Coffea bengalensis-derived extracellular vesicles: microRNA-mediated modulation of skin inflammation and neuron communication

Annalisa Tito

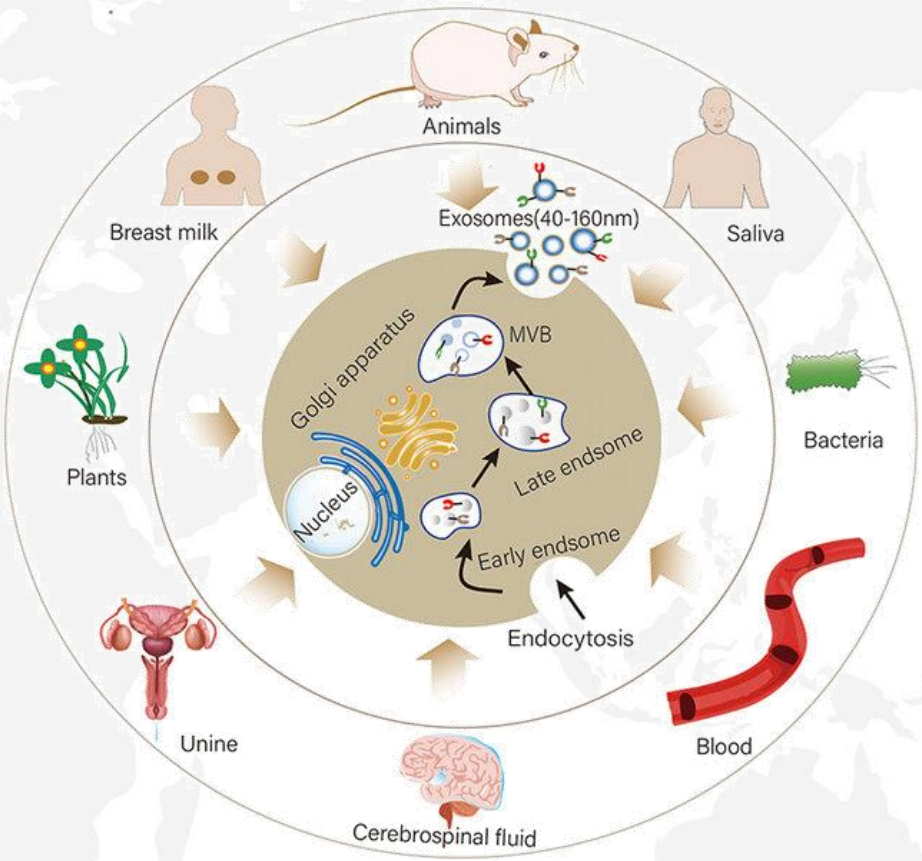
Arterra Bioscience S.p.A. / Vitalab srl

30/06/2026

Extracellular vesicles as biological information systems

Extracellular vesicles (EVs) are defined as non-viable lipid bilayer particles naturally released from cells in a wide variety of organisms, including mammals, plant, fungi, and bacteria.

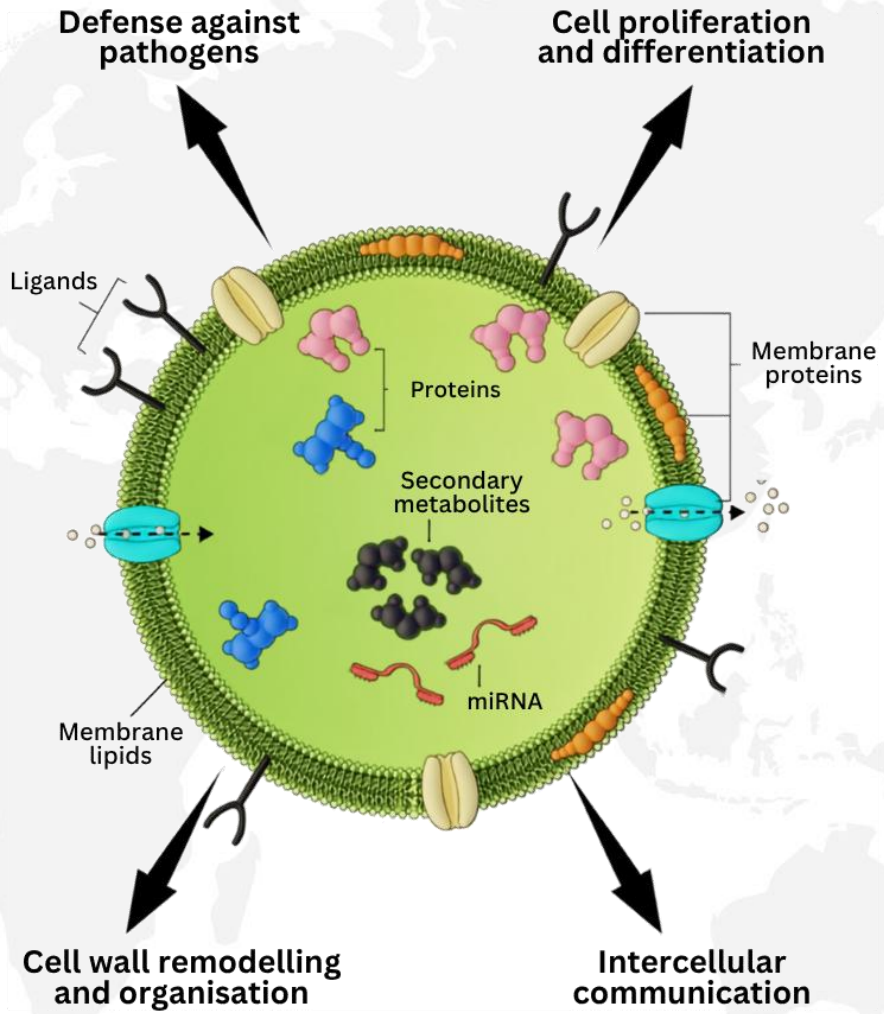
They play important role in intercellular communication and trasportation of bioactive molecules like proteins, nucleic acids and other metabolites.



