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Microalgae as a clean source of long-chain omega-3 fatty acid for pet food

By Geert van der Velden, Innovation Manager at IQI Trusted Petfood Ingredients

Microalgae are microscopic organisms that present unique opportunities as a functional ingredient in pet food applications. The most important property of certain species of microalgae is their high content of essential long-chain omega-3 fatty acid, which has benefits for the health and well-being of humans as well as cats and dogs. In particular, microalgae grown under controlled conditions through heterotrophic fermentation offer a fully traceable, sustainable, clean and high-quality source of DHA long-chain omega-3 fatty acid – with a higher concentration of these omega3s and lower levels of heavy metals and other contaminants compared to salmon oil or fish oil.

WHAT ARE MICROALGAE

Microalgae are unicellular organisms typically found in freshwater and marine ecosystems. Depending on the species, the size of these microscopic algae ranges from a few micrometers to a few hundred micrometers. Unlike macroalgae (seaweeds) or other kinds of plants, microalgae do not have roots, stems or leaves. The biodiversity of microalgae is enormous. So far, approximately 50,000 out of an estimated 200,000-800,000 existing species have been identified by scientists.

Most microalgae species produce unique products and compounds, such as carotenoids, antioxidants, omega-3 fatty acids, enzymes, polymers, peptides and sterols. Together with bacteria, microalgae form the base of the food web and are nature's original 'super food'. Different kinds of fish, for example, accumulate their omega-3 reserves by consuming microalgae. While fish oil is typically used in both human and pet food for its high omega-3 content, fish are not the original, natural source of omega-3 but an accumulation of omega-3s consumed in the form of microalgae. Besides accumulating omega-3, fish also accumulate contaminants such as PCBs, dioxins and heavy metals, which end up in the fish oil. Compared with fish oil, microalgae are a direct, cleaner and more sustainable source of essential omega-3 fatty acids.

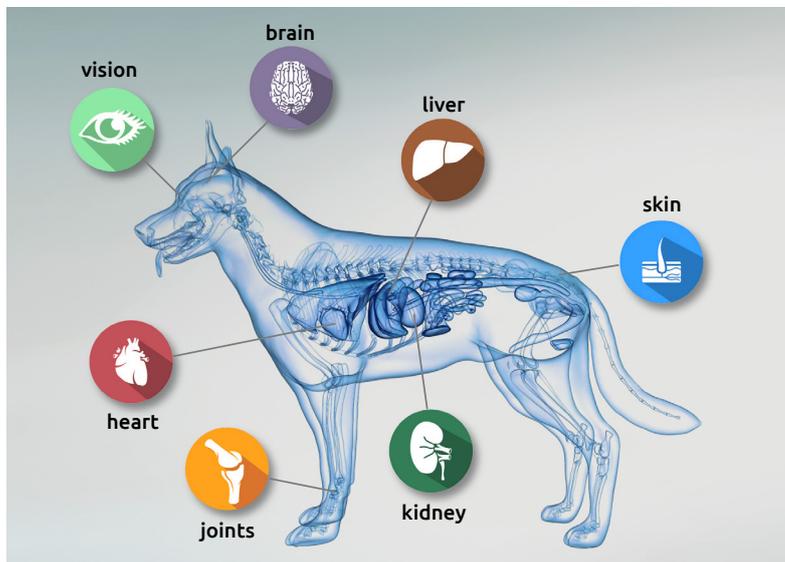
DIFFERENT KINDS OF OMEGA-3

Omega-3s or n-3s are fatty acids with an essential role in the physiological processes of humans and other mammals, such as cats and dogs. They are characterized by a double bond on the n-3 position of the fatty acid and are a main component of fats used by the body for energy, tissue growth and other functions. Omega-3 has many biological functions in the heart, blood vessels, lungs, immune system, nervous system (including the brain and eyes) and endocrine system. Omega-3s are essential for the proper structure and functioning of every cell in the body and offer a number of additional health benefits.

