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Classification, Functional Properties and Health Related Issues Associated with Consumption of Fats: A Review

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Farhan Mohiuddin Bhat*[1], Shruti Chandel[2], Sangita Sood[3], Yadvinder S Dhaliwal[4], Charanjit S Riar[5].

1, 2, 3,4 : Department of Food Technology, CSKHPKV, Palampur. Himachal Pradesh -176062

5. Department of Food Engineering & Technology, SLIET, Longowal, Punjab, 148106,

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ABSTRACT

The fatty acids play an essential role in the physiology of metabolic and structural processes in human body. Fat is an essential carrier of the fat-soluble vitamins A, D, E and K and functions as an insulator and provides protection to organs by cushioning them. Monounsaturated fatty acids are also high in vitamin E, a vitamin and antioxidant that keep your body healthy by protecting your cells from damage and extend shelf life by minimizing oxidative rancidity. Omega-3 fatty acids play a role in normal growth and development and proper brain function. They also reduce widespread inflammation and decrease your risk of chronic diseases, such as heart disease, arthritis and cancer. Omega-6 fatty acids play a role in growth, development and brain function, but they also regulate metabolism, stimulate hair growth and keep the reproductive system healthy. Foods containing monounsaturated fats reduce low-density lipoprotein cholesterol, while possibly increasing high-density lipoprotein cholesterol. The consumption of saturated fat is generally considered a risk factor for dyslipidemia, which in turn is a risk factor for some types of cardiovascular disease.

INTRODUCTION

Fats are the organic compounds having a backbone of carbon, hydrogen and oxygen and are made up of glycerol and fatty acids. It is one among the three essential nutrients used by a body as an energy sources. The energy produced by fats is 9 calories per gram, while as Proteins and carbohydrates provide only 4 calories per gram. The higher energy yield from fat than carbohydrates is due to the fact that fats contain less percentage of oxygen and higher percentage of carbon and hydrogen than carbohydrates. Fat is made up of different types of fatty acids that are usually classified as saturated, monounsaturated or polyunsaturated depending on their chemical structure**.** Fats are categorized into saturated and unsaturated fats according to the bonding and number of carbon atoms in the aliphatic chain. Saturated fats have no double bonds and unsaturated fats have one or more double bonds between the carbons in the chain. The structural differences among the polyunsaturated fats further classified these fats into omega 3 (n-3) or omega 6 (n-6) fatty acid **(**Mozaffarian et al., 2006**).** The fatty acids play an essential role in the physiology of metabolic and structural processes in human body. The membranes around the cells in our body are mainly made of phospholipids, triglycerides and cholesterol. The length and saturation of fatty acids of these components influences a range of important biological functions of these cell membranes like endocytosis (Simons & Vaz., 2004). The brain contains about 60% of fat having unique fatty acid composition. The major fatty acid present in brain and retina of human eye is docosahexaenoic acid (EFSA., 2010). Fat is an essential carrier of the fat-soluble vitamins A, D, E and K, in the intestines and thus enhances their absorption. Fat functions as an insulator and provides protection to organs by cushioning them. Fatty acids also act as signaling molecules between cells, thereby helping cells to communicate with each other for proper functioning of body. Fats play an important role in modifying many chemical, physical, and nutritional functions in the foods. Dietary fats known as triglycerides are made up of three fatty acid molecules attached with glycerol molecule. Triglycerides are used by body as source of energy and store it as body fat in the adipose tissue. Fats alter food's appearance by providing a glossy texture and also aids in the browning processes of many foods, by creating an appealing golden brown color. Fat provides desirable flavor in the food formulation due to its ability to absorb and preserve flavors. The compounds in fat also lend specific flavors to the foods. Fats take longer time to digest as compared to carbohydrates and proteins; thereby high-fat foods stay in the stomach longer and delay the feeling of hunger. Fats are also responsible for tenderization of baked goods. Fat provides a very specific, lubricating mouthfeel to a

variety of foods like dry crackers or chips. Emulsions containing fats are responsible for the creamy texture of many items like ice cream, mayonnaise. Fats act as an efficient mode of heat transfer at high levels to the surface of food without overheating the interior portions during cooking and also facilitates crust formation.

