# Something smells fishy: is your fish oil oxidized?

*Australian and New Zealand Fish Oil Products in 2016 Meet Label Omega-3 Claims and Are Not Oxidized.*

# Introduction

In 2015, a research group published a study examining the quality of fish oil supplements sold in New Zealand. We reviewed this study way back in ERD #5's Fish Oil or Snake Oil. The results were startling. Out of 32 fish oil products tested, 90% tested below the stated label claims for omega-3 content and two-thirds contained less than 70% of listed omega-3 amounts. More concerning, over 50% were considered rancid according to their TOTOX values, a measure of oil oxidation.

Fish oil oxidation and inaccurate dosage labeling can be a big issue for consumers. If the amount of DHA+EPA in a fish oil supplement is considerably lower or higher than what the label claims, you could end up over- or underdosing. With regard to oxidation, there is little research in humans on the effects of consuming poor quality fish oil. This makes it hard to say if they are safe for consumption or what safe levels of consumption may be.

As could be expected from such a startling negative finding about one of the world's most beloved supplements, media outlets howled with headlines about consumers being misled about their purchases of fish oil supplements. However, the study was not without controversy. Several experts from authoritative groups on lipids and omega-3 fatty acids claimed that the 2015 paper had several flaws, such as not using an accredited laboratory or industry-standard testing protocols. In the study under review, some of these same researchers attempted to replicate the 2015 study with a new batch of fish oil supplements common to Australia and New Zealand.

**A 2015 study on fish oil quality on New Zealand fish oil supplements showed that most did not contain the amounts omega-3 claimed on the label and were heavily oxidized. Another research group claimed that the 2015 study used improper testing methodology. The study under review is an attempted replication of the 2015 study investigating label claims and rancidity of a new batch of fish oil products from Australia and New Zealand.**

# Who and what was studied?

The study authors purchased two bottles each of 10 fish oil supplements from a single warehouse outlet in Australia. Five of the supplements were standard triglyceride fish oils claimed to provide 300-450 milligrams of EPA+DHA per capsule. The other five supplements were fish oil concentrates that claimed to provide 600-1200 milligrams of EPA+DHA per capsule. All oils were tested within 10 days from purchase and the technicians performing the analyses were blinded. Samples were analyzed at a facility with a Good Manufacturing Practices (GMP) license from the Australian Therapeutic Goods Administration and Australian Pesticides and Veterinary Medicines Authority.

> "If the amount of DHA+EPA in a fish oil supplement is considerably lower or higher than what the label claims, you could end up over- or underdosing."

The primary outcomes of this study were the peroxide value (PV), anisidine value (pAV), and milligrams per gram of fatty acids (FA). The PV is a measure of primary oxidation products (peroxides) and AV is a measure of secondary oxidation (aldehydes and ketones). As fish oil oxidizes, peroxides are produced first. As oxidation continues, aldehydes and ketones will begin to show up. Testing for both of these helps determine how severely a fish oil is oxidized. The milligrams per gram fatty acid testing was to assess label claim accuracy.

**Ten fish oil supplements claimed to provide 300-1200 milligrams of omega-3 fatty acids per pill were analyzed for label accuracy and level of rancidity (via peroxide and anisidine values). Technicians were blinded as to what samples they were testing.**

