Food and Agriculture Organization of the United Nations
World Health Organization
ICN2 Second International Conference on Nutrition
better nutrition better lives

New French Nutritional Recommendations for Fatty Acids

Philippe Legrand[1]

[1] Laboratoire de Biochimie-Nutrition, Agrocampus-INRA
65 rue de Saint Brieuc, 35000 Rennes France
Philippe.legrand@agrocampus-ouest.fr
Tel 33 (0) 223 48 55 47

Abstract

The French Food Safety Agency (ANSES) recently published the adult French population reference intakes 'Apports Nutritionnels Conseillés' (ANC) for fatty acids. This paper describes the thinking behind the 2010 update of the recommendations for fatty acid intakes for the French population. It presents the recommendations and highlights some of the rationale underlying them. The paper does not provide a comprehensive review of the science underlying each recommendation as this information can be found in the two reports that are referenced the "Complete Report on the Update of the French population reference intakes for fatty acids" and the "Opinion of the French Food Safety Agency on the update of the French population reference intakes".

This is a nutrition science paper reflecting the complex nature of the science behind the recommendations. In doing so, it does not discuss specific areas of foods or of food intakes but rather presents an account of the process and objectives of the Food Safety Agency's methods in reviewing the science and setting the new recommendations. The driving factors leading to the new French recommendations include concerns regarding:

- the proportion of total fat in the diet;
- the proportion of total saturated fatty acids in the diet and the differential effects of different saturated fatty acids;
- interactions between linoleic and alpha-linolenic acids;
- promoting adequate intakes of EPA and DHA; and
- understanding the roles of non-essential fatty acids.

There are many fatty acids with varying and multiple functions. Some fatty acids are essential, some are considered "conditionally essential" and other fatty acids (polyunsaturates, monounsaturates, and saturates) are nutrients that can be synthesized *de novo* by the body. With the goal of helping to build a credible diet, both qualitatively and quantitatively, all the main fatty acids, including those that humans can synthesize, were investigated as all have biological functions. The ANC is a reference value that encompasses the physiological requirements for almost the entire population and is similar to 'adequate intake' (AI). The values concern healthy individuals and include the objective of maintaining good health which corresponds to the limits of primary prevention.

The reference intakes (ANC) for each fatty acid were established based on considerations regarding both minimum physiological requirements and possible physiopathological aspects. The scientific data led to the following recommendations:

- new proportion of total lipids in total energy intake, with respect to overall balance between macronutrients and data related to preventing metabolic syndrome, cardiovascular risk and EFA deficiency;
- confirmed ANC for linoleic acid resulting from both the importance of reaching a total PUFA that promotes cardiovascular prevention, and limiting intake to avoid adverse effects in case of excess and maintain a linoleic acid/α-linolenic acid ratio of less than 5;

- increased ANC for α-linolenic acid upward with the aim of preventing cardiovascular diseases and increasing the conversion to EPA and DHA;
- increased ANC value for DHA, because of its very low rate of conversion from α-linolenic acid, which is now clearly documented;
- ANC for EPA, based on prevention data, for cardiovascular diseases in particular;
- distinguishing among saturated fatty acids, the subgroup of lauric, myristic and palmitic acids considered to be atherogenic in excess, and establishing a maximum value for this subgroup as well as for total saturated fatty acids;
- ANC for oleic acid, the predominant component of the MUFA group in the diet rather than for MUFA which is an heterogeneous group.

Among the most notable recommendations, the French have determined that for their population: total fat in the diet should be between 35-40% of total energy; total saturated fats should be below 12%; lauric, myristic and palmitic acids should in total be below 8%; oleic acid should be between 15-20%; the ratio of linoleic acid/alpha-linolenic acid should be less than 5; alpha-linolenic acid 1%; and both DHA and EPA intakes should be at least 250mg each.

However, dietary lipids are not limited to the fatty acids for which an ANC can be established, and many others fatty acids are likely to be of interest as future research is likely to demonstrate. The paper provides a comparison with other guidelines.

