

**61 - USE OF ANTIOXIDANTS IN PHYSICAL TRAINING.**

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**INTRODUCTION**

When there is an increase in production or decrease of antioxidant defenses there is a condition called oxidative stress, where the free radicals in excess start to cause damage to lipids, proteins, DNA, carbohydrates (FANHANI and Ferreira 2006, KLEINER, 2009; COOPER, 2005; BIANCHI, 1999).

The best prevention method of the effects of free radicals is through a diet rich in antioxidants. The antioxidants substances are comprised of vitamins, minerals, natural pigments and other vegetable compounds, and also by enzymes that fight the harmful effects of free radicals. As the name implies, they prevent the oxidation of other chemical substances (VULCZAK and MONTEIRO, 2008; MACEDO, 2005).

Antioxidants can be food borne, endogenous and of protective factors (enzymes). There are two types of enzymes that remove hydrogen peroxide. They are the catalyses and the glutathione peroxidases. Under the action of glutathione peroxidases, hydrogen peroxide reacts with the reduced glutathione, oxidizes to form two water molecules and oxidized glutathione (COSTA, 2009; STAHL and SIE, 1997). Among the preventive antioxidants are reduced glutathione (GSH), superoxide dismutase (SOD), catalyse, glutathione peroxidase (GSH - Px) and vitamin E. Among the restores are the glutathione reductase (GSH - Rd) glutathione peroxidases (GSH - Px) and ascorbic acid (CAMPOS, 2004).

Catalyse is a cytoplasmic hemeprotein that catalyzes the reduction of H<sub>2</sub>O<sub>2</sub> to H<sub>2</sub>O and O<sub>2</sub>. It is present in most tissues, but is concentrated mainly in the liver, kidney, spleen and erythrocytes. These enzymes are also found in vegetables (Weineck, 2005).

Among the phytochemicals with antioxidant properties stand out the ascorbic acid (vitamin C), vitamin E,  $\beta$  - carotene, lycopene and phenolic compounds (COOPER, 2005; KLEINER, 2009)

The relationship between metabolism and the production of free radicals in the body is worth noting, as well as the action of antioxidants in the promotion of health, especially of those engaged in physical activity.

In a recent study Benício, (2010) concluded that the supervisors of physical exercise showed a moderately sufficient knowledge about free radicals and lack sufficient information about the action mechanism of them in the body. They also demonstrated little knowledge about the diseases mentioned in the survey, related to oxidative stress. However, these supervisors recognize the importance of healthy eating combined with physical activity in health promotion. So the need for a multidisciplinary education aimed at improving the efficiency of training to promote health and quality of life becomes evident. The aim of the project is to evaluate the nutritional quality of food with emphasis on antioxidant potential related to the impact of antioxidants and functional foods in the maintenance of balance in the body which protects it against diseases.

**METHOD**

The study was conducted on the premises of NOVAFAPI, being held in 2002 (two) activities listed below: 1. Evaluation of the catalyse activity from the degradation of hydrogen peroxide; 2. Qualitative assessment of the main antioxidants in the diet and physically activity, using materials available in the Scielo database from 1990 to present time. The quantitative tests of the enzyme action were developed in the laboratories of biology and biochemistry of this Institution. 7 (seven) types of food purchased in the local market, which were tested for the presence of catalyses through the decomposition of hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) 10V according to Macedo et al (2005), were used in the quantitative test. The materials evaluated were: sweet potatoes, apples, potatoes, beets, chayote, mango, pumpkin.

There were two stages to evaluate enzymatic action of the catalyse.

- 1 – The identification of the existence of the enzyme in the materials under study.
- 2 - Heat treatment of the food for inactivity verification of the catalyse.

**RESULTS****Bibliographic search**

The data obtained in the bibliographic research demonstrate a direct relationship between physical activity, especially exhaustive exercise, and the production of free radicals. It also underscores the importance of using antioxidants, into neutralizing free radicals.

