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Squalene – antioxidant of the future?

Sourced primarily from the liver of the deep-sea shark, squalene has been referred to as the 'antioxidant of the future'.[1] Heidi du Preez discusses this unique molecule.

Squalene is an isoprenoid hydrocarbon with six isoprene units. It is produced in our bodies and also found in nature. Many antioxidants are either isoprenoids or have an isoprenoid tail. Vitamin E, vitamin A, beta-carotene and flavonoids are all isoprenoids. Isoprenoids are found abundantly in nature, but biologists are mainly interested in studying the few, including squalene and lycopene, that have extraordinary antioxidant properties.

Since squalene is a pure isoprenoid, containing only isoprene units, it has an effective and stable antioxidant configuration. Squalene is considered by many to be the most powerful and stable of the isoprenoids.[2]

In its purified form squalene is a colourless, almost tasteless, transparent liquid without a significant odour. It is the major hydrocarbon in fish oils. Since squalene is a polyunsaturated 'lipid', derived from fish oil, it should not be confused with being an essential fatty acid.

SOURCES

The best source of squalene is the liver of the deep-sea shark. The dogfish shark produces the highest yield of good-quality squalene.[3] The dogfish is a deep-dwelling shark – some swim at depths exceeding 3 000 m. It is believed that sharks can survive this harsh environment because of their gigantic liver which makes up approximately 70% of a shark's internal organs. This oversized liver contains between 50% and 70% squalene. Squalene is a source of

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energy for the sharks and allows them to live at these depths and thrive in an environment that is harsh and oxygen-poor.

The dogfish is very abundant, and is the most common shark species in the world. While the dogfish is related to the shark family, it is not on the endangered species list because of its huge numbers.[3] Living at such depths, the dogfish cannot be caught with nets. Instead, it has to be 'target' fished with lines. The use of specific, regulated fishing methods allows for efficient harvesting of the abundant dogfish without harming the valuable resources of the sea. Ethical harvesting will ensure its availability for generations to come. The whole fish is used and processed. The flesh is used for human consumption and the skin is used for tool pouches – There is no waste.

Vegetable sources of squalene are olive oil and amaranth. Many ancient Mediterranean cultures believed that olive oil increases strength and longevity, and indeed the olive tree is a rich source of squalene. Extra-virgin olive oil however only contains about 200 - 450 mg squalene per 100 g oil.[4]

HISTORY

Squalene was first found in the human body in the 1950s, when the cholesterol metabolism was first identified. Squalene is one of the intermediate steps in cholesterol metabolism. More recently, squalene was found to be abundant in the skin, the membranous lining of the gastro-intestinal and respiratory tracts, and in adipose tissue (fat).

Research avenues opened in 1963, when an article in the scientific journal *Nature* demonstrated that squalene stimulates macrophages – the principal immune cells in the inner and outer protective coat of our bodies.[7] In 1982 squalene's detoxifying function was demonstrated in several research experiments[8] and in 1993 its radio-protective effects were revealed.[9] These discoveries set the stage for the medicinal use of squalene. In 1995 a Japanese research team clearly demonstrated that squalene can prevent UV-induced oxidation of lipids in skin,[10] a key finding that finally placed squalene in the scientific spotlight.

In 1996 a human clinical trial of squalene was performed to examine its effectiveness in lowering blood cholesterol.[11] As a result of these and subsequent research studies, dietary squalene has been found to:

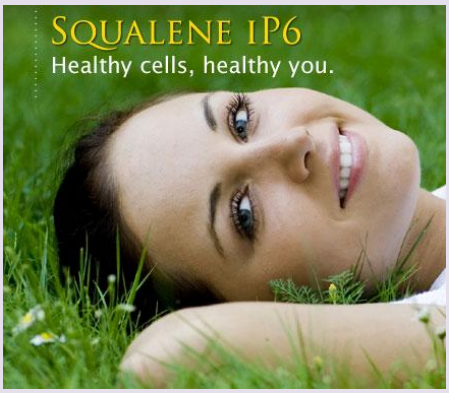
- Exhibit superior antioxidant properties.[2]
- Increase the efficiency of the immune system.[2,7,12]
- Inhibit cancer growth.[13]
- Enhance the anti-tumour action of chemotherapeutic agents.[14]
- Lower blood cholesterol – a fall in LDL levels accompanied by a rise in HDL concentration is particularly remarkable.[11]

