

SQUALENE – A GIFT FROM SEA

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Squalene is a remarkable nutrient produced in our bodies and is also found in nature. It received its name because of its occurrence in shark liver oil (*Squalus* spp.), which contains large quantities and is considered the richest source of squalene. It belongs to a class of antioxidants called isoprenoids. An isoprenoid is a cell-friendly molecule that neutralizes the harmful effects of excessive free radicals in the body. Squalene is known for its key role as an intermediate in cholesterol synthesis. Scientific research and clinical trials have shown that squalene is safe as a dietary supplement in food and in capsules and no untoward incidents have been reported in the use of squalene. Japanese people have been using squalene for centuries and have attributed their strength and health to this substance.

Sources of squalene

Shark liver oil is a natural source for squalene. Deep-sea shark liver generally have high level of hexa unsaturated isoprenoid

alkene, squalene. The liver is the principal site of lipid storage and high content of low-density squalene (specific gravity 0.86 at 25°C) is believed to provide hydrostatic lift and enable the shark to maintain neutral buoyancy.

In basking shark (*Cetorhinus maximus*) liver oil, about 7-45% is composed of squalene and another hydrocarbon Zamene. A major species of shark *Centrophorus scalpratus* abundantly available in Indian Ocean particularly off Andaman & Nicobar Islands is one of the rich sources of squalene. It contains about 80-90% unsaponifiable matter, of which 80% is squalene. Other species of sharks rich in squalene are Gulper shark (*Centrophorus granulosus*), Taiwan gulper shark (*Centrophorus niaukang*),

Mandarian dogfish (*Cirrhigaleus barbifer*), Kite fin shark (*Dalatias licha*), Bird peak dogfish (*Deania calcea*), Small-toothed sand tiger (*Carcharias ferox*) and Crocodile shark (*Pseudocarcharias kamoharai*). Squalene is isolated from shark liver oil by vacuum distillation at 240-245°C.

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In addition to the shark liver oil, squalene also occurs in a variety of other oils such as olive oil, rice bran oil, arachis oil, codliver oil, seal oil etc. Recently squalene has been extracted and purified from Amaranth seeds, which contain about 5.1-7.7% squalene. Squalene is the principal hydrocarbon of human surface lipids amounting up to 11% of total surface fat. It is also seen in dermoid cysts, cerumen, hair fat and sebum.

Structure of squalene

The structural formula of squalene was certified and fixed by Dr. Calour, a Swiss chemist and Nobel prize awardee. Chemically it is known as 2, 6, 10, 15, 19, 23 hexamethyl-2, 6, 10, 14, 18, 22 tetracosane having a molecular weight of 410.70. The triterpene, squalene ($C_{30}H_{50}$) is an isoprenoid compound containing six isoprene units (Fig 1).

The 30-carbon polyprenyl chain structure of squalene can be enzymatically collapsed into a series

