

# The Role of Nutrition in Ocular Health

The re-esterified triglyceride form of omega-3 helps resolve inflammation associated with dry eye disease.

BY S. GREGORY SMITH, MD

My training, like many ophthalmologists, offered little on the role of nutrition in eye health. For example, carrots are “good for your eyes,” was about the extent of my knowledge.

Routinely, ophthalmologists see patients who present with dry, red, irritated eyes. Upon clinical examination, almost all of these individuals have meibomian gland dysfunction (MGD) or blepharitis. For approximately 30 years, I have been treating these patients with artificial tears, warm compresses, topical steroids, topical antibiotics, oral tetracycline derivatives, and doxycycline; all with about a 5% success rate.

Approximately 3 years ago, I began treating my patients with ocular surface disease by using omega-3 fatty acids in the re-esterified triglyceride (rTG) form. I was amazed that approximately 70% of these patients reported back that their symptoms had resolved, and, upon clinical examination, their MGD was also markedly improved. After their ocular surface problems are resolved, my patients often ask, why did I get this condition?

## OMEGA-3 AND OMEGA-6 FATTY ACIDS

### What Is an Omega-3 Fatty Acid?

Omega-3 is an essential fatty acid, meaning that it cannot be manufactured by the body, it has to be obtained through one's diet.

### What Does Omega-3 Do?

Omega-3 is an antiinflammatory agent and, perhaps more importantly, an inflammation-resolving agent.

### Arachidonic Acid

All ophthalmologists are familiar with the fact that arachidonic acid is acted upon by cyclooxygenase to

“Even less well known is that cyclooxygenase acts on omega-3s to create eicosanoids that mirror the prostaglandins but are antiinflammatory in nature.”

form prostaglandins and initiate the inflammatory pathway. Not many, however, know that arachidonic acid is an omega-6 fatty acid. Even less well known is that cyclooxygenase acts on omega-3s to create eicosanoids that mirror the prostaglandins but are antiinflammatory in nature.<sup>1</sup>

### Fire and Water

Visualize a cell that contains both omega-6 and omega-3 fatty acids. When injury occurs, inflammation follows—think of omega-6 as fire. How is that inflammation healed? Think of omega-3 as water.

## WHY IS DIET IMPORTANT?

Michael Gross, MD, has described a condition called *Omegeanemia*, meaning the body has a significant lack of omega-3s.<sup>2</sup> He has stated that the typical American diet has a ratio of 24:1 omega-6s to omega-3s.<sup>3</sup> Going back to the cell example, there is a significant imbalance of omega-6s to omega-3s in this situation. The body will do everything it can to preserve the omega-3s. It can be estimated that a particular cell contains 80% omega-6s and 20% omega-3s. When injury occurs in a body that has this typical diet, there are 8 units of fire (omega-6s) and only 2 units of water (omega-3). The inflammation in that body will not resolve.

## IN PRACTICE

### MGD Patients

Now back to the clinic and patients with MGD; the real problem is chronically inflamed meibomian glands.

When MGD patients are treated with omega-3s in the rTG form, their system has been rebalanced. There is now enough water (omega-3) to put out the fire (caused by the omega-6). The goal of nutritional therapy is to get this ratio closer to 50:50.

### Why Omega-3s in the rTG Form?

This has to do with the body's ability to absorb the omega-3s. Jorn Dyerberg, MD, the author of the first three articles on omega-3s, has also studied the bioavailability of different forms of the fatty acid.<sup>4-6</sup> He designed a study with three groups of patients: one was assigned unprocessed oil from fish, one took omega-3s in a highly concentrated ethyl ester form (now known as Lovaza; GlaxoSmithKline), and one was given omega-3s in the rTG form. He found the absorption of unprocessed fish oil to be 100%. The highly concentrated ethyl ester form was absorbed at 72%, and the rTG form showed 124% absorption.

The rTG form achieved blood levels almost twice that of the highly concentrated ethyl ester form. The absorption of rTG omega-3s is approximately 98%, and that of the highly concentrated ethyl ester form is 57%. The latter represents a prescription form of omega-3s; however, most formulations are available over the counter and are not concentrated.

