

# Improving Polyphenol Recovery from Rose Hips Using Ultrasound-Assisted Extraction

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## ABSTRACT

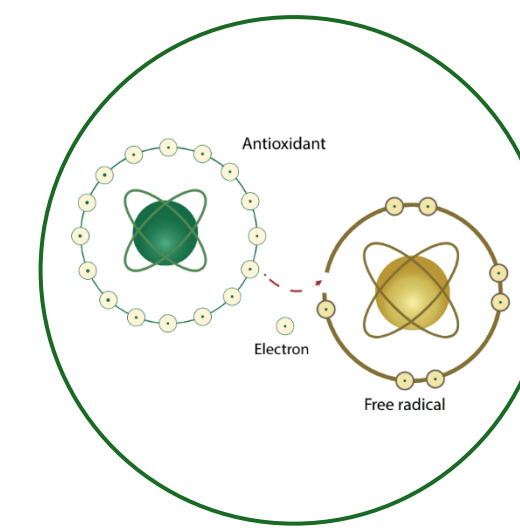
- The use of *Rosa canina* L. rose hips as an alternative source of natural colorant, preservative, or bioactive ingredient represents a growing area of research, driven by increasing consumer interest in value-added products.
- The present study aimed to apply response surface methodology (RSM) to optimize ultrasound-assisted extraction (UAE) condition for the recovery of phenolic compounds with high antioxidant activity. Temperature (25–45°C), sonication time (20–40 min), and ethanol concentration (50–90%) were selected as the main factors in a Box–Behnken experimental design. The dependent variables analyzed were total anthocyanin content (TAC), total polyphenol content (TPC), and antioxidant activity.
- The experimental results were well fitted to a quadratic model, explaining over 98% of the variability in the responses as a function of the applied UAE factors. Under optimal conditions (45°C, 40 min, 52.12% ethanol), the predicted values were 4.87 mg M3G/100 g DW for TAC, 5819.91 mg GAE/100 g DW for TPC, and 82.26% DPPH radical scavenging activity.
- The validated extract exhibited high levels of gallic acid (1683.39 ± 11.36 mg/100 g DW), hesperidin (110.09 ± 7.16 mg/100 g DW), and naringin (83.82 ± 11.54 mg/100 g DW), according to high-performance liquid chromatography (HPLC) analysis.
- The valorization of wild natural resources represents an important research direction. The rose hips valuable bioactive properties certify their technological virtues both as agents used to enhance shelf-life and as potential ingredients for functional foods.

## INTRODUCTION



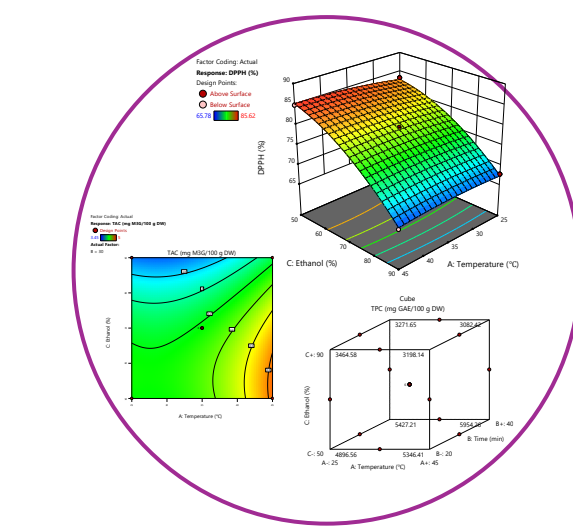
*Rosa canina* L.

It is a widely distributed wild plant recognized for its potential medicinal and therapeutic applications, largely attributed to its rich phytochemical composition.



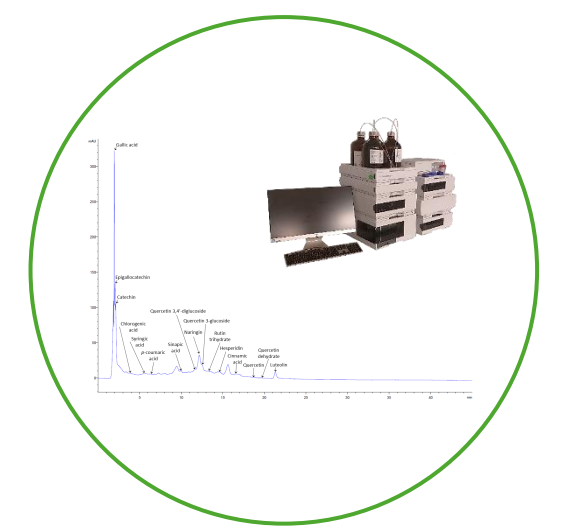
Health Effects

In recent years, rose hips have been extensively investigated for their potential role in the management of various conditions, including inflammation, diabetes, and cancer-related disorders.



