

Fats and immune system

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TOPICS

- Essential fatty acids, LC-PUFA
- Balance between n-6 / n-3 and allergy
- LC-PUFA in early life
- Recommendations

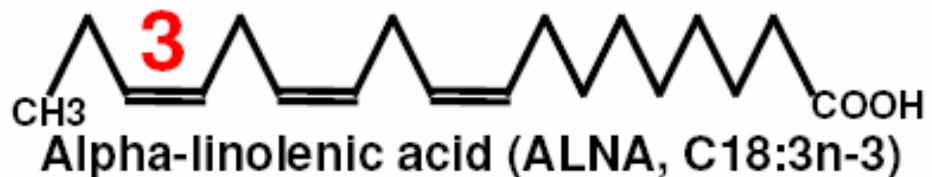
CHEMICAL STRUCTURE OF ESSENTIAL FATTY ACIDS



Linoleic acid (LA, C18:2n-6)



Plant oils:
sunflower, corn,
pumpkin seed;
green leafy vegetables

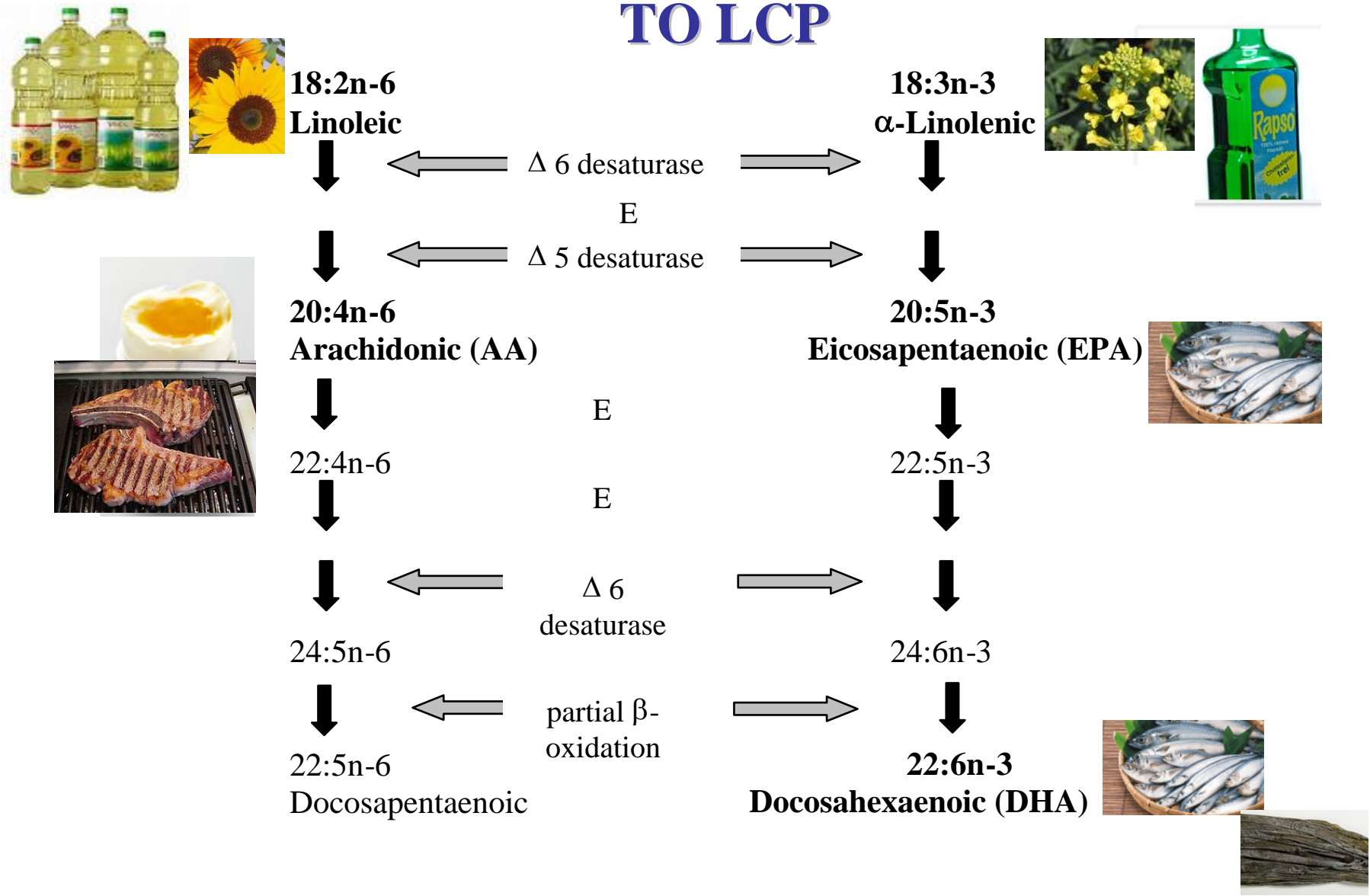


Alpha-linolenic acid (ALNA, C18:3n-3)



