

COFFEE WASTE VALORIZATION BY ACQUIRING COSMETIC INGREDIENTS RICH IN ANTIOXIDANTS

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INTRODUCTION

Coffee is a beverage that is an integral part of society's daily routine. Its popularity is evident from the fact that the global production of green coffee beans reached almost 10 million tons in the year 2020/21. Meeting the increasing market demand leads to the generation of huge amounts of waste, primarily spent coffee grounds (SCG), which amounts to approximately 3,4 million tons annually in Europe. This stream remains untapped since more than half of SCG ends up in landfills.

Meanwhile, due to its composition and physical properties, coffee waste has the potential to be utilized in various industries. The valorization of SCG is of interest to EcoBean company. In line with the ideas of sustainable development and circular economy, an innovative technological line has been developed, in which SCG are fully processed into five raw materials: coffee oil, antioxidant extract, lignin, polylactide, and protein additives.

AIM OF THE STUDY

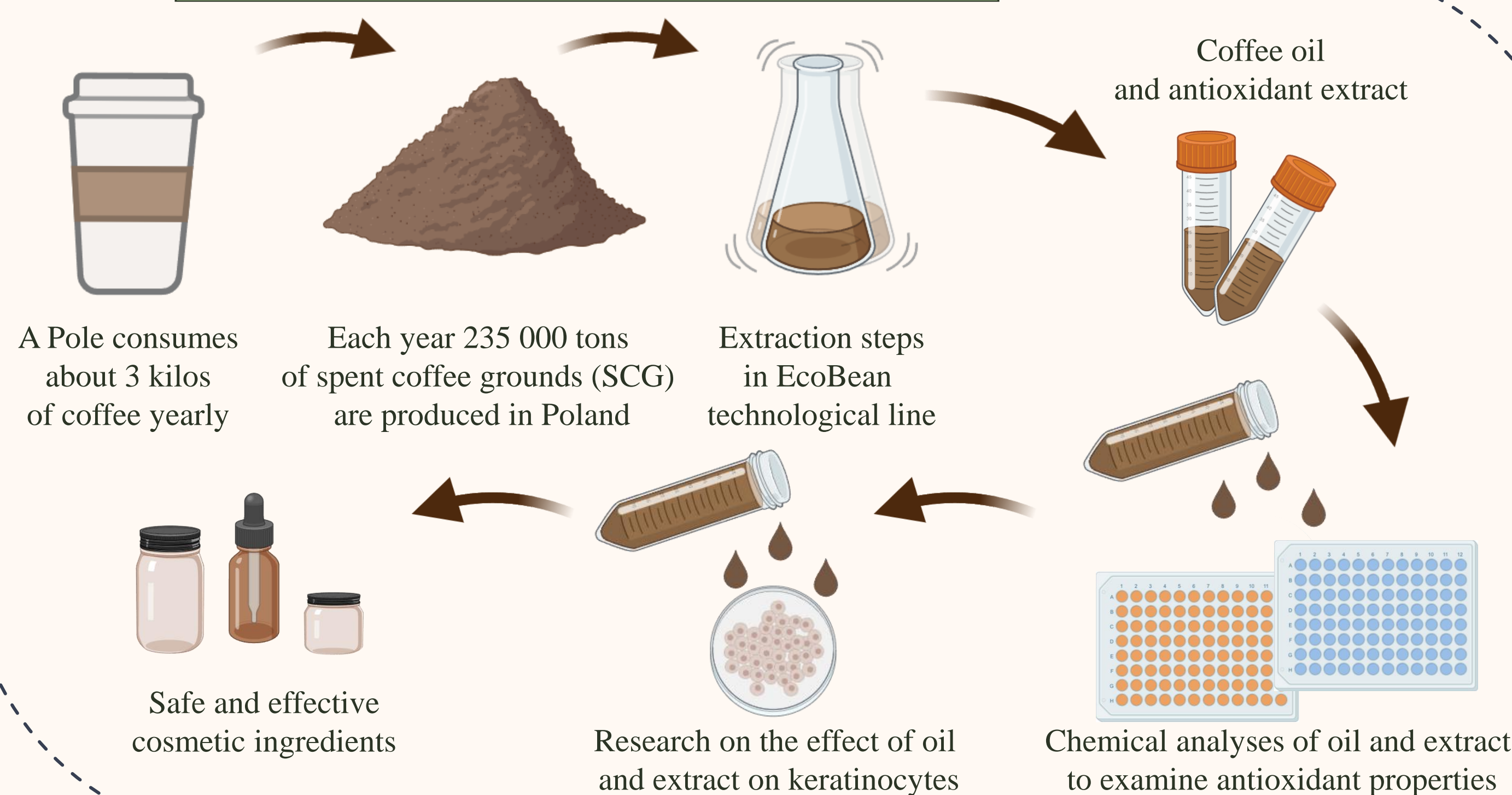


Fig. 1. The aim and conduct of the research.

METHODOLOGY

