

## A short review on sources and health benefits of GLA, The GOOD omega-6

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**Abstract:** GLA rich oils are used mainly for their antiinflammatory effects. As inflammation plays a role in a large number of diseases, GLA can also affect a large number of diseases/conditions. Clinical studies have shown that GLA regulates transepidermal water loss (TEWL), whereby, it prevents dryness and also helps heal eczema and xeroderma. GLA also is shown to stimulate apoptosis of cancer cells without affecting healthy cells. It increases the efficacy of anticancer agents (e.g. tamoxifen) and reduces their side effects by regulating apoptotic gene expression and estrogen receptors. GLA rich oils also reduce the pain and inflammation in rheumatoid arthritis. Recent clinical trial has indicated that GLA can prevent weight regain after weight loss, which is a big concern for people undergoing weight loss. Several human and animal studies have confirmed safety of GLA. The presentation will discuss the various sources for GLA and the actions of GLA in various conditions.

**Key words:** GLA rich oils, health benefits, omega-6

Over the last decade, the publicity of food supplements in the area of healthful fatty acids has been dominated by the omega-3 fatty acids, more specifically those found in Fish, EPA and DHA. This publicity is based upon a large body of scientific evidence which has established links between fish oil, or the prominent individual fatty acid in there, to decreased incidence of a number of diseases. The strongest and most widely accepted link is that of fish oil intake and lowered risk of coronary heart disease (CHD) [1].

In the same body of evidence which suggests the promising role of n-3 fatty acids on human health, n-6 fatty acids are often mentioned as a potential health threat. The basis for this bad reputation are epidemiological studies showing an improper balance between total n-3:n-6 can lead to serious health problems. The estimated ratios between of n-3:n-6 are quite diverse and range anywhere from 1:8 to 1:15 [2]. There is still much scientific debate ongoing to what the optimum ratio might be, but already there are authoritative bodies, like the ministry of health, labour and welfare in Japan, recommending consumers a n-3:n-6 ratio of 1:4.

One reason for the unbalance in the ratio is the low intake of fatty fish in our western diets. The second reason, which is just as obvious as the first, is the high intake of n-6 fatty acids, in particular of linoleic (LA) and arachidonic acid (ARA). These two fatty acids combined account for the majority of the n-6 intake, to which the lower n-3:n-6 ratio and consequent harmful

effects seen in the epidemiological studies, are linked to. The n-6 fatty acid gamma-linolenic acid (GLA), however, is only taken in small amount but is potentially just as healthful as the n-3 fatty acids. Evidence of such positive effects will be demonstrated below.

GLA is mainly found in vegetable oils, with Borage oil (24% GLA) being nature richest source. GLA is biosynthesized from LA, the true essential fatty acid of the n-6 pathway, as all enzymes needed for further conversion are present in the body (figure 1).

Historically, evening primrose oil (EPO) got most attention as the majority of the research, that started in the late-70's, was done on this oil. Much of the GLA research was pioneered by the late David Horrobin, who, through

science, laid the foundation for the commercial success of GLA-rich plants oils [3, 4]. More recently, starting in mid-eighties, Borage oil was found to be a GLA-rich and commercially viable oil and, together with EPO, now makes up the majority of the GLA market. GLA nowadays is found in a number of applications including (pet)food, food supplements, skincare products and medical nutrition.

### Proven health benefits of GLA

There are a number of different areas of use for GLA-rich oils. In this section we will try and highlight a few of the (disease) conditions that have been treated with GLA-rich oils.

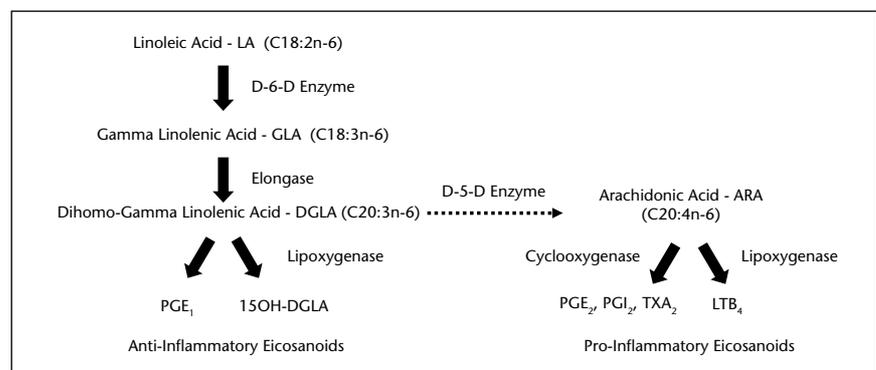


Figure 1. The metabolic pathway of n6 fatty acids and its consequent formation of eicosanoids in humans. The conversion of LA to GLA by delta-6-desaturase is the rate limiting step towards the production the anti-inflammatory eicosanoids.

