

Impact of frozen storage and defrosting on the quality and safety of bakery products

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Problem setting

EU regulation No. 1169/2011 states that for foods that have been frozen before sale and which are sold defrosted, the name of the food shall be accompanied by the designation 'defrosted'. This requirement does not apply for foods for which defrosting has no negative impact on the safety or quality of the food, such as bakery products. However, producers should be able to clearly show that defrosting has no negative impact on the quality and safety of the bakery products.

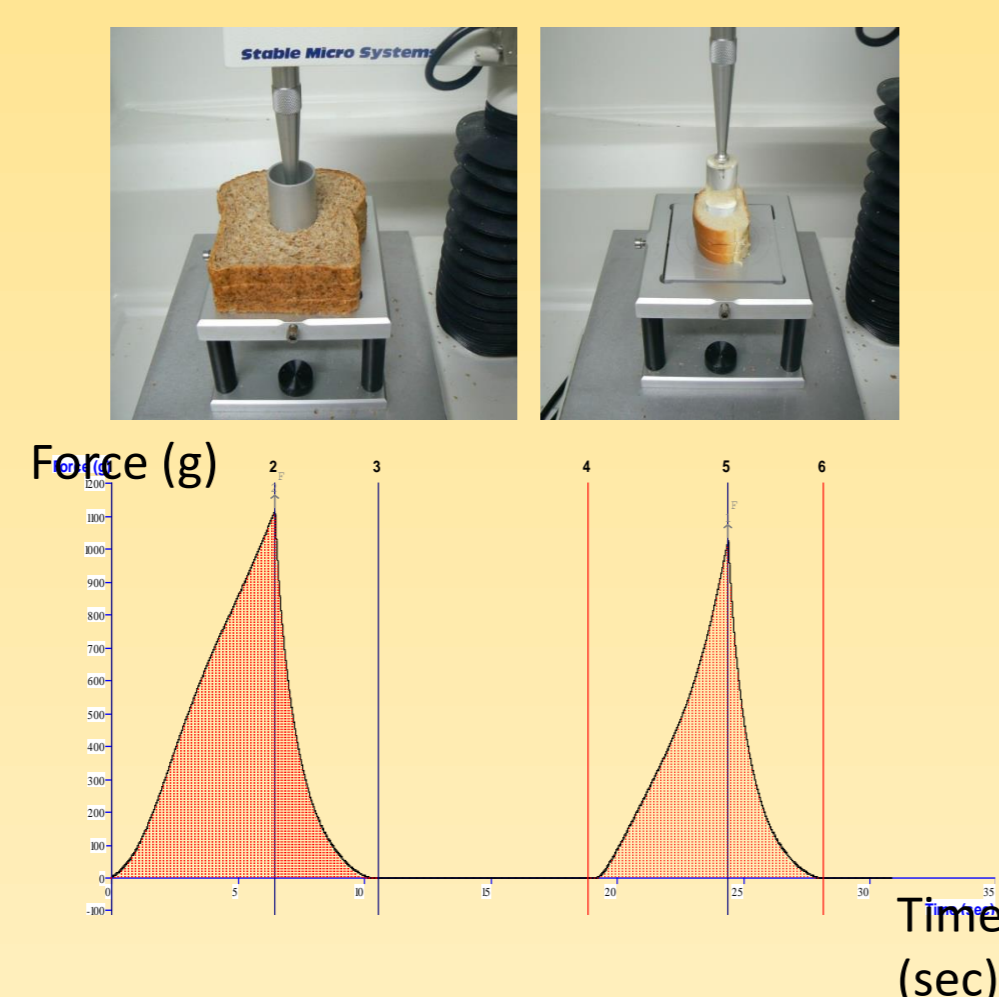
Goal

The impact of temporary frozen storage and defrosting on the quality and safety of a selection of industrially produced bakery products (whole wheat bread, sandwiches, sponge cake (with cream and fruit filling), bake-off bread and cherry pie) was studied in comparison with non-frozen products.

Quality

Texture of bread products

The impact of frozen storage and defrosting on the crumb of the whole wheat bread, sandwich and bake-off bread was investigated using a Texture Analyzer (Texture Profile Analysis – TPA).



| Bakery product | Parameter | Fresh | Frozen | Fresh | Frozen |
|---------------------------|--------------|--------------------------|----------------------------|----------------------------|--------------------------|
| | | T0 | | T0 + S | |
| Bread (S = 3 d) | Hardness (g) | 487 ± 63 ^a | 480 ± 40 ^a | 541 ± 48 ^a | 538 ± 40 ^a |
| | Cohesion (-) | 0,75 ± 0,01 ^a | 0,71 ± 0,01 ^{b,c} | 0,73 ± 0,01 ^{a,b} | 0,69 ± 0,01 ^c |
| Bake-off bread (S = 34 d) | Hardness (g) | 378 ± 96 ^a | 441 ± 83 ^a | 367 ± 46 ^a | 411 ± 81 ^a |
| | Cohesion (-) | 0,80 ± 0,02 ^a | 0,78 ± 0,02 ^a | 0,83 ± 0,01 ^b | 0,82 ± 0,01 ^b |
| Sandwich (S = 4 d) | Hardness (g) | 240 ± 33 ^a | 236 ± 39 ^a | 419 ± 46 ^b | 428 ± 37 ^b |
| | Cohesion (-) | 0,63 ± 0,02 ^a | 0,55 ± 0,04 ^b | 0,50 ± 0,02 ^c | 0,43 ± 0,02 ^d |

