

Study on the Benefits of Sesame Oil Over Coconut Oil in Patients of Insulin Resistance Syndrome, Notably Type 2 Diabetes and Dyslipidaemia

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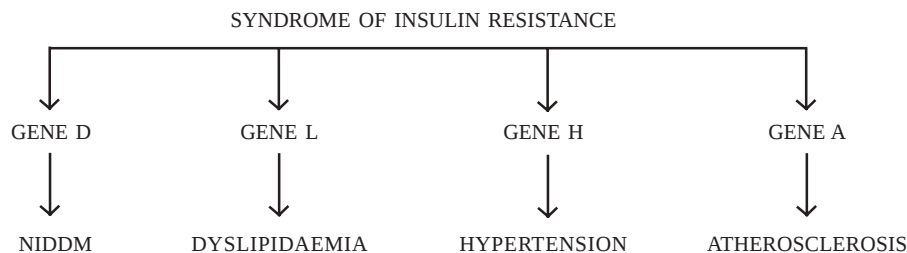
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ABSTRACT Sesame oil has been used traditionally as an edible oil in selective parts in India particularly in states of Tamil Nadu, Pondicherry, some parts of Jharkhand and Kerala. Incidence of Type 2 diabetes or Non-Insulin-Dependent Diabetes (NIDDM) is alarmingly on the rise in India and parts of South-east Asia. The exact cause is unknown but life-style and diet are the two important factors to be blamed. As health infrastructure in India lacks in several dimensions, an appropriate nutraceutical or effective dietary formulations to control the situation are the need of the hour. Sesame oil is effective to control Blood pressure and different other parameters of Insulin resistance syndrome. Here a study is presented based on data showing effects of sesame oil in comparison with coconut oil on 40 Type 2 Diabetes Mellitus patients, some of the volunteers also having dyslipidaemia.

INTRODUCTION

The hyperinsulinemic/insulin resistant state is a metabolic condition linked to such wide-spread and heterogenous clinical syndromes like hypertension, obesity, NIDDM, atherosclerosis and dyslipidaemia. About 25% of the

The 1997 WHO report has shown that 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. There will be a 42% increase from 51 to 72 million in the developed countries and 170% increase from 84 to 228 million, in the developing



non-diabetic population shows abnormalities of insulin sensitivity and compensatory hyperinsulinaemia. The prevalence of type 2 Diabetes and obesity have been increasing at epidemic proportions worldwide (Table 1 showing the leading countries in the Prevalence of Diabetes) and has become a major global health problem in economically developed as well as in countries undergoing rapid economic expansion.

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countries. The countries with the largest number of diabetic people are, and will be in the year 2025, India, China, Indonesia and United States.

Table 1: List of the leading countries in the prevalence of diabetes

Country/ Region	Extrapolated prevalence	Population estimated used
China	76,402,799	1,298,847,624 ²
USA	17,273,847	293,655,405 ¹
India	62,651,210	1,065,070,607 ²
Indonesia	14,026,643	238,452,952 ²

1. US Census Bureau, Population Estimates, 2004

2. US Census Bureau, International Data Base, 2004

In India there appear to be more men than women with diabetes and about 50% of diabetics live in towns and cities, but in the west there are almost twice as many women than men with diabetes. Diabetes occurs at a younger age in the developing countries. In the developed world, most people with diabetes are over 65 years of age while in developing countries the majority is in the age group of 45 to 64 – another factor with enormous public health implications. (King, 1998). This rising trend predicts a significant health burden due to diabetes in India. The cause of the disease is due to nature and nurture effects (Enase et al., 1992). The presence of a genetic factor (nature) and environmental causes (nurture) such as faulty dietary intake in excess, proneness to infections, poverty, malnutrition, improper concepts of hygiene and health and reduced physical activities etc may lead to increased incidence of the condition.

This problem started developing in the childhood more in the urban areas where children do not have any kind of physical exercise and consequently the life-style pattern is altered. The only thing one does is to spend long hours on the computer or the cell phone or watch television (<http://www.chennaionline.com/health/News/2005/09diabetes.asp>).

However, diabetes affects 10 percent of the Asian American and Pacific Islander American population - making them almost two times more likely than whites to have the disease. Diabetes is also the fifth leading killer of Americans of Asian or Pacific Islander descent between the ages of 45 to 64 (Fujimoto, 1995). Asian Americans are eating a more Westernized diet that includes a lot higher calorie foods and animal fat than their ancestors and relatives in Asia ate and they are leading a more sedentary lifestyle (Carter et al., 1996). The diet that Chinese people eat in China, for example, is much different from the stereotypical diet one experiences in a typical Chinese restaurant in the US. In China, meals are rice-based with plenty of vegetables and fruit. Meat is treated more like a side dish or for flavoring. Just the opposite occurs in the United States, with most American meals placing the heaviest emphasis on the meat portion of the meal. This emphasis results in meals that are significantly higher in calories and fat. Most of the growth in diabetes amongst Asian Americans is in type 2 diabetes and it develops primarily in people who are over 40, overweight, and have a family history

of the disease (Huang et al., 1996). Type 2 diabetes is increasingly occurring in young people, including children, due to obesity and sedentary lifestyle (Rosenbloom et al., 2002).

