Impact Factor:
ISRA (India) = 6.317 | SIS (USA) = 0.912 | ICV (Poland) = 6.630
ISI (Dubai, UAE) = 1.582 | РИНЦ (Russia) = 0.191 | PIF (India) = 1.940
GIF (Australia) = 0.564 | ESJI (KZ) = 8.100 | IBI (India) = 4.260
JIF = 1.500 | SJIF (Morocco) = 7.184 | OAJI (USA) = 0.350

SOI: 1.1/TAS DOI: 10.15863/TAS
International Scientific Journal
Theoretical & Applied Science
p-ISSN: 2308-4944 (print) e-ISSN: 2409-0085 (online)
Year: 2025 Issue: 05 Volume: 145
Received: 06.05.2025
Accepted/Published: 30.05.2025
https://T-Science.org

Issue Article

M.L. Tatvidze
Akaki Tsereteli State University
Doctor of Chemical and Biological Engineering, Associated Professor,
Faculty of Technological Engineering,
Kutaisi, Georgia

COMPARATIVE STUDY OF DRIED EXTRACTS OF ROSA CANINA AND VACCINIUM MYRTILLUS FOR USE IN PH-MODULATING DERMATOLOGICAL FORMULATIONS

***Abstract**: This study presents a comparative FTIR (Fourier-transform infrared) spectroscopic analysis of dried extracts of Rosa canina (rosehip) and Vaccinium myrtillus (bilberry), collected from high-mountain regions of Georgia. The aim was to evaluate their acidifying potential for topical dermocosmetic applications. Both extracts showed characteristic absorption bands associated with functional groups such as carboxylic acids and phenolic compounds. Rosehip extract demonstrated a stronger presence of carbonyl and ester peaks, suggesting greater potential to lower skin pH. The results support the use of these plant-based ingredients in natural formulations intended to restore the skin's acidic mantle.*

***Key words**: FTIR spectroscopy, Rosa canina, Vaccinium myrtillus, dermocosmetics, skin pH, carboxylic acids, phenolic compounds.*
***Language**: English*
***Citation**: Tatvidze, M.L. (2025). Comparative study of dried extracts of *Rosa canina* and *Vaccinium myrtillus* for use in pH-modulating dermatological formulations. *ISJ Theoretical & Applied Science, 05 (145),* 36-39.
Soi: https://s-o-i.org/1.1/TAS-05-145-8 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2025.05.145.8
***Scopus ASCC**: 1508.*

1. Introduction

The pH level of human skin plays a crucial role in maintaining epidermal barrier integrity and microbial homeostasis. Normally, the skin surface exhibits a slightly acidic pH, typically ranging from 4.7 to 5.5, which is essential for inhibiting the growth of pathogenic microorganisms and preserving the stratum corneum's integrity [1].

In modern cosmeceutical development, there is growing interest in formulations that support the skin's natural acidity while providing therapeutic benefits. One promising approach is the use of plant-based extracts rich in organic acids and polyphenols, which can acidify the medium and serve as bioactive ingredients [2]. These bioactive compounds not only offer antioxidant and anti-inflammatory effects but may also help regulate the pH of topical preparations.

Among the botanicals of interest, *Rosa canina* (rosehip), and *Vaccinium myrtillus* (bilberry) have demonstrated significant potential. rosehip is a natural source of vitamin C and galactolipids, often associated with epithelial regeneration and acidification of the surrounding medium. bilberry is abundant in anthocyanins and phenolics, known for stabilizing microvascular circulation and acting as potent antioxidants [3].

In this context, Fourier Transform Infrared (FTIR) spectroscopy is a valuable method for identifying functional groups and molecular structures present in plant extracts. By analyzing IR spectral patterns, specific chemical signatures such as carbonyl, hydroxyl, and carboxyl groups can be identified, which may correlate with acidifying effects in formulations [4].

This study aims to compare the FTIR spectra of rosehip, and bilberry to evaluate their potential roles in lowering the pH of dermal formulations, particularly for applications requiring enhanced skin acidity, such as in the treatment of atopic dermatitis, acne, or fungal infections.

2. Materials and Methods. This study utilized dried extracts of ripe fruits of rosehip and bilberry, collected from high-mountain regions of Georgia. The plant materials were air-dried and ground into a fine powder.

Extraction was performed using 70% ethanol at a controlled temperature of 70–80 °C. The resulting extracts were concentrated under vacuum to remove most of the solvent, followed by final vacuum drying to obtain solid residues. These dried extracts were then pulverized again to ensure a homogeneous fine powder suitable for spectroscopic analysis.

FTIR spectra were acquired using a Thermo Nicolet AVATAR 370 spectrometer (USA), operating within the spectral range of 4000–400 cm^{-1} and a resolution of 0.5 cm^{-1}.

For measurements in nujol (vaseline oil), the fine powders were thoroughly mixed with a drop of nujol to form a uniform paste, which was then placed between two potassium bromide (KBr) plates for transmission analysis.

For aqueous-based measurements, a small amount of extract was dissolved in boiling water. After cooling, a thin film of the solution was applied to a germanium window (Avatar Multi-Bounce Flat Plate, 45° Ge), air-dried, and analyzed by FTIR [5-8].

