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DIFFERENT RATIOS OF RICEBERRY RESIDUES AND WATER ON HEALTH DRINK BEVERAGE FORMULATION

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ABSTRACT: The food industry has a lot of wastes from production processes, that are beneficial to the possible when used of by-product to reduce environmental pollution. There were research reports related to the production of various type of cereal drinks by using cereals as raw materials. The objective of this research was to study the optimum ratios of riceberry residues, agar and water on health drink production. There were four experiments: Experiment 1: (control formula) blended riceberry and water 30:70, Experiment 2: blended riceberry and water 15:85, Experiment 3: blended riceberry and water 20:80 and Experiment 4: blended riceberry and water 25:75 were obtained. The results from physical measurement (L*, a and b*) were significantly different ($P \leq 0.05$). The study chemical of measurements, i.e. pH, percentage of acidity and total soluble solid were performed. The results showed that Experiment 2 had the lowest pH and gave the highest percentage of acidity values of 5.96 and 0.28, respectively. The microbiological properties revealed that amount of microorganism in each treatment was not found. The sensory evaluation used a 9-point hedonic scale. The results indicated that Experiment 3 had the highest scores of overall liking. Based on the obtained data, the formulation of beverages produced from residues, there is a high possibility of using the residues from production process. It can be developed health drink to be accepted by consumer, which has increased steadily and reduced the amount of food wastes that must be disposed of pollution that is toxic to the environment.

Keywords: Riceberry, Water, Health, Drink, Beverage

1. INTRODUCTION

At the present, Thailand food industries generate large amount of wastes or by-products annually from a variety of raw material sources. In that food wastes or by-products are an excellent source of nutraceuticals, bioactives, inherently functional and possess many components that are good for human health. Food industrial wastes or by-products convert to the functional food ingredients, it is the healthy trends in the food industry. The waste management is one of the major parts of food industries. The large volume of the low-cost by-product gives economic benefit of its potentially valuable components and environmental benefits. Therefore, the utilization of by-products to health beneficial product and economic benefit to labour and country. Now, as people become increasingly take care of the relation between foods and good health. Consumer attitude towards health foods is promising development and the scope of functional foods is growing very fast in Thailand. Consumers believe that foods are taken directly effects on their health as a good or as a bad. The market for the functional foods has seen a tremendous demand in the recent years. Today foods are not only used to demand our hunger but also to provide major and minor nutrients for human life and these nutrients having the health benefits, protecting and controlling from the diseases [1]. Rice is one of the commonly used stable foods around the world. The distribution of the rice anthocyanins depends on the rice cultivars. The consumption of colored rice varieties is increasing among the people, because of its health benefits. Riceberry is a good example as registered rice variety from Thailand, a cross-breed of Jao Hom Nin (JHN), a local non-glutinous purple rice and Khoa Dawk Mali 105 (hom mali rice). The variety was created by the Rice Science Center, Kasetsart University, Thailand. The research for nutritional properties, anthocyanin stability, and physical and cooking properties is a deep purple whole grain rice with softness and a palatable aftertaste. Riceberry has been a popular brown rice due to its health promoting properties. Inducing people to consume more brown rice could help ameliorate food-related chronic diseases like diabetes, heart disease, high blood cholesterol, obesity, and cancers [2]. Agar is a mixture of two components: the linear polysaccharide agarose and a heterogeneous mixture of smaller molecules called agaropectin. It forms the supporting structure in the cell walls of certain species of algae, and is released on boiling. Agar has been used as an ingredient in dessert. Agar can be used as a laxative, an appetite suppressant, a vegetarian

