PetGaia™ - Healthy Skin, Happy Pet: Nourish Your Pet's Skin and Fur

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The condition of a pet's skin and fur are significant markers of their general health and well-being. The health of a pet's skin and fur can be impacted by a number of variables, including genetics, nutrition, environmental stressors and disease. Maintaining healthy skin and fur is crucial for the overall health and well-being of pets. Pets such as dogs, cats, horses or rodents need a balanced diet to meet their nutritional needs including protein, energy, minerals and vitamins for healthy skin and coats.

Adequate nutrition is essential for maintaining healthy skin and fur in pets, and a lack of essential nutrients can cause dryness, flakiness, and damage to the skin, as well as brittle fur and excessive shedding. By providing the necessary nutrients, the body can better maintain and repair itself, promoting healthy skin and coat from within. More than just how it appears, a pet's skin and fur condition provide insight into their overall health.

Anti-inflammatory and antioxidant compounds are known for their potential benefits for maintaining healthy skin and fur. Palm tocotrienol and squalene are two natural compounds that have recently gained attention for their potential and unique benefits for skin and fur health. While most of the research has been conducted on their effects in humans, these natural compounds have also shown promise for improving the skin and fur health of pets.

PhytoGaia has developed PetGaia™, a unique, one of the kind, concentrated vegetable oil extract consisting of full spectrum tocotrienols, squalene and phytosterols. It is naturally extracted and concentrated from palm fruits (*Elaeis guinnensis*). This natural plant extract (tocotrienol, squalene and phytosterols) has a tremendous synergistic effect on a pet's health vis a vis healthy skin and fur (hair).

On the quality aspect, PetGaia™ is produced from plant without the use of any chemicals or solvents, making it a unique and innovative ingredient on the market. In fact, it is the first palm phytonutrient complex that is made with a natural, clean and environmental-friendly process specifically for Pet Nutraceutical and Care.

Palm fruits/ Red Palm Oil, which contains natural tocotrienol, tocopherol, phytosterols, squalene, phospholipids, coenzyme Q10 and polyphenols, is indeed a nutritious vegetable oil that is particularly high in phytonutrients[1]. In comparison to other vegetable oils, palm oil differs slightly as it has the highest level of tocotrienols[2] and squalene[3].

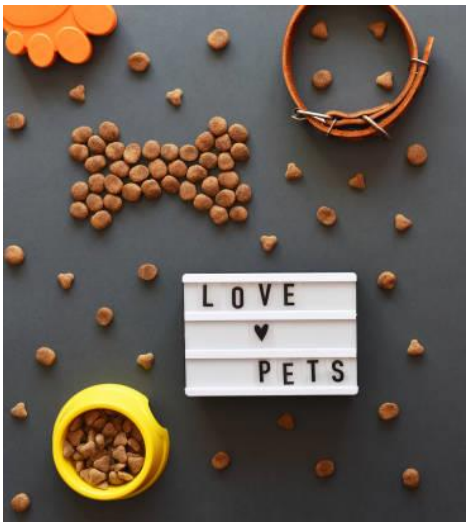
Tocotrienol: A Powerful Antioxidant

Tocotrienols are a type of vitamin E that can be found in various food sources, such as palm oil, wheat germ, barley, and certain nuts and grains. While being members of the vitamin E family, tocotrienols are distinct from the better-known tocopherols in their molecular structure and biological properties. Structurally, tocotrienols are the unsaturated forms of vitamin E, whereas tocopherols are the saturated forms. This unique molecular structure (ie: unsaturated isoprenoid side chain) confers tocotrienols with unique and superior biological activities over tocopherols. For instance, tocotrienols have the ability to penetrate through cell membranes in a more efficient manner and at a faster rate, providing better and more efficient antioxidant protection against the onslaught of free radicals generated in the cells at the strata corneum of the skin.

Based on the finding published in *Free Radical Biology & Medicine (1991)* by the late Dr. Lester Packer (the world's foremost antioxidant research scientist – a.k.a Dr. Antioxidant) and his team, tocotrienol is a much more potent antioxidant (40 to 60 times) compared to the saturated form of vitamin tocopherol[4]. In addition, they have been shown to have several other unique skin health benefits including reducing inflammation and health and promoting healthy skin and coat as well as cardiovascular and brain health.

The discovery of tocotrienol's unique health benefits and biological activities such as neuroprotective, anti-carcinogenic and cholesterol-lowering capabilities, has resulted in an increased research interest into it[4,5]. These properties of tocotrienols have also sparked interest among researchers in discovering their unique ability to prevent degenerative diseases[6].