Chemical Structure of Fats

The fats are composed of fatty acids and glycerol. The fatty acids consist of a long hydrocarbon chain attached to a carboxyl group (-COOH) at one of its terminal ends, while the Glycerol is a small organic molecule having three hydroxyl (OH) groups. Fatty acids vary in their chain length and are designated as short-chain fatty acids (2-4 C atoms); medium chain fatty acids (6-12 C atoms) and long fatty acids possessing at least a chain of 14 carbon atoms. Most of the fats occur as glycerides, particularly triglycerides formed by dehydration reactions where three OH groups of a glycerol molecule react with the carboxylic acids groups of three different fatty acids forming ester bond along with release of three molecules of water.

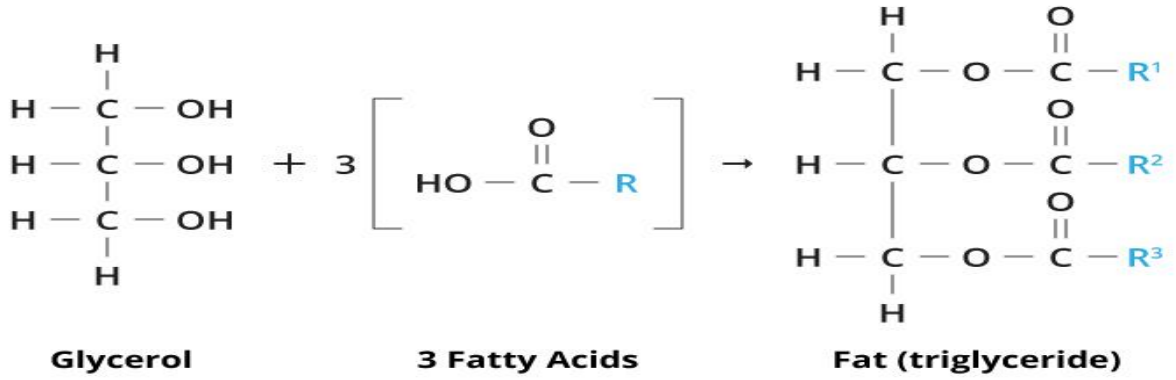

Figure No. 1. Structure of Fat molecule. The R in the three fatty acids represents a long C-C-C chain. The Rs may or may not be the same.

Classification of Fats

Monounsaturated Fats

Monounsaturated fatty acids have one double-bonded, or unsaturated, carbon atom. These fats are usually liquid at room temperature, but when you chill them, they turn solid. The position of the hydrogen atoms around the double bond determines the geometric configuration of the monounsaturated fatty acids and hence whether it is a cis *or* trans isomer.

In cis monounsaturated fatty acids, the hydrogen atoms are present on the same side of the double bond, whereas in the trans configuration, they are on opposite sides. The American Heart Association Nutrition Committee recently published a scientific statement regarding the relationship of *trans* monounsaturated fatty acids to cardiovascular disease risk (**Lichtenstein AH., 1997**). In the United States, average total monounsaturated fatty acids intake is 13% to 14% of total energy intake, an amount that is comparable to (or slightly greater than) Saturated Fatty Acids intake. In contrast, polyunsaturated fatty acids contribute less (ie, 7% of energy). Consumption of monounsaturated fatty acids has been found to reduce the levels LDL cholesterol and increase HDL cholesterol levels. Examples of foods high in monounsaturated fatty acids are olives, olive oil, canola oil, peanuts, peanut oil, almonds, pecans, hazelnuts, cashew nuts, macadamia nuts, pistachio nuts, and avocados. Monounsaturated fatty acids are also high in vitamin E, a vitamin and antioxidant that keep your body healthy by protecting your cells from damage and extends shelf life by minimizing oxidative rancidity.

