Fats and oils: The health concerns and issues- A review

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ABSTRACT
Hydrogenated vegetable oils became popular for cooking in 1950s. Soon it became established that eating food cooked in hydrogenated oils (trans fats) could be the risk factors for cardio vascular diseases. Refined oils were recommended for cooking. It was believed that refined oils are rich in monounsaturated fatty acids (MUFA or omega-6) and will help maintain low cholesterol levels. Further research proved that omega-6 rich diet reduced HDL (High density lipoprotein) as well as LDL (low density lipoprotein). World health organization recommended that we should increase omega-3 i.e. poly unsaturated fatty acids (PUFA). PUFA help in keeping healthy HDL/LDL ratio. A number of reports also suggested that natural saturated fatty acids (nSFA) were not risk factors for coronary heart disease (CHD). In this mini review an account of developments concerning these issues has been presented.

Key words: Coronary heart disease, HDL, LDL, MUFA, PUFA.

A low fat diet was recommended world over for a healthy heart for the last six to seven decades. Refined oils were one of the recommended oils for cooking as these oils were low in saturated fatty acids and rich in unsaturated fatty acids. Dalda ghee (Hydrogenated vegetable oil) became a household name as an alternative to desi ghee (clarified butter fat) in 1950s in India. The ghee was thermally stable and for its appearance like desi ghee it became very popular. One of the famous advertisements in print media carried the tag line ‘mothers who care cook in dalda’. Soon the bad effects of hydrogenated fatty acids came to be known and refined oils were popularized as alternative cooking oils. There has been conflicting and non conclusive research on the health impacts of fats. However presently a clear picture seems to emerge with better statistical tools and analytical techniques.

CLASSIFICATION OF FATTY ACIDS

Fats are broadly classified as Saturated fats and Unsaturated fats. Saturated fats are the ones which have all single bonds and are found in animal based products; butter, cheese, beef fat, coconut oil, palm oil, palm kernel oil. Unsaturated fats are further classified as MUFA (Monounsaturated Fatty Acids) and PUFA (Poly Unsaturated Fatty Acids). MUFA contain one double bond and PUFA contain more than one double bond. Olive oil, avocados and seeds are sources of MUFA. PUFA are considered essential fatty acids as human beings cannot synthesize them. Omega-3 and Omega-6 are important essential fatty acids. Fish, soyabean, cotton seed oils are some important sources of PUFA. Trans fat is generated by hydrogenation of oil and improves shelf life of fat. Trans fatty Acids (TFA) are considered risk factors for Coronary Heart Disease (CHD) (Mozaffarian et al., 2006). Saturated fats and trans fats are also called bad fats owing to health risk factors. TFAs have higher melting points, hence are solids. MUFA and PUFA have low melting points and are liquids.

Saturated fatty acids: Some of the common examples of natural SFAs are Butyric acid found in butter, Myristic acid found in cows milk and dairy products, Lauric acid found in human breast milk, cows milk and goats milk, Palmitic acid found in palm oil. Tallow, lard, red meat are rich non-vegetarian sources of saturated fats.

Unsaturated fatty acids: Monounsaturated fatty acids (MUFA): Oleic acid found in almonds (It is Omega-9 Fatty Acid).

Poly Unsaturated Fatty acids (PUFA): (i) Omega-3 fatty acids: Alpha linoleic acid (ALA) is an omega-3 fatty acid found in walnuts and Docosahexaenoic acid (DHA) found in fish, eggs are examples of omega-3 fatty acids. Flax seeds are rich source of alpha linoleic acid.

(ii) Omega-6 fatty acids: Linoleic acid (LA) is found in eggs, popcorns, vegetable oils. Gamma Linolenic acid (GLA) is found in plant based oils.

Trans fats: Elaidic Acid is trans isomer of Oleic Acid found in bovine milk (0.1%) or partially hydrogenated oils. The dairy products contain trans fats in 2-5% range. Trans fats (Hydrogenated ones) are used in cookies, pizza, biscuits, pastries etc.