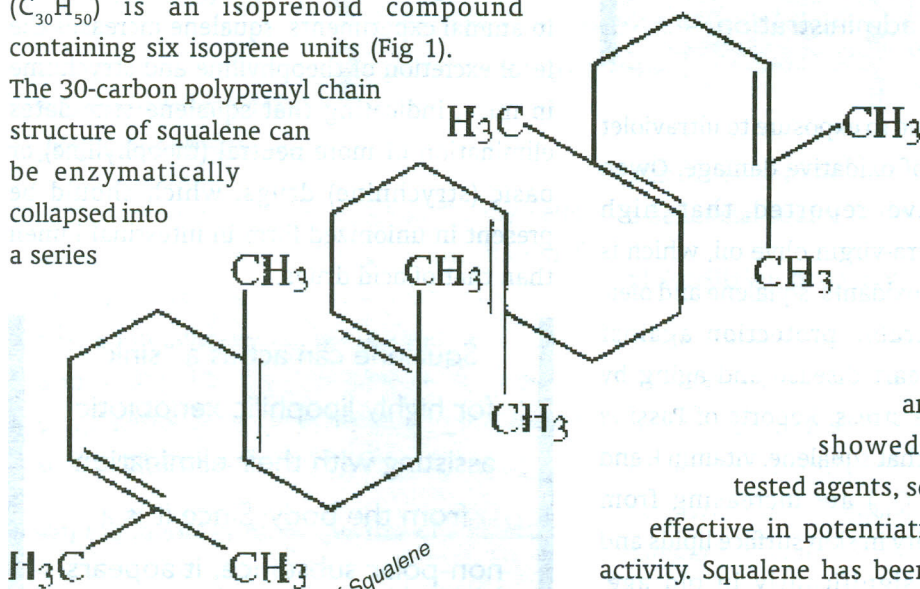


Fig.1 Structure of Squalene

of three inter-connected, closed six carbon rings attached to a five carbon ring with a prenyl side chain.

Applications of squalene

Clinical application

i) Anticancerous effect

The consumption of olive oil is believed to reduce risk for several cancers from time immemorial. Scientists have found out that squalene, as a constituent of olive oil is responsible for this chemo protective effect. Studies on its related substances like Vitamin A, E and K, b-carotene, Ubiquinone (CoQ10) and phytol indicate that the squalene as well as the related compounds are capable of suppressing the growth of tumor cells. Squalene has also

been found to be an efficient chemopreventive agent against lung metastasis in mice bearing lung carcinoma by post oral administration. Studies on squalene and its interaction with anticancerous agents showed that among the tested agents, squalene is the most effective in potentiating the antitumor activity. Squalene has been reported to have some protective action on the effect of radiation on human body. Storm *et al.*, (1993) have reported that administration of squalene as 2% of the diet to mice for 14 days pre and 30 days post exposure to lethal whole-body gamma irradiation resulted in cellular and systemic

radioprotection. Squalene treatment has been reported to significantly prolong survival time as compared with control fed mice, subsequent to exposure to lethal doses of radiation.

ii) Antioxidant properties of squalene

In vitro experimental evidence indicates that squalene is a highly effective oxygen-scavenging agent. Squalene is not easily susceptible to peroxidation and appears to function in the skin as a quencher of singlet oxygen, protecting human skin surface from

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lipid peroxidation due to exposure to ultraviolet and other sources of oxidative damage. Owen *et al.*, (2000) have reported that high consumption of extra-virgin olive oil, which is rich in phenolic antioxidants, squalene and oleic acid offer considerable protection against cancer, coronary heart disease and aging by inhibiting oxidative stress. Reports of Passi *et al.*, (2002) indicates that squalene, vitamin E and coenzyme Q₁₀ (Co Q₁₀) are increasing from childhood to maturity in skin surface lipids and decreasing again significantly in old age, suggesting that these antioxidants protect the body against exogenous oxidative insults and aging. squalene and its peroxides present in the sebum alleviate the occurrence of sunburn and protection from the damage caused by UV radiation.

iii) Squalene in detoxification of xenobiotics

Squalene can act as a “sink” for highly lipophilic xenobiotic assisting with their elimination from the body. Since it is a non-polar substance, it appears to have the highest affinity for unionized drugs. Squalene can be used as an alternative to paraffin to enhance the elimination of [14C] hexachlorobenzene (HCB) and organochlorine xenobiotics. Dietary treatment with squalene is as effective as paraffin in markedly enhancing fecal excretion of HCB. Elimination can be enhanced by oral treatment with squalene even long time after the uptake of the poison. Reports of Kamimura *et al.*, (1992) suggest that squalene can be a good candidate for antidote to reduce the toxicity of drug ingested accidentally at a high dose by enhancing the drug elimination from the body. In animal experiments, squalene increases the fecal excretion of theophylline and strychnine in mice, indicating that squalene stimulates elimination of more neutral (theophylline) or basic (strychnine) drugs, which should be present in unionized form in intestinal lumen than that of acid drugs.

