

VALORIZATION OF RASPBERRY POMACE THROUGH NADES-DERIVED EXTRACTS FOR STABLE AND BIOACTIVE TOPICAL SYSTEMS

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CONTEXT

Raspberry pomace (RP) is a sustainable source of (poly)phenols, making it attractive for dermatological and cosmetic use. Its valorization supports circular economy principles while providing high-value ingredients, but conventional extraction methods based on organic solvents limit their formulation potential. Natural Deep Eutectic Solvents (NaDESs) have emerged as eco-friendly alternatives able to efficiently extract (poly)phenols. The aim of this work was to obtain RP extracts with preserved antioxidant activity and defined phenolic profile using NaDES. The most effective was then applied in an oil-in-water (O/W) emulgel for skincare, evaluating both antioxidant efficacy and sensory stability.

METHODS

Five NaDES were synthesized at 80 ° C for 30 min using betaine as hydrogen bond (HB) acceptor.

HB donor	Citric acid	Lactic acid	Acetic acid	Glycerol	Ethylene glycol
ABBREVIATION	NaDES1	NaDES2	NaDES3	NaDES4	NaDES5

Water was used as a green reference solvent for comparison.

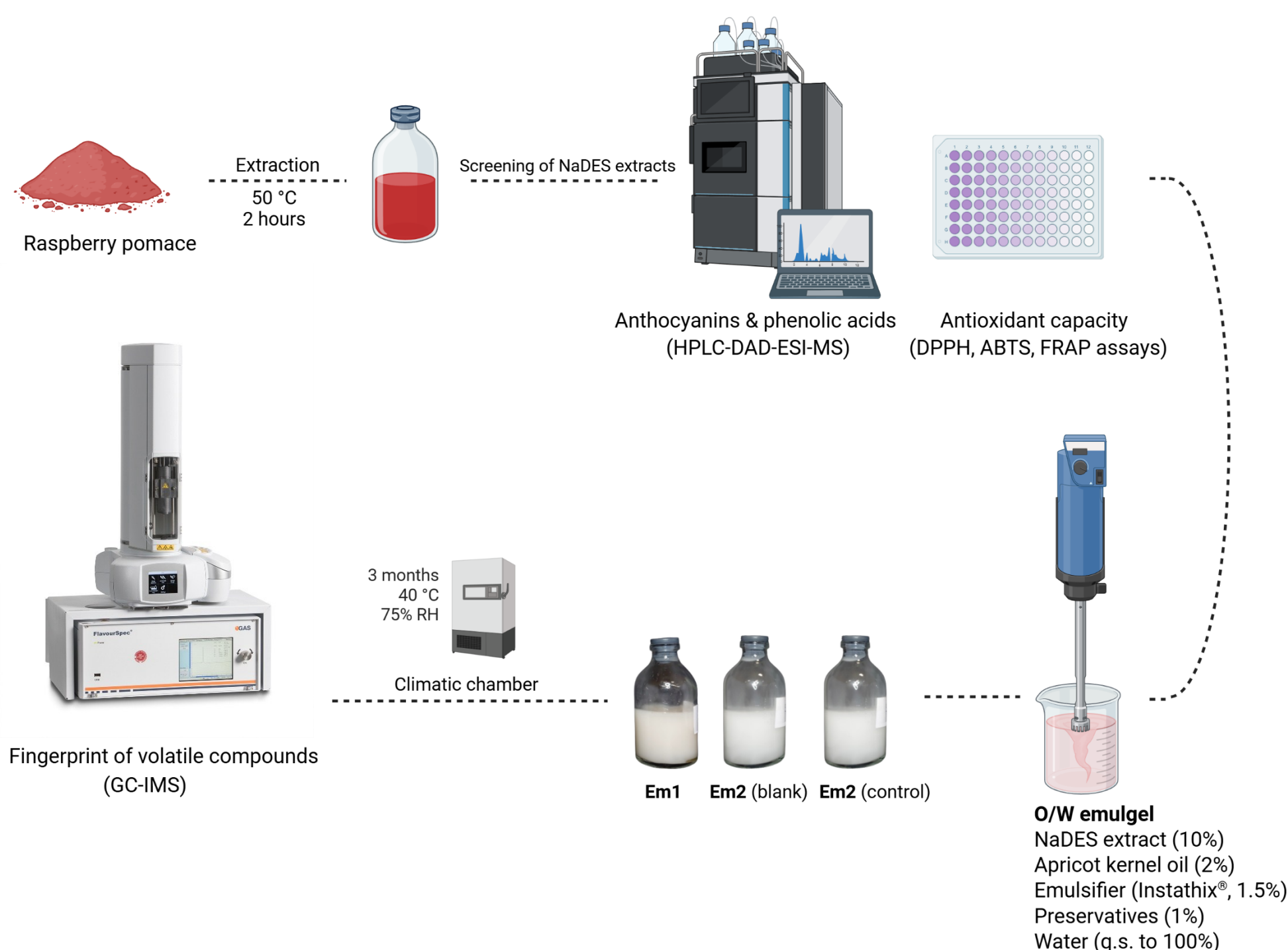


Figure 1. Experimental workflow

CONCLUSIONS

The betaine glycerol NaDES enabled efficient recovery of RP phenolics, ensuring high antioxidant activity and sensory stability in topical emulgels. This eco-friendly approach demonstrates the potential of NaDES in developing sustainable and antiaging topical products.

RESULTS

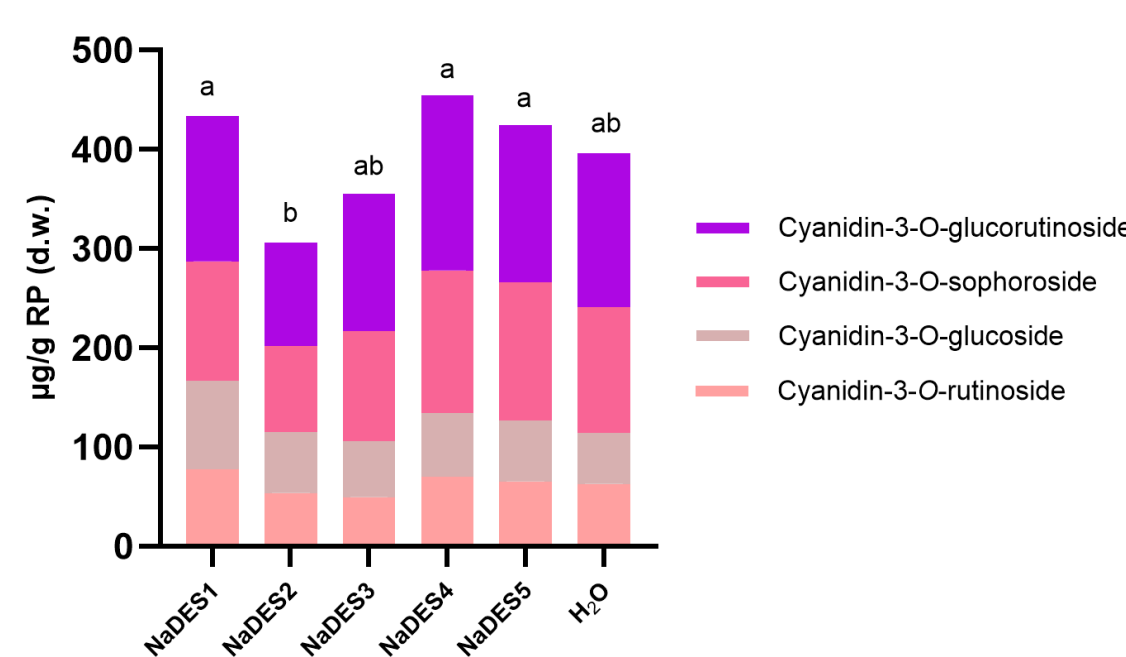


Figure 2. Anthocyanins content of RP extracts, expressed as mean \pm SD (n = 3).

