

NEutral SATurated Oil or NESATOL

Current value of saturated long chain (high carbon) triglycerides

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Discussion of this extremely broad topic would require far more space than we will be dedicating to it.

In this paper, we will supply general information about triglycerides, mainly as vehicles for skin-oriented products, followed by an explanation for the reasons that induced us to develop our eudermal triglyceride.

Triglycerides can be generally defined as follows: fatty acid esters whose alcohol part is made up of glycerol.

Nature usually provides us with triglycerides consisting of mixed fatty acids. Naturally blended triglycerides may contain some mono and/or diglycerides and small amounts of esters, free alcohol and hydrocarbons (their unsaponifiable part).

On the best of chemical classifications when natural triglycerides of vegetable or animal origin are observed at room temperature they turn into oils if they are liquid, into butter if they are pasty and into fat if they are solid, but there are some exceptions.

Triglycerides are very widely used in human activities as in many industrial fields, and just to mention some of their applications we can state: extraction of fatty acids and glycerin; production of siccative oils for the paint industry; processing of fuels and especially of the monoester derivatives of soy, sunflower, carthamus (safflower), peanut, and palm nuts. These derivatives are more expensive than diesel oil for cars, but more interesting since their use is less dangerous for the environment.

Many triglycerides are used to waterproof paper and fabrics, to formulate synthetic coatings, sealants, typographic inks and to produce linoleum. A particular example is "Crambe Abyssinica" from which industry extracts an oil containing up to 60% of erucic acid, while the average content of the same acid in colseed oil is 52%. This acid is used to produce polyethylene plasticizers (according to a Paper dated 1976 if this oil is ingested it is toxic and may cause cardiac lipidosis due to the presence of erucic acid and of thioglycosides).

Many triglycerides mixed with white oils are also used in the lubrication sector such as in the clockmaking field where neat's foot oil (bubulum oil) is still used. The use of triglycerides in the food industry is also well known. Consumers are continuously informed on the correct use of triglycerides according to strict nutritional parameters in order to protect their health.

Triglycerides are also used for skin applications and will be discussed more in detail.

Table 1: List of more/less Saturated Triglycerides

<i>triglycerides</i>	<i>prevailing</i>	<i>°C min</i>	<i>°C max</i>	<i>n° I [Wijs]</i>
linseed	unsaturated +++++	-27	-18	205
cod liver	unsaturated ++	0	10	181
safflower	unsaturated +++++	-19	-13	150
soybean	unsaturated +	-23	-8	143
grape seed	unsaturated +++++	-24	-10	137
sunflower	unsaturated +++++	-18	-16	136
whale	unsaturated +++	-2	0	135
corn	unsaturated +++++	-18	-10	133
sesame	unsaturated +++++	-6	-3	115
cottonseed	unsaturated ++	-1	2	112
rice bran	unsaturated +++++	4	10	110
rapeseed	unsaturated +++++	-10	10	106
peanut	unsaturated +++++	0	3	103
turtle	unsaturated +++++	-2	2	97
olive	unsaturated +++++	-6	10	90
castor	unsaturated +++++	-12	-10	90
neat's foot	unsaturated ++	-2	2	72
shea	unsaturated +	23	45	62

palm	unsaturated ++	23	30	60
lard	saturated +	30	45	60
cocoa	saturated ++	30	36	40
butter	saturated +	25	30	30
coconut	saturated ++++	23	27	10

Table 1 shows many of the best known triglycerides listed from highest to lowest on the basis of their iodine value, according to the Wijs method (which is equivalent to the decreasing order of their degree of saturation).

This table also shows the maximum and minimum temperature range in °C in which each triglyceride is no longer in a liquid state.

A first glance shows that triglycerides obtained in the range from linseed to castor oil are unfit for cutaneous application because of their high unsaturation degree while the others are unfit due to their short chain.

Figure 2 shows the characteristic, stereochemical structure of saturated triglycerides whose “zig-zag” shaped chains form a compact lattice. They are usually characterized by a rather high saturated fatty acid content, by their solid or pasty state at room temperature and by their low iodine value.

The stereochemical structure of unsaturated triglycerides, shown in figure 3, is characterized by chain divergence, by the prevailing unsaturated fatty acids, by their liquid state and by a high iodine value.

Historical Background

Triglycerides are excipients that have always been important. Among primitive peoples and in ancient times, as well as presently, skin care was and still remains very important. The reason is obvious: the struggle against ageing as well as maintaining one’s beauty have always been one of man’s primary concerns.