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iv) Lipid lowering effect

Squalene is directly involved in the lipid

metabolism not only as a precursor molecule of cholesterol biosynthesis, but also as a feedback inhibitor of HMG CoA reductase in regulating cholesterol metabolism in animals. Supplementation of squalene resulted in the decrease of cholesterol and triglycerides levels. It might be a useful addition to potentiate the effects of some cholesterol-lowering drugs.

v) Cardioprotective effect

Studies conducted by Farvin *et al.* (2004) showed that squalene protects the myocardial cells from isoproterenol induced myocardial infarction in rats, an experimental model for human myocardial infarction or heart attack.

vi) Cell-invigorating properties of squalene

Squalene revitalizes weakened body cells and helps to revive cell generation. Its chief attribute is the protection of cells from oxidation reactions. The human body has about six billion oxygen reliant cells. Oxygenation to the cells promotes good health to the most basic level of life.

vii) Blood purifying properties of squalene

Squalene helps to clean, purify and detoxify the blood from toxins, facilitating circulation. It cleanses the gastrointestinal tract and kidneys, causing better bowel movement and urination. Many diseases are cured if the blood is purified, by supplementing squalene.

viii) Anti-aging properties of squalene

As squalene prevents cellular damage, healthy cells are produced, which are linked together with lipoproteins, later forms lipofuscin, an anti-aging substance. It prevents the formation of harmful lipid peroxide, which destroys various kinds of vitamins.

ix) Oxygen control property

Squalene carries oxygen in the cellular level, causing further improvement in organ function through cellular metabolism, preventing the acidotic cell syndrome where cells become acidic,

deteriorate and die due to lack of oxygen.

There is a significant relationship between the degree of one's health and the amount of oxygen consumption by body cells. In today's polluted environment,

lack of exercise and poor lifestyle, squalene gives a beneficial source of oxygen for our body.

x) Sterilizing property

Squalene's terpene gives a sterilizing effect, combating the growth of various microorganisms such as Coliform acilli, dysentery Bacilli, *Micrococcus pyocynanel*, Staphylococcus, hemolytic Streptococcus, and *Candida albicans*.

xi) Generation of body hormones

Squalene naturally increases male potency and vitality through a better body. It also helps regulate the female menstrual cycle and improves irregular and abnormal cycles.

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xii) Other actions

Sebum provides normal lubrication for hairy and non-hairy skin. It keeps skin supple and forms a protective bacterial and fungicidal coating of skin and in pilosebaceous apparatus. This fatty cover helps to keep moisture on the skin surface. Squalene occurs naturally in human sebum. Thus, it is essential to have adequate dose of squalene to maintain the integrity of skin and also acts as an anti-aging compound. Squalene is now used as an immunoprotector. Squalene reduces various aches and pains, helps body organ such as the kidney, liver and gallbladder and digestive system to function properly, helps hemorrhoids to shrink and curb obesity. It also acts as relaxant, giving added vigor and vitality without the hyper-activity associated with other food supplements, generates hair and smoothens skin. It exhibits penetrating action with immediate effect on topical applications and helps to prevent various kinds of disease and speeds up the healing process in most conditions of ill health.

Industrial applications

Squalene is used as bactericide, intermediate in the manufacture of pharmaceuticals, organic coloring matter, rubber chemicals, aromatics and surface-active agents. Squalene is now extensively used as an additive in pharmaceutical preparations and certain foodstuffs. A health food called squalene powder is popular. It is prepared by

adding proteins, carbohydrates, flavoring agents etc. to squalene. This is soluble in water and stable during storage. Another important use is in finishing natural and artificial silk to which it imparts an unusually brilliant sheen. It is an excellent lubricant and also used widely in filling certain types of thermometers. As it contains a number of isoprene units, it is an excellent raw material for preparation of various chemicals, particularly aromatics, by condensation and cyclisation. It is also used in synthesis of a number of steroid hormones of immense use to the mankind.

In conclusion squalene - a bio active isoprenoid compound obtained from shark liver oil has got immense potential in curing of variety of diseases and provide with good health without any side effects.

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