Extraction Optimisation

Using RSM, extraction conditions, such as temperature, sonication time, and ethanol concentration, can be optimized to significantly enhance the recovery of antioxidant polyphenolic compounds.

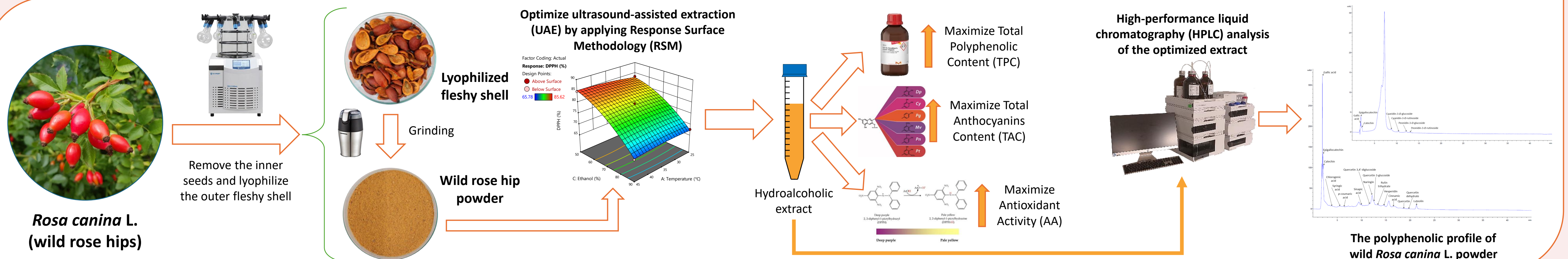


HPLC Characterisation

Furthermore, analysis by HPLC provides essential information regarding the qualitative and quantitative profile of polyphenolic compounds present in the optimized extracts.

