European Food Safety Authority

Summary: EFSA Journal 2010; 8(3):1461

SCIENTIFIC OPINION

Scientific Opinion on Dietary Reference Values for fats, including saturated fatty acids, polyunsaturated fatty acids, monounsaturated fatty acids, *trans* fatty acids, and cholesterol[1]

EFSA Panel on Dietetic Products, Nutrition, and Allergies (NDA)[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

This Opinion of the EFSA Panel on Dietetic Products, Nutrition, and Allergies (NDA) deals with the setting of Dietary Reference Values (DRVs) for fats. A lower bound of the reference intake range for total fat of 20 energy % (E%) and an upper bound of 35 E% are proposed. Fat intake in infants can gradually be reduced from 40 E% in the 6-12 month period to 35-40 E% in the 2nd and 3rd year of life. For specific fatty acids the following is proposed: saturated fatty acid (SFA) and *trans* fatty acid intake should be as low as possible; not to set any DRV for *cis*-monounsaturated fatty acids; not to formulate a DRV for the intake of total *cis*-polyunsaturated fatty acids (PUFA); not to set specific values for the n-3/n-6 ratio; to set an Adequate Intake (AI) of 4 E% for linolenic acid; not to set any DRV for arachidonic acid; not to set an UL for total or any of the n-6 PUFA; to set an AI for alpha-linilenic acid (ALA) of 0.5 E%; not to set an UL for ALA; to set an AI of 250 mg for eicosapentaenoic acid **(**EPA) plus docosahexaenoic acid (DHA) for adults; to set an AI of 100 mg DHA for infants (>6 months) and young children <24 months; to increase by 100-200 mg preformed DHA in addition to the AI for adults as an adequate supply of n-3 long chain PUFA during pregnancy and lactation; not to set any DRV for conjugated linoleic acid. For cholesterol it was decided not to propose a reference value beside the limitation on the intake of SFA.

KEY WORDS

Fat, fatty acids, total fat, saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), n-3 PUFA, n-6 PUFA, cholesterol, trans-fatty acids (TFA), conjugated linoleic acid (CLA), dietary requirements, blood lipids, lipid profile, glucose tolerance, insulin sensitivity, body weight, type 2 diabetes, blood pressure, cardiovascular disease, coronary heart disease.

---

1 On request from the European Commission, Question No EFSA-Q-2008-466, adopted on 04 December 2009.

2 Panel members: Carlo Agostoni, Jean-Louis Bresson, Susan Fairweather-Tait, Albert Flynn, Ines Golly, Hannu Korhonen, Pagona Lagiou, Martinus Løvik, Rosangela Marchelli, Ambroise Martin, Bevan Moseley, Monika Neuhäuser-Berthold, Hildegard Przyrembel, Seppo Salminen, Yolanda Sanz, Sean (J.J.) Strain, Stephan Strobel, Inge Tetens, Daniel Tomé, Hendrik van Loveren and Hans Verhagen.

Correspondence: nda@efsa.europa.eu

3 Acknowledgement: The Panel wishes to thank for the preparation of this Opinion: Carlo Agostoni, Henk van den Berg, Jean-Louis Bresson, Jean-Michel Chardigny, Albert Flynn, Karin Hulshof, Ambroise Martin, Ronald Mensink, Hildegard Przyrembel and EFSA's staff member Silvia Valtueña Martínez.

Suggested citation: EFSA Panel on Dietetic Products, Nutrition, and Allergies (NDA); Scientific Opinion on Dietary Reference Values for fats, including saturated fatty acids, polyunsaturated fatty acids, monounsaturated fatty acids, trans fatty acids, and cholesterol. EFSA Journal 2010; 8(3):1461. [107 pp.]. doi:10.2903/j.efsa.2010.1461. Available online: www.efsa.europa.eu

SUMMARY

Following a request from the European Commission, the EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA) was asked to deliver a scientific opinion on Population Reference Intakes for the European population, including fat.