Several studies have shown the potential benefits of tocotrienols for pets. For instance, a study by Khanna *et al*. (2005) found that long-term supplementation of dietary full spectrum palm tocotrienols in rodents resulted in their detection in plasma and accumulation in important organs such as the heart, lungs and skin[7]. Additionally, a study conducted on canines by Raila *et al*. (2011) found that oral intake of full spectrum palm tocotrienols improved the total plasma antioxidant capacity in them[8]. These studies suggest that palm tocotrienols supplementation has potential health beneficial effects for pets in preventing and treating degenerative disorders linked to oxidative stress.



Red palm oil is a versatile and nutritious oil commonly used in cooking and food preparation. However, its benefits extend beyond the culinary world, as it has been found to offer potential health benefits for pets as well. It is fascinating to explore the potential of this oil (which is rich in phytonutrients including vitamin E tocopherol, tocotrienols, squalene and phytosterol) and PetGaia™ as a natural dietary supplement for pets.

Scientists from China have demonstrated that supplementing with red palm oil in the dog food diet improved the health and growth of young German Shepherd dogs. This study, published in the *Feed Research* journal by Ningkun *et al*., (2017) shows that it enhances the digestibility of fat, protein and energy in the feed. Additionally, it also shows a notable improvement in the young Shepherd's hair/fur[9].

A year later, the same team of researchers published another study evaluating the effect of red palm oil supplementation in golden retrivers[10]. They examined the effects of supplementing the diet of adult golden retrievers for 28 days with various kinds of red palm oil. The findings collectively implies that red palm oil with natural palm phytonutrients, especially tocotrienols, may be beneficial for adult golden retrievers' nutrient digestibility and overall health.

Both studies found that palm phytonutrient complex supplementation was associated with significant improvements in a range of health outcomes, including improved growth, increased muscle mass and better overall health. These findings suggest that palm phytonutrients complex could be an important dietary supplement for pet owners looking to optimize the health and wellbeing of their furry companions.

Palm Tocotrienols and Pet's Skin

The skin is a large, metabolically active organ in the body. The primary function of the skin is to provide a protective barrier that protects the inner organ and pets from external objects, chemicals, and environmental stressors. Loss of integrity of the skin, due to illness or injury, could lead to severe disability or even death[11]. A pet's skin also contains nerves and nerve endings that allow the pet to sense heat, cold, pressure and pain. It is an important part of the immune system in which a healthy coat helps to regulate a pet's temperature by providing an insulating layer of fur[12].

Due to its role as a barrier, the skin is uniquely challenged by oxidants (i.e., free radicals), which increases its vulnerability to oxidative damage. As the outermost layer of the skin, the stratum corneum is continuously exposed to an oxidative environment that includes free radicals, UV radiation and air pollution. Cells produce free radicals as a result of normal metabolism, pollution, and sunlight, and they contribute to accelerated cellular ageing and death.

It has been demonstrated that palm tocotrienols provide skin protection against oxidative stress brought on by UV light and ozone[13]. In addition, palm tocotrienol possesses anti-inflammatory properties, which may be advantageous for animals with skin disorders like allergies or dermatitis[14]. According to Yam *et al*., 2009, tocotrienols have a stronger anti-inflammatory effect than tocopherols as measured by the lipopolysaccharide-induced production of IL-6 and prostaglandin E2[15].

Atopic dermatitis is a prevalent skin allergy found in dogs and cats. Tsuduki and his team in Japan conducted a study to investigate the effects of oral palm tocotrienols supplementation on Atopic Dermatitis (AD) symptoms using an NC/Nga rodents' model[16]. After 9 weeks of supplementation, rodents treated with tocotrienols showed a significant reduction in scratching behavior, dermal thickening and serum histamine levels compared to the untreated group. Notably, palm tocotrienols were found to suppress AD through the inhibition of protein kinase C activity, through anti-degranulation, histamine reduction and protein kinase C activity suppression effects. This study is the only known research to date that examines the direct treatment of AD with palm tocotrienols.

Exposure to ultraviolet (UV) irradiation generates reactive oxygen species (ROS) in the skin, which can lead to various skin problems. ROS can damage lipids, proteins and nucleic acids in the skin, resulting in issues like sunburn, wrinkles and even skin cancer. Meantime, UVB radiation has been demonstrated to produce ROS in the cells and skin that cause lipid peroxidation and DNA damage, leading to inflammation (i.e: sunburn) and the development of cancer. Palm Tocotrienols Complex have been shown to protect hairless mice from skin damage caused by UVB radiation, according to a study by Yamada *et al*. (2008)[17]. Tocotrienol was found to be more potent than the regular vitamin E tocopherol in preventing skin damage.

Additionally, palm tocotrienols have been found to accelerate skin wound healing and may be useful in controlling abnormal or impaired skin wound healing. In a 2005 study, Musalmah and colleagues found that supplementing diabetic mice with palm tocotrienols accelerated skin healing and increased free radical-scavenging enzyme activities[18].

