

FUNDING PROGRAMME PNIII-Program 3 - European and International Cooperation

SUBPROGRAM: : 3.5 - Other European and international initiatives and programs – EUREKA Traditional, EUREKA-Cluster, Eurostars Projects

PROJECT TITLE/ACRONYM: Keratin and collagen-based materials from renewable resources for leather processing in the circular economy, E! 13359 KER-COL-CE

EUREKA 
innovation across borders

**EUREKA
CERTIFICATE**

We are pleased to certify
that the EUREKA project application

E! 13359 KER_COL_CE

with the following participant

Leather & Footwear Research Institute Division (INCDTP)

has been endorsed by the
EUREKA High Level Group on 25 June 2020

CONTRACT NO.: 187/2020

TOTAL PROJECT BUDGET: 1941000 lei/ 388200 euro

INCDTP'S BUDGET: 750000 lei/150000 euro

PROJECT STARTING DATA: 14/09/2020

PROJECT ENDING DATA: 13/09/2023

PAGINA WEB: <https://www.tarocomimpex.ro/proiecte.html>

PARTNERS:

KAZLIÇEŞME DERİ ÜRN. AR-GE SAN.TİC.LTD.ŞTİ., Türkiye -coordinator of international project



SC TARO COMIMPEX SRL (TARO), Partner 1, coordinator of Romanian project

s.c. TARO* COMIMPEX S.R.L. Tannery
Bucharest - ROMANIA

INCDTP-Division ICPI, Partner 1, research partner



GENERAL OBJECTIVES:

The KER_COL_CE project is in line with the latest European strategies on the circular economy through the proposed objectives of preventing (PRODUCT DESIGN), reducing and recovering waste (WASTE MANAGEMENT)

from the leather industry, within an eco-design for the reintegration of proteins into the economic circuit. The objective of the project is to obtain at least two materials based on renewable resources for leather processing within the framework of the circular economy concept. The products made will allow the replacement or reduction of chemical materials obtained from petroleum resources (syntans, aldehydes, dyes) or polluting materials (chromium sulfate, ammonium salts).

SPECIFIC OBJECTIVES/ EXECUTION PHASES:

- Selection of extraction and conditioning methods for collagen and keratin additives
- Experimental research on the production of collagen and keratin additives
- Development of methods for the preparation of composites based on collagen and keratin
- New composites for leather processing
- Experimental research on decalcification of leather, pre-tanning and re-tanning with new biocomposites.
- New circular technology for processing bovine hides
- New biocomposites for decalcification, pre-tanning and re-tanning of hides
- Experimental research for processing wet-white hides
- Development of new biocomposites at pilot level
- Characterization of new biocomposites
- Development of technical documentation for new biocomposites
- Prototypes of hides processed with new biocomposites
- Development of technology for processing hides with new biocomposites and development at pilot level
- Characterization of prototypes of ecological hides
- Technical documentation for new circular technology
- Demonstration experiments on the preparation of new biocomposites
- Demonstration experiments on the processing of hides with new biocomposites
- New products based on bio resources for the leather industry
- New validated bioproducts and ecological hides
- Working meetings and dissemination of results
- Protection of intellectual property rights.

NOVELTY ELEMENTS/ SCIENTIFIC CONCEPT:

Making composites containing collagen or keratin hydrolysates from leather industry waste and re-introducing them into the economic circuit. Reducing the carbon footprint of leather products by valorizing protein waste and replacing auxiliary chemical materials with a significant carbon footprint with new renewable materials, composites with collagen or keratin hydrolysates.

EXPECTED EXPLOITABLE RESULTS:

Composites obtained from renewable materials for decalcification, pre-tanning and retanning of leather, as ecological alternatives to the use of ammonium salts, mineral tanning agents or retanning agents obtained from petroleum resources or poorly biodegradable ones.

OBTAINED RESULTS:

