead to increased incidence of the condition. In a country like India, there is an alarming increase in the prevalence of diabetes mellitus, especially of Type 2. The causative factors are its vast rural population, its minimum health infrastructure with heterogeneity of origin or race, geography and habits, dietary habits, socio-economic status, methods of cooking and preservation, use of pesticides, cultural diversities etc [5].

Fats and oils are a specific component of the diet which provide essential fatty acids and facilitate the delivery of various other nutrients that are vitally important for normal physiological functions. Fats and lipids are the integral parts of the structural units such as cellular and sub-cellular membranes, and nerve sheathing. These dietary fats are also responsible for normal growth, development and maturation in all spheres. Body fat or adipose tissue also helps to protect vital organs from injuries and shocks, and provides a source of energy during prolonged exercise. Vegetable oils are important sources of natural

antioxidants such as tocopherols, tocotrienols and carotenoids [6]. Dietary lipids also play an important role in the vital body functions by modulating the production of eicosanoid [7], [8], [9]. Fats and oils are consumed for caloric as well as non-caloric functions such as flavour, palatability, appearance, consistency and texture. Intake of different oils and fats takes place primarily through cooking oils, baked products, margarines and spreads, various fried products, chocolate and sugar confectionery, dairy products and desserts, salad oils, mayonnaise and other dressings [Table/Fig 1].

(Table/Fig 1) The Total World Consumption of Major Vegetable Oils in 2000 (after USDA 2000)

Oil source	World consumption (million ton)	Notes
Soybean	26.0	Accounts for about half of worldwide edible oil production.
Palm	23.3	The most widely produced tropical oil. Also used to make bio fuel
Rapeseed	13.1	One of the most widely used cooking oils; Canola is a (trademarked) variety (cultivar) of rapeseed.
Sunflower seed	8.6	A common cooking oil, also used to make biodiesel
Peanut	4.2	Peanut oil Mild-flavored cooking oil.
Cotton seed	3.6	A major food oil, often used in industrial food processing
Palm kernel	2.7	From the seed of the African palm tree
Olive	2.5	Used in cooking, cosmetics, soaps and as a fuel for traditional oil lamps

Here, the climatic conditions are favourable for the growth of a variety of oilseeds. India accounts for 9.3 per cent of the oilseed production in the world. It has the world's fourth largest edible oil economy [10]. Sesame, Groundnut, Mustard, palm and Sunflower are some of the major edible oilseeds used in the country. Besides, ghee, coconut oils and others are also commonly used in Indian kitchens. Here, an attempt has been made to compare the effects of different edible fats and oils commonly used like Sunflower oil, soyabean oil, sesame oil, mustard oil, coconut oil, palm oil, groundnut oil and ghee.in the rural Indians

Based on unpublished data from the Hamadan province, it was observed that most of the Giardiasis cases presented with bloating and malaise. Because of its wide spectrum clinical manifestations and the relatively high prevalence of this infection in the Hamadan province of Iran, this study was conducted to determine the most frequent clinical signs and symptoms of Giardiasis in the Hamadan province of Iran.

Materials and Methods

Raw ingredients (Sunflower oil, soyabean oil, sesame oil, mustard oil, coconut oil, palm oil, groundnut oil and ghee) were collected in sealed containers from a local market at Kharagpur in West Bengal (India) and were inspected to check whether they were of standardized grades or not (ISI approved). Blood bio-chemistry tests like Total Cholesterol (TC), High-density Lipoprotein (HDL), Low-density Lipoprotein (LDL) and Very low-density Lipoprotein (VLDL) were estimated using diagnostic kits from local vendors of Merck (Germany). The tests were conducted by skilled professionals using a Semi Auto Analyser (Merck, Microlab 300). All plastic measuring devises like 1000 ml measuring cylinders, were purchased from the local agents of Tarson (India). Disposable syringes were collected from the B.C. Roy Technology Hospital (BCRTH) of the Indian Institute of Technology (IIT) at Kharagpur. Height and weight of the volunteers were observed at BCRTH and BMI and were calculated accordingly.