Polyunsaturated Fats

Polyunsaturated fatty acids have more than one double-bonded, or unsaturated, carbon atom. Like monounsaturated fats, polyunsaturated fats are liquid at room temperature, but they also stay liquid when they are chilled. Fatty acid viscosity and melting temperature increases with decreasing number of double bonds, therefore, monounsaturated fatty acids have a higher melting point than polyunsaturated fatty acids due to presence of more double bonds and a lower melting point than saturated fatty acids with no double bond. Polyunsaturated fatty acids oils have an absolutely devastating effect on the body's metabolism. That's because polyunsaturated fatty acids directly interfere with the functioning of the thyroid gland, and also how well the thyroid hormones are able to be utilized, or metabolized, by the body. This type of interference with thyroid functioning is a *major* cause for a sluggish metabolism in the body. Sources of polyunsaturated fats include soybean oil, corn oil, safflower oil, salmon, trout, mackerel, herring, walnuts and sunflower seeds.

Types of Polyunsaturated Fats

Polyunsaturated fats can be divided into two categories: omega-6 fatty acids and omega-3 fatty acids. Omega-3 fatty acids play a role in normal growth and development and proper brain function. They also reduce widespread inflammation and decrease your risk of chronic

diseases, such as heart disease, arthritis and cancer. Like omega-3 fatty acids, omega-6 fatty acids play a role in growth, development and brain function, but they also regulate metabolism, stimulate hair growth and keep the reproductive system healthy. Unlike omega-3s, some omega-6 fatty acids can promote inflammation. The key to staying healthy is to consume a balance of both types of fatty acids. The University of Maryland Medical Center notes that the ratio of omega-6 fatty acids to omega-3 fatty acids should be between 2 to 1 and 4 to 1.

Health Benefits associated with polyunsaturated fats.

Polyunsaturated fats protect against cardiovascular disease by providing more membrane fluidity than monounsaturated fats, but they are more vulnerable to lipid peroxidation or rancidity (Flatten et.al., 2005). On the other hand, some monounsaturated fatty acids (in the same way as saturated fats) may promote insulin resistance, whereas polyunsaturated fatty acids may be protective against insulin resistance (**Lovejoy, J. C., 2002)**. Monounsaturated fatty acids may also help improve the function of your blood vessels. And some research shows that monounsaturated fatty acids may also benefit insulin levels and blood sugar control, which can be especially helpful if you have type 2 diabetes. Monounsaturated fatty acids are a central part of the heart-healthy Mediterranean diet. Eating monounsaturated fats instead of saturated fats and trans fats can lower your cholesterol levels and reduce your risk of heart disease and stroke.

Various researchers have found that increasing monounsaturated fat and decreasing saturated fat intake could improve insulin sensitivity, but only when the overall fat intake of the diet was low (**Vessby B et.al., 2001**). Studies have shown that substituting dietary monounsaturated fat for saturated fat is associated with increased daily physical activity and resting energy expenditure. More physical activity was associated with a higher-oleic acid diet than one of a palmitic acid diet. From the study, it is shown that more monounsaturated fats lead to less anger and irritability (**Lawrence et.al., 2013**). Foods containing monounsaturated fats reduce low-density lipoprotein (LDL) cholesterol, while possibly increasing high-density lipoprotein (HDL) cholesterol (**Merck & Co., 2009**). However, their true ability to raise HDL is still in debate.

Saturated fatty acids

A saturated fat is a fat that consists of triglycerides containing only saturated fatty acids. Saturated fatty acids have no double bonds between the individual carbon atoms of the fatty acid chain unlike unsaturated fat having one or more double bonds. That is, the chain of carbon atoms is fully "saturated" with hydrogen atoms. There are many kinds of naturally occurring saturated fatty acids, which differ mainly in number of carbon atoms, from 3 carbons (propionic acid) to 36 (hexatriacontanoic acid). Various fats contain different proportions of saturated and unsaturated fat. Examples of foods containing a high proportion of saturated fat include animal fat products such as cream, cheese, butter, ghee, suet, tallow, lard, and fatty meats. Saturated fats have a significant effect on the cholesterol levels in the human body as saturated fats will raise cholesterol levels much higher than eating dietary cholesterol.