Omega-3s are classified into short-chain and longer-chain fatty acids, of which the latter are less saturated and therefore present the biggest health benefits. The main type of short-chain fatty acid is alpha-linolenic (ALA), which is found mainly in plant oils, such as flax oil, linseed, soya oil and

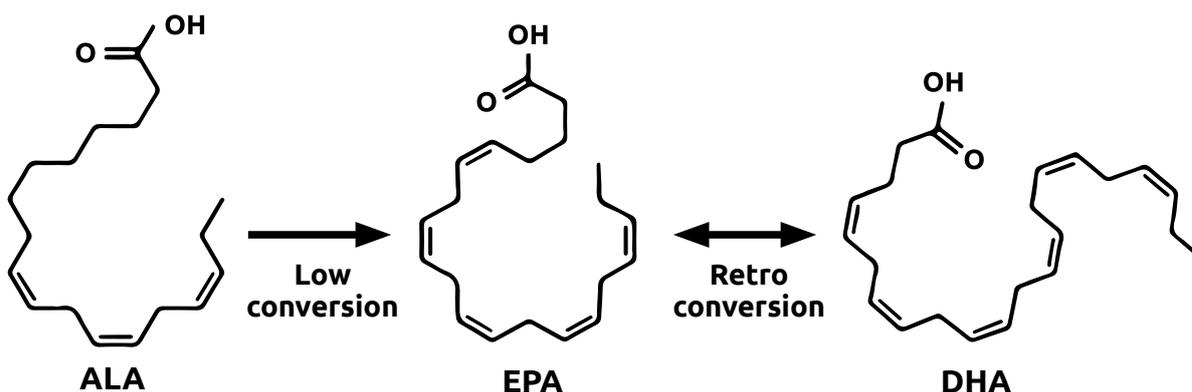
canola oils. The main types of long-chain fatty acids are docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), which are mostly found in algae and marine oils. The long-chain fatty acids most involved in the physiological processes of mammals are DHA and EPA and these offer the most significant health benefits compared to ALA.

To be beneficial as a source of omega-3, ALA needs to be converted by the body into the beneficial long-chain fatty acids DHA and EPA, but this only happens in small amounts as the conversion process is not very efficient. The conversion rate from ALA into EPA ranges from 0.2 to 10% and just 0 to 1% from ALA into DHA. This means that the majority of ALA is not converted and



utilized, but simply used or stored as energy, similar to other fats. The most efficient and beneficial method to ensure sufficient inclusion levels of beneficial long-chain fatty acids in the diets of dogs and cats is by supplying them directly via pet food. Including DHA by adding microalgae that are particularly rich in DHA also covers EPA supply needs, because the DHA can be retro converted by the animal into EPA at a rate of approximately 25% (see figure 1).

Figure 1: Conversion from ALA into EPA and DHA and retro conversion from DHA into EPA.



HEALTH BENEFITS OF LONG-CHAIN OMEGA-3 FATTY ACIDS

The EPA and DHA long-chain omega-3 fatty acids offer a number of specific benefits to the health and well-being of cats and dogs. These include increasing the absorption of vitamins and minerals, stimulating hormone production, ensuring the healthy growth and development of puppies and kittens, and helping to manage inflammatory problems in the prevention and treatment of diseases. In reproduction, DHA increases the potential for conception and reduces the risk of

