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Investigation of natural antioxidants for inhibition of peroxidation processes

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Abstract

Usage of antioxidants let us struggle against such phenomena as skin withering effectively enough, but free radicals are just one of the mechanisms leading to the aging. Applying of essential oil in complex with microbiological carotene can give the high effect of skin protection against withering at the expense of the decreasing in level of peroxidative oxidation of membranes.

Keywords: antioxidants, vegetable extracts, skin aging, microbiological carotene.

1. Introduction

There are many theories in modern science that try to explain ageing process. All of them concur with the fact that ageing – is the accumulation of defects which put out of action the whole organism with the lapse of time. However, how this happens, what is the reason for this process and what is the mechanism of defect formation, -- various theories reply in different ways.

Reasons, starting up one or another mechanism, can be divided into two big groups: exterior and interior. UV-radiation, dirt, allergens, mechanical injuries etc. are related to the first group. Among interior reasons there are genetic, neural (mental stresses), immune (derangements of disease-resistant status), hormonal and all. According to free radical theory of aging, proposed by Harman in year 1954 ^[1], free radicals, that are formed in organism due to different reasons, are capable to damage cells and their genetic apparatus irreversibly. Along with this, free radicals, generate during oxidative reactions in chondriosomes, exert negative influence on them, thereby, bring cell death closer.

Usage of antioxidants allows to overcome present phenomenon quite efficiently, but free radicals are just one of the many mechanisms, leading to aging.

Currently another one theory has got a wide spread occurrence, such as theory of glycation. Sometimes it's called Maillard theory by the name of scientist who had made a discovery of unenzymatic reaction between monosaccharides and amides of proteins in vitro more than 50 years ago ^[2].

Purpose of the research work is to investigate possibility of increasing storage time of emulsion creams and production of composition with application of examined antioxidants that promote the preservation of skin from premature aging. In order to solve this assigned task, we studied processes of lipids peroxidation in the presence of some sorts of natural antioxidants and their mixtures too.

In recent years demand for cosmetic products, which contain in their structure constituents of natural origin (emolents, film-forming materials, thickeners, preservatives, dyes et al.), swiftly increases. Meanwhile, cosmetic products must not only produce an instant effect (softening, moistening, giving of definite color, tone and masking of defects of the skin in the case of make-up), but also have attractive appearance as well as contain substances with different functional properties (antioxidant activity, reduction of wrinkles, stimulation of collagen synthesis etc.) in their composition.

At the present special attention is paid to makeup preparations that contain antioxidants that promote protection of skin cells against oxidizing stress, negative action of ultraviolet radiation and, therefore, against premature aging in their structure.

One of the most perspective sources of natural antioxidants is a grape, which contains several groups of polyphenols: anthocyanins, phenolacids, flavonols, leukocyanidines, catechines and their oligomers – proanthocyanidines, so-called tannines and microbiological carotene.

Thus, their application as biologically active constituent in production of cosmetic products, study of their properties and physiological effect on skin are actual and perspective.

2. Materials and Methods

Determination of antioxidant properties of individual substances and their mixtures was carried out. Analysis of antioxidative activity (AOA) was estimated according to its ability to inhibit thermal oxidation reactions of methyl ether oleic acid (MO) [3]. Weighted quantity of solutes in ethanol and their mixtures war added to certain volume of MO, pretreated by means of vacuum distillation. Oxidation was carried out in special oxidizing cells with porous filterglass in thermostat under 60 °C. The air was blown through the cells with such a speed so as oxidation process could flow in kinetic area, i.e. under such conditions when oxidation rate does not depend on the quantity of supplied oxygen. The oxidation process was controlled according the quantity of peroxides was forming. For the induction time value the time of methyloleate oxidation was taken before the peroxides accumulation as a quantity of 0.03 mmol/g.

