Life-SMS

Factsheet Fatty Acids and Multiple Sclerosis

Roles of fatty acids:

- integral part of the cellular membrane
- main component of the myelin sheath of the nerves
- providers and storage of nutritional energy
- regulation of body temperature (isolation)
- uptake, storage and providing of liposoluble vitamins (A (also conversion from β-Carotin), D3, E, K
- enhancement and prolongation of feeling of satiety
- starting point for the biosynthesis of (steroid)hormone
- uptake of several mineral nutrients from the gut effective integration of Calcium into the bones
- and many more

Fatty Acids are basic components of the human cells and, additionally, have several important roles in the human body (see box on the right). Apart from trans fats, every fatty acid has its particular role. Basically, there are no “good” or “bad” ones. Nevertheless, a big imbalance between the several groups can cause serious health problems. Nowadays, this imbalance is present especially between the saturated and the (poly)unsaturated fatty acids and, regarding the latter, between the so-called Omega-3 and Omega-6 fatty acids. They can't be synthesized by the human body itself and therefore are called “essential fatty acids”.

Genetics and the changes in nutrition during the human evolution

The interaction between (epi)genetics and nutrition, environment and nature is the basic principle for health and illness as well. In the past two decades, molecular biology revealed that, on the one hand, genetic predispositions define the risk for certain diseases and, on the other hand, environmental circumstances define which susceptible persons in fact get ill. In this context, nutrition is an environmental factor of utmost importance.

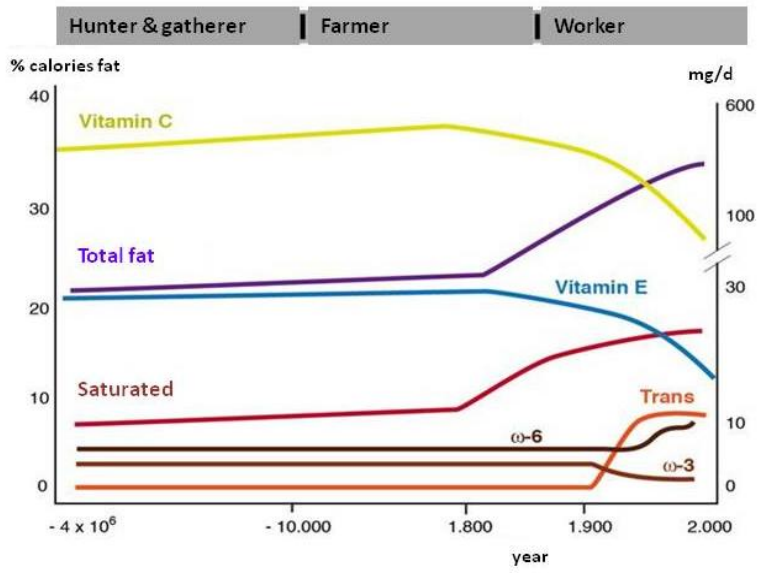

Fig. 1: long-term shift of the omega-6/omega-3 ratio and of fatty acids in general in human food, based on [Simopoulos 2008]

Whereas there have been extensive changes in our nutrition since the beginning of early agriculture, our genes haven't changed over the past 10.000 years. The estimated rate of spontaneous (and persistent) germline mutation is 0,5% per one million years. In fact, our genome nowadays is nearly identical to that from our ancestors from the Old Stone Age 40.000 years ago when our genetic profile was defined. The resulting problem becomes clear at first glance in figure 1 [after Simopoulus 2008].

Neither the composition of the fatty acids nor the content of antioxidants of today's nutrition fit our genetic profile. The fat content within our food has raised from about 20% to 35% with a simultaneous duplication of the amount of

saturated fatty acids. For the first time, with the beginning of the last century, trans fats (artificial or conditional of manufacturing) show up in the daily nutrition, and the ratio of omega-6 to omega-3 fatty acids has changed over the years from approx. (1,)?5:1 to 15:1 [Simopoulos 2008]. Therefore, the outbreak of lifestyle diseases is inevitable, there is constant trouble with a creeping inflammation inside the body and chronic diseases are increasing. By the way, the first (relatively) confirmed report about MS dates from the beginning of the 19th century (records of Augustus D'Este, son of Prince Frederick Augustus D'Este and grandson of King George III. from Great Britain).

A coincidence? Rather unlikely.

