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Biochemical, Organoleptic and Antimicrobial Characterization of Brown Rice (*Oryza sativa*)

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Abstract: *Rice is a staple food of world. Brown rice or Oryza sativa belongs to family Poaceae. Brown rice is a nutritious whole grain filled with beneficial nutrients like fiber, magnesium, thiamine, calcium, protein, antioxidant, healthy fats and potassium. These nutrients are helpful for maintaining healthy digestive track, insulin level, reproductive system and cardiovascular system. Brown rice is an excellent source of manganese. Manganese is also a critical component of a very important antioxidant enzyme called superoxide dismutase. Superoxide dismutase (SOD) is found inside the body's mitochondria (the oxygen-based energy factories inside most of our cells) where it provides protection against damage from the free radicals produced during energy production. Rice is a source of many bioactive non-nutrient compounds known as Phytochemicals. Chemopreventive phenol which acts as phtyochemical present in brown extract inhibits growth of human breast and colon cancer cells.*

The consumption of brown rice is recommended in to enhance the physiology and biochemistry of the individual. Therefore, in this paper, the proximate analysis of brown rice was carried out. Also, an edible product using brown rice was developed and it was sensorily evaluated. The data obtained from the detailed questionnaire was analyzed statistically. This aided in establishing the acceptability of brown rice among the general public.

Further studies on germinated brown rice can be carry out as it has antidaibetic effect which has bioactive compounds like γ- oryzanol and acylated steryl β- glucoside can be explored for preparation of nutraceutical products of metabolic advantages. Future prospects include standardization of oryzanol as an anti-cholesterol nutraceutical, characterization of fatty acid from brown rice and characterization of various enzymes (glutathione peroxidase and superoxide dismutase).

Keywords: *Antidiabetic , chemopreventive, nutraceuticals, oryzanol ,peroxidase and phtyochemicals.*

I. Introduction

Rice is one of the most important crops around the world. It is a staple food for a great majority of people making it widely cultivated in over 100 countries including Malaysia. The total paddy production area is about 154million hectares and the annual production of rice is about 594 million metric tons globally. Rice accounts for over 22% of global energy intake. Asia is the major rice producer, wherein rice production accounts for about 92% of the world's total production. White rice (WR) or polished rice is manufactured by eliminating the fiber-rich bran layer from unpolished rice, also known as brown rice (BR). Brown Rice contains more, nutritional components such as dietary fibers, phytic acid and B vitamins and γ-aminobutyric acid (GABA) than White Rice due to the presence of outer bran layer being the main source for the nutritional elements. Rice quality is mostly determined by its chemical, physical, cooking and also eating characteristics. Additionally, starch, a major component of rice is composed of individual granules which consist mainly of two glucose homopolymers; amylose and amylopectin. Amylose is essentially a linear polymer, whereas amylopectin molecules are highly branched and together they have been shown to affect the properties of starch .Although, Brown rice is more nutritious than White rice, its intake is somewhat limited by the chewy texture and reduced digestibility. This problem can be overcome by subjecting Brown rice to partial germination, thus, producing germinated brown rice. With an increasing realization of the role of diet in the pathogenesis of certain chronic diseases, functional diets have received a lot of attention for their promising role in the prevention of such diseases. In line with this, nowadays, consumption of germinated brown rice (GBR) is gaining appreciation among health conscious individuals due to its better nutritive and organoleptic value and textural properties than the Brown rice.

Since brown rice still features an oil-rich germ, it is more susceptible to becoming rancid than white rice and therefore should be stored in the refrigerator. Stored in an airtight container, brown rice will keep fresh for about six months. While white rice varieties should also be stored in an airtight container, they can be kept in a cool, dry place rather than the refrigerator. Stored properly, they will keep fresh for about one year. The storage of cooked rice is controversial. Most organizations recommend 4-7 days of storage in the refrigerator at most. From all of the available evidence, however, and to err on the safe side, we believe it's best to cook only the amount of rice you can consume during the day it is cooked, or at most, the following day. Several potential toxins can be produced in rice under certain conditions involving time, temperature, presence of moisture, bacterial spores, or fungi. It appears that some fungi can turn one of the amino acids (tryptophan) in rice into alpha-picolinic acid, and that this substance, when excessive, can cause hypersensitivity reactions to rice in some persons. Another mycotoxin (fungus-triggered toxin) called T-2 can also be produced in rice by the fungus Fusarium. About 300 mycotoxins are commonly found in many grains, not only rice, when these grains are allowed to become moldy. Be sure to keep your cooked rice in a tightly sealed container when stored in your refrigerator. Therefore, the experimental study on brown rice was carried out to know the awareness and nutritional content of it.

II. Aims and Objectives

The study on the staple food i.e rice (Brown rice-Oryza sativa) has been executed with the following aims and objectives:

- Determine the proximate principles of medium grain brown rice.
- Determine the antimicrobial activity of Brown rice extract against four variant species of bacteria.
- Product development of Brown rice following Sensory Evaluation of the product in order to establish the socio-cultural and organoleptic acceptance of Brown Rice.
- Biostatistically analyzing the data of sensory evaluation.
- Studied convenience foods and develop a simulated product which has a potent scope of being accepted commercially which suits the palate of all the sections of the society.
- Carry out the survey of the acceptance of the simulated product by the individuals of the community with the help of self-administered questionnaires and data thus obtained is collected and statistically analyzed.