In another study, Elsy and Khan (2017) investigated the effect of various vitamin E isoforms on stitched skin wounds in both healthy and diabetic rats[19]. The rats were divided into three groups: normal control, diabetic control and treated groups. The treated groups were given α-tocopherol, δ-tocotrienol or a combination of both orally. The results showed that the tocotrienol-treated group had better wound recovery. The researchers attributed this acceleration of wound healing effect to improved regeneration of both the epidermal and dermal components by tocotrienols.

Tocotrienol from palm oil also has been studied by Zaini and his colleagues (2016) for its ability to cure partial thickness burn wounds via its antioxidant properties[20]. They formulated a topical cream containing tocotrienol and tested it using the Sprague-Dawley rats' burn model. Tocotrienol treatment resulted in acceleration of wound healing, promotion of granular tissue development, quick re-epithelialization and regeneration of the epidermal. Treatment with tocotrienols also helps to reduce edema, hyperaemia, and re-epithelialization time. Similarly, in a study by Guo *et al*. (2020), epidermal growth factor with palm tocotrienols has ameliorating effects on deep-partial thickness burn healing parameters[21].

A study has shown that topical application of tocotrienols has potential benefits for hair follicle formation in both healthy and diabetic individuals. Ahmed *et al*. (2017) found that palm tocotrienols can promote the formation of epidermal hair follicles during fetal skin development[22]. Interestingly, the same effect was observed in adult mice, including those with diabetes, which are typically resistant to the anagen hair cycle. These findings suggest that tocotrienols have a potential therapeutic potential for hair growth in individuals with compromised hair follicle function.

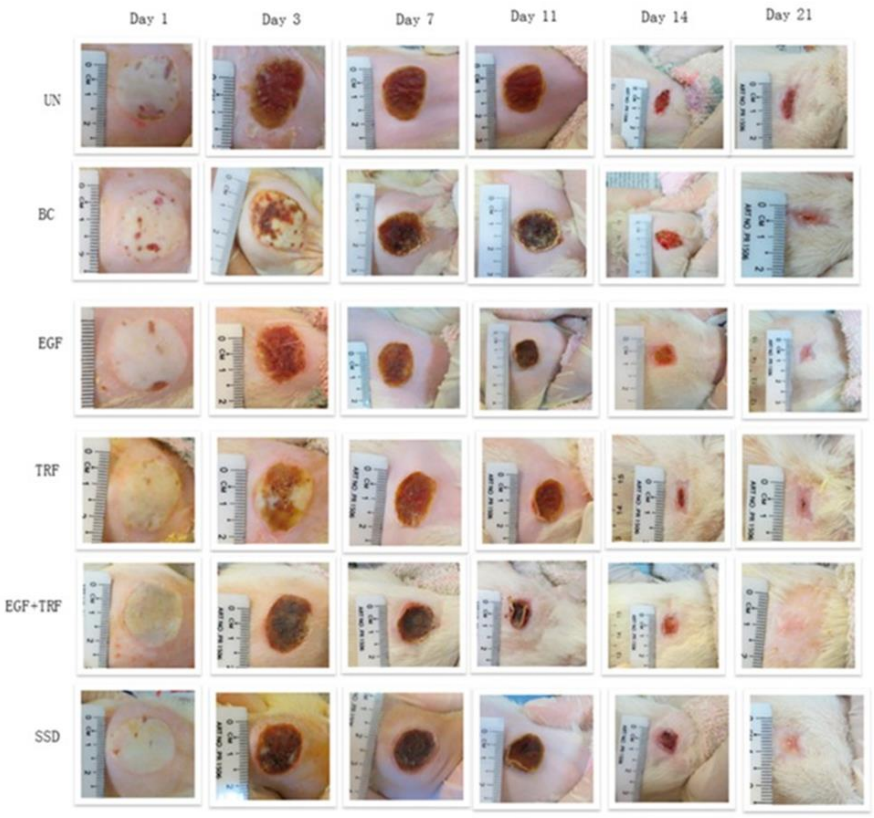


Figure: Wound closure of deep partial-thickness burn wounds over time in Sprague Dawley rats. (UN: without any treatment; BC: treated with base cream; Epidermal growth factor (EGF): treated with base cream containing c% EGF; Tocotrienol-rich fraction (TRF): treated with base cream containing 3% TRF; EGF + TRF: treated with base cream containing both c% EGF and 3% TRF; and SSD: treated with SSD cream). (Adapted from Guo *et al*., 2020)

Squalene as a Natural Emollient

Squalene is a natural organic compound found in many plants and animals, including humans and pets. It is a key component in the Mevalonate Pathway – via a vis the synthesis of CoQ10, cholesterol, steroid hormones and vitamin D. Squalene is also a precursor to a class of compounds called triterpenoids, which have anti-inflammatory and antioxidant properties.

