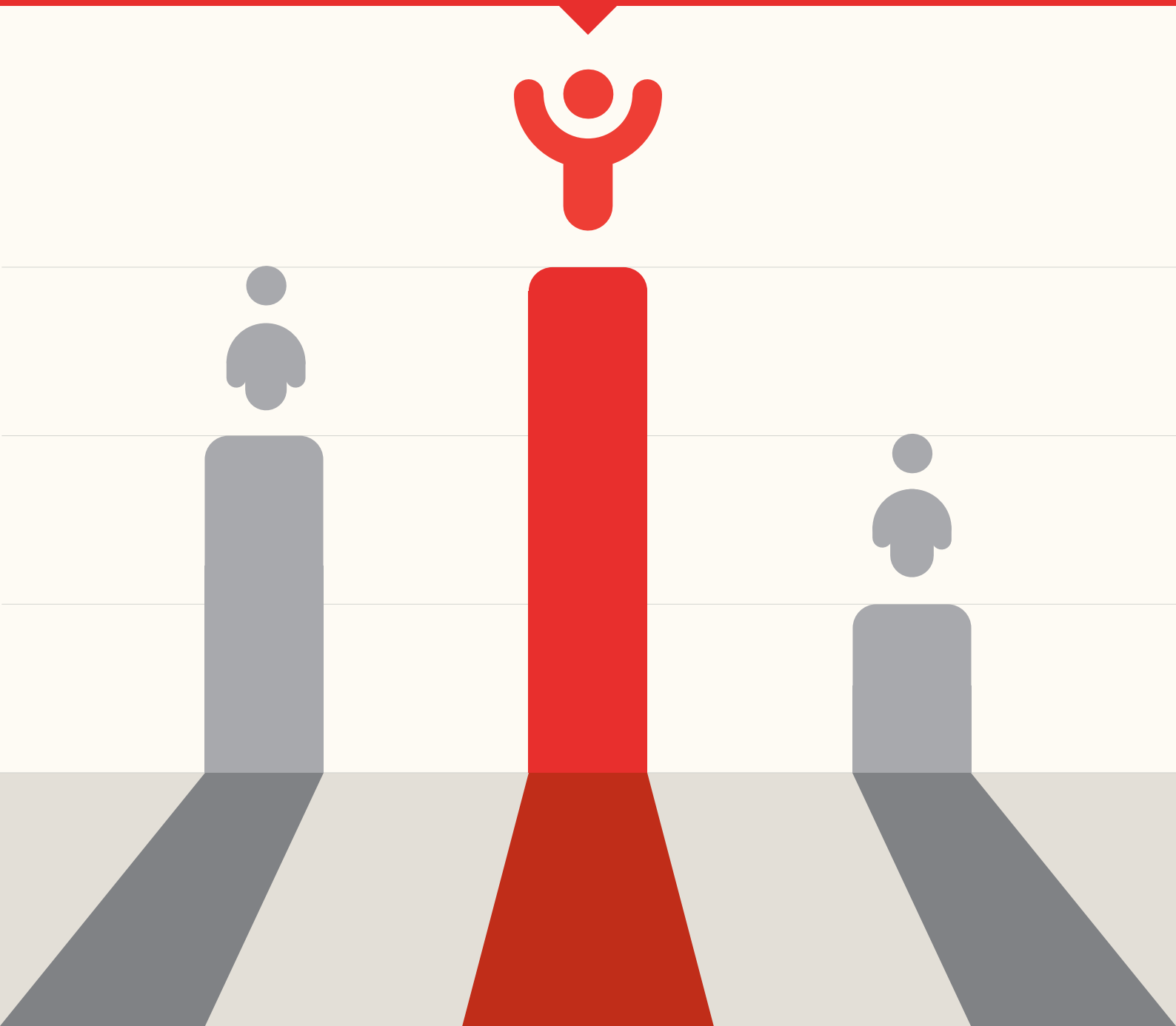
SUPERBA® KRILL

A Superior Source of Omega-3s

Optimizing The Omega-3 Index with Krill Oil

by Lena Burri, PhD



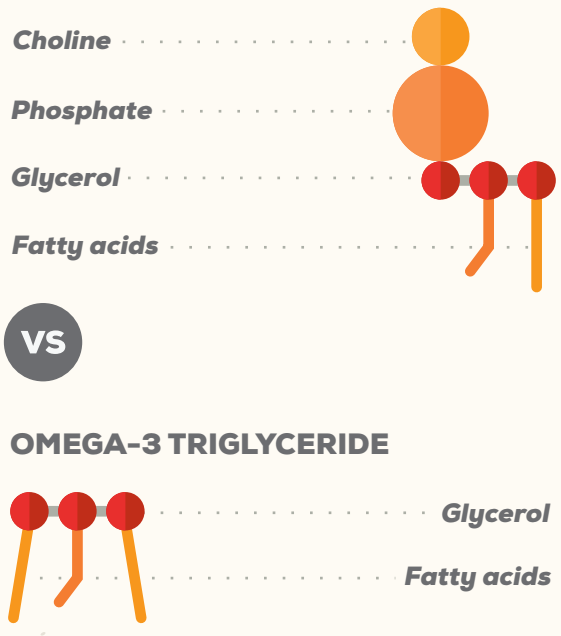
THE OMEGA-3 INDEX

is a diagnostic tool that is quickly becoming more popular with medical professionals and consumers. Beyond assessing cardiovascular health, the Omega-3 Index offers a window into a person's general state of health. This is because the presence of omega-3 fatty acids in red blood cells means they are therefore present in tissues in organs. The more Omega-3 fatty acids there are in someone's body, the less inflammation they will have and the healthier they will be. While most omega-3s will raise the Omega-3 Index, how quickly and efficiently that happens depends on the source.

Omega-3 fatty acids are among the most researched nutrients in the world *(GOED, 2012)*. The problem with omega-3s, like most nutrient categories, is that they offer benefits that cannot always be felt. But they can be measured, which is where the Omega-3 Index comes in.

Most human intervention studies on omega-3 fatty acid-associated health benefits have been performed on fatty acids esterified as triglycerides (TGs) obtained from fish or algae, while less studies are available on Omega-3s in phospholipid (PL) form[1]. The different