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Nutritional powder produced from sticky black rice malt

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Abstract

In the study of nutritious powder process from the dried black glutinous malt, we studied conditions of the stages of soaking, steaming and drying. The results showed that: the ratio of malt and soaking water 1:1 in 20 minutes indicated the highest humidity of malt at 36.41% and the lowest loss level of total dry content and high remaining anthocyanin 17,12mg/g; the steaming temperature 100 °C in 20 minutes indicated the best sensory evaluation of ripeness level of malt and low level of anthocyanin; the drying temperature 60 °C in 190 minutes indicated the lowest remained humidity of dried malt at 5,393%, the high remained anthocyanin quantity and good sensory evaluation of dried malt. The ratio of hot water and the dried malt flour used to reabsorb the flour best was 4:1.

Keywords: soaking, steaming, drying, dried black glutinous malt, nutritious powder

1. Introduction

1.1 Sticky black rice

Paddy (*Oryza sativa* L.) is the major food crop of more than half the world's population. About 20 species of *Oryza* were aware, nearly all the rice grown is *Oryza sativa* (Juliano, 1993). Glutinous black rice scientific name *Oryza sativa* L. glutinosa Tanaka, on plant taxonomy, plant rice in the *Gramineae* (Peace Conference), tribe *Oryzaceae*, genus *Oryza*. Glutinous black rice species have spend quite long (6 months), consistent with the high ground dry and ventilated. Rice coal was one of the types of rice had black brown husks, grains of rice after the shell dissection will see purple black, depending on the maturity of the seed that violet can be dedicated to grain.



Fig 1: Sticky black paddy rice field



Fig 2: Raw sticky black rice

1.2 Anthocyanin

1.2.1 Structure of anthocyanin

Black purple sticky rice is given by anthocyanin which helps blood circulation, and is an antioxidant inhibits the aging. Anthocyanin is a polyhydroxy derivatives and methoxy of flavylum. When heat the anthocyanins in aqueous HCl 20%, the sugar in the molecule (usually connected to the OH in C-3) was cut and the aglycone is called anthocyanidin. The food is popular anthocyanidin 6 (pelargonidin, delphinidin, petunidin, peonidin, cyaniding, malvidin), it's different because of the hydroxyl and methoxyl turned round b. Anthocyanin is the glucoside of root galactose by glucose, sugar, ... in combination with aglucon original colour (anthocyanidin). The original road can be attached in position 3, 5, 7 are often tied in position 3 and 5 and 7 positions are few. Anthocyanin molecules attached placement input line 3 above, is called monoglycoside 3 and 5 called diglycoside. The aglycone of anthocyanins is different because the group attached to the location of the R1 and R2, usually H, OH or OCH3.

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1.2.2 The factors affecting the anthocyanin

Temperature: the temperature increase will lead to the change of maximum absorption, the color of anthocyanin also decreases as temperature increases. pH: the pH is too high or too low will lead to the degeneration of anthocyanins coloring, the effectiveness of these pigments are maximum at pH = 3.5. Storage time and lighting: increase the storage time, the anthocyanin pigments are reduced and when preserved in different environmental conditions also affect the pigment anthocyanin. Storage time and direct lighting effects on the stability of anthocyanin. Researchers have argued that holding pattern outside the light, then the concentration of the pigment slumped over in the dark. Other factors can also affect anthocyanin color as the concentration of the pigment combined with anthocyanin, relative proportions in the mixture of anthocyanins, the influence of other pigments, such as carotenoids, chlorophyll.

1.2.3 Properties and application of anthocyanins

Anthocyanins are absorbed in the wavelength region visible, maximum absorption at wavelength 540nm ÷ 510. Absorbance is closely related to the color of the anthocyanins they are dependent on the pH of the solution, the concentration of anthocyanins; usually pH in strong acid has a large concentration of anthocyanins absorb the greater the absorbance as strong. In the food coloring substances of natural origin, anthocyanins is the most common color they exist in most higher plants and is found in some vegetables, flowers, fruits, seeds, red to purple fruit such as strawberry, purple cabbage, leaf, flower hibicut, black beans fruit, eggplant, sticky rice, rice coal company. Anthocyanins are water-soluble pigments, color of anthocyanin is determined by the chemical structure and the external environment. Two different anthocyanins for the same color or two identical anthocyanins to different colors. When increasing the number of hydroxyl groups onto the molecule will make it turn from red to green. Change of hydroxyl groups by methoxyl group will do the opposite tendency to change color. At low pH, anthocyanins are red often become colorless at pH higher than the blue at pH higher. In addition to the effects of natural pigments are used quite safe in foods, creating more attractive colors for each product, anthocyanins also compounds are more active you like: high antioxidant capacity should be used to fight aging, antioxidant or food products limited, a decrease in resistance; has the effect of making durable vascular, anti-inflammatory,

limiting the growth of the cancer cells; against these radiations. A new study by Professor David Capuzzi Medical Center in the Jefferson Myrna at stay there America shows that anthocyanins in red rice uses falling 45% recycling rate of cardiovascular complications, helping approximately 33% of cardiovascular patients avoided death after 5 years of use when for cardiovascular patients taking a drug known as Xuezhikang, are manufactured from red rice. Scientists at Louisiana State University research suggests antioxidants make this darker will "sweep" clean harmful molecules, which help protect the circuit and prevent the DNA damage that may lead to cancer. Valuable properties of anthocyanins which chemical pigments, other pigments Figure into during machining techniques do not have to be opened up a direct application of anthocyanins coloring compounds taken from nature into everyday life, especially in the food processing industry. That's a perfect fit with the current trend of the world is to study the extraction of pigments from nature for use in food, because they have high safety for the user (Tran Thi Hong Truc, 2008; Huynh Kim Cuc, 2010)

1.3 Malt

Rice seeds when ripe and has dried moisture content of mineral medium 13-14%. In this condition, it has a very low metabolic activity. When humidity increases, the aleuron layer moisture stimulate the cells that secrete the enzyme hydrolysis as amylase, protease, phytase and ribonuclease (Eugene, 1982). In the course of sprouts, nuts-fast water, the enzymes are activated, increased respiratory rate, start using the substances reserved and appear roots sprouts. This process is referred to as the sprouts (King, 1989; Swift and O'Brien, 1972). Throughout the course of sprouts, casts get the nutrients of endosperm through epithelial layer to grow. The contact with moisture as the activation of the enzymes that initiate the sprouts. The starch in the vicinity of embryos are hydrolysis into simple sugar used to nourish the embryo. Outside of this enzyme, the hormone also affects the sprouts by affecting the forming amylase in the endosperm (Posner and Hibbs, 1997).