https://doi.org/10.2147/IJN.S479697

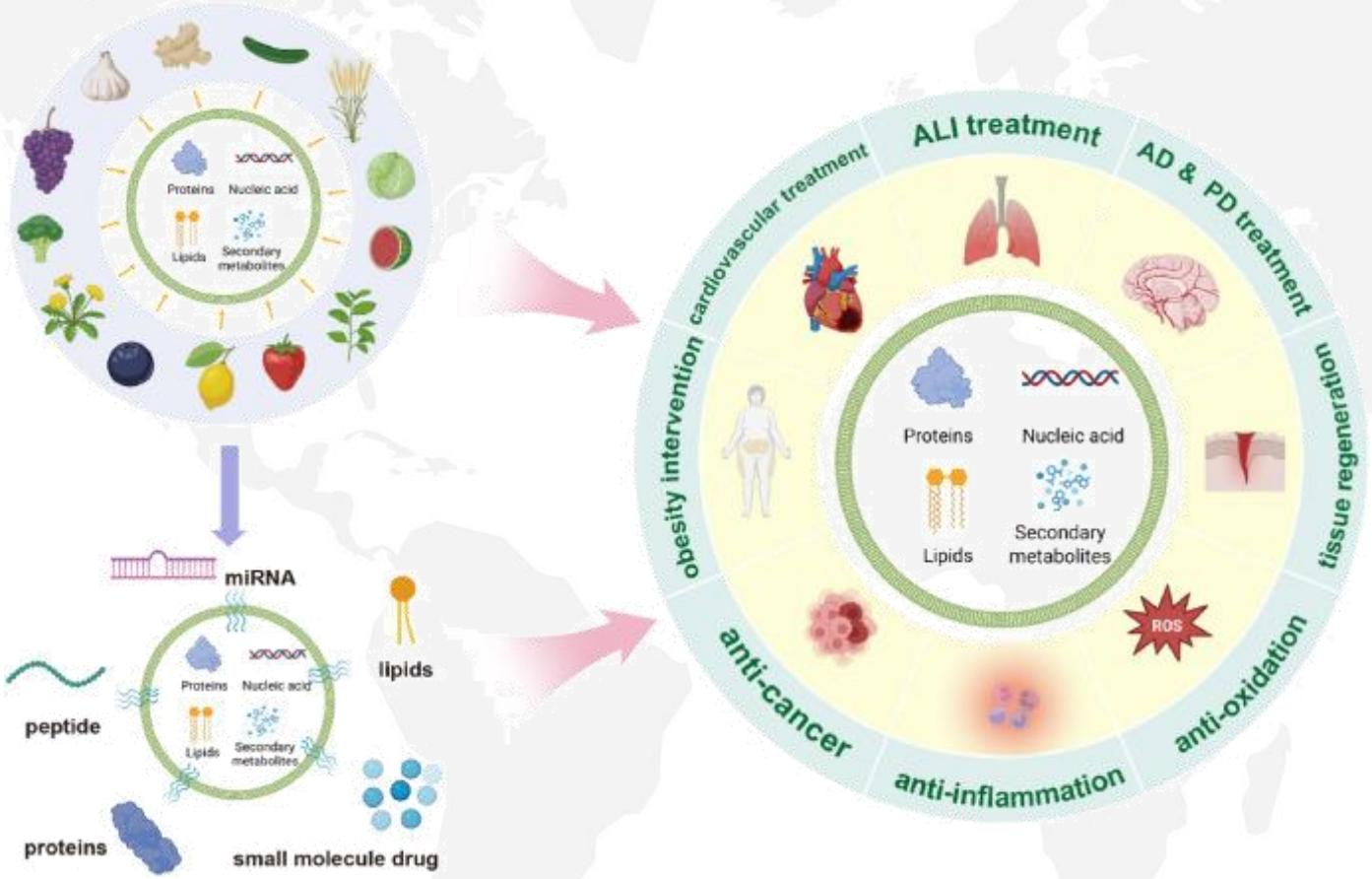
Plant derived Extracellular vesicles

Similar to mammalian extracellular vesicles, the various biologically active molecules carried by PDEVs can regulate the physiological state and morphological changes of receptor cells.



https://doi.org/10.1002/jev2.12283

Plant EVs as mediators of plant-human communication



Vesicles isolated directly from raw botanical material have different limitations:

Agronomic and environmental variability

Seasonability

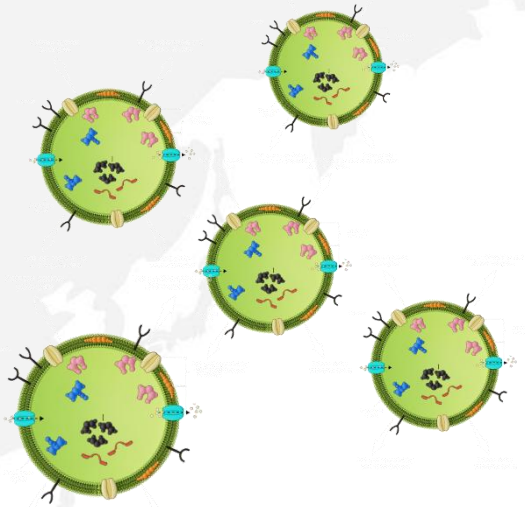
Low standardization

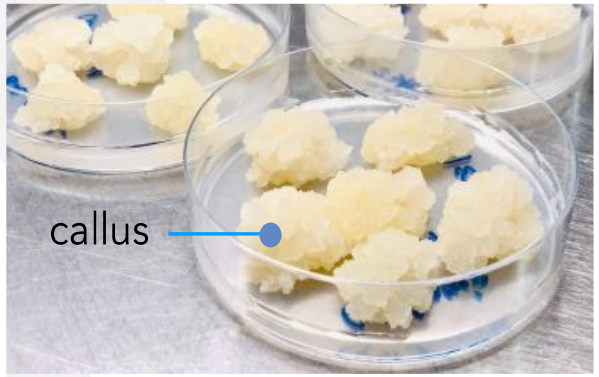
Low sustainability

https://doi.org/10.1016/j.smaim.2025.07.003

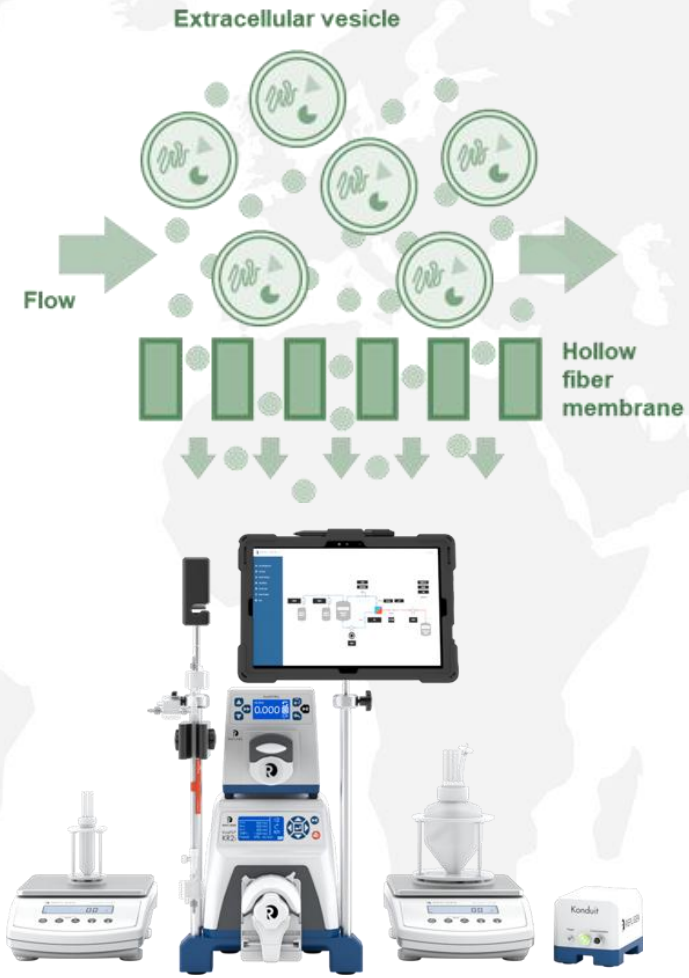
In vitro cell culture derived EVs

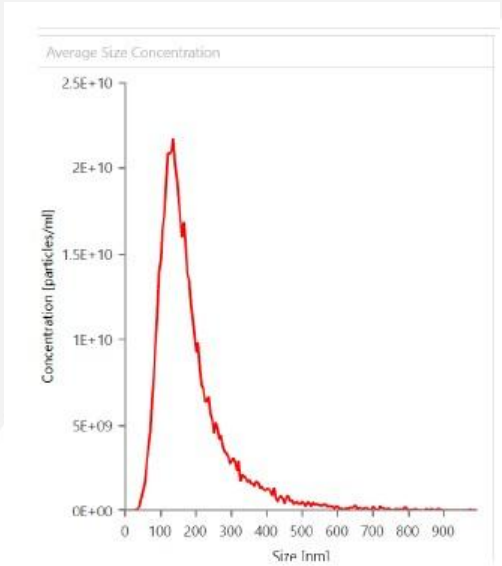
The aim of our work was the isolation and characterization of EVs from *Coffea bengalensis* cell culture





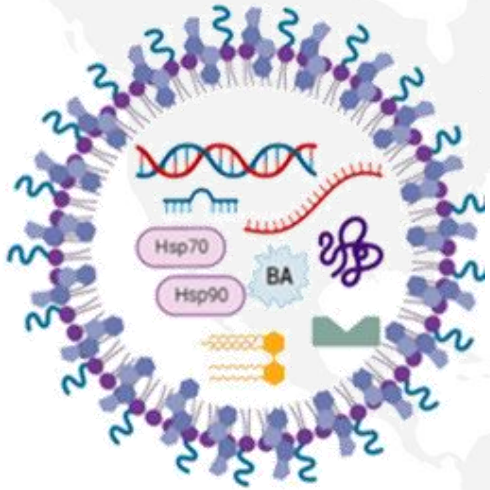
Isolation of CbEVs

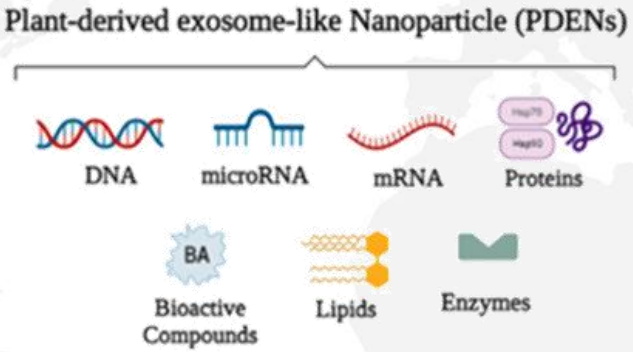




Nanoparticle tracking analysis (NTA) estimated an EV concentration
of 4.6 $\times 10^{11}$ particles / mL with a median size of 143 nm