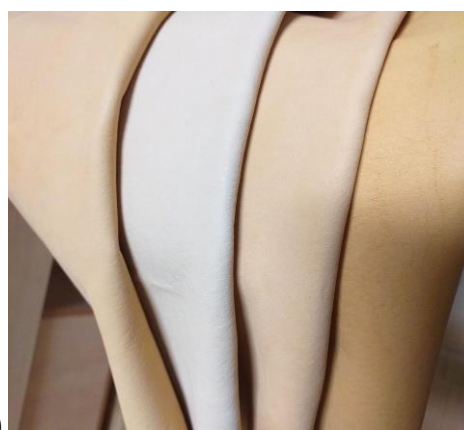
- Validation of technologies for obtaining leather decalcification products with a reduction of ammonium pollution by 84-100%.
- Validation of technologies for decalcification of bovine leather, using collagen or keratin hydrolysates with a reduction or elimination of the use of ammonium salts.
- Validation of technologies for obtaining composites for pre-tanning/retanning of leather, based on collagen/keratin hydrolysates, alternatives to the use of basic chromium salts, acrylic polymers, phenol-formaldehyde resins.
- Validation of technologies for pre-tanning of sheepskin with the production of biodegradable leather products at the end of the life cycle.
- Validation of technologies for retanning of bovine leather with composites containing keratin hydrolysates, which allow the replacement of synthetic tanning agents obtained from petroleum resources.
- Recovery of leather/hair/wool waste and reintroduction into the leather processing circuit, in the spirit of the principles of the circular economy.
- Improvement of some indicators for direct effluents from leather processing: ammonium concentration (reduction by 84-100%), organic nitrogen (reduction by 57-70%), total suspended solids (reduction by 42-47%), total dissolved solids (reduction by 22.4-85.6%), calcined residue (reduction by 36.8-63.1%) and conductivity (reduction from 11500 $\mu\text{S}/\text{cm}$ to 5050-3770 $\mu\text{S}/\text{cm}$).
- Production of leather with chemical, physical-mechanical characteristics similar to those in current production or with improved characteristics.

► Identification of improved properties:

- increase in the shrinkage temperature for decalcified leathers with keratin hydrolysate products by 30C - 50C.
- better absorption of fatty substances in the case of bovine leather samples decalcified with keratin hydrolysate products, compared to the control decalcified with ammonium salts and intensification of the color of crust leathers ($\Delta L^* = 4.34-7.61$).
- organically pre-tanned and re-tanned sheepskin can be reintegrated into nature more easily due to the absence of basic chromium salts, which reduce their biodegradability. The ecological effect of this property is extremely important at a global level, considering leather products at the end of their life cycle, which are not valued due to their low biodegradability.
- increase in shrinkage temperature by 17-180C, in the case of wet-white leathers retanned with 12% keratin hydrolysate composite, compared to control leathers.
- better absorption of fatty substances in the case of leathers retanned with keratin-based composite.
- resistance of wet-white leathers retanned with keratin hydrolysate composites to *Aspergillus niger*, leathers vulnerable to fungal attack and requiring treatments with synthetic, toxic biocides.
- improved resistance of wet-white and wet-blue leathers to gram-positive (*Saphylococcus aureus* ATCC 6538) and gram-negative (*Klebsiella pneumoniae* ATCC 4352 and *Escherichia coli* ATCC 10536) bacteria, which ensures increased protection and comfort for consumers.
- the resistance of wet-blue and wet-white leathers retanned with keratin-based composite products to ignition (EN 1021-1:2014), improved compared to classic retanned leathers, which ensures a reduction or elimination of the use of flame retardant products, which constitutes an important economic and ecological advantage.



a)



b)

Collagen and/or keratin-based composites for the ecological processing of leathers (a), leathers processed with new ecological composites (b)

DISSEMINATION, PATENT APPLICATIONS, AWARDS:

- **Scientific communications: 13**
- Poster presentation online la XXXVI IULTCS Congress, 3-5 November, 2021, Etiopia, *Circular technologies for leather processing*, authors: Carmen Gaidau, Aykut Sancakli, Fatih Arican, Mihaela Niculescu, Maria Stanca, Daniela Berechet, Cosmin Alexe, Stoica Tonea, Book of abstracts, pg. 61.
- Oral presentation, at AGIR Symposium, EDUCATION – ESSENTIAL COMPONENT OF ENVIRONMENTAL POLICY, 14th edition, with the theme Engineering for Sustainable Development, October 4, 2021, title: Designing circular technologies in the leather industry, authors: Carmen Gaidau, Mihaela Niculescu, Tonea Stoica, Daniela Berechet, Demetra Simion, Maria Stanca, Cosmin Alexe.
- Communication published in AGIR Buletin, 2021, nr. 4, Oct-Dec, pg.23-27, ISSN 2247-3548, *Designing circular technologies in the leather industry*, authors: Carmen Gaidău, Mihaela Niculescu, Tonea Stoica, Daniela Berechet, Demetra Simion, Maria Stanca, Cosmin Alexe,

