Effects of freezing on the physico-chemical properties of breads made from soy and wheat doughs

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ABSTRACT

variety of frozen doughs are available to consumers, although no g product contains enough soy protein to meet the health claim ucing heart disease. The addition of large amounts of soy protein d has been limited due to undesirable sensory and textural ies. The objective of this study was to characterize the effects of g on the mechanical properties of bread made from frozen soy and doughs. Soy (49% wet basis) and wheat doughs were prepared ced in a -10 °C freezer for 2 and 4 weeks. After thawing, the was baked and analyzed. Dynamic Mechanical Analysis (DMA), ith a single cantilever clamp, was used to determine the storage s (stiffness) of samples and to characterize phase transitions. ession tests (40%) were performed using the Instron to ine bread stiffness. A triangle test (sensory) was used to evaluate nces between soy and wheat breads made from fresh and frozen . A major phase transition ~ 0°C was observed in DMA which was ted mainly to ice melting. Freezing caused a broadening in this ransition for both wheat and soy bread and shifted the transition r temperatures for the wheat bread. Additionally, breads made month frozen dough were stiffer than those made from fresh These results correlated well with sensory analysis. Sensory ion showed that there were no differences between breads made esh and 2 week frozen doughs for soy or wheat. However, nces were reported for breads made from dough frozen for 1 Freezing dough for 2 weeks did not have a major impact on the nical properties of wheat or soy bread. Therefore, frozen soy could be used as an alternative to fresh dough.

INTRODUCTION

A soy bread was recently developed at OSU to meet the FDA health claim stating that consuming 6.25g of soy protein (per serving) along with a diet low in saturated fat and cholesterol may reduce the risk for heart disease.

The frozen bakery industry has increased its output due to the use of frozen doughs in bakeries, supermarkets and restaurants and therefore the development of a frozen soy dough was attempted.

Problems associated with bread baked from frozen dough include lower loaf volumes, longer fermentation times, and poorer quality loaves.

Therefore understanding the physico-chemical (especially mechanical) and textural attributes of the frozen dough is imperative to obtain a high quality final product.

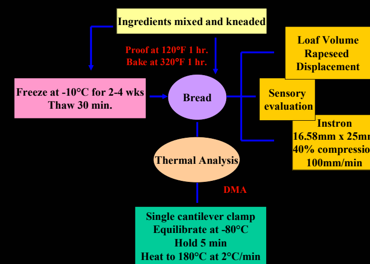
OBJECTIVE

characterize the effects of freezing on the mechanical operties of bread made from frozen soy and wheat doughs.

MATERIALS AND METHODS

Ingredients	wheat dough %	soy dough %
Wheat flour	54.3	17.5
Water	37.7	45.3
Sugar	4.0	4.5
Salt	1.0	0.9
Crisco shortening	2.1	1.7
Yeast	0.9	1.0
Gluten	-	2.3
Dough conditioner	-	0.2
Soy milk	-	6.6
Soy flour	-	19.9

Table 1. List of ingredients.



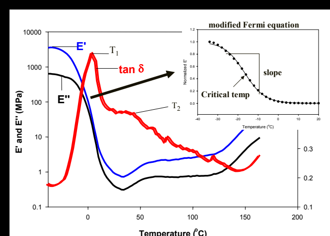


Figure 1. Typical DMA thermogram. The Storage Modulus (E') measures the stiffness of the sample. A Modified Fermi equation (f=(1-b)/(1+Exp((x-T)/a))+b)(Peleg 1993) was used to better characterize the E' (insert).

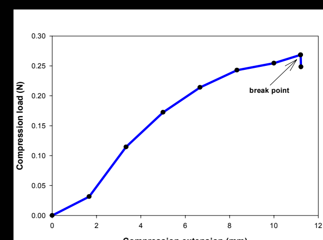


Figure 2. A typical compression test diagram obtained using an Instron. The break point signifies the force needed to compress the sample at 40% compression.

RESULTS AND DISCUSSION

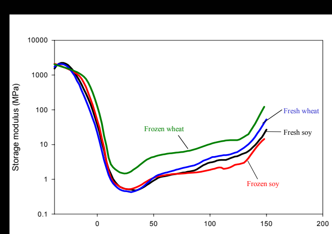


Figure 3. Comparison of storage moduli (E') obtained by DMA of breads made from frozen doughs. The drop in stiffness around 0°C is due to, at least in part, ice melting as confirmed by DSC.

