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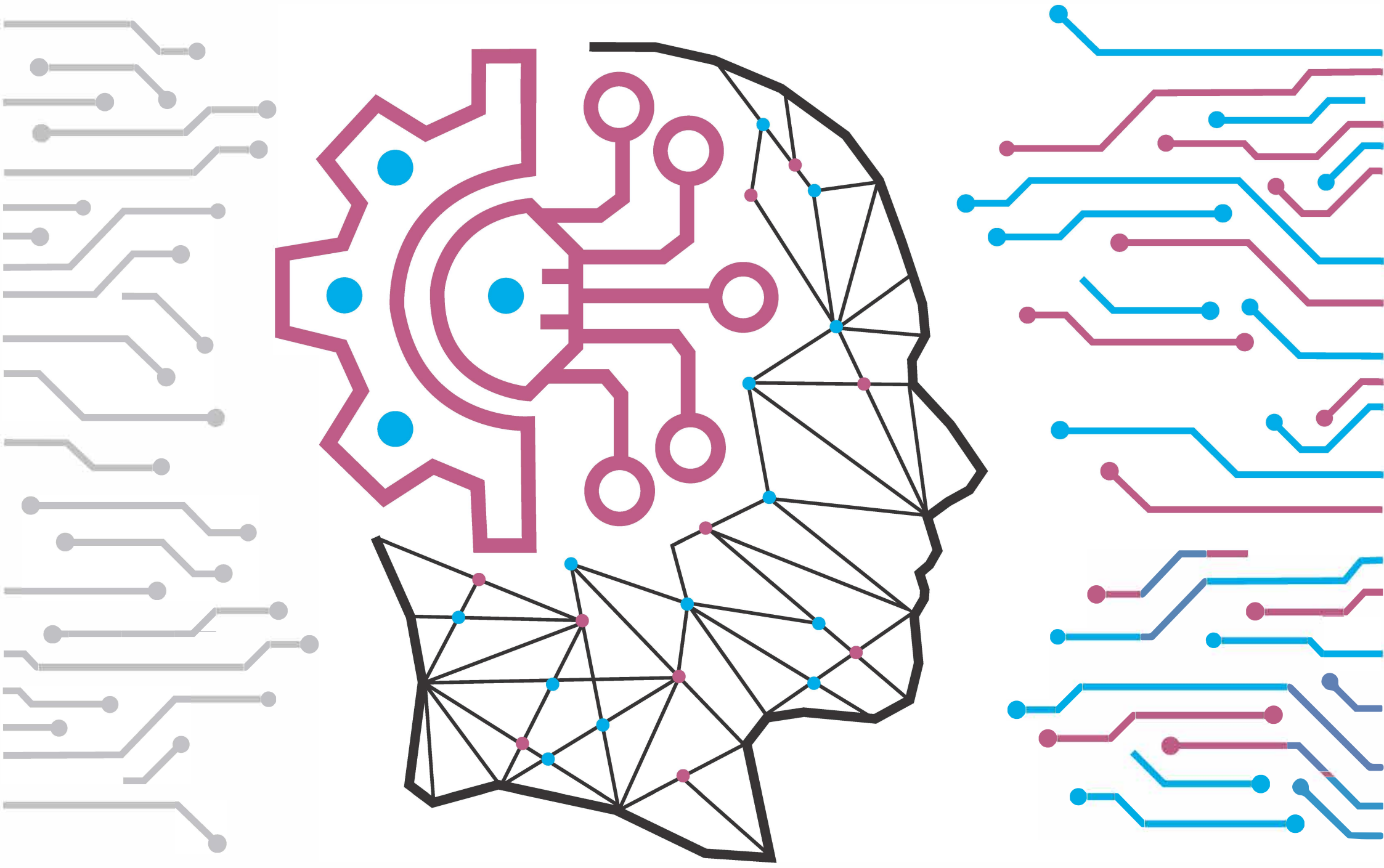

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EXTENDED ABSTRACTS

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THE 13th INTERNATIONAL
INNOVATION, INVENTION &
DESIGN COMPETITION 2024

Organized by:
Office Of Research, Industry,
Community & Alumni Network
UiTM Perak Branch

Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e- ISBN: 978-967-2776-31-4

Cover Design: Dr. Mohd Khairulnizam Ramlie
Typesetting : Zarinatun Ilyani Abdul Rahman

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RICE REIMAGINED: ENHANCING NUTRITIONAL VALUE AND GLYCEMIC CONTROL THROUGH FORTIFIED PARBOILED RICE

