Choosing foods to balance competing n-3 and n-6 HUFA and their actions

Bill LANDS
Fellow, AAAS, ASN and SFRBM, USA

Highly unsaturated fatty acids (HUFA) released by cytosolic phospholipase A2 provide n-3 and n-6 substrates for cyclooxygenases that form prostaglandins and forlipoxygenases that form leukotrienes. Cycloxygenase action is much more rapid with n-6 than n-3 HUFA, and many prostaglandin receptors respond more vigorously with n-6 than n-3 prostanoids. Similarly, LTC synthase forms cysteinyl leukotrienes much more rapidly with n-6 than n-3 LTA, and the BLT receptor responds 50-fold more vigorously with n-6 LTB4 than n-3 LTB5. Vigorous selective actions of n-6 eicosanoids can shift healthy physiology toward pathophysiology for people who have a high proportion of n-6 arachidonate in tissue HUFA[1]. As a result, the %n-6 in HUFA is a useful biomarker for health risk assessment, and diet habits that cause the value to be greater than 50% are important causal mediators to be managed with preventive nutrition. The biomarker makes evident that, in the absence of dietary n-3 nutrients, dietary n-6 linoleic has a very narrow therapeutic window that can be widened by dietary n-3 nutrients[2].

Many enzymes metabolizing the n-3 and n-6 essential fatty acids (EFA) do not discriminate much between the n-3 and n-6 structures. As a result, the relative abundances of competing n-3 and n-6 supplies strongly affect the relative rates of reaction during hydrolysis, activation, elongation, desaturation and acyl transfer and thereby affect the relative amounts of highly unsaturated fatty acids (HUFA) that are accumulated in tissues. An empirical competitive, hyperbolic relationship describes how dietary EFA maintain the relative balance of n-3 and n-6 HUFA. Using dietary EFA data (as percent of daily food energy, en%), the equation estimates successfully the observed tissue HUFA balance in 34 published studies of nearly 4,000 people in 92 groups from 11 different countries. Thus, the %n-6 in HUFA is a useful biomarker for the average dietary intakes of n-3 and n-6 EFA as well as being a useful biomarker for health risk assessment.

To more easily recognize and choose foods that will shift tissue HUFA balance in a desired direction, the Omega 3-6 Balance Score compresses data on the amounts of eleven different competing EFA in a food item (as mg per kcal), expressing them with a single number[3]. The Scores range from -100 to +200, and they relate directly to the associated health risk assessment value of %n-6 in HUFA. Foods with positive Scores increase the %n-3 in HUFA, and foods with negative Scores increase the %n-6 in HUFA. Traditional food habits have average Omega 3-6 Balance Scores near +3 for Inuit, +1 for Japanese, -3 for Mediterranean and -6.5 for American people. These average food scores correspond to health risk assessment values near 30%, 45%, 62% and 78% n-6 in HUFA, respectively. The USDA list of the top 100 American food items has an average score of -6.2, and it has no seafood with large positive scores (e.g., salmon, +62; herring, +70, mackerel, +57). Removing the ten items with the most negative scores (e.g., soybean oil, -50; mayonnaise, -46; tub margarine, -39; peanut butter, -24) gives a list of 90 foods with an average score near that for Mediterranean diets. A simple "app" with the scores of over 5,000 foods can be downloaded to computers and mobile devices to use when planning meals, shopping or talking about foods with friends[4]. A useful concept for preventive nutrition in wellness programs is to NIX the 6 while you EAT the 3.

[1]http://www.efaeducation.org/wellness-videos-balanceimpacts.html

[2]http://www.sciencedirect.com/science/article/pii/S0163782714000253

[3]http://www.nutritionandmetabolism.com/content/pdf/1743-7075-9-46.pdf

[4]http://www.efaeducation.org/Omega3-6BalanceApp.html