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EFFECT OF FREEZE-THAW ON THE TEXTURE OF GLUTEN-FREE PIE CRUST DOUGH

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ABSTRACT
Quick frozen food are becoming increasingly popular among consumers in the last decades. During the development of a quick frozen gluten-free pie crust dough product, the aim was to develop a dough that does not suffer any harmful changes after the freeze-thaw process. The texture is one of the most important sensorial properties, and has a great influence on consumer acceptance. Texture Analyser was used to measure the hardness and the brittleness of various doughs. A quick frozen pie crust dough should be easily cut, but non-crumbling after baking. The results showed that the hardness of a dough with 10% more rice flour was bigger than the other dough's hardness and it became harder after the freeze-thaw process, while the other dough's hardness have not changed during the process. The first dough was less brittle than the second dough, also before and after the freeze-thaw. In conclusion, the 1st dough is harder, so it is not more easy to cut than the 2nd dough. However, the first dough being less brittle allows cutting with less crumbs. Considering the expectations, in the future the first recipe should be used to make a fast-frozen pie crust dough product.

Keywords: gluten-free, pie crust dough, freeze-thaw, hardness, brittleness

INTRODUCTION

Quick frozen food are becoming increasingly popular among consumers in the last decades. The so-called ready to heat products require minimal preparation after purchasing (POTI ET AL., 2015). During developing a quick frozen pie crust dough product, the aim is to reach the highest available nutrient content while the dough does not suffer any harmful changes after the freeze-thaw process.
Flour mixtures made of pseudocereals can be used as nourishing ingredients in gluten-free products because they have excellent protein profiles, contain significant amounts of dietary fiber and minerals such as calcium or iron (ALVAREZ-JUBETE ET AL., 2010).
The use of flour mixtures containing two or more gluten-free cereals is advantageous in eliminating the individually displayed unfavorable sensory and texture properties (HAGER, 2013). Examining various cereals and pseudocereals, revealed that buckwheat contains most polyphenols and has the highest antioxidant capacity (GORINSTEIN ET AL., 2007). Rice has high lysine content compared to other cereals (BIENVENIDO, 1993). Researchers measured high resistance starch, dietary fiber, mineral and antioxidant content in millet (RAGAEE ET AL., 2006). In a study, biscuits with high-millet content had the best flavor, texture and overall acceptance (ENECHE'S, 1999). In an other study, it was found that the flavors that arose after baking and the freshness of the bread improved, and the dough was better preserved when it was enriched with potato flour (WILLARD AND HIX, 1987). Starch in potato improves water binding and stabilizes the texture during freeze-thawing (CRAIG ET AL., 1989).
The texture is one of the most important sensorial properties, and has a great influence on consumer acceptance (BOUACIDA ET AL., 2017). A quick frozen pie crust dough should be

easily cut, but non-crumbling after baking. Our aim was to measure the difference of hardness and brittleness in two different gluten-free pie crust dough before and after the freeze-thaw process. Additionally, to determine the freeze-thaw stability and to decide which one should be used for further development.

MATERIAL AND METHOD

Sample preparation:
Two different gluten-free recipes were used to compare the changes of the texture properties after freeze-thaw. The recipe and the method of making is based on the US5766664A patent (YIGAL AND POPP, 1998). The gluten-free flour mixture included rice-, millet-, and buckwheat flour, and potato flakes were used as starch. The difference between the two recipes was that the 1st recipe contained 10% more rice flour than the 2nd recipe. The pre-baking was at 180 °C for 8 minutes in a Lainox VE051P oven.

Quick-freezing and baking:
Nortech QCF 103 quick freezer froze the unpackaged samples to -30 °C by 3 m/s air speed. The samples were placed in polyethylene sachets then stored for 24 hours in -24 °C. After the storage, the samples were baked at 180 °C for 15 minutes. The measurements started after cooling to room temperature. In total, the whole preparation process included the making of the pie crust dough, the pre-baking, the freezing, the baking and the cooling to room temperature.