3. Results. The FTIR spectra of dried extracts of rosehip and bilberry revealed characteristic absorption bands corresponding to functional groups that may contribute to acidifying effects.

3.1. FTIR Spectral Features. Representative FTIR spectra of both extracts are presented in Figure 1 rosehip and Figure 2 bilberry. Key absorption bands and their respective functional group assignments are summarized in Table 1.

Rosehip extract exhibited prominent bands at:

- ~3400 cm^{-1}: O–H stretching (phenolic compounds and alcohols)
- ~2920 and ~2850 cm^{-1}: C–H stretching of aliphatic chains
- ~1735 cm^{-1}: C=O stretching (carboxylic acids and esters)
- ~1615 cm^{-1}: Aromatic C=C or asymmetric COO^- stretching
- ~1450 and ~1370 cm^{-1}: CH_3 and CH_2 bending
- ~1050–1150 cm^{-1}: C–O stretching (carbohydrates and organic acids)

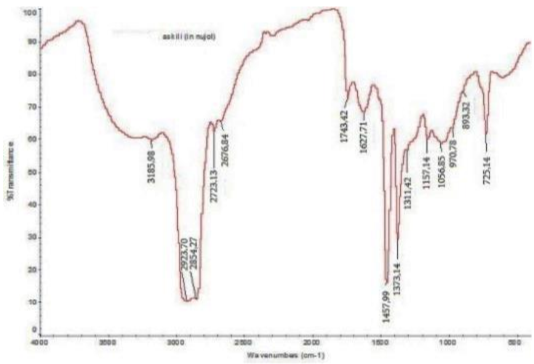

Figure 1. FTIR spectrum of rosehip extract.

Vaccinium myrtillus extract showed similar spectral features but with different relative intensities:

- ~3300–3400 cm^{-1}: Broad O–H stretching (hydroxyl-rich compounds)
- ~1720–1730 cm^{-1}: Strong carbonyl absorption (likely due to anthocyanin glycosides and phenolic acids)
- ~1600–1625 cm^{-1}: Aromatic ring vibrations
- ~1100 cm^{-1}: C–O stretching (organic acids and polysaccharides)
- ~890 cm^{-1} and ~720 cm^{-1}: C–H out-of-plane bending (aromatic substitution)

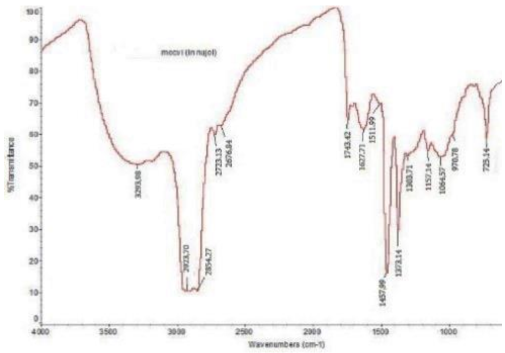

Figure 2. FTIR spectrum of bilberry extract.

Table 1. Key FTIR Absorption Bands and Functional Group Assignments

Wavenumber (cm^{-1})	Functional Group Assignment	Observed in
3400–3200	O–H stretching (phenols, acids)	Both extracts
2920 / 2850	C–H stretching (alkanes)	Both extracts
1730–1740	C=O stretching (carboxylic acids, esters)	Both, stronger in rosehip
1615–1625	Aromatic C=C or COO^- stretching	Both extracts
1450 / 1370	CH_2 and CH_3 bending	Both extracts
1150–1050	C–O stretching (acids, polysaccharides)	Both extracts
890 / 720	C–H out-of-plane bending (aromatics)	More visible in bilberry

3.2. Comparative Analysis of Acidic Functional Groups. Both extracts exhibited absorption bands characteristic of carboxylic (–COOH) and phenolic (–OH) groups, which are known to contribute to the acidifying capacity of topical formulations. The rosehip extract showed a notably stronger C=O absorption band at ~1735 cm^{-1}, indicative of a higher concentration of carboxylic acid derivatives or esters. In contrast, the bilberry extract exhibited broader O–H bands, likely due to its rich content of anthocyanins and polyphenols.

These spectral differences suggest that while both extracts possess acidifying potential, rosehip may exert a more pronounced pH-lowering effect due to its elevated carbonyl group content, which is associated with stronger organic acid presences.

4. Discussion. The FTIR profiles of the investigated extracts indicate a clear prevalence of acid-associated functional groups, such as carboxylic (–COOH) and phenolic (–OH) moieties, in both rosehip and bilberry. However, the rosehip extract demonstrated a more intense C=O stretching band at ~1735 cm^{-1}, typically associated with free acids and esters, which are directly involved in lowering the pH of topical preparations.

Carboxylic acids play a critical role in restoring and maintaining the skin's natural acidic environment (pH 4.5–5.5), thereby enhancing the function of the epidermal barrier and providing antimicrobial protection. The presence of stronger carbonyl signals in rosehip extract implies a greater concentration of organic acids, such as citric, malic, and ascorbic acids, which are well-documented in rosehip fruits [9]. In contrast, bilberry extract, despite showing similar functional groups, revealed slightly weaker carbonyl bands and broader O–H features, pointing to a higher contribution from anthocyanin compounds rather than simple acids [10].