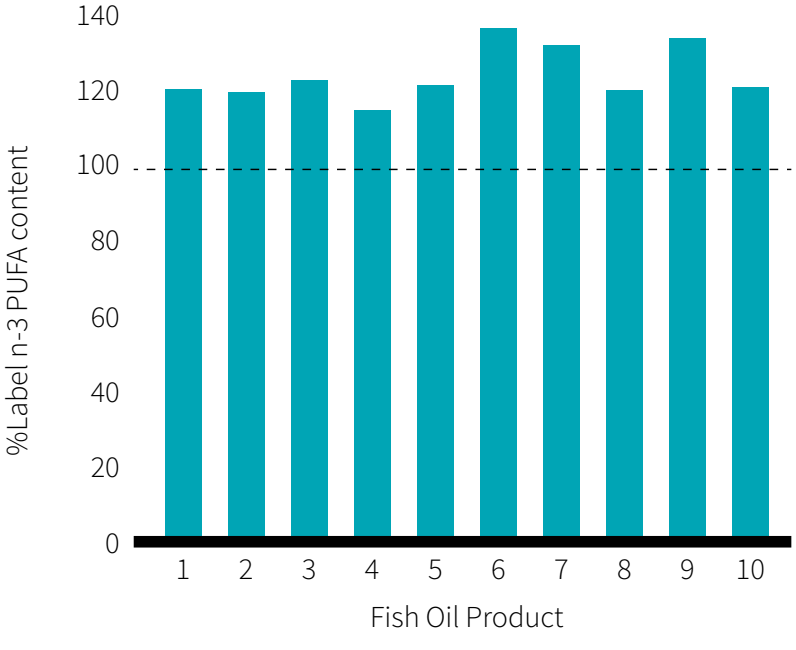
## What were the findings?

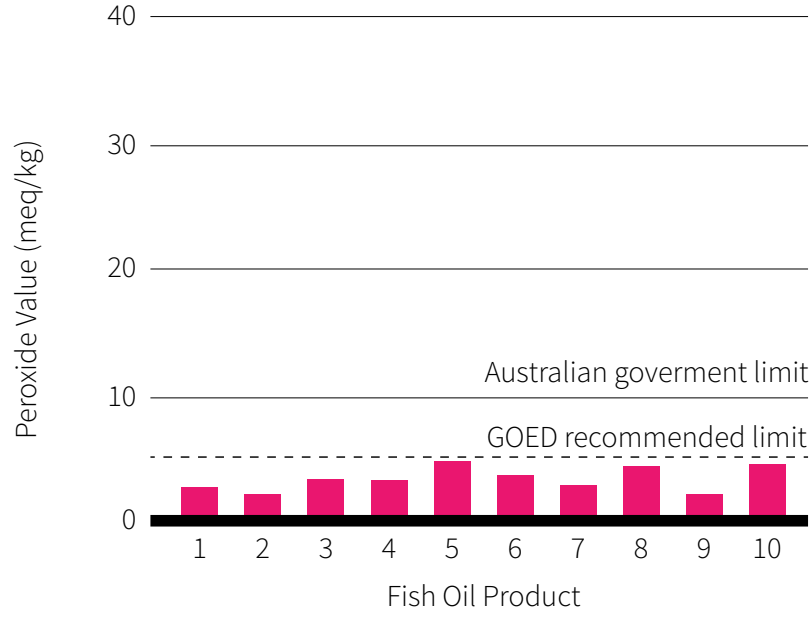
All 10 products tested exceeded the amount of omega-3s declared on their respective labels. On average, they contained 124% of the claimed total omega-3 content (ranging from 115% to 136%) and 109% of the claimed EPA+DHA content (ranging from 99% to 119%) as seen in Figure 1.

In terms of oxidation levels, all products were under the GOED (Global Organization for EPA and DHA omega-3s) PV limits (maximum of five meq/kg), and five of the 10 products were under the recommended pAV limits (20 pAV). The GOED limits are conservative, however. Using less stringent standards recommended by the Australian government and British Pharmacopoeia, all but two products fall under the pAV limit (30 pAV). The two products that still failed to meet this standard had extraordinary oxidation levels (pAV of 108 and 109), leading the authors to suggest that the supplements with added flavorings interfered with pAV assessment. This is because many of the flavorings are fruit-derived and contain aldehydes. Since the pAV is a measure of aldehyde concentrations, the flavorings can be a confounding factor. In one study, addition of a lemon flavoring increased the pAV value over 12-fold.

