

PART 1:

ANTI-OXIDANTS AND OXIDATIVE STRESS DURING PHYSICAL EXERCISE

INTRODUCTION

Today, nobody any longer doubts that, just as in human sport, an optimal diet is required for top performance in pigeons, a diet specifically attuned to physical effort. For many decades grain mixes have been supplemented as much as possible with all known missing nutritional elements. The development of extruded pigeon feeds was a real breakthrough because this modern manufacturing process makes it possible to supplement all the nutritional elements lacking in traditional grain blends in an easily digestible pellet. Initially the known nutritional elements missing from the grain blends were mainly supplemented: vitamins, essential amino acids, trace elements and minerals such as calcium.

In recent years an entirely new generation of pigeon feeds was born following the most recent trends in human nutrition. Indeed, new scientific insights indicate that the diet has a strong impact on the health, condition, immunity and recovery. This function is ascribed to so-called "nutraceuticals": natural nutritional substances with a health supporting function. In recent years an entire range of bioactive substances have been discovered with an important effect on the condition and immunity. A modern sport diet consequently not only aims to provide all the nutritional needs but should be composed in such a way that it also optimally supports the condition and immunity.

„Let food be your medicine and medicine be your food.“

This is a quote by Hippocrates from 400 BC. This ancient wisdom has increasingly more meaning these days.

ANTI-OXIDANTS AND OXIDATIVE STRESS WITH MUSCULAR ACTIVITY

What is oxidative stress?

The body is a large and complex chemical factory. Free radicals are released in a lot of chemical reactions. These are molecules with a strong oxidising activity that damage the body cells and delay recuperation. To counter these damaging effects anti-oxidants, also called defensive substances, are essential. Consequently it is important that the diet includes enough anti-oxidants to neutralise these oxidants. The balance between oxidants and anti-oxidants must always be maintained.

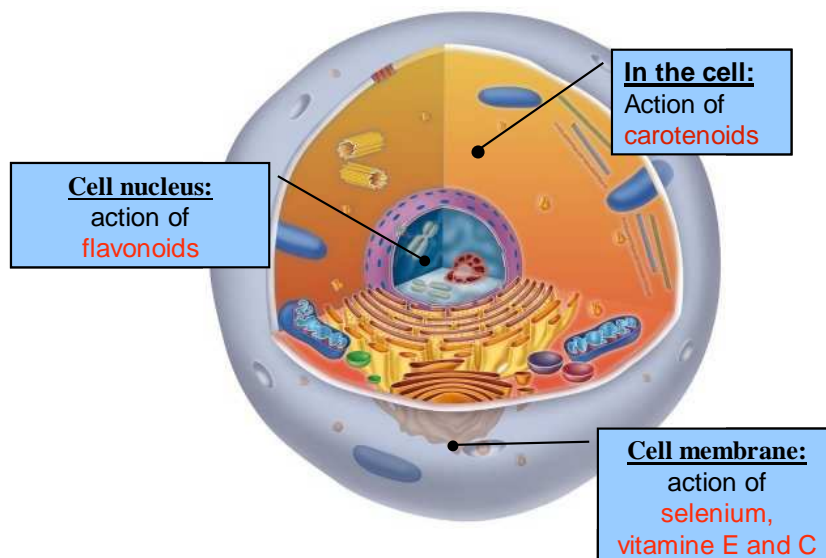
Diverse situations can result in oxidative stress in the organism. Intense physical effort is one of the main causes of this. For optimal performance it is very important to prevent this because oxidative stress damages the energy production. It has been scientifically shown that oxidative stress causes the leakage of electrons in the mitochondrial respiration, resulting in reduced energy production.

Racing pigeons suffer a lot of muscular damage due to oxidative stress with heavy aerobic effort, much more than in human athletes. Flying is a highly energy-intensive activity that makes heavy physiological demands on birds. Recent scientific research carried out in Italy (Costantini et al, 2008) measured indicators of oxidative stress in pigeons that had to fly 60 or 200 km respectively. The pigeons that had to fly 200 km had 86% more oxidative stress. It was also apparent that older pigeons had more problems with oxidative stress. Combating oxidative stress is consequently crucially important to limit muscular damage during physical effort and to keep pigeons in optimal condition.