substitute for gelatin, a thickener for soups, in ice cream, and beverage, as a thickening agent. Agar is the phycocolloid of most ancient origin. Water contributes to the formation of gels in food. Originally, and even in the present times, it was made and sold as an extract in solution (hot) or in gel form (cold), to be used promptly in areas near the factories; the product was then known as tokoroten [3]. Since there was research related to the study on the using of food waste residues for added values, therefore, the riceberry residues from the riceberry production process has been utilized since it still contains the necessary nutrients. There are some researches related to the processing of healthy beverages from Homnil rice by studying to optimize a suitable ratio between rice flour and water at 1:20, 1:30 and 1:40 ratios with rice flour extraction temperature at 50°C. The types and number of sweeteners were 60°Brix sucrose syrup and 60°Brix. The banana syrup at concentration levels of 7 and 9°Brix. and amount of gelatin stabilizer were used at 0.0, 0.1, 0.2, 0.3 and 0.4 percent and suitable period for disinfection at 90°C was studied at 15, 20, 25 and 30 mins. It was found that the most suitable ratio between rice flour and water was 1:30. The batter viscosity was 14.73 centipoises, with pH, total soluble solids, protein content, fat content, and fiber content of 6.71, 1.1, 0.23, 0.05 and 0.83 percent, respectively. The amount of anthocyanin was 0.37 mg/ml. From adjustment of total soluble solids, it indicated that the use of 7°Brix sucrose syrup was the most acceptable from testers in taste, texture, and overall liking ($p \leq 0.05$). The use of 0.3 percent gelatin (by weight) resulted in wholeness of the beverage, without layers. The beverage had viscosity of 18 centipoises, pH of 6.4, total soluble solids of 9.8 percent, and anthocyanin content of 0.7 mg/ml. It was also found that with disinfection at the temperature of 90°C for 25 minutes, the beverage could be kept for 15 days at the temperature of 4-6°C with standard number of microbes [4]. The study on preparation of enhancing GABA in germinated brown rice and its products were conducted during 2008-2010 at Pathum Thani Rice Research Center, Thailand. The results revealed that an appropriate method was malting of selected healthy brown rice in a closed container at room temperature for 20 hours after the seeds being washed with clean water and steeped for 4 hours. This freshly malting rice can be used for making blended drinks of germinated brown rice by pre-boiling with intermittently stirring the mixture of ingredients as germinated Khao Dawk Mali 105 : germinated black glutinous rice: overnight steeped soy bean: roasted white sesame: water at a ratio of 1: 0.5 : 0.3 : 0.3 : 20 by weight for 20 mins. Filtering the mixtures twice and adding 5 g of sugar per 100 ml of the mixtures. The processing of instant germinated brown rice was also conducted by pre-preparation of soy milk from a mixture of overnight soaked soybean: roasted white sesame: water at a ratio of 1 : 0.8 : 14 by weight. Rice starch mixture was then prepared by mixing germinated Khao Dawk Mali 105 : germinated black glutinous rice: soy milk at a ratio of 7:3:9 by weight and wet milling. The mixture was dried with a double drum drier then ground to fine powder. Eight g of germinated rice powder were then mixed with 5 g of fine sugar, 4 g of maltodextrin and 2 g of non dairy cream packed in aluminium foil sachet. The another experiment was conducted at Ubon Ratchathani Rice Research Center using cooked germinated Khao Dawk Mali 105 and water at a ratio of 1 : 1 by weight. The mixture was slurred and drum dried prior to ground into powder. The powder was then packed with pre-cooked soy bean and job tear powder which were prepared by overnight soaked and steamed cooked before drum dried and ground to powder. The ingredient contained 7 g of dehydrated germinated brown rice, 2 g of dehydrated soy bean, 2 g of dehydrated Job's tear, 6 g of non dairy cream, 4 g of dairy powder and 10 g of sugar [5]. From above related researches, but there was no information about the formulation of riceberry residues juice mixed with agar and water. For this reason, of riceberry residues and agar advantages, the researchers are interested in producing water-based riceberry residues juice, agar and water with the healthy drink by studying and development an appropriate amount of riceberry residues, agar and water ratios on the physical, chemical, microbiological quality and sensory acceptability of the panelists, which help with the quenching of thirst and help relax or make the body. The data obtained from this research was an alternative to make riceberry residues juice as by-products, water and agar for beverage production to improve the quite appearance characteristic, nutritional quality, acceptability test and good health of consumers also solve the problems of bringing by- products from various food industries that are being commercially used in functional food ingredients for human consumption with higher values.