Among the materials used for these purposes we can find linseed-based plasters (such as moisturizing face-packs/masks) and apricot and poppy oils. The Batak population of Sumatra (Indonesia) used to crush and stir millipedes and scorpions into coconut oil and tallow to produce anti-wrinkle preparations. In Roman civilization (or barbarism, depending on one’s point of view) olive oil was frequently used as an aftershave. Galen (150 a.C.) also used triglycerides, mainly olive oil in the formulations bearing his name, i.e. galenic products.

However, there is still some debate over triglycerides. All of them, more or less become oxidized, turn rancid and are therefore not fit for use in skin care products.

In 1965 (when Nesatol was first launched) a triglyceride was found which remains liquid at room temperature and saturated at the same time. It is oxidation resistant while not containing any oxidation-preventing compounds. The same triglyceride is also sebum-related, i.e. it has a triglyceride structure which is superimposable to the structure of the human sebum triglycerides which account for 25% to 35% of the total.

Let us now see which products are considered responsible for the undesired effects on the skin:

non-physiologic dilatation of the pores, acne, folliculitis: short chain triglycerides (coconut butter), vegetable oils and fats (maize, linseed, sesame, peanut, olive, cocoa oils), fatty acids (palmitic and stearic acids), esters and waxes (isopropyl palmitate and myristate, isocetyl palmitate and stearate, myristyl myristate, methyl oleate, lanolin (wool fat); octyl, hexadecyl, lauryl, isostearyl alcohols; PEG200, 300, 400 ethers; polyethylen ether, lanolin;

excessive stimulation of the pilosebaceous glands: saturated squalene chains (squalane – N.B. Syntesqual is not included in this classification since it is not obtained from squalene and it is only partially hydrogenated;

erythema, pruritus, urticaria: vegetable oils and fats (olive oil, castor oil), cethyl, stearyl, oleic alcohols, ethers and esters (PEG200, 300, 400 ethers; polyethylen ether, lanolin); hydrocarbons (white and yellow paraffin oils);

thickening of the Malpighi layer caused by an excessive stimulation of cell multiplication (acanthosis¹): saturated hydrocarbon chains (paraffin oils, vaseline); lipoperoxidation or formation of free radicals or cell oxidation: unsaturated oils and fats (animal and vegetable triglycerides mainly made up of unsaturated fats) as well as any substances that do not respect the skin biochemistry.

This description is certainly not thrilling, but with Nesatol these undesirable and subtle effects can be eliminated.

Figure 4 shows the special stereochemical structure of Nesatol which is half-way between saturated and unsaturated triglycerides except for its designed steric position.

Nesatol is a saturated product which has the following features: it is harmless, its solidification point is very low, it is oxidation resistant. It has emollient properties and is non-greasy, it has a sebum-like structure and may act as a carrier. It is capable of increasing the temperature range leading it from fusion to pastiness and to solidification of

¹ In our body the main sources of ROTS (Reactive Oxygen Toxic Species = free radicals) are to be found among products of incorrect lipid oxidation (research by Pearson and Show); for instance ROTS are produced by PUFA (Poly Unsaturated Fatty Acids), α linolenic acid produces thirty times more than linoleic acid and ten times more than oleic acid and lecithins with poly-unsaturated chains in position n.2

solid anhydrous compounds and can extract active lipophil sebum-related compounds. Tables 5 and 6 report the registration and specification data, respectively, concerning Nesatol.

Nesatol's strong resistance to oxidation is confirmed in a study in which researchers measured the amount of time required to increase the peroxide number, i.e. the increase of some oil constituents promoting oxygen oxidation activity. Five of the most commonly used products were compared, i.e.: extravirgin olive oil, peanut oil, soya oil, frequently used commercial glyceride and Nesatol. Each sample was oven dried at 110°C in an open container under a flow of purified air.

Table 7 is a graph showing the results obtained and calculated on the average value of three determinations. The amount of time (in minutes) required to reach the peroxide value of 100 is plotted on the X axis while the peroxide value is plotted on the Y axis.

The result obtained by Nesatol (peroxide value = 40 in 960 minutes) demonstrates that Nesatol is the most stable against oxidation. The results obtained with the other tested oils do not offer sufficient guarantees for their use under all working conditions.

