Effects of Pregelatinization on Physico-chemical Properties of Flour of Germinated Brown Rice cv. KDML 105

Abstract

This study aims to evaluate the physico-chemical properties of pregelatinized flour of germinated brown rice cv. KDML 105. The flour at various flour: water ratio (3:1, 2:1, 1:1) was produced by single screw extruder controlled barrel temperature at 60, 80, 100 °C. Result showed that barrel temperature and flour:water ratio had no effect on GABA content. Vitamin B1 content was decreased with the increasing of temperature. Pasting temperature and viscosity of pregelatinized flour at all tested conditions were lower. It was found that the pasting temperature of pregelatinized flour (at 50 °C) was lowest when barrel temperature was controlled at 80 °C or 100 °C of all flour: water ratio. However, swelling power was increased when the barrel temperature increased. Pregelatinized flour produced from 1:1 flour: water at 60 ºC had highest solubility.

Keywords: germinated brown rice, pregelatinized flour, extrusion, vitamin B1, GABA

Introduction

After brown rice is soaked in water and root is protuberance for 1-2 millimeters, this rice is called germinated brown rice (GBR). During the process of being germinated, endosperm is softened and enzymes are activated, nutrients in the brown rice change markedly (Shoichi and Ishikawa, 2004). In germinated brown rice, protein, dietary fiber, γ-aminobutyric acid (GABA), γ-oryzanol, inositols, tocotrienols, vitamin B1, magnesium, potassium and zinc are increased and phytic acid, which is an antinutrient substance, is decreased (Watchraparpalboon, 2007). The GBR is considered as a functional food. Consuming germinated brown rice gives benefits to health i.e. preventing headache, Alzheimer’s disease, heart disease and colon cancer.

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cancer (Mamiya et al., 2004). Not only the chemical properties of germinated brown rice are changed, in the germination process, enzymes are activated, α-amylase is an important enzyme that affects amylose content. It causes reduction of amylose content in germinated brown rice, resulting in loss of viscosity (Jiamyangyuen and Ooraikul, 2008). With all these changes, physical properties of flour are altered. However, the gelatinization temperature of flour is not low enough to make the flour soluble in cold water. Pregelatinization is a process which suspensions of flour or starch and water are cooked and dried to give products that disperse readily in cold water and form moderately stable suspensions (Mason, 2009). Extrusion is a process that can cause gelatinization of starch and also one of a high temperature short time (HTST) process which is considered preferable in terms of nutrients retention. Thus this study aims to evaluate the physico-chemical properties of pregelatinized flour of germinated brown rice cv. KDML 105.

**Materials and Methods**

*KDML* 105 brown rice was germinated according to the method of Khampang et al., 2009 with a slight modification. Brown rice was soaked in water at room temperature until the root of rice was long for 0.5-1 mm. Germinated brown rice was dried at 55°C for 10 hrs, ground to flour in a grinder and passed through a 300 µm (50 mesh) screen. After that germinated brown rice flour was mixed with water at ratio of 3:1, 2:1 and 1:1. The mixtures were heated at the temperature of 60, 80 and 100°C. The influence of flour: water ratio and temperature in pregelatinization process on physico-chemical properties of pregelatinized germinated brown rice flour was investigated. Vitamin B1 and GABA were analyzed according Liu et al. (2002) and Kitaoka and Nakano (1969). Pasting properties were determined by using RVA. Swelling power and solubility were determined by the method of Schoch (124) and Unnikrishnan and Bhattacharya (125).

**Results and Discussion**

GABA content in germinated brown rice and pregelatinized flour was 19.54 and 19.13 to 19.93 mg/100 g (dry basis). GABA content of pregelatinized flour from all conditions was not difference from the unprocessed germinated brown rice flour (Figure 1). This result was similar to the study of Ohtsubo et al. (2005), who reported that the GABA content of extruded germinated brown rice by twin screw extruder at 150 °C was not decreased, compared to unprocessed germinated brown rice. Hayakawa et al. (2004) pointed out that GABA can withstand temperature exceed than 135°C. In this study the temperature was between 60-100°C, which was lower than previous reports, thus GABA was not destroyed. Vitamin B1 content in germinated brown rice and pregelatinized flour was 0.6448 and 0.5123 to 0.6497 mg/100 g (dry basis). Increasing the temperature caused losing the vitamin B1 content. Vitamin B1 content in pregelatinized flour produced at 60°C was similar to the unprocessed flour but when the temperature was increased to 80 and 100°C, the vitamin b1 was decreased. Highest reduction was found in pregelatinized flour produced at 100°C (Figure 2). In this study, water content of flour had no effect on the reduction of vitamin B1. Even though the extrusion is a high temperature short time (HTST) processing, but vitamin B1 is one of the most unstable B vitamins, the temperature of 70°C can destroy this vitamin (Asadullah et al., 2010). Pasting temperature of pregelatinized flour was decreased apparently. At 80 and 100°C, pasting temperature was reduced to 50°C which was lowest. Peak viscosity and final viscosity of pregelatinized flour also decreased (Figure 3, 4 and 5). This is due to the fact that when starch granule was heated with water, swelling, granule rupture, crystallinity loss and amylose leaching were occurred, and thus pregelatinized flour could absorb water and raise viscosity instantly. Consequently, when the pregelatinized flour was reheated, it caused a decrease in paste viscosity (Musiliu and Oludele, 2009). The pregelatinized starches showed higher swelling ability and percentage of solubility than the unprocessed starches (Figure 6 and 7). This effect is due to disruption of the starch granule
during pregelatinization (Chinnasarn and Manyasi, 2010). In this study increasing the temperature and water during pregelatinization caused higher swelling ability due to high temperature caused destruction of hydrogen bond and moisture content acts as a plasticizer, which reduces the degradation of starch granules, leads to an increased capacity for water absorption therefore the flour had high swelling ability (Hagenimana et al., 2005). Percentage solubility was highest when the lowest temperature (60°C) and highest moisture content (1:1 flour: water ratio) was used. This indicated that the starch granule of pregelatinized flour in this condition had greatest degradation. This outcome was in agreement with Rolfe et al. (2001) who reported that higher barrel temperature diminished solubility.

**Summary**

Pregelatinization by extrusion had no effect on GABA content. Vitamin B1 content was decreased with the increasing of temperature. Pregelatinization caused decrease pasting temperature and viscosity. The pasting temperature of pregelatinized flour (at 50°C) was lowest when barrel temperature was controlled at 80°C or 100°C of all flour: water ratio. Swelling power was increased when the barrel temperature increased. Pregelatinized flour produced from 1:1 flour: water at 60°C had highest solubility.

**Literature cited**


Figure 1: GABA contents of germinated brown rice and pregelatinized germinated brown rice flours.

Figure 2: Vitamin B1 contents of germinated brown rice and pregelatinized germinated brown rice flours.

Figure 3: Pasting characteristics contents of germinated brown rice and pregelatinized germinated brown rice flours at 60 °C.

Figure 4: Pasting characteristics contents of germinated brown rice and pregelatinized germinated brown rice flours at 80 °C.

Figure 5: Pasting characteristics contents of germinated brown rice and pregelatinized germinated brown rice flours at 100 °C.

Figure 6: Swelling power of germinated brown rice and pregelatinized germinated brown rice flours.

Figure 7: Solubility of germinated brown rice and pregelatinized germinated brown rice flours.