Erosive and Cariogenic Potential of Commercially Available Energy Drinks in Portugal

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1 Introduction

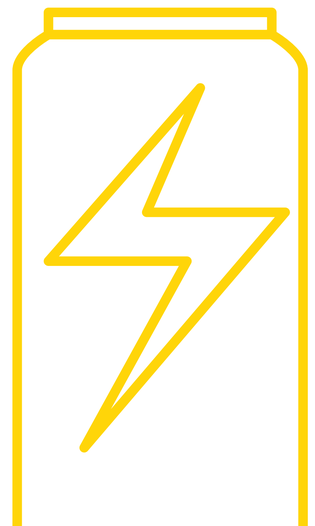
Energy drink consumption has risen significantly worldwide, particularly among adolescents and young adults. These beverages, often perceived as harmless, are frequently acidic and may contain fermentable sugars, posing a potential threat to oral health through dental erosion and caries. Despite a growing shift toward sugar-free alternatives, concerns remain regarding the role of acidity in enamel demineralization, regardless of whether sugar is present.

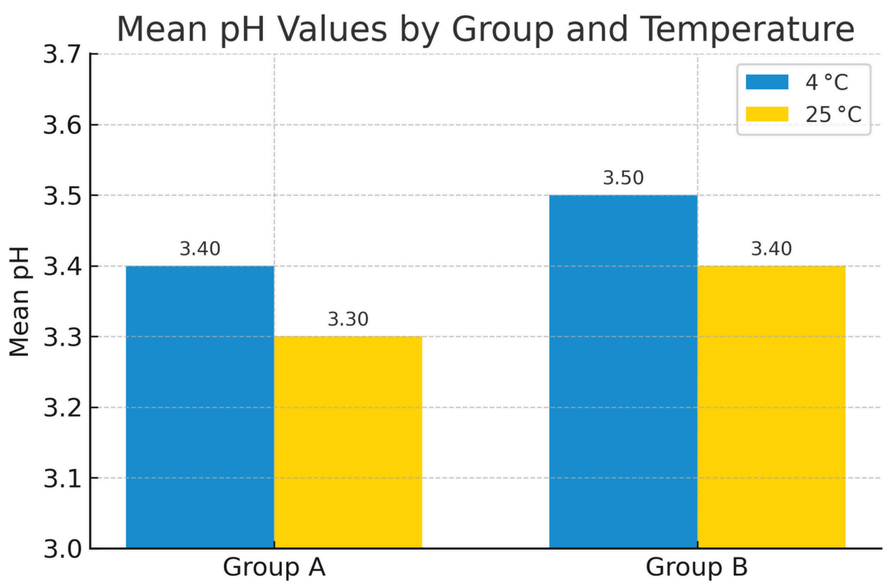
2 Aims

This study aimed to evaluate the erosive and cariogenic potential of energy drinks available on the Portuguese market by analysing their pH levels at different temperatures and assessing their implications for enamel integrity.

3 Materials and Methods

- **Study design:** *Ex vivo* analysis of 38 commercially available energy drinks.
- **Group categorisation: Group A** – Drinks with acidic preservatives and fermentable sugars→ Erosive and cariogenic potential
  Group B – Drinks with only acidic preservatives→ Erosive potential only
- **pH measurement:** Temperatures tested: 4 °C (cold) and 25 °C (room temperature)
  Equipment: CRISON® pH Meter GLP 21 with pH 50 14 electrode
  Calibration range: pH 2–4
  Temperature measured using C.AT Pt 1000 CRISON® probe
- **Sampling protocol:** 3 samples tested per beverage
  5 pH readings per sample
  Mean pH calculated per beverage, per temperature
- **Statistical analysis:** Comparison of pH values between temperatures and between groups





4 Results

- **Temperature effect:** 22 out of 38 beverages showed significantly lower pH at 25 °C ($p < 0.05$)
  13 beverages showed no significant variation
  3 beverages had lower pH at 4 °C
- **Critical pH threshold**: None of the drinks exceeded the critical threshold at either temperature
- **Mean pH – Group A (acid + sugar):** 3.4 ± 0.23 at 4 °C
  3.3 ± 0.23 at 25 °C
- **Mean pH – Group B (acid only)**: 3.5 ± 0.28 at 4 °C
  3.4 ± 0.26 at 25 °C
- **Group comparison:** No statistically significant difference between Group A and Group B→ Acidity alone appears sufficient to compromise enamel integrity

5 Conclusion

The findings challenge common perceptions by demonstrating that sugar-free beverages can be as erosive as those containing sugar, and may also be detrimental to dental structure[1,2].

These findings highlight the importance of assessing acidity as an independent risk factor while also recognising the protective function of saliva in the oral environment[3].

Saliva plays a crucial role in neutralising acids and supporting enamel remineralisation, thanks to its buffer capacity and the presence of ions such as calcium, phosphate, and fluoride[4,5].

While pH remains a central indicator of erosive potential, it alone does not capture the full complexity of the process[6]. The interaction between acidic exposure and endogenous defence mechanisms underscores the multifactorial nature of enamel erosion in real-life conditions and reinforces the need for greater public awareness and regulatory oversight regarding these products[2,7].

6 References

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