This suggests that rosehip extract may exert a more immediate and stronger acidifying effect, making it a preferable ingredient in formulations where pH reduction is a primary goal. In addition, the presence of esters and low-molecular-weight acids could support both the skin's chemical balance and keratinocyte function, especially in compromised skin conditions.

The high-mountain origin of both raw materials may enhance their efficacy, as environmental stress is known to stimulate the accumulation of secondary metabolites, including organic acids and phenolics [11].

5. Conclusion. This study demonstrated that both *Rosa canina* and *Vaccinium myrtillus* dry fruit extracts contain functional groups—primarily carboxylic and phenolic—that are relevant for pH-lowering applications in topical formulations. FTIR analysis revealed that the rosehip extract, in particular, exhibited stronger carbonyl absorption bands, indicating a higher concentration of free acids and esters. These features suggest that *Rosa canina* may serve as a more potent acidifying agent in dermocosmetic products aimed at restoring or maintaining the skin's natural acidic barrier.

While bilberry also displayed beneficial chemical characteristics, including broad O–H and aromatic vibrations likely related to anthocyanins and polyphenols, its acidifying potential appears comparatively moderate. However, its antioxidant profile may complement other functions in multifunctional skincare applications.

The findings support the targeted use of wild plant extracts from Georgia's high-mountain regions as pH-modulating ingredients in natural cosmetic formulations. Further research may explore synergies between these extracts and their behavior in full emulsified systems or clinical environments.

References:

1. Coates, J. (2000). Interpretation of Infrared Spectra, A Practical Approach. In R.A. Meyers (Ed.), *Encyclopedia of Analytical Chemistry* (pp. 10815–10837). Wiley.
2. Socaciu, C. (2013). Application of Fourier Transform Infrared Spectroscopy for the Characterization of Sustainable Cosmetics and Ingredients with Antioxidant Potential. *Academia.edu*. https://www.academia.edu/6339047
3. Shaheen, G., et al. (2022). Antioxidant, Antimicrobial, Phytochemical and FTIR Analysis of *Peganum harmala* (Fruit) Ethanolic Extract From Cholistan Desert, Pakistan. *Dose-Response*, 20(3), 15593258221126832. https://doi.org/10.1177/15593258221126832
4. Ahmad, A., et al. (2016). In Vitro Antimicrobial Bioassays, DPPH Radical Scavenging Activity, and FTIR Spectroscopy Analysis of *Heliotropium bacciferum*. *BioMed Research International*, 2016, 3818945. https://doi.org/10.1155/2016/3818945
5. Stamin, F. D., Vijan, L. E., Topală, C. M., & Cosmulescu, S. N. (2024). The Influence of Genotype, Environmental Factors, and Location on the Nutraceutical Profile of Rosa canina L. Fruits. *Agronomy*, *14*(12), 2847. https://doi.org/10.3390/agronomy14122847
6. Alecu, A., Albu, C., Badea, G. I., Alionte, A., Enache, A. A., Radu, G. L., & Litescu, S. C. (2025). Infrared Laser-Assisted Extraction of Bioactive Compounds from Rosa canina L. *International Journal of Molecular Sciences*, *26*(3), 992. https://doi.org/10.3390/ijms26030992
7. Elferjane, M. R., Milutinović, V., Jovanović Krivokuća, M., Taherzadeh, M. J., Pietrzak, W., Marinković, A., & Jovanović, A. A. (2024). Vaccinium myrtillus L. leaf waste as a source of biologically potent compounds: Optimization of polyphenol extractions, chemical profile, and biological properties of the extracts. *Pharmaceutics*, *16*(6), 740. https://doi.org/10.3390/pharmaceutics16060740
8. Traksele, L., & Snitka, V. (2022). Surface-enhanced Raman spectroscopy for the characterization of Vaccinium myrtillu s L. bilberries of the Baltic–Nordic regions. *European Food Research and Technology*, *248*(2), 427-435. DOI: 10.1007/s00217-021-03887-8
9. Górnaś, P., et al. (2018). “Phenolic Compounds of Rosehip (Rosa canina L.) and Their Antioxidant Properties.” Molecules, 23(7), 1761.
10. Lohachoompol, V., Srzednicki, G., & Craske, J. (2004). The change of total anthocyanins in blueberries and their antioxidant effect after drying and freezing. *BioMed Research International*, *2004*(5), 248-252. https://doi.org/10.1155/S1110724304406123
11. Wangchuk, P., Keller, P. A., Pyne, S. G., Taweechotipatr, M., Tonsomboon, A., Rattanajak, R., & Kamchonwongpaisan, S. (2011). Evaluation of an ethnopharmacologically selected Bhutanese medicinal plants for their major classes of phytochemicals and biological activities. *Journal of Ethnopharmacology*, *137*(1), 730-742. https://doi.org/10.1016/j.jep.2011.06.032