

Effect of Drying Conditions on the Bioactive Compound Profile of Wild *Crataegus monogyna* L. Fruits

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ABSTRACT

The incorporation of powders obtained from the drying of wild *Crataegus monogyna* L. fruits into food matrices may contribute to the development of a category of products with high biological value, due to the anti-inflammatory, antioxidant, and antidiabetic effects.

The aim of the study was to perform a comparative analysis of infrared (IR) and hot-air convection (CD) drying at temperatures of 50, 60, and 70°C, applied to *Crataegus monogyna* L. purée, evaluating their influence on the drying rate, polyphenolic and carotenoid profiles, as well as antioxidant activity.

The drying curves highlighted the specific characteristics of the two techniques regarding drying rate as a function of moisture content. The differences observed between the two techniques are attributed to distinct mechanisms of water removal from the plant matrix structure, as well as structural changes in the particles under the action of the heat source.

The highest values of total polyphenol content and antioxidant activity were observed at 70°C for both techniques. This phenomenon can be explained by the partial inactivation of enzymes involved in browning reactions. However, the values obtained through IR drying were higher than those corresponding to CD drying, suggesting a gentler nature of infrared drying process. Regarding total carotenoid content, the maximum values were recorded at 70°C for IR drying (628.06 ± 4.50 mg/100 g DW), while for CD drying, the obtained value was 587.09 ± 5.79 mg/100 g DW at 60°C.

IR drying represents a faster alternative that may reduce the degradation of bioactive compounds, thereby promoting the production of a functional powder rich in biologically active compounds, with potential application as a food ingredient.

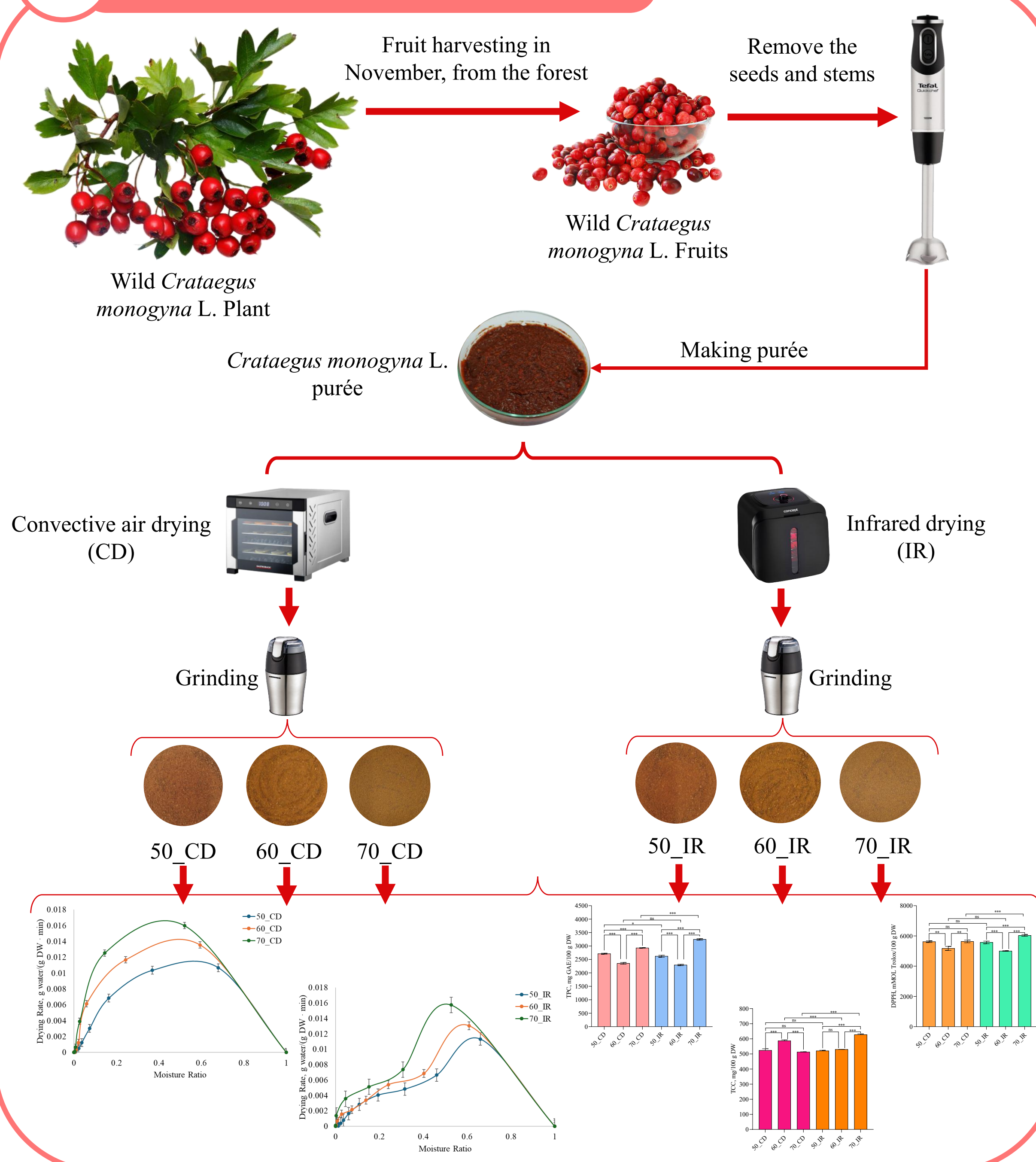
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INTRODUCTION