In India population is vast and there is heterogeneity of origin or race, geography and habit, socio-economic status, dietary habits, methods of cooking and preservation, use of pesticides. These factors, along with known variables like age, sex etc. influence lipid profile of individuals. The South Asian population is known to be at risk of atherosclerosis even though the subject does not have the clinical evidence of Coronary Artery Disease (CAD). The lipid profile in Indians may appear benign but the high triglycerides and low HDL levels actually increase the rate of CAD. Persons with high Low Density Lipoprotein (LDL), high triglyceride and low High Density Lipoprotein (HDL) have a 3-fold higher rate of CAD (Krishnaswamy, 1989).

Mustard oil, sesame oil, sunflower oil etc. can be used for deep frying while flax oil, due to its more number of double bonds and propensity to more degradation on heating, is solely used as salad oil and daily consumption of about 15 - 20 g is sufficient. Linoleic acid containing oil can be used for deep-frying, but the process is not so safe unless the oil is protected by adequate quantity of anti-oxidants (Raheja, 1999). The per capita oil consumption in India is 30-35 g per day (Roy, 2000).

METHOD

40 newly diagnosed Type 2 Diabetes patients, in whom diabetes was less than 1 year of duration, living nearby Kharagpur which is a small town in Midnapur (West) District of West Bengal, were randomly selected for the experiment based on initial data from different hospitals and health centers and written questionnaire responses. The patients so screened were randomly divided into 2 groups of 20 patients each- one for experimentation and the other for control. The experiment was so designed that it maintained identical conditions in both groups particularly in dietary intake patterns and life-styles. The patients with known renal and hepatic dysfunction and those on lipid, blood pressure and blood sugar lowering therapies were excluded from the study. The patients underwent clinical, anthropometrical evaluation before and after the study. Initial biochemical evaluation, presented in the tables

below, was also conducted before the study. The oil was used for 2 months and effects observed. In the control group the oil medium is coconut oil as it is one of the most consumed oils in India.

Sesame oil obtained by cold process extraction (Ghani at Balarampur Avoy Ashrama) was collected and stored in amber coloured container filled up to brim and kept in a dark place to prevent oxidation. Patients were asked to take about 35 ml of the oil per day as cooking medium (Roy, 2000). The oil could be used for cooking and did not undergo destructive changes while cooking (Chow, 1992). Sesame oil was subjected to controlled heating for 15 minutes at 140°C to simulate maximum heat induced effects in Indian cooking conditions. The volume of the oil and the fatty acid compositions of the oil and the diet were measured (AOAC, 1996; Rangana, 1986; Swaminathan, 1990). Sesame oil 35ml/day was given to the volunteers to see the effects (Sankar et al., 2003).

In order to see the effect of sesame oil on the NIDDM patients, blood samples were taken by an indwelling catheter into ante-cubital vein and analyzed for fasting blood glucose (FBS), triglyceride (TG), total cholesterol (TLC), high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), and very low-density lipoprotein cholesterol (VLDL). Boehringer Mannheim Limited supplied the reagents that were necessary for the tests and the tests were conducted as per standard technique (Mannheim, 1983).

RESULTS

The patients underwent clinical, anthropometrical evaluation before the study. The observations were:

Age - 45.16 ± 2.20 years,
Sex: males - 20, females-20,
Weight - 66.46 ± 8.16 kg,
Body Mass Index (BMI) - 22.46 ± 1.78 .

At the end of study anthropometrical evaluation remains more or less the same. Body weight changes by 0.3kg in the group receiving sesame oil and BMI changes by -0.06. In other

groups no significant changes were observed. The patients did not show any changes in clinical parameters during the study. Regarding other biochemical markers serum uric acid value increased by 0.2 mg/dl during the study.

The analysis of sesame oil showed that the fatty acid composition of the oil was not altered much by heating and contains palmitic acid 12%, palmitoleic acid 0.3%, stearic acid 7%, oleic acid 40%, linoleic acid 41%. The volume of the oil was reduced by 7%. Coconut oil showed no changes in fatty acid proportions on identical heating and volume was reduced only by 2%.

