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CHEMICAL CHARACTERIZATION AND SENSORY EVALUATION OF BAKED GOODS ENRICHED WITH CAPSICUM CHINENSE EXTRACTS

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Abstract:

Abstract: The purpose of this study was to evaluate the effect of adding a mixture of ethanolic extracts of different Capsicum chinense varieties on some nutritional and sensory properties of baked goods. Two sets of products were prepared by adding the extracts at two different concentrations. The finished products were subjected to chemical analysis to determine the content of phenolic compounds. In particular, the evolution of the phenolic profile of the baked goods following the addition of the extracts was evaluated. In addition, sensory analyses were conducted to assess the acceptability of the products and the intensity of the spicy sensation. Sensory analyses showed a positive correlation between the concentration of the extracts and the intensity of the spicy sensation, while maintaining overall acceptability of the products. The study demonstrated the feasibility of enriching bakery products with C. chinense extracts, resulting in functional foods with increased content of bioactive compounds and potential health benefit due in part to their antioxidant activity. **Keywords:** bakery products, chili pepper, polyphenols, capsaicin, sensorial analysis

Introduction:
Capsicum peppers represent a valuable source of bioactive compounds, including capsaicin, flavonoids, carotenoids, vitamins, and minerals. These compounds contribute to antioxidant, anti-inflammatory, and antimicrobial effects. The chemical composition of the substance is subject to variation due to factors such as variety, color, the stage of the baking process, and environmental conditions. Notwithstanding its considerable potential, the utilization of chili peppers in the food industry is frequently constrained to their pungent effect. Recent research has demonstrated the applicability of extracts of red pepper in dairy products, meat, and bread, with the objective of enhancing their nutritional value and improving their microbiological stability. In the present study, a range of bread products were formulated with ethanolic extracts from Capsicum chinense. These products were subsequently analyzed in terms of their phenolic composition and sensory acceptability. The objective of this study was to develop a series of functional, thermally stable products that have the potential to offer significant health benefits.

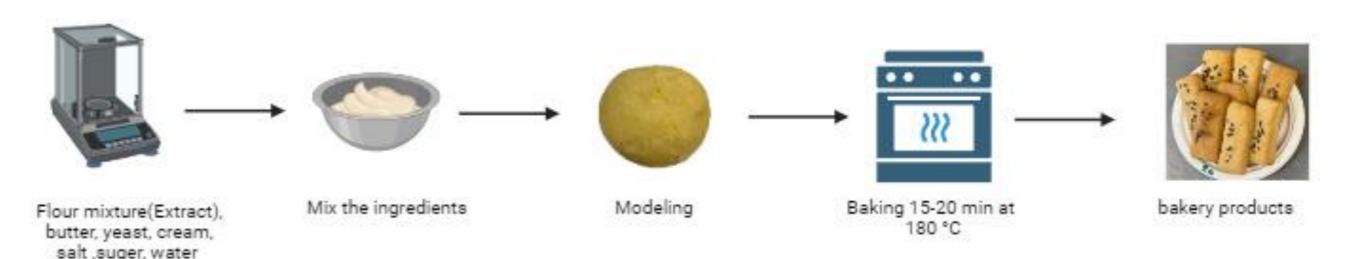**Figure 1. Presentation of bakery products**

Results and discussions

Sensorial analysis of the bakery products.
The acceptability assessment of the bakery products added with *Capsicum* extracts was performed by sensorial analysis, recruiting 20 people, and by 5-point aid of a hedonic scale. As shown in figure 1, the cookies were presented in dishes coded with C, 20 and 40: C (control without extract); B20 (added with 20 µl of E6); B40 (added with 40 µl of E6).

Sensory attributes (appearance, aroma, texture, taste, and overall acceptability) were evaluated using a 5-point hedonic scale. Most samples received scores between 2.50 and 3.49, indicating moderate acceptability. Exceptions included the taste and overall acceptability of B40, which were rated as slightly acceptable. The addition of the extract did not significantly influence the appearance. However, B40, containing the highest extract concentration, recorded the best scores for aroma and taste, suggesting a positive sensory impact. Thus, the chili extract primarily enhanced the aroma and taste, while maintaining acceptable visual and textural qualities.