- Consumer interest in the utilization of local food sources is increasing, especially when it comes to wild forest fruits such as *Crataegus monogyna* L. These fruits are recognized for their complex composition, including polyphenols with high antioxidant activity, vitamins A and C, amino acids, pectin, and carotenoids, as well as for their health-promoting properties, such as cardioprotective, digestive, and antidiabetic effects.
- One of the main limitations of these fruits is their seasonality, as they are available only in autumn, from late September to early December. Therefore, the aim of this study was to identify appropriate drying conditions to preserve the bioactive compounds in these fruits, making them more accessible to consumers and suitable for long-term storage.
- Moreover, the incorporation of this natural fruit powder into food products can improve their functional and technological properties. Due to its pectin content, it can enhance rheological characteristics, while polyphenols, carotenoids, and vitamin C contribute to antioxidant capacity, helping to extend shelf life and improve overall product stability and nutritional value.

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MATERIALS AND METHODS



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RESULTS AND DISCUSSION

- According to **Fig. 1**, significant differences can be observed in the drying rate as a function of moisture ratio between convective drying (CD) and infrared (IR) drying methods. These differences are mainly related to the drying mechanisms, particularly the way the thermal agent interacts with the plant material and facilitates water removal.
- In the case of convective drying, the material undergoes significant structural changes, including cell wall shrinkage and the formation of larger intercellular spaces, resulting in increased porosity and specific surface area, which may hinder efficient moisture removal. In contrast, infrared drying better preserves tissue integrity, inducing only minor surface alterations while promoting moisture transfer from the interior toward the surface.
- As a result, IR drying, due to its ability to penetrate deeper into the material and directly convert radiation into thermal energy, promotes a more uniform moisture removal process, reduces drying time, and contributes to improved quality of the final product by maintaining texture and structural stability.

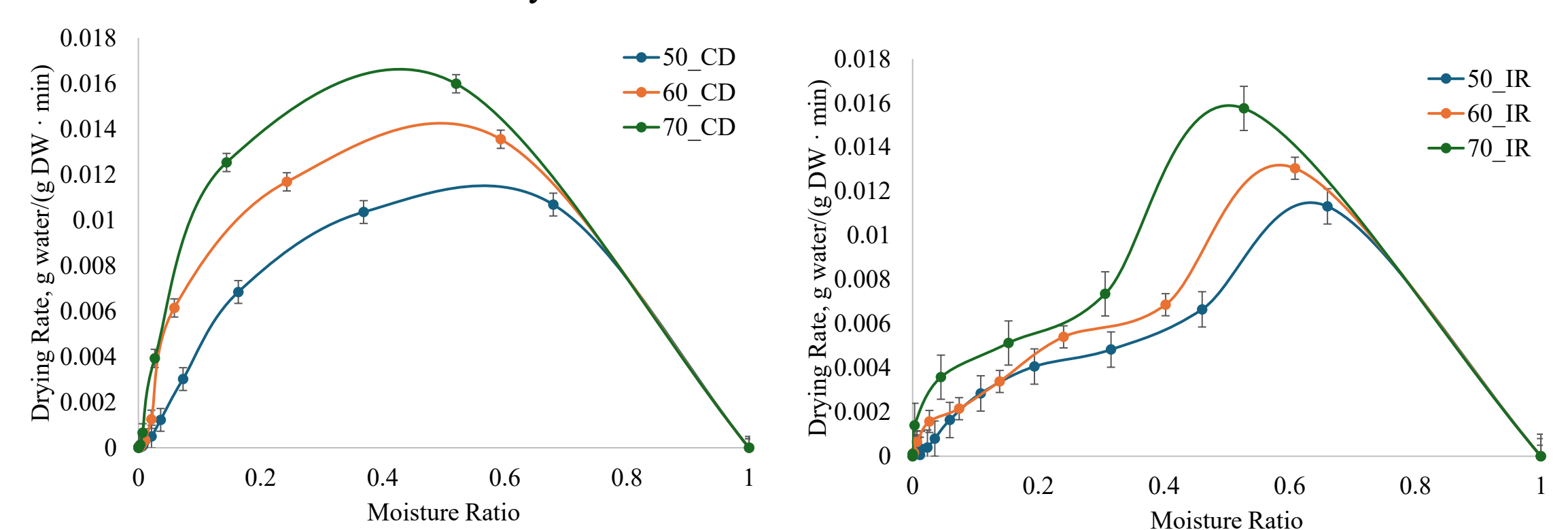


Figure 1. Drying Rate (DR) versus Moisture Ratio of *Crataegus monogyna* L. purée under CD and IR drying at 50 °C, 60 °C and 70 °C