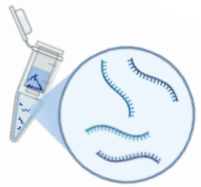
Characterization of CbEVs

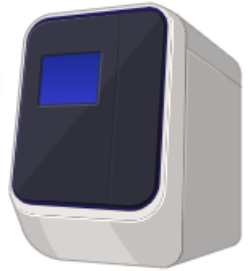




https://doi.org/10.3390/biomedicines11041053

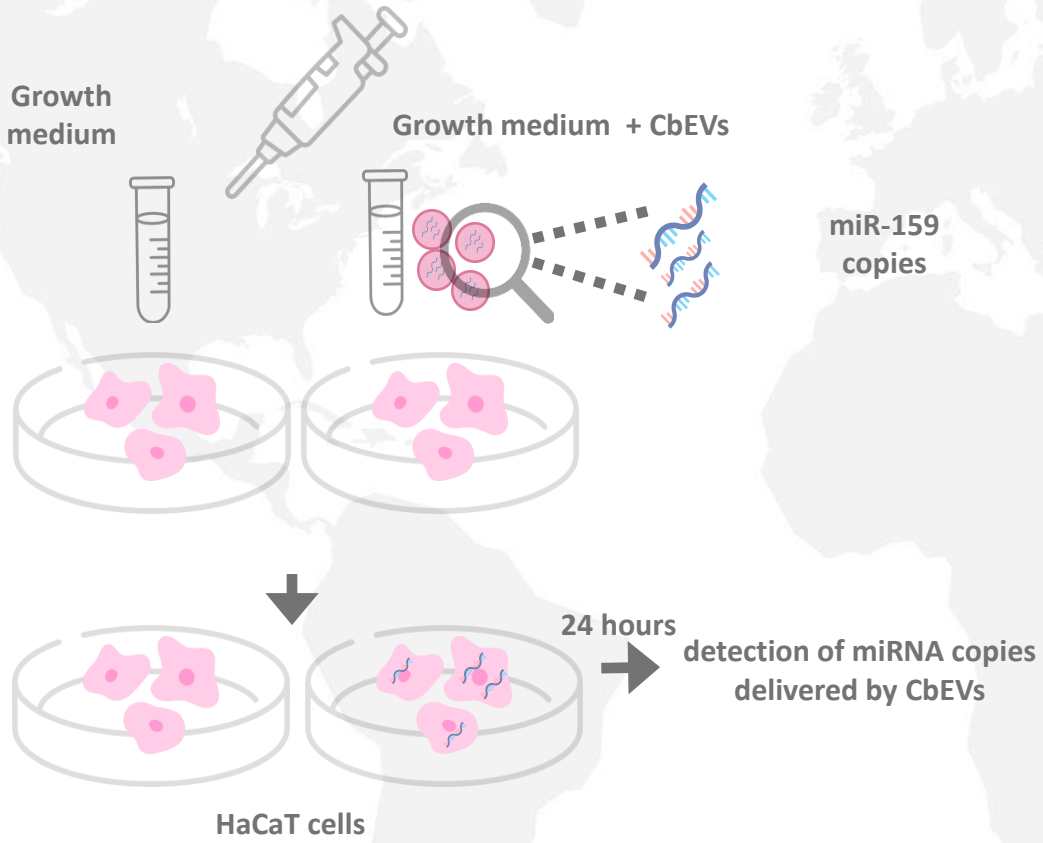
- Quantification of **total protein**: 181ug BSA eq/100mg of lyophilized exosomes
- Detection of **TET8** on surface: 2.2 ± 0.3 signal-to-noise ratio relative to 2.5 x 10^5 particles
- **ABTS value** of 47.92 ± 10.58 nmol Trolox equivalent/100mg of lyophilized exosomes (bioactive compounds)
- **4 microRNAs** were found in exosome by dPCR

