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Survey of the material and the factors affecting the process of malt production from sticky black rice

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Abstract

Glutinous black rice, also known as sticky black rice, is the unpolished, whole grain of traditional sticky white rice containing a lot of nutritious elements such as amino acids, minerals and antioxidants. In this study, we carried out the survey to identify the effects of materials and technical factors affecting to malting process for application of black glutinous malt to nutritious drink, especially fermented drink. The glutinous black rice material was examined moisture content, length of grain, germinating capability, impurity ratio, total soluble protein and sensory characteristics. Our study on soaking process for producing glutinous black rice malt indicated that moisture content: 11.70%; cross weight: 21.50 g / 1000 grain; impurity: 2.12%; length of grain: 7.40 mm; protein: 8.90% N; glucid: 76.50%; decay: 0%; germinating capability: 95.40%; characterized color of black sticky rice, no bad smell, no mold smell. The highest germinating moisture content of grain was 38.67%; soaking temperature 30 °C in 72 hours and the ratio of material: solvent 1:3.

Keywords: sticky black rice, nutritious element, malting process, fermented drink.

1. Introduction

Cereal is a source of abundant energy to the body and in particular the type of color makeup use value because the benefits to health that they bring about. Black rice is an heirloom variety of rice that contains high levels of pigments, which make each grain appear dark purple to black in color. Though the rice has been cultivated for years, black rice is gaining popularity in Vietnamese market place as an alternative to white rice due to its nutritional benefits. Consuming black rice provides your body with a number of nutrients, including some compounds not found in white or brown rice. Black Glutinous rice grains are purple-black from the outside until the bowel of rice, intriguing taste special, different from a variety of glutinous rice usually. In the sticky black rice contains about 75% of starch, with a very high mineral content, rich in amino acids that specifically contain large amounts of anthocyanins with the antioxidant effect good for the health of users [1, 5, 7, 8].

Ulaiwan Usansa *et al.* (2009) showed the influences of steeping duration and temperature on the α - and β -amylase activities of six Thai rice malt cultivars (*Oryza Sativa L. Indica*). A preliminary study of malting conditions for six Thai rice cultivars was conducted. Three non-glutinous rice cultivars (KDML105, PT60, and WR) and three glutinous rice cultivars (SPT, RD6, and KND) were selected. The steeping durations (24, 48, and 72 h) and temperatures (20, 25 and 30°C) were investigated for their effect on α - and β -, the key enzymes for malt quality evaluation. During steeping, the production of both enzymes was lower than at the germination process. The longer the steeping duration, the lower the maximum β -amylase activity obtained. The contradictory effect was observed for α -amylase activity, near the end of the germination time. Additionally, temperature influenced the water absorption content as well as the amyolytic enzyme activity. Particularly at 30 °C, the maximum β -amylase activity (6.7 unit/mg protein) was found in KND malt steeped for 24 h, and maximum α -amylase activity (20 unit/mg protein) was found in PT60 malt steeped for 72 h. The amount of enzyme production depended on the variety rather than the amylose content in the rice. The optimal condition for malting rice regarding β -amylase activity and α -amylase activity was analyzed at 30 °C, with steeping for 24 h and germination for 4–5 days [9].

Ulaiwan Usansa *et al.* (2011) optimized of malting conditions for two black rice varieties, black non-waxy rice and black waxy rice (*Oryza Sativa L. Indica*). Two black rice varieties, “black non-waxy” and “black waxy”, were investigated as possible raw materials for the at

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three levels: adjustment degrees of steeping were 38, 41, and 44%, germination times were 6, 7, and 8 days, and the temperatures were 20, 25 and 30 °C. At the end of the germination process, all samples were kilned at 50 °C for 24 h, and shoot/rootlets were removed before a detailed quality assessment was performed. Data analysis was performed using the Design Expert Statistic Program. The optimal conditions found for both rice varieties were as follows: germination time of 8 days at 30 °C and 44% grain moisture. Although the extract yield, and α -amylase and β -amylase activities of both rice malts were lower than barley malt, the higher activity of limit-dextrinase enzyme and apparent attenuation limit (AAL), which was higher than 80%, suggests that rice malt has potential for use in brewing [10].

