

# COMPREHENSIVE ANALYSIS AND IMMUNOMODULATORY EFFECTS OF LENTIL PHENOLIC EXTRACTS

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## INTRODUCTION

- **Lentils** offer **essential nutrients** like protein, fiber, and flavonoids.
- With a **low glycemic index** that helps avoid peaks in blood glucose, recent epidemiological data is suggesting **potential benefits against cardiovascular diseases and diabetes**. Yet, lentil consumption remains low.

**OBJECTIVES:** This project aims to identify the lentil variety with the highest phenolic and flavonoid content, antioxidant activity and anti-diabetic effect, to then evaluate its cytotoxicity and immunomodulatory activity.

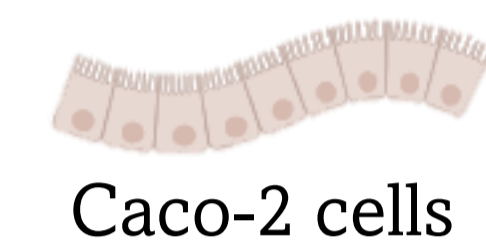
## METHODS

- Raw and cooked *Lens culinaris L.* varieties :



- Determination of total phenolic and flavonoid content and antioxidant activity;
- Anti-diabetic activity assessment;
- Cytotoxicity and immunomodulatory activity.