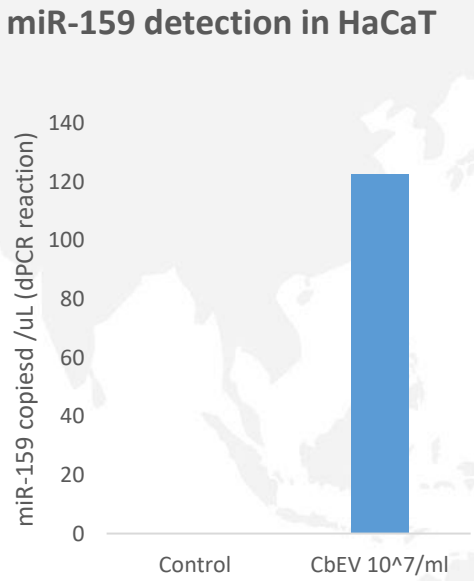




miRNAs	copies/uL
miR-156	8936
miR-159	84850
miR-166	32
miR-168	132

CbEVs **uptake** from human keratinocytes

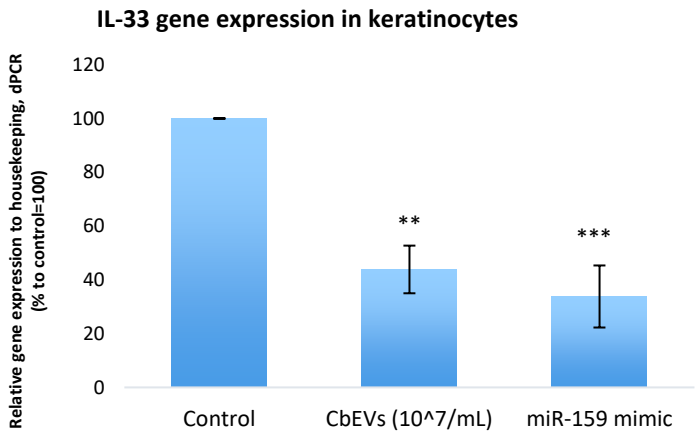




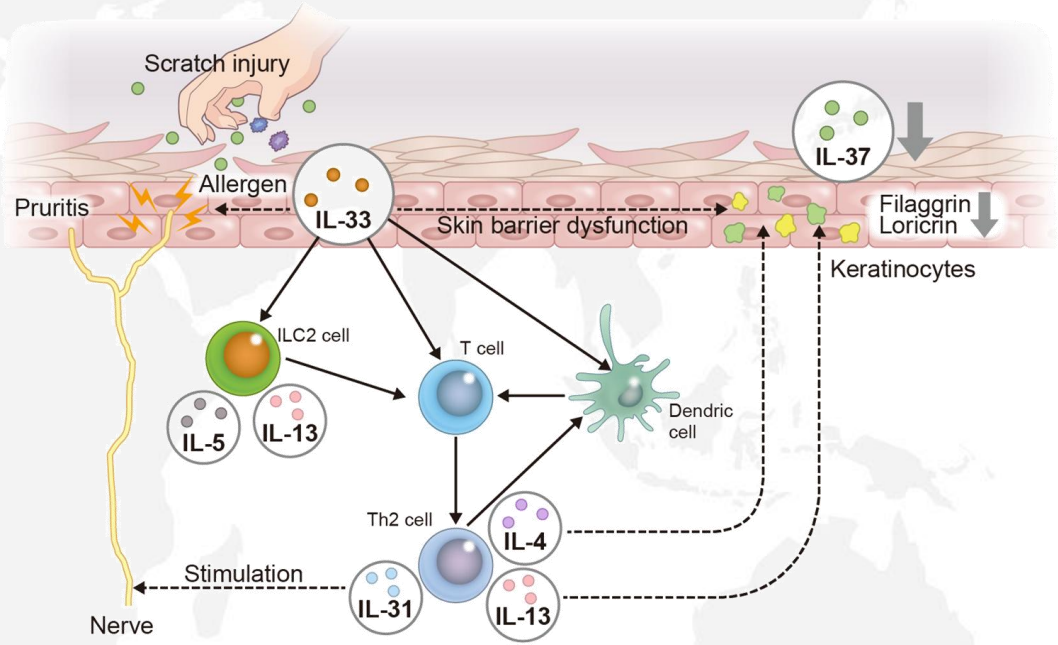
CbEVs derived miR-159 **downregulate IL33** in human keratinocytes

Target Prediction

https://doi.org/10.1093/nar/gkz757



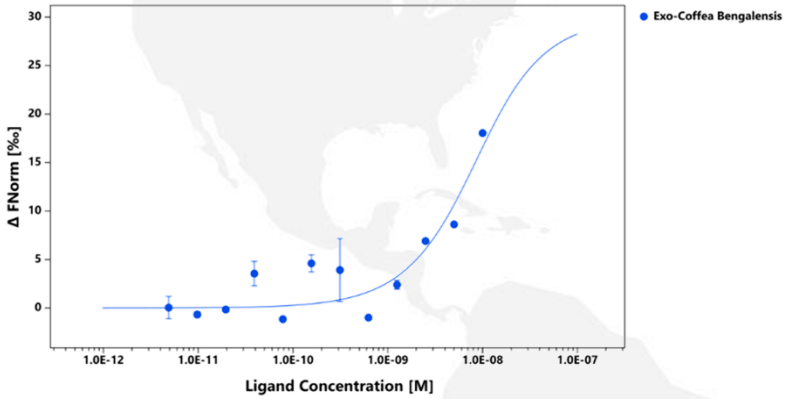
** *pvalue <0.01*
*** *pvalue <0.001*



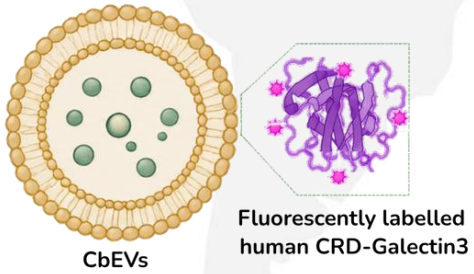
https://doi.org/10.3390/ijms241914633

Interaction of CbEV with Galectin 3

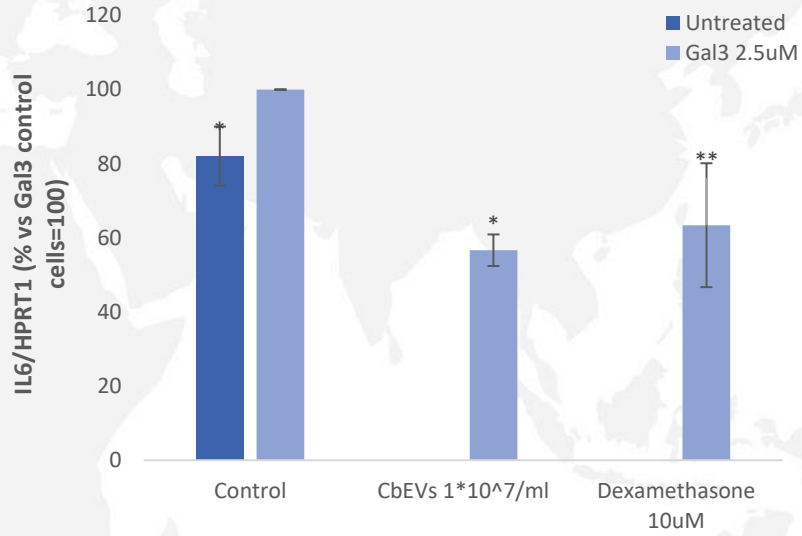
Microscale thermophoresis of CbEVs and recombinant CRD-Gal3 interaction: binding curve graph obtained by plotting the normalized fluorescence of CRD Gal3 in the presence of increasing concentrations of CbEvs



Physical interaction between CbEVs and CRD-Galectin3



Galectin 3: a β-galactoside binding lectin expressed in skin and involved in inflammatory and allergic reactions

