

SCIENTIFIC OPINION

Labelling reference intake values for n-3 and n-6 polyunsaturated fatty acids

Scientific Opinion of the Panel on Dietetic Products, Nutrition and Allergies on a request from the Commission related to labelling reference intake values for n-3 and n-6 polyunsaturated fatty acids ¹

(Question No EFSA-Q-2009-00548)

Adopted on 30 June 2009

PANEL MEMBERS

Jean-Louis Bresson, Albert Flynn, Marina Heinonen, Karin Hulshof, Hannu Korhonen, Pagona Lagiou, Martinus Løvik, Rosangela Marchelli, Ambroise Martin, Bevan Moseley, Hildegard Przyrembel, Seppo Salminen, Sean (J.J.) Strain, Stephan Strobel, Inge Tetens, Henk van den Berg, Hendrik van Loveren and Hans Verhagen.

SUMMARY

Following a request from the European Commission, the Panel on Dietetic Products, Nutrition and Allergies was asked to review and provide advice on labelling reference intake values for n-3 and n-6 polyunsaturated fatty acids (PUFA).

The proposed labelling reference intake values for n-3 and n-6 PUFA provided by the Commission in the terms of reference are intended to represent typical recommended daily intakes (adults). These values can be used in food labelling to facilitate comparison of the PUFA content of food products and to help convey the relative significance of the food as a source of PUFA in the context of a total daily diet, and can also be used to set appropriate conditions of use for health claims on PUFA. For practical application, a single reference intake value is proposed for each nutrient using rounded values for ease of calculation.

The PUFA for which advice on labelling reference intakes is requested are the n-3 PUFA α -linolenic acid (ALA), the long chain n-3 PUFA (mainly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)), and the n-6 PUFA (mainly linoleic acid (LA)).

Labeling reference intake values for PUFA may be derived from science-based intake recommendations for the general population established by national and international authorities taking into account observed intakes in the population. For these PUFA, intake recommendations for the general population are sometimes aimed at the avoidance of

¹ For citation purposes: Scientific Opinion of the Panel on Dietetic products, Nutrition and Allergies on a request from European Commission related to labelling reference intake values for n-3 and n-6 polyunsaturated fatty acids. *The EFSA Journal* (2009) 1176, 1-11.

deficiency symptoms but more usually are based on evidence of relationships between intake and neurodevelopment and/or cardiovascular health. PUFA intake recommendations for the general population established by national authorities in different EU countries are not uniform and reflect the different criteria on which they are based.

n-3 polyunsaturated fatty acids

The n-3 fatty acid most abundant in food is ALA. The proposed labelling reference intake value for ALA (2g) is towards the upper end of the range of average intakes observed in adults in some European countries (0.7 - 2.3 g/d or ~0.4-0.8 E%). Intake recommendations for ALA based on considerations of cardiovascular health and neurodevelopment are about 1 E%, corresponding to 2 - 3 g ALA/day for energy intakes 1800-2700 kcal/day. The Panel considers that the proposed labelling reference intake value for the n-3 PUFA ALA (2g) is consistent with recommended intakes for individuals in the general population in some European countries based on considerations of cardiovascular health.

Long-chain n-3 polyunsaturated fatty acids

The quantitatively most important long-chain n-3 PUFA in the diet are EPA and DHA.

Most recent evidence shows that the intake of EPA plus DHA is negatively related to cardiovascular risk in a dose-dependent way up to about 250mg/d (1–2 servings of oily fish per week) in healthy populations. The proposed labelling reference intake value for long chain n-3 PUFA (200 mg) is lower than this value, as are observed average intakes of EPA plus DHA in adults in some European countries, which vary between 80mg/d and 420 mg/d.

The Panel proposes 250mg/d as the labelling reference intake value for the long-chain n-3 PUFAs EPA plus DHA, which is in agreement with most recent evidence on the relationship between the intake of these fatty acids and cardiovascular health in healthy populations.

n-6 polyunsaturated fatty acids

n-6 PUFA mainly include LA, and to a lesser extent arachidonic acid (ARA).

