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FULL LENGTH ARTICLE

Effect of apple pomace on quality characteristics of brown rice based cracker

Shabir Ahmad Mir [a,*], Sowriappan John Don Bosco [a], Manzoor Ahmad Shah [a], Swaminathan Santhalakshmy [a], Mohammad Maqbool Mir [b]

[a] *Department of Food Science and Technology, Pondicherry University, Puducherry 605014, India*
[b] *Division of Fruit Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Jammu and Kashmir 190025, India*

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Abstract Formulation of gluten free crackers based on brown rice flour from two varieties and apple pomace was studied during the present investigation. Pomace flour blends were prepared by incorporating 0%, 3%, 6% and 9% apple pomace in brown rice flour. Viscosity profile showed decrease in pasting properties except pasting temperature which increased with increase in pomace level. The hunter colour value (L^*) and fracture force of crackers are decreased with increase in pomace level. The crackers were investigated and compared for composition, antioxidant properties (DPPH, total phenolic content, total flavonoid content, reducing power), minerals and sensory properties. The increased amount of apple pomace in the flour formulation resulted in higher antioxidant properties, total dietary fibre and minerals in the final product. Based on the present study, pomace based rice crackers have good potential for consumer and regarded as health promoting functional food, especially for coeliac disease patients.
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1. Introduction

Snack foods are an integral part of the diet and have been over a period of time commercially exploited on large scale. Crackers are the popular snack products which have appreciable demand amongst the consumers (Maneerote et al., 2009; Sedej et al., 2011). Cereals occupy an important place in human nutrition as major proportion of population consumes it all over the world and mostly exploited for cracker formulation. However, coeliac disease patients are unable to consume cereal products that contain gluten proteins. Rice is one of the most suitable cereal crops for gluten-free products because it has a low level of prolamine. It also possesses unique nutritional, hypoallergenic and bland taste properties (Ali et al., 2014; Mir and Bosco, 2014).

Since majority of minerals and phytochemicals are concentrated in the bran layer of the whole grain (Abdul-Hamid

* Corresponding author. Tel.: +91 7298624287; fax: +91 413 2656743.
E-mail address: shabirahmir@gmail.com (S.A. Mir).
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et al., 2007), it is supposed that products based on the use of whole raw materials might be considered as food with high antioxidant and mineral potential. Recent studies have shown that brown rice had a wide range of biological activities, including antioxidant, anticarcinogenic, antiallergic activities, antiatherosclerosis and amelioration of iron deficiency anaemia of the body (Deng et al., 2013).

Consumer interest is increasing in functional foods and this has led to the demand of such products in the market. Therefore, different sources have been incorporated as raw material into cereal products which have health benefits (Masoodi and Chauhan, 1998; Wang et al., 2012). Apple pomace, a fruit industry by-product is one of the potential food ingredients used in bakery products (Rupasinghe et al., 2008; Zarein et al., 2015). Phytochemicals present in apple pomace have been associated with many health enhancing benefits e.g. cancer cell proliferation, lipid oxidation decrease and lower cholesterol level (O'Shea et al., 2012). In addition, apple pomace fibres are known to consist of bioactive compounds such as flavonoids, polyphenols and carotenoids and also have been considered as a source of better quality dietary fibre (Fernandez-Ginez et al., 2003). Lu and Foo (2000) indicated that the polyphenols, which are mainly responsible for the antioxidant activity, are present in apple pomace and hence could be a cheap and readily available source of dietary antioxidants. Several authors have reviewed the importance of dietary fibre (O'Shea et al., 2012). Dietary fibres from different sources have been used to replace cereal flour in the preparation of bakery products (Foschia et al., 2013). Therefore, the present work was undertaken to formulate and study the influence of apple pomace on the chemical, antioxidant and sensory properties of rice crackers.