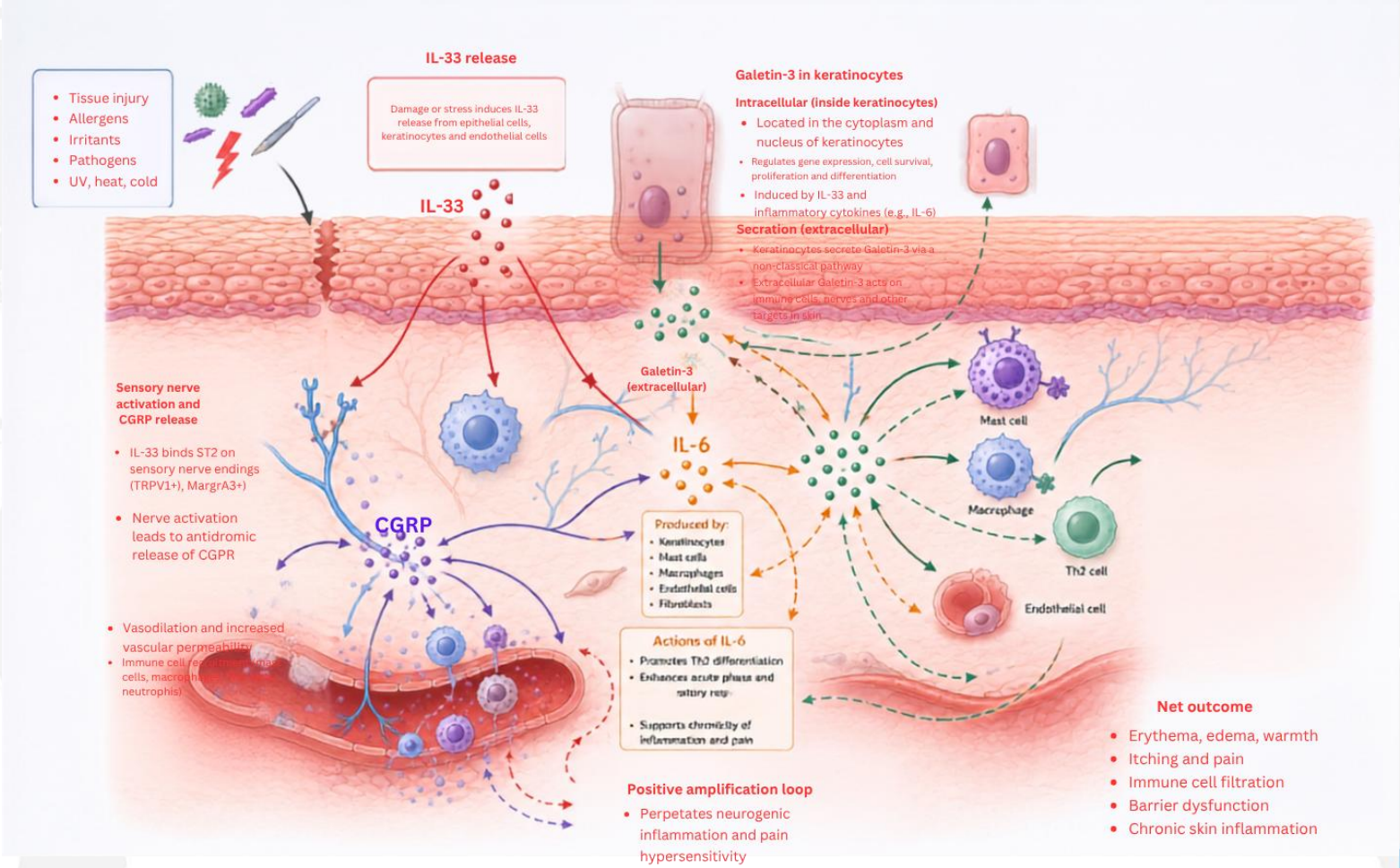


CbEVs reduce IL6 stimulation by Gal3

* *pvalue <0.05*
** *pvalue <0.01*

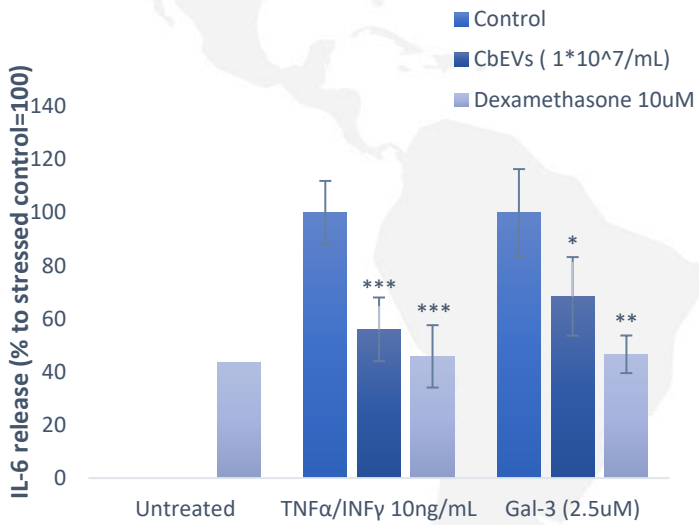
How to **counteract** neurogenic inflammation?

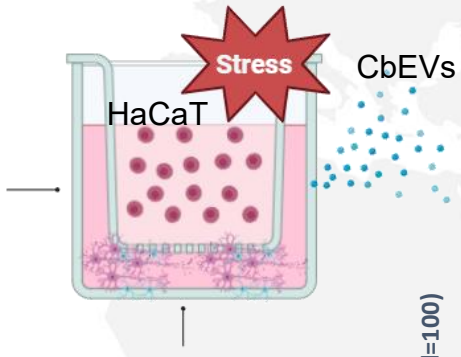
The release of **IL33** and **IL6** mediated by **Galectin3** is driver for inducing neurogenic inflammation. Could CbEVs be used to attenuate this phenomena?



