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THE EXAMINATION OF UV ABSORPTION OF POLYPHENOLS (NATURAL SUBSTANCES IN UV PROTECTION)

Abstract

Thereinafter, as a continuation of the earlier published article about fulvic acids (The examination of the role of natural substances in the protection against UV radiation - Hadmérnök VIII. Évfolyam 1. szám - 2013. március) the author introduced a subsequent natural substance, the solution red grape skin extract ie. polyphenol extract. In the military health care, the advanced sunscreen products play an important role as being integral part of the new UV radiation protection system and the training system the authors have planned. These substances must meet the following criteria: efficient, natural, easily available in large quantities, cheap, non-toxic, antioxidant. In his series of experiments, the author was looking for substances complying with these principles. [1] As earlier fulvic acids and last polyphenols were taken into account, and the author examined if, on the basis of the UV absorption of these substances, it may be used as the component of the sun protection cream the authors have imagined.

A következőkben a szerző egy korábban megjelent, a fulvósavakkal foglalkozó cikk (The examination of the role of natural substances in the protection against UV radiation - Hadmérnök VIII. Évfolyam 1. szám - 2013. március) folytatásaként újabb természetes anyagot - a vörös szőlő héj kivonatát, azaz polifenol kivonatot - mutat be. A katonai egészségvédelemben a szerző által tervezett új UV sugárvédelmi rendszer és kiképzési rendszer szerves részeként fontos szerepet játszanak a korszerű napvédő anyagok. Ezeknek az anyagoknak a következő szempontoknak kell megfelelniük: hatékony, természetes, nagy mennyiségben könnyen előállítható, olcsó, nem toxikus, antioxidáns tulajdonságú. Kísérlet sorozatban ezen elveknek megfelelő anyagokat keresett a szerző, így első lépésként a fulvósavak kerültek látóterébe és azt vizsgálta, hogy ezek az anyagok UV abszorbciója alapján alkalmas lehet-e az általa elképzelt napvédő krém komponenseként alkalmazni.

Keywords: *fulvic-acid, polyphnol, UV absorption ~ fulvósav, polifenol, UV abszorpció*

INTRODUCTION

In the following, the author will present that for personal UV protection, as being part of the complex UV protection planned in the Hungarian Army, the author plans to examine an efficient, cost effective substance of natural origin.

UV radiation is one of the most predictable health-endangering agents among the extreme external factors affecting soldiers serving in missions far away from our country (e.g. Afghanistan, Iraq, Cyprus and Egypt).

In these duty stations, the number of hours spent in the direct sunlight is high in working hours or rest period, entailing short and long-term risks of irreversible effects. In Cyprus for example, the approximate number of the sunny days can be 300 per year, the UV index is almost always in the in the range of 8 to 10 in the summer, and even the extreme value of 11+ is not rare, based on personal experience. [3]

This subject needs to be a requirement as part of military culture for those on military service in Hungary on a regular basis, because even here this environmental factor is a danger of increasing significance. Because of its adverse effects, it may jeopardise the performance abilities of the military personnel both short term (e.g. immune suppression) and long term (e.g. melanoma).

PERSONAL UV PROTECTION

The complex UV protection is divided into following parts

- primer prevention e.g.: education regulation, personal protection
- secunder prevention screening tests (pre- and post-test)

Personal protection is one of the forms of prevention, it can be by the usage of personal protective equipment (e.g. sunglasses), appropriate clothing (sun cap hat, shell-jacket) and sunscreen (sun protection creams).

The currently available sun protection creams, ointments, solutions are mostly artificial, multicomponent and relatively expensive.

However, the protective material the author has imagined contains 1 or 2 natural materials apart from the carrier that can be produced in large quantities very cheaply. The UV absorption is in the appropriate range and has significant antioxidant effects, which can slow down, prevent or reverse disease processes.

That is how the author started the work with fulvic acid, which can be recovered from peat that occurs in the nature and is a cheap source in large quantities. [1] [4] and continues work with polyphenols recovered from grapes.