1.4 The process of steaming and drying in the production of nutritional powders

1.4.1 Steaming

When starch in endosperm has absorbed enough of the necessary amount of water, the seeds need to be heat to higher temperatures the temperature of starch to ensure the starch turned entirely starch, making cooked-grain, soft. Physics: the temperature increases, the volume increases the hardness, grains of rice continued to decrease. Grain of rice continues to absorb the water increases its volume. Seed moisture content increased up to about 38% during steaming. Chemistry: water attack on powerful starch granules, break the hydrogen bonds of starch and break the link hydrate, husk starch breaks down starch that turns into a starch (the starch turns). When cooked starch, the temperature at which called at that time, the temperature of starch does not return to its original state again. Microbiology: temperatures climb to destroy some microscopic organisms like the cold, detached works a number of enzymes. Influential factors: material: grain size of starch, amylose and amylopectin ratio, the degree of branching and length of the amylopectin. In addition the level of indoor humidity depends chemistry grain of rice before the outdoor goods. Temperature: outdoor temperature turns the starch of about 60-100 °C, if the temperature is too high will cause the dissolved starch off

into water forming the form of glue, is not conducive to the product structure. Time: time turns the long starch outdoor goods as high, however if too long will adversely affect grain structure, a readily particle breakage. Meanwhile, time is short but appropriate temperature will make the structure rice seed so much better. Pressure: the higher the pressure, the driving force for greater process, water has more energy to penetrate to the inside rice seeds and combine with the starch molecules that help the process of outdoor goods as happens more quickly. Saturated steam is the most common heat environment because it does not lose moisture during reheating (Gariboldi, 1974).

1.4.2 Drying

Drying is the process of using heat to separate the water from the sample material, the water is separated from the sample material under the principle of evaporation or sublimation, in order to reduce the moisture content of the sample, which inhibits microorganisms and some enzymes helps prolong storage time. This process is done due to the difference in water vapor pressure in the surroundings (P_{xq}) and on the surface of moist products (P_{sf}). To make the amount of moisture on the surface of the product evaporate should have provided that $P_{sf} > P_{xq}$. In the process of drying, the steam of the surroundings as much, i.e. P_{xq} rise and humidity of products off to a certain index at reaching equilibrium. When that moisture and $P_{sf} = P_{xq}$ which called the moisture balance. At the moisture balance and drying process stopped. Physicist: about the appearance, size, volume will decrease, Crispy increased ...Chemistry: chemical reactions occur such as the Maillard reaction, oxidation reactions of compounds like anthocyanins and Biology: due to the thermal effect and reduced water activity of the microorganisms is inhibited or destroyed during the drying process. Factors that influence: drying method: depending on the different drying methods on quality of sensory, nutritional products is different. Duration: too long, too short will cause the dark not microbiological safety. Temperature: temperature too high will make burnt particles, if too low will extend drying time, wasting your energy costs (Tran Minh Tam, 2004)

1.5 Studies about sticky black rice

1.5.1 In Vietnam

In 2006, "research using rice malt in the processing of non-alcoholic beverage from ricefield" of Quan Le Ha. Research results show that using malt grains to mashing Cam rice flour in the production of non-alcoholic beverages provided malt: rice paddy field rate is 1: 1; pH 4.7; mashing time 5 hours. Compared to the case using barley malt, malt's translation component and areas containing much more amino acid (15.31 vs. 12.6 mg/l), much more glucose (38.81 than 27.67 g/l), but at least the disaccharide more (60.03 compared with 74.20 g/l). In 1994, the "identification of anthocyanins from *Oryza sativa l. glutinosa* Tanaka" by Pham Thanh Quan. The results showed that 2 major anthocyanins, they contain groups of OH in position C3 of the loop C of flavylum ion, they differ only by the C4 methoxy group at position 1 of round B of flavylum ion.

1.5.2 Other countries

Research in other countries in the world are primarily focused on characterization, the nutrient content in raw materials, yet focused research on application in the food-processing industry from raw materials of fine coal. In 2006, in Thailand have anthocyanin extraction research from sticky

black rice, "Extraction of anthocyanins from Black glutinous rice (*Oryza sativa l.*)", by Duangkamol Luemchan and associates. Results of studies optimal conditions for extraction of coal from the sticky rice anthocyanin is temperature 62 -65 °C in 67-75 minutes, with the rate for rice: water is 1: 3. In 2006, in China there are studies on the nutritional composition of sticky black rice, "A study on special nutrient of purple glutinous rice", by Gu Defa and associates. Research the presence of nutrients especially in sticky black rice as fiber, protein, B vitamins, minerals (Ca, P, Fe, etc.), much higher than ordinary rice and completely beneficial to human health. In 2008, Laos has a study on the characteristics of molecule created the aroma of fine coal, "Chemical and molecular characterization of fragrance in black glutinous rice from Lao PDR", of C. Bounphanousay. This is the first study on the structure and molecular properties of glutinous black rice varieties in Lao. In 2010, in Thailand there is exploitation and application research of antioxidants from black glutinous rice, "Extraction and application of antioxidants from black glutinous rice", by Tananuwong Kanitha and associates. Study on determination of the optimum extraction conditions of anthocyanins and antioxidant of fish oil. Black glutinous rice flour is mixed in the extraction of water for 70% 30% at pH 6.8 delicacy, in 4 hours to bring crude extracts with the highest antioxidant. And the dry content of the supplement to the fish oil is 1000 mg/kg for the antioxidant results well.