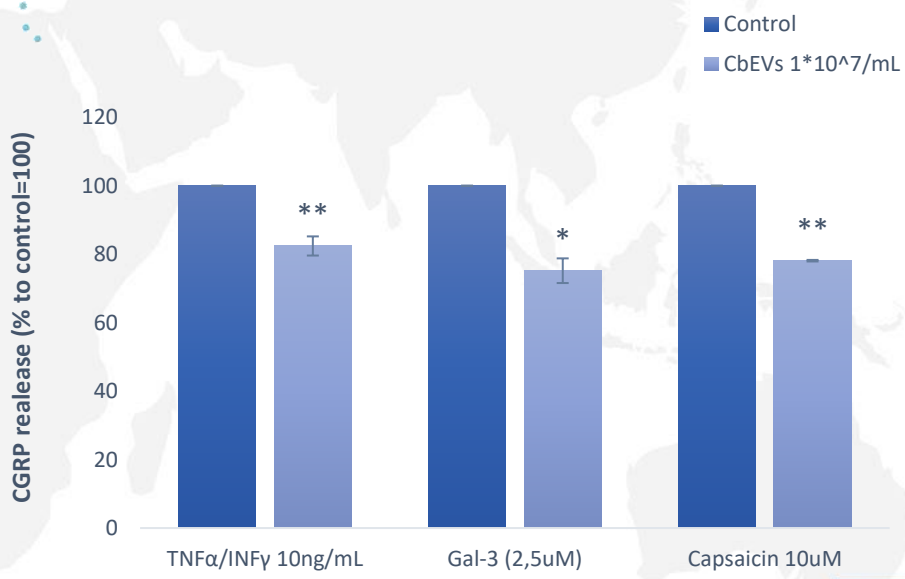
CbEVs can **reduce** neurogenic inflammation

IL6 release from keratinocytes





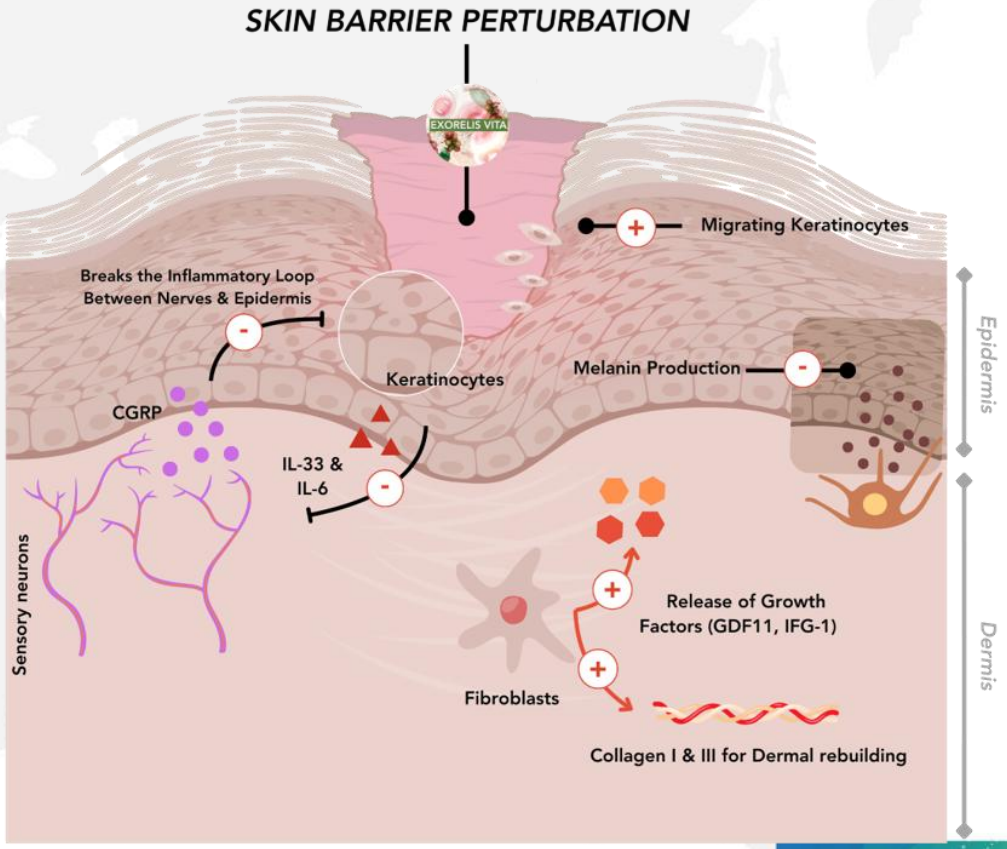
CGRP release from sensory neurons



* pvalue <0.05
** pvalue <0.01
*** pvalue <0.001

Biological efficacy from *in vitro* & *ex vivo* studies

	Additional data for CbEVs	
Anti-inflammatory activity	IL6 in inflamed HaCaT	-22%
	IL8 in inflamed HaCaT	-46%
	PAR2 in inflamed HaCaT	-43%
Tissue renewal	ProCollagen I	+55%
	Collagen I in ex vivo skin explants	+65%
	IGF1 in HDF	+74%
	GDF11 in HDF	+167%
	AQP3	+70%
	Wound healing in HaCaT	+50%
	Wound healing in HDF	+74%
Pigmentation control	Melanin content	-20%



Could CbEVs be used for controlling post-treatment inflammation?

To

1 Session of **Morpheus 8**

T24hr

At home recovery treatment with **0.5% ExoRelis Vita** or Placebo

T5days

Basal

Evaluation performed before Morpheus 8

Post Morpheus

Evaluation performed 24 hr after Morpheus 8

Post at home recovery

Evaluation performed 5 days after starting the at home recovery treatment.