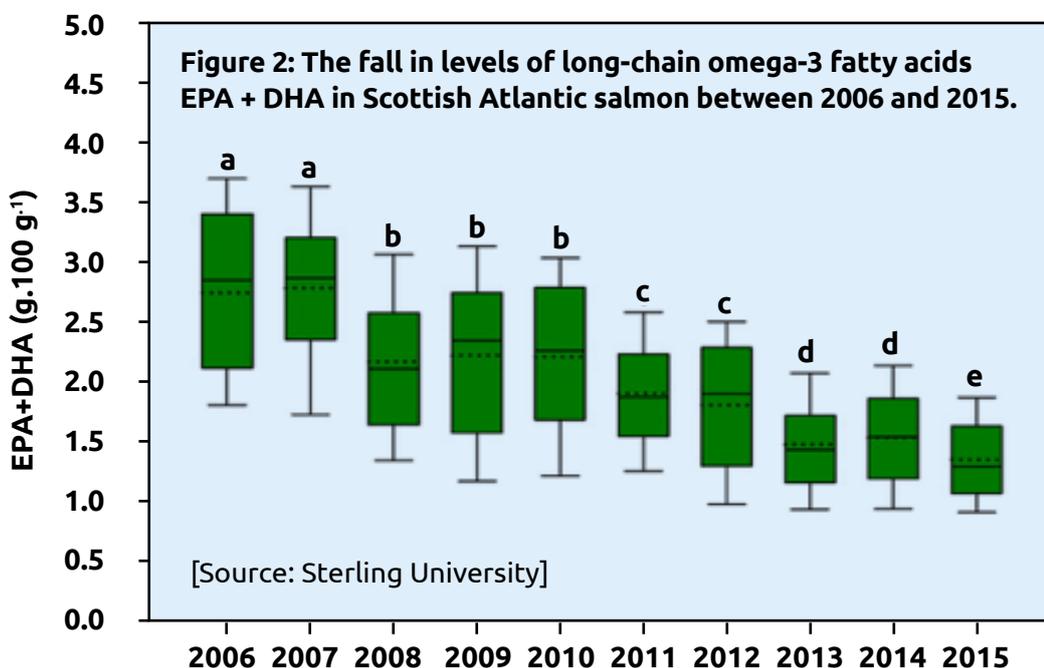
miscarriage. Furthermore, the intake of long-chain omega-3 fatty acids is reported to support healthy joints, skin/coat, heart, eyes and brain function.

The kinds of ingredients used in pet food are critical to a pet's ability to obtain sufficient amounts of long-chain omega-3 fatty acids to achieve these health benefits. Traditionally, pet food manufacturers have added different sources of omega-3 to the pet food formula, including vegetable oils, salmon oil and fish oil. All of these, however, have quality, sourcing and/or consistency challenges.

OMEGA-3/OMEGA-6 RATIO

Quality is a particular issue with vegetable oils, such as flax or rapeseed/canola oil, which are rich in the short-chain omega-3 fatty acid ALA. As previously mentioned, this needs to be converted by the animal into the long-chain omega-3s DHA and EPA, which happens at a very inefficient rate. Furthermore, vegetable oils are high in omega-6 which leads to an imbalance of omega-6 and omega-3 in pet food. High amounts of omega-6 can cause inflammatory health problems. This is an even bigger issue when vegetable oils are combined with commonly used poultry ingredients, which add even more omega-6 to the pet food mix and further increase the imbalance between omega-3 and omega-6.

As opposed to vegetable oils, salmon oil and fish oil have traditionally been considered to be rich in the long-chain omega-3 fatty acids EPA and DHA. However, the concentration of EPA and DHA in salmon oil has changed over the years as fishmeal has been replaced as the primary source of protein in the salmon feed (source of salmon oil) by soya-based proteins and other animal proteins (see figure 2). As a result, the level of long-chain omega-3 fatty acids in farmed salmon oil has fallen to an average of 7% - approximately four times less than the percentage of DHA in algae.



Unlike salmon oil, fish oil is produced from different species of fish. Wild anchovies and sardines have the highest concentration of omega-3 fatty acids, averaging 18% EPA and 12% DHA, but this varies during the year. Furthermore, their availability depends on the season and geographical location, causing strong fluctuations in price. The supply of fish oil is already exceeded by global demand and this gap is expected to increase drastically over the coming years due to fishing quota limitations and growing demand for its use in aquaculture feed, which has a CAGR of 4%.

With fish stocks under pressure and global demand for omega-3s increasing, the pet food industry would benefit from a sustainable, consistent and high-quality source of long-chain omega-3 fatty acids to ensure a healthy balance between omega-3 and omega-6. In this respect, microalgae offer a fully traceable, sustainable, and high-quality alternative to marine-based omega-3s with a consistently high level of DHA long-chain fatty acid.

PRODUCTION OF DHA FROM MICROALGAE

Microalgae can be cultured under different conditions and using different methods, including a phototrophic or heterotrophic culture strategy. Using a phototrophic strategy, the microalgae need water, nutrients, air and light to convert the absorbed water and CO₂ into biomass through photosynthesis. This can be done in open ponds or in a closed photo-bioreactor. However, phototrophic methods are limited in their production scale and economic viability due to the complex light supply system required. The most viable, sustainable and economically interesting production method is to grow microalgae under controlled conditions through heterotrophic fermentation in closed reactors.