The purpose of our research is to build work flow manufacture nutritional powders from malt rice soaking process: prospecting sticky black rice (the influence of the rate of rice malt: water and of soaking time up moisture and anthocyanin content of rice malt), surveyed the steaming process (influence of steaming time to the perception of maturity) drying process, surveys (the influence of temperature and drying time and moisture balance and levels of anthocyanins of rice malt).

2. Material and method

2.1 Raw material

2.1.1 Sticky black rice: Vietnam. The main raw material for the product is rice glutinous varieties *Oryza sativa l. glutinosa* Tanaka bought at the Vinh Hung plant protection stations, Long An province, Vietnam.

2.1.2 Water: meeting standard TCVN 5502:2003

2.1.3 Refine sugar: Use refined sugar is produced at Bien Hoa sugar joint stock company in Bien Hoa I industrial zone, Bien Hoa, Dong Nai, Vietnam.

2.1.4 Kali sorbat: Potassium sorbate is the additive group in additives for preservation, anti-oxidation, stable. The INS: 202, ADI: 0-25 (3742/2001/QD-BYT). Against the decision on the drinking water from the sticky black rice malt products there are 1000 ML: ppm (non-carbonated soft drinks)

2.1 Chemicals & equipments

2.1.1. Chemicals

CoSO ₄ .7H ₂ O	H ₂ SO ₄
Iod solution	HCl
Ethanol	NaOH
Glucose	Phenolphthalein

2.2.2. Equipments

Water bath	Philip mixer
Electric cook	Spectrophotometer UV-VIS
Brix meter	Vaccum filtration
Dry oven	Vaccum packing
Analytical balance	Sterilizer
pH meter	Others.

2.3 Research method

Determination of processing parameters in the soaking, steaming, drying and use of finished products in the build process nutritional powder manufacturing technology from malt rice coal. Construction of malt powder quality standard products. Friction split the pod craft by baseball, ready to blow the clean type pod. Define malt volume shrinkage rate after separation of the shell. Grains of rice after the split pod is given into the basket against a quick shake, rinse in water, dust escaping and surviving pod of floating on the surface, drain waiting for steaming. Quick action limiting the losses of dissolved substances, particularly anthocyanin in water. Check the amount of anthocyanins in the wash. The rice is soaked in water to rice ratio: 30 °C fit enough in time to wet rice in function after immersion is highest and the level of losses of dry substances, as well as anthocyanins is the lowest. Rice, after dipping to stainless steel mesh basket over and give in autoclaves have thermal water in the pot to 100 °C. Steaming lasts until rice reaches maturity, for the best sensory quality and minimize loss of anthocyanins in the process of steaming. Rice was dried at temperatures and times to appropriate moisture balance, at the same time reduce at least the loss of anthocyanins in the rice after drying. Rice drying after offering flour mill ground, sieve sieve hole size 0.1 x 0.1 mm to hit and fineness of the finished malt powder. The packaging used in nutritional powder products have colored type of packaging for the optical block, impervious to gas, sterile and etc (Dong Thi Anh Dao, 2005). Thus malt powder vacuum packing was brought, for the box of paper and stored in a cool place.

2.4 Analyzing method

2.4.1 Quality control of the finished malt powder

- Sensory evaluation of product: TCVN 3215-79.
- Nutritional elements.
- Microbiological indicators, heavy metals and toxins: test according to regulation 46/2007 of the Ministry of health.

Table 1:The indicators examine nutrient content of malt flour products

Indicators	Method
Moisture	Drying at 105 °C to basic weight
Crude protein	Kjeldahl
Lipid	Soxhlet
Glucid	FAO FNP 14/7
Anthocyanin	Color comparison CoSO ₄
Dietary fiber	AOAC 991.43-2010
Vitamin B3	QTTN/KT3 036:2005

2.4.2. Basic standards for nutritional powder

This product belongs to the category of dry food and food nutrition, alternative food specials (with heat treatment before use), based on the analysis results of dry malt ingredients used and the test results the physiochemical,

biological, heavy metals and toxins in accordance with 46/2007 of the Ministry of health, proceed to build the basis for standard products under the guidance of QD 867/1998/QD-BYT

2.4.3. Analysis of physiochemical, sensory uses in research

Moisture:	Drying at 105 °C to constant weight
Dry matter:	Refractometer Atago 0-32%
Amylase activity:	Klimopski and Rozdevic method
Mashing capability:	Le Thanh Mai <i>et al.</i> , 2005
Anthocyanin:	Compare color to CoSO ₄ standard
Extraction recovery:	Weight method
Reduced sugar:	Ferrycyanure
Total sugar:	Ferrycyanure
Sensory evaluation:	TCVN 3215 – 79

2.5 Statistical analysis

Using Statgraphics Plus, Excel softwares to handle experimental data.

3. Result & Discussion

3.1 Effect of soaking to anthocyanin in rice malt

Anthocyanin pigment is soluble in water, immersion mode with surplus ratio in the long run will cause the loss of a lot of anthocyanin in water-soaked.