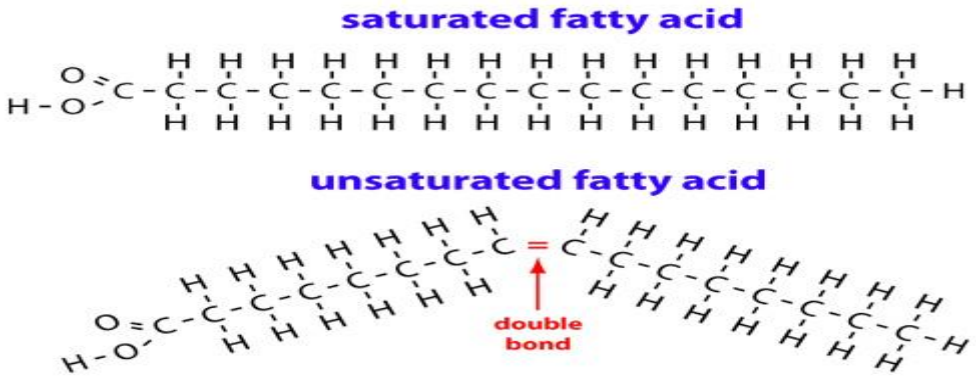

Figure No. 2. Structure of Saturated fatty acids and unsaturated fatty acids chains.

Certain vegetable products have high saturated fat content, such as coconut oil, cottonseed oil and palm kernel oil. Any prepared foods are high in saturated fat content, such as pizza, dairy desserts, bacon and sausage. Lauric and myristic acids are most commonly found in "tropical" oils (e.g., palm kernel, coconut) and dairy products. The saturated fat in meat, eggs, cacao, and nuts is primarily the triglycerides of palmitic and stearic acids.

Examples of saturated fatty acids

Butyric acid with 4 carbon atoms.

Lauric acid with 12 carbon atoms.

Myristic acid with 14 carbon atoms.

Palmitic acid with 16 carbon atoms.

Stearic acid with 18 carbon atoms.

Health problems associated with saturated fatty acids

Saturated fatty acids have detrimental effects on health, as represented by the widespread public health message advising a reduction in saturated fatty acids intake to less than 10% or even 7% of total energy (**Eyre et.al., 2004**). The consumption of saturated fat is generally considered a risk factor for dyslipidemia, which in turn is a risk factor for some types of cardiovascular disease. There are strong, consistent, and graded relationships between saturated fat intake, blood cholesterol levels, and the mass occurrence of cardiovascular disease (**Labarthe and Darwin ., 2011**). Research has revealed various types of cancers associated with saturated fat intake. saturated fatty acids leads to the descrease in bone mineral density, and have a negative effect on bone health (**Corwin RL,2006**). Saturated fat may also increase your risk of type 2 diabetes. Lipoproteins and their associated apoproteins are strong predictors of the risk of coronary heart disease (CHD). Controlled dietary trials have now demonstrated that the total saturated fat content and the type of saturated fatty acid in the diet affect serum lipid and lipoprotein levels (Mensink RP., 2013). A mixture of saturated fatty acids strongly elevates serum total cholesterol concentrations. It was predicted that when 10% of dietary energy provided by carbohydrates was exchanged for a mixture of saturated fatty acids, serum total cholesterol concentrations would increase by 0.36 mmol l1. This increase in total cholesterol will result from a rise in both LDL and HDL cholesterol concentrations. Saturated fatty acids will also lower fasting triacylglycerol concentrations compared with carbohydrates. Increased platelet aggregation may be an important risk marker for the occurrence of cardiovascular disease and different types of fatty acids can modify platelet aggregation.