*In vitro* cellular model

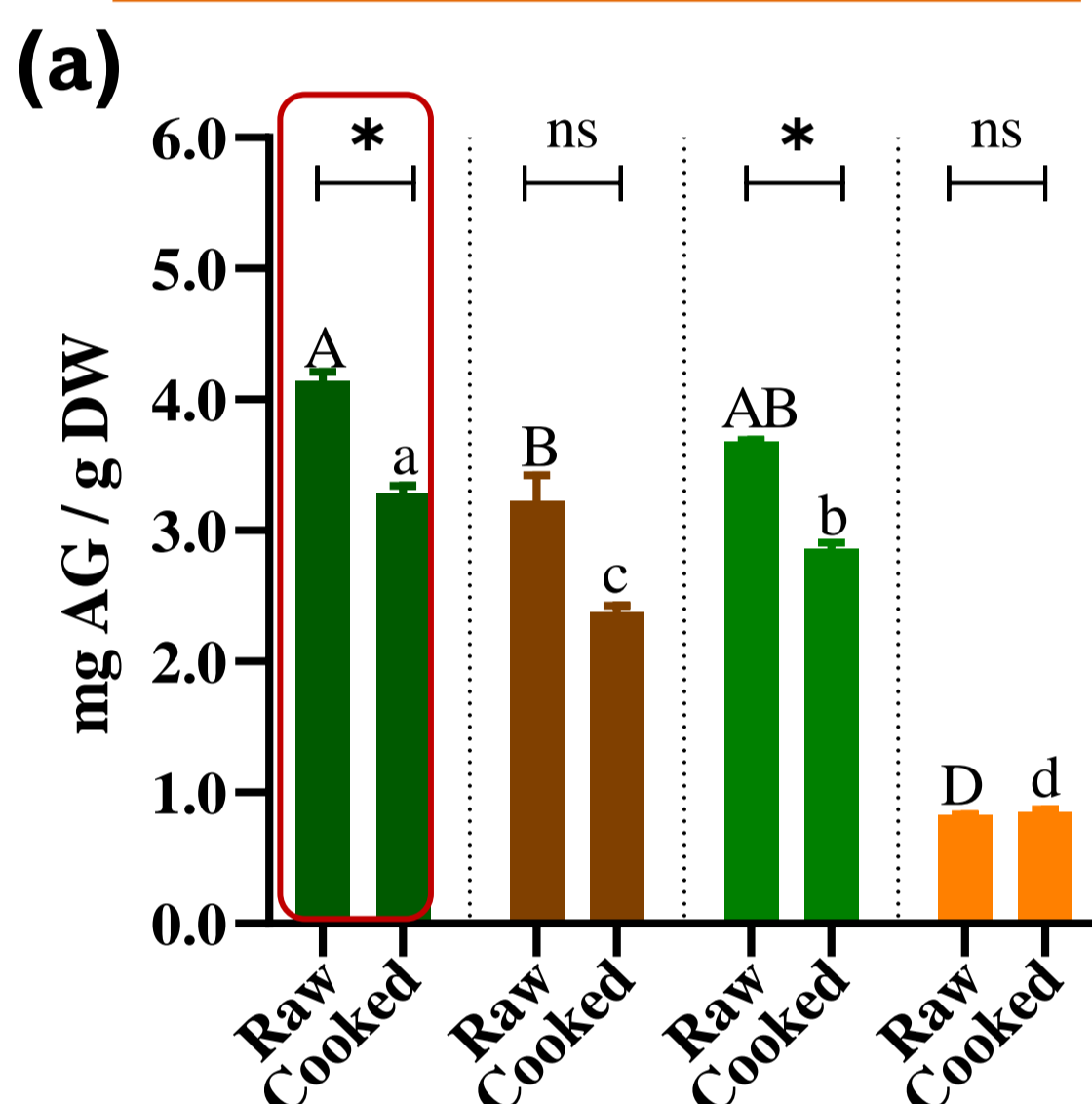


Caco-2 cells

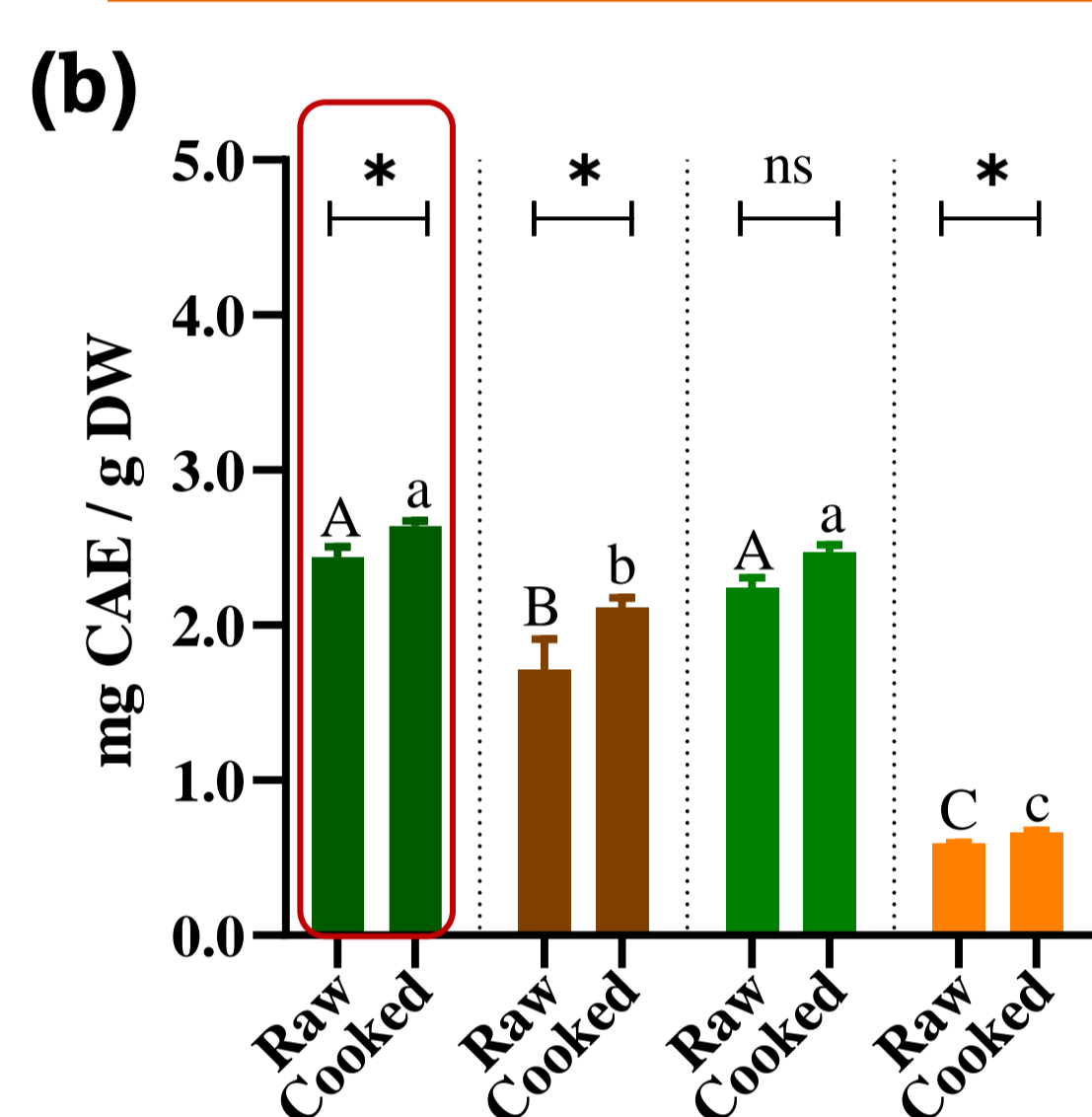
IL-6  
IL-8

## RESULTS & DISCUSSION

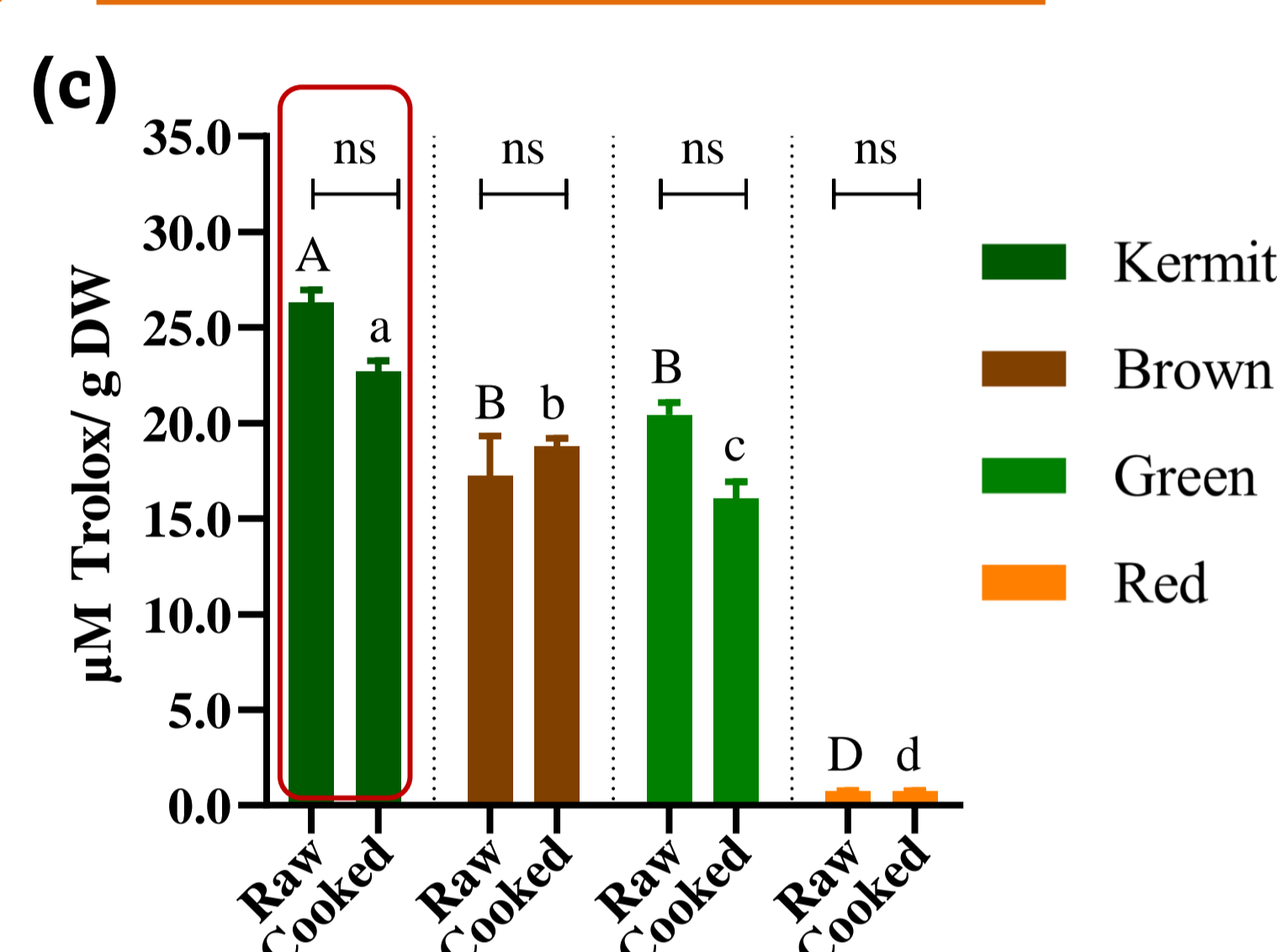
### PHENOLIC CONTENT



### FLAVONOID CONTENT



### ANTIOXIDANT ACTIVITY



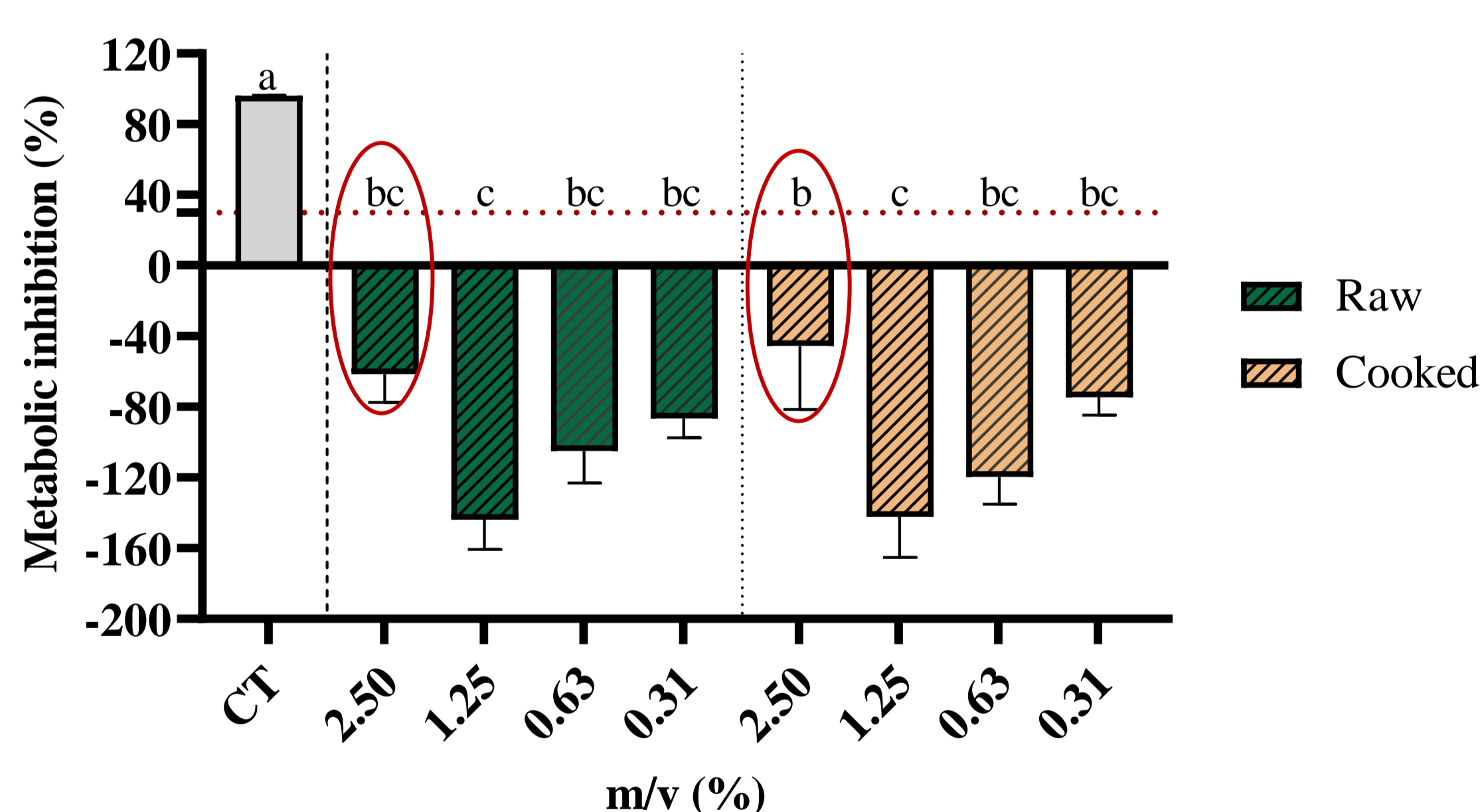
**Figure 1** – Total phenolic content (a), total flavonoid content (b), and antioxidant activity (c) of *Lens culinaris L.* varieties. Each value represents mean  $\pm$  SEM in (a) mg of gallic acid equivalent, (b) mg of catechin, and (c)  $\mu$ M of Trolox equivalent per g of dry extract (DW). Capital letters indicate differences among raw varieties, while lowercase letters indicate differences among cooked varieties. Different letters indicate significant differences ( $p < 0.05$ ). Significant differences between raw and cooked forms of the same varieties are indicated at \* $p < 0.05$ .