Valorification of Wild Rose Hips

## MATERIALS AND METHODS



## RESULTS AND DISCUSSION

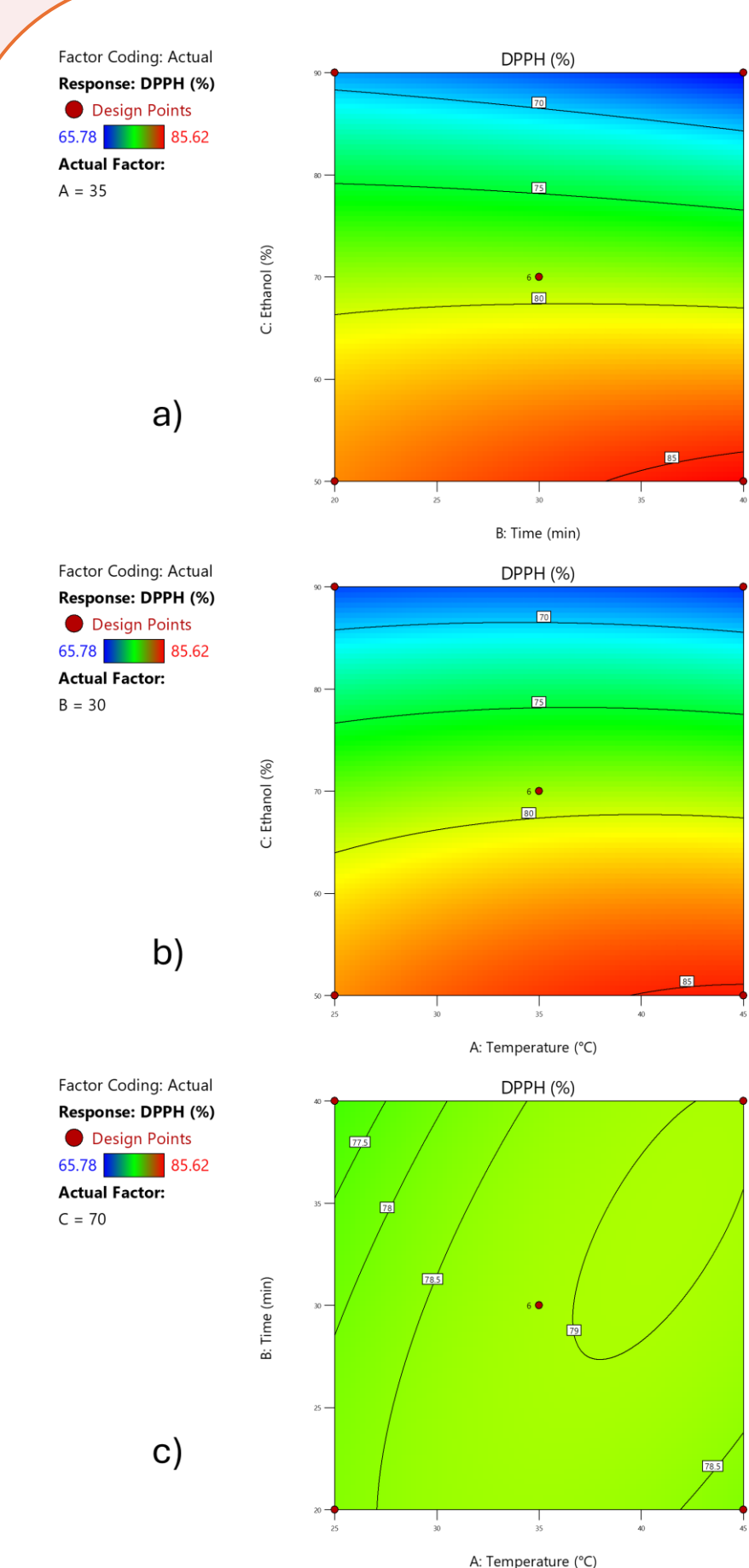


Figure 2. Contour plot analyzing the interaction effects of temperature and extraction time (AB), ethanol concentration and extraction time (BC), and temperature and ethanol concentration (AC) on the extraction of bioactive compounds with antioxidant activity

❖ In Fig. 1, it can be observed that the interaction between temperature and time (AB) is not statistically significant, while the interactions between ethanol concentration and time (BC) and between temperature and ethanol concentration (AC) have a greater impact on polyphenol recovery. This phenomenon can be explained by the fact that higher ethanol concentrations may excessively reduce the polarity of the solvent, thereby affecting the extraction efficiency of bioactive compounds.

❖ In Fig. 2, it can be observed that the significance of the interactions is similar to that in Fig. 1, which may explain the strong linear relationship between TPC and DPPH.