III. Materials and Methods

Brown rice packet was bought from normal grocery shop (unbranded and loose).Medium grain brown rice (kaccha rice) was used for proximate analysis. Standard Biochemical Protocol was used for carrying out proximate analysis of brown rice. Sample preparation:

- **Aqueous extract –** 5 grams of brown rice powder + 10 of water. Straining the filterate and the filterate obtained is diluted with 50ml of distilled water. The aqueous extract was used to estimate carbohydrates, protein and vitamin C.
- **Ash solution –** 3grams of sample weighed in crucible . It was incinerated at 100°c for 20 min. Then it is cooled in dessicator and add 5ml of 1:1 HCL, then dilute the ash solution with 50 ml distilled water. The ash solution is used for mineral estimations.

1.Proximate analysis

1.1.Moisture content - 5g of brown rice sample was kept in the oven at110°c for 45 mins. Entire moisture is removed which is determine by loss in weight of sample.

1.2.Carbohydrate content by Anthrone method - Aqueous extract of sample was hydrolysied using concentrated Sulphuric acid and Anthrone reagent. Boiled the tubes in water bath and cooled, colorimetrically read at 630 nm.
1.3.Protein content by Folin–Lowry method – Aqueous extract treated with alkaline copper sulphate and with Folin-ciocalteau reagent containing phosphorus molybdic acid to give a coloured complex. Colormetrically read at 660 nm.
1.4.Vitamin C content by Dichlorophenol indophenol blue method - 10 ml of aqueous extract add 1ml glacial, heat to boil and titrate against the dye i.e. 2,6 dichlorophenol indophenol blue till color changes from colorless to pale pink.

2.Mineral estimation
2.1Iron content by Wong's method-3ml of ash solution was treated with saturated potassium persulphate solution and potassium thiocyanate solution and mixed the tubes and after 30 min .It was colorimetrically readed at 470nm.
2.2Phosphorus content by Fiske-Subbarow method - 0.5 ml ash solution was treated with Acid molybdate reagent and ANSA reagent was thoroughly mixed and colorimetrically read at 660nm.
2.3Sodium and Potassium content by Flame Photometry method – Ash solution was aspirated over a flame set a specific wavelength for sodium and potassium.
2.4 Calcium content by EDTA method - 10 ml of ash solution is used add ammonium buffer and 2 drops of Eriochrome black T indicator and titrate against EDTA solution to get constant burette reading.

3.Fat content by Soxhlet method- Oil from sample is extracted with petroleum ether, dried and weighed to calculate % of fat content in brown rice. Components of lipids are separated by Thin layer chromatography.

4.Isolation of starch and its purity was estimated by Willstatters method- Percentage yield of starch was estimated from brown rice. Further starch powder was quantitatively treated with phenyl hydrazine test to form glucosazones of brown rice. .

5.Qualitative test for reducing sugars were performed from brown rice like benedicts test, barfords test, fehlings test and lead test.

6.Sensory evaluation - A product was developed from brown rice which was sensorarily evaluated by semi-trained panelist members and biostatistically data was analyzed through questionnaire. All idea of product developed was highly approved by panelist.

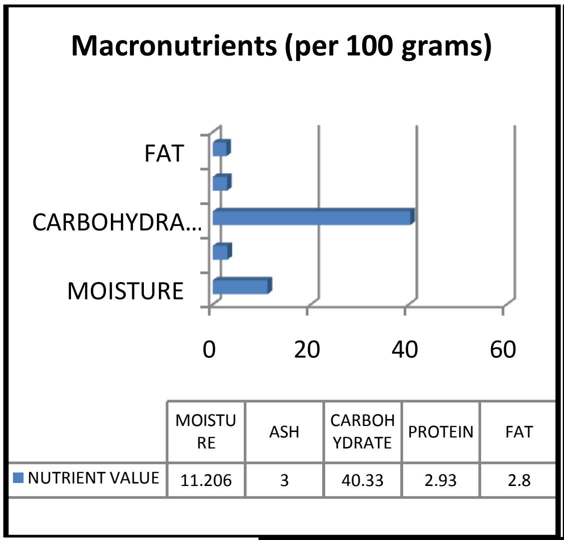
7.Antimicrobial activity of brown rice was determined by four variant bacterial species. Minimum inhibitory zone was calculated against each bacterial species.

