

EFFECT OF SOAKING TIME ON GABA CONTENT AND BROWN RICE QUALITY IN THE SOAKING PROCESS OF PADDY FOR GERMINATED BROWN RICE

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ABSTRACT

The objective of this study was to compare the effect of soaking time by 2 methods of grain watering in the soaking process of germinated brown rice, i.e. soaking in stagnant water and circulating water through grains, on the content of Gamma-aminobutyric acid (GABA), root length and brown rice quality (percentage of total brown rice, color difference and yellowness of brown rice). Twelve levels of the soaking time were tested, namely 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44 and 48 hours. The water quantity was set constant at 10 times of paddy by weight. The water temperature was kept constant at 35°C. After soaking, the wet paddy was sacked and kept at room temperature for 30 hours. The Khao Dok Mali 105 rice variety was chosen for this study. The results showed GABA content of paddy rice under circulation method was higher for all soaking times. The higher the soaking time, the higher the GABA content in both watering methods.

Keywords: GABA; Germinated Brown Rice; Brown Rice Quality

INTRODUCTION

Rice is a staple food for half of the world's population [1]. Rice is Thailand's major export crop that plays an important socio-political-economic role in this country [2]. In 2014, Thailand produced a total of 30 million tons. More than 11 million tons of rice (about 180,000 million baht) have been exported with brown rice making up 5 million tons [3].

Germinated brown rice contains nutritional components, such as dietary fibers, minerals, proteins, vitamin B and E, essential amino acids, especially γ -aminobutyric acid (GABA) [4,5]. GABA is a free amino acid widely distributed in nature and is one of the major inhibitory neurotransmitters in the central nervous system [6,7]. It provides beneficial effects for human health such as preventing Alzheimer's disease [8] and controlling stress [9]. Germinated Brown rice is produced by soaking brown rice in water to initiate germination, and GABA accumulates during the process [10,11].

At germination stage, paddy rice seed produces phytochemicals that are essential for human health. One way of value added concept for rice production is to germinate paddy rice grain to increase nutritional quality before selling. Typical method of soaking paddy grain in stagnant water for 1 to 2 days has been employed for germination. Water flowing through rice grains instead of being stagnant may increase its nutritional quality. To the authors' knowledge, the effects of soaking method and time in the soaking process of germinated paddy on gamma aminobutyric acid (GABA) content and brown rice quality have never been studied. The objective of this work is therefore to study the effect of soaking methods and time on GABA content and properties of germinated brown rice.

MATERIALS AND METHODS

The testing unit consisted of a chamber to contain whole rice, a water storage tank, a pump, and a temperature control device. The

pump circulated water from the storage to the temperature control device, then to the whole rice chamber and forced the outflow back to the storage tank. Water temperature and the temperature and relative humidity of ambient air were recorded by automatic data logger.

The Khao Dok Mali 105 rice variety was chosen for this study because it is one of the most popular varieties in Thailand. It was harvested in 2012, from Khon Kaen province, Thailand. Averages of some properties of rice before testing were as follows: grain moisture content of 11.15% (wet basis), germination rate 69.20%, GABA content 1.60 mg/100g dry matter, percentage of total brown rice 73.50%, percentage of whole grain brown rice 85.85%, yellowness of brown rice 21.38, bulk density of paddy 538.16 g/l and average weight of 1,000 kernels of 26.26 g.

Before testing, the paddy was cleaned 3 times by a seed cleaner [12] with a blower air velocity of 6 m/s. The 2 sets of the cleaned paddy, 3 kg each, were used for testing, one for normal soaking and the other with water circulating. The circulation rate was set constant by the inflow valve at 3 l/min/kg of paddy. Twelve levels of the soaking time were tested, namely 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44 and 48 hours, for both methods of soaking and circulating. The water quantity was set constant at 10 times of paddy by weight. The water temperature was kept constant at 35°C. After circulating/soaking, the wet paddy was sacked and kept at room temperature for 30 hours. Traditional soaking and circulating water methods were carried out as shown in Fig. 1.