The proposed labelling reference intake value of 6g of n-6 PUFA is lower than mean intakes observed in Europe (between 7 and 19 g/d). It is also lower than the lower bound of intake recommended for individuals in the general population by some national and international authorities based on considerations of cardiovascular health (4 E%, equivalent to 8-12 g/d for adults).

The Panel proposes 10g as labelling reference intake value for the n-6 PUFA LA, which is consistent with recommended intakes for adult individuals in the general population in European countries based on considerations of cardiovascular health.

Key words: labelling reference intake values, n-3 polyunsaturated fatty acids, n-6 polyunsaturated fatty acids, essential fatty acids, alpha-linolenic acid, linoleic acid, long-chain polyunsaturated fatty acids, eicosapentaenoic acid, docosahexaenoic acid, dietary reference values, dietary recommendations.

TABLE OF CONTENTS

Panel Members 1
Summary 1
 n-3 polyunsaturated fatty acids 2
 Long-chain n-3 polyunsaturated fatty acids 2
 n-6 polyunsaturated fatty acids 2
Table of Contents 3
Background as provided by the EC 4
Terms of reference as provided by the EC 4
Assessment 5
1. Introduction 5
2. Polyunsaturated fatty acids 8
 2.1. n-3 polyunsaturated fatty acids 8
 2.2. Long-chain n-3 polyunsaturated fatty acids 8
 2.3. n-6 polyunsaturated fatty acids 8
Conclusions 9
References 9
Glossary / Abbreviations 11

BACKGROUND AS PROVIDED BY THE EC

In the context of the procedure for the authorisation of health claims under Regulation (EC) No 1924/2006, the Member States discussed and voted at a meeting of 20 February 2009 in the Standing Committee of the Food Chain and Animal on the first batch of health claims applications to be either authorised or rejected.

To this end, the Member States and the Commission discussed concerns expressed by some Member States in relation to the conditions of use for the health claim on essential fatty acids (α -linolenic acid and linoleic acid) and normal growth and development of children.

The Member States and the Commission agreed that EFSA should be asked to give general advice on reference values for the purpose of labelling for fatty acids to enable the review of the conditions of use for the health claim referred to, but equally important to be able to set appropriate conditions of use for the foreseen health claims on fatty acids, both for health claims pursuant to Article 14 of Regulation (EC) No 1924/2006 but also for health claims covered by Article 13 of that Regulation.

EFSA has already provided advice on nutrition claims concerning omega-3 fatty acids, monounsaturated fat, polyunsaturated fat and unsaturated fat (EFSA-Q-2004-1073), commented on the Recommended Nutritional Intake (RNI) for essential fatty acids, and advised to distinguish RNI for α -linolenic acid in the range of 2 g/day for adults, and RNI for long chain n-3 polyunsaturated fatty acids (LC n-3 PUFA), mainly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), for which recommended intakes for cardio-protective effects are in the range of 200-500 mg/day.

SCF defined in 1993 Population Reference Intakes (PRI) of 2 E% for omega-6 polyunsaturated fatty acids (n-6 PUFA). The corresponding amounts for n-6 PUFA are 4.5 g/day for females and 6 g/day for males, respectively. Considering that the point of reference for the omega-3 fatty acids in the EFSA opinion is the daily intake for an adult male, 6 g/day is included into the terms of reference.

TERMS OF REFERENCE AS PROVIDED BY THE EC

EFSA is requested to provide an opinion in accordance with Article 29(1)(a) of Regulation (EC) No 178/2002 on the following aspects:

- Whether reference values for the purpose of labelling for essential fatty acids can be established.

To this end, EFSA is asked in particular to consider the appropriateness of:

- 2 g for short-chain omega-3 fatty acids
- 200 mg for long chain omega-3 fatty acids
- 6 g for omega-6 fatty acids

ASSESSMENT

1. Introduction

The proposed labelling reference intake values for n-3 and n-6 polyunsaturated fatty acids (PUFA) provided by the Commission in the terms of reference are intended to represent typical recommended daily intakes (adults). These values can be used in food labelling to facilitate comparison of the PUFA content of food products and to help to convey the relative significance of the food as a source of PUFAs in the context of a total daily diet, and can also be used to set appropriate conditions of use for health claims on PUFAs. For practical application, a single reference intake value is proposed for each type of PUFA using rounded values for ease of calculation.