Introduction and Method of Expert Assessment

The French Food Safety Agency (ANSES) issued an internal request to update the adult French population reference intakes 'Apports Nutritionnels Conseillés' (ANC) for fatty acids. The former ANC for fatty acids (FA) were defined in 2001 [1]. The scientific data acquired since 2001 raise questions about the need to:

- reassess the proportion of total fatty acids in energy intake;
- make a recommendation for eicosapentaenoic acid (EPA; C20:5n--3), reassess the recommendation for DHA, and make a recommendation that covers both;
- reassess the recommendation for linoleic acid and α-linolenic acid;
- reassess the proportion of total saturated FA in energy intake and the need to distinguish between recommendations for different saturated FA.

The Opinion [2] summarized here includes the key points from a full report that provides all the rationale from the literature forming the basis of ANSES recommendations. The full report will be available shortly on the website of the French agency [3]. Collective expert assessment was provided by a working group (see composition below) whose Opinion was then adopted by the Scientific Panel on 'Human Nutrition' of the French Agency.

There are many FA involving multiple functions. Among the PUFAs, some are known as 'essential' precursors (linoleic, C18:2n--6 and α-linolenic, C18:3n--3 acids) because they are essential for growth and physiological functions, and cannot be synthesized by humans. Derivatives of these essential precursors are called 'conditionally essential' since humans and animals can synthesize them (contingent on having essential precursor FA). Other FA (other polyunsaturates, monounsaturates, and saturates) are nutrients that can be synthesized de novo by the body. These characteristics of FA bring about complex balances. The working group has considered the main FA, including those that humans can synthesize, because all have a biological functions and the goal is to help build a credible diet, qualitatively and quantitatively.

The ANC is a reference value that encompasses the physiological requirements for almost the entire population and is very similar to 'adequate intake' (AI). The values concern healthy individuals and include the objective of maintaining this good health, which corresponds to the limits of primary prevention.

For the essential and 'conditionally essential' FA, the requirements correspond to a necessary intake for:

- avoiding any dietary deficit of essential FA and ensuring proper functioning of the entire body, particularly brain development and function; these are minimum physiological requirements (table 1, first column);
- ensuring preventive roles in physiopathological terms (primary prevention).

The following disorders will be considered: metabolic syndrome, diabetes, obesity, cardio-vascular diseases, cancers (breast and colon, in particular) and other diseases such as age-related macular degeneration (AMD).

The method for setting the ANC (= adequate intake AI) for these essential and 'conditionally essential' FA includes the following steps:

- estimation of the minimum physiological requirement;
- identification of data enabling adapting the minimum physiological requirement for each of the disorders listed above (prevention);
- integration and synthesis of all the physiological and physiopathological considerations available for defining ANC (table 1, last column).

For the nonessential fatty acids, the minimum physiological requirement has not been established, due to a lack of sufficient data. ANC for nonessential FA have thus been established taking into account physiopathological considerations and the need for balance among the different FA, within the limit of requirements of total lipids with he goal of building a credible and feasible diet, quantitatively and qualitatively.

Considering that much of the data on nutrition have been and continue to be gathered primarily in animals, the working group has included studies ranging from in vitro models to animal models and epidemiological intervention studies in humans, to provide the most comprehensive support for establishing ANC for FA.

Determination of ANC (= AI) in Adults

Determination of the Proportion of Total Lipids in Energy Intake (table 1)

The available data have led to the definition of a minimum physiological requirement of total FA of 30% of energy intake (EI). Indeed, in Western countries a lipid intake below 30% of EI results in a significant reduction in intake of PUFA (DHA), falling below dietary needs. In primary prevention, the available data clearly indicate that the total amount of energy, and not the dietary lipid content, is generally correlated with the risk of disorders such as metabolic syndrome, diabetes, obesity, cardiovascular diseases, cancers and AMD. They also indicate that the sharp decrease in the proportion of lipids below 35% of EI, in favor of carbohydrates, does not result in any added benefit in terms of reducing the risk of the pathologies mentioned and could sometimes induce deleterious effects. Thus, after considering minimum physiological requirement and physiopathological data, a total lipid intake of 35--40% of EI is recommended in adults for an energy intake of nearly 2,000 kcal.