SUPERIOR ANTIOXIDANT

Oxygen is the great forgotten nutrient. Lack of it has been pinpointed as a cause of, or contributing factor in, nearly all degenerative diseases. Squalene is the closest thing we have to an oxygen supplement.[15] It facilitates oxygen delivery throughout the body.[3]

Another threat to our cells that is causing disease states such as cancer, atherosclerosis, arthritis, diabetes, dermatological system disorders, cataracts and other age-related diseases is free radicals. They are unstable molecules with unpaired electrons. Free radicals are produced constantly within- and outside the cell, some as by-products of energy-releasing oxidation in the mitochondria, others by UV light, radioactivity and the metabolism of drugs and chemicals. Inhalation of cigarette smoke and exposure to air pollution is also accompanied by an increased production of free radicals.[4]

Each cell possesses its own defence mechanism – the antioxidant defence system – that maintains a dynamic internal balance between free radicals and antioxidant nutrients. Antioxidants neutralise free radicals. Increased generation of free radicals can lead to oxidative stress, producing imbalance and resulting in oxidative damage, cell death, tissue damage and disease. However, there is also growing evidence that having too many antioxidants is just as harmful as not having enough. In fact, our body as a whole must maintain a proper balance between oxidants and antioxidants. Our focus should therefore not be to take as many antioxidants as possible but to help the system maintain its oxidant-antioxidant balance. It alone knows its precise needs, and therefore endogenous antioxidants (those synthesised in the cells) will play a greater role in oxidant-antioxidant balance than exogenous (dietary) ones. Cell and tissue damage caused by oxidant-antioxidant imbalance is referred to as oxidative damage. The first step in this damage process is the lipid peroxidation chain reaction, which breaks down cell membranes.[2]



Squalene is an excellent antioxidant because of its great capacity to receive or donate electrons without suffering molecular disruption. Squalene's very low ionisation threshold accounts for its very large capacity to donate electrons, like vitamin E. This unique stability is the key to squalene's ability to terminate a lipid peroxidation chain reaction. According to laboratory research, this happens specifically in the skin's surface.[10] It is reasonable to assume that it performs a similar function wherever it is found, for example within individual cells and in the biomembrane.[2]

It is commonly believed that vitamin E is the principal antioxidant of lipid peroxidation chain reactions in the biomembrane, but this may not be the case after all. The comparison in Table I proves that the usefulness of vitamin E as the primary antioxidant in the biomembrane may be exaggerated, and the role played by squalene may be more significant.

Table I. Comparison of vitamin E and squalene[2]

Vitamin E	Squalene
A mixed isoprenoid of three isoprene units with very good antioxidant capacity	A pure isoprenoid of six isoprene units with very good antioxidant capacity
Exogenous (dependent on dietary sources) and not necessarily available when needed	Endogenous (manufactured on demand) and readily available under normal circumstances
Cannot be synthesised in the body – available only in certain foods	Manufactured within the cell from readily available glucose
Limited integration into the biomembrane, where it becomes embedded in the lipid bilayers	Strongly attached to the hydrophobic band between the two lipid layers of the biomembrane, where risk of lipid peroxidation is greatest
Is fixed in the lipid layer and cannot move freely	Can move freely throughout the biomembrane
Too many vitamin E molecules alter the biomembrane's physiological properties and structural configuration	Large quantities do not alter the physiological properties of the biomembrane
Requires recycling by endogenous antioxidants such as glutathione and squalene	Does not require recycling
Is itself susceptible to free radical attacks	Relatively resistant to free radical attacks
The usefulness of vitamin E as the sole terminator in the biomembrane is limited	The role played by squalene as a terminator in the biomembrane is significant

IMMUNE RESPONSE

Experimental studies have shown that squalene-supplemented diets lead to increased performance of the immune system. Laboratory studies have confirmed that squalene enhances the function of macrophages.[7,12,16] Evidence suggests that the immune cell's biomembrane is protected against oxidative stress by squalene during phagocytosis.[2] Squalene exhibits anti-viral, anti-fungal and anti-bacterial properties.[3]

CANCER TREATMENT AND PREVENTION

Various epidemiological and laboratory data suggest that squalene may help prevent cancer and can also fight established tumours. Because it combats cancer at the earliest stages, squalene's preventive and therapeutic possibilities are extremely promising. Squalene's powerful antioxidant and cytoprotective effects are very significant. A research team from Toronto's Hospital for Sick Children demonstrated that squalene has selective cytoprotection in *in vitro* and *in vivo* models.[17,18]

