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Short communication

Radappertization of ready-to-eat shelf-stable, traditional Indian bread – *Methi Paratha*

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HIGHLIGHTS

- Shelf-stable ready-to-eat (RTE) *Methi Paratha* (flavored Indian unleavened flat bread) was developed.
- A combination of hurdles irradiation, vacuum-packaging and natural antioxidants was used.
- *Methi Paratha* was microbiologically safe and sensorialy acceptable for 180 days.

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ABSTRACT

Shelf-stable ready-to-eat (RTE) *Methi Paratha* (flavored Indian unleavened flat bread) was developed using combination of hurdles including radiation processing. The *Methi Paratha* was prepared using dough containing wheat flour, dried fenugreek leaves and spices. The samples were vacuum packed in multi-layered pouches and irradiated at 25 kGy in frozen conditions. Samples were evaluated for microbiological counts, lipid peroxidation and sensory attributes during storage under ambient conditions. Samples were found to be devoid of any viable microorganism throughout the storage period of 180 days. The thiobarbituric acid reactive substances (TBARS) value which indicates lipid peroxidation of samples did not show any significant increase with time. The *Methi Paratha* was found to be acceptable by the evaluating panelists.

1. Introduction

Wheat is a major cereal crop of India. Currently, India is the second largest producer of wheat in the world with about 12% share in total world wheat production. More than 80% of wheat produced in India is consumed in the form of traditional products such *chapati, roti, paratha* and *poori. Paratha* is one of the most popular unleavened flat breads. The *paratha* is prepared by mixing vegetables along with salt and spices with flour and kneading to make dough, rolled, and shallow fried. The *paratha* can be eaten with butter, chutney, pickles, yogurt, or curries.

Fenugreek has number of health benefits and is counted among the healthiest foods. Fenugreek leaves are very rich in vitamins and minerals and are reported to posses anti-diabetic, hypo-cholesterolemic, antioxidant potency, digestive stimulant, hepato-protective, anti-cancer, anti-microbial and anti-parasitic properties.

Methi Paratha is flavored with fenugreek leaves and has shelf life of 24–48 h. It becomes unfit for consumption due to development of molds and texture deterioration. *Methi Paratha* preserved in ready-to-eat form is suited for situation where cooking facilities are limited or non-existent. This could be useful for armed forces or calamity relief operations.

Radappertization is application of a dose of ionizing radiation sufficient to reduce the number and/or activity of viable microorganisms to such an extent that very few, if any, are detectable in the food by any recognized method (viruses being exception). No microbial spoilage or toxicity becomes detectable in a food so treated, no matter how long or under what conditions it is stored, provided the package remains undamaged. The required dose is usually in the range of 25–45 kGy (Diehl, 1995). Therefore, the objective of this study was to develop safe, shelf-stable RTE *Methi Paratha* using a dose of 25 kGy.

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2. Material and methods

2.1. Materials

Branded whole wheat flour, salt, refined sunflower oil, spices were procured from a local market. Media for the microbiological analyses other chemicals used were of analytical grade.

2.2. Preparation of methi paratha

The dough for the *Methi Paratha* was prepared by mixing whole wheat flour, salt, spices (red chili powder, cumin seeds, carom seeds, ginger–garlic paste, and turmeric powder), dried fenugreek leaves, vegetable oil and water in automated dough kneader. The dough was set aside for 15 min; *Paratha* was prepared, cooled and packed.

2.3. Packaging and radiation processing

Methi Paratha was vacuum packed in multilayered pouches (12 μm PET+9 μm Aluminum+15 μm Nylon+70 μm CPP). Irradiation was carried out in frozen condition (using dry ice in an insulated irradiation box) in a Food Package Irradiator with a ^{60}Co source at a dose rate of 3 kGy/h. In preliminary studies, samples were irradiated at doses upto 30 kGy and 25 kGy irradiation dose was found to be optimum to obtain a microbiologically safe product. Hence, further studies were carried on samples irradiated at 25 kGy. Dosimetry was performed using a cerric-cerrous dosimeter calibrated against Fricke's dosimeter. The dose mapping experiments were carried out according to the guidelines of ISO/ASTM 51204:2002 (E) (ASTM, 2002).