structures distinguish themselves by either containing two (PLs) or three (TGs) fatty acids attached to a glycerol group. Moreover, PLs have a phosphorus group and a specific head group, such as choline. *See Fig. 1.*

Fig. 1. Molecular structure of omega-3 phospholipids and triglycerides



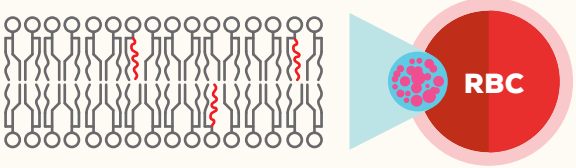
Omega-3 fatty acids enriched in PLs are found in krill oil extracted from the Antarctic crustacean *Euphausia Superba*[2]. In addition to omega-3 PLs, krill oil differentiates from fish oil by the presence of the antioxidant astaxanthin. This carotenoid gives krill oil its distinctive red color and is supposed to protect the fatty acids in krill from oxidation[3,4]. Several animal and human studies on krill oil have proposed more potent benefits for human health when the omega-3 fatty acids are linked to PLs instead of TGs[5-10]. In particular, two clinical studies have shown that Superba™ krill can increase total plasma EPA and DHA more than fish oil intake after both 4-week and 7-week long supplementation periods[8,10].

Taken together, these studies suggest that enhanced bio-efficiency of omega-3 fatty acids in the body is desirable. More specifically, increased levels of EPA and DHA in blood have been associated with decreased risk of sudden cardiac death and other harmful cardiac events[11].

