



# ProTain®

Making a difference  
in stabilizing feed ingredients

## Feed additives that give key benefits

- Highly efficient protection against oxidation
- Prolonged shelf life
- Preventing loss of fat-soluble vitamins A, D, E and K
- Preserved pigment quality
- Maintained product palatability

# Highly effective antioxidants

Oxidation of feed ingredients is a common problem in the feed industry. The negative effects of oxidation can be summarized as:

- Breakdown/degradation of fat-soluble vitamins A, D, E and K
- Breakdown/degradation of oils, fats and pigments
- Loss of palatability
- Loss of energy
- Development of toxic metabolites

Feeding oxidized feed to animals can result in decreased animal health and performance. Therefore it is crucial to prevent oxidation of feed and feed ingredients.

## Bottom line loss

The following is an example of how oxidation can lead to a loss of profitability. Oxidation can devalue some feed ingredients by 5–25%.

	Vitamins	Fish Meal	Oils&Fats
Devaluation of feed ingredients*	25%	5%	5%
Average cost of feed ingredients per tonne	€ 14,000	€ 1,000	€ 900
Devaluation per tonne	€ 3,500	€ 50	€ 45

\*Feed ingredients become unusable after complete oxidation

## Oxidation

Oxidation is the irreversible chemical reaction in which oxygen reacts with feed and feed components.

## The oxidation process

The oxidation process is like a chain reaction. Once the process has started it cannot be stopped, only delayed. The oxidation process can be divided into three phases:

### Initiation

In the initiation phase a lipid reacts under the influence of oxidation catalysts (metal ions, light, oxygen, temperature and specific enzymes). As a result of this reaction, a free radical is formed (•).

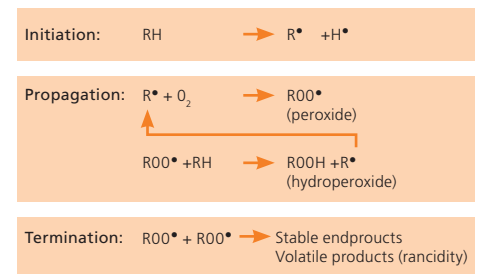
### Propagation

In the propagation phase the free radical reacts with oxygen, forming a peroxide radical. In turn, the peroxide radical reacts with a lipid, forming a hydroperoxide and another free radical. In this phase the chain reaction starts. Peroxide radicals and hydroperoxides will be formed as long as there are lipids.

## Termination

In the termination phase the radicals react with each other and form end product like aldehydes, ketones and organic acids. When this phase is finished the feed or feed ingredients are destroyed completely.

A schematic view of fat and oil oxidation is illustrated in the following diagram.



## Choosing the right ones

The technical data of the ProTain® range of feed additives that make a difference in stabilizing feed ingredients are presented below. They are discussed under two topic headings:

- ProTain® antioxidant additives
- Typical ProTain® applications

You can obtain detailed information on their properties, application and effectivity from our application specialists or our website: [www.perstorpfed.com](http://www.perstorpfed.com)

Perstorp is a supplier of ProTain® antioxidants to the petfood and feed industries.



# ProTain® antioxidant additives

Perstorp's solution to the problem of oxidation is an antioxidant product line called ProTain®.

ProTain® products prevent the chemical reactions involved in the oxidation process from taking place as early and quickly as possible. The main benefits of these solid or liquid feed additives are:

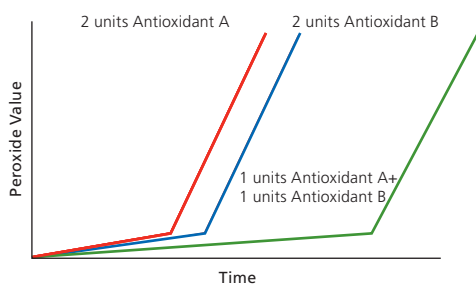
- Prolonged product shelf-life through ingredient stabilization.
- Protection of nutritional value and organoleptic quality.
- Highly efficient synergistic combinations of antioxidants with chelators.
- Maximal dispersion and effectivity of the antioxidant through optimal physical properties.

The ProTain® range is based on the following principles.

## Synergistic antioxidant mixtures

Antioxidant mixtures have proved to be far more effective than single antioxidants because of the synergistic effects between antioxidants.

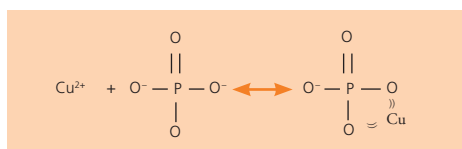
The following graph shows the principle of synergistic effects between antioxidants.



Synergistic effect of mixed antioxidants.