Samples Collection

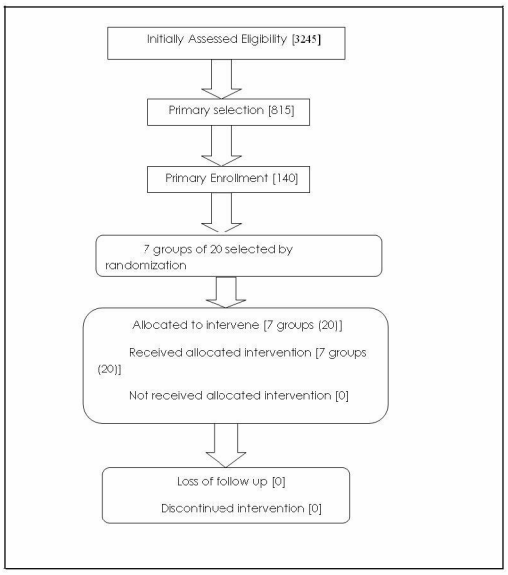
20 sealed cans (5 liters ISI approved), each of different raw ingredients as mentioned, were purchased after careful inspection from a local market in Kharagpur (West Bengal, India).

Selection of Volunteers

For the present study based on the data available from different villages such as Kharagpur, Khajra, Kulbani, Nachipur, Keshiyari, Balarampur and Kaushalya in the West Midnapore District, 3245volunteers were identified (in the age range of 45-55 years and apparently non-obese). From these, 3245 patients and 815 volunteers were screened, based on the following criteria- they were not taking any drugs for Reevan's pathosis and for hepato-billiary impairment, they agreed to participate in the study and were free from any diabetic/hypertensive/dyslipidaemic complications and were symptomatically normal. Out of these 815 volunteers, 140 volunteers were randomly selected (lottery), mainly based on financial reasons (inadequacy of funds) and daily monitoring conveyance.

They were divided into seven groups by the random selection (lottery) of 20 patients each [Table/Fig 4]**.** The volunteers were informed about the details of the study including the benefits and risk involved in vernacular and strict compliance was emphasized. The Institute Ethical Committee was approached, highlighting the fact that there was minimum risk involvement in this experimental work and clearance was obtained from them. The written consents from volunteers were taken prior to the study. The volunteers mainly resided in three villages and it was being observed though the random selection process was being followed for selecting twenty volunteers in a group the sex biasness was not there as male: female ratio in different groups were either 11:9 or 10:10 (adult M: f = 1.1:1 in these village).

Processes are being involved in the study. The research team prior to use will check the quality and quantity of oils being used in the study. Two Ayurvedic doctors are present in the research team and written permission of the patients is obtained for the study.



(Table/Fig 4) Consort Flow Chart of volunteers in the study

Experimental Design

The experiments were designed to maintain identical conditions for all the groups. The volunteers underwent clinical, anthropometrical and biochemical evaluations before and after the study [Table/Fig 2]. The volunteers were made to adhere strictly to the conditions laid down for the study to maintain identical conditions in all groups. For this purpose, six associates were appointed by the researchers to look into the maintenance of identical conditions of diet and life-style patterns. The associates held regular discussions amongst themselves and the volunteers to fix up and settle the issues, but at the same time, also to make sure to not fix the schedule into non-acceptable limits. Monotony in diet and freedom of life-styles in human beings was reduced through a consensus. The researchers were intimated daily of the proceedings and weekly meetings amongst volunteers, associates and researchers were held. Any change in the schedule, difficulties faced, clinical assessments, drop outs, follow up processes etc, were in the agenda. Such meetings were usually presided by the local *panchayet pradhan* and other pertinent health issues like vaccination, heath awareness camps, qualitative and quantitative diet planning etc, were also discussed.

Administration Of Oils

The associates employed for the process measured the oil/day consumption in volunteers and accordingly provide. They further kept the records and also preserved the sanctity involved in the process. A daily dose of 35ml was administered to each volunteer [11]. The health of volunteers were observed and enquired daily by the associates. The associates further maintained the records of individual oil consumptions in the family and particularly of the volunteer who was not permitted the use of any other oils as his/her cooking medium during the study.

Collection of Blood samples and Measurement of biochemical parameters

Blood samples were collected from each group before the study and at monthly intervals for three months. Blood was collected by professionals using strict aseptic techniques from the anti-cubital vein of volunteers using adult size tourniquets supplied by BCRTH. The professionals were not told of the study earlier, to reduce bias. The collected blood (5ml) was kept in two vials, one vial containing 2ml of blood with anticoagulant (potassium oxalate and sodium fluride in 1:4) for the estimation of FBS and the other vial

containing 3ml of blood without anti-coagulant for serum separation in order to estimate the desired lipid fractions. The vials were sent immediately to the School of Medical Science and Technology in IIT at Kharagpur.

Statistical Analysis

The data was expressed as mean ± standard deviation (S.D). Statistical comparisons were performed by one-way analysis of variance (ANOVA).