MS and dysfunctions in the metabolism of fatty acids

Concerning MS, there are two really interesting points:

First, there exists an alternate hypothesis describing the disease as a chronic dysregulation of fatty acid metabolism and thereby explaining four aspects of onset and progression: 1) pathophysiologyi, 2) genetic susceptibility, 3) environmental factors and pathogens, and 4) the differing incidence in women and men. To make a long story short: men are more likely to get atherosclerosis, women rather are more likely to get MS. The review published by Angelique Corthals in 2011 explains multiple sclerosis much better than the current accepted autoimmune hypothesis [Corthals 2011].

Second, vascular comorbidity, whether at the early onset of symptoms or later during progression of the disease, causes a significant higher risk of progression of disability with multiple sclerosis. The mean time from first diagnosis to ambulant need for assistance was 12,8 years for patients with accompanying vascular diseases and 18,8 years for patients without [Marrie 2010]. Hence, the treatment of vascular comorbidities and its impact on the course of disease value further examination as well as the treatment of a defective metabolism of fatty acids itself.

MS and fatty acids – a story of contradictions

Saturated fatty acids

For decades, saturated fatty acids have been suspicious in playing a major role in disease progression of MS. The major reason for this is the fact that saturated fatty acids with a high melting point are incorporated into the cellular membrane thus influencing the cellular metabolism [Holmann 1998]. Although not taken seriously by academic medicine, remarkable success could be achieved with diets that almost completely omit saturated fatty acids. Prominent examples are the Swank Diet or the dietary change proposed by Prof. Jelinek in the context of the OMS project (cf. web links).

Newer studies convey a much more differentiated picture: Saturated fatty acids are as functionally relevant for the body as (poly)unsaturated fatty acids. An inverse correlation between the EDSS[ii] and FFS[iii] and the incorporation of medium- and long-chained fatty acids into the cellular membrane has been shown, thus meaning a positive impact on the course of the disease [Hon 2009].

The medium-chained lauric acid ($C_{12}H_{24}O_2$) is a main component (ca 45%) of coconut oil, and also the long-chained myristic acid ($C_{14}H_{28}O_2$) accounts for approx. 25%. Not only for that reason, coconut oil has a predominant role in the MS diet, but also because of its content of medium-chained fat (MCT) being a precursor for ketone bodies (an alternate source of energy for the brain, cf. factsheet sugar

and MS) and showing strong antiviral and antibacterial effects. The reproduction of the viruses will be disturbed by intercalation of the MCTs into their envelopes.

On the other hand, animal testing revealed that palmitic acid ($C_{16}H_{32}O_2$) promotes glucose intolerance and increases the level of LDL cholesterol, thus being a risk factor for coronary diseases [Devi 2010].

Finally, everything is depending on the type of saturated fatty acids.

Mono- and polyunsaturated fatty acids

Regarding MS, monounsaturated fatty acids can be regarded as "neutral", in which olive oil (main component: oleic acid, 55-83%) deserves a prominent role due to its high content of polyphenols. The many assets of olive oil regarding health and longevity are due to its high content of oleuropein, a polyphenol which helps lowering LDL-values and blood pressure, prevents cognitive dysfunction and cancer and protects against oxidative stress [Omar 2010].

Concerning polyunsaturated fatty acids, things are more complicated. Concerning inflammatory diseases such as MS, Omega-3 and Omega-6 fatty acids are of high significance because they regulate inflammatory processes. Whereas arachidonic acid (an omega-6 fatty acid) promotes inflammation, omega-3 fatty acids are the anti-inflammatory counterpart. The adjacent figure (fig. 2) illustrates the role of omega-3 and omega-6 fatty acids (for the) in prostaglandin biosynthesis and hence their impact on inflammatory processes. The omega-3 branch exclusively has an anti-inflammatory role whereas the metabolites from the omega-6 branch are Janus-faced: DGLA can either be the precursor for anti-inflammatory prostaglandins (type 1) or (give raise to) increase pro-inflammatory tissue hormones (prostaglandin type 2). As stated above, our genome was arranged for a certain balance of omega-3 and omega-6 fatty acids. Nowadays, the mean omega-6/3 ratio in the population is about 15:1 whereas only a ratio of <3:1 can be regarded as inflammatory – neutral. Therefore, a MS-specific diet has the goal to avoid the uptake and the biosynthesis of arachidonic acid and of prostaglandins type 2. This can be realized in two different ways:

