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## Effect of freezing and hot water soaking on the functional properties of rice flour derived from four Sri Lankan traditional rice varieties

C. M. Peries<sup>\*a</sup>, K.B. Wijesekara<sup>a</sup>, S.B. Navarathne<sup>b</sup>

<sup>a</sup>Department of Science & Technology, Faculty of Science & Technology, Uva Wellassa University, Passara Road, Badulla, Sri Lanka

<sup>b</sup>Department of Food Science & Technology, Faculty of Applied Sciences, University of Sri Jayawardenepura, Nugegoda, Sri Lanka

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### Abstract

Rice cultivation nowadays has become a major concern to Sri Lanka due to high dependency of chemical fertilizers. There is an interest to promote utilization of rice obtained from traditional rice varieties which are well adopted to Sri Lankan environmental conditions, such varieties are highly nutritious and less dependent on agrochemicals. Thus they are ideal candidates in promoting organic food products without chemical inputs. Rice flour is a good substitute for imported wheat flour in bakery industry. However due to lack of gluten protein, rice flour cannot be used directly in bakery products without any modifications. In this study rice grains derived from four traditional rice varieties namely *Madathuwalu*, *Kaluhenati*, *Pachaperumal* and *Ratdal* were subjected to freezing at  $-20^{\circ}\text{C}$  (24 hours and 48 hours), hot water soaking at  $80^{\circ}\text{C}$  (5 minutes and 10 minutes) individually and in dual combinations. Untreated rice flour served as the control and experiments were conducted in triplicates. Water Absorption Index (WAI), Water Solubility (WS), Swelling Power (SP) and pH values were measured in both treated and untreated rice flour. Results showed that these physical treatments to the rice grains bring about a significant difference ( $p < 0.05$ ) on the functional properties of rice flour both individual and in dual combinations. Strong correlation ( $p = 0.000$ ) was obtained between WAI and SP. Dual modification treatments were found to be highly effective in improving functional properties of all selected traditional rice varieties compared to the single modification. Freezing at  $-20^{\circ}\text{C}$  for 48 hours was more effective than the 24 hours freezing to improve the functional properties. Therefore, this study proves that simple physical treatment methods such as freezing and hot water soaking could bring about a significant effect on the functional properties of traditional rice flour.

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**Keywords:** Traditional rice; freezing; hot water soaking; functional properties

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\* Corresponding author. E-mail address: [maheshika.peries85@gmail.com](mailto:maheshika.peries85@gmail.com)

## 1.0 Introduction

Rice (*Oryza sativa*) provides the main staple food for Sri Lankans as well as for three billion people worldwide. Sri Lanka has dedicated 0.77 million/ha for rice cultivation yet there is a growing deficit between rice production and consumption. Rice varieties cultivated in Sri Lanka are mainly improved commercial varieties and the percentage of cultivation of traditional rice varieties is significantly less. Traditional varieties, though average in yield, are best adapted to Sri Lankan conditions and are resistant to diseases and pests, highly nutritious and less dependent on chemical fertilizers. The traditional rice varieties have been found to contain higher amounts of glutamic acid, vitamins, fiber and give a lower glycemic index compared to the commercially available rice varieties<sup>1</sup>. This makes traditional rice varieties better candidates for organic type of farming at the same time a possible alternative to substitute wheat flour in the bakery industry. Use of rice flour in the bakery industry would lessen Sri Lanka's dependency on imported wheat flour and it also provides a solution for those consumers who are sensitive to gluten proteins. However, limitations could be identified for rice flour when used in the bakery industry due to the lack of gluten which is an essential requirement to maintain the quality of the baked products<sup>2</sup>. Rice flour can be modified using chemical, physical and enzymatic methods<sup>3</sup>. However, this study used only physical modification methods since it is very cheap and convenient method compare to chemical and enzymatic methods. Further, consumers are reluctant to buy chemically and enzymatically modified products due to their health concerns. It has been shown that application of simple physical treatment methods such as, heat and cold water soaking of rice kernels could improve functional properties of rice which in turn gives the desired body and texture to the products made out of flour from the treated kernels<sup>3</sup>. The main objective of this study was to investigate the changes in functional properties of rice flour derived from four Sri Lankan traditional rice varieties after the application of single and dual physical treatment methods for the fortification of bakery products.

## 2.0 Methodology

Four Sri Lankan traditional rice varieties namely, *Madathawalu* (G1), *Kaluhenati* (G2), *Pachchaperumal* (G3) and *Rathadal* (G4) were selected based on the nutritional status and the availability. All these selected rice varieties were rich in proteins and antioxidants<sup>4</sup>. Seed samples were collected from Rural Network Farmers Organization and the identification and certification of varieties were done by the Rice Research Institute at Bathalegoda, Sri Lanka. Rice kernels polished to 100% were obtained separately for all four varieties by removing the bran by dry milling process. The milled samples were aspirated in an aspirator for 30-60 seconds to clean the rice by removing any loose bran remaining on the surface of the kernels. Two different physical treatment methods, freezing at -20° C and hot water soaking at 80° C were applied to rice kernels individually and in combination for various time intervals. Eight treatments methods applied to rice kernel were as follows:

Dual modification treatments

T1 – Freezing at -20° C for 24 hours followed by hot water soaking at 80° C for 5 minutes

T2 - Freezing at -20° C for 24 hours followed by hot water soaking at 80° C for 10 minutes

T3 - Freezing at -20° C for 48 hours followed by hot water soaking at 80° C for 5 minutes

T4 - Freezing at -20° C for 48 hours followed by hot water soaking at 80° C for 10 minutes

Single modification treatments

T5 - Freezing at -20° C for 24 hours

T6 - Freezing at -20° C for 48 hours

T7- Hot water soaking at 80° C for 5 minutes

T8- Hot water soaking at 80° C for 10 minutes

Flour obtained from untreated rice kernels of all four varieties, *Madathuwalu* (F1), *Kaluhenati* (F2), *Pachchaperumal* (F3) and *Ratthal* (F4) served as the control. Flour obtained from treated rice grains were ground and flour was analyzed separately for different functional properties such as water solubility (WS), swelling power (SP), water absorption index (WAI), and pH according to the standard methods respectively<sup>5</sup>. Experiments were conducted in triplicates and data obtained were analyzed using Minitab 16.0 software package. One-Way Analysis of Variance (ANOVA) and Tukey Simultaneous Test were performed at  $p < 0.05$  level of significance to compare the individual and combined treatment effects for changes in functional properties of flour.

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