### ANTI-DIABETIC ACTIVITY

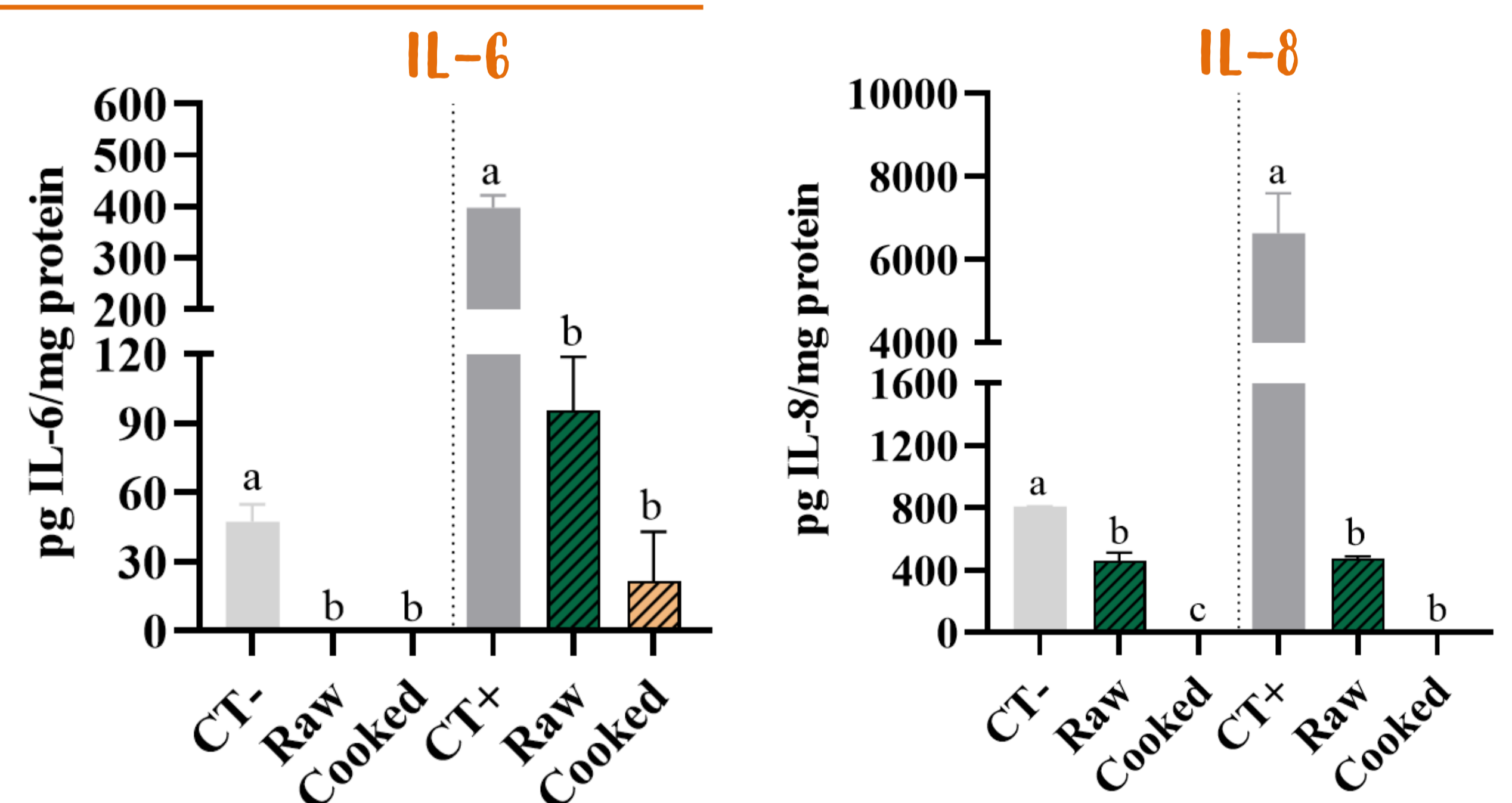
**Table 1** – Anti-diabetic activity of raw and cooked *Lens culinaris L.* varieties. Each value represents mean  $\pm$  SEM. Different letters indicate significant differences ( $p < 0.05$ ).