2. METHODOLOGY

The research was carried out at the Division of Food Science and Technology, Faculty of Agricultural Technology, Rajamangala University of Technology Thanyaburi. (RMUTT) Pathum Thani Province Thailand. The samples used in this study were purchased from Rangsit Market which located in Pathum Thani Province Thailand. This research was performed as four experiments (three replications): 1) (control formula) blended

riceberry and water 30:70; 2) blended riceberry and water 15:85; 3) blended riceberry and water 20:80 and Experiment 4: blended riceberry and water 25:75 details as the Table 1 [6],[7].

2.1 Riceberry Juice Preparation

The riceberry was soaked in amount of water in a stainless steel pot according as shown in Table 1. Then, allowed to mix homogeneously. The aliquot was filtered through a white cloth and again an aliquot was clarified. The aliquot was heated, then 50g of sugar was added and allowed to dissolve homogeneously after which pandan leaf juice was gradually added. An aliquot of this was heated at 65°C for 30 mins, then the temperature was reduced, and the liquid poured into a sterilized plastic bottle [6],[7].

2.2 Preparation of Riceberry Residues Agar

Weigh 8.3 g of agar powder and 100 ml of water were placed in a stainless steel pot and heated to 90 °c for 6 mins until allowed to dissolve homogeneously. Then 100 g of sugar to simmer until it dissolved until a homogeneous aliquot. Then, put 30 ml of pandan juice was added and allow to dissolve homogeneously and then cooled at room temperature. (This step should add pandan juice before lifted down) from the stove, because the aliquot of simmering for too long affecting on the pandan leaf color causing separation from each other). Put them in the prepared mold, then add the boiled rice berry residues from the riceberry juice (as 2.1), then let it cool to be mixed well [6],[7].

2.3 Recording of Data#

The numerical data were collected and recorded from experiments (three replications) for statistical analysis. The Experimental design for physical and chemical quality analysis were evaluated by using a completely randomized design (CRD). A randomized complete block design (RCBD) for sensory evaluation was used with analysis of variance. Analysis of the mean differences of experiments was performed using Duncan's new multiple range test [8].

2.4 Physical Measurement

The color brightness (L*), color as red (+a*) and yellow (+b*) were measured by using Minolta CR-10 [9] and recorded as values adapted from [9]. The sedimentation was detected by using eye detection adapted from [9].

2.5 Chemical Measurement

The pH, total soluble solid (TSS) and percentage of total acidity (calculated as citric acid) were measured by using pH meter OHAUS ST3100-F, using hand refractometer and titration with 0.1N sodium hydroxide (phenolphthalein as indicator) as values, respectively adapted from [10].

2.6 Microbiological Measurement

The total microbiology was measured as total plate count by using plate count agar adapted from [11].

2.7 Sensory Evaluation

The sensory evaluation was carried out by 30 untrained panelists in Rajamangala University of Technology Thanyaburi (RMUTT), Thailand. Panelists were asked to analyze their level of preference for each treatment by using a 9-point hedonic scale test based on the attributes of color, odor, taste, body, clarify and overall acceptability. A randomized complete block design was used with analysis of variance. Analysis of the mean differences of experiments was performed using Duncan's new multiple range test [12].

3. RESULTS AND DISCUSSION

3.1 Physical Appearances of Blended Riceberry Residues Juice and Agar

From the Fig 1, the study of the outside appearance of the riceberry products mixed with riceberry, agar and water. The images could be seen that the red color in all experiments were not significantly different. As a result of the ratio of riceberry juice, agar and water. When considering the appearance, it was found that all the experiments were suspended, which is the pulp of riceberry, which is derived from riceberry, agar and others. When considering the color revealed that all the samples were dark brown as the color results of the anthocyanin [13]. The anthocyanin is water-soluble vacuolar pigments that, depending on their pH, may appear red, purple, blue or black. Food plants are abaundant in anthocyanins include the blueberry, raspberry, black rice, and black soybean, among many others that are red, blue, purple, or black. Some of the colors of riceberry are derived from anthocyanin. The color of anthocyanin is quite distinct and different chemical compositions and structures in riceberry. The color characteristics can be seen that when the amount of water is much, the color is pale. When considering the appearance, it indicated that the Experiment 1 gave a lot of suspended sediments of riceberry residues than the other experiments. The odor

was varied with the amount of increased riceberry and the decreased amount of water which compared to control samples. The taste indicated that all experiments were little sweet and little salty taste. This is due the increasing proportion of riceberries, whereas reducing the amount of water that results in dilution effects caused the flavor to not be concentrated [14].