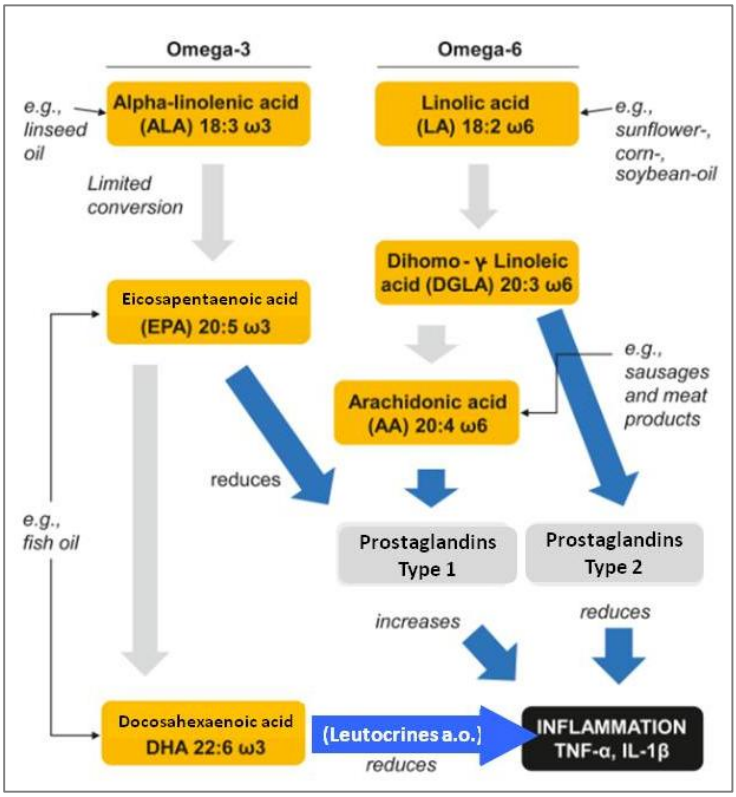

Fig. 2: Metabolism of Ω-3 and Ω-6 fatty acids

1. Fixing the imbalance between omega-3 and omega-6 fatty acids in nutrition

A main reason for this imbalance is the increasing use of cheap, omega-6-rich vegetable oils by the food industry, especially as a component of animal feed (soy pellets). Indirectly, there is a usage of approx. 700g soy flour in animal husbandry per week per German citizen. Given the high percentage of omega-6 fatty acids in soy bean oil (above 50%), this concentrated feed alone leads to a prominent source of omega-6 fatty acids in our daily nutrition. Along with this, there is sunflower oil (64%), corn oil (52%) and soy bean oil (51%) with high amounts of omega-6, respectively.

In contrast, game meat or meat from grass-fed animals without maize feeding rather represents a source of good fats. In addition to that, we use to eat too little fish[iv] or products from fish also bred with industrial feed and hence rich in omega-6 fatty acids.

Contents of omega-6 fatty acids in vegetable oil

- sunflower oil 64%
- maize-germ oil 52%
- soy bean oil 51%
- rape seed oil 19%
- olive oil 8%

2. Diet with food preventing the conversion of linoleic acid to arachidonic acid

There are three possibilities:

a) fish products with a high content of omega-3 fatty acids
Good sources are fat fish such as herring, mackerel, sardines and salmon. Because of the pollution from the sea, heavy metal content should be noted. In this context, the first three fish are more favourable than salmon hence they are further down in the food chain.
Regarding vegetable oils, linseed oil is extraordinary rich in omega-3 α-linolenic acid (56-71%). However, this "vegetal" omega-3 fatty acid can only partially be transformed into the biologically important omega-3 fatty acids EPA and DHA because the machinery is mostly occupied by the high amount of omega-6 fatty acids. Only fish oil contains pure EPA and DHA [Henn 2014].

b) Less consumption of sugar and lowering of blood insulin level
A low level of insulin blocks the formation of arachidonic acid from its antecedent DGLA and reduces the blood levels of triglycerides and LDL (Low Density Lipoprotein) [Siri-Tarino 2010].

c) Nutritional supplementation with curcuma (main component of curry) and sesame (part of the Asian cuisine)
Curcumin [Koeberle 2009] and sesamin [Wu 2009] block the production of arachidonic acid and its derivatives, the pro-inflammatory prostaglandins type 2. In the far eastern cuisine, these natural medicines are known and used for centuries!

Omega-3 as a dietary supplement

Natural fish oil is a complex of more than 50 fatty acids showing similar positive effects (as)to the consumption of fish alone. When choosing an oil, quality and dosage have to be respected. To get a regulative or therapeutic effect, more than 2g omega-3 (approx. 10ml fish oil) per day are required. Natural fish oil contains up to 35% omega-3 fatty acids.

Omega-3 concentrates are not recommendable! Concentrates are produced by a chemical process. This destroys the natural triglyceride-structure and may cause adverse side-effects. With fish oil capsules, there is always the suspicion that the content of omega-3 has already been destroyed by

oxidative processes and hence might be ineffective. This could be the reason why the consumption of linseed oil has proved to be more advantageous for MS than the consumption of fish oil capsules [Jelinek 2013].