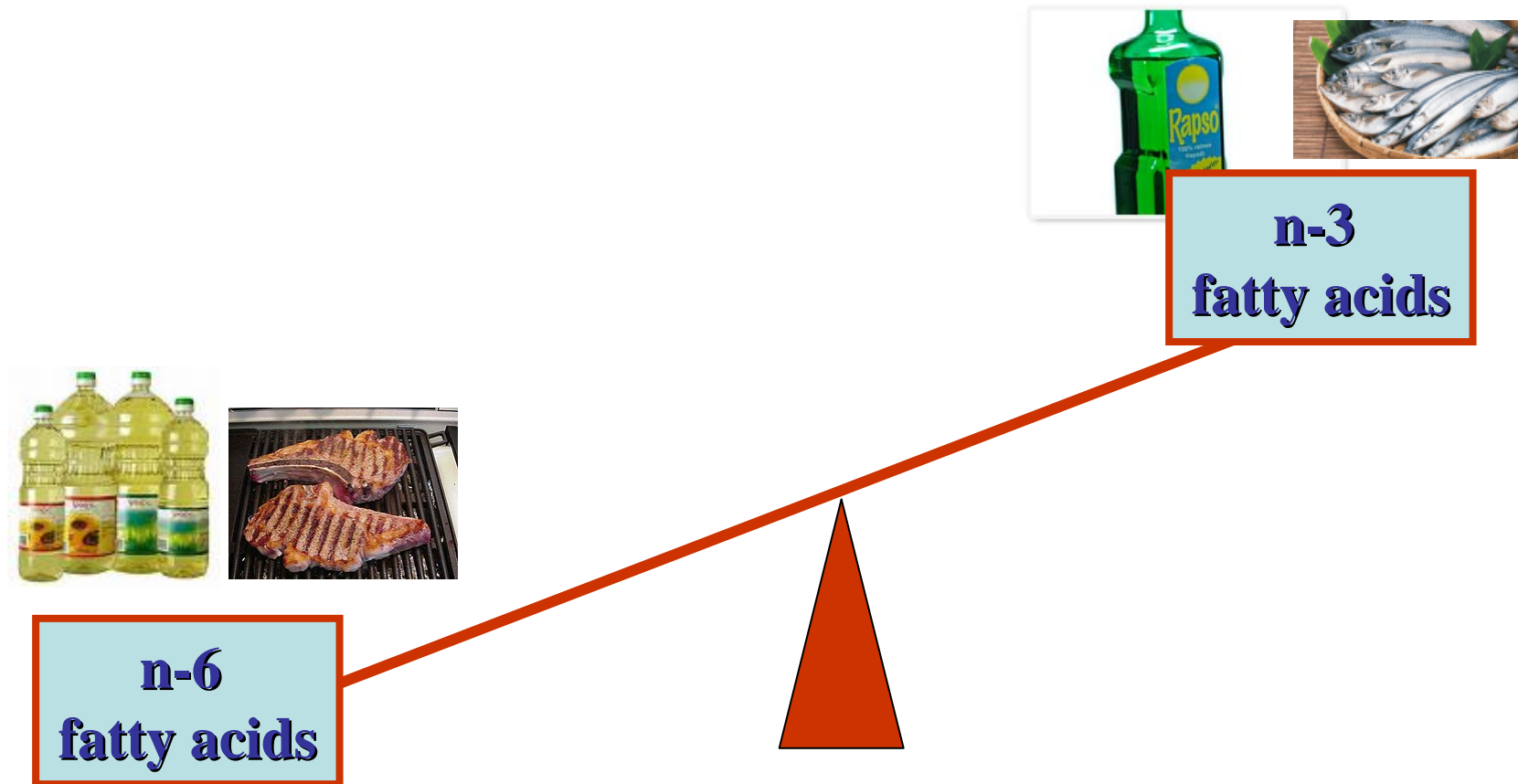
rapeseed, soybeans,
walnuts, linseed

CONVERSION OF ESSENTIAL FATTY ACIDS TO LCP