Texture analysis:
Hardness and brittleness were measured with a Texture Analyser (TA.XT plus, Stable Micro Systems – SMS) on cuboid pieces (20 mm diameter, 10 mm height and 50 mm lenght). A cutting test was performed with the Blade Set at room temperature, at a constant deformation speed of 2 mm/sec the blade cut through the samples. The cutting test was performed with both samples of dough and each measurement was done twelvefold. The average value for hardness and brittleness was calculated. Hardness was defined as the maximum of the cutting force (F [N]), and the deformation belonging to the maximum force was defined as brittleness (D [mm]) according to the analyser's application study (TA.XTPLUS APPLICATION STUDY, 2000).

RESULTS

Figure 1 shows the instumentally determined hardness of the 2 different pie crust dough before and after freeze-thaw. The 1st recipe dough was harder than the 2nd recipe dough and it also became 4 N harder after the freeze-thaw process. The hardness of the 2nd dough has not changed after the freeze-thaw process. Even though the 1st dough became harder because of the freeze-thaw, this difference is minor compared to the difference between the two kinds of dough. The expectation is an easy-to-cut product, and we concluded that the 2nd dough is less hard that the 1st, so the 2nd recipe would be better for product development according to the results of the hardness measurements.

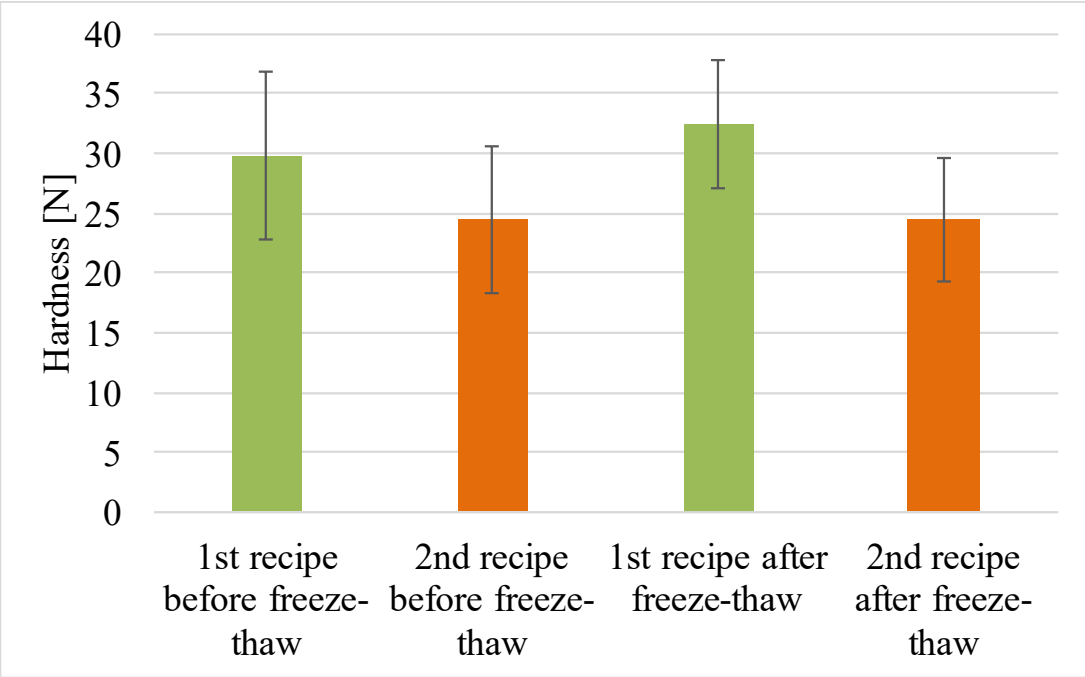

Figure 1. Instrumentally determined hardness of various pie crust doughs

The data of the instrumentally determined brittleness of the 2 different kind of dough can be seen in *Figure 2*. The brittleness was defined as the deformation belonging to the maximum force, and the smaller this value is, the more brittle the product was. The 1st dough became more brittle after the freeze-thaw process, but the 2nd dough became less brittle after freeze-thaw process, although this change was not considerable. The most important is that the 1st dough was nearly twice less brittle before the freeze-thaw, and 20% less brittle after the freeze-thaw.