NATURAL SATURATED FATS ARE RELATIVELY SAFE
For a long time people were advised to have low consumption of saturated fats(SFs) as SFs were considered...
cardiovascular risk factors. Recent studies have failed to establish a link between heart diseases and consumption of natural saturated fats. Natural saturated fats are believed to increase cholesterol levels in blood. Mainly two types of proteins carry cholesterol through blood: low density lipoproteins (LDLs) and High density Lipoproteins (HDL). LDL is considered high risk factor and HDL is considered good for heart. LDLs are further classified as small dense LDL and large LDL, based on their molecular diameters. It is the small LDL particles that have been found to be associated with Coronary artery disease (CAD) (Christopher et al., 1996). Reduced HDL levels are also correlated to CAD (Murtuza et al., 2016). In a study small, dense LDL particles were found to be significantly associated with a threefold increased risk of myocardial infarction, independent of age, sex, and relative weight (Melissa et al., 1988). A diet high in saturated fat intake can result in increase of large LDL (Dreou et al., 1998) with particular reference to Myristic acid. Myristic acid is found in mother’s milk, cow’s milk and goat’s milk. Another study at University of Bergen found improvement in ectopic fat storage, triglyceride levels, blood sugar, blood pressure, insulin when subjects were put on high intake of saturated fat (Veum et al., 2017). Diet low in fat may raise LDL levels. One study found no significant change in the LDL levels of men having large LDL, when their diet was changed to a very low fat diet (Dreou et al., 1999). Replacing saturated fat by modifying dietary fat (taking unsaturated fat or oil from plant origin) reduced the risk of cardiovascular events by 14% (Hooper et al., 2012). But merely reducing total fats had no effect on cardiovascular mortality. A meta analysis report published in 2010 found no evidence of association between saturated fat consumption and Coronary Heart Disease (CHD) or cardiovascular disease (Siri-Tarino et al., 2010). In a study on Dutch population no association was found in high SFA intake with ischemic heart disease (Praagman et al., 2016). In the worldwide dietary recommendations of replacing saturated fatty acids with LA (Omega-6) found in safflower oil was considered beneficial for cholesterol reduction. Recent studies have established no evidence of reduction in cardiovascular diseases from replacing saturated fat with LA (Christopher et al., 2013). Main sources of LA are vegetable oils.

ISSUES AND CONCERNS

Trans Fats: Conjugated Linoleic acid (CLA), a natural trans fatty acid, is found in dairy products and a report even suggests reduced risk of heart disease with diet consisting of CLA (Bonthuis et al., 2010). Intake of dairy products was not associated with mortality of increased heart risk. The study was conducted over a period of sixteen years. Natural sources of fatty acids contain small amounts of Trans fats. However studies on artificial Trans fats have confirmed their bad effects. Replacement of Saturated fatty acids with hydrogenated fats (trans fats) resulted in decreased HDL in blood and ability of arteries to dilate was also impaired (de Roos et al., 2001). Trans fats are bad in a way that they reduce HDL and increase LDL in blood increasing the risk of cardiovascular disease greatly. Food and Drug Agency of USA (FDA) has directed edible oil manufactures to completely phase out Trans fats by 2018. Trans fatty acid contents in erythrocytes have been found to be associated with an elevated risk of Cardiovascular Heart Disease (CHD) in a nested case-control study among US women (Sun et al., 2007). Another study carried out on Finish men over a period of 6 years observed a significant positive association between the intake of trans fatty acids and the risk of coronary death (Pietinen et al., 1997). Younger women were found to be at higher risk of CHD owing to high trans fat intake (Oh et al., 2005).

Omega 3 vs. Omega 6 fatty acids: Omega-3 and omega-6 refers to the position of double bond from methyl end of the fatty acid. Studies show a link between diet containing omega-3 fatty acids and reduction in life threatening diseases such as heart diseases, arthritis and cancer (The nutrition source). Apart from these benefits omega-3 has been found to have anti-inflammatory properties and prevents diabetes. Omega-3, EPA (Eicosapentaenoic acid), DHA (Docosahexaenoic acid) and ALA (alpha-linolenic acid) are three important omega-3 acids. DHA is good for nervous system, good sleep and improved mood. EPA and DHA are considered good for pregnant women while humans being cannot directly use ALA but are able to convert ALA to DHA (DHA EPA Omega-3 Institute). Human body is capable of producing all fatty acid except LA (Omega-6) and ALA (Omega-3). Hence LA and ALA are essential fatty acids i.e. they must be a part of the diet. Excessive intake of omega-6 fatty acids is reported to interfere with health benefits of omega-3 fatty acids as both types compete for same enzymes (Simopoulos, 2002). Typically an omega 6 to omega 3 ratio in diet should be 1:1 based on evolutionary trends (Simopoulos, 2006). Modern diet ratio for the same is 16:1 which indicates lower omega-3 intake. A study in India has also documented low omega-3 intake across large segments of the population (Ghafourunissa, 1998). Some studies have linked this diet to breast cancer in post menopausal women and prostate cancer. Many other studies suggest an ideal ratio of 4:1 is good for health. One thing is for sure we are taking much higher amounts of omega 6 fatty acids than are actually needed. We need to either considerably reduce refined oils (that are rich in omega-6) or increase consumption of omega-3 fatty acids to maintain healthy ratio.