**Assessment of the Catalyse's Activity**

The Data from the tests done on foods for the presence of catalyse are listed in Tables 1, 2 and 3. The Identification of catalyse in food was done by simple procedures, where samples were added to test tubes containing hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) 0.1 M according to Macedo et al (2005). Tests were carried out in food crushed, not crushed and subjected to heating. The catalyse enzyme captures the hydrogen peroxide and decomposes into oxygen and water before it can form hydroxyl radicals. Oxygen and water produced in this process are then reused by the cells as part of normal metabolism.

Table 1 - Presence (activity) of catalyse in not crushed materials

FOOD	CATALYS E'S ACTIVITIES
Sweet potato	++
Apple	++
Potato	+++
Beet	+++
Chayote	+++
Mango	++
Pumpkin	++

++ - Little activity

+++ - Medium activity

Table 2 - Presence (activity) of catalyse in crushed materials

FOOD	CATALYSE'S ACTIVITIES
Sweet potato	+++++
Apple	++
Potato	+++
Beet	+++
Chayote	+++++
Mango	++
Pumpkin	++

++ - Little activity

+++ - Medium activity

+++++ - Great activity

Table 3 - Thermal Test of Catalyse (Boiling Water)

FOOD	Not Boiled	Boiled (1 minute)
Potato	+++	No activity
Chayote	+++	No activity
Beet	++	No activity

++ - Little activity

+++ - Medium activity

Under the conditions of this experiment - considering positive test for the presence (activity) of the catalyse enzyme, when there was the release of oxygen (O<sub>2</sub>) shown by the formation of bubbles, foods with higher catalyse activity were sweet potato, potato, beet and chayote. Catalyse (formerly called hidropoxidase) is an intracellular enzyme, found in most organisms, which decomposes hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) under the chemical reaction:  $2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2\text{O} + \text{O}_2$ . The activity of catalyse is conditioned by several factors. High temperatures inactivate the enzyme catalyse. In this experiment were tested three foods subjected to boiling water for 1 minute. There was the inactivity of catalyse in the three foods tested (Table 3), due to high temperature.

The evaluation of the catalyse enzyme can be made by using materials of animal origin: in blood cells, brain, liver, heart and other important organs and tissues (FERREIRA, 1997; GARCIA, 2002).

## DISCUSSION

Several studies show that during exercise, especially intense exercise and with prolonged duration may cause the increase of free radicals (SCHNEIDER, 2004; PASCHOAL, 1998; VULCZAK and MONTEIRO, 2008).

The increased production of free radicals during exercise may occur by increasing the level of catecholamine by lactic acid production, the increase of the auto-oxidation of hemoglobin by hyperthermia and mainly by oxygen consumption (Garcia, 2002; VULCZAK and MONTEIRO, 2008).

In the intense physical effort, there is an increase in oxygen consumption, and a higher percentage of oxygen is not reduced by the enzyme cytochrome - oxidizes and consequently higher production of free radicals. On the other hand, the mechanism of reperfusion ischemia that occurs in intense exercise also leads to the production of free radicals (COOPER, 2005; CRUZAT, 2007; WEINECK, 2005) during exercise, the blood flow is restricted in many organs and tissues in order to increase the contribution to the active muscles according to Garcia (2002). The muscles of regions temporarily deprived of adequate flow enter in a state of hypoxia, which is greater the more intense is the exercise. All affected areas, re-oxygenated leads to increased production of free radicals according to Garcia, (2002) and Schneider, (2004). Another mechanism of free radical production is the auto-oxidation of catecholamine, whose levels can be increased during physical efforts. Besides hyperthermia, catecholamine may increase the rate of production of free radicals (MARTIM, 2007).

Catecholamine is the collective denomination of two hormones, adrenaline and noradrenalin. Increased levels of catecholamine during exercise may be explained by the need for increased glucose uptake, increased heart function, vasoconstriction to redistribute blood volume and increased respiratory requirements. The role of free radicals in the ischemia and reperfusion process, causing tissue injury, has been extensively studied in the intestine, stomach, liver, pancreas, kidneys, heart and brain. (NETO, 2005; SANTOS, 2006; VULCZAK and MONTEIRO, 2008).