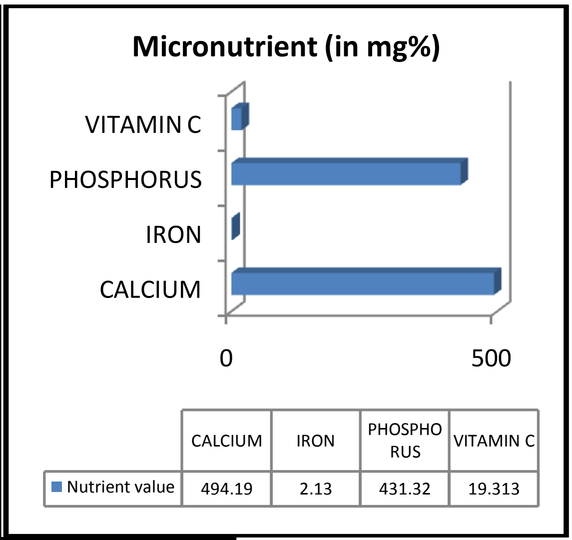
IV. Results and Discussion

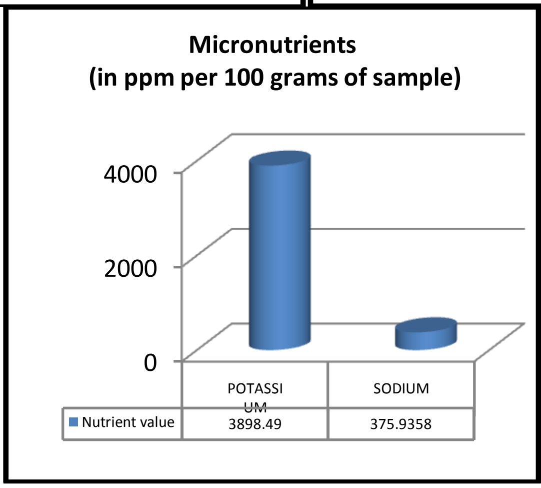
Experiments performed using standard biochemical protocols, the results are as follows:

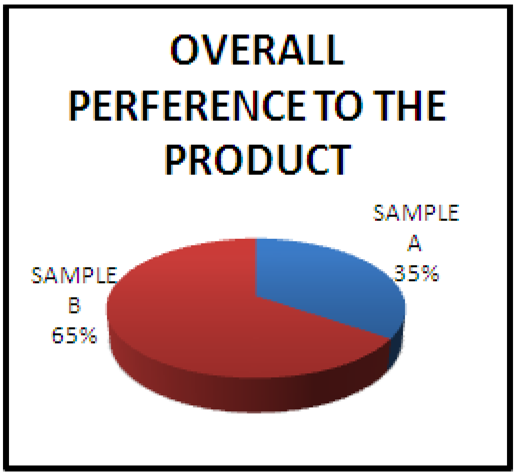
Table: Antimicrobial activity of brown rice

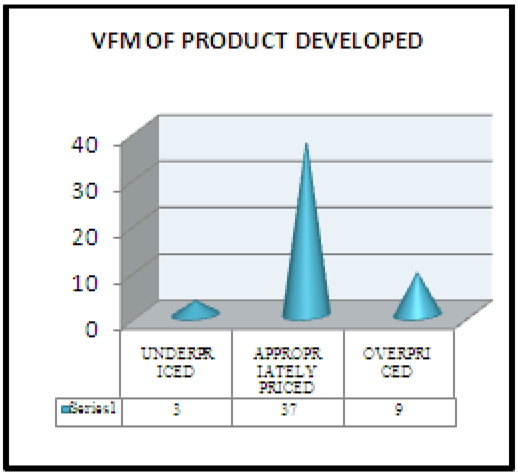
Serial Number	Test organism	Net Zone of inhibition (mm)	Remarks
	E. coli	---	No activity
	K. pneumonia	---	No activity
	S. aureus	8	Moderate activity
	B. subtilis	8	Moderate activity











From the above figures it is evident that brown rice is highly nutritious whole grain which has significant amount of vital micronutrients and macronutrients. As there is no reducing sugar present ,its healthy for diabetic patients. One of the major bioactive components in BR is γ-oryzanol (Orz), a mixture of ferulic acid esters with phytosterols . Orz possesses a variety of biologic properties, including cholesterol-lowering , anti-inflammatory , anticancer , anti-diabetic , and antioxidant activities.

V. Conclusion

In conclusion, recent studies have shown that whole-grain diets improve insulin sensitivity and prevent the occurrence of diabetes compared with refined-grain diets. In our ongoing studies, brown rice (BR) decreased postprandial blood glucose and insulin levels compared with white rice (WR) in humans. Interestingly, switching the staple food from white rice to brown rice was associated with a significant loss of body weight in subjects with metabolic syndrome. Brown rice is known to improve glucose intolerance and prevent the onset of diabetes. However, the underlying molecular mechanisms of these phenomena are unclear. This research effort is dynamic hence it can give rise to further endeavours. The work on the antioxidant activity of brown rice along with the anti-cancer properties of the brown rice samples can be studied and compared with commercially available white rice. Hence, this research effort can be of great significance in the emerging field of nutrigenomics.

VI. Future prospective

The consumption of brown rice is recommended to enhance the physiological and biochemistry of an individual. Future prospects includes characterization of fatty acid and standardization of oryzanol as anti – cholesterol nutraceutical and characterization of enzymes (glutathione peroxidase and superoxide dismutase).

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