- Numbers with equal letters within the same parameter are not significantly different (SPSS Anova, $\alpha=0,05$)
- T0: delivery date of the product, either fresh or frozen
- S: number of storage days, depending on the product

Sensorial evaluation

The sensorial evaluation was performed by a triangle test. The results show that for some bakery products a difference between fresh and frozen/defrosted was observed. However this difference was not always perceived as negative as for some products the acceptability did not decrease. Differences between fresh and frozen products could be due to a batch effect.

| Bakery product | Significant difference? | | Acceptability (%) | |
|---------------------------|-------------------------|----------|-------------------|----------|
| | @ T0 | @ T0 + S | @ T0 | @ T0 + S |
| Bread (S = 3 d) | No | No | 79 | 61 |
| Bake-off bread (S = 34 d) | No | No | 87 | 70 |
| Sandwich (S = 4 d) | Yes | No | 92 | 100 |
| Sponge cake (S = 2 d) | Yes | Yes | 80 | 94 |
| Cherry pie (S = 4 d) | No | Yes | 79 | 83 |



Safety

Water activity (a_w) (25 °C)

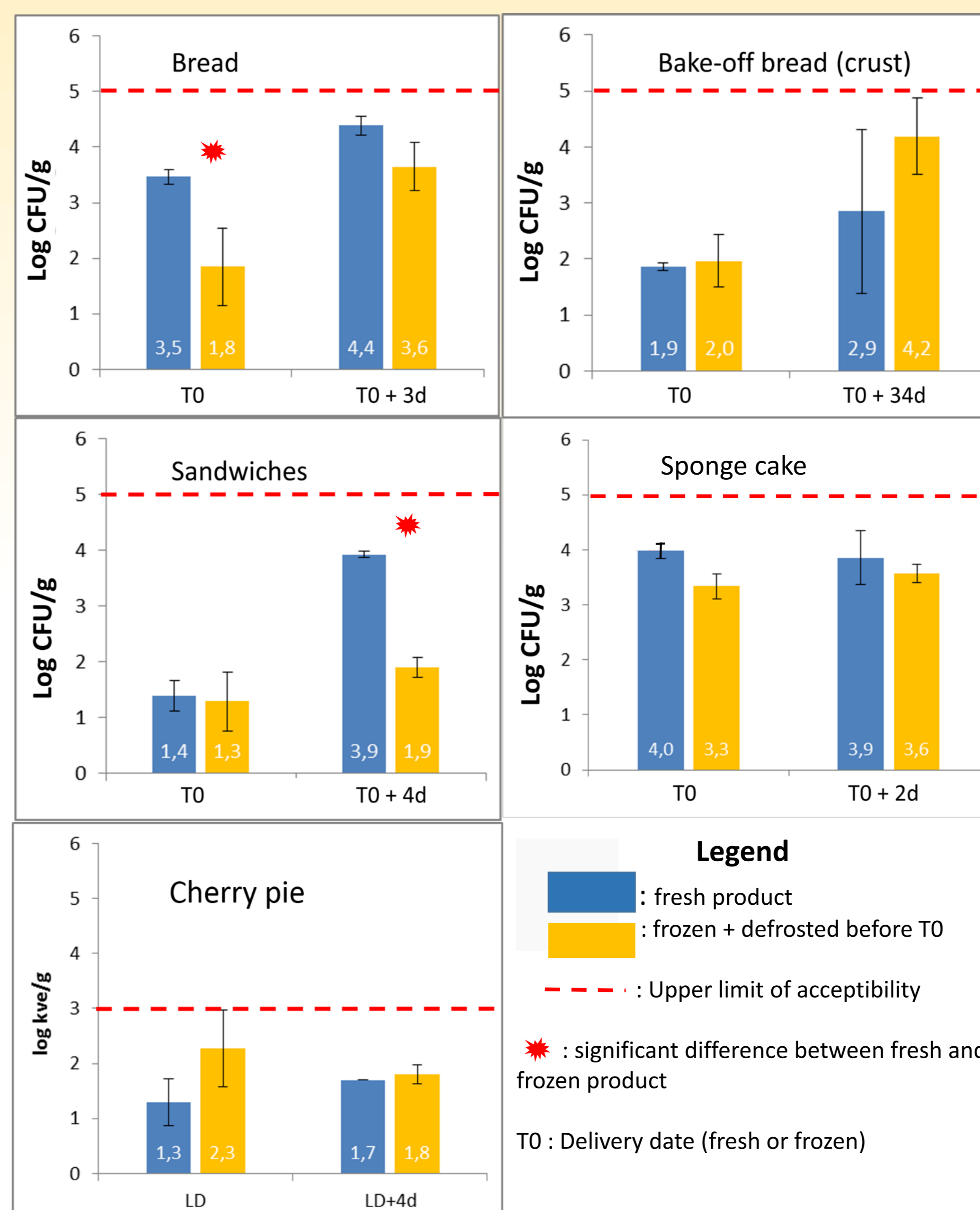
No significant differences between fresh and frozen products of the following categories were reported: bread, sponge cake, bake-off bread and cherry pie.