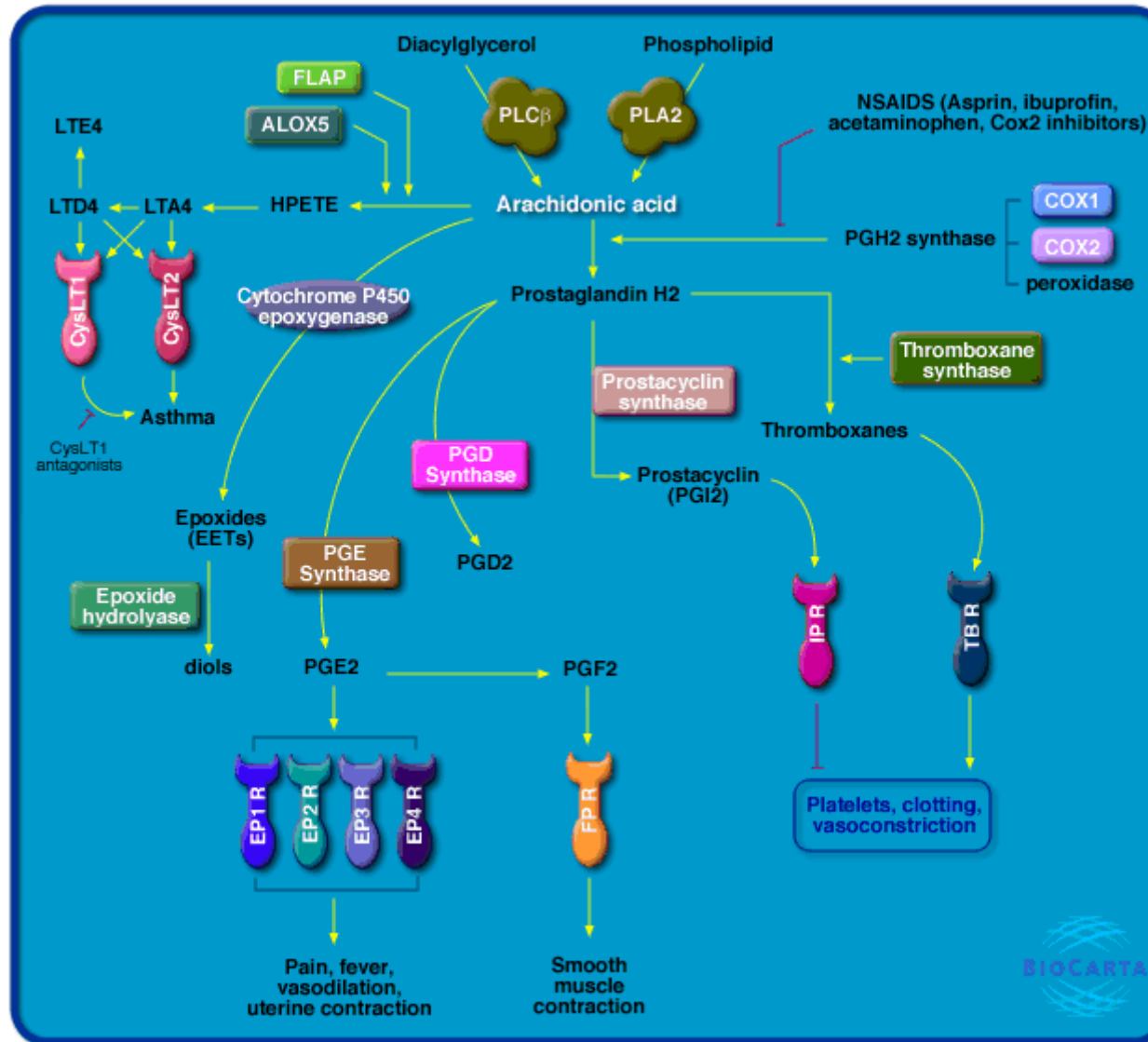
Innis, S. M. Omega-3 fatty acids and neural development... *JPGN*, 2009