## Chelators

Chelators, e.g. citric acid and phosphoric acid, react with metal ions and form stable complexes. Through this reaction the catalyzing effects of metal ions in the initiation phase are prevented and thus the oxidation time is extended. The chelation process is shown in the diagram.



The chelation of metal ions.

## Dispersion

### Surfactants

The liquid ProTain® products contain surfactants to ensure that the antioxidants are perfectly dispersed in fats and oils.

### Nanometer-size particles

The solid ProTain® products consist of nanometer-size particles. This particle size gives a high surface to volume ratio, which means that the antioxidant has a high contact surface with the material that needs stabilizing. This leads to a highly increased effectiveness of the antioxidants.

## Natural antioxidants

Through our ongoing research activities a natural antioxidant range, ProTain® NA has been developed. ProTain® NA products are based on synergistic combinations of natural antioxidants like tocopherols and plant extracts in combination with natural chelators. Natural antioxidants are commonly used in the food and petfood industry.

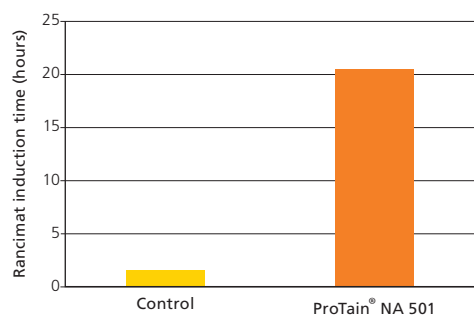
## Measuring oxidation

There are multiple methods to test the oxidation level of raw materials/end-products. They can be divided in predictive and indicative testing methods.

### Predictive testing

Rancimat test is a fast test which predicts the stability of a fat or oil. The method is based on a simple principle: a fat or oil is exposed to, elevated temperature (80-120°C) and air flow. Finally this results in oxidation.

The time needed to start the oxidation process is known as the induction time. A longer induction time means a more stable fat or oil in practice. The graph below shows a result from the rancimat test. The longer it takes to reach a certain amount of volatile acids, the more stable the fat or oil is.

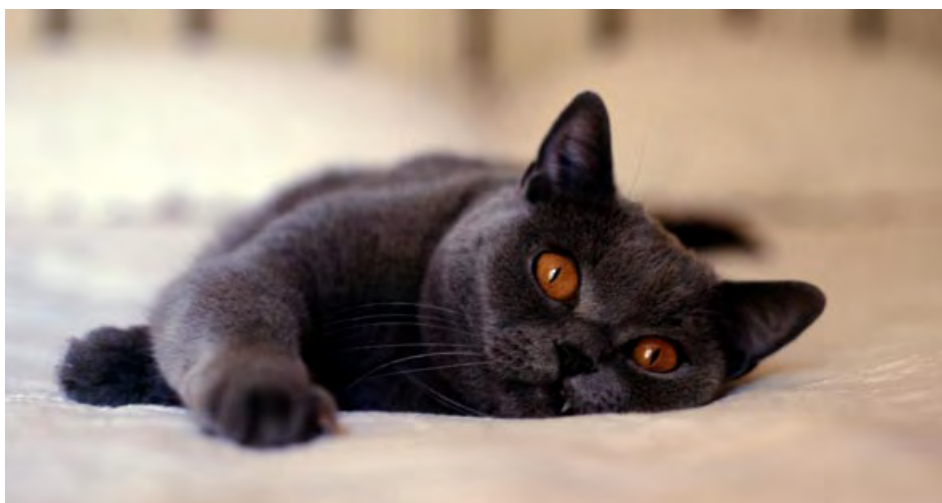


Efficiency of natural antioxidants on animal fat at a dosage rate of 200 ppm.

### Indicative testing

Peroxide Value, which measures the peroxide and hydroperoxide concentrations that are formed. Peroxide Value can also be followed over time to test the stability of feed or feed ingredients. When the Peroxide Value exceeds 20 meq/kg, the quality of the feed or feed ingredient has decreased in such a way that it is not suitable for use anymore.

The Rancimat test, Peroxide Value and measuring the antioxidant level in stabilized products are practical tools we offer our customers to provide good service. We can recommend the best antioxidant and dosage rate for each customer individually and furthermore we can follow their stabilized products over time.

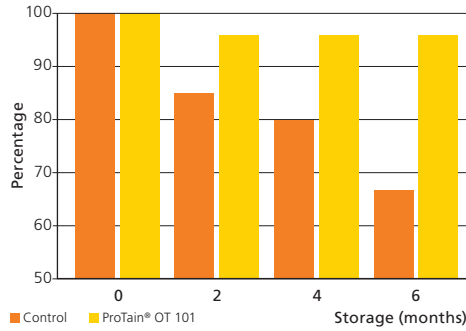


# Typical ProTain® applications

ProTain® is typically used to prevent the oxidation in:

- Premixes
- Feed
- Pet food
- Vegetable oils
- Fish oil/meal
- Animal fat
- Vitamins
- Pigments

For maximum protection ProTain® should be added as soon as possible and at the correct dose levels. The following graph shows the effect of adding ProTain® OT 101 to protect vitamin A in a premix.