Treatment	a value (slope)	T value (critical temp) (°C)
Fresh soy bread	12.4±0.3ᵃ	-37.4±2.8ᵈ
2 week frozen soy bread	14.3±0.8ᵇ	-34.6±4.0ᵈ
1 month frozen soy bread	13.2±0.8ᵃᵇ	-37.6±0.4ᵈ
Fresh wheat bread	11.1±0.6ᵃ	-27.5±2.2ᵉ
2 week frozen wheat bread	16.2±0.2ᶜ	-36.0±0.3ᵈ
1 month frozen wheat bread	15.9±0.04ᵇᶜ	-35.4±0.09ᵈ

Table 2. Results of the E'(T) curve of the DMA with a modified Fermi equation. The wheat samples became more heterogeneous and resulted in lower transition temperatures with freezing. Freezing had little effect on the soy bread. Samples containing the same letter in each column are not statistically different.

Bread made from	Avg. Maximum load (N)
Fresh soy dough	1.8±0.3 [a]
2 week frozen soy dough	2.0±0.4 [a]
1 month frozen soy dough	2.9±0.5 [b]
Fresh wheat dough	0.2±0.2 [c]
2 week frozen wheat dough	0.4±0.1 [c]
1 month frozen wheat dough	1.0±0.4 [d]

Table 4. Stiffness results reported from Instron. Soy bread initial stiffness was greater than wheat bread. For both wheat and soy, breads became stiffer with increased frozen dough storage, especially after 1 month frozen storage of the dough. Samples containing the same letter are not statistically different.

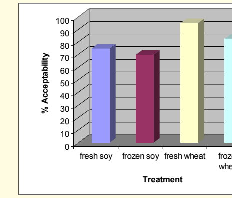


Figure 3. 40 panelists were asked to rate acceptability of each bread. Based on th panel, all bread treatments were found a by at least 70% of the subjects tested.

Table 5. Loaf volume results. The soy breads had a lower loaf volume than their wheat counterparts but freezing had little effect. The lower loaf volumes of the soy breads is attributed to the high density loaves. Samples containing the same letter are not statistically different.

Bread made from	Weight (g)	Loaf Volume (cm^3)	De (g
Fresh soy dough	600.3	1100 [a]	0
2 week frozen soy dough	586.3	1075 [a]	0
1 month frozen soy dough	560.4	1050 [a]	0
Fresh wheat dough	800.0	2820 [b]	0
2 week frozen wheat dough	652.5	2100 [b]	0
1 month frozen wheat dough	793.1	2075 [b]	0

Bread made from	1 month freezing	2 weeks freezing
Frozen wheat dough vs. frozen soy dough	Difference (P=0.001)	Difference (P=0.001)
Frozen wheat dough vs. fresh wheat dough	Difference (P=0.01)	No difference (P=0.23)
Fresh soy dough vs. frozen soy dough	Difference (P=0.04)	No difference (P=0.47)
Fresh wheat dough vs. fresh soy dough	Difference (P=0.001)	Difference (P=0.001)

Table 6. Results from triangle test for soy an breads. 40 panelists were asked to recognize sample in each triangle test. No differences w detected between fresh and 2 week frozen soy wheat doughs.

CONCLUSION

Freezing caused a broadening in the main transition of the E'(DMA) and shifted the transition to a lower temperature for the wheat bread.

The soy bread transitioned at an earlier temperature than the wheat brea but freezing had little impact on this main transition.

Wheat and soy breads both became stiffer with increased frozen dough storage; stiffness was only significantly different after 1 month frozen storage.

Loaf volume was not affected by frozen dough storage; the soy bread had lower loaf volume than the wheat bread due to the higher density loaf.

Sensory panel revealed that there were no differences between the fresh and 2 week frozen breads (wheat and soy).

At least 70% of all subjects found all breads to be acceptable.

REFERENCE

Peleg M. (1993) Mapping the stiffness-temperature-moisture relationship o solid biomaterials at and around their glass transitions. *Rheol Acta* 32:575-