Skin Recovery

Double-blind placebo controlled clinical study

40 volunteers

- Healthy caucasian women
- 36-68 years old
- Fitzpatrick skin photype II-III

2 groups

- 0.5% CbEV
- Placebo

5 days

- Face treatment
- Apply twice per day on clean and dry skin

Erythema Index by Mexameter (vs. T24hr)

-17.8%*
Placebo ns

PI Lesion Count by Visia (vs. T24hr)

-78.5%***
better than placebo (-57.9%***)

Itching Score by Dermatological Evaluation (vs. T24hr)

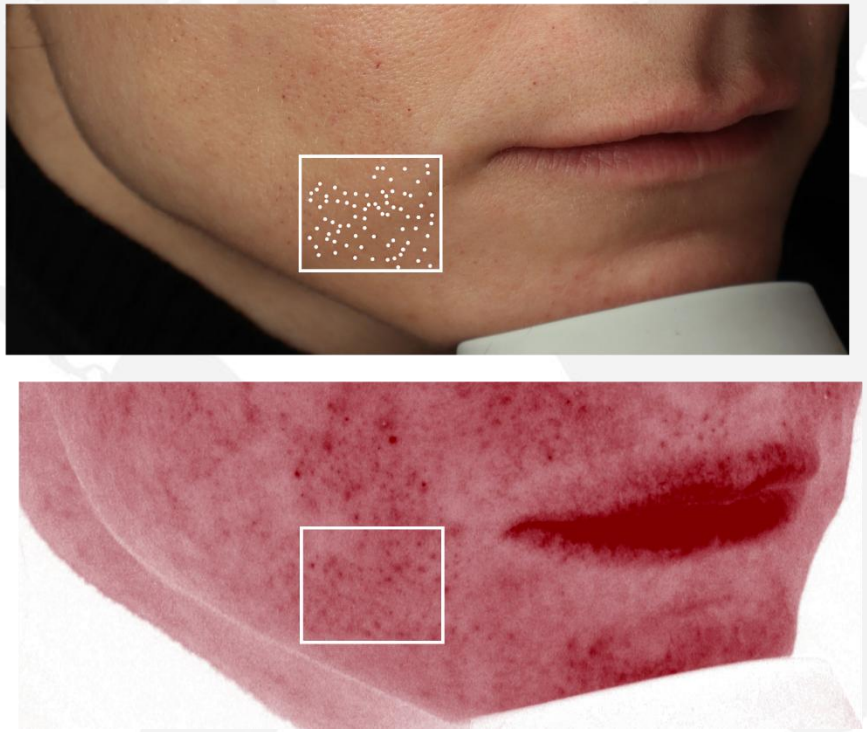
80% of Volunteers declare no itch
50% in placebo group

* *pvalue <0.05*
*** *pvalue <0.001*

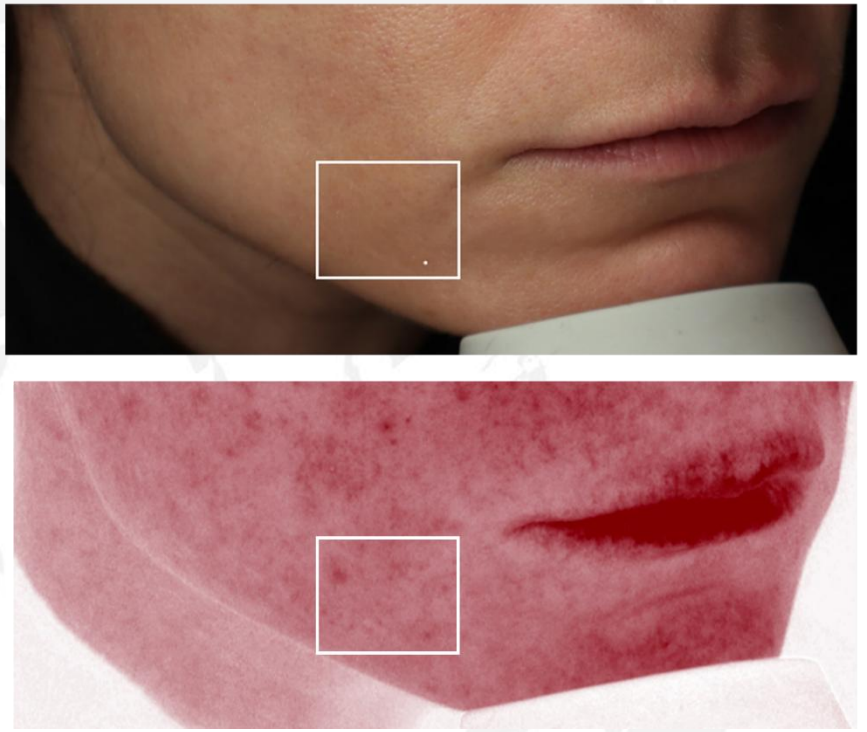
Post-inflammatory lesions count

Picture of a representative volunteer in active group

T24h



T5d



Thanks to

Arterra Staff:

Giuditta Vitiello, Marta Schettino, Antonio Colantuono

Chiara Niespolo, Francesca Morra, Assunta Tortora, Fiorella Nugnes

Vincenzo Fogliano, Giuseppe Ferrante, Maria Gabriella Colucci


IFSCC

Coffea Bengalensis-Derived Extracellular Vesicles: microRNA-Mediated Modulation of Skin Inflammation and Neuron Communication

SCIENTIFIC PAPER

Vitalab team
Claudia Zappelli
Natascia Grimaldi
Francesca La Penna

CRB
Melodie Debacker
Arnaud Kindbeiter
Catherine Rochat

University of Naples Federico II
Prof. Sonia Laneri
Ritamaria Di Lorenzo
Eleonora Vardaro
Prof. Francesca Ungaro
Teresa Silvestri

IBB- CNR
Luciano Pirone

Studio Santorelli
Adriano Santorelli
Alessia Cirillo
Michele Ventrone