Cold-pressed linseed oil[v] contains more omega-3 fatty acids than fish. Whereas 100g linseed oil may contain up to 55g omega-3 fatty acids, even fat sea fish such as herring, mackerel or tuna do not contain more than 3g. However, the α-linolenic acid (ALA) from linseed oil first has to be transformed into EPA and DHA by the human body. Due to the high content of omega-6 in our daily nutrition, the conversion factor typically reaches only 0,5 – 10%. Studies on rodents show that the uptake of ALA has to be 9-30fold the amount of omega-6 to reach an optimal level of EPA+DHA in the fat tissue [Talahalli 2009]. Therefore, the influence of linseed oil on the omega-3 to -6 ratio is limited. Linseed oil has to be fresh. If it tastes rancid, it can be used for wood preservation at best. Hence you should keep linseed and fish oil in the dark and the refrigerator.

Individual measurement of the Omega-6 / 3 ratio

The individual omega-6 / 3 ratio and additional fatty acid-values (as for example the amount of trans-fats and the omega-3 index) can be determined by blood collection and laboratory analyses or the analysis of dry blood samples. The costs are depending on its range. When focusing on omega-3, omega-6 and trans- fatty acids, refer to the data shown in the box on the right.

Analytics of fatty acids

determination of

- Omega-6/3 ratio, omega-3 index, amount of trans-fats
- Costs for the patient from 60-80€
- GOÄ cipher 3726
- Stability between 60 and 80 days
- recommended laboratories: e.g. Biovis or Omegametrix (for Germany)

Consequences for the treatment of MS

The results of your individual analyses determine your personal therapy. If there is an imbalance (omega-6/3 ratio > 3) or high amounts of saturated or trans-fatty acids are detected, taking measures is highly recommended.

Specific recommendations in brief

- increase the amount of “healthy” fat in your diet. Renounce, as far as possible, on long-chain, saturated fatty acids, such as palm fat. Especially palm fat promotes coronary heart diseases [Devi 2010]. Focus on coconut oil and medium-chain fatty acids. Completely abstain from hydrogenated fats and trans fats (for example margarine, croissants, fried food)

- necessarily use high amounts of cold-pressed native olive oil (preferably from purely biological cultivation) when cooking.

- Consume oil seed with a favourable omega-6/omega-3 ratio, such as chia, hemp or linseed

- Add sufficient fresh oils containing high amounts of omega-3 to your diet. Either with fresh fish or fish oil from wild catching as nutritional supplement. The therapeutic(al) dosage is at least 2 g of pure omega-3 fatty acid per day (approx. 10ml fish oil).

- Additionally use cold-pressed linseed oil[vi] and hempseed oil preferably from purely biological agriculture and with appropriate freshness.

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- Reduce the consumption of sugar and care for a low blood level of insulin.
- Use considerable amounts of curcuma and sesame when cooking.
- Do a baseline-analysis of your spectrum of fatty acids and repeat this after 9-12 months.
- Keep this kind of diet as soon as you see an improvement.

Concluding remarks

Surely, a diet consisting of healthy fats and oils is not a sole remedy for MS or other neurodegenerative diseases. But it is an essential precondition for supplying energy and the basis for stabilization, regeneration and convalescence for the body. Hence, this diet is an important element of the treatment of MS.

Additional literature and web links

http://www.overcomingmultiplesclerosis.org/ (The OMS project)

http://www.swankmsdiet.org/About%20The%20Diet (The Swank diet)

http://terrywahls.com/ (The Wahls protocol)

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Figures

Fig. 1: long-term shift of the omega-6/omega-3 ratio and of fatty acids in general in human food, © DSGIP with friendly support by Govi-Verlag Pharmazeutischer Verlag GmbH; based on [Simopoulos 2008]
Fig. 2: Metabolism of omega-3 and omega-6 fatty acids, © SAN OMEGA GMBH

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End notes

[i] The teaching on abnormally altered functions of the body

[ii] EDSS – Expanded Disability Status Scale

[iii] FSS – Functional Systems Score

[iv] Salmon also has a relatively high amount of arachidonic acid (ca. 300 mg/100g; significantly more than pork). But because of the simultaneously high amount of omega-3 (salmon > 3000mg/100g vs. pork 100mg/100g), the production of pro-inflammatory cytokines is blocked.

[v] Made by using a screw press! As soon as the temperature during production goes above 35° C, the oil gets useless because of oxidation

[vi] In principle, a modification of the omega-6/3 ratio is also possible using linseed oil. But in doing so, a significant reduction of the omega-6 uptake is required, which might be very demanding given the present-day nutrition.

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