The PUFAs for which advice on labelling reference values is requested are the n-3 PUFA α -linolenic acid (ALA), the long chain n-3 PUFAs (mainly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)) and n-6 PUFAs (mainly linoleic acid (LA)). Labelling reference intake values for PUFA may be derived from science-based intake recommendations for the general population established by national and international authorities (DoH, 1991; GR, 2006; NNR, 2004; AFSSA, 2001; DACH, 2008; Eurodiet, 2000; WHO, 2003; USDA, 2005) taking into account observed intakes in the population. For these PUFA, intake recommendations for the general population are sometimes aimed at the prevention of deficiency symptoms but are more usually based on evidence of relationships between intake and neurodevelopment and/or risk of cardiovascular diseases. PUFA intake recommendations for the general population established by national authorities in different EU countries are not uniform and reflect the different criteria on which they are based (Table 1).

Table 2 compiles dietary intakes of n-3 and n-6 PUFAs among adults according to recent dietary surveys in some European countries. National dietary surveys from most European countries report intakes of total PUFAs, whereas only some provide data for n-6 PUFAs and/or LA, and for n-3 PUFAs and/or ALA, EPA and DHA.

Table 1. Proposed labelling reference intake values for n-3 and n-6 PUFAs and recommended dietary intakes from national and international bodies (adults).

	n-3 PUFA		ALA		EPA+DHA		n-6 PUFA (mainly LA)	
	% of energy	g/day	% of energy	g/day	% of energy	mg/day	% of energy	g/day
Reference intake value in ToR	-	-	-	2	-	200	-	6
SCF, 1993	0.5	-	-	-	-	-	2	-
WHO, 2003	1-2	-	-	-	-	-	5-8	-
United Kingdom DoH, 1991			>0.2				>1	
SACN, 2004	-	-	-	-	-	450	-	-
Eurodiet, 2000	-	-	-	2	-	200	4-8	-
The Netherlands (GR, 2001 and 2006)	-	-	1	-	-	450	2	-
Nordic Countries (NNR, 2004)	1	-	1	-	-	450	≥4	-
France, (AFSSA, 2001)								
Adult men	0.8	2	-	-	0.2	500	4	-
Adult women	0.8	1.6	-	-	0.2	400	4	-
USA (FNB, 2002)			0.6-1.2		-	-	5-10	-
Adult men				1.6				14-17
Adult women				1.1				11-12
Germany, Austria, Switzerland (D-A-CH, 2008)	0.5	-	-	-	-	-	2.5	-

Table 2. Mean dietary intake of n3- and n-6 polyunsaturated fatty acids (and clusters) among adults according to recent dietary surveys in some European countries

	ALA				EPA + DHA				LA				References
	Men		Women		Men		Women		Men		Women		
	g/d	E%	g/d	E%	mg/d	E%	mg/d	E%	g/d	E%	g/d	E%	
Austria	1.2	0.5	1.1	0.6	280	NA	251	NA	17	7.1	14	7.1	Elmadfa et al., 2009
France	0.9	0.36	0.7	0.38	420	0.17	350	0.18	10.6	4.1	8.1	4.2	Astorg et al., 2004
Finland	2.5	1.0	1.8	1.0	NA	NA	NA	NA	9.9	3.9	7.2	3.9	Paturi M et al., 2008.
Germany *	1.59	0.6	1.32	0.6	290	0.11	210	0.10	14.3	5.2	10.9	5.2	Linseisen et al., 2003
**	2.25	0.8	1.51	0.8	340	0.12	220	0.11	18.6	6.5	11.6	5.8	Linseisen et al., 2003
The Netherlands	1.95	0.6	1.26	0.6	100	0.03	80	0.05	17.8	5.8	12.0	5.5	Kruizinga et al., 2007
Sweden #	1.5	NA	1.2	NA	-	-	-	-	9.7	NA	7.8	NA	Becker and Pearson, 1998

* German EPIC Cohort from centre H and ** centre P

median intake; median intake of EPA = 100 mg for males and females; median intake of DHA = 240 mg for males and 210 mg for females.