2. Materials and methods

2.1. Raw materials

The paddy varieties K-332 and Khosar were procured from the Sher-e-Kashmir University of Agriculture Science and Technology, Kashmir, India. The grains were dried and dehusked in a THU-34A Stake Testing Rice Husker (Stake, Japan) to obtain brown rice. Flour was obtained by grinding the brown rice using Mini Grain Mill (A11B, IKA Inc.) and sifting the material through 300 μm sieve and kept in a refrigerator at about 4 °C for further analysis. Fresh apples obtained from local market of Pondicherry were washed well with water to remove the adhering dust. The apples were cut into small pieces and crushed into the juicer mixer (Crompton Greaves, CG-BX, India). The juice was squeezed completely from the pulp and pomace was dried in tray drier at 40 °C and grounded with grinder mill and sieved into a fine powder. Commercially available sugar, vegetable fat, salt and baking powder were brought from the local market of Pondicherry. Carboxymethyl cellulose sodium salt was obtained from the Merck, Mumbai, India.

2.2. Preparation of rice cracker

The rice cracker formulation was brown rice flour (100 g), sugar (10 g/100 g), salt (3 g/100 g), fat (30 g/100 g), carboxymethyl cellulose (2 g/100 g), baking powder (0.8 g/100 g), water (optimum) and apple pomace powder (0 g/100 g, 3 g/100 g, 6 g/100 g and 9 g/100 g).

The dry ingredients except sugar were mixed in a mixer, whilst the liquid ingredients and sugar were mixed separately to form emulsion. The emulsion was incorporated into the dry ingredients and mixed by high speed mixer. Dough was wrapped in polyethylene bags and left to rest at room temperature for 30 min to ensure uniform distribution of liquids. The dough was then manually sheeted to 2.5 mm thickness and cut by pressing mould into 35 mm diameter. Baking was done in a double deck baking oven (T26/DDO, Technico, Chennai, India) at 170 °C for 10 min. After cooling for 5 min to room temperature, the crackers were wrapped in plastic container and kept at room temperature for further investigation.

2.3. Pasting properties of pomace-rice flour blends

Pasting characteristics of rice flour-pomace blends were determined by using Rapid Visco Analyzer (Starch master 2, Newport Scientific Pty. Ltd, Warriewood, Australia). Powder sample of 3 g was weighed in RVA canisters followed by addition of 25 ml of water. The prepared slurry in the canister was heated to 50 °C and stirred at 160 rpm for 10 s to enable the complete dispersion. The slurry was held at 50 °C for 1 min and temperature was raised to 95 °C for 7.5 min and subsequently held at 95 °C for 5 min. The slurry was cooled at 50 °C for 7.5 min, and then held at 50 °C for 2 min. Pasting temperature, peak viscosity, holding viscosity, final viscosity, breakdown viscosity and setback viscosity were determined.

2.4. Colour of rice cracker

The cracker colour was determined by CIE colour scales L^*, a^* and b^* using Hunter Lab digital colorimeter (Model D25M, Hunter Associates Laboratory, Reston, USA). Calibration with black and white standards was performed before colour measurement. The total colour difference (ΔE) was estimated as:

$$\text{Total colour difference } (\Delta E) = \sqrt{[(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]}$$

where

$$\Delta L = (L_{\text{sample}} - L_{\text{standard}})$$

$$\Delta a = (a_{\text{sample}} - a_{\text{standard}})$$

$$\Delta a = (b_{\text{sample}} - b_{\text{standard}})$$

2.5. Texture of rice cracker

The fracture force test was measured using a Texture Analyzer (TA) TA-HD plus, Stable Micro Systems, Surrey, UK. The cracker samples were rested on the platform supported at two points and the blade was attached to the crosshead of the instrument. The peak force from the resulting curve was considered as the fracture force of the biscuit. The average force was calculated for five cookies and reported as fracture force (g).

2.6. Composition

Fat and protein of the samples were determined according to the standard methods of AACC (2000).

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