Anti-oxidants

To combat oxidative stress the antioxidant capacity of the serum must be improved. The anti-oxidant capacity of the serum is primarily defined by the anti-oxidants supplied via the food. Anti-oxidants are natural nutritional components that make free radicals in the body harmless. The new trend to give as many anti-oxidants as possible in the pigeon's diet via extruded pellets is consequently an interesting development.

Figure: _____ the place in the body cell where the various dietary anti-oxidants act



The **flavonoids** belong to the most powerful anti-oxidants. Flavonoids are polyphenols that occur through vegetable nutritional components and consequently also in vegetables and fruit. In vegetables and fruit these substances are responsible for the great variety of colours, from yellow to red and dark purple. Subgroups within the flavonoids include flavonols, flavones, flavanones, catechins, anthocyanins and

isoflavonoids. Currently approximately 4000 types of flavonoids have been described. Flavonoids mainly occur in vegetables and fruit and also in tea and red wine.

Carotenoids are also powerful anti-oxidants. Besides chlorophyll and flavonoids, carotenoids are the main natural colorants. They are responsible for the red, orange and yellow colour of fruit and vegetables. Carotenoids are the precursors of vitamin A and occur in many types of vegetables and fruit. There are more than 500 variants, including β -carotene and lutein. Carotenoids are fat-soluble anti-oxidants.

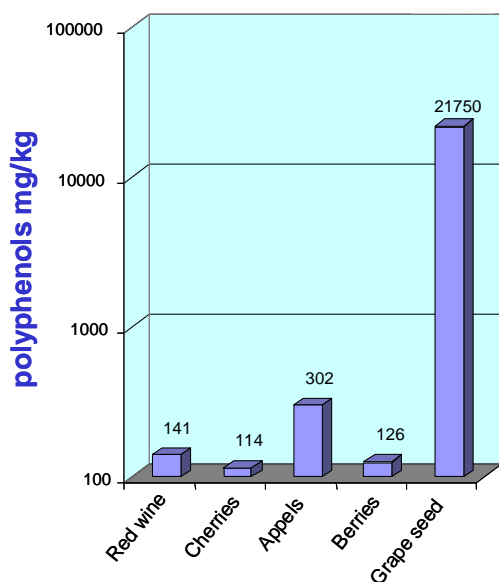
Other nutritional substances with an anti-oxidant action; **vitamins C, E** and the mineral **selenium**.

Sources of anti-oxidants

➤ Grape seed extracts

In human sport nutrition, grape seed extract is very frequently used as it combats oxidative stress and muscular damage due to its high concentration of **flavonoids** with anti-oxidative characteristics (e.g. **resveratrol**). A lot of sports drinks are enriched with grape seed extract for that reason.

Recent scientific studies (Lafay et al, 2009) showed the **performance improving action** of grape seed extracts in athletes.



Giving athletes grape seed extract resulted in the following positive effects:

+23.9% improvement of physical performance

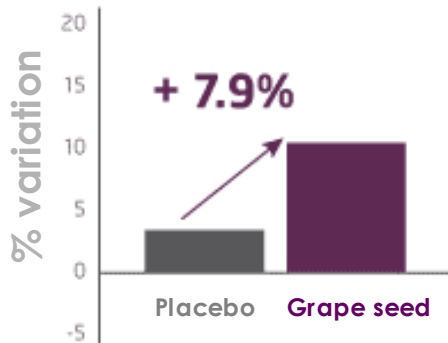
+7.9% increase in recovery capacity

+3.6% increase of the oxygen supply in the muscles

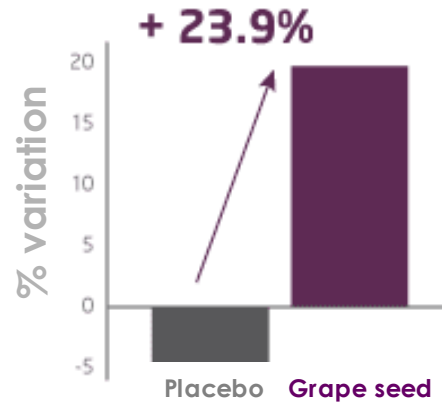
-100.9% decrease in muscular damage

- 48.8% decrease in inflammation

Increase in Recovery capacity



Increase in Performance



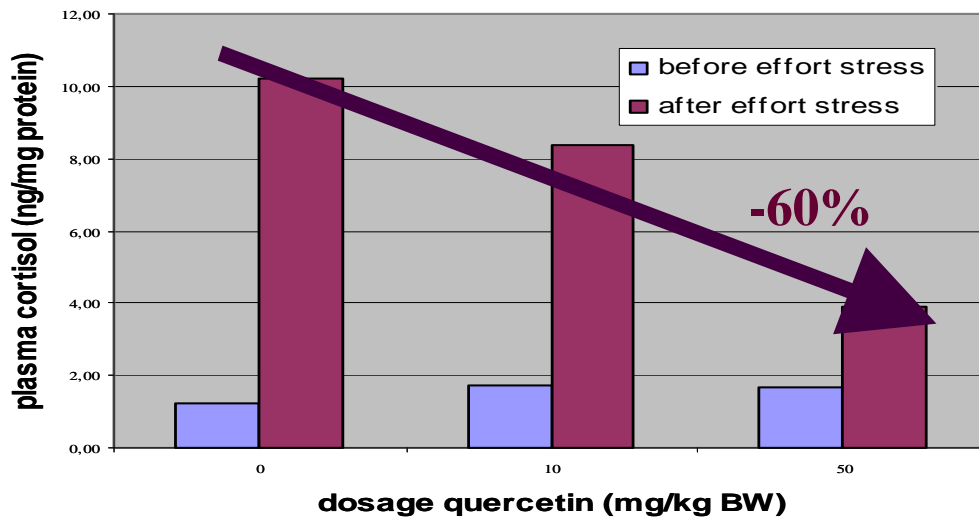
Graph: positive effects of grape seed extract in athletes

➤ Elderberry and cranberries

Elderberries and cranberries are very rich in flavonoids with a powerful and anti-oxidative action. For instance, the purple colour of berries is caused by anthocyanins. These purple pigments are not only ascribed anti-oxidative but also anti-viral characteristics. Furthermore anthocyanins stimulate the immunity.

Another flavonoid in elderberries is quercetin. Scientific studies (Kawabata et al, 2009) indicated that a diet rich in quercetin ensures that the body generates less of the hormone cortisol that breaks down muscles after stress or intensive physical effort. Quercetin consequently helps to ensure that there is less muscular breakdown after flight.

Cortisol release in function of quercetin supplementation



Graph: the administration of quercetin reduces the release of the muscle damaging hormone cortisol after effort.

Another special feature of elderberries is the presence of lectins which are attributed with virus-inhibiting characteristics. Lectins are special vegetable proteins with a special binding capacity. For these reasons the lectins in elderberries bind viruses and are used in man for respiratory infections and flu. 2400 years ago, the Greek philosopher Hippocrates already

described the special qualities of elderberries. According to the Greeks the positive effects on the body were not limited to the berries but also included the branches, flowers and leaves. This fact survived down the ages and elderberry continued to be used frequently during the Middle Ages to increase the body's resistance. It took until well into the 20th century before the secret of the black elderberry was successfully unravelled.

Over the last 20 years attention for the unique characteristics of elderberry has revived. The awareness increasingly grew that this conventional wisdom is based on true foundations and that elderberries do actually have a powerful positive effect on the immune system.

The elderberry story is a good example of how conventional wisdom is finally confirmed by science. The conclusion is consequently also that berries such as elderberries and cranberries also have a scientifically proven health supporting action for pigeons.