The extraction methods for deriving coffee oil and antioxidant extract from SCG, which are a part of EcoBean's circular technological process, were optimized.

Antioxidant properties of the raw materials were evaluated through spectrophotometric chemical methods, such as Folin-Ciocalteu (determining the total polyphenol content) and CUPRAC (measuring antioxidants' capacity to reduce copper ions).

To test the influence of the raw materials on the viability of skin cells (HaCaT), an MTT assay was performed. To examine their antioxidant effect, DCF-DA dye was used, allowing the indirect quantification of the reactive oxygen species (ROS) produced by cells.

COFFEE OIL

Upon conducting chemical tests, it was determined that SCG oil possesses much better antioxidant properties compared to commercially available oil from roasted coffee beans. Furthermore, the tested range of concentrations of SCG oil did not have a cytotoxic effect on keratinocytes. At the same time, the raw material has demonstrated an ability to reduce the amount of ROS produced by cells to approximately 80%.

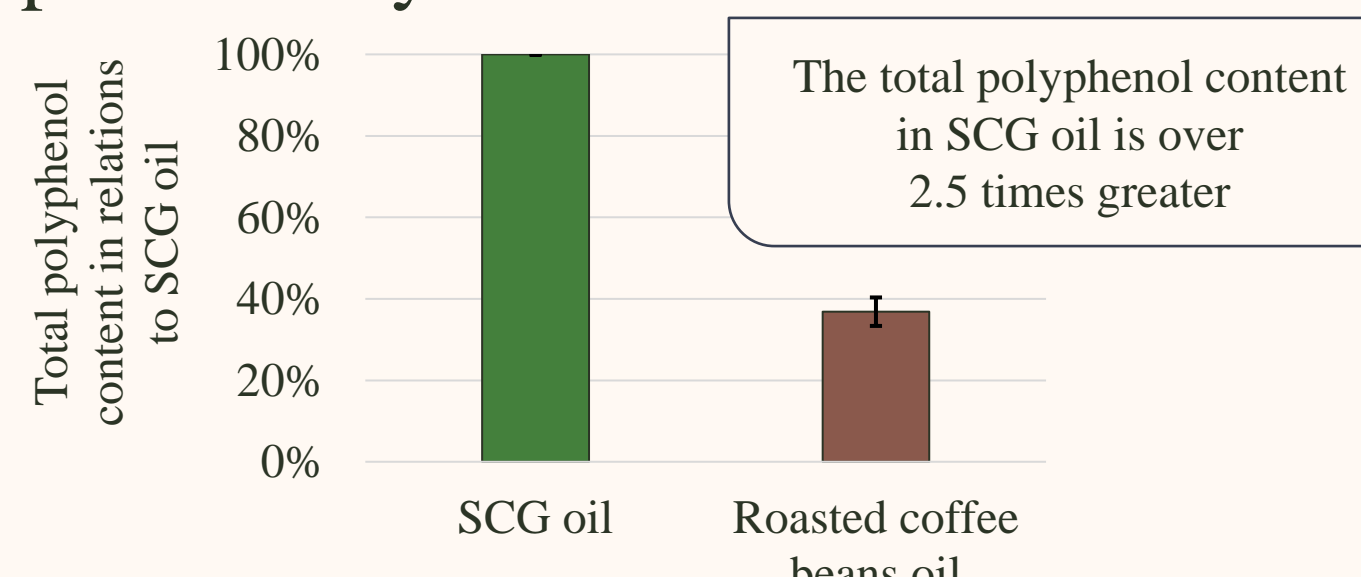


Fig. 2. Comparison of oils regarding total polyphenol content according to Folin-Ciocalteu assay.