Cold pressed oils vs. refined oils: Cold pressed oils retain their nutritional values as compared to refined oils that are processed at very high temperatures to get rid of ketones and other substances. During the heating process refined oils considerably lose their nutritional value. Mustard oil, extra
Virgin olive oil, Coconut oil, Canola oil is extracted by cold press techniques. However we should not be misled by Canola oil or Olive oil prepared by refining process. Refined Olive oil can be as bad as other refined oils. EVO (Extra Virgin Olive oil) prepared by cold press technique is low in omega-6 and omega-3 but consists of chlorophyll, squalene, beta carotene, phystosterols which are important healthy components. Mustard oil (Kachi Ghani i.e. cold pressed oil) is rich in tocopherols which is a natural antioxidant and acts as a natural preservative. Mustard oil has 6% omega-3 (ALA) and 15% Omega-6 (LA). However a report published by FDA banned used of Mustard oil as vegetable oil (Import Alert 26-04) in US due to high erucic acid (20-40%) content which has been found to be toxic in animal studies. NIN ICMR 2010 guidelines recommend mixing mustard oil with rice bran/cottonseed/groundnut oils for reducing erucic acid content. Canola oil can also be substituted for mustard/rapeseed oil. Rice bran oil in combination with soyabeen oil or mustard oil and blend of sesame oil with mustard oil provides good amount of plant sterols which are known to block cholesterol absorption in intestine Ghafoorunissa (2009). Sesame oil (Til oil) is considered better for deep frying and massage as mentioned in Ayurveda. A diet rich in omega-6 and low in omega-3 can lead to inflammations (Russo, 2009). Lipoxins and resolvins are metabolites of EPA and DHA that have significant anti-inflammatory properties (NIN, ICMR 2010). Soyabeen Oils and canola oils have been found to contain toxic trans fats as high as 4.2% (O’ Keefe, 1994). A high omega-6 to omega-3 ratio has been linked to depression and inflammatory diseases (Kiecolt-Glaser et al., 2007)

**Desi ghee:** A study on desi ghee on rats (for both the heated and native ghee) found a significant decrease in serum total cholesterol levels, a decrease of 20–25% in serum triglycerides, a 14–16% decrease in liver total cholesterol levels, a 14–29% decrease in liver triglyceride levels (Sharma et al., 2010). Preparation of ghee by traditional ayurvedic method contains higher amount of DHA. This method involves preparing ghee from curd (Joshi et al., 2014). DHA is an omega-3 acid and considered good for eyes, heart and brain. Another study concluded that consumption of increased mustard oil was associated with higher CHD as compared to desi ghee (Manna et al., 2016) contrary to popular belief even among medical fraternity.

**WHY WE NEED FATS IN DIET**

Fats are storehouse of energy. 1 gram of fat provides 9 calories irrespective of its type. Essentials fats are important components of our brain and play important role in nerve function and transport of fat soluble vitamins; A, D, E and K. These vitamins play an important role in biological functions. A fat deficient diet may lead to deficiency of these vitamins. Fats are precursors for steroid hormones and regulate transport across cell membranes. The body stores fat around vital organs to protect them from shock. Fat layer under our skin protects as an insulating sheet and saves us from sudden temperature changes. When temperature drops very low, body metabolizes fat molecules to unlock energy and keep us warm. Dietary Fats are important precursors of Prostaglandins (Hassam et al. 1979) which regulate a number of biological functions.

**IMPORTANCE OF CHOLESTEROL**

Cholesterol is infamous for causing cardiovascular diseases. Cholesterol has important role in human body; as a precursor for bile acids it plays a role in digestion, building cell membranes, block of tissues and production of sex hormones like oestrogen and testosterone. About 25% of the cholesterol in body is present in Brain. New studies have emerged linking cholesterol deficiency to Alzheimer (Mulder et al., 1998′). Cholesterol production occurs mainly in liver. The lipid profile is an indicator of risk of cardiovascular disease. For Indian adults a total fat intake of 20–40 gram (Sedentary to high physical activity) per day has been recommended (ICMR, 2010). Total diet cholesterol must be less than 30mg per day. SFA:MUFA:PFA are recommended at 1:1:1 levels.