Through extensive research, squalene has further been shown to:

- Prevent the occurrence of certain cancers.[19-29]
- Prevent carcinogenic agents from inducing cancer due to its detoxification properties and its ability to prevent activation of the *ras* oncogene.[2,19,22,30-33]
- Protect cells from the effects of radiation,[9,34,35] which makes it a suitable protector of healthy cells against cancer radiotherapy.
- Act directly against cancer tumour activity.[36,37]
- Optimise the activity of chemotherapeutic agents.[11,23,32]

The strong detoxification properties of squalene are very promising. Because it is a lipid, it detoxifies lipophilic (fat-soluble) poisons, which the body finds much harder to deal with than water-soluble poisons.

Four independent researchers have tested the detoxifying abilities of squalene by measuring the extent to which squalene helps cleanse laboratory animals of xenobiotics.[8,38-41] (*Xenobiotics – Manmade chemicals/pollutants. For example, burning plastics and certain fertilizers produce a chemical called dioxin, a xenobiotic toxin so pervasive, it can be found in virtually every human being alive today*).

Although the detoxifying mechanism is still not clearly known, it is thought that squalene may possibly increase the mobilisation of lipid-soluble xenobiotics enabling elimination through the intestine. Also, when xenobiotics accumulate in fat cells, stored squalene may be released into the general circulation, stimulating bile flow and enhancing xenobiotic elimination.[2]

HEART DISEASE

These days we are so intent on keeping cholesterol levels down that we seem to have forgotten that a certain level of cholesterol is essential to health. Cholesterol is manufactured in individual cells in a complex series of biochemical steps known as the mevalonate pathway. Glucose is first converted into mevalonic acid, and this in turn produces three isoprenoids – geranyl, farnesyl and squalene. Some two dozen steps later, the cell has a supply of cholesterol, essential for the manufacture of hormones and bile salts.

Cynics might be concerned that since squalene is one of the very ingredients that the body uses to manufacture cholesterol, dietary squalene might elevate cholesterol levels. However, research suggests that squalene actually lowers high blood concentrations of cholesterol and triglycerides,[11,15,42,43]

apparently by increasing the liver's filtering capacity. Cholesterol elimination in the faeces increases parallel to a rise in squalene levels. These laboratory findings are supported by epidemiological correlations of squalene-rich olive oil consumption with a low incidence of coronary heart disease.[44]

SKIN HEALTH

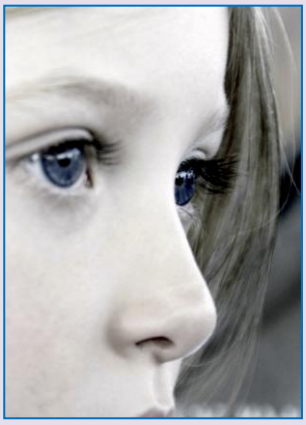
Squalene is found abundantly in the skin, where it acts to protect against free radicals. In a chemical quenching reaction of free radicals, the squalene molecule incorporates the radical chemically, producing squalene hydroperoxide – a new molecule. Squalene hydroperoxide is not an antioxidant but it is an excellent emollient that, in skin, serves as a natural sunscreen and moisturiser.[2] Squalene has the ability to provide relief, and protects, nourishes and restores harmony to dry, sensitive skin.

Squalene can also be used topically, where it can help to heal wounds, help prevent scarring, and provide a natural and very effective moisturiser. Squalene keeps skin smooth and supple, preventing fine lines and wrinkles. Squalane is a synthesised form of squalene, which is used in cosmetic applications because of its greater stability.

Unlike the internal mucosae, the skin is subjected to direct sunlight, which includes UV-B radiation, a source of free radicals and potential skin damage. Various research studies substantiate squalene's role in protecting skin from UV radiation.[47,48] This may help explain why sebum contains such a high proportion (12%) of squalene.[45,49]

WHY DO WE NEED SQUALENE?

Rising levels of oxidative stress in our environment – due to ozone depletion, increased background radiation, UV exposure and accumulation of xenobiotics, carcinogens and other chemicals – put tremendous pressure on the squalene metabolism in the body. Metabolic response of squalene to this stress is an increased synthesis and consumption of endogenous squalene, beyond the body's ability to cope, with adverse consequences. In the short-term, we can expect an increase in all kinds of cancers, and a generally weakened immune response. The long-range prognosis includes accelerated aging, decreased fertility and changes in psychological behaviour.



