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EFFECTS OF HYDROCOLLOIDS ON YEAST ACTIVITY, DOUGH RHEOLOGY, AND QUALITY OF FROZEN MINI-BAGUETTES DURING STORAGE

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Introduction

Frozen dough technology is one of the most important directions of development in the modern bakery industry due to the advantages it offers in technological process flexibility, distribution optimization, and shelf-life extension of bakery products. However, freezing and frozen storage processes induce complex structural and biochemical modifications in the dough matrix, directly affecting yeast viability and fermentative activity, as well as the rheological properties of the dough and the quality of the final product. This study investigated the effect of guar gum, xanthan gum, and HPMC on frozen dough and mini-baguette quality during 56 days at −18°C. Hydrocolloids improved yeast activity, dough stability, and product quality compared with the control. Xanthan gum showed the best rheological performance and volume retention, while HPMC achieved the highest sensory acceptability. Overall, hydrocolloids acted as cryoprotective agents, helping maintain dough and bread quality during frozen storage.

Materials and methods

- Four formulations analyzed:
  - Control
  - Guar gum
  - Xanthan gum
  - HPMC
- Hydrocolloid concentration: 0.3%
- Storage at −18°C for 56 days
- Evaluated parameters:
  - CO_2 production
  - Specific volume
  - Texture
  - Sensory acceptability

- Frozen dough technology increases production flexibility and shelf life.
- Freezing may reduce yeast viability and damage gluten structure.
- Hydrocolloids can act as cryoprotective agents.
- Objective: evaluate guar gum, xanthan gum, and HPMC in frozen mini-baguettes.

Nr. Crt.	Material name	U.M.	Sample A_1	Sample A_2	Sample A_3	Sample A_4
			Cantități pentru 1000 g aluat			
1.	White wheat flour 650	g	620,35	619,19	619,19	619,19
2.	Fresh yeast	g	24,81	24,77	24,77	24,77
3.	Salt	g	12,41	12,38	12,38	12,38
4.	Bread improver	g	1,24	1,24	1,24	1,24
5.	Water	mL	248,14	247,68	247,68	247,68
6.	Ice	g	93,05	92,88	92,88	92,88
7.	Guar gum	g	-	1,86	-	-
8.	Xanthan gum	g	-	-	1,86	-
9.	Hidroxiproprilmethylcellulose (HPMC)	g	-	-	-	1,86

Mini-baguettes weighing 72 g of dough were prepared according to the manufacturing recipe described in Table 1.

Results and discussions

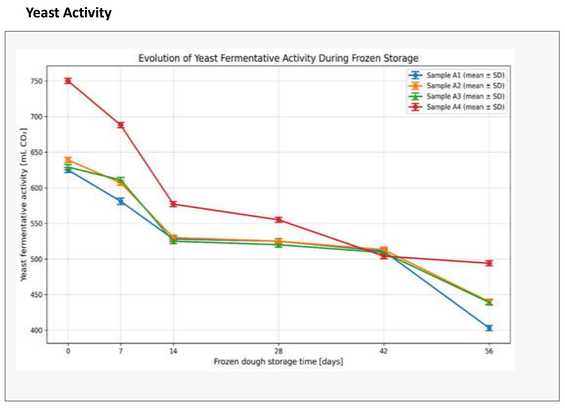
- Hydrocolloids improved frozen dough stability.
- HPMC maintained highest sensory acceptability.
- Xanthan gum preserved highest fermentative activity.
- Positive correlation between CO_2 production and specific volume.

The comparative analysis of yeast fermentative activity highlights the protective effect of hydrocolloids on yeast viability and fermentative performance during frozen storage of mini-baguette dough. The results obtained demonstrate that the addition of hydrocolloids contributes to maintaining the fermentative activity of frozen mini-baguette dough, the cryoprotective effect varying depending on the type of hydrocolloid used. Among the hydrocolloids studied, HPMC showed the highest efficiency in preserving yeast fermentative activity during frozen storage at −18 °C, followed by xanthan gum and guar gum. These results confirm that hydrocolloids can improve the biological and technological stability of frozen dough by reducing the negative effects of thermal and osmotic stress on yeast cells. The control sample (A1) recorded the most pronounced decrease in overall acceptability, from 8.67 to 7.00, indicating a faster degradation of sensory quality during storage. In contrast, the samples containing hydrocolloids (A2–A4) showed superior maintenance of acceptability, confirming their beneficial effect on product stability.