**Cholesterol level indicators in blood:** Total Cholesterol: Less than 200mg/Dl is desirable; above 240 mg/Dl is high risk; HDL Cholesterol: Below 40mg/Dl is high risk; Tryglycerides: Below 150mg Dl is normal and above 500mg/Dl is very high risk.

**VITAMIN C AND CHOLESTEROL**

A meta analysis carried on 13 trials indicate that 500mg per day dose of ascorbic acid (Vitamin C) can significantly reduce LDL and Triglycerides over a period of 4 weeks (McRae 2008). Vitamin C dose of more than 400mg per day was found to be inversely associated with Cardiovascular Heart Disease in a pooled analysis of nine cohort studies (Knekt et al. 2004). There is a strong evidence that replacing carbohydrates and Saturated Fatty Acids with MUFA rich diets increases HDL levels and lowers LDL Cholesterol (FAO 2008). A study found that replacing carbohydrates and saturated fats with MUFA rich diets lowers LDL levels without affecting HDL levels (Mensink and Katan 1992 and NIN ICMR 2010). Replacing SFAs with PUFA in diet lowers total cholesterol/HDL ratio (NIN, ICMR 2010). Indian Council of Medical Research recommends a LA to ALA ratio to be between 10:1 to 5:1. A diet rich in legumes, green leafy vegetables, sea foods and fish is recommended for the same. A study on blending of rice bran oil and olive oil (In ratios: 70:30 & 80:20) achieved desirable MUFA and PUFA ratios (Choudhary and Grover 2013).

**Analytical results of some oils:** 30 brands of oils and fats were analyzed by Pollution Monitoring Lab of Centre for Science and Environment New Delhi (Johnson and Saikia 2009). The analytical results of only those oils and fats that have values close to WHO recommended limits are mentioned for brevity.
(i) Omega 6 to Omega 3 Ratio: Mustard oil (Dhara Refined)- 4.1, Desi Ghee (Milk Food) - 6.7, Butter (Amul) - 0.5. It is worthwhile to mention that popular brands like saffola oil have very high omega 6/3 ratio. Butter and Rice bran oil have higher omega 3 content as compared to other oils. American Heart Association (AHA) recommends that a person suffering from coronary disease should consume 1g EPA + DHA daily. However for better health and longevity an omega6/omega 3 ratio should ideally be 4:1 (Caramia 2008).

(ii) PUFA/SFA: Groundnut Oil (RR Primo)-1.8, Saffola Gold-2.2, Coconut Oil (Parachute)-0.0, Olive Oil (Figaro)-0.6, Rice Bran Oil (Shalimar)-1.2, Palm Oil (Palm Gold Active) 0.2, Desi Ghee (Milk Food)- 0.2, Butter (Amul) - 0.1

(iii) Trans Fatty Acids: The CSE report analyzed a total of 30 products out of which 11 contained higher amount of Trans fatty acids as compared to the 2% standard of Denmark.

(iv) Omega 3: Butter and Rice Bran oil has higher amount of omega-3 as compared to other oils analyzed by the lab.

CONCLUSION

Diet high in refined oils reduces cholesterol levels. Diet high in omega-6 may lower HDL (Good Cholesterol) as well as LDL (Bad Cholesterol). However a higher omega-3 diet maintains HDL levels and lowers LDL. Modern diet is low in omega-3 fatty acids, fish may be taken as a source of omega-3 as recommended by AHA. Inflammatory diseases and hypertension incidents are on the rise due to low omega-3 and high omega-6 in the American diet (Simopoulos 2002). Moreover there is no conclusive evidence that saturated fatty acids (Desi Ghee and other natural SFAs) are bad for health (Cholesterol Levels). Natural SFAs have been reported to raise HDL levels in blood. There is conclusive evidence that trans fatty acids are bad. Some reports even distinguish between natural and processed trans fatty acids. Processed fatty acids/hydrogenated oils are used in all packaged food available in the market. There is a downward trend world over in consumption of trans fatty acids. Among the refined oils Rice Bran oil seems to be the best bet whereas Mustard oil and Desi Ghee have desirable omega-3 levels (CSE report). ICMR recommends blending of mustard oil with other oils to control erucic acid level and appropriate omega6/3 ratio. Vitamin C should be made part of the daily diet and natural/homemade food should be encouraged.

REFERENCES