The non-irradiated samples served as control. Until irradiation was over, non-irradiated samples were kept frozen (−25 °C). All the samples were thereafter stored at ambient temperature (25–30 °C).

2.4. Moisture content and water activity

The moisture content of the *Methi Paratha* was determined using the gravimetric method. 10 g of samples were placed in pre-weighed petri plates and dried in oven at 100 °C till the weight of the sample stabilized. Water activity of the samples was determined using water activity meter.

2.5. Microbiological analysis

Samples in duplicate from the irradiated and their corresponding non-irradiated control batches of *Methi Paratha* were aseptically homogenized in a Stomacher and appropriate serial dilutions were carried out. Total viable aerobic and anaerobic count (by pour plate method) was determined using plate count agar. For spore count, the homogenate was subjected to heat shock to kill vegetative cells and cooled rapidly. Baird Parker's Agar was used for enumeration of Staphylococcus spp., and Violet Red Bile agar for fecal coliforms. Molds were determined using Potato Dextrose Agar.

2.6. Texture analyses

Texture analysis of radiation treated *Methi Paratha* was carried out using Texture Analyzer. *Paratha* strips of 25 mm × 90 mm were cut. The strips of *paratha* were mounted to the film extension grips of the instrument and stretched until breakage. Puncture strength was determined using needle probe. Five independent samples were analyzed at each storage point.

2.7. Lipid oxidation

The lipid peroxidation in *Methi Paratha* was measured in terms of TBARS by distillation method (Pikul et al., 1983). The results were reported as mg of malonaldehyde per kg of samples. Five independent samples were analyzed at each storage point.

2.8. Sensory quality

The sensory characteristics of the *Methi Paratha* were analyzed by 15 experienced members of staff who were familiar with the attributes of the product. The samples were warmed in a microwave oven. Attributes like appearance, taste, odor, texture and overall acceptability were evaluated on 9-poing hedonic scale, 9 corresponding to highest quality. A score of 5 was taken as the lower limit of acceptability (Moskowitz, 1982). One paratha was distributed among 3 panelists. Five independent samples were analyzed at each storage point.

3. Results and discussion

3.1. Moisture content and water activity

Barrier properties of packaging material determine moisture changes during storage of packed food. Moisture content and water activity of freshly prepared *Methi Paratha* was 25.5% and 0.921 respectively. There was no significant change in these parameters due to radiation processing and storage. This retention of total and available moisture in the *Methi Paratha* can be attributed to the packaging system used. Rao et al. (1986) reported 7% and 0.2% moisture loss in *chapatis* when they were kept wrapped in wax paper or packaged in a polypropylene film respectively.

3.2. Texture analysis

The texture of *Methi Paratha* before and after radiation processing was determined using a Texture Analyzer. Parameters like hardness and puncture force were determined. The tensile strengths of non-irradiated and irradiated samples were 55.6 kPa and 54.6 kPa respectively (Fig. 1a). The tensile strength increased steadily for 60 days but remained stable thereafter. Similarly, the puncture forces for non-irradiated and irradiated samples were 0.24 N and 0.25 N respectively (Fig. 1b). As in case of tensile strength, the puncture force also increased for the first 60 days of storage and remained stable later. These results are in agreement with the previous findings where storage has been reported to increase hardness and stiffness of chapatis (Khan et al., 2011; Shaikh et al., 2007).

3.3. Lipid peroxidation

The TBA value which is an index of secondary lipid oxidation was monitored during radiation processing and storage studies. Irradiation is expected to accelerate lipid oxidation because ionizing radiation generates hydroxyl radicals, a strong initiator of lipid oxidation (Thakur and Singh, 1994). However, in the present study there was no significant increase in rancidity of *Methi Paratha* due to radiation processing. This could be attributed to the fact that product was vacuum packed in pouches with high barrier properties and irradiation was carried out in frozen condition. Both the factors minimize oxidative effect of radiation processing. Also, product contained fenugreek and a number of other spices which serve as natural antioxidants that minimize radiation induced lipid peroxidation. There was a slight increase in TBA value