**All products exceeded the amounts of omega-3s claimed on the label and were under the recommended PV limits. Eight of the products were under the pAV and the two that exceeded recommended limits were probably false positives due to confounding attributable to added flavorings.**

Figure 1: Fish oil content and peroxide value results



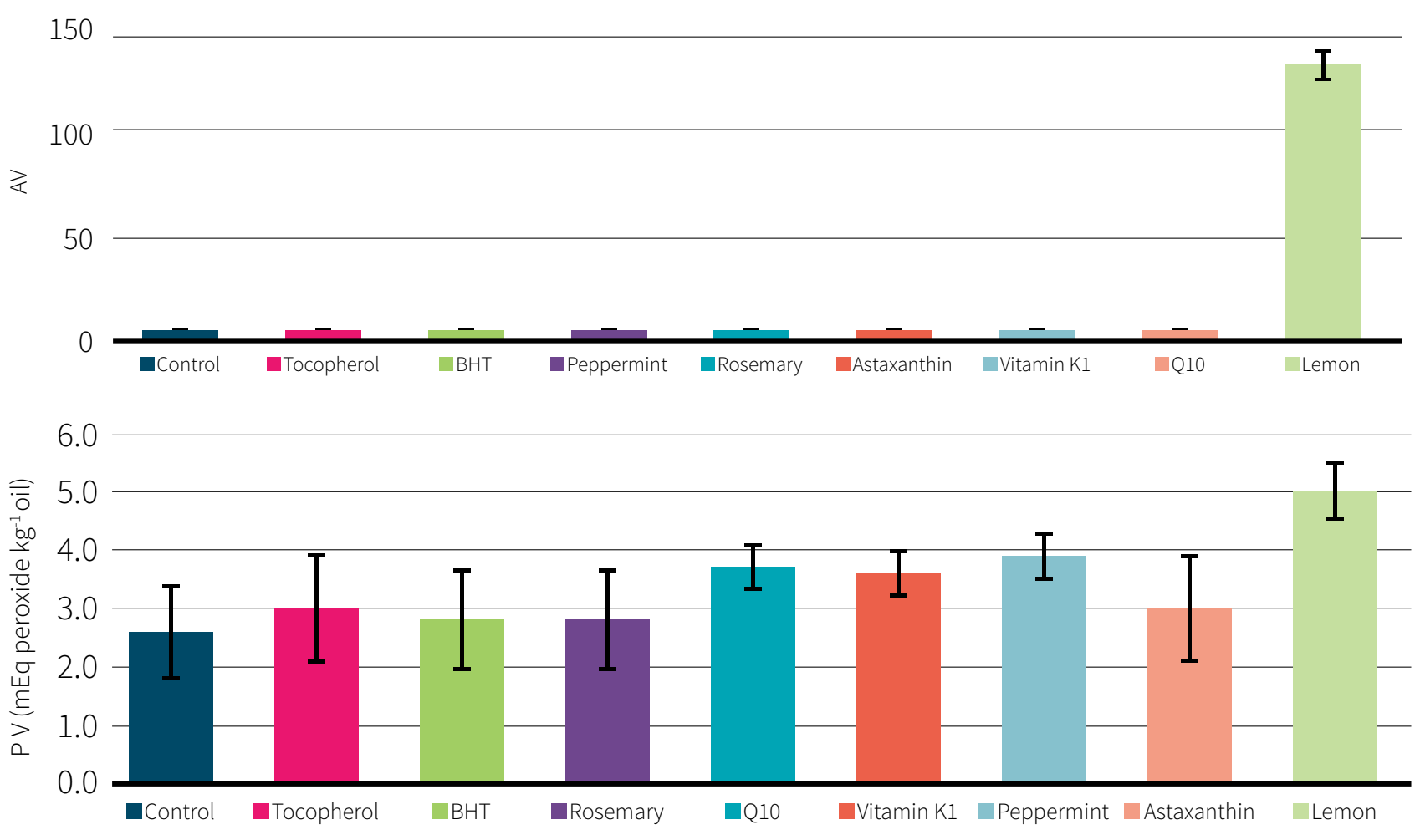
# What does the study really tell us?