These results seem to penalize extravirgin olive oil which – we must stress – is rightly considered the best lipid for our nourishment. This result is not only due to its different fatty acid content, which is even higher in peanut oil (with a 40% to 75% oleic acid content and linoleic acid content ranging from 13 to 35%), to the effect of their place of origin, but also to the presence of tocopherols which do not exceed 150µg/l in olive oil and 25µg/l in peanut oil, while in soya oil they reach 800µg/l (neither Nesatol nor commercial glyceride OOO contain tocopherols). The Nesatol molecule was carefully designed and testing guarantees complete harmlessness.

Not only did Nesatol pass all the pharmaceutical tests listed in Table 8, but it also scored best after a series of tests performed according to official protocols which, on the contrary, penalized a long list of lipids which are commonly used for skin care.

Acanthogenicity [Butcher 1950; Burlando 1982], chronic dermatitis and hyperpigmentation [Maybach] (likely caused by mineral oils); cosmetic acne [Kligman and Mills, 1972] (likely caused by isopropyl myristate; olive, peanut and sesame oils, cocoa butter); comedogenicity [Lanzet 1986] (likely caused by isopropyl esters, decyl oleate, octyl palmitate, myristyl lactate, capric/caprylic triglycerides, oils extracted from coconuts, peach nuts, grape-seeds, sweet almonds, peanuts, sunflower) comedogenicity and/or epithelium irritation [Fulton 1989] (likely caused by decyl and isodecyl oleate, myristyl lactate and myristate, isostearyl isostearate, isopropyl isostearate, linoleate, myristate, palmitate; short chain reconstituted triglycerides, oils extracted from wheat germ, sesame, maize, soy, cotton, peanut jojoba seeds; avocado, primrose, olive, almond, apricot seed, jojoba oil; carnauba and candelilla waxes.

Nesatol is used in a wide range of applications in the dermatopharmaceutical and cosmetic fields: oleolites, ointments, pastes, lipogels, w/o and o/w fluid, solid and mixed emulsions soaps and syndet, an extraction of liposoluble active agents, adjustment of the melting point, of retraction and dilatation of solid anhydrous systems.

Many application studies have been carried out to determine the best use for Nesatol in very different classes of pharmaceutical as well as cosmetic end products for skin care.

A first study was conducted to assess whether Nesatol affects the chemical-physical properties of three different triglyceride mixtures. It was found that the iodine number, acidity, saponification values, percentage of their unsaponifiable part, density and pH did not change, while the melting and solidification points, and the peroxide value were lowered by adding Nesatol.

Then the same mixtures were tested for their technical features with regards to the formulation of suppositories. Adding Nesatol led to a slightly reduced volume, shorter softening and melting time, an appreciably increased cooling time and a 50% decrease in the number of broken suppositories. Furthermore the effect that Nesatol has on bodily absorption of some antipyretic suppositories was also assessed. All 144 tests confirmed an increase in the amount of medication in the blood and in the antipyretic activity over the first hour (good decrease in temperature within the first hour).

Another element of great interest for the manufacturers is the stability of Nesatol thanks to its constant and chemically defined composition. On the contrary, short chain triglycerides, and generally speaking, all vegetable oils are not very stable. They cannot guarantee stability nor constant composition and may sometimes be the cause of problems directly affecting the end product.

The following tables give some examples of simple formulations and their related characteristics.

BABY OIL

Syntesqual	50.0%
Nesatol	25.0%
Isostearene	25.0%

Appearance: clear liquid
colour: straw yellow
odour: pleasant, not lingering

viscosity (50 rpm): 45 cps

SUNSCREEN OIL

Syntesqual	50.0%
Nesatol	25.0%
Isostearene	20.0%
Megasol-complex	4.5%
Perfume	0.5%

Appearance: clear liquid

colour: yellow

odour: pleasant

viscosity (50 rpm): 48 cps

LIPIDIC GEL

Syntesqual	47.0%
Nesatol	25.0%
Isostearene	20.0%
Lipophos	3.0%
Silotrat	5.0%

Appearance: clear gel

colour: straw yellow

odour: pleasant

viscosity (50 rpm): 15.000 cps

O/W CREAM

Xalifin-15	10.0%
Nesatol	15.0%
Glycerin	5.0%
Water	68.7%
Undebenzofene-C	1.3%

Appearance: homogeneous, fine, shining

viscosity (50 rpm): 4.700 cps

stability: centrifuge (3000 rpm, 30')

pH: 5.0

Conclusions

Nesatol provides manufacturers with a neutral, emollient, odourless stable oil of consistent composition. Nesatol does not irritate, is non acanthogenous, non greasy nor degreasing and has no drying out effect. It is lubricant, orthodermal and improves the spreadability of the end product.