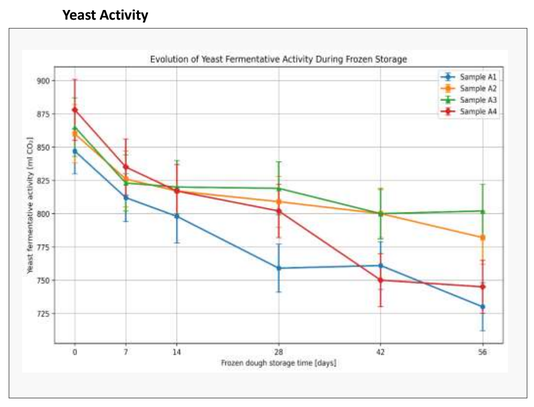
Among the analyzed variants, sample A4 (HPMC) demonstrated the best preservation of sensory quality, maintaining the highest score after 56 days (7.83), followed by sample A3 (xanthan gum, 7.67) and sample A2 (guar gum, 7.17). These samples also presented higher values during intermediate storage stages, indicating slower degradation compared to the control.

The results indicate that hydrocolloid addition contributes to improving and maintaining the overall acceptability of frozen mini-baguettes, most likely through effects on water retention, crumb structure stability, and limitation of staling phenomena. HPMC stood out through the most pronounced protective effect on sensory quality, followed by xanthan gum, while guar gum showed a positive but less pronounced effect.

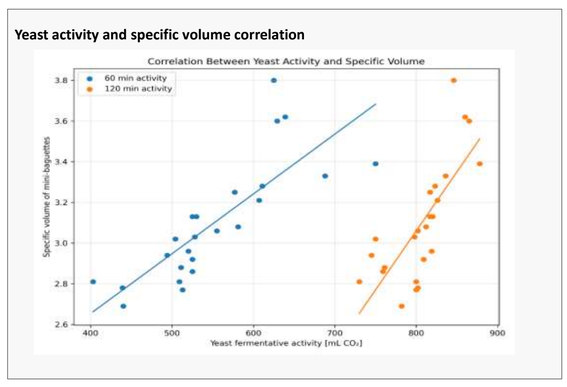
Yeast Activity



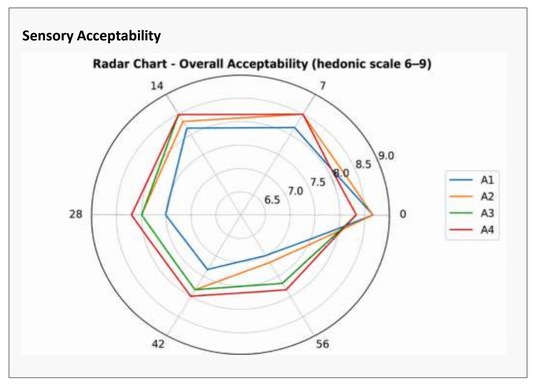
Yeast Activity



Yeast activity and specific volume correlation



Sensory Acceptability



✓ HPMC = highest sensory stability

✓ Xanthan gum = best CO_2 preservation

✓ Hydrocolloids improved frozen dough quality

Conclusions

The results of the study demonstrate that the addition of hydrocolloids significantly influences the behavior of baker's yeast and the technological properties of frozen mini-baguette dough. Frozen storage at −18 °C for 56 days caused a progressive reduction in yeast fermentative activity for all analyzed variants; however, the samples containing hydrocolloids showed superior stability compared to the control sample, confirming their cryoprotective effect. HPMC exhibited the best capacity to maintain fermentative activity after 60 minutes of fermentation and contributed to obtaining the highest sensory scores during storage, while xanthan gum showed the best fermentative stability after 120 minutes and the most favorable results regarding maintenance of textural properties and specific volume of mini-baguettes. Guar gum also had a positive effect on frozen dough stability, although to a lesser extent compared to the other hydrocolloids analyzed. The addition of hydrocolloids contributed to limiting the increase in hardness and maintaining the structure of the final product during frozen storage, an effect associated with improved water retention and protection of the gluten network against degradation induced by ice crystallization. Furthermore, the correlations observed between yeast fermentative activity and the specific volume of mini-baguettes confirm that maintaining cell viability directly influences proofing capacity and the final quality of the product. Overall, the obtained results support the use of hydrocolloids as an efficient technological strategy for optimizing the stability and quality of bakery products obtained from frozen dough, highlighting their potential to improve fermentative performance, structural properties, and sensory acceptability of final products.