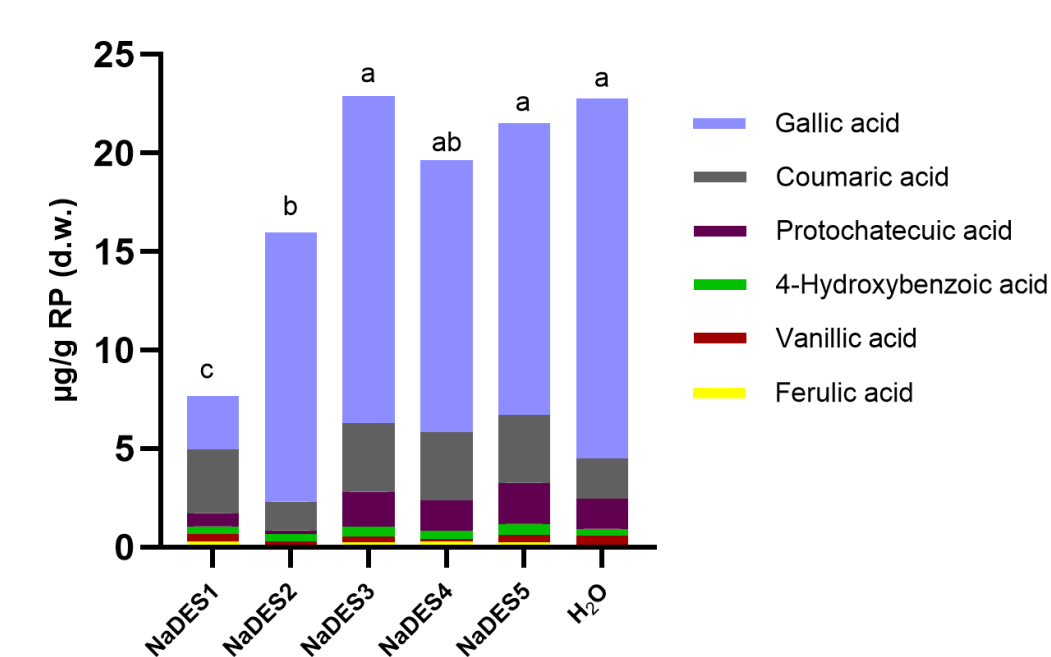


Figure 3. Phenolic acids content of RP extracts, expressed as mean \pm SD (n = 3).

Extracts were dominated by **cyanidin-3-O-glucorutinoside** and **cyanidin-3-O-sophoroside**, while **gallic acid** was generally the main phenolic acid.