Result

Clinical, anthropometrical and biochemical evaluations of the volunteers before and after the study were performed [Table/Fig 2].

(Table/Fig 2) Anthropometrical, Clinical and Biochemical characters of Volunteers (n=140)

	Experimental group	Control group
Age	48. 62± 4.76 years	47.38±3.78 years
Males Females	36 34	36 34
Weight	72±3kg(beginning) 72±2kg(end)	76±3kg(beginning) 76±2kg(end)
Body Mass Index (BMI)	24.4± 2.4 units(beginning) 24.3± 2.3 units(end)	24.5± 2.3 units (beginning) 24.3± 2.2 units (end)
Systolic Blood Pressure	146±12 mm of Hg(beginning) 144±14 mm of Hg(end)	140±14 mm of Hg(beginning) 138±14 mm of Hg(end)
Diastolic Blood Pressure	100±12 mm of Hg	94±8 mm of Hg
Mean Pressure	115±8 mm of Hg	109±10 mm of Hg
Total Cholesterol	188±8 mg/dl	182±6 mg/dl
Low Density Lipoprotein	114±6 mg/dl	110±7 mg/dl
High Density Lipoprotein	48±3 mg/dl	45±4 mg/dl
Very Low Density Lipoprotein	28±5 mg/dl	27±5 mg/dl
Triglycerides	138±7 mg/dl	135±8 mg/dl
Fasting Blood Sugar	152±7 mg/dl	154±6 mg/dl
SGPT	42±7 IU/ml	39±5 IU/ml

Here in all the groups, biochemical parameters of interest, that is, FBS, TC, LDL, VLDL and HDL were estimated in all 20 volunteers who comprised a group for three months[Table/Fig 3].

(Table/Fig 3) Biochemical Parameters of Edible Oils

Items	Month	FBS	TC	LDL	VLDL	HDL
Sunflower oil (Group –I)	1	94.85±14.23	184.50±18.03	118.90±18.60	27.20±4.90	38.30±2.71
	2	93.60±23.29	181.45±17.72	115.95±17.82	26.30±4.05	38.90±2.35
	3	93.10±13.32	178.65±17.95	118.35±25.59	25.75±3.62	39.30±2.00
Soyabean oil (Group – II)	1	114.75±46.16	205.30±20.27	137.55±19.65	30.70±7.86	37.10±3.14
	2	112.35±44.50	201.45±18.80	134.75±22.71	28.80±6.59	39.05±3.23
	3	110.95±44.13	198.05±18.95	128.95±19.85	27.85±6.54	40.80±3.38
Sesame oil (Group –III)	1	149.95±7.54	171.90±9.39	106.75± 9.31	31.15±4.34	33.65±4.36
	2	145.40±7.08	162.35±8.44	96.25±8.72	29.25±3.85	36.60±3.77
	3	140.25±5.98	155.45±7.14	87.65±6.68	27.25±4.05	39.50±3.94
Mustard oil (Group – IV)	1	93.55±14.43	187.75±30.77	126.15±28.45	28.95±6.69	37.20±3.45
	2	92.75±13.74	194.25±33.84	123.10±27.43	26.85±5.89	39.70±3.98
	3	92.70±13.43	186.75±24.64	119.25±26.69	25.70±5.65	41.05±3.21
Coconut oil (Group – V)	1	100.50±11.90	181.90±10.88	107.10±8.27	37.40±3.15	37.65±2.71
	2	102.00±12.00	184.00±10.76	108.05±8.59	38.10±3.12	37.20±2.50
	3	103.20±13.06	186.15±11.60	110.10±9.58	39.10±3.35	37.30±2.57
Palm oil (Group – VI)	1	94.20±	180.50±25.11	105.05±20.37	36.45±4.17	39.10±2.38
	2	93.95±	278.55±22.95	105.90±20.51	36.50±3.94	40.30±2.97
	3	93.85±	186.95±17.83	107.10±19.84	37.15±3.54	41.10±3.38
Ghee (Group – VII)	1	102.60±24.58	187.00±23.81	117.85±23.16	32.95±7.25	37.40±3.87
	2	103.75±25.12	191.10±23.25	118.85±22.42	33.80±7.52	38.50±2.74
	3	104.70±25.57	194.80±23.37	121.05±23.71	34.35±7.49	40.45±2.56
Ground Nut oil (Group – VIII)	1	90.25±9.61	189.90±18.90	119.05±11.37	37.20±1.76	38.05±1.85
	2	105.55±65.99	197.35±12.28	172.30±22.45	37.95±2.11	36.80±2.14
	3	91.25±9.67	199.80±12.41	123.±13.03	39.35±3.04	35.70±2.27