Anatomy of the Omega-3 Index

The Omega-3 Index that has been proposed as a novel biomarker for cardiovascular risk is defined as the percentage of EPA and DHA in red blood cell (RBC) fatty acids[12]. *See Fig. 2.*

Fig. 2. Definition of the Omega-3 Index



There are 64 fatty acids in this model membrane, 3 of which are EPA and DHA

OMEGA-3 INDEX= 3/64 = 4.6%

The History of the Omega-3 Index

"The concept of the Omega-3 Index was born over a beer. Dr. Clemens von Schacky and I were taking a break during the 2002 American Heart Association Scientific Sessions in Chicago. We were discussing the new data from Christine Albert's lab at the Brigham and Women's Hospital showing that blood omega-3 levels were a strong risk predictor for sudden cardiac death, substantially confirming David Siscovick's 1995 observation. It occurred to us that blood -- more specifically red blood cells (RBC) -- omega-3 levels were not just a marker of fish intake, but a bona fide risk FACTOR, like cholesterol.

We agreed that an omega-3 test ought to be available for physicians to use in clinical practice to help manage heart disease risk for their patients. At that point, we mused about starting companies in Germany and the US to offer such a test. Over the next year we crystallized our thinking on the "omega-3 as a risk factor" idea and published a paper in Preventive Medicine in April 2004 describing the rationale for making the "Omega-3 Index" a new cardiac risk factor.

In the years that followed, Dr. von Schacky founded Omegametrix in Munich, Germany, and I founded OmegaQuant Analytics in the US, both of which offer the standardized "HS-Omega-3 Index" test (HS stands for Harris and Schacky). Dr. Yongsoon Park at Hongyang University in Seoul, Korea subsequently founded OmegaQuant Asia, the third lab in our informal network of laboratories offering the HS-Omega-3 Index test.

Since then, the concept has gathered traction and more and more researchers now report the Omega-3 Index (RBC EPA+DHA, as a % of total fatty acids) as a valid biomarker of overall omega-3 status. We ourselves (Harris, von Schacky and/or Park) have more than 150 papers using or discussing the HS-Omega-3 Index.

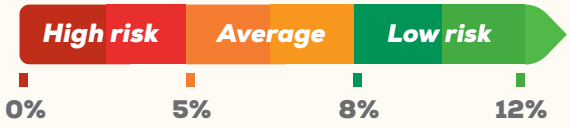
An important development occurred in 2011 when Health Diagnostic Laboratory, Inc. in Richmond, VA acquired the technology to analyze the HS-Omega-3 Index. This major clinical laboratory has now performed well over 1.5 million tests for physicians in the USA who are dedicated to the optimal management of their patients' risk for cardiovascular disease. Plans are afoot for a similar development in Europe. As the Omega-3 Index becomes more and more a part of routine clinical care, patients and their physicians can focus on bringing the index up to the optimal 8% target by increasing the intake of oily fish and/or taking omega-3 supplements.

Although the HS-Omega-3 Index was born in the cardiovascular arena, it will very likely someday have a role to play in the diagnosis and management of neurocognitive (e.g., depression, dementia) as well as in ocular disorders (e.g., dry eye, macular degeneration). This is just the beginning."

Dr. William Harris,
Founder, OmegaQuant Analytics, & Creator of the HS-Omega-3 Index Test

Steady-state, but also increased levels of the Omega-3 Index after supplementation have been shown to directly correlate with EPA and DHA levels in human cardiac tissue[13-15]. In contrast to plasma fatty acid measurements that reveal short-term omega-3 intake[16], the Omega-3 Index is believed to mirror overall tissue EPA and DHA levels and therefore a person's health status. An omega-3 index of 8% or above is considered optimal[17], while a low Omega-3 Index indicates a higher risk of sudden cardiac death. *See Fig. 3.*