NA = not available

2. Polyunsaturated fatty acids

2.1. n-3 polyunsaturated fatty acids

The n-3 fatty acid most abundant in food is ALA. ALA is considered to be nutritionally essential because of its specific function as precursor for the long-chain n-3 PUFA EPA and DHA.

The proposed labelling reference intake value for ALA (2 g) is towards the upper end of the range of average intakes observed in adults in some European countries (0.7 - 2.3 g/d or ~0.4-0.8 E%) (Table 2). Intake recommendations for ALA range from a minimum of 0.2 E% (aimed at the prevention of deficiency symptoms) to about 1 E% (based on considerations of cardiovascular health) (Table 1). One E% corresponds to between 2 and 3 g /day for energy intakes of 1800 kcal/day for women and 2700 kcal/day for men (EFSA, 2005).

The Panel considers that the proposed labelling reference intake value for the n-3 PUFA ALA (2 g) is consistent with recommended intakes for individuals in the general population in European countries based on considerations of cardiovascular health.

2.2. Long-chain n-3 polyunsaturated fatty acids

In most European populations the quantitatively most important long-chain n-3 PUFA in the diet are EPA and DHA. Dietary long-chain n-3 PUFAs also include DPA. Long-chain n-3 PUFAs can also be synthesised from ALA in animal tissues through the sequential action of various desaturases and elongases. Together with the n-6 PUFAs, long-chain n-3 PUFAs are important structural components of cell membranes and contribute to their functions. EPA is also a precursor of eicosanoids.

National and international bodies have based their recommendations for dietary intake of EPA and DHA on the inverse relationship observed between the consumption of these long-chain n-3 PUFAs (primarily from fish and fish oils) and a lower risk of coronary artery disease. Such recommendations range from 200 mg to 500 mg per day (Table 1; EFSA, 2005). Most recent evidence derived from meta-analysis of randomized trials and large prospective studies shows that, when only healthy subjects are considered, the intake of EPA plus DHA is negatively related to cardiovascular risk in a dose-dependent way up to about 250 mg/d (1–2 servings of oily fish per week), with little additional benefit observed at higher intakes (Mozaffarian and Rimm, 2006; Mozaffarian, 2008; Harris et al., 2008, 2009a and 2009b). The proposed labelling reference intake value for long chain n-3 PUFAs (200 mg) is lower than this value, as are observed average intakes of EPA plus DHA in adults in some European countries, which vary between 80 mg/d and 420 mg/d (Table 2).

The Panel proposes 250 mg/d as the labelling reference intake value for the long-chain n-3 PUFAs EPA plus DHA, which is in agreement with most recent evidence on the relationship between the intake of these fatty acids and cardiovascular health in healthy populations.

2.3. n-6 polyunsaturated fatty acids

n-6 PUFAs mainly include LA, and to a lesser extent arachidonic acid (ARA). Strictly speaking, only LA is essential. Since the synthesis of ARA from LA seems to be sufficient in humans after 6 months of age under the current lifestyle and dietary habits, no requirement

for preformed ARA can be defined. Linoleic acid, when incorporated into skin ceramides, is essential for maintaining the water-permeability barrier of the skin thereby avoiding excessive trans-epidermal water loss and the accompanying energy loss from water evaporation. AA is the precursor for series 2 prostanoids and series 4 leukotrienes.

In Europe, average intakes of cis n-6 PUFAs range between 3.8 E% to nearly 6 E%. Distribution of intakes were only available for the Netherlands, ranging from 2.6 to 9.8 E% at the 5th and the 95th percentile, and for the UK, ranging from 1.9 to 10.5 E% at the 2.5th and 97.5th percentile, respectively. Since LA is the primary n-6 PUFA, the intake of LA might be only slightly lower than the intake of total n-6 PUFA. In some European countries, average LA intakes in adults range from nearly 7 g/day to approximately 19 g/day, corresponding to 3.9 to 6.5 E% (Table 2).