Statistical analysis was made and the results indicated that Sunflower oil played a more significant role in the reduction of fasting blood glucose levels ($p<0.25$). Soyabean oil played a role in the reduction of the total cholesterol levels ($p<0.30$) and it's role was found to be more significant than that of sesame oil ($p<0.40$) at 5% level of significance. High-density lipoprotein levels were increased by Sesame oil ($p<0.35$) and mustard oil ($p<0.40$), while soyabean oil, palm oil, groundnut oil and ghee showed lesser effects when compared with mustard oil ($p<0.50$). But coconut oil and sunflower oil did not play any roles in increasing high-density lipoprotein levels. Low-density lipoprotein levels were decreased more by soyabean oil ($p<0.35$) than by sesame oil ($p<0.50$). But other oils did not have any significant roles in lowering the Low-density lipoprotein levels. Palm oil had a more significant effect on the reduction of very low-density lipoprotein levels ($p<0.30$) than palm oil ($p<0.40$) and mustard oil ($p<0.45$), while other edible oils showed no effects.

Discussion

The omega 3 polysaccharide fatty acids have a major role impact on thinking of medicine. The parent fatty acid in the omega 3 fatty acid family is alpha-linoleic acid (ALA), which is an essential fatty acid found in high concentrations in certain plant oils. Alpha linoleic acid is the principal of omega 3 fatty acid, which a healthy human will convert into eicosapentaenoic acid (EPA) and later into docosahexaenoic acid (DHA). Eicosapentaenoic acid (EPA) and gamma linoelic acid (GLA) synthesized from linoleic acid (omega-6), are later converted into hormone like compounds known as eicosanoids which aid in many bodily functions including vital organ functions and intracellular activity. Omega-3-linoleic acid is found in Sunflower oil, soyabean oil, mustard oil, sesame oil, groundnut oil, ghee, coconut oil and palm oil [12]. In the present study, we investigated whether the edible oils had any effects on the biochemical parameters in all groups. The continuous treatment with different edible oils for 90 days showed differential reduction in specific biochemical parameters of interest in all the groups. Major cardiovascular diseases are caused due to lipid abnormalities in diabetic patients. Edible oil samples not only decreased the total cholesterol (TC), low-density lipoprotein (LDL) and very low-density lipoprotein (VLDL) levels, but also increased high-density lipoprotein levels after 90 days of treatment. Several studies have shown that an increase in high-density lipoprotein levels were associated with a reduction of coronary risk [13]. Mitra et al. (2007) found that beneficial changes in the blood biochemistry in persons taking sesame oil may be due to the increased uptake of PUFA and monounsaturated fatty acids [11]. Ramesh et al. (2005) found that diabetic rats which were fed with sesame oil, when compared with controls (diabetic rats not receiving sesame oil), showed a significant reduction in the levels of blood Glucose [14]. High-density lipoprotein levels were increased by a combination of Sesame oil and mustard oil, but showed a lesser increase in levels when treated with sesame oil alone. But coconut oil and sunflower oil did not show any role in increasing high-density lipoprotein levels. In summary, different edible oils such as Sunflower oil, soyabean oil, sesame oil, groundnut oil, mustard oil, coconut oil, ghee and palm oil exhibited hypolipidaemic activities

Conclusion

Different oils exhibited different biological effects, depending on various factors. The presence of genetic factors (nature) and environmental causes (nurture), faulty dietary intake in excess, proneness to infections, poverty and malnutrition, improper concepts of hygiene and health and reduced physical activities etc, are important in a country like India. The differential effects are further compounded by its vast rural population, minimum health infrastructure with heterogeneity of origin or race, geography and habits, dietary habits, socio-economic status, methods of cooking and preservation, use of pesticides, cultural diversities etc. Various workers worked on the biological effects of oils in their respective conditions, while a few studies were done in rural Bengal. Our study highlighted that sesame oil had the most benefit, followed by mustard oil.

Acknowledgement

The authors are indebted to Dr. Arunava Mitra of Mumbai, an industrial worker, for financial support. The authors are also indebted to Prof. A. K. Nanda, Prof. A. K. Ray, Prof. J. Chatterjee, Prof S. Dhara, Dr. Seema Ray, Sri Anil Roy, Sri R. R. Misra, Sri K. Pattanayek and Sri P. P. Maiti for the help rendered for the completion of this project. The authors are deeply thankful to the volunteers, their families, *panchayets* and local people of the villages for their involvement in the work.

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