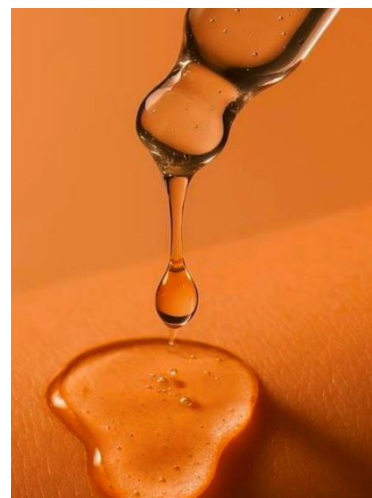


# ANTIOXIDANT BIO-BASED ALTERNATIVE FOR COSMETIC APPLICATIONS

Evaluation of lignin-derived additives as sustainable substitutes for synthetic ingredients in cosmetic formulations.

## INTRO

Cosmetic formulations suffer constant degradation due to environmental factors that compromise their stability, causing rancidity, colour changes or loss of efficacy. For this reason, antioxidants are indispensable components to guarantee product shelf life and dermal protection against oxidative stress. The **ZEBRA-LIFE** project has evaluated the viability of lignin-derived bioaromatic additives as sustainable substitutes for traditional synthetic antioxidants.



## ABOUT ROKA FURADADA

[Roka Furadada](#) is a Deep-Tech start-up founded in 2019 in Barcelona (Spain) focused on developing active ingredients to protect skin health with low environmental impact. Our role centred on cosmetic validation, analysing the performance of the different lignin derivatives across WP2 and WP4. The evaluation consisted of physicochemical characterisation, compatibility with cosmetic formulations and stability, UV photoprotective performance, and in vitro cellular cytotoxicity and antioxidant capacity.

## WHAT WAS VALIDATED

The validation focused on the **ZEBRA** LMW and MMW fractions, obtained from [CENER](#)'s process, which transforms the paper industry's black liquor into bio-based alternatives to standard synthetic antioxidants. Their suitability was analysed in standard Oil in Water (O/W) emulsions, assessing cosmetic processing parameters such as premixing, homogeneous dispersion, and physical stability across different temperatures, while measuring their performance as active sunscreen and antioxidant ingredients.

## HOW THE PROCESS WENT

During the development phase, Roka collaborated closely with CENER to evaluate antioxidant products at both laboratory and pilot scales, and with [BQC](#) to assess the antioxidant capacity of the additives in cosmetic formulations.

Regarding **ZEBRA-LMW**, an interesting observation was that while these fractions showed limited efficacy as sunscreens and lacked synergistic effects when combined with commercial UV filters, they demonstrated competitive cellular antioxidant activity (ROS reduction), even outperforming commercial antioxidants such as ascorbic acid. However, the final LMW emulsions faced development challenges related to long-term stability and organoleptic properties.

On the other hand, the evaluation of the **ZEBRA-MMW** fraction was specifically introduced during the project's development to improve the low UV absorbance capacity observed in previous stages. However, significant technical barriers emerged for this fraction, as its high insolubility created severe compatibility constraints with standard cosmetic vehicles, preventing its homogeneous dispersion into the formulas.



“The validation work in the **ZEBRA** project has shown that lignin-derived ingredients can be applied in cosmetic formulations. The results obtained position these lignin-derived additives as competitive bio-based alternatives to traditional synthetic antioxidants in the cosmetic industry.”

**Gonzalo Rotea San Luis, Scientific Researcher on bio-based products, Roka Furadada.**

## NEXT STEPS

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To achieve full commercialisation and successful validation in cosmetic applications, future work will put the evaluation of the MMW fraction on hold and focus exclusively on the LMW fraction, as it yielded the most promising and successful results during the project.

For **ZEBRA-LMW**, the next steps must focus on the fractionation of this complex additive to resolve the minor aesthetic and organoleptic limitations observed. From a regulatory perspective, this fractionation strategy is also essential to isolate and eliminate specific restricted allergens such as vanillin, ensuring cosmetic compliance standards. Finally, working with these less complex LMW fractions will allow us to try to improve the UV absorbance capacity.