➤ Azuki beans

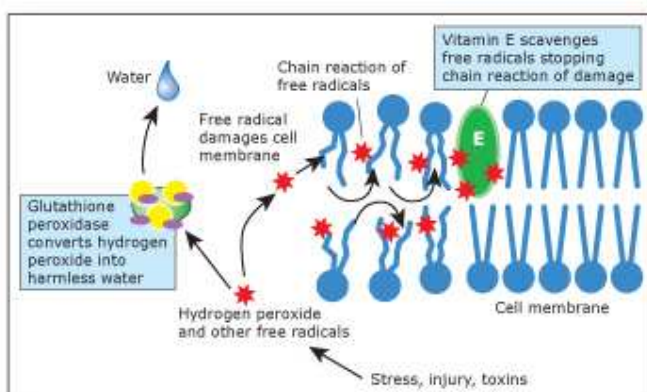
The Azuki bean is mainly popular in the Far East, specifically in Japan. This purple-red easily digestible bean with a long white germ grows in Japan, China and South Asia. The oval beans have a diameter of +/- 5 mm. The white comb on one side is highly characteristic. Like the majority of beans, azuki beans are rich in water-soluble fibres that promote intestinal balance. Azuki beans are also a good source of magnesium, potassium, iron, zinc, copper, manganese and vitamin B3. However, the red Azuki beans contain particularly **high levels of flavonoids**, including **pro-anthocyanidins**: powerful biological anti-oxidants are with cell protecting action. These pro-anthocyanidins may also have a clear antibacterial and antiviral activity.



The azuki bean owes its red colour to the high levels of cell-protecting bioflavonoids

➤ Organic selenium

The trace element selenium also has an important function as a protector of cells and particularly for muscle cells exposed to "oxidative stress" with physical performance. The anti-oxidant action of selenium is attributable to the fact that it is an essential part of the cell protective glutathione peroxidase.



*Figure:
As a component in glutathione peroxidase, selenium helps to protect the cell membrane against free radicals*

Selenium can only carry out its cell protecting function if the selenium element is supplied in the right form. Usually selenium is supplemented in feeds in an inorganic form. However this form cannot be absorbed well at all by man or animal.

This inorganic form of selenium is absorbed by plants or yeasts and converted into organic selenium. This organic form of selenium is biologically very well assimilable by pigeons.

Organic selenium has recently been authorised for use as a nutritional additive and organic selenium is now added to the better pigeon feeds.

The amount of selenium in the grains and seeds is decreasing worldwide. Acid rain results in chemical reactions in the soil which causes the selenium compounds present to disintegrate

and the remaining free selenium is not absorbed by the plants and consequently by animals and man. A selenium deficiency may result amongst other things in hepatic, pancreatic and muscular disorders.

In addition to being an antioxidant, selenium is also important in numerous other functions in the body, such as fertility, immunity, muscular development and brain activity. In pigeons organic selenium moreover ensures better feather development, stronger egg shells and better hatching percentages.

The action of organic selenium in racing pigeons was recently investigated by the Faculty of Veterinary Science of Liege (Schoonheere et al, 2009). Two groups of 8 pigeons were respectively given a ration with normal (30.3 µg Se/kg) or high level organic selenium (195.3 µg Se/kg). A higher activity of the cell protecting glutathione peroxidase could be shown amongst the pigeons given the ration with the highest level of organic selenium and furthermore significantly less lactic acid is formed. The clear muscle protective activity of organic selenium in pigeons is consequently also apparent from this study.

Recent scientific studies indicate that organic selenium protects the muscles and reduces the formation of lactic acid in pigeons.

Conclusion.

In recent years a lot of scientific information has become available that shows that a lot of bio-active substances via the diet can impact sporting performance. This knowledge is already fully exploited in the human top sporting world. These new insights are also extremely important for pigeons and we are at the beginning of a new generation of feeds enriched with nutraceuticals that affect the health, condition and immunity.

Neutralising the consequences of oxidative stress caused by physical effort through the provision of a diet rich in anti-oxidants is important for optimal top performance. For instance, grape seeds, elderberries, azuki beans and/or organic selenium may be added to the diet via an extruded pellet.

How extruded pigeon feeds can affect the digestive health will be described in a next article.

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