<https://www.buletinulagir.agir.ro/articol.php?id=3233>

- Oral communication at CoSolMat, 11-15 October 2021, Bucharest, Romania Workshop, "Contemporary solution for advanced materials with high impact on society", titlul: *Protein based byproducts conversion into advanced materials* authors: Carmen Gaidau, Mihaela Niculescu, Maria Stanca, Cosmin-Andrei Alexe, Maria Rapa".
- Poster Presentation at III IULTCS EUROCONGRESS, Vicenza, Italy, 17-21 September 2022, published in the volume of works, pg.300, ISBN 979-12-210-1755-7, *Protein by-products recovery and their potential use in leather processing*, authors: Carmen Gaidau, Maria Stanca, Mihaela Niculescu, Aykut Sancakli, Fatih Arican, and Stoica Tonea.
- Poster Presentation at III IULTCS EUROCONGRESS, Vicenza, Italia, 17-21 September 2022, published in the volume of works, pg.295, ISBN 979-12-210-1755-7, *Keratin Production by The Enzymatic Method and Its Reuse in The Leather Process*, authors: Aykut Sancakli, Fatih Arican, Aysegul Uzuner Demir, Carmen Gaidau, Mihaela Niculescu, Maria Stanca, Daniela Berechet, Cosmin Alexe, Stoica Tonea.
- Poster Presentation at 12TH INTERNATIONAL CONFERENCE ON MATERIALS SCIENCE & ENGINEERING, BRAMAT 2022, 9-12 March 2022, Brasov, published in the volume of abstracts. pg. 55, *Renewable Tanning Materials for Biodegradable Leathers*, authors: Carmen Gaidau, Mihaela Niculescu, Maria Stanca, Daniela Berechet, Demetra Simion, Traian Foias, Tonea Stoica.
- Poster Presentation at 4th World Conference on Sustainable Life Sciences, Istanbul, Turkiye, 1-7 August, 2022, *Collagen and Keratin-Based New Products for Circular Economy*", authors: C. Gaidau, M. Becheritiu, M. Stanca, R. Horoias, C.-A. Alexe, S. Tonea.
- Poster Presentation at Biotechnology for a Circular Bioeconomy, 28-29 March 2023 organized by European Federation of Biotechnology and Asian Federation of Biotechnology and published in Book of Abstract, pg 44, *Protein waste processing by chemical-enzymatic hydrolysis for designing new materials in the frame of a circular economy*, authors: Carmen Gaidau, Stoica Tonea, Maria Stanca, Mariana-Daniela Berechet, Rodica-Roxana Constantinescu, Cormin-Andrei Alexe.
- Poster Presentation at 10th International Conference on Sustainable Solid Waste Management, 21-24 June 2023, Chania, Grecia, online (poster 80) <http://chania2023.uest.gr/poster.html>, *Bio-based materials processed from protein waste for circular technologies development in the leather industry*, authors: C.Gaidau, M.Rapa, M.Stanca, S.Tonea, M.D. Berechet, C.A. Alexe.
- Poster Presentation at 15th European Exhibition of Creativity and Innovation Iasi, Romania, 11-13 May 2023 www.euroinvent.org, cu titlul: *Keratin and Collagen Based Materials from Renewable Resources for Leather Processing in the Frame of Circular Economy E!13359_ KER_COL_CE project*, authors: Carmen Gaidau, Stoica Tonea, Mihaela Niculescu, Cosmin-Andrei Alexe, Maria Stanca, Mariana Daniela Berechet, Demetra Simion, Aykut Sancakli. The presentation was appreciated with the Diploma of Excellence, the Award of Excellence and the Diploma of Excellence.

- Poster Presentation at 6th EuChemS Conference on Green and Sustainable Chemistry, 3-6 September 2023, Salerno, Italia, published in Book of Abstracts, P21, Designing New Materials in the Frame of a Circular Economy by Using Collagen and Keratin-Based Waste, authors: Carmen Gaidau, Stoica Tonea, Maria Stanca, Daniela Mariana Berechet, Rodica Roxana Constantinescu, Cosmin-Andrei Alexe.
- Presentations at the working meetings in Stages I, II, III and IV that took place virtually and physically on 22.09.2020; 30.06.2021; 17.03.2022 (in Bucharest) and 28.07.2023.
- **Patent Applications:**

OSIM no A/00685/26.10.2022, “Agent de retanare regenerabil si procedeu de obtinere si aplicare” (“Renewable retention agent and process for obtaining and applying it”) applicants: INCDTP-Division ICPI and SC Taro Comimpex SRL, authors: Gaidau C, Berechet M-D, Georgescu E.

- **Awards: 3**

Diploma of Excellence at the 15th Edition of Euroinvent, 13 May, Iasi 2023

Diploma of Excellence from IMNR, 15th Edition of Euroinvent, 13 May, Iasi 2023

Diplona de excelenta from IMNA, 15th Edition of Euroinvent, 13 May, Iasi 2023





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