PCA revealed that PC1 and PC2 explained 100% of the total variance (67.17% and 32.83%, respectively), clearly differentiating the samples. The control sample was associated with resveratrol and overall acceptability, suggesting distinct characteristics from the enriched variants. B20 showed strong correlation with caffeic acid, while B40 was associated with higher levels of epicatechin and resorcilic acid. Total phenolic content (TPC) and coumaric acid contributed significantly to sample differentiation. Sensory attributes clustered near the origin, indicating moderate influence on variability. These results highlight that phenolic profiles vary across samples and are closely linked to the extract concentration.
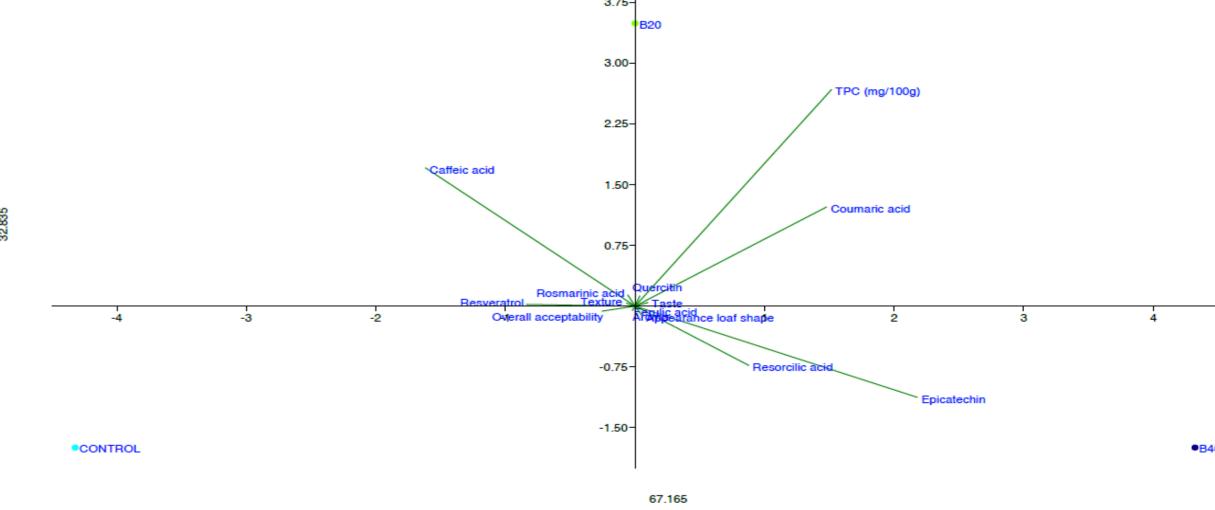
Material and method:
Ethanolic extracts were obtained from six Capsicum chinense cultivars provided by the Accademia Italiana del Peperoncino (Diamante, Italy): Carolina Reaper Chocolate, Carolina Reaper Red, Carolina Mustard, Naga Salmone, Bhut Jolokia Chocolate, and Pimenta da Neyde. The fruits were macerated in ethanol at room temperature, and the resulting extracts were pooled into a final mixture (E6) with a concentration of 50 mg/mL. Three types of baked products were formulated: a control (C), and two samples enriched with 20 µL (B20) and 40 µL (B40) of E6 extract. The formulation included wheat flour, butter, cream, yeast, salt, sugar, water, and chia seeds. After kneading, the dough was refrigerated, rolled out, cut, and baked at 180°C for 15–20 minutes. Sensory evaluation was conducted with 20 panelists aged between 19 and 50, using a 5-point hedonic scale to assess appeara

Table 1. Recipes for composite bakery products								
Sample	Flour (g)	Extract (µl)	Butter (g)	Yeast (g)	Cream (g)	Salt (g)	Sugar (g)	Water (g)
C	200	-	125	12.5	100	2.5	2.5	50
B20	200	20	125	12.5	100	2.5	2.5	49.98
B40	200	40	125	12.5	100	2.5	2.5	49.96

Conclusions:
Cookies enriched with *Capsicum chinense* extract demonstrated enhanced phenolic profiles, particularly through increased epicatechin levels and the presence of coumaric and ferulic acids. Sensory analysis revealed that the extract mainly influenced aroma and taste, with a slight decrease in overall acceptability at higher extract concentrations. PCA analysis confirmed the correlation between phenolic composition and sensory properties, distinguishing the control by higher resveratrol content and B20/B40 by their unique phenolic signatures. Future research should address formulation optimization and bioavailability of polyphenols, as well as the use of chili extracts in other food matrices for the development of functional foods.