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## INTRODUCTION

Herbal tea infusions differ from one another in amounts and composition of different compounds such as polyphenols which are present in them. This can be a result of different manufacturing methods and standardised guidelines related to preparation procedures.

The most common group of plant polyphenolic compounds are the flavinoids.

Flavinoids have a basic structure consisting of 2 aromatic rings bound by 3 carbon atoms that form an oxygenated heterocycle (Figure 1), termed as the C6-C3-C6 configuration. Based on the type of heterocycle, flavinoids can be divided into 6 subclasses: flavonols, flavones, flavanones, flavanols, anthocyanins and isoflavones.<sup>2</sup>

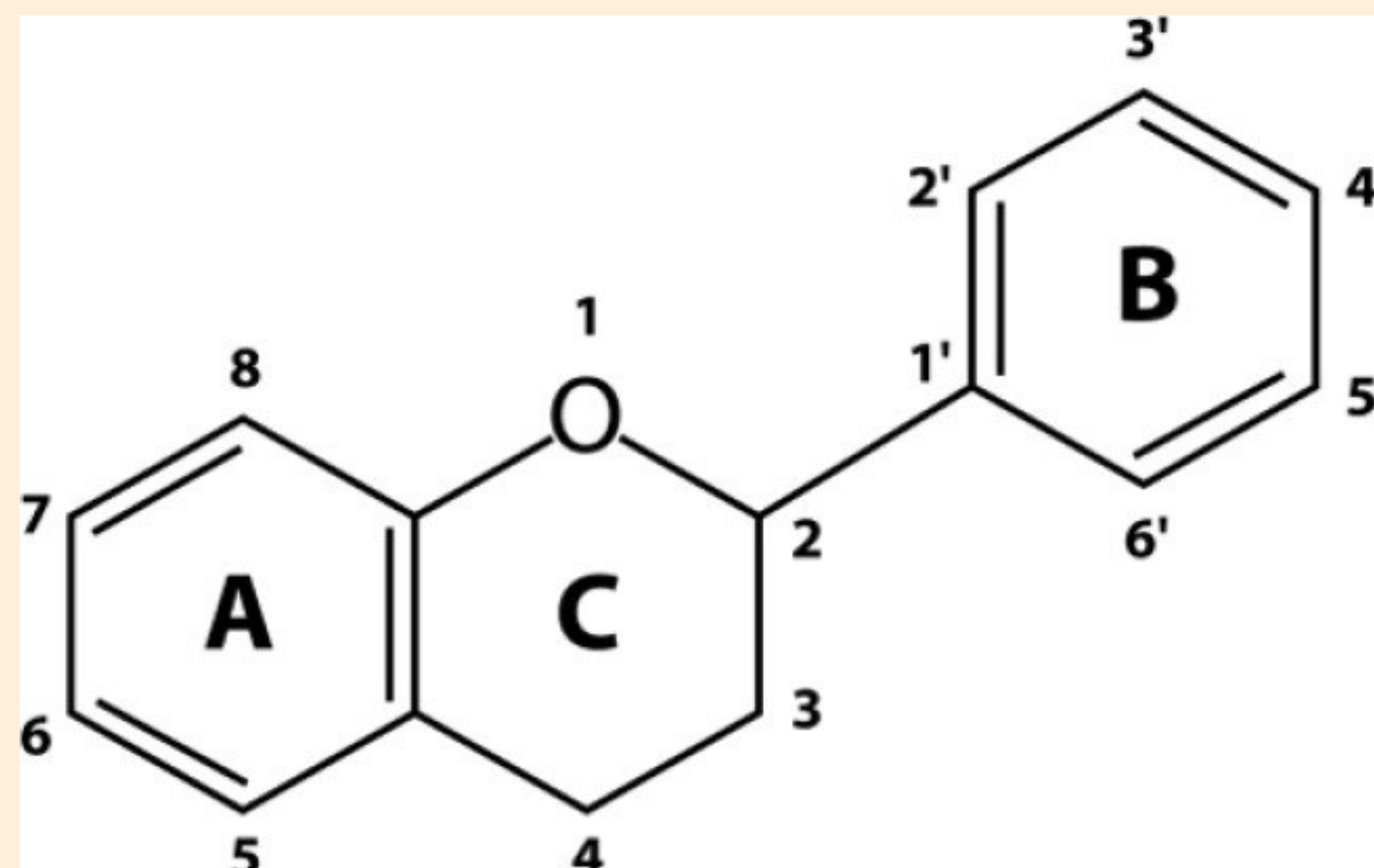


Figure 1: Chemical structure of flavinoids<sup>1</sup>

## AIMS

To determine polyphenolic content in five different commercially available and popular herbal tea infusions and investigate physicochemical properties of the herbal infusions using UV analysis and absorbance.

## METHOD

Physicochemical properties (colour intensity, tint ratio, flavinoid ratio, anthocyanin content, %red, % yellow and % blue) and the polyphenolic content in relation to steep time and temperature were investigated.

The physicochemical properties were determined using a UV-vis spectrophotometer (Lightwave II-WPA). A methanol: 1M hydrochloric acid (95:5 v/v) solvent was used.

The teas tested in this investigation included mint, white, sage raspberry and maté teas. Temperature analysis was carried out by preparing infusions from each tea in distilled water at temperatures of 80°C, 60°C, 40°C, 20°C and 5°C.

Three samples of 1ml each were extracted after 5 minutes from each type of infusion. Infusion samples were also taken every minute for 20 minutes starting

from a temperature of 80°C, to determine the appropriate infusion time. Samples were analysed using the same physicochemical parameters mentioned above.

The polyphenolic content was determined by using the Folin-Ciocalteu (FC) test for polyphenols.<sup>3</sup> The FC reagent and sodium carbonate solution were successively added to the different samples obtained alongside gallic acid standard solutions. All samples were tested in triplicates.

