COMBINED EFFECT OF ASCORBIC ACID AND SUGAR ON TEXTURE PROPERTIES OF MAIZE COMPOSITE BREAD

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INTRODUCTION

Bread is one of the world's most widely consumed staple foods of immense importance. The utilisations of new materials, ingredients as well as bakery machinery and tools have resulted in ever improving bread making technology. In recent years, numerous studies regarding bread making have been globally conducted in order to improve bread nutritional value (macronutrients: carbohydrates, proteins, fat and dietary fibres; micronutrients: minerals and vitamins), health supporting bioactive compounds, sensory acceptability, shelf life and to match its affordability.

Due to its positive effects on dough properties, ascorbic acid (AsA) has been used as a flour improver for a long time. Ascorbic acid is a very popular and widely used flour improver in bread products to eliminate oxidising process . The addition of ascorbic acid has a well-studied strengthening effect on dough that leads to a higher rising of the dough. In typical bread production, 2-3% sugar is adequate to sustain yeast activity. Due to the affinity with water, it has been reported that sugar exerts a limiting effect on gluten formation during the dough preparation stage.

The present study was carried out to demonstrate the combined effects of ascorbic acid and sugar on the texture properties of maize composite breads.

MATERIAL AND METHODS

Plant materials

The experimental material consisted of one bread wheat (*Triticum aestivum* L.) and four maize (*Zea mays* L.) genotypes recently developed at the Maize Research Institute, Zemun Polje, in the vicinity of Belgrade, Serbia. The maize genotypes were chosen on the basis of kernel colour and kernel type (light blue maize - dent, blue and red maize - popping, yellow maize - semi-flint).

Flour samples preparation

Wheat flour (particle size <180 μm) was produced in the experimental mill (Laboratory mill; Bühler MLU-202). Whole maize kernels were ground on a Perten 120 lab mill to fine powder (<500μm).

Bread-making procedure of composite bread

The composite flours were made of wheat flour (70%) and different maize flours (30%) (light blue, blue, red and yellow maize). The basic formulation of the composite breads included: 300g composite flour, 7.5g yeast, 6g salt, 3g vegetable fat and water according to farinograph absorption. The total of 12 breads were prepared in four replications out of which four were control breads (composite flour with light blue, blue, red and yellow maize), four were breads with ascorbic acid and four were breads with ascorbic acid and sugar. All formulations of twelve bread samples were made according to the method described by Simić et al. (2018). Briefly, all ingredients were mixed in a laboratory mixer and the dough was left to rest in bulk. The dough was divided into 115±1 g portions, manually rounded, rolled and put into tin pans. The final fermentation lasted 35 min. The baking was carried out at 230°C for 20 min in a deck type oven. Baked breads were cooled down and stored at 24°C for 24 h and then their quality was evaluated.

Texture properties

Bread loaf volumes (mL) and specific volumes (mL/g) were determined by VolScan profiler (Stable Micro Systems, Surrey, UK). Texture analyses of the bread crumbs were carried out on a texture analyser TA.XT plus (Stable Micro Systems, UK). The hardness, chewiness, cohesiveness, resilience and springiness of bread crumbs were equipped with a 36 mm cylindrical probe according to the AACC method 74-10A modified as described by Filipčev et al. (2010).

Statistical analysis

The results were statistically analysed using the Statistica software version 5.0 (StatSoft Co., Tulsa, OK, USA). Significance of differences between samples was analySed by the Tukey's test. Differences at $p<0.05$ were considered as significant.

