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FATTY ACIDS AS BIOCOMPOUNDS: THEIR ROLE IN HUMAN METABOLISM, HEALTH AND DISEASE – A REVIEW. PART 1: CLASSIFICATION, DIETARY SOURCES AND BIOLOGICAL FUNCTIONS

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Background. Fatty acids are substantial components of lipids and cell membranes in the form of phospholipids. This review consists of two parts. The present part aims at describing fatty acid classification, dietary sources and biological functions. The second part will focus on fatty acid physiological roles and applications in human health and disease.

Results. In humans, not all fatty acids can be produced endogenously due to the absence of certain desaturases. Thus, specific fatty acids termed essential (linoleic, alpha-linolenic) need to be taken from the diet. Other fatty acids whose synthesis depends on essential fatty acid intake include eicosapentaenoic acid and docosahexaenoic acid, found in oily fish. Dietary sources of saturated fatty acids are animal products (butter, lard) and tropical plant oils (coconut, palm), whereas sources of unsaturated fatty acids are vegetable oils (such as olive, sunflower, and soybean oils) and marine products (algae and fish oils). Saturated fatty acids have been related to adverse health effects, whereas unsaturated fatty acids, especially monounsaturated and n-3 polyunsaturated, are thought to be protective. In addition, *trans* fatty acids have been shown to have negative effects on health, whereas conjugated fatty acids might be beneficial. Lastly, fatty acids are the main components of lipid classes (triacylglycerols, phospholipids, cholesteryl esters, non-esterified fatty acids).

Conclusion. Fatty acids are important biocompounds which take part in complex metabolic pathways, thus having major biological roles. They are obtained from various dietary sources which determine the type of fat consumed and consequently health outcome.

INTRODUCTION

Dietary modifications that have occurred over time include changes in the type of fat consumed toward increased consumption of saturated animal fat in particular, and lower intake of unsaturated fat (plant and marine sources) (ref.[1,2]). This change in the composition of diet may have a great effect on the fatty acid composition of human tissues and affect metabolism and health[3].

Fatty acids (FA) play multiple roles in humans and other organisms. Most importantly, FA are substantial part of lipids, one of the three major components of biological matter (along with proteins and carbohydrates) (ref.[4]). Fatty acids are also important energy substrates comprising around 30% of total energy intake for humans. They can be stored in excess amounts in adipose tissue, especially when increased dietary intake of fat and energy occurs resulting in obesity.

Fatty acids are either saturated or unsaturated carboxylic acids with carbon chains varying between 2 and 36 carbon atoms. Polyunsaturated FA (PUFA) are characterized by pentadiene configuration of double bonds. Most FA have an even number of carbon atoms, as they are synthesized from two-carbon units. Specifically, fatty acids are synthesized *ad hoc* in the cytoplasm from two-carbon precursors, with the aid of acyl carrier protein, NADPH and acetyl-CoA-carboxylase. Their degradation by β-oxidation in mitochondria is accompanied by energy release.

Fatty acid composition is species as well as tissue specific. In animal and plant tissues, the most abundant FA are those with 16 and 18 carbon atoms, i.e. palmitic, stearic, oleic and linoleic. Fatty acids in mammalian organisms reach a chain-length of 12-24 carbon atoms, with 0-6 double bonds. However, fatty acids with chain lengths shorter than 14 and longer than 22 carbon atoms are present only in minor concentrations. Approximately half of the FA in plants and animals are unsaturated and contain 1-6 double bonds.

Fatty acids can be desaturated endogenously up to the Δ9 position due to lack of certain enzymes in humans (Δ12- and Δ15-desaturases). For this reason linoleic (LA; 18:2n-6) and α-linolenic (ALA; 18:3n-3) acids must be taken from the diet and are termed essential. Further elongation and desaturation of these fatty acids to produce long-chain (LC) PUFA, including eicosapentaenoic acid (EPA; 20:5n-3), docosahexaenoic acid (DHA; 22:6n-3) and arachidonic acid (AA; 20:4n-6), is possible but not very efficient in humans. Thus, these fatty acids may be characterized as conditionally essential depending on essential fatty acid availability. Recommendations for minimum dietary intake of EPA plus DHA vary between 250-450 mg/day, especially for pregnant women and those