Dietary fats or lipids include triacylglycerols, phosphatidylcholine and cholesterol. Along with proteins, carbohydrates, and alcohol, fats are a major energy source for the body. Fatty acids are also involved in many other vital processes in the body (e.g. structural components of cell membranes, precursors for bioactive molecules, regulators of enzyme activities, regulation of gene expression).

Fatty acids can be classified according to their number of double bonds. Saturated fatty acids (SFA) have no double bonds, while monounsaturated fatty acids (MUFA) have one double bond and polyunsaturated fatty acids (PUFA) have two or more double bonds. These double bonds can have either the *cis* or *trans* configuration. Most unsaturated fatty acids in the diet have the *cis* configuration, but *trans* fatty acids (TFA) are also present as either *trans*-MUFA or *trans*-PUFA. *Trans*-PUFA have at least one *trans* double bond and may therefore also have double bonds in the *cis* configuration.

In most countries, separate dietary recommendations exist for total fat intake, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, and *trans* fatty acids. For this purpose, polyunsaturated fatty acids are frequently subdivided into n-6 polyunsaturated fatty acids, n-3 polyunsaturated fatty acids, and n-3 long-chain polyunsaturated fatty acids (n-3 LCPUFA). This latter class of fatty acids has 20 or more carbon atoms. Except for the n-3 long-chain polyunsaturated fatty acids, recommendations are expressed as percentage of total dietary energy (E%) or as grams per day.

Due to its physical properties, cholesterol is also a fat. It does not provide energy, but plays a central role in many metabolic processes. Recommendations are expressed in milligrams per day (mg/day) or in milligrams per megajoule (mg/MJ).

Total fat

Fat is an important dense source of energy and facilitates the absorption of fat-soluble dietary components such as vitamins. Fats and oils are also important sources of essential fatty acids (EFA). High-fat diets may decrease insulin-sensitivity and are positively associated with changes in fasting and postprandial factor VII, which may increase cardiovascular risk. However, a precise dose-response relationship can not be defined. There is evidence that a moderate fat intake (<35 E%) is accompanied by a reduced energy intake and therefore moderate weight reduction and/or prevention of weight gain. However, there are not sufficient data to define a Lower Threshold Intake (LTI) or Tolerable Upper Intake Level (UL) for total fat. The Panel concludes that only a Reference Intake range can be established for total fat intake, partly based on practical considerations (e.g. current levels of intake, achievable dietary patterns). At the lowest observed intake of total fat (20 E%) in European countries no overt signs of deficiencies have been observed nor adverse effects on blood lipids. Total fat intakes > 35 E% may be compatible with both good health and normal body weight depending on dietary patterns and the level of physical activity. The Panel proposes to set for adults a lower bound of the Reference Intake range of 20 E% and an upper bound of 35 E%.

Fat intake in infants, which is high during the breastfeeding period, can gradually be reduced in the second half of the first year of life from the start of the complementary feeding period up to three years of age: 40 E% in the 6 to 12 month period and 35 to 40 E% in the 2nd and 3rd year of life. Fat intakes below 25 E% have been associated with low vitamin levels in some young children.

Saturated fatty acids

SFA are synthesised by the body and are not required in the diet. Therefore, no Population Reference Intake (PRI), Average Requirement (AR), Lower Threshold Intake (LTI), or Adequate Intake (AI) is set.

There is a positive, dose-dependent relationship between the intake of a mixture of saturated fatty acids and blood low density lipoprotein (LDL) cholesterol concentrations, when compared to carbohydrates. There is also evidence from dietary intervention studies that decreasing the intakes of products rich in saturated fatty acids by replacement with products rich in n-6 polyunsaturated fatty acids (without changing total fat intake) decreased the number of cardiovascular events. As the relationship between saturated fatty acids intake and the increase in LDL cholesterol concentrations is continuous, no threshold of saturated fatty acids intake can be defined below which there is no adverse effect. Thus, also no Tolerable Upper Intake Level can be set.

The Panel concludes that saturated fatty acids intake should be as low as is possible within the context of a nutritionally adequate diet[4]. Limiting the intake of saturated fatty acids should be considered when establishing nutrient goals and recommendations.