No intake recommendations have been specifically set for ARA in adults. Intake recommendations for LA range from a minimum of 1 E% (aimed at the prevention of deficiency symptoms) to about 4-10 E% (based on considerations of cardiovascular health and mean observed intakes in healthy populations), which correspond to 2-3 and 8-30 g LA/day, respectively, for energy intakes of 1800-2700 kcal/day. The lower bound of intake recommendations based both on considerations of cardiovascular health and on average observed intakes in healthy populations is 4 E%, which corresponds to about 8-12 g/d (Table 2).

The proposed labelling reference value of 6 g has been calculated from the SCF (1993) Population Reference Intake (PRI) of 2 E% for n-6 PUFA (mainly LA), which was based on rough estimates from feeding studies in infants, extrapolated to a reference energy intake of 2700 kcal/day (adult male). This amount is lower than mean intakes observed in Europe (between 7 and 19 g/d). It is also lower than intakes recommended for individuals in the general population based on considerations of cardiovascular health (4 E%; equivalent to 8-12 g/d for adults) by some national and international authorities (Table 1).

The Panel proposes 10 g as labelling reference intake value for the n-6 PUFA LA, which is consistent with recommended intakes for individuals in the general population in European countries based on considerations of cardiovascular health.

CONCLUSIONS

The Panel concludes that:

- The proposed labelling reference value for the n-3 PUFA ALA (2 g) is consistent with recommended intakes for individuals in the general population in European countries based on considerations of cardiovascular health.
- The Panel proposes 250 mg/d as the labelling reference intake value for the long-chain n-3 PUFAs EPA plus DHA, which is in agreement with most recent evidence on the relationship between the intake of these fatty acids and cardiovascular health in healthy populations.
- The Panel proposes 10 g as labelling reference intake value for n-6 PUFA LA, which is consistent with recommended intakes for individuals in the general population in European countries based on considerations of cardiovascular health.

REFERENCES

AFSSA (Agence Française de Sécurité Sanitaire des Aliments), 2001. Apport nutritionnels conseillés pour la population Française. Paris, Lavoisier Tec et Doc.