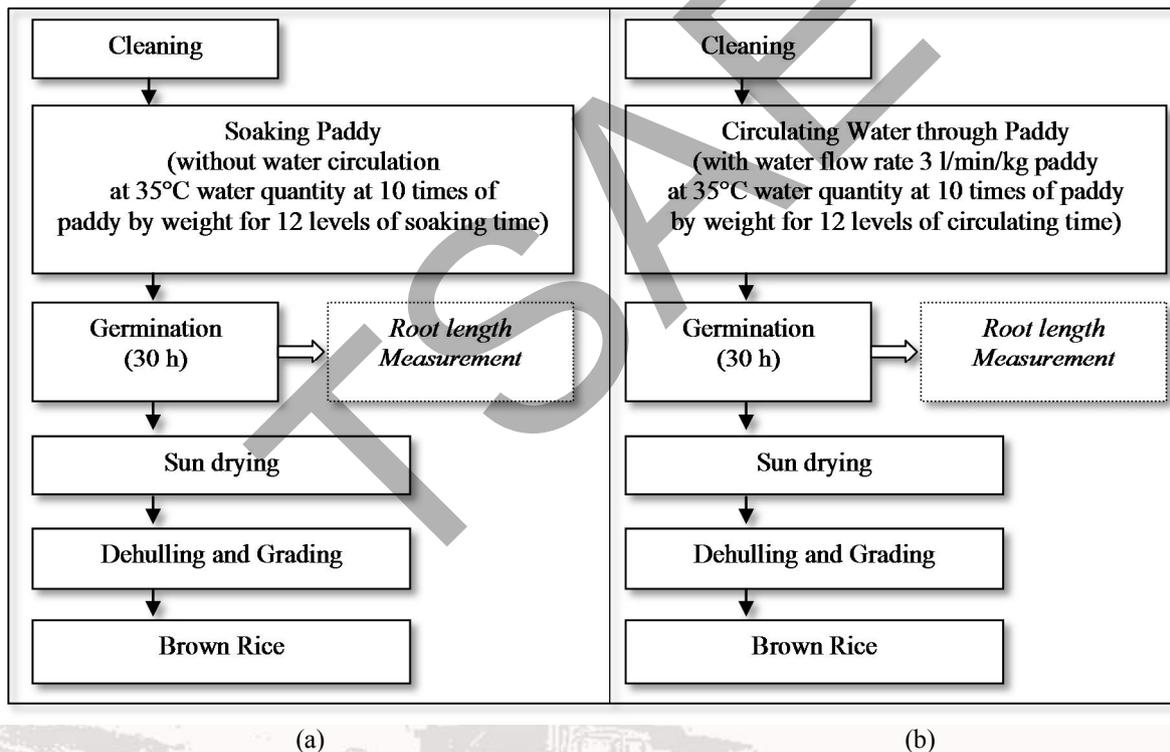


Fig.1 Production with (a) stagnant soaking method, and (b) circulation soaking method.

After testing, 100 grains of germinated rough rice were measured for the root length with 500-171 Absolute Digimatic Caliper (Mitutoyo, Japan) for 3 replications. Then dehumidification of the germinated rough rice occurred until achieving less than 14 % wb by sun drying [13]. The dried germinated rough rice was dehulled with THU35B Testing Husker (Satake, Japan) and graded with TRG05B Testing Rice Grader (Satake, Japan) for 3 replications. Brown rice colors consisting

of the color difference and the yellowness, were measured using a CR-10 Color Reader (Konica Minolta, Japan) to obtain the color values (L^* , a^* and b^*) for 9 replications, which L^* representing lightness, a^* redness/greenness and b^* yellowness/-blueness ($*$ after L , a and b are according to Commission Internationale d'Eclairage which are derived from L , a and b) [14]. The color difference (ΔE) could be determined by Eq. 1 [15].

The GABA content was determined using High Performance Liquid Chromatography (HPLC) technique, following the method of Lin and Wang (1980) [16], by Co-Ordinate Laboratory and Academic Service, Faculty of Pharmaceutical Sciences, Khon Kaen University, Khon Kaen, Thailand. The GABA quantity was reported as an average value from 9 replications.

RESULTS AND DISCUSSION

The effects of soaking time and soaking methods on the properties of germinated brown rice were compared by considering mean values in Table 1, consisting of the content of GABA, root length, percentage of total brown rice, color difference and yellowness.

The results indicated that the amount of GABA content increased as the soaking time increased and the circulation soaking method gave higher GABA content (Fig.2).

maximum content of GABA was 14.67 mg/100g rice at the highest soaking time of 48 hours. The highest GABA content resulting from the stagnant soaking method was 8.61 mg/100g rice. The root length from the circulation (10.50 mm average) was longer than that from the stagnant method (1.66 mm average) (Fig.3). Therefore germination rate of circulation method was higher than that of stagnant method. And this may be the reason for higher GABA of circulation method.

The percentage of total brown rice from the circulation method (average value of 73.24%) was slightly less than for the stagnant one (average value of 75.33%). The color difference of brown rice did not change with both soaking methods. The yellowness of brown rice from the circulation method (average value of 21.53) was slightly less than for the stagnant method (average value of 22.07).

