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Studies on preparation of dietetic *rasgulla* (cheese ball) from edible quality flours and antioxidant rich vegetable oils

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ABSTRACT

Dietetic *rasgulla* (cheese ball) made from deoiled edible quality soy or sesame flour is known as non-dairy *rasgullas* (NDRs). Dietetic *rasgullas* were supplemented with specific antioxidant such as oryzanol obtained from rice bran oil (RBO). All the experimental non–dairy *rasgullas* and control dairy *rasgulla* (DR) were assessed for physicochemical (proximate composition, oxidative stability, antioxidant activity, penetration and colour property), *in vitro* multienzyme protein digestibility, microbiological and sensory properties. The penetration values of RBO incorporated deoiled soy or sesame based NDRs were lower in comparison with DR. The RBO incorporated deoiled soy flour based NDRs exhibited significantly higher inhibition (%) of 2, 2–diphenyl–1–picrylhydrazyl (42.16 ± 0.65%; $p \leq 0.05$) compared with DR (9.37 ± 0.30%) on the first day of manufacturing (0 day of storage). The overall acceptability scores of RBO incorporated deoiled soy flour and sesame flour based NDRs were significantly lowers than that DR. The RBO incorporated deoiled soy flour and sesame flour based NDRs showed highest digestibility than NDRs made from whole soybean seed or sesame seed. Total viable count and yeast & mold count increased slowly in the samples stored at 4 °C in refrigerator for 30 days.

1. Introduction

Traditionally *rasgulla* the sweet syrupy cheese ball was prepared from *chenna*, a co-precipitate obtained by heat and acid precipitation of milk protein and whey protein (David, 2016). *Rasgulla* is common name in India and the dessert is known as *Rosogolla* or *Roshogolla* in Bengali. Dietetic *rasgullas* made from non-dairy material such as soy or sesame flour are known as non-dairy *rasgulla* (cheese ball). *Rasgullas* which are generally made from cow milk have high nutritional value because they contain high amount of protein, calcium, phosphorus, vitamin A and vitamin D (Kumar & Prasad, 2010). Due to its health benefit to human, consumption of *rasgulla* was increased at an annual rate of more than 20% (Singh, Tanwar, Kumar, & Singh, 2007). Development of non–dairy food products from edible quality oil seed flours such as soybean and sesame could provide specific health benefits beyond the conventional dairy products which have certain limitations from nutritional aspects (Krupa, Jana, & Patel, 2011). Soy has good amino acid balance, high amount of essential fatty acids, soluble fiber, vitamins, minerals, phytochemicals which have strong antioxidant property, cholesterol lowering property and significant disease–fighting power (Ganesan & Xu, 2017; Messina & Messina, 2010; Nguyen, Kisiala, Andreas, Emery, & Narine, 2016; Ramdath, Padhi, Sarfaraz, Renwick, & Duncan, 2017). Sesame seed is also rich in antioxidants and polyunsaturated fatty acid as well as sesamin, a type of phytoestrogen which has excellent cholesterol lowering property (Pathak, Rai, Kumari, & Bhat, 2014). Rice bran oil (RBO) is balanced in saturated, monounsaturated, and polyunsaturated fatty acids and is rich in antixidants/nutraceuticals such as tocopherols, tocotrienols and gamma oryzanol, phytosterols (El Rhaman, 2010). This research work for the first time reported about the incorporation of RBO in making nutritionally superior quality non–dairy *rasgulla* (NDR) from deoiled edible soy flour or sesame flour or whole soy seed and sesame seed. Despite the excellent health benefits of soy and sesame ingredients (Xiao, 2008) and affordability, fortification of NDR with RBO improves its nutritional and medicinal profile. The objective of the present research work was to prepare non–dairy *rasgullas* from deoiled edible quality oilseed flours (soy and sesame flour) with antioxidant rich rice bran oil. Evaluation and comparison of

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physicochemical, microbiological, sensory properties, antioxidant activity and in *vitro* multienzyme protein digestibility of non–dairy *rasgullas* with those of dairy *rasgulla* during storage for 30 days in refrigerated condition will be also carried out.

2. Material and methods

2.1. Chemicals and reagents

Soybean, sesame seeds and pasteurized toned cow's milk (fat, 3 g/100 g of milk and solid non fat, 8.5 g/100 g of milk) were purchased from the local market (Kolkata, India). Decorticated and defatted soybean cake known as edible soy flour was provided by M/S Progressive Exim, Raipur, India. Decorticated sesame flour was purchased from B.M. Agarwal, Kolkata. RBO was provided by M/S Shethia oil Mill (West Bengal, India). Chemicals used was purchased from MERCK, India. Calcium lactate, cane sugar (double refined) and rose water were obtained from local shop of Kolkata, India.