IMBALANCE n-6 / n-3

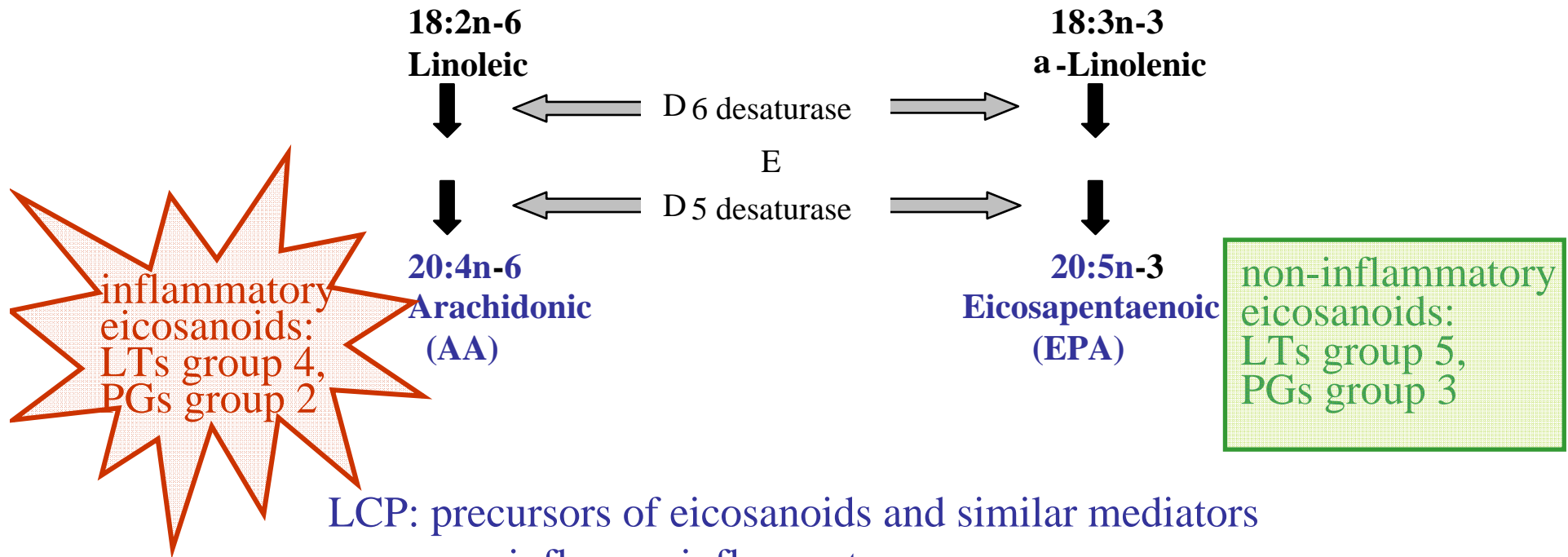


The time over which large changes in the type of fat consumed have occurred in western populations matches the period of the increased prevalence of atopic disease.

LC-PUFA POTENT BIOLOGICAL EFFECTS



PUFA AND IMMUNE RESPONSE



LCP: precursors of eicosanoids and similar mediators
can influence inflammatory process

AA-derived eicosanoids: roles in sensitization to allergens and
allergic inflammation

n-3 LCP: inhibit AA incorporation into cell membranes
metabolism to eicosanoids

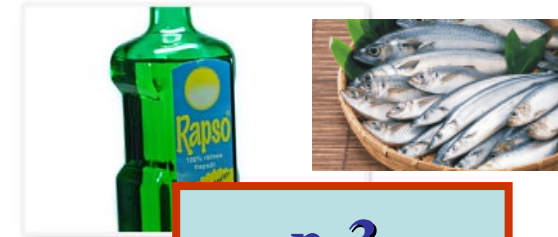
< inflammatory response (therapeutic properties)