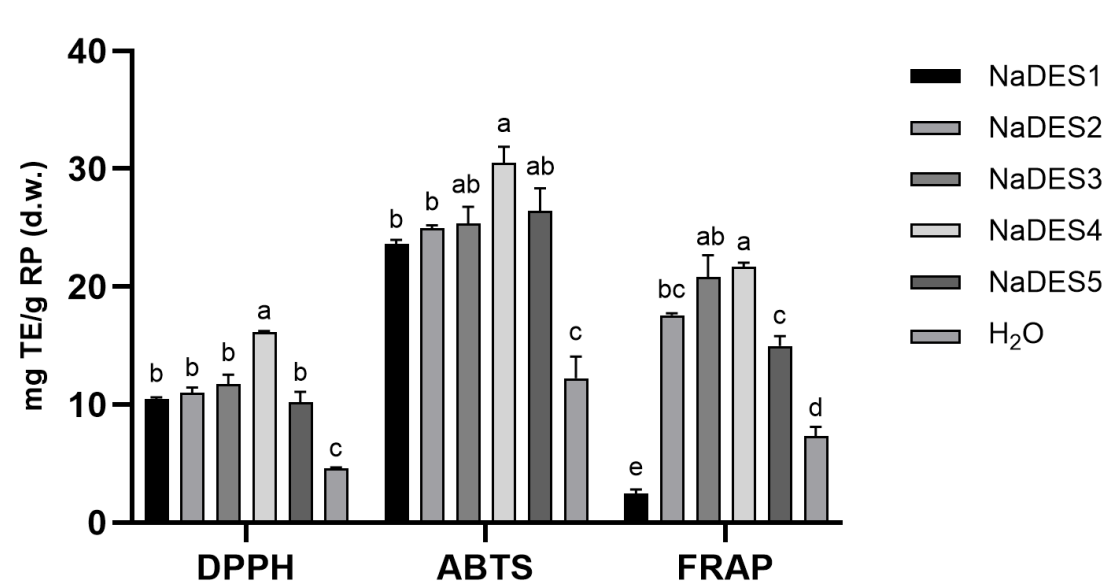


Figure 4. Antioxidant capacity of RP extracts, expressed as mean \pm SD (n = 3).

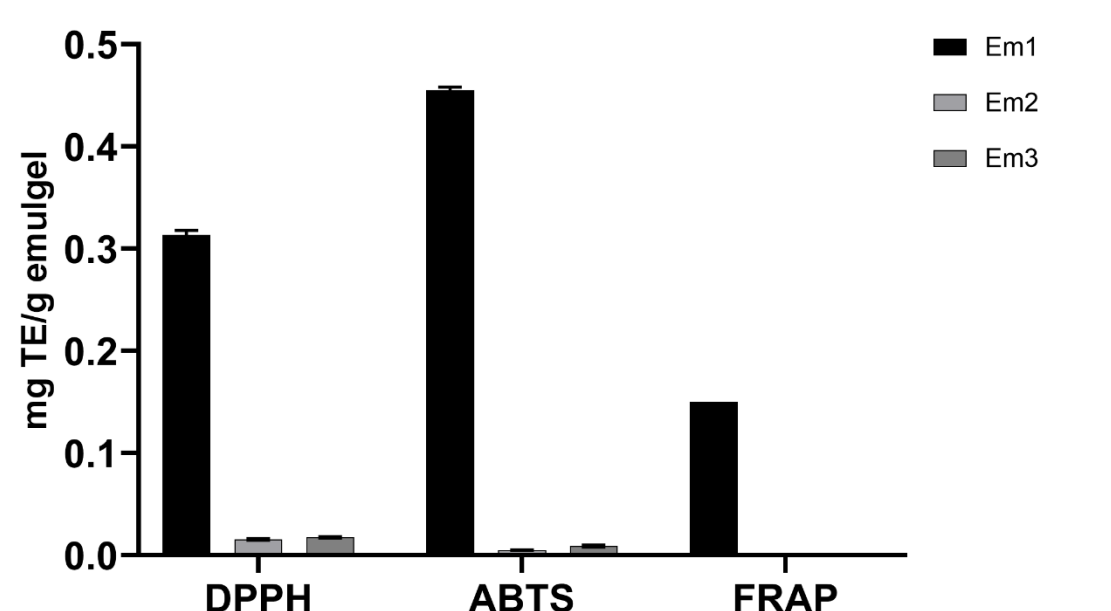


Figure 5. Antioxidant capacity of emulgels, expressed as mean \pm SD (n = 3).

NaDES4 (glycerol-based) was the most effective system, showing the highest radical-scavenging and reducing power values. Its strong **antioxidant activity** and **biocompatibility** justified its use in the topical formulations.

The emulgel with RP extract (Em1) **retained** antioxidant activity during processing, with markedly higher capacity than blank and control, as expected, confirming its potential as antiaging topical system.