Thus, the acute physical exercise, due to the increase in oxygen consumption, promotes increased formation of free radicals, causing various pathologies according to Voet, (2001). Several authors found a strong relationship between the excessive production and muscle injury that can range from an ultra structural injury of muscle fibers to even traumas involving complete muscle rupture. Antioxidants offer protection against these injuries. It has been emphasized that vitamin E has an important function in reducing muscle damage. (KLEINER, 2009)

However, physical training is able to generate adaptations capable of mitigating the harmful effects caused by free radicals. These adaptations are related to a series of systems, which the most important are the enzymatic systems and other antioxidants, the authors emphasize that the factors most directly related to oxidative stress are the intensity and level of exhaustion of the individual subjected to exercise and, therefore the exposure to higher oxygen flow (SCHNEIDER and OLIVEIRA, 2004).

As a consequence of increased production of free radicals, occurs a greater common of antioxidants, meaning that the oxidative stress antioxidant depletion occurs faster (HALLIWELL, 1990).

This demand of antioxidants in the body must be satisfied, otherwise, may occur the pathological oxidative stress. Vitamin E (alpha-tocopherol), which is found intercalated in the lipid molecules of membranes, controls the peroxidation. This enzyme supplies hydrogen atoms, preventing the chain spread of the peroxidation of cell membranes. (MAHAN, 2010; PASCHOAL, 1998)

The human body defense system consists mainly of the catalyse enzymes, superoxide dismutase and glutathione peroxidase, requires the existence of adequate levels of minerals such as zinc, copper and selenium, in addition to sufficient quantities of high quality protein and vitamins according to Rocha, (2010). The antioxidants taken through diet help strengthening

our defenses against the excess of free radicals. The most important external antioxidants (exogenous) are vitamin C, vitamin E and Beta Carotene (HALLIWELL, 1994; SHAMI, 2004; COOPER, 2005).

In tests conducted to evaluate the activity of catalase proved the presence of this antioxidant enzyme in all foods tested.

Under the conditions of this experiment - considering positive test for the presence (activity) of the catalase enzyme, when there was the release of oxygen (O<sub>2</sub>) shown by the formation of bubbles, foods with higher catalase's activity were sweet potato, potato, beet and chayote. The catalase (formerly called hidroperoxidase) is an intracellular enzyme, found in most organisms, which decomposes hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) under the chemical reaction: 2 H<sub>2</sub>O<sub>2</sub> → 2 H<sub>2</sub>O + O<sub>2</sub>

The activity of catalase is conditioned by several factors. High temperatures inactivate the enzyme catalase. In this experiment were tested three foods subjected to boiling water for 1 minute. It was verified the inactivity of the catalase in the three foods tested (Table 3), due to high temperature.

The evaluation of catalase can be made using materials of animal origin: in blood cells, brain, liver, heart and other organs and tissues important (FERREIRA, 1997; GARCIA, 2002).

### CONCLUSION

According to the results obtained, it is possible to conclude that sweet potato, potato, beet and Chayote showed higher catalase activity. However, it is noteworthy that the catalase activity is conditioned by several factors, such as high temperatures, sharp variations of pH and other that inactivate the enzyme. Another important aspect of this study was the possibility to qualitatively assess, using a simple methodology, the action of this in seven products purchased in the local market, and that are a part of the diet especially of those that practice physical activities.

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### USE OF ANTIOXIDANTS IN PHYSICAL TRAINING.

#### ABSTRACT

This study aimed to characterize foods with antioxidant potential, using available material on the Scielo's database from 1990 to the present time and to assess the antioxidant actions of the cellular catalases enzyme in foods. The activity evaluation of the catalases enzyme was carried out from the degradation of the hydrogen peroxide. The data obtained in the

bibliographic research demonstrates a direct relationship between physical activity, especially the exhaustive exercise, and the production of free radicals. The tests for the presence of catalyses were positive in all foods analyzed. The thermal test for catalyses demonstrated the inactivity of the enzyme in the three foods tested, due to high temperature. The results of this research show a direct relationship between physical activity, especially the exhaustive exercise, and the production of free radicals. Also underscore the importance of using antioxidants to neutralize free radicals. But there is a need for more studies on the subject.