### Why Are There all These Formulations in the First Place?

Back to diet: unfortunately, the oceans have been contaminated with mercury, polychlorinated biphenyls, and other heavy metals and compounds. At certain levels, these can become carcinogenic.

Therefore, consumers are warned with regard to how much fish they can safely eat. If we are to "eat our way into balance" with fish consumption, we will have to be content with consuming these contaminants. Thus, omega-3s are subjected to a purification process to remove these materials and leave only the omega-3s.

Fish have their omega-3s in the TG form. During the purification process, the TG group attached to the omega-3s is stripped off and replaced as an ethyl ester group by adding ethyl alcohol. It is an even costlier step to re-esterify the omega-3s so that the alcohol is removed, leaving a clean triglyceride. This step, however, allows the body to more easily absorb the omega-3s.

## THERAPY

A key concept that Dr. Gross and William Harris, PhD, have elucidated is that it is necessary to

achieve a therapeutic level of omega-3s in the blood. Dr. Harris has pointed out that the serum level must be higher than 8% when measured in red blood cells.<sup>7</sup> Dr. Gross has said that it is necessary to take 2,000 to 3,000 mg of omega-3s in the rTG form in order to achieve such a level.

Physicians should think of omega-3s as penicillin—the pharmacokinetics are important. One must take 250 mg of penicillin four times a day to achieve the blood level necessary to kill bacteria. If the body does not achieve a therapeutic level, the effect will not be sufficient. With omega-3s, it is not necessary to space out the dosing, the entire amount can be taken at one time.

The importance of therapeutic levels is also critical when evaluating studies of omega-3s. If penicillin were dosed at 250 mg once a day, would it be thought to be an effective antibiotic? The Age-Related Eye Disease Study 2 (AREDS2) concluded that using 1,000 mg of an ethyl ester form of omega-3s once a day provided no additional benefit in reducing the risk of progression to advanced AMD.<sup>8</sup> Using a markedly subtherapeutic dose is not going to generate a therapeutic result.

## CONCLUSION

When patients say they are taking omega-3s, it should now be clear why the rTG form is so important. The drugstore variety is not a concentrated ethyl ester form, and the absorption is suboptimal. A patient taking 1,000 mg of fish oil may only be able to absorb 200 mg of omega-3s.

Back to answering the patient's question, why did I get dry eyes in the first place? My answer: I changed your diet, and your dry, red, irritated eyes resolved. I would have to say it was your diet that caused your dry eyes. ■

*S. Gregory Smith, MD, is in practice at Delaware Eye Surgeons in Wilmington and is an attending surgeon at Wills Eye Hospital in Philadelphia. He is a consultant to PRN Physician Recommended Nutraceuticals. Dr. Smith may be reached at (302) 993-1300; sgsmith@deeyesurgeons.com.*



1. Calder PC. Polyunsaturated fatty acids, inflammation, and inflammatory diseases. *Am J Clin Nutr*. 2006;83(6):S1505-S1519S.

2. Gross MB. The unsilent killer. *Advanced Ocular Care*. 2010;(2):35

3. Simopoulos AP. The importance of the ratio of omega-6/omega-3 essential fatty acids. *Biomed Pharmacother*. 2002;56(8):365-379.

4. Dyerberg J, Madsen P, Møller JM, et al. Bioavailability of marine n-3 fatty acid formulations. *Prostaglandins Leukot Essent Fatty Acids*. 2010;83(3):137-141.

5. Dyerberg J, Bang HO. Haemostatic function and platelet polyunsaturated fatty acids in Eskimos. *Nutrition*. 1995;11(5):475; discussion 474, 476.

6. Dyerberg J, Madsen P, Møller JM. Bioavailability of marine n-3 fatty acid formulations. *Prostaglandins Leukot Essent Fatty Acids*. 2010;83(3):137-141.

7. Harris, WH. Omega-3 fatty acids: the "Japanese factor"? *J Am Coll Cardiol*. 2008;52:425-427.

8. The Age-Related Eye Disease Study 2 (AREDS2): Study design and baseline characteristics. AREDS2 Report No. 1. *Ophthalmology* 2012;26:26.