HARMFUL UV SPECTRUM

7% of the sunlight is in the ultraviolet range (Nicholson et al., 2005) [5], but only a fraction reaches the surface of the earth. According to the absorption in the atmosphere, further division of the high-energy optical radiation is possible on the basis of wavelength. UVC between 100-280 nm is fully absorbed and dispersed by nitrogen and oxygen molecules of the atmosphere. UVB, 315 – 280 nm, is absorbed by ozone, generated by UVC. UVA with longer wavelength reaches the surface without hindrance, similar to the visible light. [6]

UVA (315-400 nm)	Biological effect: It causes neither erythema nor pigmentation in low doses. At higher doses, together with UVB, it is followed by erythema or pigmentation. At high doses, erythema is caused without direct pigmentation.
UVB (280-315 nm)	Biological effect: Direct erythema, after 12-24 hours, indirect pigmentation, which regresses It irritates conjunctiva and cornea Synthesis of vitamin D3 synthesis Carcinogenesis!
UVC (180-280 nm)	It does not reach the surface.

1. Figure Biological effects of UV radiation[7]

Thus, the sunscreen substances sought must absorb in UVA and UVB range.

HISTORY OF SUNSCREEN

In 1938, a Swiss chemistry student named Franz Greiter suffers sunburn while climbing Mount Piz Buin on the Swiss-Austrian border and sets out to invent an effective sunscreen. In 1944 Benjamin Green, an airman and pharmacist, uses a greasy substance called "red vet pet" (red veterinary petrolatum) to protect himself and other soldiers from ultraviolet rays during World War II. Heavy and unpleasant, it works primarily as a physical barrier between the skin and the sun. After the war, Mr. Green mixes red vet pet, cocoa butter and coconut oil into a product that would eventually become Coppertone suntan cream. In 1946 Mr. Greiter's product, called Gletscher Crème (Glacier Cream), comes to market under the brand Piz Buin, which is still sold today. The familiar Coppertone Girl was drawn by an illustrator named Joyce Ballantyne. She used her 3-year-old daughter, Cheri, as the modelin 1956. In 1970's Piz Buin introduces sunscreens with ultraviolet A and ultraviolet B filters. In 1978 The Food and Drug Administration proposes to regulate sunscreens, recommending standards for safety and effectiveness. These guidelines — some parts of which never took full effect — mostly dealt with establishing SPF testing and labeling. However, the official document did state, "In the long run, suntanning is not good for the skin." In 1988 The F.D.A. approves a sunscreen product containing avobenzone, a UVA-only filter. The other approved filters until then were UVB ones that had incidental UVA protection. In 1997 The F.D.A. allows sunscreen makers to market the fact that their products contain avobenzone for UVA protection. In 2006 The F.D.A. misses a deadline set by Congress to approve proposed guidelines for sunscreens. In 2007 The F.D.A. finalizes its proposed rules on UVA testing and labeling and starts accepting comments on the proposals. In 2010 The F.D.A. is expected to approve the 2007 guidelines, but the target date is pushed back yet again, most recently to October from May [8]

The author has imagined an advanced sunscreen products must meet the following criteria: efficient, natural, easily available in large quantities, cheap, non-toxic, antioxidant. As a first step, fulvic acids were taken into account, and the author examined if, on the basis of the UV absorption of these substances, it may be used as the component of the sun protection cream.