Calder, *World Rev.Nutr.Diet*, 2001; Calder, *Am J Clin Nutr* , 2006

Prescott, S., *Nutrit Immunological Homoestasis*, 2009

HYPOTHESIS

Atopy is associated with:
> intake of n-6 PUFA
< n-3 PUFA



**n-3
fatty acids**



**n-6
fatty acids**

**n-3 LCP may be protective
towards
development of allergy**

Hodge, et al, Increased consumption of polyunsaturated oils may be a cause of increased prevalence of childhood asthma. *Aust.N.Z.J.Med.*, 1994

Black, Sharpe, Dietary fat and asthma: is there a connection? *Eur.Respir.J.*, 1997

RATIO n-3 / n-6 AND ALLERGIES

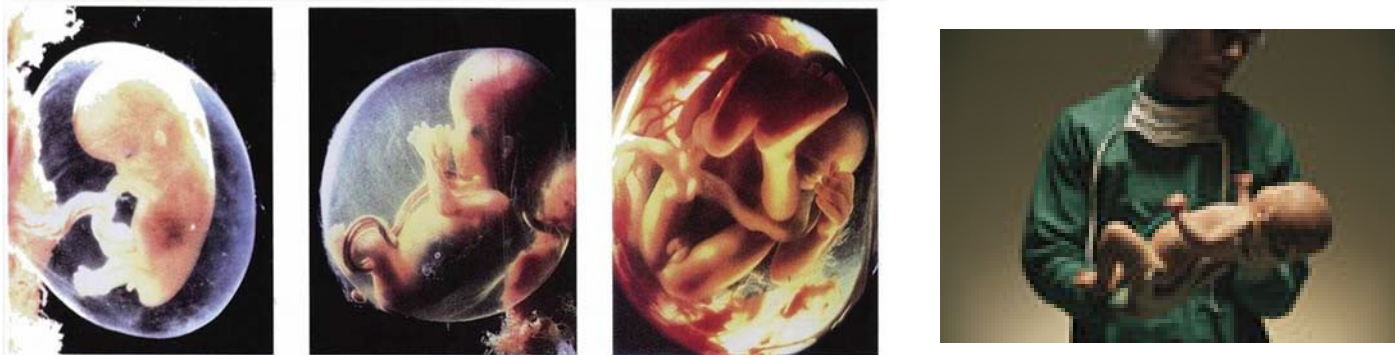
- **Cochrane Meta Analysis:** Little evidence to recommend that people with asthma, or those at risk, modify their dietary intake of fish oil.
- Since allergies appear to be determined in early life or even in utero, n-3 LCP intervention once allergic disease is established may be too late.

De Luca et al, Cochrane, 2004

Calder et al, Early nutrition and immunity-progress and perspectives. *Br.J.Nutr.*, 2006.

THE MOST IMPORTANT “WINDOW OF OPPORTUNITY” FOR ALLERGY PREVENTION: IN UTERO

- **The developmental origins of adult disease:
“DOHaD (Barker) hypothesis”**
- In utero exposures: have epigenetic effects on developmental programming → adult disease
e.g. obesity, CVD, type 2 diabetes, etc.