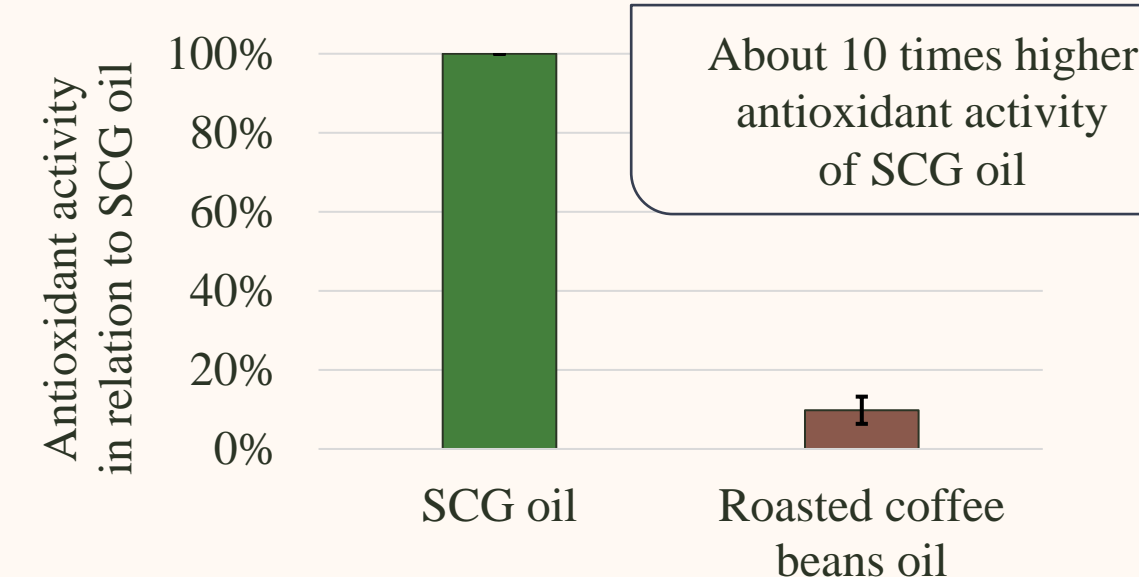


Fig. 3. Comparison of oils regarding antioxidant activity according to CUPRAC assay.