Culturing microalgae in closed reactors through heterotrophic fermentation offers the advantage of full control over the physical, chemical and biological environment of the culture and its temperature gradients, and protection from outside contaminants. Sugar is used as a nutrient for the microalgae instead of CO₂ and light. The sugar originates from sugarcane and the sugarcane waste (straw or bagasse) is used as a renewable fuel to power the fermentation facility and the sugarmill that extracts the sugar from the sugar cane. In the fermentation tank, microalgae of the strain *Schizochytrium* sp. convert renewable, sustainable plant sugars into algal biomass in a matter of days. The resulting culture is then dried and either packaged as a powdered product or processed with a rapeseed oil to create a liquid product that offers the manufacturer versatility and choice.

This method enables large production volumes of DHA at an economic scale and offers a consistent supply of DHA at a consistent quality, independent of geography, seasonality or changing climate conditions, to keep up with industry demand. It has a low carbon, water and land use impact compared to other omega-3 sources and helps to prevent the depletion of small fish species as the global demand for omega-3s increases.

ALGAE DHA SOLUTIONS FROM IQI TRUSTED PETFOOD INGREDIENTS

Together with its partner Corbion, IQI Trusted Petfood Ingredients supplies traceable, sustainable, high-quality algae DHA products (AlgaPrime™ DHA) to the pet food industry. AlgaPrime™ DHA is based on the algae strain *Schizochytrium* sp., which converts renewable and sustainable plant sugars in closed fermentation tanks into biomass that is rich in the omega-3 fatty acid DHA. The plant sugars used in the process come from sustainable sugar cane production in Brazil within a 30-50 km radius of the manufacturing plant, located 2,500 km from the Amazon and rainforest. Analysis of satellite images over a period of 20 years has shown zero deforestation related to this production method. Due to the large production volumes and controlled manufacturing process at Corbion, IQI guarantees a steady supply with a consistent omega-3 content.

IQI's [AlgaPrime™ DHA](#) liquid suspension (LS) and [AlgaPrime™ DHA](#) P3 (the biomass powder version) both have an exceptionally high minimum DHA content of 33,5% and 35% respectively. Thanks to their high thermostability and the total absence of contaminants typically found in fish oils, such as PCBs and dioxins, their application provides the flexibility pet food brands need to increase DHA levels in their formulations and provide higher-quality, healthier options for pets. For more information on AlgaPrime™ DHA and the finest ingredients for the pet food industry, please visit our [website](#) or contact us directly.



Want to know more?

[Corbion supplier of microalgae omega-3](#)

[Global Organization for EPA and DHA omega-3](#)

[A 2022 Systematic Review and Meta-Analysis of Enriched Therapeutic Diets and Nutraceuticals in Canine and Feline Osteoarthritis](#)

ABOUT IQI TRUSTED PETFOOD INGREDIENTS

IQI Trusted Petfood Ingredients is a global provider of premium-claim ingredients to the top brands in the pet food industry. Founded in 1994 as a trading company in raw pet food materials, today IQI offers an extensive variety of services to aid and assist our customers and suppliers worldwide. IQI Trusted Petfood Ingredients employs highly skilled personnel, owns and operates a global network of logistical hubs, and relies on a global supply network to obtain the purest natural resources available.

For IQI, quality is key. IQI Trusted Petfood Ingredients goes to great lengths to ensure the quality of its products and develop innovative new products. IQI also invests a great deal in maximizing the quality of its partnerships. Since this business is all about trust, IQI needs to bond with its partners to succeed. By working closely with both its customers and suppliers, IQI creates full transparency in the supply chain. IQI oversees and controls every step in the process from source to shelf and supplies products that are pure and traceable to their source.



ABOUT GEERT VAN DER VELDEN

Geert van der Velden is IQI Trusted Petfood Ingredients' Innovation Manager responsible for Business Development, generating new products and concepts that meet the needs of existing and new customers. Geert has more than 25 years' experience in the international pet food industry and has gained knowledge and experience in many sections of IQI's business.

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