Determination of ANC for the Different Fatty Acids (table 1)

The ANC, shown in table 1, are established for adult subjects (men or women) for an energy intake of 2,000 kcal. The table shows the minimum physiological requirement (limited to essential FA), estimated requirements in terms of prevention for each disorder, and finally the ANC. Lacking specific data, the values also apply to elderly subjects. In view of recent data, the biochemical classification of FA, namely as ‘polyunsaturated, monounsaturated and saturated’, no longer corresponds to the diversity of FA, the accuracy of the studies, the specificity of functions and effects, and is of little relevance for public health. Thus, in this Opinion, the essential FA are distinguished from the nonessential FA (table 1).

Essential Fatty Acids

Given the scientific data available, the assessment of physiological requirements in adult men and women is confined to three essential FA: linoleic acid (C18:2n--6), α-linolenic acid (C18:3n--3) and one of its derivatives, DHA (docosahexaenoic acid, C22:6n--3). The essential nature of DHA is related to its low formation by conversion of α-linolenic acid and has led to the definition of a minimum physiological requirement.

Linoleic Acid (C18:2n---6). Recommendations for this FA have steadily increased since being established as essential. Subsequently an international debate arose, suggesting that the proposed needs were overestimated in epidemiological studies due to a lack of accurate measurements of n--3 PUFA intakes, and in clinical studies due to numerous bias and to the lack of n--3 PUFA intakes or measurements if present. However, in animals, the addition of α-linolenic acid to diets deficient in

linoleic acid reduced the specific requirement of linoleic acid by limiting the signs of deficiency and the observed impairment of growth. The need to specify the minimum physiological requirement of linoleic acid is also aiming to limit the imbalance between the two PUFA families when consumption of n--3 PUFA is low (α-linolenic precursor and long-chain derivatives). Indeed, this imbalance is detrimental to the synthesis and availability of n--3 LC-PUFA (EPA and DHA) and to their incorporation into the tissues, which could accentuate physiological disturbances and contribute to the occurrence of pathologies such as neuropsychiatric disorders, cardiovascular diseases, inflammatory diseases, diabetes and obesity. In this context, a linoleic acid/α-linolenic acid ratio below 5 is generally accepted. Finally, on the basis of the available data, the minimum physiological requirement of linoleic acid is estimated at 2% of EI, which is equivalent to 4.4 g/day for an energy intake of 2,000 kcal/day. ANSES established the ANC at 4% of EI. This value reflects both the importance of achieving a total for PUFA that contributes to cardiovascular prevention and limiting intakes to maintain a linoleic acid/α-linolenic acid ratio below 5, to avoid adverse effects of linoleic acid excess and thereby prevent disease studied on the basis of risk biomarkers, or at times using incidence data as in the case of AMD.

α-Linolenic Acid (C18:3n--3). As an n--3 family precursor, the essential nature of this FA relates to its role in proper cerebral and visual function. It has been shown recently that in humans, α-linolenic acid is very well catabolized and can be converted into DHA to a limited extent, but undergoes lesser catabolism in rodents. Therefore, it is appropriate, to cover the needs of almost the entire population, to define a minimum physiological requirement for humans that is higher than the value resulting from animal studies in rodents. On the basis of the available data, the minimum physiological requirement of α-linolenic acid is estimated at 0.8% of EI for adults, which is equivalent to 1.8 g/day for an energy intake of 2,000 kcal/day. The ANC is set at 1% of EI given the favorable data derived from numerous observational epidemiological studies in the cardiovascular field, and the need to reach a total of n--3 + n--6 PUFA conducive to cardiovascular prevention and to strictly maintain a linoleic acid/α-linolenic acid ratio lower than 5.

The linoleic acid/α-linolenic acid ratio is of less significance currently since the physiological requirements for linoleic and α-linolenic acids are well established and if (1) they are covered, and (2) the intakes of EPA and DHA are assured. However, this ratio may remain a practical benchmark in terms of overall diet. It also retains its importance if there is any imbalance due to a deficiency of α-linolenic acid intake and/or an excess intake of linoleic acid, and even more still if there is an additional deficiency of EPA and DHA intakes.

Docosahexaenoic Acid (DHA; C22:6n--3). This n--3 PUFA is a major constituent of cerebral and visual structure and function. The new data, specifically those related to the very low conversion of α-linolenic acid into DHA, now clearly demonstrated, has led to the minimum physiological requirement being set at 250 mg/day for an adult, a value twice as high as that suggested in 2001. The data in the literature related to the prevention of different risks generally indicate values of around 500 mg/day, for the sum of EPA+DHA, due to the consumption and use of fish and fish oil (sources that contain EPA+DHA in close enough proportions) in epidemiological and clinical studies. Thus, ANSES has established an ANC of 250 mg/day for DHA.