Table 1 The comparison of germinated brown rice properties for 2 watering methods and 12 levels of soaking time.

Soaking Time (hr)	Measured Properties									
	GABA (mg/100g rice)		Root Length (mm)		Total Brown Rice (%)		Color Difference		Yellowness	
	Soaking	Circulating	Soaking	Circulating	Soaking	Circulating	Soaking	Circulating	Soaking	Circulating
4	1.68 ^a	2.56 ^b	0.04 ^a	0.48 ^b	75.76 ^a	74.93 ^a	1.87 ^a	2.74 ^a	21.69 ^a	22.07 ^a
8	2.33 ^a	3.96 ^b	0.31 ^a	1.27 ^b	75.61 ^b	74.98 ^a	4.76 ^a	3.05 ^a	21.77 ^a	21.90 ^a
12	2.92 ^a	7.76 ^b	0.48 ^a	4.13 ^b	75.40 ^b	74.98 ^a	2.58 ^a	3.46 ^a	21.63 ^a	21.89 ^a
16	5.36 ^a	5.61 ^b	1.20 ^a	5.78 ^b	75.58 ^b	74.73 ^a	2.63 ^a	3.61 ^a	21.99 ^a	22.47 ^a
20	4.72 ^a	5.97 ^b	1.38 ^a	5.91 ^b	75.33 ^b	73.30 ^a	3.49 ^a	3.37 ^a	21.19 ^a	22.53 ^b
24	4.61 ^a	7.34 ^b	1.73 ^a	8.14 ^b	75.19 ^b	73.96 ^a	4.50 ^a	3.56 ^a	21.68 ^a	22.53 ^b
28	5.49 ^a	7.87 ^b	2.36 ^a	11.29 ^b	75.22 ^b	73.15 ^a	4.12 ^a	3.65 ^a	21.50 ^a	21.77 ^a
32	5.75 ^a	6.59 ^b	2.45 ^a	13.84 ^b	75.07 ^b	72.50 ^a	4.96 ^a	4.58 ^a	21.26 ^a	22.00 ^a
36	4.36 ^a	10.04 ^b	2.20 ^a	17.28 ^b	75.41 ^b	72.93 ^a	4.16 ^a	3.46 ^a	21.06 ^a	22.27 ^b
40	4.91 ^a	9.15 ^a	2.31 ^a	17.71 ^b	75.33 ^b	72.41 ^a	3.46 ^a	3.22 ^a	21.41 ^a	21.61 ^a
44	6.35 ^a	11.33 ^b	2.59 ^a	18.77 ^b	74.82 ^b	71.04 ^a	4.47 ^a	3.92 ^a	21.58 ^a	22.03 ^a
48	8.61 ^a	14.67 ^b	2.83 ^a	21.44 ^b	75.30 ^b	69.99 ^a	2.61 ^a	3.52 ^a	21.63 ^a	21.74 ^a

Means with different superscripts in the same row for each property are significantly different by Least Significant Difference ($p < 0.05$)

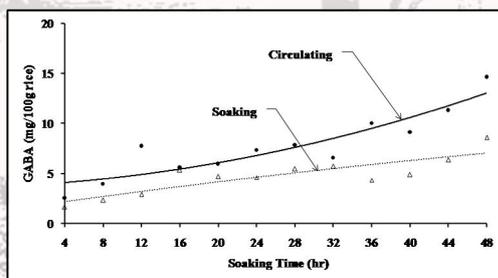


Fig. 2 Relationship between soaking time and GABA.

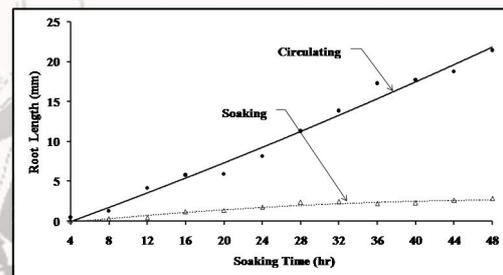


Fig. 3 Relationship between soaking time and root length.

CONCLUSIONS

Two soaking methods, stagnant and circulation, for producing germinated brown rice were tested for Khao Dok Mali 105 variety. Twelve levels of the soaking time were used for each method, namely 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44 and 48 hours. The circulation rate was constant at 3 l/min/kg of paddy and no flow for stagnant method. It was found that the GABA content was higher when the soaking time was longer. The circulation method gave higher GABA content for all soaking duration. The average paddy root was also longer for the circulation technique, whereas the percentage of total brown rice and the yellowness of brown rice were slightly less. However, the color difference of brown rice did not change with treatments.

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