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Tocopherols in fats and oils: Preserving valuable nutrients

Nutriswiss uses innovative processes to protect natural vitamins and antioxidants

Edible fats and oils are rich in natural nutrients, but traditional refining can reduce their levels substantially. A gentle new process developed by Nutriswiss AG, the Swiss specialist for high-quality, customised edible fats, not only preserves these valuable ingredients but also improves their stability and purity. The protection

of valuable ingredients such as vitamin E and unsaturated fatty acids is particularly important when refining lipids for infant formula. Nutriswiss studies show that its innovative distillation technology produces raffinates with a higher vitamin content and better shelf life than conventional deodorisation.

Mild distillation technologies can be used

to efficiently remove or significantly reduce impurities in fats and oils. However, it is important that product quality remains stable or is better than that achieved via conventional processes. Nutriswiss has therefore conducted extensive tests to determine the ideal process parameters to meet this goal. Mild distillation is ideal for sensitive raw materials such as omega-3-rich seed oils, including rapeseed and linseed, as well as algae and other speciality oils. Finding the right blend and quality of oils, especially for infant formula, is a major challenge, not only because the fatty acid profile must be optimally balanced, but also because the raw materials must meet the highest quality guidelines and strict specifications for harmful substances. Such oils require customised treatment and a higher degree of care than ordinary oils in order to preserve essential fatty acids and micronutrients such as vitamins. Tocopherols, commonly known as vitamin E, are categorised into four forms: α - and β -tocopherols provide the highest vitamin functionality, while γ - and



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Top: Tocopherols have strong antioxidant properties. They are present in vegetable oils in varying concentrations and support both human health, and product stability.

Left: The protection of valuable components such as vitamin E or unsaturated fatty acids is essential, especially when refining lipids for infant formula.

δ -tocopherols have a low vitamin content but strong antioxidant properties. All four forms are present in vegetable oils in varying concentrations. They also provide protection against oxidation when heated, for example in frying oils. As valuable ingredients, tocopherols are therefore welcome not only from a nutritional point of view, but also for product stability and in specific applications. The content of tocopherol forms also depends on the type of oil. For example, sunflower oil naturally contains more α -tocopherol and therefore has a higher vitamin E content, while rapeseed oil contains more γ and δ forms, and so has better antioxidant stability.

Controlled processing for optimal vitamin retention

All stages of processing affect the storage stability of a fat, starting with growing and harvesting conditions, and storage of the oilseeds, followed by pressing and storage of the oil. During the refining process, the individual steps - from degumming, neutralization and bleaching to deodorization or special distillation - influence tocopherol content and storage stability. Depending on the process, antioxidants can also be affected to varying degrees.

As a rule, between 20 and 50% of natural tocopherols are degraded during fat refining. Some of these are removed with the separated fractions but, depending on the process, they may also be degraded or converted to other compounds through chemical reactions such as esterification. A large proportion of these natural vitamins and antioxidants are removed at the end of the refining process by classic deodorization - a steam distillation process. The use of mild distillation technology also reduces antioxidants along with fatty acids, which are subsequently found in the condensate, but this process is much gentler on the product than deodorization and offers other advantages.

The goal is to preserve as much natural vitamin and antioxidant content in the oil as possible through carefully controlled processing. Experiments have shown that while tocopherols are lost in the refining process through separation or oxidation, regeneration or even an increase in tocopherol content is possible in certain process steps. This can be explained by cleavage of dimeric bonds between tocopherol molecules or ester



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bonds between tocopherols and other compounds. The step analyses, performed as standard at Nutriswiss after each refining step, revealed that in some cases even more tocopherols were found than were present in the original material. The refining processes have therefore been adjusted accordingly to take advantage of such effects.

Protecting what's good while removing contaminants

Whereas in the past, up to 50% of tocopherols were lost and no longer present in the end product, it is now possible to achieve zero or significantly lower losses. Frank Möllering, Head of Research & Development at Nutriswiss, sees great potential: "Our optimised process shows positive results with all oils and that is a clear technological advantage for us. By considering differing raw material properties and managing the balancing act between weak and intensive treatment, we have succeeded in retaining higher levels of natural vitamin E and removing undesirable substances without compromising the stability of the end product."

When unwanted byproducts such as

pesticides, herbicides, insecticides, plasticizer impurities or mineral oil saturated and aromatic hydrocarbons (MOSH/MOAH) have to be separated from the crude oil by deodorization or mild distillation, a loss of vitamins and antioxidants cannot be completely avoided. So it is better to



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remove these valuable components from the highest possible starting point than from a tocopherol content that has already been cut in half. For optimal results, the refining process must be coordinated across all treatment steps, depending on the oil to be refined and its initial analysis values, and must be as gentle as possible on the product.

Less oxidation, improved stability, better quality

In practice, Nutriswiss has been able to show that, despite the unavoidable reduction in tocopherols, storage stability and vitamin E content are not affected by modern distillation technologies if the process is managed correctly. Storage stability measurements such as the determination of the peroxide number (POZ) and the TOTOX number, which record the development of primary and secondary oxidation products, or the Rancimat test, which shows the stability of fats against atmospheric oxygen in comparative tests, showed no negative impact on molecular distillation compared to conventional processes such as deodorization. On the contrary, time to the onset of oxidation, which is characterized by the formation of secondary oxidation products such as aldehydes, ketones and short-chain fatty acids, was significantly prolonged. As a result, POZ and

Top: Natural tocopherols in sunflower oil make it a valuable source of Vitamin E

Left: The right blend and quality of oils, especially for infant formula, is a major challenge. The fatty acid profile needs to be optimally balanced and all raw materials must meet highest quality guidelines.



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Top: Nutriswiss uses mild refining technologies to remove or significantly reduce contaminants in fats and oils for infant formula.

Rancimat tests often yielded better results than conventionally refined oils. In a specific comparative test conducted by Nutriswiss with a palm oil fraction that had been conventionally processed and then either deodorized or subjected to a gentle short path distillation, it was shown that the oxidation values of the sample from the short-path distillation increased much more slowly. This was as a result of secondary oxidation products being removed in a finer and more sustained manner. The oil or fat enters storage with a lower load of oxidation products and, at the same time, their formation appears to be delayed and reduced.

Even though the underlying mechanisms of this observation have not yet been clarified, Frank Möllering is more than satisfied with the results of the mild refining process. "Here, our many years of expertise in oil refining are paying off," he says. "Despite changing raw material properties and the balancing act between weak and intense treatment, we have honed the refining process to such an extent that we can preserve valuable ingredients and remove undesirable substances without impairing the stability of the end product." The new Nutriswiss process results in contaminants and other undesirable ingredients being largely removed, formation of harmful 3-MCPD and glycidyl fatty acid esters is avoided. At the same time a higher proportion of natural antioxidants and vitamins is retained. The mild processes generally achieve a higher or the same tocopherol content as traditional physical refining.

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