Health Effects of Dietary Unsaturated Fatty Acids

Fat provides energy; indeed it is the most energy dense of all the macronutrients with 1g providing 37kJ (9kcal). However, the constituent parts of fat, fatty acids, are required by the body for many other functions than as simply an energy source and there is an increasing awareness of the potential health benefits of specific types of fatty acids. Fatty acids are long hydrocarbon chains with a methyl group at one end (the omega or n- end) and an acid group at the other. Unsaturated fatty acids are hydrocarbon chains containing at least one carbon–carbon double bond; monounsaturated fatty acids contain one double bond, polyunsaturated fatty acids contain many double bonds. The position of the double bond relative to the omega end determines whether a polyunsaturated fatty acid is an n-3 (omega 3) or an n-6 (omega 6) fatty acid.

Most fatty acids can be synthesised in the body, but humans lack the enzymes required to produce two fatty acids. These are called the essential fatty acids and must be acquired from the diet. In humans, the essential fatty acids are the n-3 polyunsaturated fatty acid α-linolenic acid and the n-6 polyunsaturated fatty acid linoleic acid. Although humans can elongate dietary α-linolenic acid to the long chain n-3 polyunsaturated fatty acids eicosapentaenoic acid and docosahexaenoic acid, the rate of synthesis may not be sufficient to meet requirements and it is therefore recommended that good sources of these fatty acids, namely oil-rich fish, are also included in the diet.

Fat is found in most food groups and foods containing fat generally provide a range of different fatty acids, both saturated and unsaturated. In the UK, the major dietary sources of unsaturated fatty acids include meat & meat products, cereals & cereal products and potatoes & savoury snacks; primarily as a result of the vegetable oil used in processing. Recommended intakes of both total fat and the different types of fatty acids have been set for the UK population and it is possible to monitor fat intake from the data collected in nationwide dietary surveys. As a population, we are not currently meeting these recommendations so there is still scope for dietary change. In Western diets, n-6 fatty acids are the predominant polyunsaturated fatty acids, and this is in line with current dietary advice to consume a minimum of 1% energy as n-6 polyunsaturated fatty acids and 0.2% energy as n-3 polyunsaturated fatty acids. The balance of n-3 and n-6 polyunsaturated fatty acids in Western diets has changed substantially over the last 100 years or so and as the two families of polyunsaturated fatty acids share a common metabolic pathway, concerns have been raised that this might be detrimental to health; what is becoming increasingly clear is that both n-3 and n-6 PUFAs have independent health effects in the body and as intakes of the n-6 PUFAs are within the guidelines for a healthy diet, concerns about the n-6:n-3 ratio are driven by low intakes of n-3 rather than high intakes of n-6. Currently in adults n-6 polyunsaturated fatty acids contribute to 5.3% energy.

Detecting associations between components of the diet and risk of various diseases is notoriously complex and in many cases, the evidence is still accumulating. Cardiovascular disease, characterised by hardening and narrowing of blood vessels and/or the development of blood clots, is one of the leading causes of mortality and morbidity worldwide. The type and total amount of dietary fat has a clear part to play in affecting an individual’s disease risk, yet the precise mechanisms by which unsaturated fatty acids reduce cardiovascular disease risk are still unclear. A number of mechanisms have been identified whereby dietary fatty acids could influence the progression of cardiovascular disease and its risk factors. These include effects on blood lipid levels, blood pressure, inflammatory response, arrhythmia and endothelial function along with many other effects, both known and as yet undefined. A well established risk factor for cardiovascular disease is an elevated plasma LDL cholesterol concentration. Replacing saturated fatty acids with either monounsaturated fatty acids or n-6 polyunsaturated fatty acids reduces LDL (the ‘bad’) cholesterol and so reduces the risk of developing the disease. Unsaturated fatty acids, such as linoleic acid or monounsaturated fatty acids, also slightly raise HDL (the ‘good’) cholesterol which assists in the removal of TAGs from the blood stream. Interest in the health effects if the long chain n-3 polyunsaturated fatty acids found in fish oils is also increasing. There is strong supportive, but not yet conclusive
evidence that these fatty acids protect against fatal heart disease. On the basis of this conclusion, in 2004 the Scientific Advisory Committee on Nutrition advised the UK Government to adopt the population-wide dietary recommendation to eat at least two portions of fish per week, of which one should be oily, equivalent to 0.45g of the long chain \( n-3 \) polyunsaturated fatty acids per day. In recent years, the potential health benefits of \( \alpha \)-linolenic acid has attracted attention and evidence is mounting on the role that this \( n-3 \) fatty acid may play in preventing the progression of cardiovascular disease, although it is currently unclear what, if any, association exists.