RESULTS

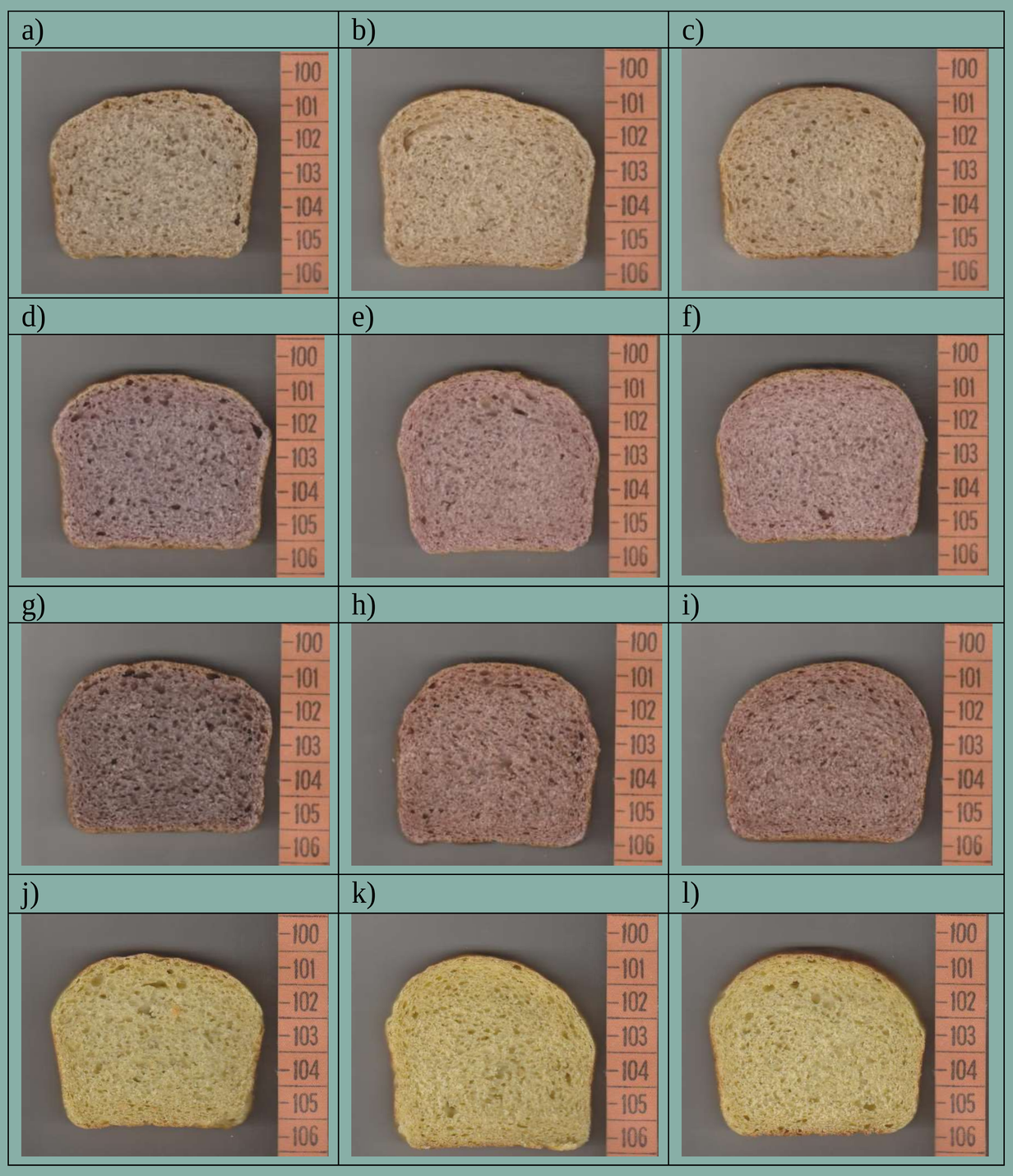

FIGURE 2. Cross-section of maize composite breads: a) Light blue control, b) Light blue with AsA, c) Light blue with AsA and S, d) Blue control, e) Blue with AsA, f) Blue with AsA and S, g) Red control, h) Red with AsA, i) Red with AsA and S, j) Yellow control, k) Yellow with AsA, l) Yellow with AsA and S. AsA - ascorbic acid, S - sugar