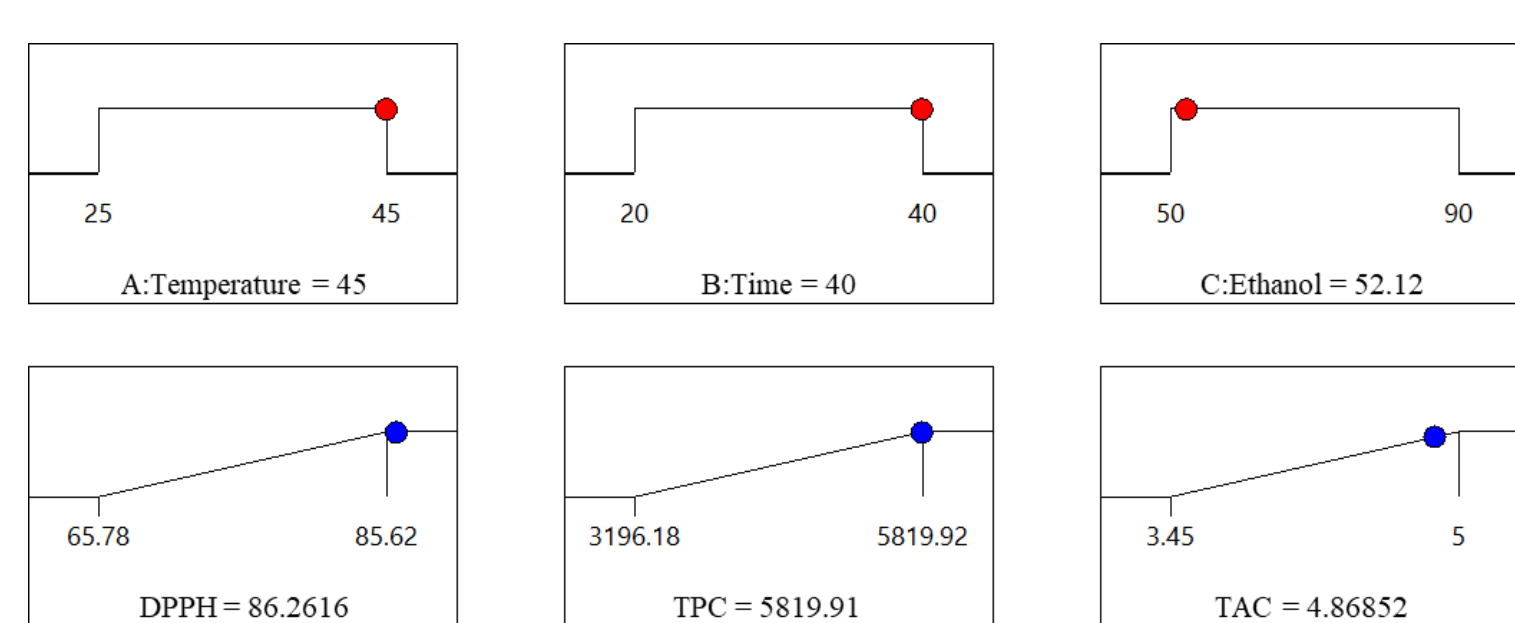


Figure 3. Ramp plot showing the predicted optimal conditions for maximizing TPC, TAC, and antioxidant activities

❖ In Fig. 2, the optimal conditions for maximizing the recovery of polyphenolic compounds with antioxidant activity are presented. Higher temperatures and longer sonication times enhance the release of bioactive compounds through the formation and collapse of cavitation bubbles, which disrupt plant cell walls. At the same time, the solvent system improves the solubility of these compounds, facilitating their extraction.

❖ Chromatographic analysis showed that the optimal extract exhibited a rich polyphenolic profile, with 20 identified phenolic compounds. High levels of gallic acid (1683.39 ± 11.36 mg/100 g DW), hesperidin (110.09 ± 7.16 mg/100 g DW), and naringin (83.82 ± 11.54 mg/100 g DW) were observed, as shown in Fig. 4.

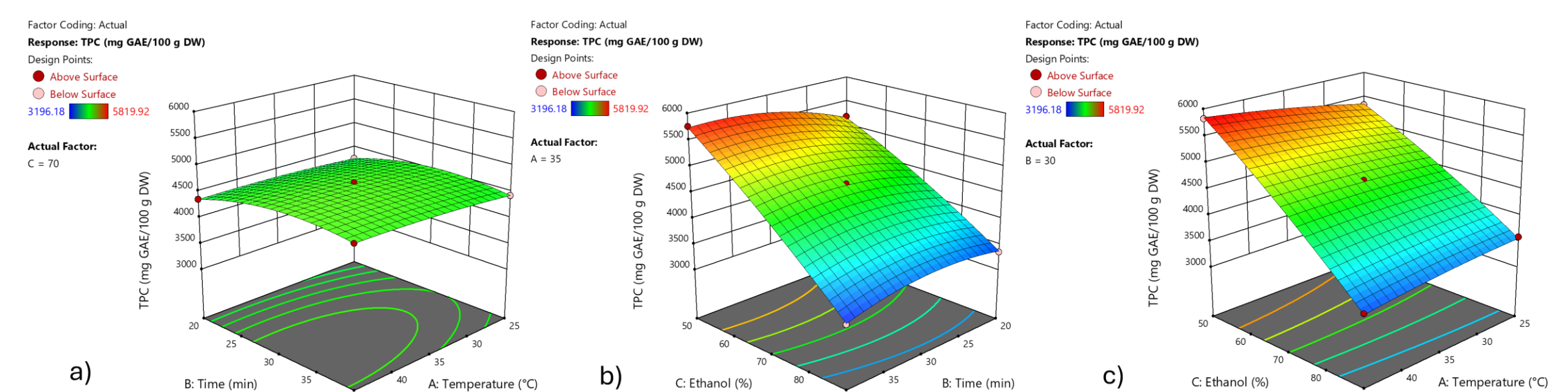


Figure 1. 3D response surface for TPC extraction from rose hips, analyzing the interaction effects between temperature and time (AB), ethanol concentration and time (BC), and temperature and ethanol concentration (AC)