The rural diet did not differ much in both the groups and composed of 70-80% of carbohydrates, 10-15% of protein and 10% of fats. In the sesame-using group, the ratio of saturated fat and unsaturated fat was 1:1 while in the control group it was 1.5:1 respectively.

The initial blood pressure measurements showed Systolic Blood Pressure (SBP) was in the range of 136 ± 12 mm of Hg and the Diastolic Blood Pressure (DBP) was 84 ± 8 mm of Hg. The SBP reading after first month showed 122 ± 9 mm of Hg and second month 116 ± 7 mm of Hg ($p \leq 0.05$). DBP values show a value of 76 ± 6 in the first month and 72 ± 6 in the second month ($p \leq 0.025$).

Values of blood parameters of 20 Type 2 diabetes patients who were on coconut oil as being shown in Table 2 showed, TLC was initially 162 ± 8 mg/dl and it increased to 168 ± 8 mg/dl ($p \leq 0.075$). HDLC was initially 46 ± 6 mg/dl and it increased to 48 ± 4 mg/dl ($p \leq 0.05$). LDLC showing an increase from initial values of 104 ± 6 mg/dl to 112 ± 8 mg/dl ($p \leq 0.25$). TG show an increase from 96 ± 7 mg/dl to 100 ± 8 mg/dl ($p \leq 0.025$). FBS shows changes from initial values of 162 ± 6 mg/dl to 165 ± 5 mg/dl ($p \leq 0.025$).

Values of blood parameters of 20 NIDDM patients who were on sesame oil as being shown in Table 3 showed, clearly that TLC, LDLC and FBS were significantly reduced whereas reduction in TG was not so appreciable. Values of HDLC are increased considerably. TLC values were reduced from 172 ± 8 mg/dl to 166 ± 8 mg/dl ($p \leq 0.075$). HDLC values were increased from 40 ± 7 mg/dl to 45 ± 9 mg/dl ($p \leq 0.025$). LDLC values

Table 2: Values of blood parameters of 20 Type 2 diabetes patients who were on coconut oil.

Time(months)	TLC(mg/dl)	HDLC(mg/dl)	LDLC(mg/dl)	VLDLC(mg/dl)	TG(mg/dl)	FBS(mg/dl)
0	162 ± 8	46 ± 6	104 ± 6	18 ± 5	96 ± 7	162 ± 6
1	162 ± 8	47 ± 5	106 ± 7	18 ± 4	96 ± 7	165 ± 7
2	168 ± 8	48 ± 4	112 ± 8	20 ± 3	100 ± 8	165 ± 5

Table 3: Values of blood parameters of 20 NIDDM patients who were on sesame oil.

Time (month)	TLC (mg/dl)	HDL C(mg/dl)	LDLC(mg/dl)	VLDLC(mg/dl)	TG(mg/dl)	FBS(mg/dl)
0	172 ± 8	40 ± 7	106 ± 6	27 ± 5	133 ± 6	153 ± 8
1	167 ± 9	43 ± 5	99 ± 7	26 ± 7	129 ± 5	147 ± 6
2	166 ± 8	45 ± 9	95 ± 9	23 ± 7	130 ± 6	144 ± 7

reduced from 106±6 mg/dl to 95.9 mg/dl ($p \leq 0.075$). VLDLC values decreased from 27±5 mg/dl to 23±7 mg/dl ($p \leq 0.025$). TG values reduced from 133±6 mg/dl to 130±6 mg/dl ($p \leq 0.025$). FBS values reduced from 153±8 mg/dl to 144±7 mg/dl ($p \leq 0.005$).

On the basis of Analysis of Variance (ANOVA) the means of the different blood parameters were listed to see whether there is any significant difference between the values before applying the sesame oil and after applying the oil. This hypothesis got rejected. Then on the basis of Tukey's multiple comparison test which is based on a t-statistic the blood parameter(s) for which the hypothesis of ANOVA got rejected was looked. This resulted in the conclusion that fasting blood glucose levels in the groups over the study period show a significant decline in fasting blood glucose levels, and the decline was dependent on intake of sesame oil. Cholesterol and various lipoprotein cholesterol levels at baseline and at follow-up were also measured. It was found that sesame oil produced significant beneficial changes in terms of increment of HDL and reduction of TLC, LDL, VLDL and TG values in comparison to intake of coconut oil.

DISCUSSION

Rural Indian diet is diabetogenic (Mitra and Bhattacharya, 2005). Ghafoarunissa (1996) found that poor Indian diet lacked fats and rural Indians being poor, diet is deficient particularly in omega-3 fatty acid and mono-unsaturated fatty acid intake. Chow (1992) found imbalance of fatty acid intakes, particularly omega-3 to omega-6 ratio is one important cause of diabetes. With a diet low in fats for a long time as is evident in Indian diets particularly diet of a rural Indian the differences in effects of w-3 and w-6 decreases (Sanders et al., 1985) which was contrary to the view expressed by Raheja (1970).