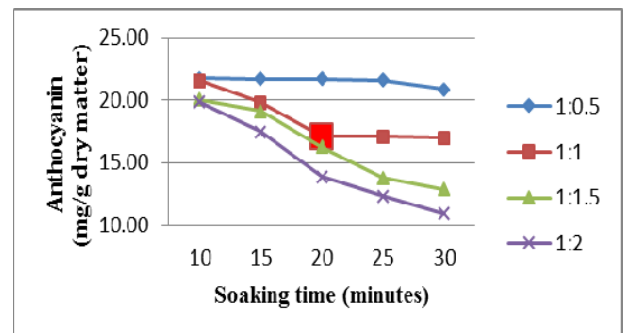


Fig 3: Anthocyanin content variation of rice malt by soaking mode

Based on the survey results, finding that at a proportion of 1: 0.5, the concentrations of anthocyanins virtually unchanged with rice malt initially bring soaked, observed the water soaking too little should be drain on grain. With a 1: 1 ratio amounts falling in the beginning but after 20 minutes of soak amounts virtually unchanged, indicating that at this time, the seeds are almost-shallow water inside should have minimal anthocyanin losses out of solvent soaked excess. Also with the ratio of 1:1.5 and 1:2, the anthocyanin content diminishes over time and the rate of water to soak.

3.2 Effect of soaking to moisture content in rice malt

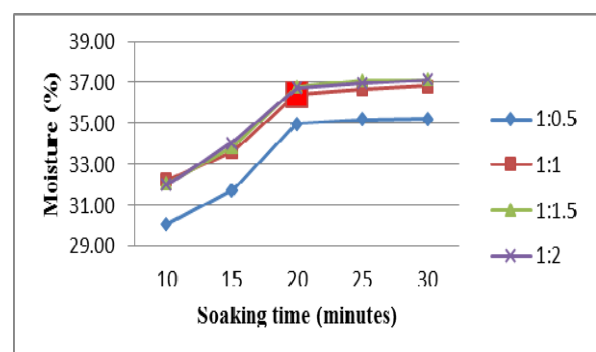


Fig 4: Malt moisture by soaking time

Rice malt has no outer husks crust, the water easily diffuses rapidly into the endosperm particles do increase moisture, easy outdoor goods than paddy. According to Gariboldi (1985), the humidity when soaking rice asked to outdoor goods completely during steaming is about 30%. The following moisture soaking of rice malt by soaking rate shows the moisture of rice malt increases with the rate of solvent and soak time. The results showed that, at the rate of rice malt: water is 1: 0.5 then the moisture after dipping as low as the water penetrates into the starch grains at least leads to low humidity. In the malt ratio rice water-soaked coal: is 1: 1; 1: 1.5 and 1: 2, the moisture is achieved after 20 minutes of soaking, no difference in the statistical significance level of 5%. However, if soaked in water the excess dipping long range will cause loss of solute and anthocyanin in seed. In the same conditions of temperature, longer immersion time, the humidity will rise, because water diffuses into the inside nuts and more, the starch will suck water and Zhang blooms increases the volume, the ability to link between water and starch grains increased humidity makes the sticky black rice malt increases. But when given time to soak the moisture in nuts rise very slowly, no sense in terms of statistics, showed that starch grains were in a State that almost told the peace links. The results showed that the humidity of the grain fades out 20 minutes after 20 minutes of soak, soak beans-add water very slowly from the outside, and the moisture of the seed from 20 minutes to 30 minutes of soaking, the change does not have the difference in statistical significance level of 5%. The survey results the influence of soaking up moisture and anthocyanin content of rice grain to malt mash mode then hit the high moisture content conducive to the process of steaming but reduces at least the loss of anthocyanins is soaked in malt rice ratio: just enough water is 1: 1, in 20 minutes at room temperature will reach moisture is 36.41% and anthocyanin content remaining in the seeds is 17.12 mg/g.

3.3 Effect of steaming to rice malt

Steaming help the turned entirely starch, making steamed-grain, soft, when steaming the seeds need to be heat to higher temperatures the temperature of starch chemistry (Gariboldi, 1974). The temperature of rice starch in the range 70-75 °C, while steaming the minimum ripening for about 15-20 minutes (Nguyen Ba Khoi, 1998). According to Aoto and Associates (2003), the level of gelatin, the best germ rice is 5-50%, better than 5-30% and preferably 10-20%. If the level is less than 5% of rice culture gelatin will have rough state when eating and high rate of cracked when drying. Conversely, if the level of gelatin on 50%, then the grains of rice to stick together making it difficult for the drying and reduces the efficiency of the drying process. In addition, the author also did research and found that steaming at temperatures ranging from 98-180 °C during 3 seconds to 30 minutes is appropriate. If the temperature is lower, the 98 °C time steaming are needed for the gelatin to the desired level lasts, this isn't appropriate in large volumes of industrial production. Conversely, if the temperature of the steaming process is higher than the 180 °C gelatin turns take place too quickly, if done in a short time, the level of irregular goods gelatin, if taken for long periods, the grain of rice will be Zhang bloom. Similarly, if the time steaming is lower than 3 seconds then the level of irregular granules of gelatin. If time steaming last longer than 30 minutes, turned gelatin process takes place too many nuts and the rice will be Zhang bloom. At the same time, the process of hydrothermal processing also helps reduce phytic acid a considerable amount more. Besides, the steaming also loads animated enzymes, inhibit the process of sprouts, help keep the nutrient being transformed again (Ogbonnaya and Friday, 2009). Sticky malt rice coal after soaking are indoor culture do steaming by method of steam in period from 10-30 minutes, helping limit losses and solute to water to cook rice in anhhocyanin concentrations as well as malt if boiled by steaming.