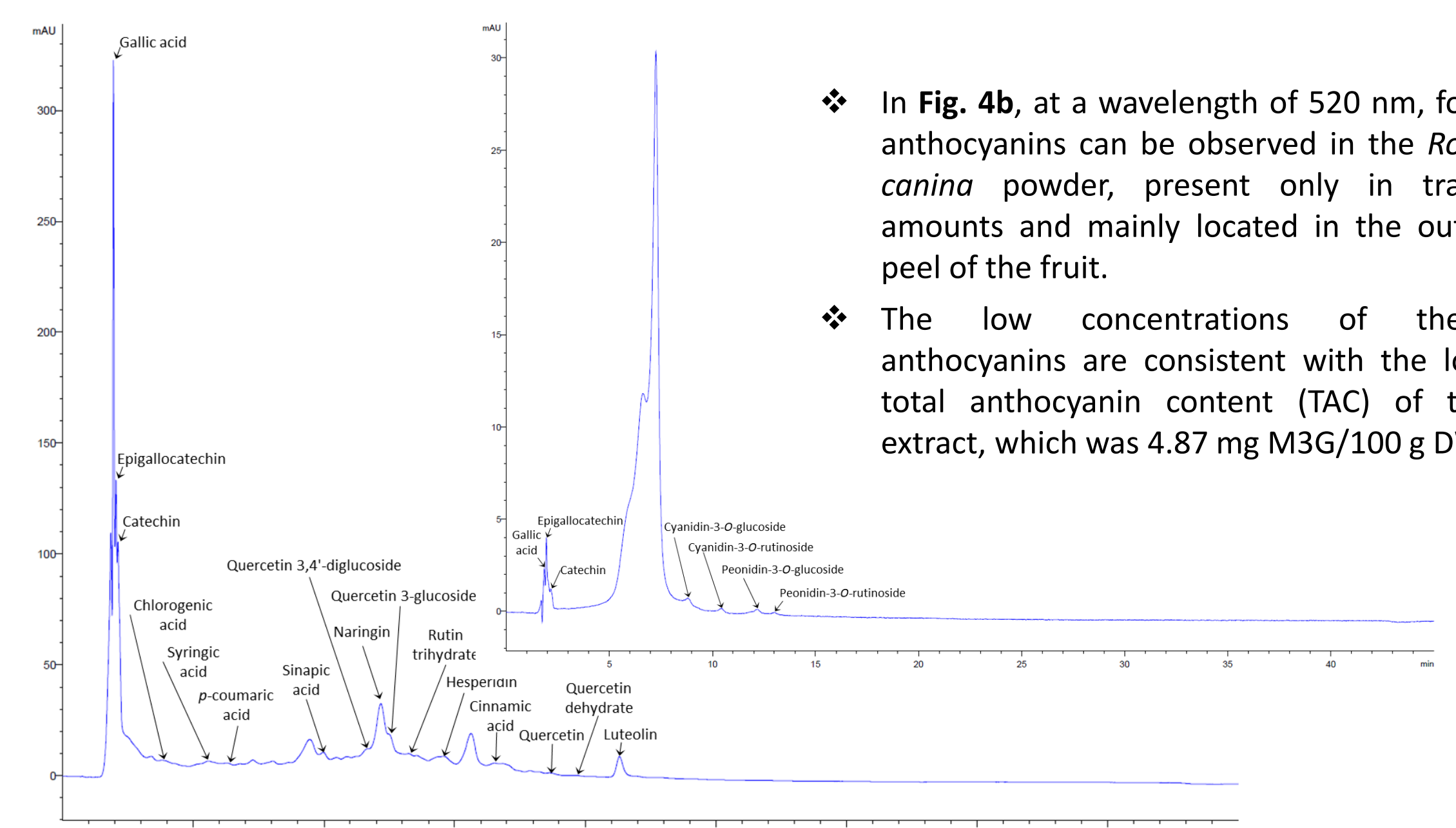


Figure 4. Polyphenolic compounds quantified at 320 nm (a) and 520 nm (b) in wild *Rosa canina* L. extract

❖ In Fig. 4b, at a wavelength of 520 nm, four anthocyanins can be observed in the *Rosa canina* powder, present only in trace amounts and mainly located in the outer peel of the fruit.

❖ The low concentrations of these anthocyanins are consistent with the low total anthocyanin content (TAC) of the extract, which was 4.87 mg M3G/100 g DW.

## CONCLUSION

❖ The utilization of wild forest fruits, such as rose hips, can be an important source of polyphenolic compounds with antioxidant activity and represents an alternative strategy for developing high value-added products, in accordance with consumer demand for natural sources.

❖ The application of RSM in the extraction of bioactive compounds showed that the interaction between ethanol concentration, temperature, and sonication time significantly influences the solubilization of phenolic compounds. This effect is due to the ultrasound-induced bubble formation, the polarity of the solvent, and the reduction of surface tension at higher temperatures and longer sonication times.

❖ HPLC analysis of the optimized extract showed a large number of phenolic compounds. Many of them can exert potential antidiabetic, anti-inflammatory, and antimicrobial properties, which may contribute to improving shelf life and preventing human diseases.