In contrast to the 2015 Albert *et al.* paper, this study reported on a wide range of fish oil brands in the Australia and New Zealand markets. It found that the products tested met omega-3 label content claims and were not heavily oxidized. The stark discrepancy in these may come down to differences in testing methods. As noted by the study under review and other publications, the Albert *et al.* trial may have used standards not accepted by the Therapeutic Goods Administration or other industry-accepted methods.

However, Albet *et al.* had their own concerns with the study under review. Notably, they criticized the small sample size used, citing unpublished data, and how some of the authors did not declare any conflicts of interest even though many were associated with the Omega-3 Centre. Nichols *et al.* replied, saying that their sample size reflected "over 80% of the Australian market". They also stated that some of the previously cited unpublished data has now been peer-reviewed and published, and that while some authors are affiliated with the Omega-3 Centre, it is a "not for profit organization...with an unpaid board and scientific advisors" (although it should be noted that the Omega-3 Centre funded the present study by Nichols *et al*). The authors also went back and forth on what the appropriate testing methodology for fish oils are - the full details are in their respective comments here and here.

It's possible that added flavors may have confounded the 2015 Albert *et al.* results. As seen in Figure 2, certain flavorings can affect measures of PV and pAV values. However, the researchers made no mention

Figure 2: Influence of antioxidants and additives on PV and pAV measures




While many common additives, antioxidants, or flavorings used in fish oil supplements do not significantly affect the pAV values (with the exception of lemon), there was greater variability for the PV measures.

Source: Analytical Methods for Determination of the Oxidative Status in Oils, TN Semb 2012

of which brands were tested and if they contained flavorings that may not have been controlled for. The flavorings may have artificially increased the PV or pAV values in the Albert *et al.* results, making the oils seem more oxidized than they actually were. But we cannot know for sure as these details were not provided.

The Albert *et al*. paper also reported a TOTOX value, which is calculated using the formula: pAV + 2PV. The lower the TOTOX value, the better the oil quality will be. The GOED recommends no more than a TOTOX of 26. While Albert *et al*. reported over 50% of products tested exceeded the TOTOX value of 26, the GOED states that reporting TOTOX as a measure of oxidation is "not valid for any oils containing other ingredients or that have strong colors, including flavored oils, krill oils and virgin salmon oils." Albert *et al*. did not report if they controlled for these in their findings.

**This study conflicts with the 2015 Albert *et al*. paper, which concluded that many of the New Zealand fish oils were of poor quality. The authors of the present paper contest that this is due to the use of non-standard testing procedures by Albert *et al*. However, Albert *et al*. contest that their testing methods were well-accepted as valid in the literature. Another possibility for the large difference in results is that Albert *et al*. did not control for artificial flavorings, which can confound the oxidation testing (although this cannot be known for sure as flavoring information was not provided).**

## The big picture

It is difficult to determine the quality of fish oils on a global scale. Differing manufacturing standards, oil sourcing, and government regulations can all affect fish oil omega-3 content and oxidation levels. Luckily, in the case of New Zealand and Australia, there have been a handful of other studies that shed light on the overall body of evidence at this regional level.

In 2014, the Australian Commonwealth Scientific and Industrial Research Organization collaborated on a study examining the content of EPA+DHA in a batch of Australian products. Of the nine fish oil products analyzed, six matched or exceeded label claims, two fell slightly below, and one fell significantly below. The samples also fell well below tolerable daily intake levels for any persistent organic pollutants.

In response to the results seen in Albert *et al*., the GOED set up a program to conduct randomized testing of omega-3 supplements found in the New Zealand market. In all, 47 products were analyzed for EPA+DHA and oxidation. When using the Australian authority's standards, all oils were under the pAV limit of 30 and 98% were under the PV limit of 10 meq/kg. 91% reported accurate EPA+DHA content claims. Similar results were shown in the study by Killeen *et al*., where the 11 samples tested showed an EPA+DHA content claim accuracy of 91% or higher. While Albert *et al*. did not report which brands they tested, it is very likely that the GOED study significantly overlapped their sample. However, there is no way to know for sure.