Fig. 3. Target zones for the Omega-3 Index

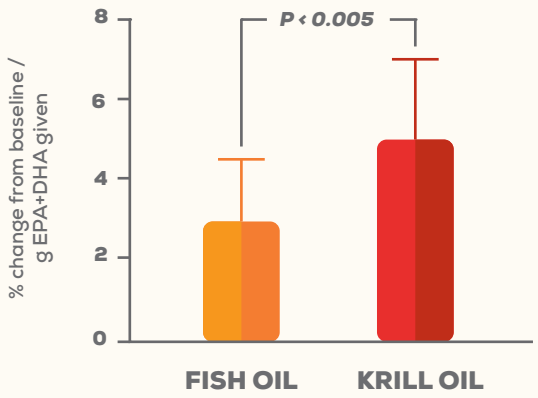


Krill Oil & the Omega-3 Index

Since increases in EPA and DHA levels are correlated with sudden cardiac death[18], researchers have recently turned their investigations toward krill oil to see if it can increase omega-3 RBC levels. In an unpublished clinical study, healthy volunteers took either 2 grams of Superba™ Krill for 8 weeks or 2 grams of an omega-3 enriched fish oil. The goal of the study was to compare the delivery of omega-3 fatty acids – PLs versus TGs – to see if the form influences the increase in Omega-3 Index.

The results of the study showed that krill oil increased the Omega-3 Index significantly more than fish oil after 8 weeks of supplementation. In fact, krill oil increased the Omega-3 Index about 70% more than fish oil at the end of study after dose adjustment between the two treatment groups. *See Fig. 4.*

Fig. 4. Subjects receiving krill oil increased their Omega-3 Index 70%



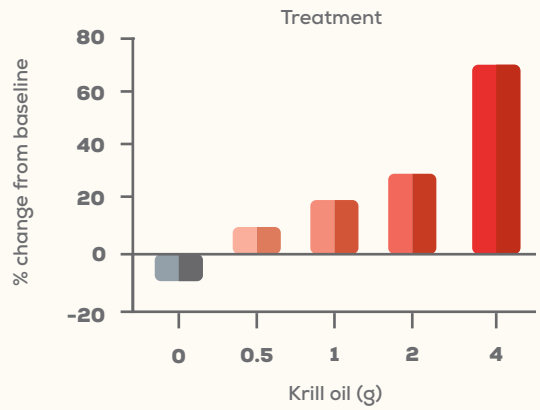
These results go hand in hand with a recently published study, which investigated the effect of 12 weeks daily Superba™ krill intake in volunteers with "borderline high" or "high" blood triglyceride levels. A total of 300 volunteers were divided into five groups and supplemented with krill oil at either 0.5, 1, 2 or 4 grams per day or placebo (olive oil). The subjects included in the study had blood triglyceride values between 150 and 499 mg/dL. Blood lipids were measured at baseline, 6 weeks and 12 weeks of treatment[19].

Relative to subjects in the placebo group, those administered krill oil had a statistically significant 10% reduction in serum triglycerides. Moreover, LDL cholesterol levels were not increased in the krill oil groups relative to the placebo group, which is an important finding because an increase in LDL cholesterol has been observed in some fish oil trials[19].

Additionally, the subjects taking 4 grams of krill oil per day raised their Omega-3 Index from 3.7% to 6.3%. *See Fig. 5.* Comparable increases in the Omega-3 Index have been linked to decreased risk for sudden cardiac death in previous studies – in a prospective cohort study by about 80%[11] and in a case control study by 90%[20].

Fig. 5. % increase in the Omega-3 Index from baseline after 12 weeks treatment with placebo (olive oil), 0.5, 1, 2 or 4 g krill oil.

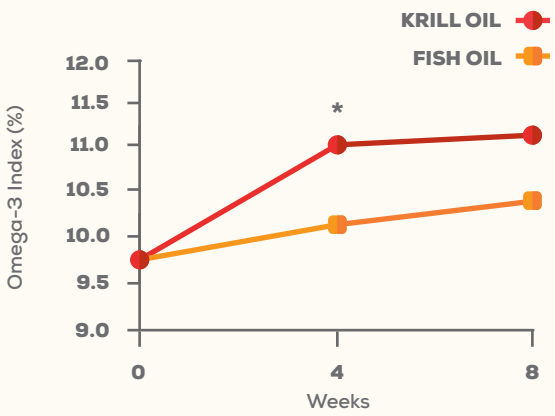
*Significantly different from placebo, P<0.05.