Only for sandwiches, frozen storage impacted the a_w of the crust on T0 (delivery date of sandwiches, either fresh or frozen). No significant difference remained visible after 4 days (T0 + 4d) (crust $a_w \approx 0,921$).

| a_w sandwich | Fresh T0 | Frozen T0 |
|----------------|---------------|---------------|
| Upper crust | 0,921 ± 0,008 | 0,878 ± 0,022 |
| Bottom crust | 0,918 ± 0,003 | 0,898 ± 0,015 |



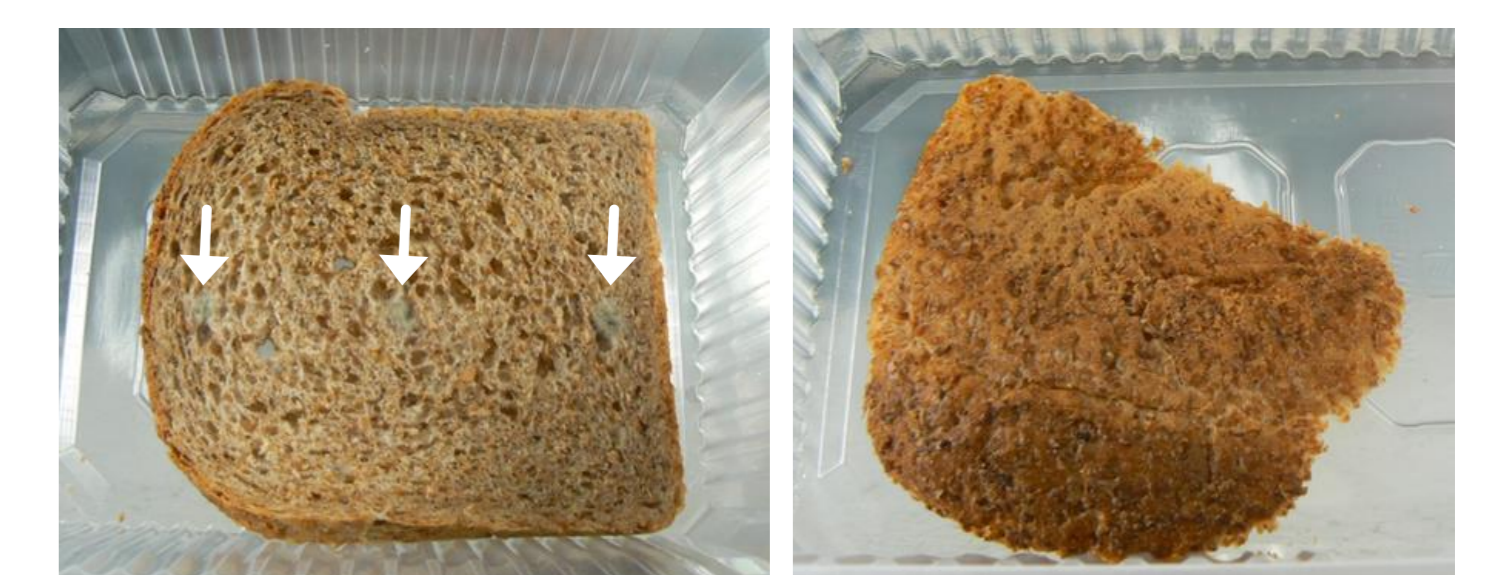
Total plate count measurement



Challenge test with spoilage fungi

No significant differences were observed between fresh and frozen bakery products in a challenge test. Each bakery product was inoculated with specific mould spore solutions and incubated for a selected time. The number of incubation days needed for growth of the microorganisms was recorded.

| Bakery product | Organism | Incubation (days) |
|----------------|-----------------------------|-------------------|
| Bread crust | <i>Penicillium paneum</i> | >7 |
| Bread crumb | | 3 |
| Sandwiches | | 7 |
| Sponge cake | <i>Eurotium amstelodami</i> | >15 |
| Cherry pie | | 7 |



Conclusion

The impact of temporary frozen storage of bakery products on product quality and safety was not always negative or even visible. For bread, the impact on quality was minimal and led to a decrease in microbial load. A significant reduction in microbial load was also found for sandwiches at the end of the shelf life time. Safetywise, the impact of temporarily frozen storage of the tested bakery products was negligible or even improved.

The main impacts of temporarily frozen storage on product quality were reported on sandwiches and cherry pie. Despite of the fact that differences in quality were perceived, the consumer's acceptability of the products did not significantly decrease. It could be concluded that the impact of temporarily frozen storage of bakery products can not be catalogued as being negative.