Brain cells are especially rich in certain long chain polyunsaturated fatty acids. This has led to the suggestion that dietary status of these long chain fatty acids might influence cognitive function and behaviour. Research in this field is still in its early stages, but there is a small amount of evidence to suggest improvements in cognitive function following fatty acid supplementation. In contrast, it is well established that pregnant women must have an adequate supply of the long chain \( n-3 \) polyunsaturated fatty acids before and throughout pregnancy and lactation to support normal growth, neurological development and cognitive function of the baby. As \( n-6 \) polyunsaturated fatty acids are more abundant in the diet, achieving an adequate intake is less problematic. However, this is not the case for the \( n-3 \) polyunsaturated fatty acids; increasing fish consumption beyond 2 servings of oily fish per week or relying on fish oil supplementation is not appropriate during pregnancy due to the potential problems associated with heavy metal contamination of fish, or the high vitamin A levels in some fish oil supplements.

Unsaturated fatty acids have also been associated with a number of other diseases and although the evidence is by no means conclusive, it is an area that is attracting a huge amount of interest. Dietary fat affects a number of different metabolic pathways including those involved with glycaemic control, so the types and amounts of dietary fat may have a role to play in the management of type 2 diabetes. Unsaturated fatty acids may also be associated with a reduced risk of developing certain cancers including cancers of the colon, breast and prostate, although currently the level of evidence is not deemed sufficient by authoritative bodies such as the WCRF, WHO and Department of Health to make any specific dietary recommendations. There are a number of inflammatory conditions, such as asthma, Crohn’s disease and arthritis, which could potentially be alleviated by dietary modification. The fatty acid composition of cell membranes can be altered by consumption of both \( n-3 \) and \( n-6 \) polyunsaturated fatty acids, and this can result in reduced inflammatory activity. However, whether this effect brings about a significant reduction in clinical symptoms is still unclear. It is also important to note that there are concerns that the beneficial effects on certain disease outcomes are only observed with very high intakes of unsaturated fatty acids which could realistically only be achievable by supplementation. Few nutritionists would be comfortable recommending supplement use as the only alternative to fish as this can be expensive and goes against the idea that all the nutrients that our bodies require can be obtained from the food that we eat if the right choices are made.

Unsaturated fatty acids are now a nutritional hot topic and their presence in foods has attracted both public and industrial interest. There is currently no specific legislation to control the use of health claims relating to the fatty acid content of foods. However, an EU Directive is expected imminently which will formally set down the criteria that a product will have to meet in order to make any nutrition or health claim. With regards to the current recommendations, those for the UK are in line with those around the world. However, as a population, we need to increase our consumption of long chain \( n-3 \) polyunsaturated fatty acids and decrease intake of saturated fatty acids. To facilitate this, food technologists are looking at ways in which the fatty acid profile of a food can be modified in order to bring dietary improvement without requiring a major change in dietary habits. However, public health messages surrounding the optimum intakes of fatty acids must be clear and consistent to ensure that a favourable change in the fatty acid profile of the UK diet occurs.

© British Nutrition Foundation 2006