Nonessential Fatty Acids

Eicosapentaenoic Acid (EPA; C20:5n--3). The functions that this n--3 PUFA carries out are essential (precursor of a family of eicosanoids) but currently there are insufficient data for considering it to be absolutely essential and for defining a minimum physiological requirement. Indeed, the conversion of α-linolenic acid into EPA is significant since the intakes of α-linolenic acid (and of linoleic acid, for competing reasons) are adequate. However, in terms of risk prevention, an ANC for EPA has been defined on the basis of bibliographic data that often group together EPA+DHA. Thus, an ANC of 250 mg/day is defined for EPA using prevention data, by subtracting from the combined value of 500 mg/day for EPA+DHA.
Saturated Fatty Acids. Saturated FA cannot be regarded as a unit because they differ in their structure, their metabolism, their cell functions and even their deleterious effects in case of excess. From now on it is advisable to distinguish the subgroup of 'lauric, myristic, and palmitic acids' which is atherogenic in the event of excess. Based on available studies, ANSES established a maximum intake of 8% of EI for this subgroup. Other saturated FA, particularly the short and medium chains plus stearic acid, have no known harmful effect and some of them even have rather beneficial effects. However, at present, it is not possible to establish recommendations for them and ANSES considers it prudent to maintain an intake of total saturated FA lower than 12% of EI.
Oleic Acid (C18:1n--9). Oleic acid is now properly identified within the heterogeneous 'monounsaturates' group, within which oleic acid is the predominant component in the diet. The ANC for oleic acid is expressed as a range from 15 to 20% of EI. The lower intake limit is based on the risk related to the substitution of oleic acid by saturated FA which are 'atherogenic in excess'. As for the upper intake limit, it is suggested by epidemiological and clinical data on cardiovascular risk factors.
Other Nonessential Fatty Acids. This group includes a varied set of FA (polyunsaturated, monounsaturated, trans and conjugated), each present in very low amounts but whose total accounts for about 2% of EI. They may play major physiological roles such as arachidonic acid (C20:4n--6), a precursor of a family of eicosanoids, also provided by the active conversion of linoleic acid, or potentially important physiological roles like certain n--3 PUFA (stearidonic acid C18:4n--3 and especially docosapentaenoic acid C22:5n--3) which are convertible into EPA or DHA. This is also true for some conjugated FA such as rumenic acid.
For all of these FA, the available data are insufficient for defining a minimum physiological requirement and an ANC.

Conclusion

The innovative nature of this assessment lies in the fact that the ANC of each fatty acid studied has been established from minimum physiological requirements and by considering the physiopathological aspects.

Thus, the scientific data acquired since the previous assessment of ANC (2001) have led to:

- setting an ANC for linoleic acid resulting from both the importance of reaching a total PUFA that promotes cardiovascular prevention, and limiting intake to avoid adverse effects in case of excess and maintain a linoleic acid/α-linolenic acid ratio of less than 5;
- revising the ANC for α-linolenic acid upward with the aim of preventing cardiovascular diseases and increasing the conversion to EPA and DHA;

- raising the ANC value for DHA, because of its very low rate of conversion from α-linolenic acid, which is now clearly documented;
- defining an ANC for EPA, based on prevention data, for cardiovascular diseases in particular;
- distinguishing, among the saturated fatty acids, the subgroup of 'lauric, myristic and palmitic acids' considered to be atherogenic in case of excess, and establishing a maximum value for this subgroup and for the total saturated fatty acids as well.
- assigning an ANC for oleic acid and not for MUFA, which is an heterogeneous group, within which oleic acid is the predominant component in the diet;
- changing the proportion of total lipids in total energy intake, with respect to overall balance between macronutrients and data related to preventing metabolic syndrome and cardiovascular risk.

Thus, after considering minimum physiological requirement and physiopathological data, a total lipid intake of 35--40% of EI is recommended in adults for an energy intake of nearly 2,000 kcal, without being suggestive of a risk of the diseases under consideration, as part of primary prevention.