2.2. Preparation of soy or sesame milk from whole soy bean and whole sesame seeds

Soy milk from whole soy seeds and sesame milk from whole sesame seeds were prepared according to Sengupta, Bhattacharyya, & Bhowal (2013) and Quasem, Mazahreh, and Abu–Alruz (2009) respectively. Schematic diagram for the preparation of soy milk and sesame milk was given in Fig. 1.

2.3. Preparation of deoiled soy and deoiled sesame flour

Deoiled soy flour was used in manufacturing non–dairy *rasgulla*. The defatted sesame flour was prepared according to the following procedures: full–fat sesame flour was extracted with a 10–fold volume of hexane for 4 h and centrifuged at 1000 × g for 10 min; the supernatant was collected; hexane was removed by steam distillation and the resulting defatted sesame flour was stored in a refrigerator at 4 °C.

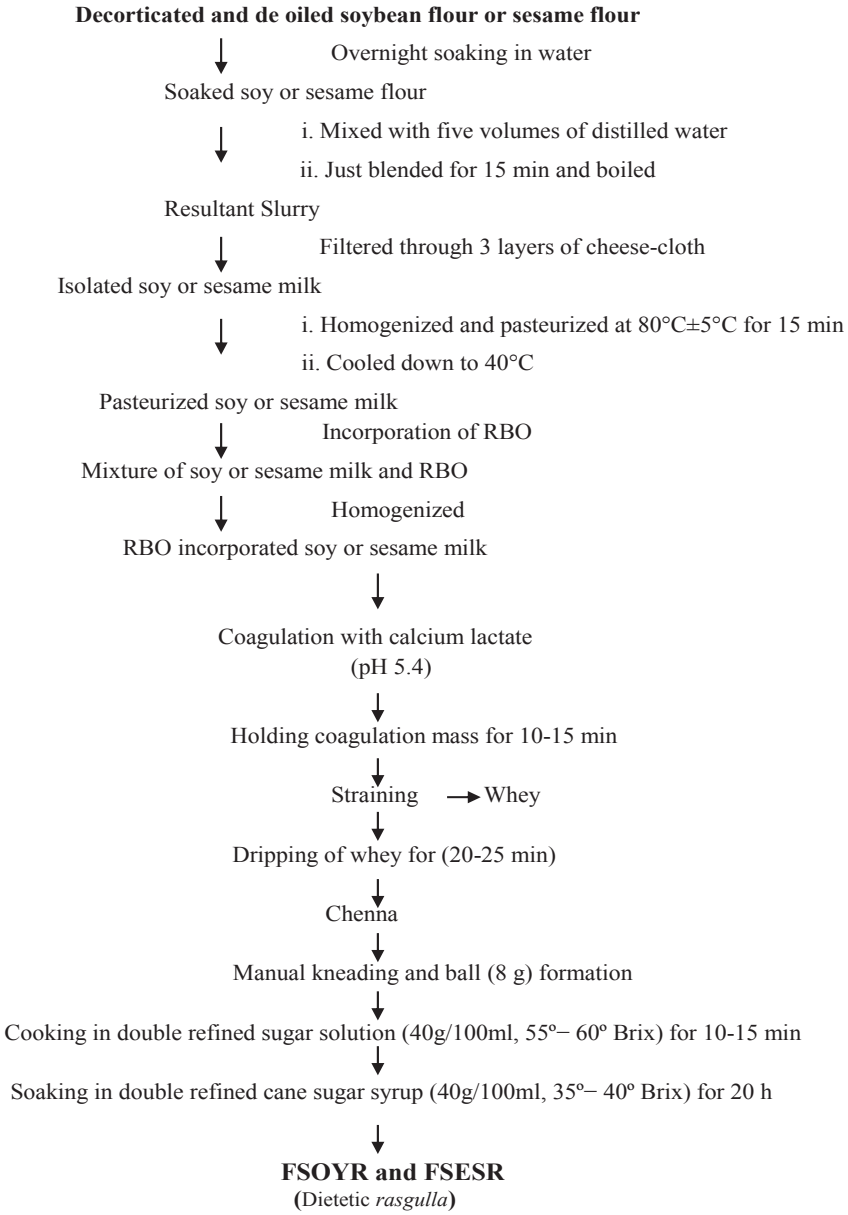

Fig. 1. Preparation of *rasgulla* from dairy, soy milk (whole soy seeds) and sesame milk (whole sesame seed).