3.2 Physical Measurement

Table 2, the results showed that all of L*, +a* and +b* values and physical appearance depending on different ratios of riceberry residues, agar and water. The results showed that all values were different ($P \leq 0.05$). The physical characteristics of blended riceberry residues, agar and water, comparing the differences between the experiments of color values L*, +a* and +b*, they revealed the brightness value (L*) was of 33.3, 29.0, 31.2 and 32.1, respectively. The color values (+a*) was 4.1, 3.1, 3.6 and 2.5, respectively. The color values (+b*) was of 10.59, 12.13, 12.51 and 13.55, respectively [15]. Riceberry had a deep purple color. This may be caused by the ratios between riceberry residues, agar and water with different amounts due to each experiment to have different values. The experiment with a large amount of riceberry residues ratio had a darker color and more brightness than the experiment with ratio of the less amount of riceberry residues [16]. One possible reason ricebeery has a anthocyanin as a main pigment, a pigment that is red color and soluble in water well. The proportion of the amount of riceberry that increase redness will increase according to the amount of riceberry, but increasing the amount of riceberry residues results in an increasing trend of all values [17].

3.3 Chemical Measurement

Table 3, the results revealed that the pH, total soluble solid and percentage of total acidity in riceberry juice products with agar and water, depended on the different ratios. The result was found that the measured values (percent of acidity) were statistically significant differences ($P \leq 0.05$) while pH and total soluble solid were not statistically different. This value depends on the increasing riceberry residues, agar and water ratio, resulting in lower pH values (more acidity). The results indicated that a tendency for the percent of total acidity decrease low values in comparison with the control samples. The analyzed values were consistent with the percentage of total acid content in the form of citric acid that is higher with organic acid (such as citric acid). The total soluble solid was not significantly different ($P > 0.05$). The anthocyanins are the most important water-soluble pigments that belong to the flavonoid group and are accountable for the different color in plant tissues [18]. The pH is one of the most influencing factors of stability, and color of the anthocyanins. The anthocyanins are more stable in acidic condition than in the alkaline condition. This reason be due to anthocyanin may be used as pH indicators because their color changes with pH; they are red or pink in acidic solutions ($pH < 7$), purple in neutral solutions ($pH \approx 7$), greenish-yellow in alkaline solutions ($pH > 7$) and colorless in very alkaline solutions, where the pigment is completely reduced. [19]. Apart from this, there was some main compounds of total phenolic content in riceberry.#Therefore, if the riceberry was heated to a high temperature level and took too long time, it did not affect in pH change of riceberry. This can be seen that the pH value might not be very low. Because the heat was used to boil, it took short time, so the amount of pH was not very low [20],[21].

3.4 Microbiological Measurement

Based on the analysis of total microbial counts by using the total plate count method in blended riceberry residues, agar and water. the results showed that microorganisms were not found in all experiments. One reason possibility was due to the completed pasteurization process of blended riceberry residues juice agar and water before packaging. This processing is a thermal processing method with the main purpose to destroy pathogenic microorganisms, including microorganisms and enzymes that cause food degradation [22],[23].