Heidi Mayer *et al.* (2014) studied production of a scarifying rice malt for brewing using different rice varieties and malting parameters. This study was conducted to produce rice malt suitable for beer brewing. An all-rice beer would be particularly appealing to individuals with celiac disease because rice does not contain gluten proteins. Furthermore, rice malt could also contribute to new beer flavors and brands. A screening of 10 rice varieties was conducted. The varieties Balilla and Centauro were found to be suitable for the production of an all-rice malt beer without the need of exogenous enzymes. They were characterized by a low diastatic power but nevertheless they saccharified well, likely due to other endogenous amylolytic enzymes such as limit dextrinase and α -glucosidase. The addition of CaCl_2 and lactic acid during mashing lowered the pH value and increased saccharification. However, the Balilla variety saccharified without the need of these additives. We also show that the soluble nitrogen and free amino nitrogen content of rice malt wort can be increased by the incorporation of the acrospires and rootlets during mashing [2].

In preparation for the development of products from this source material, original research we surveyed the only digest the storage of raw materials and the effects of the conditions of germination in the creation process of glutinous black rice malt.

2. Material and Methods

2.1 Raw material

Glutinous black rice varieties (*Oryza Sativa* L.) was purchased at plant protection station in the Vinh Hung district, Long An province ; cultivated fields of Long An province in the Mekong Delta, Vietnam [3, 4, 6, 7, 8].



Fig 1: Glutinous black rice

2.2 Research method

2.2.1. Survey the physiochemical characteristics of glutinous black rice grain

To ensure quality and stability of material before malt production, glutinous black rice grain should be carefully examined.

2.2.1.1. Determine moisture content of grain

Moisture content measurement method under Nzelibé and Nwasike. Weigh approximately 20 g of seeds and finely. Mix carefully to get 5 g dry clean cup to know in advance the weight. Cover and weight to weight with an accuracy of 0.001 g. open lid and place into the installed drying temperature 105 °C start timing when drying reaches temperatures above. Drying for 3 hours taking the cup off the cooling equipment of room temperature for about 20 minutes and then weigh. Drying time 1 again again and again with an accuracy of 0.001 g.

Moisture content of grain:

$$W = \frac{m_1 - m_2}{m_2} \times 100, \%$$

2.2.1.2. Determine length of grain

Weight 20 g samples of rice grain 50 randomly bring peeled. Use a caliper to measure the length 50 grains of rice to flip and then calculate the average length of a grain of rice. The measure is divided into the smallest rate by 0.01. Length of grain is determined as following formula: $l = L/50$, (mm) Whereas: l is the average length; L is the total length of 50 grains.

2.2.1.3. Determine cross weight of grain

Absolute volume is determined by count and weight of 1000 seeds. After having sampled medium stir cubes peeled repeatedly staging all over the tray. Use the rod wiper blades 2diagonals. Accurate counts in the first triangle 2 250 grain and then included in 250 counties in the triangle area, is the mass of the particle is 500 ml (g). Do the same with the remaining two opposite triangles to be m_2 (g). If the difference between two results of 2 samples of 500 grains does not exceed 5%, then accept the return in excess of 5%, then to proceed again.

Cross weight of grain:

$$X = (m_1 + m_2) * (100 - W) / 100, (\text{g}/1000 \text{ grain})$$

Whereas: X : weight of 1000 grains; m_1 , m_2 : weight of 500 grains; W : moisture of grain.

2.2.1.4. Determine germinating capability of grain

Germinating capacity is determined by the method of Aubrey. Put 2 sheets of filter paper to apetri for 100 grains should analyze on staging are then sealed the lid to avoid moisture escape. For exactly 8 ml, 4 ml of water into the cover and fasten the lid to avoid evaporation of water and sealed in plastic bags. To sample in a chamber temperature of 20 °C. After 24 hours, 48 hours, 72 hours, since the start of experiments taking out counting the seeds have germinated this and removed immediately. After each take the sealed bag to leave. The seeds have germination is defined as follows: open the cover plate and remove the seeds have germinated and signs have germinated when visible sprouts or root. If not found then sprouts treated as counties have yet to germinate.

