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Influence of frozen storage on quality of multigrain dough, par baked and ready to eat *thalipeeth* with additives

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ABSTRACT

Developing frozen products with good physical properties and storage stability is a big challenge. The objective of the present study was to improve the quality of dough, par-baked and ready-to-eat (RTE) *thalipeeth* by adding additives [guar gum (GG) 0.75 g/100 g and glycerol monostearate (GMS) 1 g/100 g] followed by frozen storage for 45 days. Dough, par-baked and RTE *thalipeeth* after every 15 days interval of frozen storage; were analyzed for rheological (stickiness, cohesiveness), textural (tear force, extensibility), thermal (differential scanning calorimetry analysis) and sensory characteristics. A rheological study showed an increase in dough stickiness (0.36 N–0.53 N) and reduction in cohesiveness (1.37 mm/s to 0.98 mm/s) due to the addition of additives during frozen storage. RTE *thalipeeth* with GG showed more extensible (4.3 mm) after 45 days storage. Thermal studies indicated the reduction in ΔH in samples containing additives compared to that of control (without additives) samples (dough, par-baked and RTE) during frozen storage. Sensory characteristics were also improved by the effect of additives and frozen storage (freezing and additives). Maximum improvement in rheological properties of dough, textural, thermal and sensory properties was observed in all the GG added *thalipeeth* samples during frozen storage as compared to others.

1. Introduction

In the past decade, the commercial use of frozen dough has increased in the market with manifold improvement. Freezing is a long-established food preservation method that produces high-quality foods with a long storage life. In general, the term freezing refers to the process in which the temperature of the food is reduced to a temperature below its freezing point, while the term frozen is used to describe the subsequent state the food is kept in much lower temperature than freezing point such as −18 °C. The product relevant to such technologies like refrigerated dough (Tao, Xiao, Wu, & Xu, 2018), frozen dough, par-baked (Almeida, Steel, & Chang, 2016) and ready to eat (RTE) is available. The process of par-baking consists of producing variety of products such as bread and flatbread (*chapatti*) in a similar manner to the conventional process, but in the baking stage, the above product is only baked up to a certain point, instead of being completely baked and after this stage, it is stored and re-baked after frozen storage to complete the process (Altamirano-Fortoul & Rosell, 2011). The softening of the crumb, dough stability during proofing, specific volume, moisture retention, palatability, sensory and anti-staling of frozen dough and par-baked products such as bread and *chapatti* could be improved by the use of different additives (guar gum (GG), locust bean gum, Arabic gum, carboxyl methyl cellulose [CMC] hydroxyl propyl methyl cellulose [HPMC]) (Anwaar et al., 2013). Use of additives studied in the preparation of frozen dough bread (Jasim & Thomas, 2018) and par-baked *chapatti* (Anwaar et al., 2013).

Thalipeeth is an Indian traditional unleavened multigrain flatbread prepared from multigrain flour dough. Multigrain flour is a medley of cereal and legume flours. The whole grains (two or more) are dry roasted on low flame in a pan and ground to form fine flour. Blending of whole grains which are rich in protein, dietary fiber as well as with the low glycemic index in staple and breakfast food items considered beneficial for health (Arya & Gaikwad, 2017). Preparation of dough is a tedious job which lacks dough elasticity and possesses poor rollability thus causes cracks and non-uniform, non-circular shape to *thalipeeth*. For *thalipeeth* preparation it requires skills. To prevent this problem, it is very necessary to incorporate additives and improve its rheological properties. Also, *thalipeeth* is highly susceptible to staling during storage as compared to other flatbreads. The extension of *thalipeeth* shelf-life needs to be achieved by applying adequate anti-staling strategies. Some advanced techniques such as freezing, par-baking and RTE frozen products are efficiently capable to slow down staling of flatbread. The results of this study will help to improve the quality of the frozen dough and *thalipeeth* with respect to texture and sensory which will meet the

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consumer's acceptance. There is no evidence available in the literature about the effect of additives on dough and *thalipeeth* quality made from frozen dough. Therefore, the aim of this work was to investigate the effect of additives on the rheological characteristics of dough and the quality (textural, thermal and sensory) of *thalipeeth* prepared from frozen dough, par-baked and ready to eat (RTE) *thalipeeth* made from frozen storage.

2. Materials and method

2.1. Raw materials

Sorghum, wheat, chickpea, green gram and black gram were purchased from agriculture produce market committee (APMC), Mumbai, India. Salt (Tata Chemicals Ltd., Mumbai, India), red chili powder (Everest., Mumbai, India), cumin seed powder (Everest., Mumbai, India), turmeric powder (Everest., Mumbai, India), onion, garlic ginger paste, coriander leaves were procured from local market Matunga, Mumbai, Maharashtra, India. The optimized dough additives including guar gum (GG) and glycerol monostearate (GMS) were provided by Fine Organic Industries Pvt Ltd., Mumbai, India.

2.2. Methods

2.2.1. Preparation of multigrain flour

Multigrain flour was prepared by using the standard procedure previously explained by Arya and Gaikwad (2017). An individual roasting of sorghum, wheat, chickpea, green gram, black gram at controlled temperature 150 °C for 20 min on low flame until the development of brown color with pleasant flavor was done. Roasted grains were dry ground into flour by using flour mill (5 kg capacity), hammer type, New India Trading Co, Mumbai, India. The obtained flour was passed through 0.425 mm mesh to get the uniform flour quality. This roasted flour was known as *bhajani,* packed in an airtight container till its final usage.