3.5 Sensory Evaluation

Table 4, the results of the sensory analysis showed that there were differences in all experiments ($P \leq 0.05$) [24],[25],[26]. Based on the color, odor, taste, body, clarify and overall acceptability values. Experiment 1 had the greatest odor and taste from panelists due to the highest amount of riceberry residues being added [26],[27]. One possible reason might be due to the highest proportion of riceberry resiudes and the lowest of water. The color values showed that Experiment 4 was the most acceptable, but Experiment 2 gave the highest body score value. This may have been due to the riceberry residues and water ratios level resulted in preferred acceptance level or the panelists preferred the color of the drink containing reddish purple color of riceberry. The experiment with the highest clarify and overall acceptability were the Experiment 3. For one possible reason, the increased amount of water, if increased too much,

caused the color and appearance to appear paled color. The reduction of the total soluble solid values is due to the dilution of water, which is main reason that consumers do not accept the product [28],[29].

Fig. 1 riceberry soaking

Fig. 2 electrical riceberry blending

Fig. 3 riceberry residues

Fig. 4 aliquot filtration

Fig. 5 riceberry residues paste

Fig. 6 dissolved agar powder

Fig.7 blended riceberry residues and agar

Table 1 Different Ratios of blended riceberry residues juice agar and water

ingredient	Experiment			
	1	2	3	4
riceberry (g)	210	105	140	175
filtered water (ml)	490	595	560	525
sugar (g)	50	50	50	50
pandan leaf juice (ml)	52	52	52	52

Table 2 Physical measurement of blended riceberry residues juice agar and water

Experiment	physical values*		
	L*	a*	b*
1	33.3^{c}	4.1^{c}	10.59^{c}
2	29.0^{a}	3.1^{b}	12.13^{b}
3	31.2^{b}	3.6^{b}	12.51^{ab}
4	32.1^{b}	2.5^{a}	13.55^{a}

Note: a-d The different letters in the same column mean significant difference ($P \leq 0.05$)

Table 3 Chemical measurement of blended riceberry residues juice agar and water

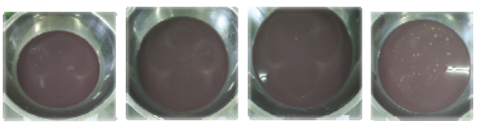
Experiment	chemical values		
	pH^{ns}	TSS (°Brix)^{ns}	percent of total acidity*
1	33.3^{c}	4.1^{c}	10.59^{c}
2	29.0^{a}	3.1^{b}	12.13^{b}
3	31.2^{b}	3.6^{b}	12.51^{ab}
4	32.1^{b}	2.5^{a}	13.55^{a}

Note: a-d The different letters in the same column mean significant difference ($P \leq 0.05$) and ns non significant difference ($P>0.05$)

Table 4 Mean score of preference for sensory properties of blended riceberry residues juice agar and water

Exp	scores					
	color*	odor*	taste*	body*	clarify*	overall acceptability*
1	6.29^{b}	6.42a	6.50^{a}	6.30^{b}	6.22^{b}	6.64^{b}
2	6.18^{b}	6.38^{b}	6.38^{b}	6.67^{a}	6.26^{b}	6.60^{b}
3	6.41^{b}	6.03^{b}	6.42^{b}	6.44^{b}	6.41^{a}	6.91^{a}
4	6.86^{a}	6.02^{b}	6.37^{b}	6.39^{b}	6.29^{b}	6.82^{b}

Note: a-d The different letters in the same column mean significant difference ($P \leq 0.05$)



E1 E2 E3 E4

Fig.8 different ratio of blended riceberry and water products
E1: blended riceberry and water 30:70
E2: blended riceberry and water 15:85
E3: blended riceberry and water 20:80
E4: blended riceberry and water 25:75

4. CONCLUSION

1. The uses of different ratios of by-products as raw material preparation had effects on the quality of mixed riceberry residues, agar and water.
2. The results of the physical properties analysis showed that all values were statistically significant differences ($P \leq 0.05$).
3. The results of the chemical analysis showed that the percent of total acidity (except pH and total soluble solid) were significantly different ($P \leq 0.05$).
4. Blended riceberry residues, agar and water 20:80 gave the most overall acceptability of 6.91 values from the panelists.
5. The results of total plate count indicated that the microorganism in each experiment was not found.
6. Based on this research, researchers will be able to launch new health drink products in the future for functionalities and health benefits of food by-products and their functional ingredients.

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