Germinating ratio after 72 hours soaking:

$$\text{Germinating ratio} = \frac{n_{24} + n_{48} + n_{72}}{400} \times 100, \%$$

Where as n_{24} , n_{48} , n_{72} are germinated grains in 4 Petri dishes after 24, 48, 72 hours.

Mean germinating time, MGT:

$$\text{MGT} = \frac{n_{24} + 2 \times n_{48} + 3 \times n_{72}}{n_{24} + n_{48} + n_{72}}$$

Speed of germination = 10/MGT.

2.2.1.5. Analyze physicochemical parameters

- Impurity is identified by visual and screening;
- Decay is identified by visual;
- Total protein is identified by Kjeldahl method;
- Color and flavor is identified by sensory evaluation TCVN 594 – 2004.

2.2.2. Different factors affecting to malt germination

2.2.2.1. Effect of glutinous black rice: solvent to malt germination: Experiments in order to find out the ratio of raw material and water soaked optimum but still ensure sufficient absorbent granules.

Survey sample mass is 100 g with initial raw material humidity is 11.7%. The ratio of change in turn is 1: 2; 1: 3; 1: 4; 1: 5; in certain conditions, the water temperature is 30 °C immersion, immersion time 12 hours, stirring the mix 30 minutes at a time. Humidity measurement conducted 4 samples after every 2 hours.

2.2.2.2. Effect of soaking time to malt germination

Experimental survey of seed soaking time to reach moisture to germinate. Survey sample mass is 100 g with initial humidity is 11.7%. Soaking time prospecting in turn is 12 hours, 24hours, 36 hours, 48 hours, 60 minutes, 72 hours; in certain conditions, the water temperature dipping 30 °C, the ratio of ingredients: solvents retrieved results from experiments on the mixing conditions, 30 minutes at a time. Moisture was determined after every 12 hours

Data were processed statistically using the Stat graphics software 3.0.

3. Results and Discussion

3.1. Physicochemical characteristics of glutinous black rice material: Through table 1, we find: the moisture of wheat by 11.70% moisture is safe to preserve seeds, at room temperature, aeration is not perverse phenomenon occurs. The absolute mass of the higher the rice endosperm ratio as much leverage ratio of raw materials in the manufacture of larger. The absolute mass of the grains of glutinous black rice is lower than the absolute volume of rice, blue (33-37 g/1000 seeds) should the ratio of disposed of glutinous black rice is higher than the remaining rice. Raw glutinous black rice used in the experiments was the same rice bought in plant protection Stations Vinh Hung district, Long An province should the ratio of impurities (sand, stone, gravel, straw, grain, nuts ... the half empty) was 2.12% demonstrates a relatively clean fuel. Black glutinous rice with protein ratio 8.90% in humidity 11.70% higher than ordinary rice (5.8%-7.7% in humidity 14%). Glutinous black rice when removing layers of husk, grain of rice black-purple flip (science has proven this bold colours, the iron content and the higher the anthocyanin) this is also the prominent characteristics of the varieties of glutinous rice paddy is often compared to black. Based on the classification

according to grain length TCVN 592-2004 black glutinous rice grains, length is 7.4 mm shall be classified as very long grain rice. Black Glutinous rice harvest has not long ago should not have damaged phenomenon of color odor, retains the color characteristic smell of raw materials.

Table 1: Physicochemical characteristics of glutinous black rice material

Parameter	Result
Moisture (%)	11.70
Cross weight (g/1000 grain)	21.50
Impurity (%)	2.12
Length (mm)	7.40
Protein (%N)	8.90
Glucid (%)	76.50
Decay (%)	0
Germinating capability (%)	95.40
Color of glutinous black paddy	Characterized color of paddy
Color of dehusked unpolished glutinous black rice	Black pink color
Color of polished glutinous black rice	Dark black color
Smell	Special flavour of paddy, no strange smell or mold smell.