Currently, squalene is extracted from shark liver oil. However, due to concerns over sustainability and animal welfare, many companies have shifted towards using plant-based sources such as palm oil, and PetGaia™ is an excellent alternative as it's naturally extracted and concentrated from palm fruits, through a natural and environmentally friendly process without the use of solvents and chemicals.

Squalene is important for pet health as it is a component of the skin's natural oils and helps to maintain healthy skin and coat. It has been shown to have anti-inflammatory and anti-allergic

effects, making it an effective natural compound for treating skin conditions such as atopic dermatitis in dogs. As a polyunsaturated triterpene, squalene is classified as the molecule with the highest degree of unsaturation among lipids[23]. This unsaturation allows squalene to be a potent natural lubricant with excellent penetration efficiency.

Squalene has been reported to possess antioxidant properties and appears to be critical in reducing free radical oxidative damage to the skin. The scavenging action of squalene on superoxide anion generation in keratinocytes of rats subjected to oxidative stress was discovered by Aioi and colleagues in 1995. This finding shows that squalene plays a protective role in reducing skin irritation[24].

Natural squalene can be found in the sebum of both human and animal skin. Its hydrating and antioxidant qualities make it a valuable component in many skincare products. Squalene has also been discovered to provide a variety of advantages for a pet's skin/coat and fur. Due to its antioxidant activity, squalene helps maintain healthy skin and preserve it from the detrimental impact of the environment[25].

Additionally, squalene also serves a vital role in aiding wound healing. In a number of *in-vivo* studies, by Shanmugarajan and the team, squalene has been shown to have this ability in managing inflammatory responses related to wound healing[26]. It enabled the re-epithelization of the burned skin areas and the consequent tissue repair by suppressing inflammatory cells, which is a significant finding for wound healing in pets.

Moreover, according to Sanchez-Quesada (2018), squalene causes M1 pro-inflammatory macrophages to produce less TNF- and NF-B while increasing the synthesis of anti-inflammatory cytokines including IL-10, IL-13, and IL-4[27]. Squalene also improved signals for remodeling and repair (TIMP-2) as well as signals for eosinophil and neutrophil recruitment, which are involved in phagocytosis processes. These findings indicate that squalene promotes the macrophage response to inflammation, which in turn can accelerate wound healing.

Long-term or excessive oxidative stress can be harmful to fish and animals, such as slow growth and development, decreased immune function and increased disease incidence[28]. Studies have shown that squalene has the potential to improve their overall health. Researchers from Shanghai Ocean University in China recently published a new exciting study that examined the benefits of squalene as an antioxidant in fish feed[29]. They used transgenic zebrafish to evaluate the impact of squalene on antioxidant and inflammatory responses. The findings indicated that squalene exhibited a high free radical scavenging capacity of up to 32% and significantly reduced reactive oxygen species (ROS) levels.

Additionally, squalene demonstrated a potent anti-inflammatory impact by effectively reducing the number of neutrophils in the inflammatory foci and reducing the severity of the inflammatory symptoms. Furthermore, squalene positively impacted the expression of immune-related genes linked to oxidative stress and inflammation, providing protection against CuSO4-induced injury. Overall, this particular study suggests that squalene can also be a beneficial active ingredient in aquafeed, offering both anti-inflammatory and antioxidative properties for fish.

Conclusion

In recent years, there has been a growing interest in using natural compounds to enhance the health of pets' skin and fur. The powerful and synergistic combination of tocotrienol and squalene offers a unique solution, providing antioxidant protection against harmful free radicals while also moisturising and safeguarding the skin. By incorporating tocotrienols and squalene (PetGaia^{TM}) into the pets' diets and skincare routines, pet owners can ensure that their furry companions have healthy skin and vibrant fur, ultimately promoting their overall wellbeing.

PetGaia^{TM} with its powerful and synergistic natural antioxidants (i.e. tocotrienols, squalene and phytosterols), offers a cutting-edge solution, leveraging its unique quality attributes and robust scientific evidence that empower pet supplement companies to formulate pet nutraceuticals, pet foods and skin care – to ride on the rapidly expanding market for pet health products and leveraging PetGaia's unique quality attributes for product differentiation in a crowded pet supplements / pet food and skin care markets.

Take Home Messages: -

i) PetGaia^{TM} – First of its kind in the market with these two synergistic active ingredients (squalene & tocotrienol).
ii) PetGaia^{TM}'s significant and compelling science specifically in supporting as well as maintaining of healthy skin and fur in pets.
iii) Chemical- and Solvent-Free extraction process (Non-biodiesel route)
iv) BaP- and PAH-compliant (EU Specification and Requirement for these two known carcinogens).
v) Clean-Labeling – Cleaner & Purer without unwanted contaminants
vi) Product differentiation and marketing advantage in a crowded market

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