Another unpublished study found that even in heart disease patients with a very high starting Omega-3 Index (mean of 9.8%), Superba™ krill was able to increase the Omega-3 Index higher than those taking fish oil. Eight weeks of daily supplementation with 2 grams of Superba™ krill (delivering 0.651 g EPA+DHA) improved the Omega-3 Index more than with 2 grams fish oil (delivering 1.0 g EPA+DHA). This effect was significant after 4 weeks of treatment. *See Fig. 6.*

Fig. 6. Change in the Omega-3 Index in subjects with a very high Omega-3 Index. Subjects were given 2 g krill oil (n=22) or 2 g fish oil (n=18) for 8 weeks.

*Significantly different from fish oil, P<0.05.



Conclusion

The data presented in this paper summarize the advantages of krill oil when it comes to raising a person's Omega-3 Index. Most important, these studies show that krill oil more effectively raises the Omega-3 Index compared to fish oil, even though krill oil delivers lower amounts of EPA and DHA on a gram per gram basis compared to fish oil. Clear health benefits, in particular for heart health, have been shown by raising one's Omega-3 Index higher than 8%.

By turning to ingredients such as Superba™ krill, consumers have the ability to make up the difference between what their bodies need and what their diets provide in the way of omega-3 fatty acids. Superba™ krill provides these fatty acids mainly in the form of phospholipids, which are structurally different than omega-3 triglycerides found in marine and algal oils. Since every cell membrane is made up of phospholipids, omega-3 supplementation in phospholipid form helps facilitate their incorporation into the various tissues of the human body. Furthermore, only krill oil provides – in addition to omega-3 fatty acids – the essential nutrient choline, which is crucial for cell structure, function, and signalling, and like omega-3 fatty acids, contributes to cardiovascular, hepatic and cognitive health.

About the author:

Lena Burri, Ph.D., has been involved in fundamental research and is together with co-authors credited with several original protein discoveries. She has published scientific articles in leading journals, and contributed book chapters, review articles and peer-reviewed manuscripts on many subjects,

including omega-3 fatty acids. Lena earned her Master of Science from the University of Basel (Switzerland) and her Ph.D. at the Ludwig Institute for Cancer Research (Switzerland). Her post-doctoral education included stays at Melbourne University (Australia), University of British Columbia (Canada) and University of Bergen (Norway). She now works as a scientific writer specializing in omega-3 phospholipids.

About Aker Biomarine Antarctic

Aker BioMarine is an integrated biotechnology company dedicated to the sustainable harvest of krill and development of krill-derived biotech products. The company supplies biomarine ingredients through a completely transparent value chain. Aker BioMarine's Superba™ krill products are provided with 100% traceability from sea to shelf. Only Aker's krill fishery has been awarded Marine Stewardship Council (MSC) certification.

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Aker BioMarine Antarctic AS
Fjordallèen 16, 0115 Oslo, Norway
post@akerbiomarine.com
Phone: +47 24 13 00 00

USA Subsidiary:
Aker BioMarine Antarctic US, Inc.
info.us@akerbiomarine.com
Phone: +1 206 855 6736

Asia Contact:
info.asia@akerbiomarine.com
Phone: +1 206 660 6756

Australasia Subsidiary:
Aker BioMarine Antarctic Australasia Pty Ltd
info.anz@akerbiomarine.com
Phone: +61 3 9999 1112

China Subsidiary:
info.china@akerbiomarine.com
+86-21-6035-6300

India Subsidiary:
info.india@akerbiomarine.com
+91-2266915757

www.superbakrill.com