- In **Fig. 2a**, it can be observed that at 70°C, both methods led to the preservation of polyphenolic compounds. This can be explained by the partial inactivation of enzymes involved in enzymatic browning, such as polyphenol oxidase and peroxidase, as well as by the limitation of oxygen access, which could otherwise promote the auto-oxidation of these compounds, due to the significantly shorter processing time compared to 50°C.
- Among the two drying methods applied, this temperature resulted in the highest values of total phenolic content (TPC) (**Fig. 2a**), as well as antioxidant activity (**Fig. 2c**), indicating a linear relationship between the obtained values. However, the use of infrared (IR) drying led to the highest values, a phenomenon attributed to the milder water evaporation mechanism, which has a reduced impact on the degradation of these compounds and on antioxidant activity.
- In the case of carotenoids (**Fig. 2b**), IR drying resulted in the highest values at 70°C. This can be attributed to the more efficient penetration into the plant material and the uniform moisture evaporation, which prevents surface crust formation, as occurs in convective drying (CD). Furthermore, the decrease in carotenoid content above 60°C in convective drying can be explained by possible isomerization processes of all-trans-β-carotene into cis isomers, which are associated with thermal degradation.

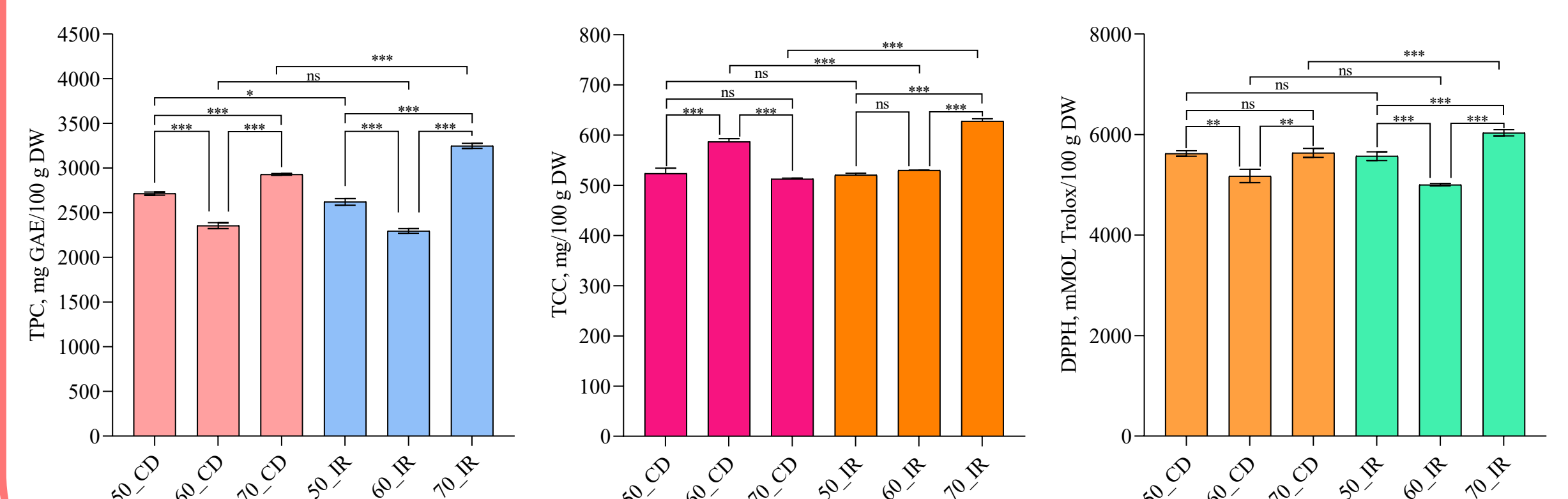


Figure 2. The influence of drying conditions on total polyphenolic content (TPC) (a), total carotenoid content (TCC) (b), and antioxidant activities (c) of *Crataegus monogyna* L. powders.

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CONCLUSION

- The drying technique significantly influenced the polyphenolic and carotenoid profiles, as well as the antioxidant activity. Both heat transfer and the water evaporation mechanism were affected, with observable differences in the diffusion process of water.
- Browning enzymes had a significant impact on the polyphenolic profile, while the application of a temperature of 70°C led to a reduction in their activity, as reflected by the high values of the polyphenolic profile and antioxidant activity.
- Therefore, the use of these powders can serve as an ingredient in high-value products due to their rich content of biologically active compounds, representing a strategic alternative to meet consumer demand for functional products.