Sesame oil is rich in linoleic acid and oleic acid, which constitutes about 80-85% of total fats in it. Further it is a rich source of vitamin E and the lignan- sesamin, both being good antioxidants. Oleic acid and linoleic acid have proven its role in control of FBS and in inducing beneficial

changes in lipid profile (Lands, 1986; Cunnane, and Thompson, 1995). Diets with olive oil as the dominant fat source may help reduce visceral fat, blood glucose, blood clotting, triglycerides and oxidation of LDL cholesterol and ultimately heart disease deaths.

Despite high intakes of salt, the relatively low rates of strokes in Cretan men in the 1960's may have been due to the protective effect of the high intake of olive oil. In contrast, the Japanese men had very low fat intakes (10% energy intake), high intakes of salt and much higher rates of stroke. However, the evidence that low fat diets may increase the risk of stroke is equivocal. Revan (2004) reported that monounsaturated fats could lower plasma cholesterol as much as polyunsaturated fat. Other studies since have resulted in the general consensus that both polyunsaturated and monounsaturated fats reduce blood LDL cholesterol when they replace saturated fats in the diet, but the polyunsaturated fats have a larger impact (Gardner and Kraemer, 1992). The effects on HDL cholesterol were similar, although some studies have shown that w-6 fats can lower and monounsaturated fats tend to raise HDL cholesterol (Mensink and Katan, 1995). Greek-born Australians in the Health 2000 study conducted by the Anti-Cancer Council have been found to have a higher prevalence of diabetes than Anglo-Australians. Interestingly, the former had significantly higher blood levels of carotenoids (due to their high intakes of vegetables and olive oil) and much lower death rates than the latter, despite their higher prevalence of diabetes and obesity. More studies are required to determine if Greek-born Australian diabetics also have a lower prevalence of diabetes complications due to their diet. The problem with olive oil is its overabundance of oleic acid, which inhibit prostaglandin production, which can increase the risk of breast cancer and incidence of ischaemic heart disease (Kouris-Blazos, 2001; Mercola, 2004).

Gamma-Linolenic Acid (GLA) which is produced from w-6 fatty acids causes reduction of blood pressure. The effect may be due to-increased production of vasodilatory prostaglandins and reduced pressure responsiveness to

vasoconstrictors, enhanced baroreceptor response, compositional changes of tissue fatty acids and subsequent membrane permeability alteration, blood pressure regulation through rennin-aldosterone axis and alteration of renal Na⁺/K⁺ ATPase enzyme activity and changes in vascular tone dependent intracellular calcium (Marguerite, 1995).

Cooking with sesame oil appears to help reduce high blood pressure and lower the amount of medication needed to control hypertension (Sankar et al., 2003 ; Melissa, 2003). The effect of the oil on blood pressure may be due to polyunsaturated fatty acids (PUFA), and the compound sesamin – a lignan present in sesame oil. Both compounds have been shown to reduce blood pressure in hypertensive rats. Sesame lignans also inhibit the synthesis and absorption of cholesterol. (Ramesh et al. 2005). Sesame is a rich source of antioxidants and other therapeutic agents. Although sesame oil contains low levels of tocopherols, it has good amount of other phenols that appear to be unique to sesame oil and that contribute to its superior oxidative stability. Sesamol forms from sesamol during processing which undergoes dimerisation and gives anti-oxidative protection. Conversion of sesamol to sesaminol may also give anti-oxidative protection (Fukuda, 1986). In both the small intestine and the colon, some cells are nourished by fat instead of sugar. The presence of sesame seed oil can provide those cells with essential nourishment. In recent experiments in Holland by Ayurvedic physicians, the oil has been used in the treatment of several chronic disease processes, including hepatitis, diabetes and migraines (<http://www.youthingstrategies.com/qualities.htm> ; Bhattacharya, 1977). Ramesh et al. (2005) found that diabetic rats fed with sesame oil when compared with diabetic rats not receiving sesame oil, a significant reduction in levels of blood glucose occurred (222.02 ± 8.27 mg/dL) in the group receiving sesame oil with reduction of glycolated haemoglobin values. Collinge Williamollinge (1996) stressed the need of holistic approaches in the treatment of diabetic diseases and puts emphasis on life-style and dietary managements.

CONCLUSION

Sesame oil has proven benefits on blood pressure reductions, which is more marked on first month of therapy. The beneficial changes in

blood biochemistry in the persons taking sesame oil may be due to increased uptake of PUFA and Monounsaturated Fatty Acids. Clearly, further studies are needed to obtain a conclusion in this respect.

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