Even though there is evidence conflicting with the results of Albert *et al*., the paper did raise some important points. The limits for fish oil oxidation are mostly based on ensuring the label claims match the bottles content. But more research needs to be done to look at setting oxidation limits based on the safety of consuming oxidized oils. Few studies are available examining effects of oxidized fish oils on health, although the studies in animal models indicate deleterious outcomes.

Another angle to consider is this: when we see conflicting data about fish oil quality, how do we know it isn't simply a result of the quality of the supplement used in the study? Depending on where the fish oil is being sourced from, there can be seasonal variations in amounts of EPA+DHA. Additionally, manufacturing practices can change over time, so a brand tested today

might be a fundamentally different product when compared to that same brand a few years back. Research on fish oil oxidation and label claims may be a reasonable estimate of quality for certain brands or of the region where the supplements were sourced from. But extrapolating these results to how a brand/region may perform in the future is dicey at best. It would take continual monitoring of fish oil quality to make broader claims.

**A handful of studies tested the fish oil quality of brands local to New Zealand and Australia. Their results indicated a low level of oxidation and that label content claims of DHA+EPA were generally accurate. These results represent a vast majority of the products available in this region. However, these results should not be extrapolated beyond the regions, brands, and times tested.**

# Frequently asked questions

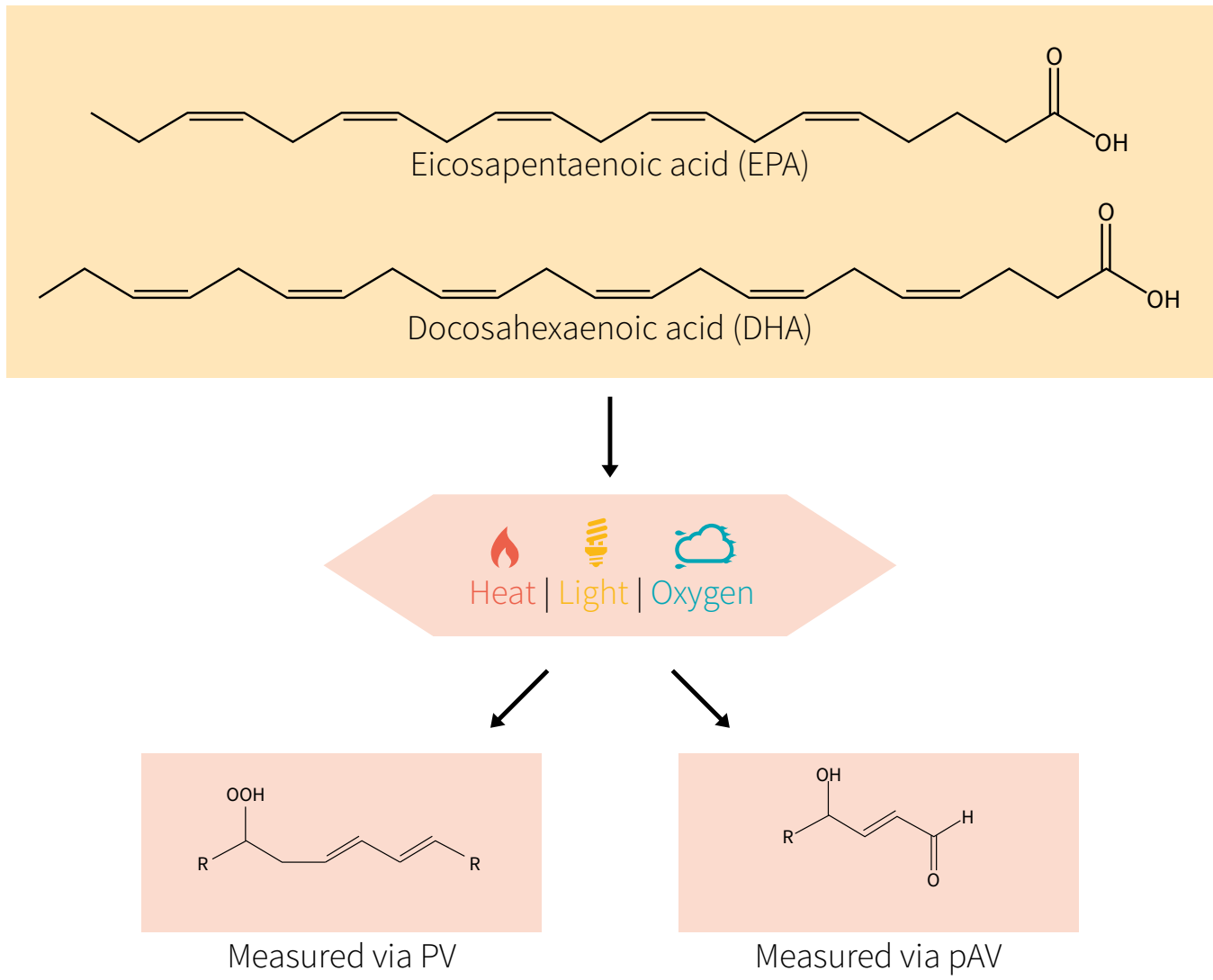
***What can I do to help prevent my fish oils from oxidizing?***