2.2.2. Preparation of multigrain flour dough

Multigrain flour dough formulations and production were as described in our previous work reported by Arya and Gaikwad (2017). Since the present work intended to study the effect of added additives on the frozen dough, par-baked and RTE *thalipeeth* quality. Additives such as GG (0.75 g/100 g) and GMS (1 g/100 g) were added at w/w basis to multigrain flour. The range of additives was taken according to earlier experiments done for optimization of additives.

A single batch was prepared for guar gum additive-base dough formation (1260 g) The dough was divided into three parts (420 g each). One part of it was further divided into 4 parts (105 g each) to store for 0, 15, 30 and 45 days respectively. 105 g dough further divided into 3 parts; All individual dough ball (35 g) in triplicate were stored at a frozen temperature (−18 °C) in freeze tolerant plastic containers. The same bifurcation and packaging followed for par baked and RTE *thalipeeth* of remained dough (420 g each). The similar batches for dough formation (with GMS and without additives) were prepared and proceeded for frozen storage. All individual samples (dough, par baked and RTE) in triplicate were stored at a frozen temperature (−18 °C) in freeze tolerant plastic containers.

2.2.3. Preparation of par-baked thalipeeth

The dough was rolled into a diameter of 14 cm and 2 mm of thickness was placed on a hot plate (140 °C) (Arya & Gaikwad, 2017) and baked for 20 s on one side and 15 s on the other side. Preservation of par-baked *thalipeeth* was performed in triplicates, followed by storage at −18 °C for a period of 45 days in freeze tolerant plastic container; special care was taken to exclude air as much as possible in order to avoid damage and to maintain *thalipeeth* structure. From the freezer, the frozen par-baked *thalipeeth* samples were collected at 15-day intervals, and were allowed to thaw for 2 h, with re-baking for 15 s on one side and 10 s on the other side, followed by cooling for 10 min at 25 °C. The freezing and thawing conditions were set based on a previous study conducted by (Anwaar et al., 2013).

2.2.4. Preparation of RTE thalipeeth

Thalipeeth were prepared by using the standard procedure previously explained by Arya and Gaikwad (2017). The formed dough was divided into a dough ball and flattened by rolling pin. It was baked on hot griddle at 140 °C for 1 min and kept for cooling. Fully baked RTE *thalipeeth* samples were stored at a frozen temperature (−18 °C) in freeze tolerant plastic containers.

2.2.5. Effect of additives and frozen storage (−18 °C) on multigrain flour dough stickiness and cohesiveness

The rheological characterization of multigrain dough was performed by using a TA. XT2i texture analyzer, Stable microsystems (Godalming, Surrey, UK) at 25 °C. Dough stickiness was measure at 25 °C by using the Chen-Hoseney dough stickiness rig test, with accessories such as 25-mm Perspex cylinder probe (P/25P). SMS/Chen-Hoseney dough stickiness cell (A/DSC) attached to Texture Analyzer. The parameters obtained were dough stickiness and dough cohesiveness (Ghodke & Ananthanarayan, 2007).

2.2.6. Effect of additives and frozen storage (−18 °C) on water absorption index (WAI) and water solubility index (WSI) of multigrain flour dough

WAI and WSI of the frozen dough samples were determined by slightly modifying the method (Kaisangsri et al., 2016). WAI is the weight of residue obtained after removal of the supernatant per unit weight of original dry solids, whereas WSI is the weight of dry solids in the supernatant expressed as a percentage of the original weight of sample.

2.2.7. Effect of additives and frozen storage (−18 °C) on tear force (g) and extensibility (mm) of thalipeeth prepared from frozen dough, par-baked and RTE thalipeeth

The tear force of *thalipeeth* was evaluated by using of TA. XT2i texture analyzer, Stable microsystems (Godalming, Surrey, UK), according to the method described by Ghodke and Ananthanarayan (2007). *Thalipeeth* was cut into strips of specific length and width (3.5 cm × 7.5 cm). The upper tensile grip was attached to the load cell carrier and the lower tensile grip was secured to the base of the machine. The *thalipeeth* strips were placed one end into the lower rig grip and tightening the grip and the same procedure was performed to anchor the other end to the upper grip. The texture of *thalipeeth* was measured as tear force and extensibility.

2.2.8. Effect of additives and frozen storage (−18 °C) on thermal properties of dough, par-baked and RTE thalipeeth

Thermal properties studies were carried out by DSC-60 (Shimadzu Analytical Pvt. Ltd., Singapore) fitted with TA-60 WS detector and computo-aided data analysis to measure the degree of gelatinization properties for the sample (dough, par-baked and RTE *thalipeeth*) (Ban, 2016). Dough, par-baked and RTE *thalipeeth* sample (5 mg each) were weighed in the DSC pan sealed hermetically and placed in the sample side. An empty pan was used as a reference. Duplicate sample pans were prepared and each was heated from 30 to 150 °C, rate 10 °C/min. The energy required for onset (T_o), peak (T_p), conclusion (T_c) and the enthalpy with starch retrogradation (ΔH) was calculated and expressed in J/g of dry sample.

2.2.9. Effect of additives and frozen storage (−18 °C) on sensory evaluation of thalipeeth prepared from frozen dough, par-baked and RTE thalipeeth

Thalipeeth prepared from frozen dough, par-baked and RTE *thalipeeth* samples were submitted to a panel of ten trained research students