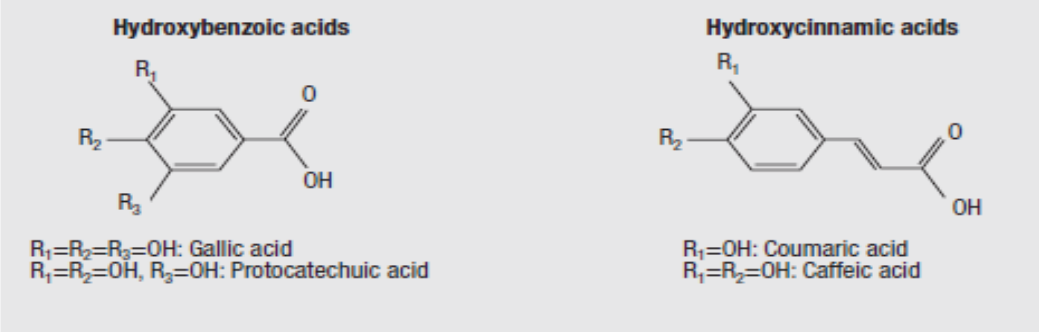
POLYPHENOLS

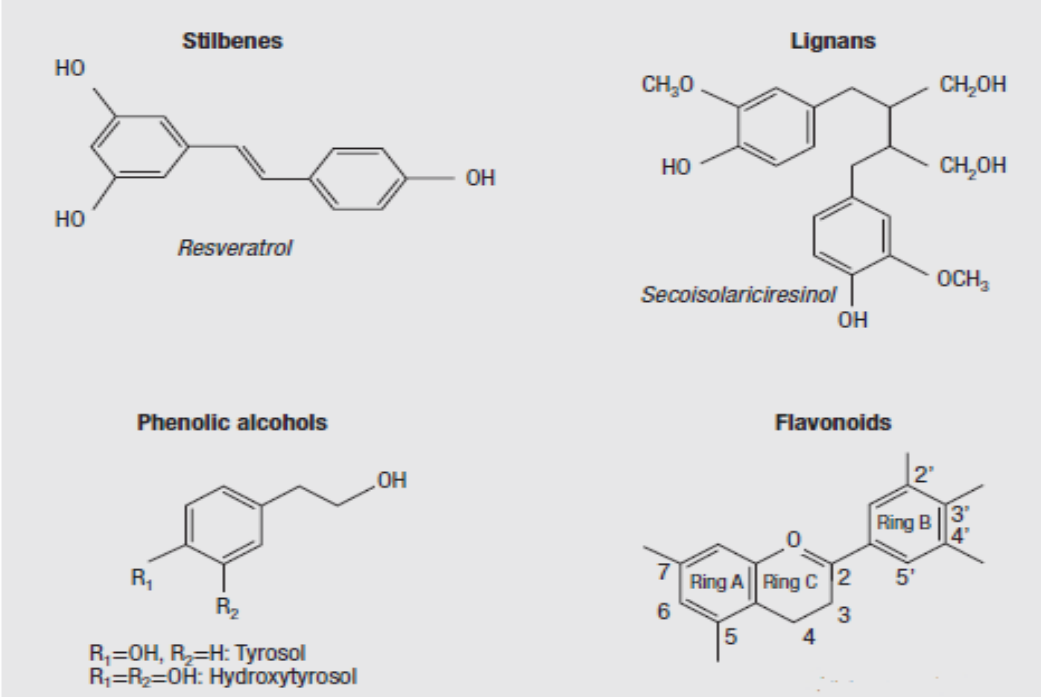
Fruit (grape) and beverages such as tea and red wine represent the main sources of polyphenols. Despite their wide distribution, the healthy effects of dietary polyphenols have come to the attention of nutritionists only in the last years. The main factor responsible for the delayed research on polyphenols is the variety and the complexity of their chemical structure. Emerging findings suggest a large number of potential mechanisms of action of polyphenols in preventing disease, which may be independent of their conventional antioxidant activities. [9] Grapes contain a large amount of polyphenols. Grapes are cultivated largely for the wine

industry, which generates huge amounts of grape pomace as an industrial waste. Some research work has been carried out to seek industrial uses for this waste, including use as animal feed, as nutritive ingredients, in the production of citric acid and the use of anthocyanins from grape skins as colorants. [10] These were why the authors found the red grape skin is a proper source of polyphenols.

Polyphenols comprise a wide variety of moleculesthat have a polyphenol structure (*i.e.* several hydroxylgroups on aromatic rings), but also moleculeswith one phenol ring, such as phenolic acids andphenolic alcohols. Polyphenols are divided into severalclasses according to the number of phenol ringsthat they contain and to the structural elements that bind these rings to one another. The main groups of polyphenols are: flavonoids, phenolic acids, phenolic alcohols, stilbenes and lignans [9]