Limit for saturated fatty acids intake

The American Heart Association recommends aiming for a dietary pattern that achieves 5% to 6% of calories from saturated fat. That means, for example, if you need about 2,000 calories a day, no more than 120 of them should come from saturated fats. That's about 13 grams of saturated fats a day. The Heart Foundation (Australia) recommends for heart health that saturated fat be reduced to 7% of total energy.

CONCLUSION

The key to staying healthy is to consume a balance of both omega-3 and omega-6 fatty acids. Saturated fatty acids have detrimental effects on health, as represented by the widespread public health message advising a reduction in saturated fatty acids intake to less than 10%. Eating monounsaturated fats instead of saturated fats and Tran's fats can lower your cholesterol levels and reduce your risk of heart disease and stroke. Substituting dietary monounsaturated fat for saturated fat is associated with increased daily physical activity and resting energy expenditure.

REFERENCES

[1] Corwin, R. L., Hartman, T. J., Maczuga, S. A and Graubard, B. I. "Dietary saturated fat intake is inversely associated with bone density in humans: Analysis of NHANES III". The Journal of nutrition, 136 (1): 159–165, (2006).
[2] European Food Safety Authority (EFSA). Scientific Opinion. EFSA Journal 8(10): 1734, (2010).
[3] Eyre, H., Kahn, R and Robertson, R. M. Preventing cancer, cardiovascular disease, and diabetes: a common agenda for the American Cancer Society, the American Diabetes Association, and the American Heart Association.pp. 3244–3255, (2004).
[4] Flatten, A., Bryhni, E. A., Kohler, A., Egelandsdal, B and Isaksson T. Determination of C22:5 and C22:6 marine fatty acids in pork fat with Fourier transform mid-infrared spectroscopy. Meat Science, 69 (3): 433–440, (2005).
[5] Labarthe and Darwin "What Causes Cardiovascular Diseases?".Epidemiology and prevention of cardiovascular disease: a global challenge (2 ed.). Jones and Bartlett Publishers. 7637-4689-6 (2011)..
[6] Lawrence, K., Janice, Y. B., Connie, L. T., Julie, A. D., Karen, I. C., David, B. E., Timothy, R. K and Deborah, M. M. "Substituting dietary monounsaturated fat for saturated fat is associated with increased daily physical activity and resting energy expenditure and with changes in mood". The American Journal of Clinical Nutrition. 97 (4): 689–697, (2013).
[7] Lichtenstein, A. H. Trans fatty acids, plasma lipid levels, and risk of developing cardiovascular disease. a statement for healthcare professionals from the American Heart Association.95:2588-90, (1997).
[8] Lovejoy, J. C. "The influence of dietary fat on insulin resistance". Current Diabetes Reports 2 (5): 435–40, (2002).
[9] Mensink, R. P. Health effects of saturated fatty acids. Maastricht University, the Netherlands. 225–230, (2013).
[10] Merck & Co. Inc. "You Can Control Your Cholesterol: A Guide to Low-Cholesterol Living"03-14 (2009).
[11] Mozaffarian, Dariush, Katan, Martijn, B, Ascherio, Alberto, Stampfer, Meir, J., Willett, Walter, C. "Trans Fatty Acids and Cardiovascular Disease". New England Journal of Medicine. 354 (15): 1601–1613,(2006).
[12] Simons, K and Vaz, W. L. Model systems, lipid rafts, and cell membranes. Annual Review of Biophysics and Biomolecular Structure 33: 269-295, (2004).
[13] Vessby, B., Unsitupa, M., Hermansen, K., Riccardi, G., Rivellese, A. A., Tapsell, L. C, Nälsen, C., Berglund, L., Louheranta, A., Rasmussen, B. M., Calvert, G. D., Maffetone, A., [14] Pedersen, E., Gustafsson, I. B and Storlien, L. H. "Substituting dietary saturated for monounsaturated fat impairs insulin sensitivity in healthy men and women.44 (3): 312–9, (2001).