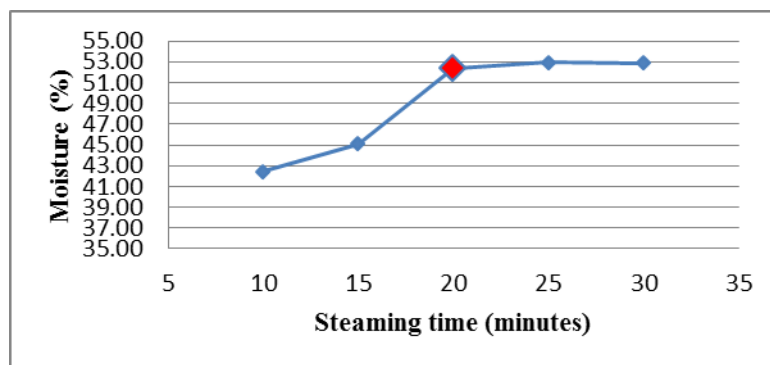


Fig 5: Malt moisture by steaming time

Table 2: Sensory score of cooked malt rice

Steaming time (minutes)	10	15	20	25	30
Sample	201	202	203	204	205
Average score	-0.87 ^a	-0.02 ^b	0.64 ^e	0.54 ^{cd}	-0.33 ^{ab}

Note: a, b, c, d, e, (p < 0.05); meaningful differences

At the same time, the temperature conditions mean to influence steaming humidity and sensory to the maturity of glutinous sticky black rice malt grain after steaming. In the

process of steaming, to outdoor goods, starch grains of rice to absorb the adequate amount of water needed, if not then require steaming during long enough to complete chemical

starch. According to Gariboldi (1985), the moisture required to completely soak the rice chemistry hydrate in order to make the process of steaming is about 30%. Sticky malt rice seed bring steaming with moisture after soaking is 36.41%. So in the process of steaming the moisture of grains increased rapidly from January at 0 to 10 minutes steaming, and many counties have yet to bloom. The moisture of the seed falling slowly from 10 minutes to 20 minutes of steaming later, the seeds from steamed to 20 minutes, are all blooming well. Parnsakhorn and Noomhorm (2008) when making rice steamed after soaking at 100 °C in the period of 10, 15 and 20 minutes, increasing hardness values, capable of absorbing water of rice grains during cooking declining, probably due to the variation of grain starch makes the structure of the grain of sticky black rice should be hard than hard water from entering within the county should increase the slow speed moisture in the seeds after this time. Sensory evaluation results showed that time steaming influence the structure of the product, hence affecting the level of overall favorite products. Color doesn't notice the difference with samples of rice germ does not make the process of steaming because of the characteristic of glutinous black rice grains there are dark red-brown. In the course of sprouts, due to the natural appearance of the enzyme amylase hydrolyzes starch part made up of many different sugars (Kaneko and Associates, 2002) recommended products following rice steaming has sweet taste sticky black rice is cooked from grain of didn't up sprouts. The moisture of the seed from 20

minutes to 30 minutes steaming then there is no difference in the statistical significance level 5%, yet the perception about the maturity model in 20 minutes (203 models) for best results. Rice malt was steaming a 20-minute time period, then the moisture of grains totaled 52.35%; rice seed ripens, blooms are soft and not too Pasty for the best rice quality. So we choose the steaming time for sticky black rice malt 20 minutes.

3.4 Effect of drying

Moisture content of one of the key factors affecting the ability to preserve and crushed rice grains of powder properties. Rice drying process also reduces the moisture content, created the scent for the product longer suspension of enzyme activity, especially the enzyme lipase in the shell that will be inactivated under the effect of temperature, this helps prolong storage time due to product limitations are the OH utility byenzymes (Ogbonnaya and Friday, 2009). Water soluble vitamins are the most heat-poor nutrition, especially B vitamins characteristic of grain (Ronald and Associates, 2008), they are easily destroyed by heat (Steve Blake, 2008). Besides the pigment anthocyanin also suffered increases in the temperature handle. Therefore, the higher the drying temperature of anthocyanins and losing more and more. Statistical processing results from the variation of moisture by the time the rice drying malt at each temperature, draw the graph represents the respective drying process as follows:

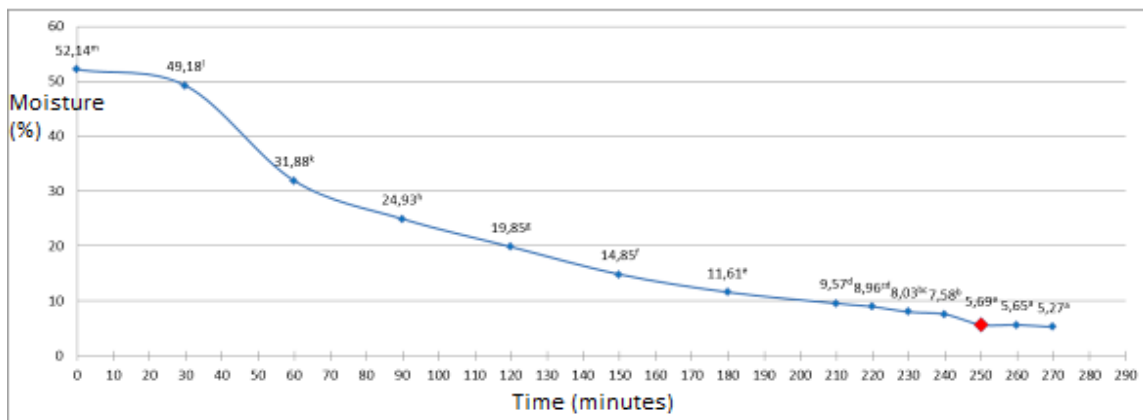


Fig 6: Moisture content by time when drying rice malt in 50 °C

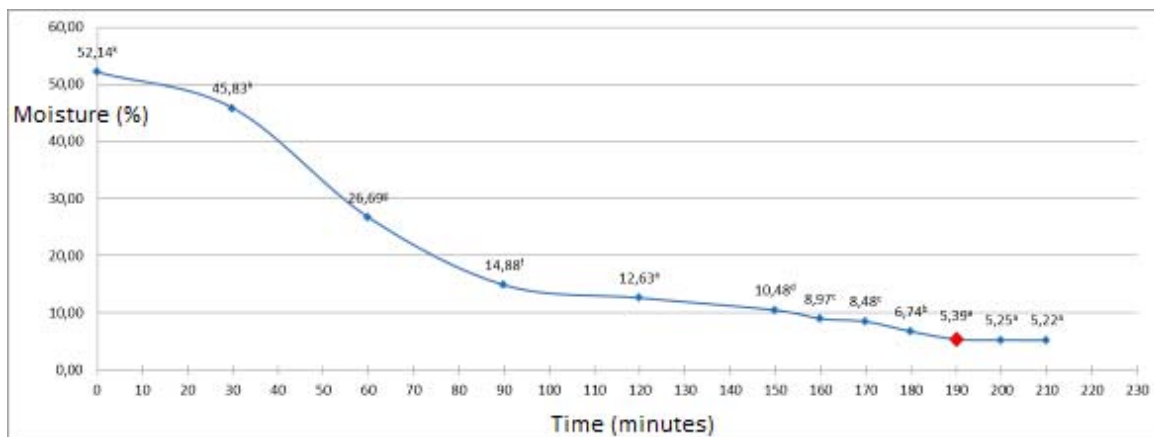


Fig 7: Moisture content by time when drying rice malt in 60 °C

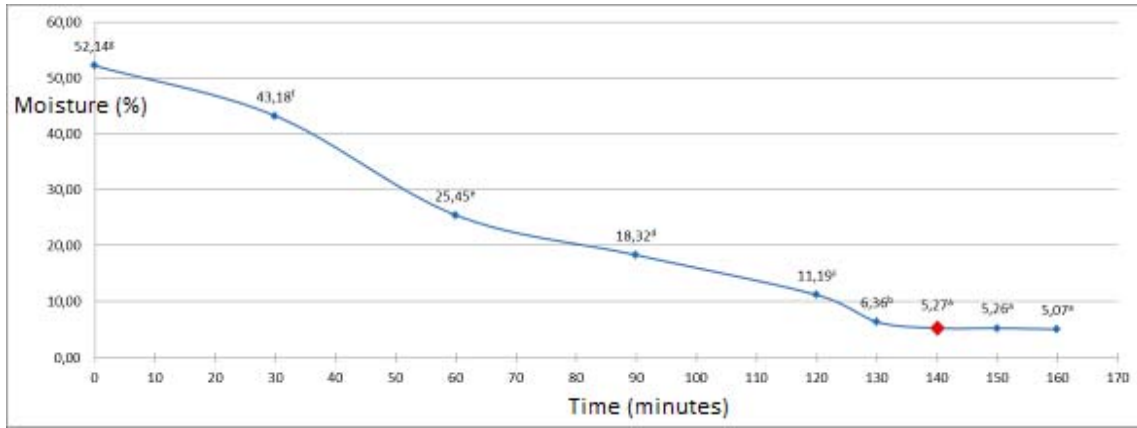


Fig 8: Moisture content by time when drying rice malt in 70 °C

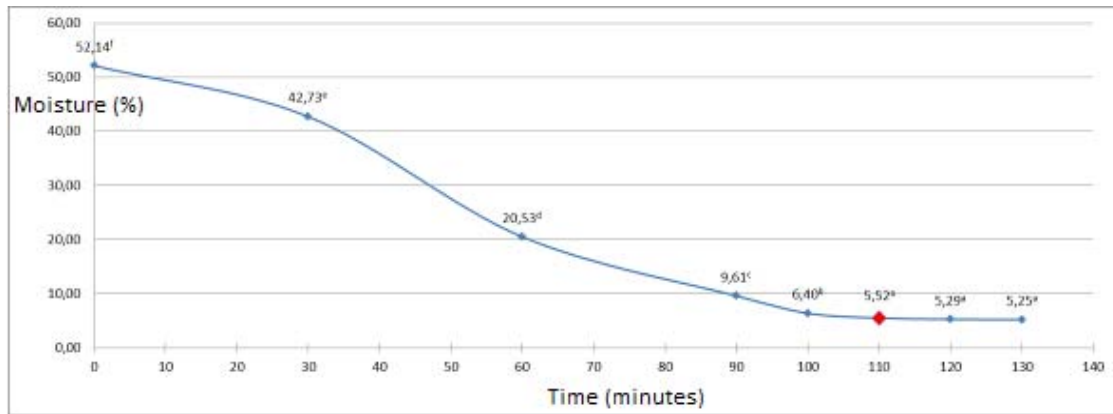


Fig 9: Moisture content by time when drying rice malt in 80 °C

From the result handle, we determined the drying malt rice survey reaches equilibrium moisture content as follows:

Table 3: Rice malt drying regimes reached moisture balance

Temperature (°C)	50	60	70	80
Time (minutes)	250	190	140	110
Moisture (%)	5.69	5.39	5.27	5.52

In each drying mode, identify the anthocyanin content of the result as follows:

Table 4: The remaining content of anthocyanins through each drying mode

Drying mode	Temperature (°C)	50	60	70	80
	Time (minutes)	250	190	140	110
Anthocyanin (mg/g)		9.87 ^c	9.62 ^c	8.28 ^b	6.64 ^a

From the survey results found that, to achieve a balanced humidity rice after drying with very long time inversely proportional to temperature drying. Drying at a temperature of 50 °C, drying time for the longest (250 minutes) because of the slow rate of water evaporation. Drying at a temperature of 60, 70, 80 °C: drying time is gradually reduced from 190, 140, 110 minutes for the rice to achieve moisture balance. According to the drying time, the moisture in the rice clumps intensifies is slowly decreasing due to liberal countries have escaped many in the beginning and intermediate water remaining affiliate and the water in the rice very difficult split. As a result of determining

anthocyanin remaining in the sample after every drying mode, realize there is significant in the drying mode 50 °C and 60 °C, but 600 C drying time is faster to 60 minutes. While drying in a 50-minute faster than 70 °C but significant losses to anthocyanin, and the drying pattern in 80 °C as losses more anthocyanins. Furthermore, from the comments above to save on drying time, limiting the losses of anthocyanin should choose the drying mode for rice malt balanced humidity reached 5.39 percent to 60 °C in 190 minutes, and then the remaining content of anthocyanins is 9.62 mg/g.