The microtitre plates were incubated for 20 minutes at 20°C in the dark, after which the absorbance was read at 750nm. The gallic acid equivalents as %w/w were obtained from the calibration curve ( $Abs = 0.0022 \cdot Conc + 0.0253$ ,  $r^2 = 0.9975$ ) in terms of the infusion polyphenolic content in the infused herb material. ANOVA and the Bonferroni Post-Hoc test were used to determine the significance of results at a p value of 0.05. The infusions were compared using the Pearson correlation and the Principal Components Analysis (PCA).

## RESULTS

Pearson's correlation showed a significant correlation between colour intensity and anthocyanin content ( $r = 0.992$ ) and between tint ratio and % yellow ( $r = 0.915$ ).

A good correlation was observed between % red and flavinoid ratio ( $r = 0.883$ ) and anthocyanin content ( $r = 0.888$ ). Negative correlations were observed between the tint ratio and % yellow against %red, %blue and anthocyanin content ( $r = -0.691$ ). Maté tea had low values for colour intensity (<0.772), %red (<35.223) and %blue (<30.276). Raspberry tea had the lowest polyphenolic content (<1.929%, w/w) while mint and white teas showed the highest polyphenolic content with <9.598% w/w and <7.174% w/w respectively.

An infusion time of 5 minutes was found to be appropriate for the herbal teas investigated as after this time the values for the total polyphenolic content did not differ significantly. When the herbal teas were infused at a water temperature of 5°C the polyphenolic content in solution was low. As the temperature was increased, the polyphenolic content was increased. Mint tea had a higher polyphenolic content at higher water temperatures. White and mint teas had superior complexive physicochemical properties compared to the rest of the teas according to the PCA analysis.

## CONCLUSION

The study shows the difference between physicochemical parameters and polyphenolic content in different herbal teas. Worldwide there is a strong disagreement on infusion times and temperatures for herbal teas. According to this study, the optimum infusion time and temperature, based on the optimum yield of infused polyphenols are 5 minutes and 80°C respectively. This applies to the 5 investigated teas. This study provides a simple protocol of how manufacturers can base the preparation instructions of their products. This may be extended to other herbal substances.

**Reference(s)** 1. Wang H, Provan GJ, Helliwell K. Tea flavonoids: their functions, utilisation and analysis, Trends Food Sci. Technol. 11, 152-160 (200)  
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