$\alpha$ -Glucosidase Inhibition (%)		
<b>Kermit</b>	Raw	37.6 $\pm$ 1.1 <sup>a</sup>
	Cooked	36.9 $\pm$ 0.6 <sup>a</sup>
<b>Brown</b>	Raw	33.4 $\pm$ 1.3 <sup>abc</sup>
	Cooked	35.0 $\pm$ 1.0 <sup>ab</sup>
<b>Green</b>	Raw	28.9 $\pm$ 0.9 <sup>cd</sup>
	Cooked	31.2 $\pm$ 0.7 <sup>bc</sup>
<b>Red</b>	Raw	25.4 $\pm$ 1.2 <sup>de</sup>
	Cooked	21.1 $\pm$ 0.8 <sup>e</sup>

### CYTOTOXICITY AND IMMUNOMODULATORY ACTIVITY



**Figure 2**- Cytotoxicity of raw and cooked phenolic extract of Kermit towards Caco-2 cells at different concentrations. CT is the negative control (40% of DMSO). The dotted line represents 30% cytotoxicity limit (ISO 10993-5:2009). Different letters mean significant differences ( $p < 0.05$ ).



**Figure 3**- Modulation of immune response in Caco-2 cells by raw and cooked phenolic extract of Kermit [2.50 m/v (%)]. The left part corresponds to the non-stimulated cell's response, and the right to the inflammatory effect (using IL-1 $\beta$ ). Different letters mean significant differences within each stimulus treatment ( $p < 0.05$ ).

## CONCLUSIONS

- The **Kermit variety** exhibited the **highest phenolic and flavonoid content, antioxidant and anti-diabetic activity**, making it the chosen candidate for *in vitro* analyses.
- **No deleterious effect in terms of metabolic inhibition** was observed in Caco-2 cells when exposed to raw and cooked phenolic extracts of Kermit. Regarding the immunomodulatory results:
  - The production of IL-6 and IL-8 significantly decreased with raw and cooked Kermit phenolic extracts.
  - In cells stimulated with IL-1 $\beta$ , the raw and cooked Kermit phenolic extracts showed relevant **anti-inflammatory effects**, as demonstrated by reductions in the selected cytokines' secretion.

## REFERENCES

Bing, Z., et al., *Phytochemicals of lentil (Lens culinaris) and their antioxidant and anti-inflammatory effects*. *Journal of Food Bioactives*, 2018. 1(1).  
Ferreira, H., et al., *Benefits of pulse consumption on metabolism and health: A systematic review of randomized controlled trials*. *Crit Rev Food Sci Nutr*, 2021. 61(1): p. 85-96.

## ACKNOWLEDGEMENTS

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