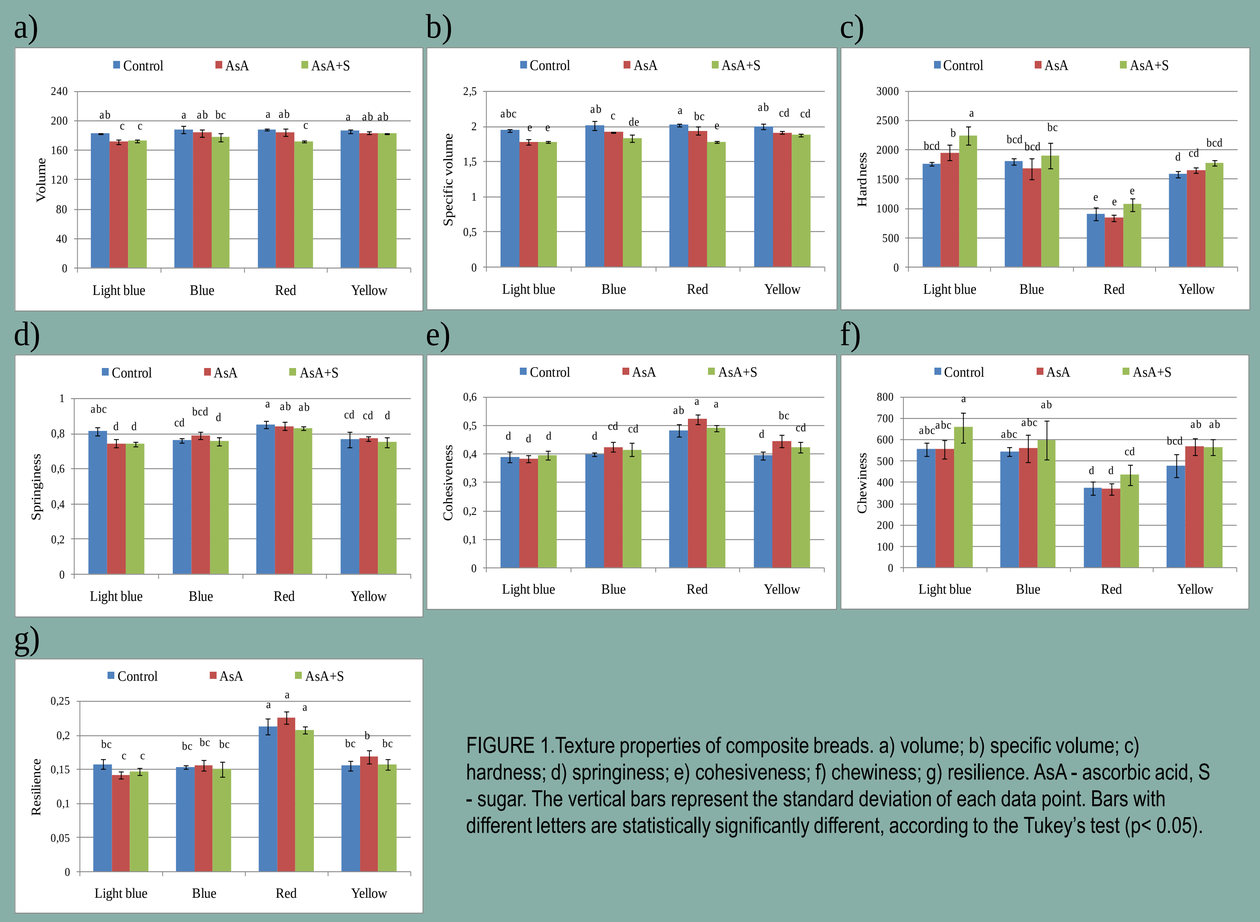

FIGURE 1.Texture properties of composite breads. a) volume; b) specific volume; c) hardness; d) springiness; e) cohesiveness; f) chewiness; g) resilience. AsA - ascorbic acid, S - sugar. The vertical bars represent the standard deviation of each data point. Bars with different letters are statistically significantly different, according to the Tukey's test ($p< 0.05$).

CONCLUSIONS

- **Addition of ascorbic acid and sugar negatively affected the volume as well as the specific volume of composite breads. The highest loaf volume reduction of 8.7% was detected in red maize composite bread with the AsA+sugar addition.**
- **The texture analysis showed that the addition of AsA had no impact on springiness, cohesiveness and resilience of bread crumb, while it increased crumb hardness.**
- **Results showed that hardness was significantly higher when AsA and sugar were added to the light blue composite bread.**
- **The AsA addition increased crumb hardness by 11.09% and 4.5% in light blue and yellow composite breads, respectively.**
- **Composite breads made with AsA and AsA+sugar showed a more compact structure, with a larger number of cells and smaller mean cell areas.**
- **Bread samples with AsA+sugar had the lowest springiness, which is indicative of brittleness and reflects the tendency of the bread to crumble when slicing.**