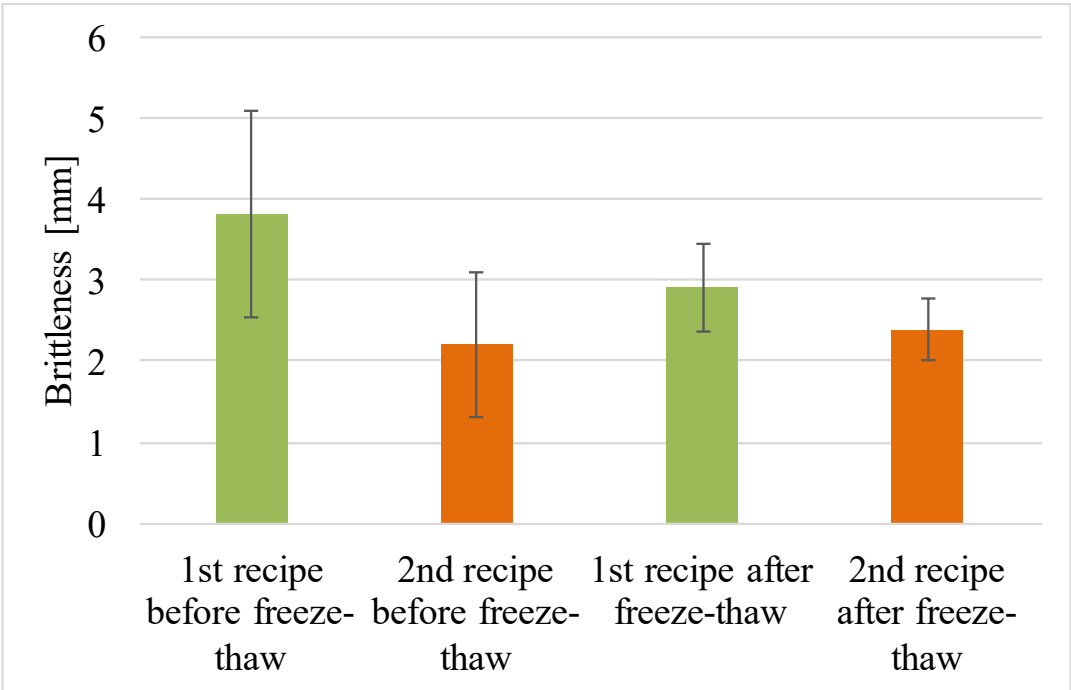

Figure 2. Instrumentally determined brittleness of various pie crust doughs

In conclusion, the 1st dough was harder than the 2nd dough, and the 1st dough was less brittle than the 2nd one. The main expectation in our product development was a non-crumbling gluten-free pie crust dough, and the less brittle dough is considered as less crumbling, thus the 1st recipe was chosen for further analysis. Even though the 1st dough is harder, it is less brittle, so in conclusion, the product will be easily cut with little crumbling.

CONCLUSIONS

In this study, perception of cutting a pie crust dough was measured with a texture analyser to decide between two gluten-free dough recipes. Texture attributes can be correlated to usability of the dough. In the development of ready-to-heat products, like the pie crust dough we have developed, the freeze-thaw stability is an important criterium. After this process, the dough should be easily cut and non-crumbling. Using 10% more rice flour in the gluten-free dough resulted in increased hardness and decreased brittleness compared to the dough with less rice flour.
However, it is unclear how the dough's texture will change after filling it. It is recommended that during the next cycle of product development this subject is further investigated in an other study.

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