Cis-monounsaturated fatty acids (cis-MUFA)

Cis- monounsaturated fatty acids are synthesised by the body, have no known specific role in preventing or promoting diet-related diseases, and are therefore not indispensable constituents of the diet. The Panel proposes not to set any Dietary Reference Value for cis- monounsaturated fatty acids.

Cis-polyunsaturated fatty acids (cis-PUFA)

In view of the different metabolic effects of the various dietary *cis*- polyunsaturated fatty acids, the Panel proposes not to formulate a Dietary Reference Value for the intake of total *cis*- polyunsaturated fatty acids. Also, the Panel proposes not to set specific values for the n-3/n-6 ratio as there are insufficient data on clinical and biochemical endpoints in humans to recommend a ratio independent of absolute levels of intake.

n-6 polyunsaturated fatty acids (n-6 PUFA)

Linoleic acid (LA) cannot be synthesised by the body, is required to maintain "metabolic integrity", and is therefore an EFA. However, there are not sufficient scientific data to derive an Average Requirement, a Lower Threshold Intake or a Population Reference Intake.

There is a negative (beneficial), dose-dependent relationship between the intake of linoleic acid and blood LDL cholesterol concentrations, while this relationship is positive for HDL cholesterol concentrations. In addition, linoleic acid (LA) lowers fasting blood triacylglycerol concentrations when compared to carbohydrates. There is also evidence that replacement of saturated fatty acids by n-6 polyunsaturated fatty acids (without changing total fat intake) decreases the number of cardiovascular events in the population. As the relationship between linoleic acid intake and the blood lipid profile is continuous, no threshold value of linoleic acid intake can be identified below which the risk for cardiovascular events increases.

[4] Nutritionally adequate diets" are the subject of food-based dietary guidelines and mean a dietary pattern which provides all essential nutrients in adequate amounts as well as energy delivering macronutrients in proportions that are known to maintain health

The Panel proposes to set an Adequate Intake for linoleic acid of 4 E%, based on the lowest estimated mean intakes of the various population groups from a number of European countries, where overt LA deficiency symptoms are not present.

Arachidonic acid (ARA) is synthesised by the body from linoleic acid and is therefore not an essential fatty acid despite its important role in maintaining "metabolic integrity". The Panel proposes not to set any Dietary Reference Value for arachidonic acid.

Finally, there is at present no consistent evidence that the intake of any of the n-6 polyunsaturated fatty acids has detrimental effects on health (e.g. in promoting diet-related diseases). The Panel proposes not to set a Tolerable Upper Intake Level UL for total or any of the n-6 polyunsaturated fatty acids.

n-3 polyunsaturated fatty acids (n-3 PUFA)

Alpha-linolenic acid (ALA) cannot be synthesised by the body, is required to maintain "metabolic integrity", and is therefore considered to be an EFA. However, there are not sufficient scientific data to derive an Average Requirement, a Lower Threshold Intake or a Population Reference Intake.. The Panel proposes to set an Adequate Intake for alpha-linolenic acid of 0.5 E%, based on the lowest estimated mean intakes of the various population groups from a number of European countries, where overt alpha-linolenic acid deficiency symptoms are not present. There is no convincing evidence that the intake of alpha-linolenic acid has detrimental effects on health (e.g. in promoting diet-related diseases). The Panel, therefore, proposes not to set a Tolerable Upper Intake Level for alpha-linolenic acid.