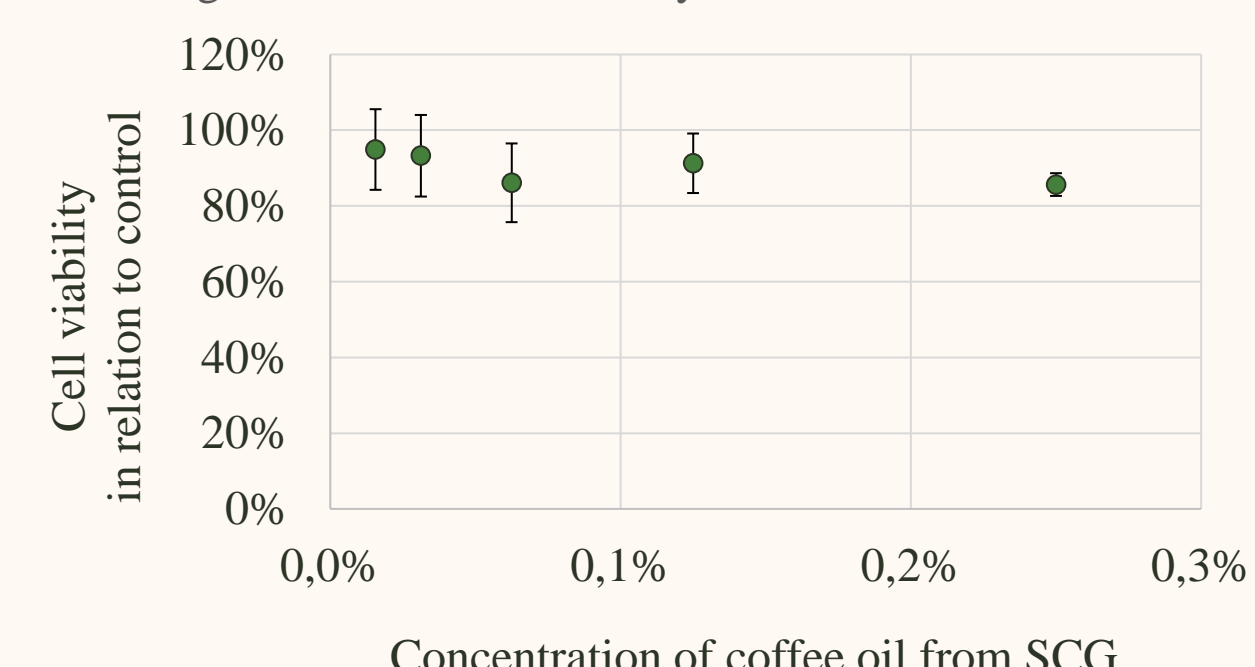


Fig. 4. The influence of SCG oil on cell viability according to MTT assay.

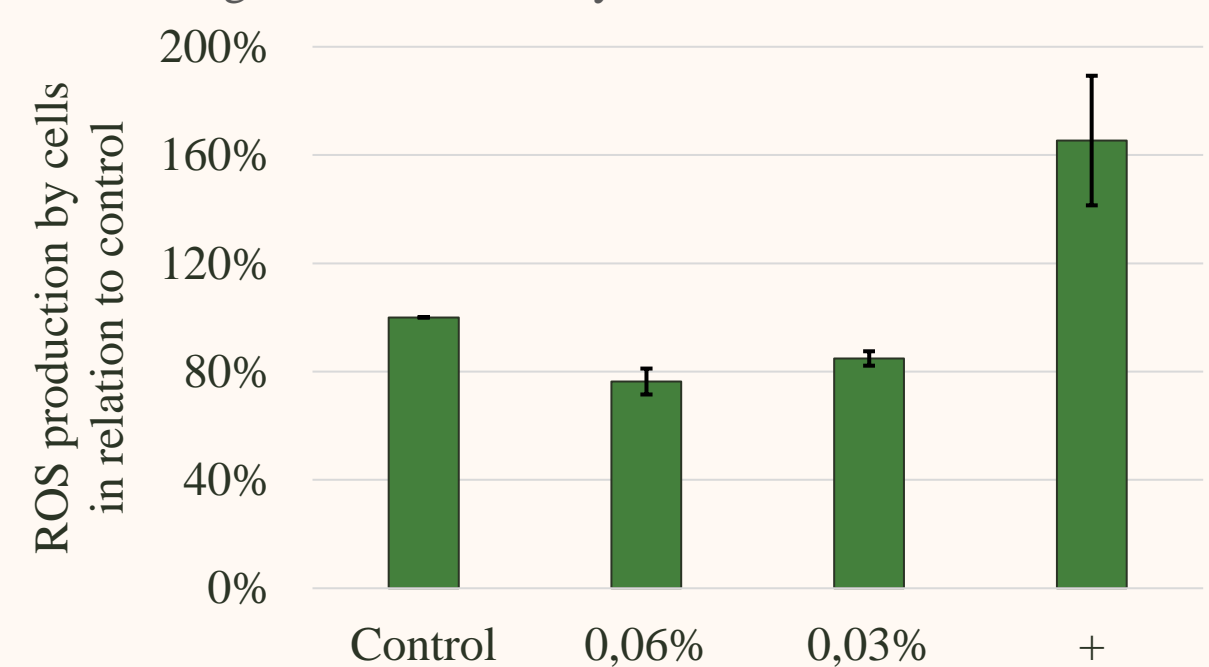


Fig. 5. The influence of SCG oil on ROS production by cells (+ 0.5% addition of H₂O₂).