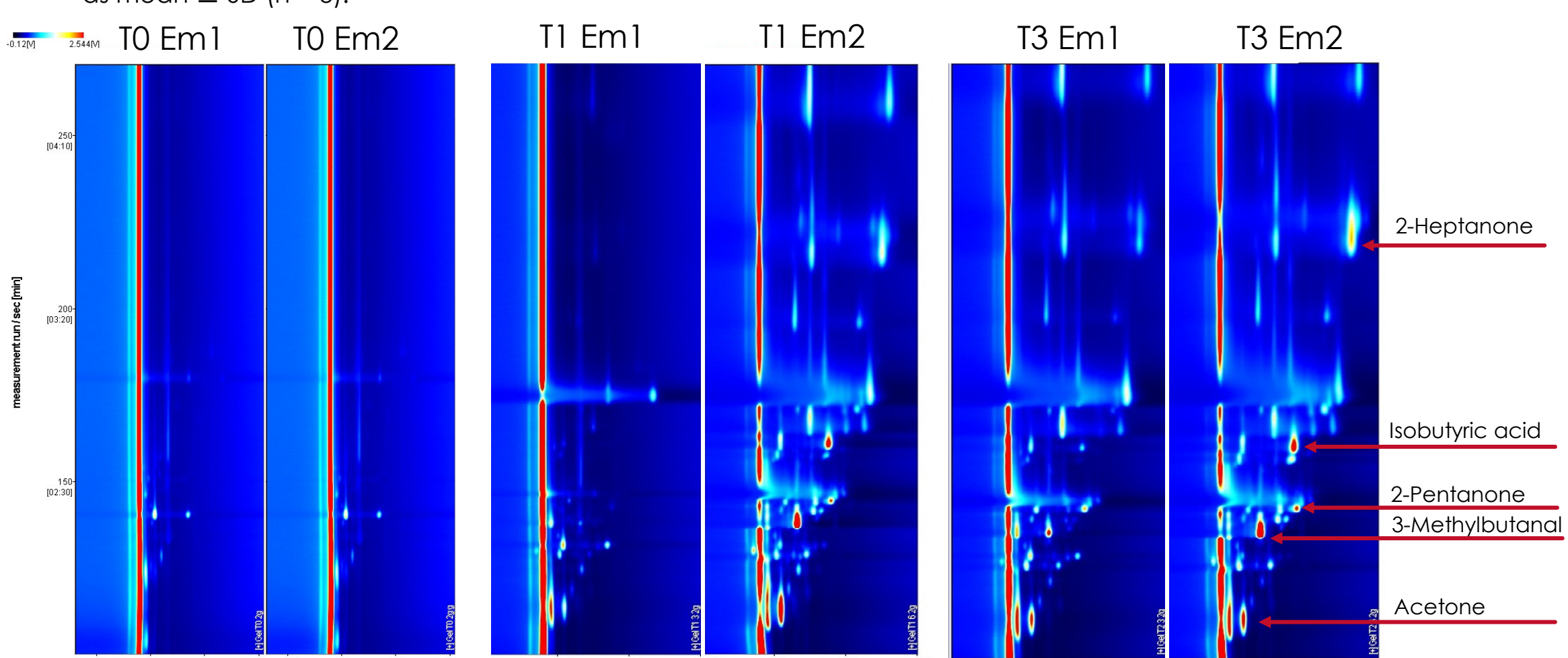


Figure 6. Volatile profile of emulgels (Em1, Em2) analyzed by GC-IMS. Storage times are indicated as follows: T0 = freshly prepared (no storage), T1 = after 1 month of storage, and T3 = after 3 months of storage.

Volatile fingerprinting confirmed **greater sensory stability** in the RP emulgel (Em1) compared to the blank (Em2), with fewer degradation-related signals.

ABBREVIATIONS

RP – Raspberry pomace, NaDES – Natural Deep Eutectic Solvent, HB – Hydrogen bond, O/W – Oil-in-water, DPPH – 2,2-diphenyl-1-picrylhydrazyl, ABTS – 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid), FRAP – Ferric Reducing Antioxidant Power, d.w. – Dry weight, TE – Trolox equivalent.

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