3.5 Effect of hot water dissolving in mixing malt powder:

The finished malt powder after crushing with low humidity, when used to mixing with boiling water, and depending on the purpose of the user which can add water to the powder

and liquid or solid. However the results to determine the rate of boiling water added to finished products using powder based on your preferred sensory evaluation with the mixing ratios are different survey.

Table 5: Sensory evaluation results following flour stirring with boiling water rate

Powder: boiling water	1:02	1:03	1:04	1:05	1:06
Sample name	401	402	403	404	405
Average	0.71 ^a	0.06 ^{ab}	0.69^{bc}	0.44 ^c	0.48 ^c

Note: a, b, c, (p < 0.05); meaningful differences

3.6 Anthocyanin loss after different treatments

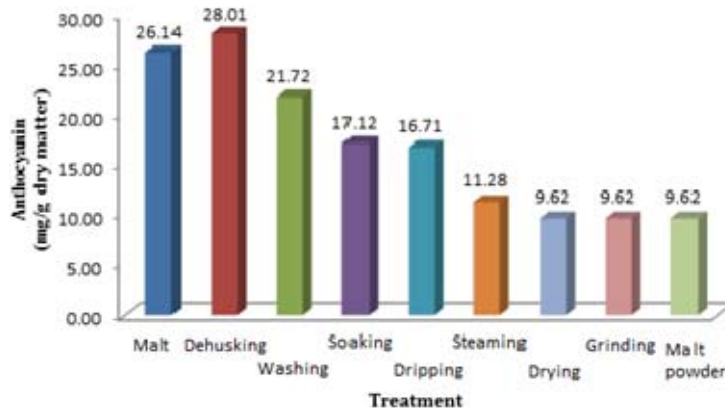


Fig 10: Anthocyanin in malt powder after various treatments

From results determined levels of anthocyanin production by then, we can calculate the shrinkage rate of anthocyanin content of the finished malt powder compared to raw materials was 65.2%. Through the figures obtained, found levels of anthocyanin losses, many in the washing, steaming

and drying and soaking followed. The technology of making the dough has too many agents do affect the anthocyanin content as well as durable as mentioned above, the loss is inevitable.

3.7 Quality of malt powder

3.7.1 Sensory evaluation

Table 6: Sensory evaluation on malt powder

Indicator	Score of each specialist										Total	Important score	Unemphasized score	Emphasized score	
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀					
Color	3	3	5	3	4	5	3	3	3	4	36	1.3	3.6	4.7	
Aroma	5	4	5	4	3	5	5	4	4	3	42	1.2	4.2	5.0	
Taste	3	3	4	4	5	4	3	3	4	5	38	0.5	3.8	1.9	
Appearance	5	3	5	4	3	5	5	3	4	3	40	1	4.0	4.0	
Total score														15.6	15.6

According to the result table of sensory Board consisting of 10 members by the method for points (5 points, 6 levels), with an overall score that weighs is 15.6. Therefore, nutritional powder products from glutinous black rice malt with sensory evaluation results achieved the kind of pretty.

3.7.2 Nutritional value

Table 7: Nutritional value on malt powder

Parameters	Unit	Result
Moisture	%	5.39
Total protein	%	8.7
Total lipid	%	2.4
Total glucid	%	77.8
Ash	%	1.3
Dietary fiber	%	16.25
Anthocyanin	mg/g	9.62
Vitamin B3	mg/kg	3.6

Note: results analysis in the technical center quality assurance 3

Product nutrition facts easy to digest because it is produced from domestic raw materials were up sprouts and processed steaming set, in which levels of dietary fiber, accounts for a significant proportion (16.25%) as very beneficial in the prevention of many diseases such as cancer risks, in many

soluble fiber β -glucan that stimulates white blood cells make up the type of pathogen is root bacteria or viral infection and cancer cells (Duong Thanh Liem, 2010). There are also more resistant to oxidation due to anthocyanin component (9.62 mg/g) in product.

3.7.3 Microorganism, heavy metal and toxic in malt powder

Table 8: Microorganism in malt powder

Microorganism	Unit	Limit	Result
TPC	CFU/g	105	6.5×10^2
Coliforms	CFU/g	102	<10
<i>E.coli</i>	CFU/g	10	<10
<i>S.aureus</i>	CFU/g	102	<10
<i>Cl. Perfringens</i>	CFU/g	10	<10
<i>Salmonella</i>	CFU/25g	Not detected	Negative
<i>B.cereus</i>	CFU/25g	102	2.3×10^1

Note: results analysis in the technical center quality assurance 3

Table 9: Heavy metal and toxic in malt powder

Group of parameters	Parameter	Unit	Limit	Result
Heavy metal	Arsen (As)	mg/kg ~ ppm	1	0.09
	Cadimi (Cd)	mg/kg ~ ppm	0.1	Not detected
	Lead (Pb)	mg/kg ~ ppm	0.2	< 0,10
Toxin	Ochratoxin A	$\mu\text{g/kg} \sim \text{ppb}$	5	Not detected MLOD= 0.15 $\mu\text{g/kg}$
	Aflatoxin B1	$\mu\text{g/kg} \sim \text{ppb}$	5	Not detected MLOD= 0.1 $\mu\text{g/kg}$
	Aflatoxin B2	$\mu\text{g/kg} \sim \text{ppb}$	15	Not detected MLOD= 0.1 $\mu\text{g/kg}$
	Aflatoxin G1	$\mu\text{g/kg} \sim \text{ppb}$	15	Not detected MLOD= 0.1 $\mu\text{g/kg}$
	Aflatoxin G2	$\mu\text{g/kg} \sim \text{ppb}$	15	Not detected MLOD= 0.1 $\mu\text{g/kg}$

Note: results analysis in the technical center quality assurance 3, and the Institute of hygiene and public health in Ho Chi Minh City.