**KEYWORDS:** nutrition, training, and antioxidants.

#### **UTILISATION D'ANTIOXYDANTS DANS LES ENTRAÎNEMENTS PHYSIQUES**

##### **RÉSUMÉ**

Cette étude a eu pour but de caractériser des aliments comme potentiel antioxydante, en employant le matériel disponible dans la base de données Scielo de la période de 1990 jusqu'à l'actualité et d'évaluer l'action antioxydante de l'enzyme catalase cellulaire dans les aliments. L'évaluation de l'activité de l'enzyme catalase a été conclue à partir de la dégradation du peroxyde d'hydrogène. Les données obtenues dans la recherche bibliographique démontrent un rapport direct entre la pratique de l'activité physique, surtout les activités exhaustives, et la production des radicaux libres. Les tests pour la présence de catalase ont été positifs dans tous les aliments analysés. Le test thermique pour la catalase a démontré l'inactivité de l'enzyme dans les 3 aliments testés, en raison de la température élevée. Les résultats obtenus dans cette recherche démontrent une étroite relation entre la pratique d'activité physique, principalement les exercices exhaustifs, et la production des radicaux libres. On relève aussi l'importance de l'utilisation d'antioxydante dans la neutralisation des radicaux libres. On a besoin cependant de plus d'études sur ce sujet.

**MOTS-CLÉS:** nutrition, entraînement et antioxydante.

#### **USO DE ANTIOXIDANTES EN ENTRENAMIENTOS FÍSICOS.**

##### **RESUMEN**

Este estudio tuvo como objetivo caracterizar a los alimentos con potencial antioxidante, utilizando el material disponible en la base de datos de Scielo de 1990 hasta el presente, y para evaluar la enzima catalasa en los alimentos antioxidantes celulares. La evaluación de la actividad de la catalasa se llevó a cabo a partir de la degradación del peróxido de hidrógeno. Los datos obtenidos en la literatura demuestran una relación directa entre la actividad física, especialmente el ejercicio exhaustivo, y la producción de radicales libres. Las pruebas para detectar la presencia de la catalasa fue positiva en todos los alimentos analizados. La prueba térmica para la catalasa exhibió la falta de actividad de la enzima en los tres alimentos analizados, debido a las altas temperaturas. Los resultados de esta investigación muestran una relación directa entre la actividad física, especialmente el ejercicio exhaustivo, y la producción de radicales libres. También subrayan la importancia del uso de antioxidantes para neutralizar los radicales libres. Pero necesitan más estudios sobre el tema.

**PALABRAS CLAVE:** nutrición, capacitación y antioxidantes.

#### **UTILIZAÇÃO DE ANTIOXIDANTES EM TREINAMENTOS FÍSICOS.**

##### **RESUMO**

O presente estudo visou caracterizar alimentos com potencial antioxidante, utilizando-se de material disponíveis em base de dados Scielo do período de 1990 a atualidade e avaliar a ação antioxidante da enzima catalase celular em alimentos. A avaliação da atividade da enzima catalase, foi realizada a partir da degradação do peróxido de hidrogênio. Os dados obtidos na pesquisa bibliográfica demonstram uma relação direta entre a prática de atividade física, especialmente os exercícios exaustivos, e a produção de radicais livres. Os testes para presença de catalase foram positivos em todos os alimentos avaliados. O teste térmico para catalase demonstrou a inatividade da enzima nos 3 alimentos testados, em função da alta temperatura. Os resultados obtidos nesta pesquisa demonstram uma relação direta entre a prática de atividade física, especialmente os exercícios exaustivos, e a produção de radicais livres. Também ressaltam a importância da utilização de antioxidantes, na neutralização dos radicais livres. Necessitando porém de mais estudos a respeito do tema.

**PALAVRAS-CHAVE:** nutrição, treinamento e antioxidantes.