ANTIOXIDANT EXTRACT

The research confirmed the high antioxidant activity of SCG extract, which was compared with literature values for blueberries and walnuts, both of which are known sources of polyphenols. The tested concentrations of this raw material did not cause any notable impact on the viability of skin cells. The antioxidant extract was also shown to cause a significant reduction in ROS production by cells when compared to the irradiated, untreated control. Additionally, it has better protective properties against ultraviolet (UV) radiation than reparative ones.



Fig. 6. The total polyphenol content of the concentrated SCG extract compared to other sources of these compounds according to the Folin-Ciocalteu assay. Based on [2], [3].

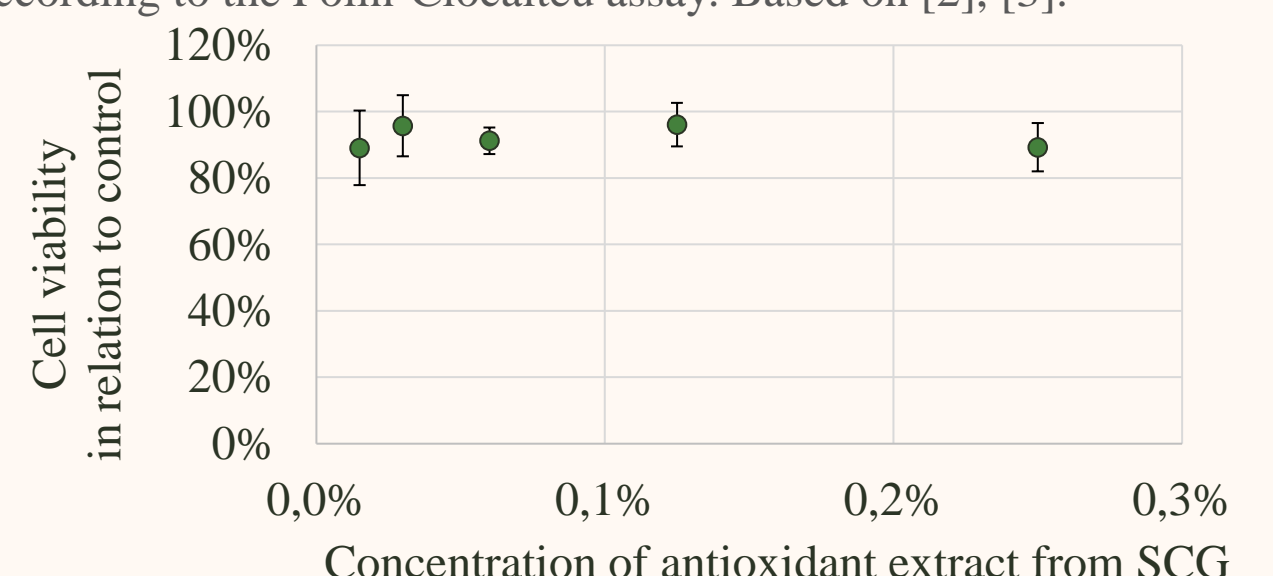


Fig. 7. The influence of SCG extract on cell viability according to MTT assay.