Nutritional powder products after analyzing the norms of hygiene and food safety under the provisions of regulation 46/2007 of the Ministry of health asking for product categories of dry food and food nutrition, alternative food specials (with heat treatment before use) shall result in limiting the ability to allow. This product fully qualify as nutritious foods and safe for consumers to use.

3.8 The production cost of nutritional powder products

The finished malt powder volume obtained = original 70.62% rice ingredients

Table 10: Nutritional powder production from 1 kg of raw material malt

Component	Unit	Quantity	Unit price (VND)	Amount (VND)
Malt	Kg	1	24,358	24,358
Water	m ³	0,01	11,000	110
Electricity	Kwh	0.1	2,000	100
Total (VND)				24,568

Note: the total cost of the product not included costs for packaging, labor and equipment depreciation

Quantity of finished malt powder = 70.62% x 1kg = 0.762kg.
 Cost of 1 kg malt powder = 24,568/0.762 = 32,241 VND.
 Compared with the nutritional cereal flour products currently on the market such as: flour, malt Ovaltine (117,895 VND/kg), rice flour cereal milk Light Quasure of Bibica (138,000 VND/kg), cereal nutrition Viet Dai (121,300 VND/kg), the price of the flour in this nutritious black rice malt after balancing the profit referred to the market will ease competition and attract because nutrient content easy to digest, the distinctive scent of rice malt flavor, along with sticky black rice, after drying and especially the pigment anthocyanin antioxidant that helps the product's strengths.

3.9 The standard basis for nutritional powder

Nutritional powder products in product group of dry food and food nutrition, alternative food specials (with heat treatment before use), based on the analysis results of dry malt ingredients used and the test results the physiochemical, biological, heavy metals and toxins in accordance with 46/2007 of the Ministry of health, have developed standard nutritional powder products facility from the sticky malt base standard as follows:



Fig 11: Sticky black rice malt powder products after packing and labelling

Table 11: The standard basis for nutritional powder

No	Raw material	
1	Sticky black rice	- Moisture 11.7% - Germinating capability 95.44% - Foreign matter 2.12%
2	Water	TCVN 5502:2003
Sticky black rice malt		
3	Appearance, status	- Fine powder - Color: brown red
4	Nutritional powder (100g edible part)	- Moisture: 5.39% - Protein: 8.7% - Lipid: 2.4% - Glucid: 77.8% - Vitamin B3: 0.0036 mg - Ash: 1.3% - Anthocyanin: 1.625%
5	Microorganism	- TPC: 6.5×10^2 (CFU/g) - Coliforms: <10 (CFU/g) - <i>E.coli</i> : <10 (CFU/g) - <i>S.aureus</i> : <10 (CFU/g) - <i>Cl. Perfringens</i> : <10 (CFU/g) - <i>Salmonella</i> : Not detected (CFU/25g) - <i>B.cereus</i> : 2.3×10^1 (CFU/25g)
6	Heavy metal, toxin	- Arsen (As): 0.09 (mg/kg ~ ppm) - Cadimi (Cd): Not detected - Lead (Pb): <0.10 (mg/kg ~ ppm) - Ochratoxin A: Not detected ($\mu\text{g/kg}$ ~ ppb) - Aflatoxin B1: Not detected ($\mu\text{g/kg}$ ~ ppb) - Aflatoxin B2: Not detected ($\mu\text{g/kg}$ ~ ppb) - Aflatoxin G1: Not detected ($\mu\text{g/kg}$ ~ ppb) - Aflatoxin G2: Not detected ($\mu\text{g/kg}$ ~ ppb)

4. Conclusion

After the process of studying and conducting experiments, survey processing parameters in nutritional powder manufacturing process from glutinous black rice malt, draw the conclusions are as follows: the dry Malt bring split pod currency rice malt, husks removed constituted original 29.85% malt volume. The process of maceration: malt after split pod will last wash and soak the rice in water with malt malt 1gao rate: 1 water; at 30 °C in time is 20 minutes; seeds will be the humidity is 36.41; and anthocyanin content of the dried substance mg/g 17.12. The process of steaming: after grain mash was steaming the steaming 20-minute period; steamed rice reached the humidity is 52.35%. Drying: drying malt offered Rice at 60 °C; in time 190 minutes; reaching the moisture balance is 5.39%; and concentrations of anthocyanins is 9.62 mg/g of dry matter. The use of malt flour give stir in boiling water at the rate of 1 powder: 4 water are the most popular. Malt powder has moisture is 5.39%; protein: 8.7%; lipids: 2.4%; glucid: 77.8%; the ashes: 1.3%; dietary fiber: 16.25%; anthocyanins: 0.962%; vitamin B3: 3.6 mg/kg; micro-organisms, toxins, heavy metals within the limits permitted under regulation 46/2007 of the Ministry of health. Price: 32, 24.000 USD/kg. From the conclusions above suggest nutritional powders from malt rice coal was the product rich in nutritious and safe to use for all ages. Product viable, and capable of practical application as high as contains many nutrients with relative price accordingly. Recommendations: the process of separating the casing: separate cover with modern equipment to avoid shrinkage of nutrients as well as loss of economic value. Steaming, drying: can use extruded to shorten the stages of production and for better quality nutritional powder. Survey on timing as well as the influence of the conditions of preservation of the quality of the flour.

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