The values proposed for ANC account for different conditions for each FA considered, this depending on the physiopathological data available and the essential or nonessential nature of the FA. However, dietary lipids are not limited to the FA for which an ANC can be established and many others FA are likely to be of interest, as future research should demonstrate.

Composition of the Working Group

P-O. Astorg, P. Bougnoux, J. Calvarin, S. Chalon, J. Dallongeville, C. Dumas, P. Friocourt, M. Gerber, P. Guesnet, E. Kalonji, A. Lapillonne, A. Morise, J-M. Lecerf, I. Margaritis, P. Moulin, G. Pieroni, P. Legrand (Chair)

References

1 Legrand P, Bourre JM, Descomps B, Durand G, Renaud S: Lipides; in: Apports nutritionnels conseillés pour la population française. Paris, Tec et Doc Ed, 2001, pp 63--82.

2 Opinion of the French Food Safety Agency on the update of French population reference intakes (ANC) for fatty acids. 2010. www.anses.fr

3 Complete report on the update of French population reference intakes (ANC) for fatty acids : www.anses.fr

ANC

Pour un adulte consommant 2000 kcal/jour
Les valeurs sont exprimées en pourcentage de l'apport énergétique.
Dans le cas du DHA et de l'EPA les valeurs sont exprimées en milligramme/jour.

		BESOIN PHYSIO-LOGIQUE MINIMAL	PREVENTION DU RISQUE					ANC 2010
			Syndrome métabolique -diabète -obésité	Pathologies Cardiovasculaires	Cancers : sein et côlon	Pathologies neuro-psychiatriques	Autres pathologies : DMLA	
Lipides totaux		30	30 - 40	35 - 40	35 - 40	35 - 40	< 40	35 - 40
AG indispensables	Acide linoléique C18 :2 n-6	2	2	5	2	2	≤ 4	4
	Acide α-linolénique C18 :3 n-3	0,8	0,8	1	0,8	0,8	0,8	1
	Acide docosahexaénoique DHA, C22 :6 n-3	250 mg						250 mg
AG non indispensables	Acide eicosapentaénoïque EPA, C20 :5 n-3	-	500 mg	500-750 mg	500 mg	≥ 200-300 mg	500 mg	250 mg
	Acide laurique (C12:0) + Acide myristique (C14:0) + Acide palmitique (C16:0)	-	-	≤ 8	-	-	-	≤ 8
	Acides Gras Saturés totaux	-	-	≤ 12	≤ 12	-	-	≤ 12
	Acide oléique C18 :1 n-9	-	-	≤ 20	-	-	-	15 - 20
	Autres AG non indispensables	-	-	-	-	-	-	-

ANC

Pour un adulte consommant 2000 kcal/jour
Les valeurs sont exprimées en pourcentage de l'apport énergétique.
Dans le cas du DHA et de l'EPA les valeurs sont exprimées en milligramme/jour.

		BESOIN PHYSIO-LOGIQUE MINIMAL	PREVENTION DU RISQUE					ANC 2010
			Syndrome métabolique -diabète -obésité	Pathologies Cardiovasculaires	Cancers : sein et côlon	Pathologies neuro-psychiatriques	Autres pathologies : DMLA	
Lipides totaux		30	30 - 40	35 - 40	35 - 40	35 - 40	< 40	35 - 40
AG indispensables	Acide linoléique C18 :2 n-6	2	2	5	2	2	≤ 4	4
	Acide α-linolénique C18 :3 n-3	0,8	0,8	1	0,8	0,8	0,8	1
	Acide docosahexaénoique DHA, C22 :6 n-3	250 mg						250 mg
AG non indispensables	Acide eicosapentaénoïque EPA, C20 :5 n-3	-	500 mg	500-750 mg	500 mg	≥ 200-300 mg	500 mg	250 mg
	Acide laurique (C12:0) + Acide myristique (C14:0) + Acide palmitique (C16:0)	-	-	≤ 8	-	-	-	≤ 8
	Acides Gras Saturés totaux	-	-	≤ 12	≤ 12	-	-	≤ 12
	Acide oléique C18 :1 n-9	-	-	≤ 20	-	-	-	15 - 20
	Autres AG non indispensables	-	-	-	-	-	-	-