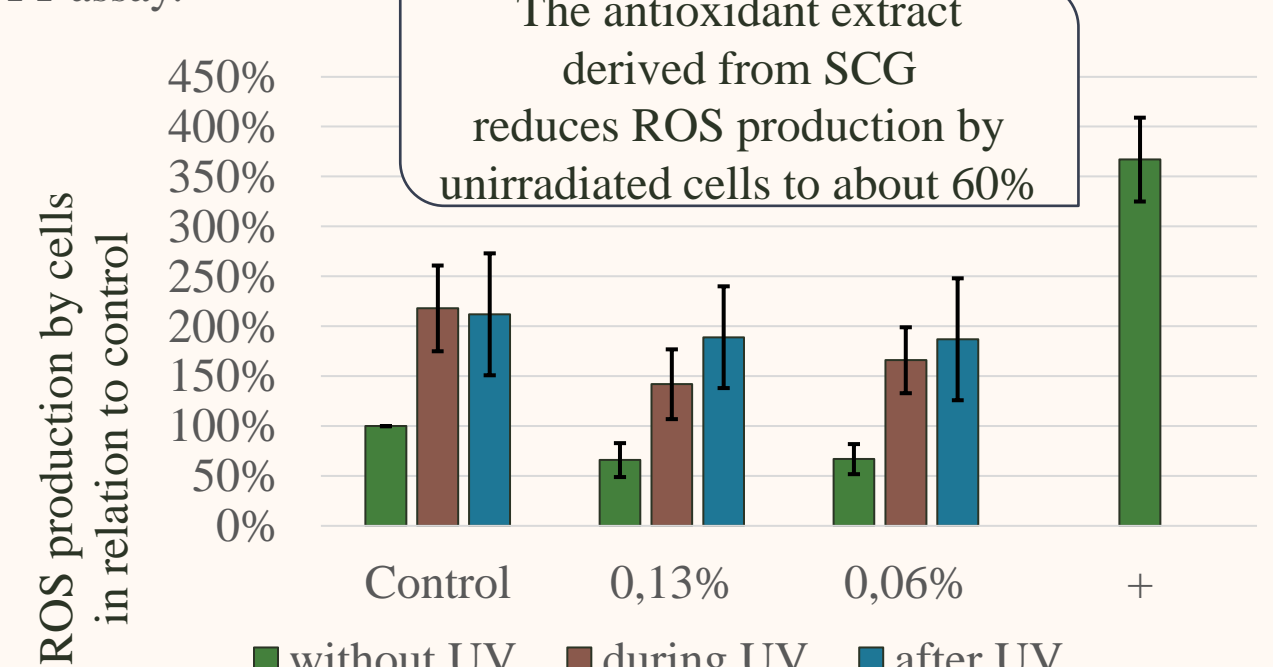


Fig. 8. The influence of SCG extract on ROS production by cells (+ 1% addition of H₂O₂).

CONCLUSIONS

Research has demonstrated that coffee oil and antioxidant extract obtained from coffee waste according to the principles of circular economy, possess very good properties with regards to antioxidant activity and the safety of their use in the cosmetics industry.

ACKNOWLEDGMENTS

- [1] International Coffee Organization. World Coffee Production. ico.org (dostęp 21.08.23)
 - [2] Kim, D.W., Han, H. A., Kim, J.K., Kim, D.H., Kim, M.K. (2021). Comparison of Phytochemicals and Antioxidant Activities of Berries Cultivated in Korea: Identification of Phenolic Compounds in Aronia by HPLC/Q-TOF MS. *Prev Nutr Food Sci*. 2021 Dec 31;26(4):459-468
 - [3] Zujko, M. E., Witkowska, A. M. (2013). Antioxidant Potential and Polyphenol Content of Beverages, Chocolates, Nuts, and Seeds. *International Journal of Food Properties*, 17(1), 86-92
- Fig. 1. created with BioRender.com

WALORYZACJA ODPADÓW KAWOWYCH POPRZEZ POZYSKANIE SUROWCÓW KOSMETYCZNYCH BOGATYCH W ANTYOKSYDANTY

W wyniku parzenia kawy każdego dnia w Europie powstaje ok. 9 tys. ton odpadów, które w większości trafiają na składowiska. Jednakże, zawarte w nich liczne substancje, w tym antyoksydanty, skłaniają wielu naukowców do badań nad wykorzystaniem ich w różnych gałęziach przemysłu. Prezentowane rozwiązanie dotyczy pozyskiwania z pozostałości po kawie oleju oraz ekstraktu antyoksydantów. Analizy chemiczne oraz badania na komórkach skóry *in vitro* wykazały wysoką aktywność antyoksydacyjną oraz brak istotnego efektu cytotoksycznego tych surowców. Zatem, mogą być one wykorzystane jako cenne składniki czynne preparatów kosmetycznych, stanowiąc przyjazne środowisku zamienniki stosowanych obecnie substancji.

odpady kawowe, waloryzacja odpadów, antyoksydanty, olej kawowy, ekstrakcja