3.2. Different factors affecting to germinating malt.

3.2.1. Effect of material: solvent to germinating capability of glutinous black rice

Table 2: Effect of material: solvent to germinating capability of glutinous black rice

Glutinous black rice: water	1 : 2	1 : 3	1 : 4	1 : 5
Moisture after soaking (%)	15.12 ^b	17.08 ^a	17.27 ^a	17.45 ^a

a, b: performed the differences of the values in the same row with 5% significance level.

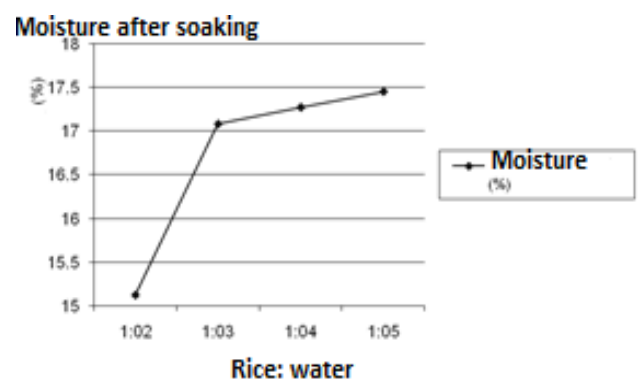


Fig 2: Effect of material: solvent to germinating capability of glutinous black rice

By table 2 & figure 2, the results showed: in rice ratio: water immersion is 1: 2, the moisture after dipping as low as the water penetrates the pod into the little particles lead to low germination capacity. In the ratio of rice to water: soak 3 is 1: 1:1, 4, 5 then the moisture gain after soaking is the largest difference and no statistically significant at the 95%probability level. So we chose rice ratio: water immersion is 1:3 for the next survey.

3.2.2. Effect of soaking time to germinating capability of glutinous black rice

Table 3: Effect of soaking time to germinating capability of glutinous black rice

Soaking time (hour)	12	24	36	48	60	72	84
Moisture after soaking (%)	17.03 ^f	26.67 ^e	27.74 ^d	30.21 ^c	34.12 ^b	38.67 ^a	38.69 ^a

a, b, c, d, e, f: demonstrated the differences of the values in the same row with 5% significance level.

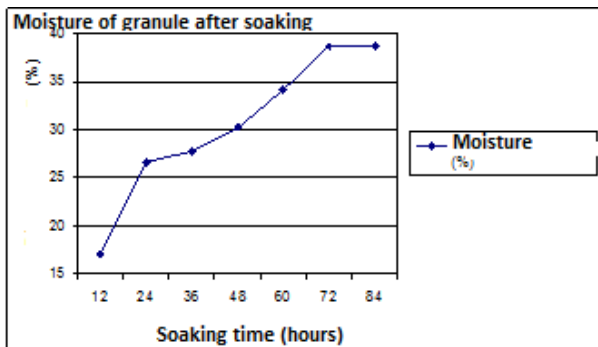


Fig 3: Effect of soaking time to germinating capability of glutinous black rice

By table 3 & figure 3, the results show: raw rice with moisture 11.70% during the soak water penetrates the pod in amount of water as rice grain in grain increases. The humidity of the ascendant in the 72 hours of soaking, after 72 hours soaking seeds cannot-add water freely from outside humidity of constant beads. Humidity of grain rose rapidly from 0 to 24 hours immersion at the time. The moisture of the seed falling slowly from 24 hours to 72 hours of soaking. After 72 hours of soaking humidity of grain rose insignificant. So we chose rice soaking time is 72 hours and the maximum humidity that peeled-38.67% is.

4. Conclusion

The production of a rice malt could be used as an ingredient in gluten-free foodstuffs, especially for brewing purposes. The endogenous enzymatic activities developed during the malting process and which characterize the diastatic power of the obtained rice malts. The conditions of the malting process were checked and optimized to produce rice malt with the desired color and aroma. Enzymes found in germinating rice also play important roles on starch and protein digestion. Since enzymes are protein, concerning of cereal protein and enzyme production in malting process should be emphasized in upcoming researches.

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