

## SUMMARY

of the doctoral thesis entitled:

### FUNCTIONAL COSMETIC PRODUCT FOR PROTECTION AGAINST ARTIFICIAL LIGHT

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Romania has a diverse flora, from plants and wild mushrooms (Petran M. and colab., 2020). Plants with therapeutic potential are a valuable resource for obtaining functional products in the biotechnology industry. New trends in biopharmaceuticals are also addressed in studies related to topical administration, representing a great advantage; research has determined biological activities *in vivo* and *in vitro* (Patra J.K. and colab., 2018). Cosmetic skin care products for improving skin appearance and treating dermatological conditions have increased in recent years (Goyal A. and colab, 2022). Bioactive plant-based compounds are becoming increasingly popular as cosmetic ingredients because they protect and heal the skin (Goyal A. and colab., 2022). Compared to synthetic cosmetics, herbal products are easier to tolerate, biodegradable and have biological and therapeutic activities. Compared to natural products, the potential side effects that can occur with synthetic skin care products are skin irritation, dryness, various allergic reactions and disruption of the skin barrier.

The use of a carrier vehicle to deliver phenolic compounds increases bioavailability *in vivo* and reduces the yield of biotransformations that limit the expression of bioactivity (Vulic' J and colab, 2019). For example, gallic acid has no stability in the fermentative action of microbiota, but resistance to the action of oxidative stress is mediated by this compound (Vamanu E. and colab., 2018). Its action is limited by the amount absorbed in the small intestine because the remaining amount is inaccessible *in vivo* (Hussain M.B. and colab., 2019).

The work includes a part of bibliographic studies, structured in two chapters and a part of own contributions, structured in six chapters, including the chapter of general conclusions and recommendations.

The present work addresses, in the first two chapters, different aspects from the specialized literature, regarding studies on the physical and biochemical properties of the three studied extracts, but also determinations of their antioxidant components. Working hypothesis shaping around the current study of knowledge of extracts and their benefits.

*Centaurea cyanus* has been used in traditional medicine to protect and heal the skin. It has a calming effect, which can be assimilated to that caused by chamomile products (Garbossa W.A.C. and colab., 2016). *Ribes rubrum* has a high content of vitamins and minerals that help repair processes and has a known antimicrobial effect. It is a fruit rich in polyphenols with combined antioxidant and anti-inflammatory effects, which help regeneration processes and reduce possible local infections (Kostic M. and colab, 2023) *Lactarius piperatus*, a little known product in the cosmetic industry, needs to be exploited more. It is conditionally edible, but with numerous biopharmaceutical effects due to a complex pattern of bioactive molecules. Antibiofilm effects have been demonstrated, leading us to use it to reduce the inflammatory processes associated with skin lesions, but also for a healing result due to the polysaccharides (Choi E.J. et colab., 2020).

The largest volume of information is allocated to their own researches which had three main objectives in mind: (1) determining the efficacy of the extracts, *in vivo* and *in vitro* evaluations, (2) obtaining a safe and

effective cosmetic product, (3) determining the safety and of the effectiveness of the cosmetic product, so that it can be used in safe conditions.

The research topic aims to combat / remedy the problems caused by the occurrence of oxidative stress due to the action of blue light through a combination of original natural products.

Chapter III includes the studies done on the extracts. One of the studies focused on examining the *in vivo* and *in vitro* biological activity of *Lactarius piperatus*, *Centaurea cyanus* and *Ribes rubrum*. Their anti-inflammatory effects were studied and the content of anthocyanins, proanthocyanidins and phenols of each plant was determined.

A first stage of verifying the bioavailability of the extracts is that of following the effect of digestion *in vitro*, through which the resistance of the compounds to the different digestive levels is checked, i.e. more precisely: phase I = oral phase, of the stress produced by saliva, phase II = gastric phase, that is, that of stomach acids and phase III = the intestinal phase with the alkaline environment. After each phase, we analyzed the antioxidant capacity and the total amount of phenols and flavonoids of the plant extracts kept in these solutions, from this cascade of simulations. The mixtures obtained (phase I solution + studied plant extract) in the first phase are the starting point for the next phase. That is, we imitated the sequence of reactions in the compartments through which an ingested biocompound or phytochemical passes, starting with its entry into the oral cavity and ending with its settling in the intestinal tract, prior to elimination, as a result of digestion.

Chapter IV presents the stages of cosmetic product formulation. It was aimed for the cosmetic product created to have a pleasant texture, to be pleasant in smell and appearance, the creation of a formula as safe as possible, tests regarding the microbial load.

The microbiological analysis of the cream regarding microbial contamination, following the total number of aerobic microorganisms, but also that of pathogenic or conditionally pathogenic microorganisms, is compliant from the point of view of the microbial load. The determined values were significantly below the maximum imposed by the European Pharmacopoeia.

Chapter V presents a study that was carried out at the Eurofins Evic Product Romania test center, under the guidance of the general director of the investigation center - Elena Alina Nanu, the main investigator - Doctor Rozalia Olsayszky (dermato-venerology specialization), statistician Ioan Dopcea, co-investigator - Ana-Maria Drăghici-Ionescu (dermato-venerology resident) and study monitor Cristina-Monica Papa.

The purpose of the study was to determine the safety and effectiveness of the cosmetic product, in order to be able to use it in safe conditions.

The study monitored the completion of a dermatologically controlled patch test to confirm the skin compatibility of the investigational product in a group of healthy human subjects after a single application under maximized and controlled experimental conditions.

This preliminary study revealed the nutricosmetic effect of the three extracts incorporated in the formulation of a face cream. These extracts have demonstrated *in vitro* and *in vivo* protection against free radicals, effectively mitigating adverse effects caused by prolonged exposure to blue light emitted by commonly used electronic devices. Furthermore, an *in vivo* study supported these findings by demonstrating that direct application of the face cream to the skin of volunteers resulted in increased skin elasticity and induced anti-inflammatory effects. In addition, the improved bioavailability of the phenolic compounds and the antimicrobial properties of the cream suggest its potential for protective and restorative use in cases of sunburn.

The chapter of general conclusions, derived from the other experimental chapters, is also completed by a series of recommendations, both at the level of fundamental research and at the level of proposals for continuing the production of the cosmetic product.