BREAST MILK

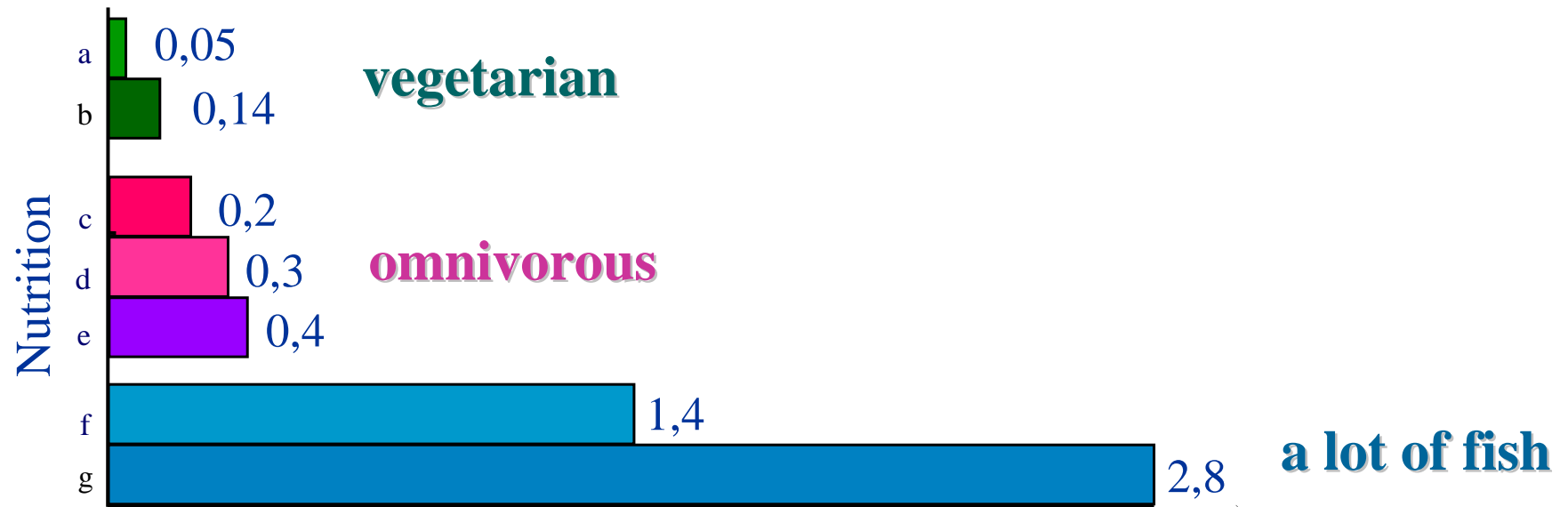
Immunomodulatory factors:

- immunoglobulins, cytokines
- maternal immune cells
- lactoferrin, lysozymes
- oligosaccharides
- “probiotic” bacteria
- LCP
- nucleotides, hormones
- antioxidants
- ...many other bioactives



THE INFLUENCE OF NUTRITION ON DHA CONTENT IN HUMAN MILK

Epidemiological studies



DHA content in lipids of mature human milk (wt.%)

^aFinley et al, *Am J Clin Nutr*, 1985;

^cKoletzko et al, *Am J Clin Nutr*, 1988;

^eGuesnet et al, *Eur J Clin Nutr*, 1993;

^gChluei et al, *J Nutr*, 1995

^bReddy and Sanders, *Eur J Clin Nutr*, 1994

^dGibson and Kneebone, *J Nutr*, 1980

^fInnis and Kuhnlein, *Early Hum Dev*, 1988

n-3 LCP

- Fish oil in pregnancy has effects on neonatal immunological function
 - < inflammatory products
 - effects on T-cell function



Prof. Prescott: Role of Dietary Immunomodulatory Factors in the Development of Immune Tolerance; <http://www.nestlenutrition-institute.org/Pages/HomePage.aspx>

Prescott, Dunstan, JACI, 2007 Prescott, Dunstan, Clin. Sci, 2007



RELEVANCE TO PREVENTION

- PKC ζ better marker to “predict” allergy
- Can be modified by intervention (fish oil)
- RCTs in progress
 - in pregnancy (n=616): 3000 mg tuna oil from 20 weeks (Makrides, Gibson et al)
 - in newborns (n=440): 650 mg fish oil from 0-6 months of age (Prescott, Dunstan)

Prof. Prescott: Role of Dietary Immunomodulatory Factors in the Development of Immune Tolerance; <http://www.nestlenutrition-institute.org/Pages/HomePage.aspx>



- **RECOMMENDATIONS**



n-3 LC-PUFA INTAKE

- Pregnant and lactating women should consume **≥ 200 mg DHA/day.**
- Women of childbearing age should consume **one to two portions of sea fish per week, including oily fish.**



FISH CLASSIFICATION

Oily or Fatty
store fat in flesh and liver
> 5% fat in flesh



sardines



salmon



herring



mackerel

Lean or White
store fat in liver
< 5% fat in flesh



codfish



halibut

LCP INTAKE IN INFANCY

- Healthy term infants:
 - **Breastfeeding:** the preferred method of feeding (supplies preformed LC-PUFA)
 - **Infant formula:** when breastfeeding is not possible (0.2 - 0.5 wt. % DHA; min amount of AA equivalent to the contents of DHA)
- **Dietary LC-PUFA supply should continue after the first six months of life, but currently there is not sufficient information for quantitative recommendations.**