The human body can synthesise eicosapentaenoic acid **(**EPA) and docosahexaenoic acid (DHA) from alpha-linolenic acid. Intervention studies have demonstrated beneficial effects of preformed n-3 long-chain polyunsaturated fatty acids on recognised cardiovascular risk factors, such as a reduction of plasma triacylglycerol concentrations, platelet aggregation, and blood pressure. These effects were observed at intakes ≥1g per day, well above levels that were associated with lower cardiovascular disease (CVD) risk in epidemiological studies. With respect to cardiovascular diseases, prospective epidemiological and dietary intervention studies indicate that oily fish consumption or dietary n-3 long-chain polyunsaturated fatty acids supplements (equivalent to a range of 250 to 500 mg of eicosapentaenoic acid plus docosahexaenoic acid daily) decrease the risk of mortality from coronary heart disease (CHD) and sudden cardiac death. An intake of 250 mg per day of eicosapentaenoic acid plus docosahexaenoic acid appears to be sufficient for primary prevention in healthy subjects. Therefore, and taking into account that available data are insufficient to derive an Average Requirement, the Panel proposes to set an Adequate Intake of 250 mg for eicosapentaenoic acid plus docosahexaenoic acid for adults based on cardiovascular considerations.

To this intake 100 to 200 mg of preformed docosahexaenoic acid should be added during pregnancy and lactation to compensate for oxidative losses of maternal dietary docosahexaenoic acid and accumulation of docosahexaenoic acid in body fat of the foetus/infant.

In older infants, docosahexaenoic acid intakes at levels of 50 to 100 mg per day have been found effective for visual function in the complementary feeding period and are considered to be adequate for that period.

The Panel proposes an Adequate Intake of 100 mg docosahexaenoic acid for older infants (>6 months of age) and young children below the age of 24 months.

The currently available evidence does not permit to define an age specific quantitative estimate of an adequate dietary intake for eicosapentaenoic acid and docosahexaenoic acid for children aged 2 to 18 years. However, dietary advice for children should be consistent with advice for the adult population

(i.e., 1 to 2 fatty fish meals per week or ~250 mg of eicosapentaenoic acid plus docosahexaenoic acid per day).

Trans fatty acids (TFA)

Trans fatty acids are not synthesised by the human body and are not required in the diet. Therefore, no Population Reference Intake, Average Requirement, or Adequate Intake is set.

Consumption of diets containing *trans*-monounsaturated fatty acids, like diets containing mixtures of saturated fatty acids, increases blood total and LDL cholesterol concentrations in a dose-dependent manner, compared with consumption of diets containing *cis*-monounsaturated fatty acids or *cis*-polyunsaturated fatty acids. Consumption of diets containing *trans*-monounsaturated fatty acids also results in reduced blood HDL cholesterol concentrations and increases the total cholesterol to HDL cholesterol ratio. The available evidence indicates that *trans* fatty acids from ruminant sources have adverse effects on blood lipids and lipoproteins similar to those from industrial sources when consumed in equal amounts. Prospective cohort studies show a consistent relationship between higher intakes of *trans* fatty acids and increased risk of coronary heart disease. The available evidence is insufficient to establish whether there is a difference between ruminant and industrial *trans* fatty acids consumed in equivalent amounts on the risk of coronary heart disease.

Dietary *trans* fatty acids are provided by several fats and oils that are also important sources of essential fatty acids and other nutrients. Thus, there is a limit to which the intake of *trans* fatty acids can be lowered without compromising adequacy of intake of essential nutrients. Therefore, the Panel concludes that *trans* fatty acids intake should be as low as is possible within the context of a nutritionally adequate diet. Limiting the intake of *trans* fatty acids should be considered when establishing nutrient goals and recommendations.

Conjugated linoleic acids (CLA)

There is no convincing evidence that any of the conjugated linoleic acids isomers in the diet play a role in prevention or promotion of diet-related diseases. The Panel therefore proposes not to set any Dietary Reference Value for conjugated linoleic acids.

Cholesterol

Cholesterol is synthesised by the body and is not required in the diet. Therefore, no Population Reference Intake, Average Requirement, or Adequate Intake is set.

Although there is a positive dose-dependent relationship between the intake of dietary cholesterol with blood LDL cholesterol concentrations, the main dietary determinant of blood LDL cholesterol concentrations is saturated fat intake. Furthermore, most dietary cholesterol is obtained from foods which are also significant sources of dietary saturated fatty acids, e.g. dairy and meat products. Therefore the Panel decided not to propose a reference on cholesterol intake beside its conclusion on the intake of saturated fatty acids.