As a person ages, the distribution and concentration of squalene changes. It is mostly secreted up to and around age 20. At age 25 the secretion of squalene gradually decreases. This is one of the reasons why our skin becomes dry and wrinkled as we age. Due to the increased threat of oxidative stress in our environment and accelerated aging, exogenous sources of squalene prove to be imperative.

Squalene's antioxidant nature, its immune-stimulant action and its ability to protect cellular structures and improve cellular repair response should be enough reason to take squalene.

Further benefits of taking squalene include:

- Increased stamina and energy.
- Improved digestive health due to the increased production of bile acids. Normalisation of both constipation and diarrhoea and effective in the treatment of gastritis.
- Balancing of hormone levels through its involvement in the production of steroid hormones, resulting in increased sexual vitality, improvement in premenstrual syndrome, menopausal problems and even fertility.
- Improved action of a number of pharmaceutical drugs, to the extent that lower doses achieve the same results.
- Minimisation of the side-effects of drugs through its detoxifying action.

- Improved and facilitated healing of damaged articulation cartilages, therefore useful in cases of osteoarthrosis and sport injuries.
- Vibrant hair, nails and skin through squalene's ability to rejuvenate and activate cells.
- Beneficial effects on various eye disorders.[3,50]

SQUALENE AS DIETARY SUPPLEMENT

Squalene supplements have been widely tested for toxicity[3] and there is considerable proof that squalene is non-toxic. However, not all the squalene dietary supplements on the market are safe. Some have been found to contain PCBs (*Polychorinated Biphenyls are persistent organic pollutants – causing endocrine disruption and neurotoxicity. PCB's have been used in coolants, lubricants, adhesives, paints, etc.*), heavy metals and other carcinogens. Many of the so-called squalene supplements offered on the market are actually raw shark liver oil. They have considerably lower levels of squalene content. It is very important to take only 100% pure and natural extracted squalene that is standardised and certified.

Squalene is safe as long as it is carefully extracted through highly specialised distillation processes and a purity of 99.9% is maintained at every stage of production. The end product should contain not less than 99% squalene. In Japan, top squalene manufacturers are directly involved in the whole process, from fishing operations right through to marketing of the end-product. This ensures supply consistency, product quality, as well as flexibility in storage which remains a vital part in the whole process. Squalene iP6 has been endorsed by many reputable health professionals and research laboratories around the world for being superior in quality.

The usual recommended dose of squalene is two (450 mg) capsules per day, taken on an empty stomach. Anyone suffering from illness or infection may temporarily increase their dose to 6 or 8 capsules a day. Children and infants can safely take squalene at a dose of 1 capsule per day, which can be increased to 2 capsules daily during illness. Squalene is also safe and very beneficial to take during pregnancy. For cancer patients, 2 - 4 g of squalene is usually recommended. It is advisable to take squalene under the care of a qualified health practitioner.

CONCLUSION

While squalene may be very beneficial, it is by no means a 'cure-all'. No one substance or 'magic pill' can bring about health. Optimum health is only achieved through a healthy lifestyle, i.e. a balanced whole-food diet, a healthy environment, exercise, rest and spiritual development. The answer to good health is 'prevention by anticipation and not by reaction'.

Squalene is more than just a superior antioxidant. It has an adaptogenic effect, balancing hormones, cholesterol and oxygen levels. It supports the innate healing processes of the body. This unique molecule, with its indisputably rich past, has a great future in preventive therapy and integrative medicine.

End of Article

PETdiatric Laboratories Squalene AKG

Dosage and Usage

Petdiatric Laboratories Squalene AKG is formulated and best for increasing your pets immune system. It is aim at reducing the symptoms of allergies caused by allergen and malnutrition. It is advice to take Squalene AKG on daily basis.

Squalene AKG contains high concentration of anti-oxidants; it promotes growth of new skin cells and increases immune system. It is suitable for cats and dogs.

Pets below 20 kg, should take one softgel every alternate day. For pets weigh between 21kg and above, it is advisable to intake one softgel per day. PETdiatric Laboratories Squalene AKG is specially price effectively to be enjoyed by all pet's owners. It merely cost RM1.33per day for a healthy skin and coat.

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