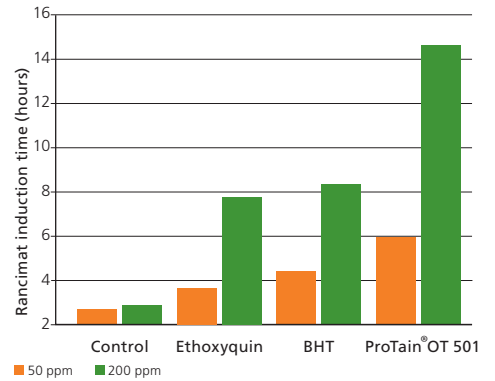


Recovery (%) of remaining vitamin A in a premix.

The measured vitamin A content in the premix remained stable when ProTain® was added and showed a large decrease when no antioxidant was added. The high price of vitamins therefore makes it economically attractive to add ProTain®.

The effect of different antioxidants and dosage levels on preventing the oxidation of animal fat can be seen in the following graph.

The results clearly show that dosage rate and type of antioxidant make an important difference in protecting against oxidation. To achieve the maximum protection of feed and feed ingredients, it is of great importance to consult our application specialist to choose the right ProTain® product and dose level.



Effect of antioxidants on lard at different dosage rates.



{ healthier }

# An innovative leader in the feed additive market

For nearly fifty years Perstorp has been involved with developing a range of highly effective feed additives to improve the performance of farm animals.

During the 1960s Perstorp was one of the first companies to introduce acid-based silage additives to the market. And in the '80s, Franklin Products International – now integrated with Perstorp – was pioneering the use of lactic acid in formulas for acidifiers and antibacterials in the European market.

Today, the range, quality and properties of our feed additives make a real difference in helping you to become more competitive. As a world leader in this arena, we aim to keep it this way.

## Maintaining feed value and animal health

There are a number of ways that Perstorp feed additives maintain the nutritional and economic value of feed, and protect animal health:

- Inhibiting microbial growth to preserve the nutritional value of feed.
- Specifically inhibiting the growth of pathogenic bacteria like *Salmonella*, *Campylobacter* and enteric bacteria like *Escherichia coli* to protect animal and human health along the food chain.
- Acidifying the gastrointestinal tract for rapid adjustment of farm animals to compound feed after weaning.
- Prevention of diarrhea in animals.
- Prolonging shelf-life.
- Improving the digestibility of feed.
- Stabilizing feed ingredients.



## Our “Pro” lines for professionals

The core product lines and benefits of Perstorp feed additives are:

### ProSid®

Mould inhibitors, toxin binders and immune stimulants for preventing and overcoming mould-related problems.

### ProMyr®

Silage additives for the preservation of nutrients, minimizing bacterial spores and increasing the storage life of roughage.

### ProPhorce®

Acidifiers, antibacterials and feed preservatives that result in healthier animals and higher performance.

### ProFare®

Enzymes for increasing the digestibility of feed and the nutritional value of feed ingredients.

### ProTain®

Antioxidants for stabilizing feed ingredients and prolonging product shelf-life.

## An extensive program of customer care

As our product knowledge is complemented with thorough technical support, you can depend on us for your feed needs along the food chain. Perstorp employs several application specialists to promote good customer care through personal contact, discussing relevant feed topics, and following up our activities with you.

As we like to form a partnership with you, we do our best to satisfy your feed additive requirements and foster long-term relationships. Through our unique raw material position and know-how with formic acids, formates, propionic acids and propionates, we are able to continue developing cost-effective customer solutions.

When you choose Perstorp as your partner, we strive to safeguard your investment.





## Your Winning Formula

The Perstorp Group is the world leader in several sectors of the specialty chemicals market. Few chemical companies in the world can rival its 125 years of success. Today we have a rich performance culture distilled from our long history and extensive knowledge in the chemical industry. That culture and knowledge base enables us to produce Winning Formulas for a wide variety of industries and applications.

Our products are used in the aerospace, marine, coatings, chemicals, plastics, engineering and construction industries. They can also be found in automotive, agricultural feed, food, packaging, textile, paper and electronics applications.

Our production plants are strategically located in Europe, North America and Asia and are supplemented by sales offices in all major markets. We can offer you speedy regional support and a flexible attitude to suit your business needs.

If you want a partner for feed additives who can offer you focused innovation to enhance your product or application, which is delivered reliably and responsibly, look no further. We have a winning formula waiting for you.