The determination of antioxidative activity (AOA) for compositions of different substances and their mixtures was determined as difference ratio of induction times on the methyloleate oxidation curve with addition of compositions and their mixtures τ_{det} and concentration of pure methyloleate τ_0 to the concentration of antioxidant – C:

$$AOA = \frac{\tau_{det} - \tau_0}{C} \tag{1}$$

Relative AOA for substances was determined as ratio of increase in oxidative induction time with corresponding antioxidant to time increase of such induction with standard antioxidant, and therewith induction times related to 1 mol of the substance. Antioxidant 4- methyl – 2, 6 – ditretbutylphenol (ionol) [3] was used as the standard. In such a way, relative AOA was determined according the following equation:

$$\epsilon = \frac{\Delta\tau}{C_{AO}} : \frac{\Delta\tau_{st}}{C_{st}} \tag{2}$$

Where: C_{AO} – antioxidant concentration,
 $\Delta\tau$ – time increase of oxidative induction of methyloleate in the presence of antioxidant,
 C_{st} – concentration of ionol,
 $\Delta\tau_{st}$ – time increase of oxidative induction of methyloleate in the presence of ionol.

Also the antioxidative properties of water-alcohol-glycerol (WAG) and carbon dioxide (CO₂) extracts were analyzed. It was proved thermal oxidation of methyloleate (MO) is one of the adequate models of the self-oxidation. Natural antioxidants has got the property being common for all of them, such as an ability to inhibit the oxidative reaction. In order to determine antioxidative activity the ability of WAG and CO₂ extracts to inhibit thermal oxidation reactions of methyl ester of oleic acid.

Investigation were carried out with MO in the range of concentrations beginning with 5,0 x 10⁻⁵ to 2,3 x 10⁻¹ m/l. Choice of concentrations for WAG and CO₂ extracts was made taking into the consideration the contents of carotenoids and tocopherols in accordance to doses used for prophylaxis and treatment [4].

For the induction time value also it was taken the time of methyloleate oxidation until the accumulation of peroxides in the quantity of 0,03 mmol/g. Antioxidative properties were estimated as the difference ratio of oxidative induction time for the solutions of compositions investigated in MO and one for MO itself ($\Delta\tau/\tau_0$) [5].

3. Results and discussion

Results of antioxidative properties analysis for WAG and CO₂ extracts of microbiological carotene, pine tree and Calendula officinalis essential oils et al. and their mixtures as well, are represented in the Table 1.

Table 1: Antioxidative properties analysis for water-alcohol-glycerol and carbon dioxide extracts, and their compositions.

Water-alcohol-glycerol extracts						
Indexes	Carrot seeds	Pine tree essential oil	Calendula officinalis	Rosemary	Green tea	Combined extract (essential oil with carotene)
Oxidative induction time, $\Delta\tau/\tau_0$	0,86	2,73	0,46	2,65	2,12	2,26
Confidence interval for this value ($\Delta\tau/\tau_0$) while $q=0,05$	0,08	0,11	0,06	0,11	0,12	0,11
Carbon dioxide extracts				Microbiological carotene		Microbiological carotene + carotene of Calendula officinalis
Oxidative induction time, $\Delta\tau/\tau_0$	2,44	6,73	1,67	5,72	5,04	6,62
Confidence interval for this value ($\Delta\tau/\tau_0$) while $q=0,05$	0,11	0,13	0,20	0,12	0,12	0,11

Analysis of results obtained showed that all WAG and CO₂ extracts and carotenoids mixtures, obtained from different sources, as well possess the common for all of them property – to inhibit oxidation reaction. According to data obtained for WAG extracts the most intense AO properties have extract of pine tree essential oil ($\Delta\tau/\tau_0 = 2,73 \pm 0,11$), microbiological

carotene and combined WAG extract ($\Delta\tau/\tau_0 = 2,26 \pm 0,11$), while extract made from Calendula officinalis shows the properties close to antioxidative.

Analysis of the data obtained for carotenoids mixtures from different sources carried out with the WAG complex extract showed antioxidative properties of such unique biological

additive to be higher than ones of all WAG extracts , and this was equal to ($\Delta\tau/\tau_0 = 6,62 \pm 0,11$). Possibly, such a situation is caused by that besides complex extract the microbiological carotene itself has got high antioxidative activity. Usage of antioxidants let us struggle against such phenomena as skin withering effectively enough, but free radicals are just one of the mechanisms leading to the aging. Applying of essential oil in complex with microbiological carotene can give the high effect of skin protection against withering at the expense of the increasing in level of peroxidative oxidation of membranes.

4. Conclusions

Application of complexes containing biologically active compositions and obtained by means of different methods can be used in development of prophylactic-aimed creams for withering skin.

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