## Coronary heart disease

We already mentioned the well accepted benefits of fish oil in the prevention CHD, but correlations between the intake of GLA and CHD also exist. These correlations are less clear than for fish oil, but the effects are apparent.

Mice being fed a high GLA diet showed a reduction of VLDL and LDL cholesterol, as well as a reduction of atherosclerotic lesions [5, 6]. Similar effects were seen in an intervention study with seniors [7]. In that study the researchers showed effective bioconversion of GLA dihomog-DGLA and consequent reduction of a number of CHD risk factors.

Next to (V)LDL cholesterol and atherosclerotic lesions, hypertension is also a common risk factors of CHD. Independent studies showed that supplementation with GLA led to a reduction of blood pressure, up to 6-16%, which is even better compared to some pharmaceutical agents [8-10].

## Arthritis

Symptoms of arthritis include morning stiffness, inflammation and, generally, painful joints.

Treatment of arthritis, which is a chronic disease, is usually done with non-steroidal anti-inflammatory drugs (NSAIDs). In different clinical trials arthritis sufferers were supplemented with GLA and a sharp decrease was seen in all the mentioned symptoms above. Most noticeably was the reduction in NSAIDs users, which decreased from 100% to approximately 25% after 9 months of supplementation [11].

## Skin health

Our skin is the biggest organ we have and its' key function is that of a barrier. A healthy skin is rich in lipid membranes, that combined with coenocytes, form the structural basis for the barrier role.

Topical application, as well as oral supplementation with GLA, has been shown to improve skin smoothness and moisture in healthy human subjects. With the oral supplementation a 18% increase was noticed after 12 wks of supplementation with 700 mg GLA/day [12, 13].

Eczema (approx. 10% of the population) and Psoriasis (approx. 2% of the population) are common skin problems affecting the quality of life for many. In psoriasis inflamed skin lesions are formed, with varying intensity and lesion sizes. Normally this is treated with topically applied corticosteroids, but these are not always effective. In two independent case studies patients were supplemented GLA for five months or more and the results showed a dramatic decrease of symptoms (97% and 72%) [14].

GLA has also been shown to be effective in treating eczema. After twelve weeks of GLA supplementation, patients scored common eczema symptoms as inflammation, oozing and vesicle formation slightly lower, and itching significantly lower (Intensity at start 7.8; after twelve weeks 1.0) [15].

## Discussion and conclusion

Only a few health benefits have been mentioned in this article, but other researchers have pointed out that there are many more possible beneficial roles of GLA e.g. diabetes, cancer and even weight management [16]. We have looked at all the disease conditions mentioned here and it seems that inflammation/reactive oxygen species (ROS) form a commonality. Inflammation is most obviously seen in arthritis and skin conditions, but it is also well evidenced that ROS play a major role in the formation of oxidation of LDL and atherosclerotic lesions in CHD [17]. Also, a surplus of ROS on a cellular level can lead to DNA mutations, possibly leading cancer [18].

Inflammation and ROS, the latter also being formed during inflammation itself, are believed to be a function of genetic, lifestyle and dietary factors. We know that activity of an important rate limiting enzyme as delta-6-desaturase (D6D) is heavily influenced by its location in the body. In the skin this enzyme does not seem to be active, not allowing further downstream conversion, as shown in figure 1. Another enzyme in the pathway, delta-5-desaturase, is also inactive in skin [12].

The effect of lifestyle and dietary factors upon disease is still not well understood, however, technology of the last 20 years have allowed science to progress rapidly. It is now well known that smoking, for instance, has a detrimental effect upon the activity of D6D.

A deficiency in nutrients as vitamin B6 and zinc also decreases the activity of D6D, as they are important co-factors.

From the above it is obvious that many factors can influence the activity of crucial enzymes in the fatty acid biosynthesis pathway, but adding to that is, of course, the actual intake of fatty acids themselves. As mentioned in the introduction, most western diets are unbalanced in their n-6:n-3 intake but a closer look also shows us an imbalanced consumption within the n-6 family. LA is the most available n-6 fatty acid in our diets and can be found in common vegetable fats, margarines and other products. Next to LA, ARA in our diets is found mostly in meats. GLA, on the other hand, is hardly consumed and only found in a few specific plant oils.

Taking into account the slow conversion of LA to GLA, as mentioned earlier, a shortage of GLA and a surplus of ARA may exist for those living a

“western” life style. This is an unfavourable balance as from ARA pro-inflammatory eicosanoids are formed, contributing to the disease conditions described earlier. Supplementation with GLA, therefore, might restore a more healthy balance within the n-6 fatty acid family. We believe that this restored balance between GLA and ARA will contribute to increased production of more favourable anti-inflammatory eicosanoids and could help improve disease conditions that have inflammation/ROS-like causes, as evidenced in this article.

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