Since fish oil is primarily polyunsaturated fat, it is prone to becoming rancid and oxidizing. Oxidation largely depends on exposure to heat, light, and oxygen as shown in Figure 3.

The addition of antioxidants to the final product can reduce the rate of oxidation during storage. Vitamin E is typically used, but there's a lot of research on other antioxidants like carnosic acid suggesting they might be superior. It's easy enough to do a quick search of antioxidants in your favorite fish oil to see how it performs, or if there is any research supporting its use. Otherwise, vitamin E is a safe bet.

Part of the responsibility for ensuring fish oil remains unoxidized is on the buyer. Exposure of fish oil to light,

Figure 3: Fish oil oxidation




Adapted from: Killeen DP et al., J Agric Food Chem. 2017 May 3

heat, and oxygen accelerates the oxidation of the oil, with the magnitude of damage depending on the length and degree of exposure. Once you buy the supplement, it is prudent to store it in a cool place away from light, such as the fridge. If you buy oil in a bottle, the bottle should be tinted to prevent light from getting through and small enough that you can work through it in a month or two. After all, oxygen gets in the bottle every time you open it. Some fish oil bottles come with a pump, which can help reduce oxygen exposure. Buying capsules instead of bottles can also help prevent oxidation.

How do I go about selecting a high-quality fish oil? One strategy to help ensure you are buying a quality fish oil supplement is to buy those that have been independently tested by third party companies such as NSF, USP, Informed-Choice, and Consumer Lab. There is even a fish-oil specific independent testing certification provided via the International Fish Oil Standards program (IFOS). These companies can independently test things like purity, label accuracy, and bioavailability of the product. Good manufacturing practices are also commonly taken into account. Random testing is often a requirement for the products to remain certified. However, these certifications to do not ensure that the health claims made by manufacturers are evidence-based.

## What should I know?

This study, along with a handful of others, indicate the fish oils available in the New Zealand and Australian markets are, at present, not heavily oxidized and that the actual content of DHA+EPA closely matches or exceeds the label claims. These results should not be extrapolated to other regions, as manufacturing processes and oil sourcing can greatly vary, nor can they be wholly predictive of supplemental fish oil quality in the future. This study also highlights the need for standardized testing procedures between labs so that results can be more easily compared. ◆

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Can you trust the content claims made on your supplement bottles? Head on over to the ERD Facebook forum for more discussion on fish oil quality.