Research in recent years strongly supports a role for polyphenols in the prevention of degenerative diseases, particularly cancers, cardiovascular diseases and neurodegenerative diseases . Polyphenols are strong antioxidants that complement and add to the functions of antioxidant vitamins and enzymes as a defense against oxidative stress caused by excess reactive oxygen species (ROS). Although most of the evidence of the antioxidant activity of polyphenols is based on *in vitro* studies, increasing evidence indicates they may act in ways beyond the antioxidant functions *in vivo*. In the meantime, chemically, polyphenols are a group of natural compounds with phenolic structural features. It is a collective term for several sub-groups of phenolic compounds, however, use of the term ―polyphenols‖ has been somewhat confusing and its implied chemical structures are often vague even to researchers. Studies have also shown that different polyphenol subgroups may differ significantly in stability, bioavailability and physiological functions related to human health. More than 8000 phenolic structures are currently known, and among them over 4000 flavonoids have been identified. Although polyphenols are chemically characterized as compounds with phenolic structural features, this group of natural products is highly diverse and contains several sub-groups of phenolic compounds. Fruits, vegetables, whole grains and other types of foods and beverages such as tea, chocolate and wine are rich sources of polyphenols. The diversity and wide distribution of polyphenols in plants have led to different ways of categorizing these naturally occurring compounds. Polyphenols have been classified by their source of origin, biological function, and chemical structure. Also, the majority of polyphenols in plants exist as glycosides with different sugar units and acylated sugars at different positions of the polyphenol skeletons. [11]

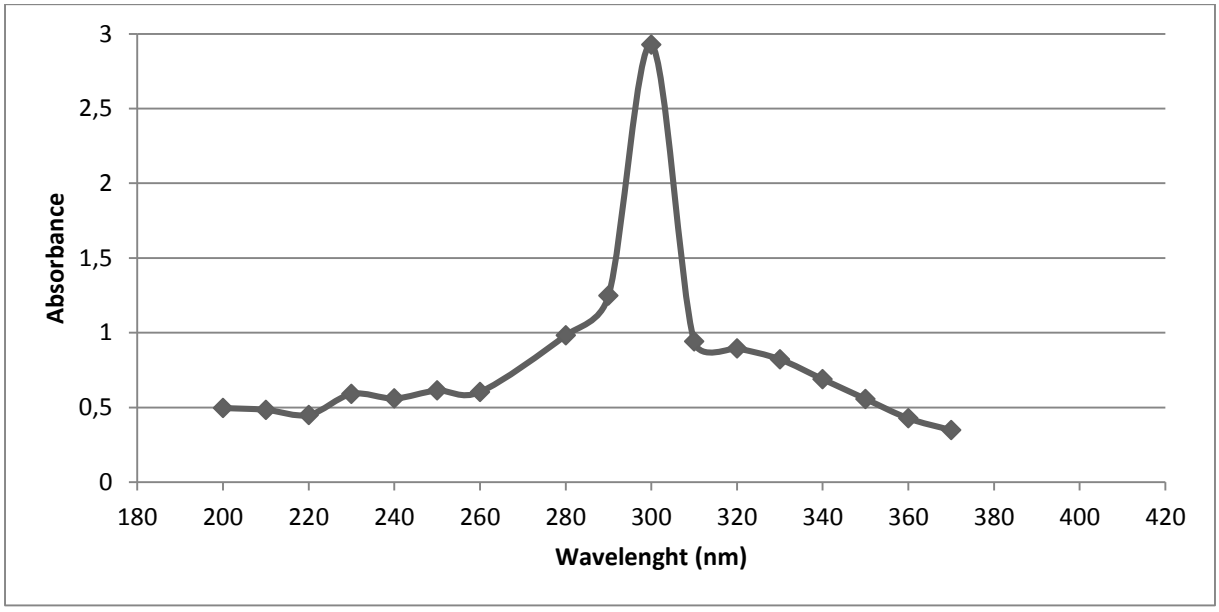




2. Figure. Chemical structures of polyphenols.[9]

UV ABSORPTION OF POLYPHENOLS (RED GRAPE SKIN EXTRACT)

In order to use polyphenols as sunscreen substances, need to examine if it absorbs in the adequate ultraviolet spectrum. During the study, the author found that the solution red grape skin extract absorbs in both UVA and UVB spectrum. This is illustrated in the following graph:



3. Figure Rate of absorbance of polyphenols
(source: author)

SUMMARY:

In this article, polyphenols were presented, a naturally occurring, non-toxic substance that can be expensively produced as potential sunscreen substance. As a result of the absorption test, a new substance fitted in their planned set of experiments was known, that can be the component of the sunscreen substance the authors had planned.

The author made the similar analysis of fulvic acid and they are planning to examine the UV protective effect of the different composition of these substances.

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