- Astorg P, Arnault N, Czernichow S, Noisette N, Galan P, Hercberg S, 2005. Intake levels and food sources for the principal n-6 and n-3 polyunsaturated fatty acids of the adult population in France. *Cahiers de Nutrition et de Diététique* 40(5), 260-269.
- Becker W and Pearson M, 2002. Riksmaten 1997-1998. Befolkningens kostvanor och näringsintag. Metod- och resultatanalys. Livsmedelsverket, Uppsala.
- D-A-CH (Germany, Austria, Switzerland), 2008. Referenzwerte für die Nährstoffzufuhr. Umschau/Braus Frankfurt/M.
- DoH (Department of Health), 1991. Dietary reference values for food energy and nutrients for the United Kingdom. Report of the Panel on Dietary Reference Values of the Committee on Medical Aspects of Food Policy, HM Stationary Office, London.
- EFSA (European Food Safety Authority), 2005. Opinion of the Scientific Panel on Dietetic Products, Nutrition and Allergies on a request from the Commission related to nutrition claims concerning omega-3 fatty acids, monounsaturated fat, polyunsaturated fat and unsaturated fat. *The EFSA Journal* 253: 1-29. http://www.efsa.europa.eu/cs/BlobServer/Scientific_Opinion/nda_op_ej253_nutrition%20claims%20for%20fats_en_revised2,3.pdf?ssbinary=true
- Elmadfa I, Freising H, Novak V, Hofstätter D, Hasenegger V, Ferge M, Fröhler M, Fritz K, Meyer AL, Putz P, Rust P, Grossgut R, Mischek D, Kiefer I, Schätzer M, Spanblöchel J, Sturtzel B, Wagner K-H, Zilberszac A, Vojir F, Plsek K, 2009. Österreichischer Ernährungsbericht 2008. 1. Auflage, Wien, März 2009.
- Eurodiet core report, 2000. Nutrition & diet for healthy lifestyles in Europe; science & policy implications. *Public Health Nutrition* 4(2A), 265-273.
- FNB (Food and Nutrition Board), 2002. Dietary Reference Intakes for Energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. Institute of Medicine, National Academic Press, Washington. <http://www.nap.edu/books/0309085373/html/>
- GR (Gezondheidsraad), 2001. Dietary Reference Intakes: energy, proteins, fats and digestible carbohydrates. The Hague: Health Council of the Netherlands, 2001; publication no. 2001/19R (corrected edition: June 2002).
- GR (Gezondheidsraad), 2006. Guidelines for a healthy diet 2006; publication no. 2006/21E.
- Harris WS, Kris-Etherton PM, Harris KA, 2008. Intakes of long-chain omega-3 fatty acid associated with reduced risk for death from coronary heart disease in healthy adults. *Curr Atheroscler Rep* 16(6), 503-9.
- Harris WS, Mozaffarian D, Lefevre M, Toner CD, Colombo J, Cunnane SC, Holden JM, Klurfeld DM, Morris MC, Whelan J, 2009a. Towards establishing dietary reference intakes for eicosapentaenoic and docosahexaenoic acids. *J Nutr* 139(4), 804S-19S.
- Harris WS, Mozaffarian D, Rimm E, Kris-Etherton P, Rudel LL, Appel LJ, Engler MM, Engler MB, Sacks F, 2009b. Omega-6 fatty acids and risk for cardiovascular disease: a science advisory from the American Heart Association Nutrition Subcommittee of the Council on Nutrition, Physical Activity, and Metabolism; Council on Cardiovascular Nursing; and Council on Epidemiology and Prevention. *Circulation* 119(6), 902-7.
- Kruizinga AG, Westenbrink S, Bosch LMC van den, Jansen MCJF, 2007. De inneming van Omega-3 and -6 vetzuren en van vitamines A, D en E bij jongvolwassenen. Aanvullende berekeningen op basis van Voedselconsumptiepeiling 2003. TNO rapport V7451. Zeist, TNO KvL.

- Linseisen J, Schulze M, Saadatian-Elahi M, Kroke A, Miller AB, Boeing H, 2003. Quantity and quality of dietary fat, carbohydrate, and fiber intake in the German EPIC cohorts. *Ann Nutr Metab* 47, 37-46.
- Mozaffarian D, Rimm EB, 2006. Fish intake, contaminants, and human health: evaluating the risks and the benefits. *JAMA* 296: 1885-1899
- Mozaffarian D, 2008. Fish and n-3 fatty acids for the prevention of fatal coronary heart disease and sudden cardiac death. *Am J Clin Nutr* 87(6),1991S-6S.
- NNR (Nordic Nutrition Recommendations), 2004. Integrating nutrition and physical activity. Nord 2004:13. Nordic Council of Ministers, Copenhagen.
- Paturi M, Tapanainen H, Reinivuo H, Pietinen P, 2008. The National FINDiet 2007 Survey. Report B23/2008. KTL-National Public Health Institute. Helsinki.
- SACN (Scientific Advisory Committee on Nutrition) (2004). Advice on fish consumption: benefits & risks. London. http://www.sacn.gov.uk/pdfs/fics_sacn_advice_fish.pdf
- SCF (Scientific Committee on Food), 1993. Nutrient and Energy Intakes for the European Community. Commission of the European Communities, Directorate General Industry. Office for Official Publications of the European Communities, Luxembourg.
- WHO (World Health Organization), 2003. Diet, nutrition and the prevention of chronic diseases. Report of the WHO/FAO Joint expert consultation. WHO Techn Rep Ser 916, Geneva.

GLOSSARY / ABBREVIATIONS

E%	expressed as % of energy intake
EU	European Union
kcal	Kilocalories