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ABSTRACT

Rice (oryza sativa l.) is one of the essential foods and a major source of energy-nutrients for the global population. Rice production is about 480 million metric tons per year, with major contributions from Asia, accounting for more than 90% of global production and 88% of consumption. Despite rice being a source of energy, the process of refining rice removes essential vitamins and minerals, resulting in an increased risk of nutritional deficiencies in populations that consume rice as a staple food. More than 870 million people worldwide suffer from chronic nutritional deficiencies, especially in developing countries. In addition, rice has a high glycemic index (GI) of >73, which causes high blood sugar spikes (hyperglycemia) and increases the risk of obesity and type-2 diabetes. Replacing high-glycemic-index white rice with low-glycemic-index white rice is fundamental due to the surge in obesity and diabetes. Globally, every 5 seconds, one person dies of diabetes, and at the national level diabetes is the third leading cause of death. The needed alternative is medical rice, rich in nutrients with a low glycemic index (GI) <55. Rice bran, as a by-product of rice milling, can be a potential solution due to its high content of nutrients and functional compounds. Parboiling and fortification methods in rice can be used to improve the nutritional quality of rice and lower the glycemic index of rice. Parboiling increases the absorption of rice bran nutrients into the rice, while fortification adds polyphenols and essential nutrients, resulting in nutrient-rich rice with a low glycemic index. The results show that fortified parboiled rice has a high nutrient content and lower glycemic index.

Keyword: rice, rice bran, parboiled, fortification, glycemic index

1. INTRODUCTION

Rice (oryza sativa l.), as an essential food and the main source of energy-nutrients for most of the global population, has seen a significant increase in production. About 480 million metric tons of rice are produced annually, with global production reaching 509.87 million metric tons in 2021-2022 (Muthayya et al., 2014; Muchlisyiyah et al., 2023). Asia's population leads in both rice production and consumption, accounting for more than 90% of global production and 88% of consumption (Muchlisyiyah et al., 2023).

Despite contributing energy, protein and fat, rice has limitations in providing a wide array of vitamins and minerals necessary for human health. Primarily, this is because the rice milling process tends to reduce or even eliminate the content of micronutrients essential for health, increasing the risk of vitamin and mineral deficiencies among populations that rely on rice as a staple food. More

than 870 million people are estimated to be chronically malnourished globally, the majority of whom live in developing countries where rice is the main staple (Muthayya et al., 2014).

Moreover, rice in the form of white rice also has a high glycemic index (GI) (73-93%), which increases the risk of obesity and type-2 diabetes (T2D) (Pereira et al., 2021; Watanabe et al., 2016). Thus, it becomes urgent to replace the type of rice consumed with lower GI rice. One emerging alternative is nutrient-rich medical rice with GI <55, which can prevent obesity and diabetes.

In this context, rice bran, which is produced as a by-product of rice milling, can be a solution due to the important nutrients and functional ingredients it contains. Rice bran has a higher content of bioactive compounds compared to white rice (polished rice grains), such as γ-oryzanol, phytic acid, ferulic acid, γ-aminobutyric acid, tocopherols, and tocotrienols that have significant health benefits. In addition, rice bran also contains less carbohydrates than white rice, while having twice as much protein (Pereira et al., 2021). The complex carbohydrates, proteins, and bioactive compounds in rice bran play a role in reducing GI and providing the body's nutritional needs.

Utilization of rice bran to overcome vitamin and mineral deficiencies and reduce GI can be done by combining parboiling and fortification methods. Rice has a structure consisting of the outer husk layer, bran, and endosperm. Through various levels of milling, these layers are removed to produce white rice. Typically, rice yields 25% husk, 10% bran, and 65% white rice. Parboiling, which involves soaking and partially steaming the grain before milling, is a solution to minimize nutrient loss. Thus, some vitamins and minerals from the rice bran can migrate into the rice grains. Meanwhile, fortification techniques increase the nutritional content of rice by adding vitamins and minerals from the bran material into the rice grains (Muthayya et al., 2014).

Fortified parboiled rice has been shown to have a lower glycemic index ranging from 50.97 to 59.79 compared to unfortified parboiled rice (58.80 to 62.53) and untreated rice (78.71 to 84.4). Therefore, parboiled rice is known to reduce blood glucose levels for both healthy people and people with diabetes type 2 (Muchlisyiyah et al., 2023). Thus, utilization of rice bran by parboiling method and rice fortification is a promising strategy to improve the quantity and quality of rice nutrition, lower the glycemic index and reduce its negative impact on health.

2. METHODOLOGY

The analysis was carried out using a combination of parboiling and fortification methods. The following is a picture of the stages of the method of combining parboiling and fortification.

Figure 1 Methodology of Combining Parboiling Method with Fortification

3. FINDINGS

The idea of changing rice processing methods is based on the fact that white rice has a high glycemic index (GI around 73-74), which can increase the risk of degenerative diseases such as type 2 diabetes, obesity, heart disease, and others (J et al., 2012). The use of rice processing methods that

combine parboiling and fortification is a response to this urgency to meet the need for rice with a low glycemic index, good nutrient content, and long shelf life. This technique retains more nutrients, such as B-complex vitamins and minerals, as well as polyphenol content, a health-beneficial antioxidant, compared to regular rice processing which tends to remove essential nutrients.

In the parboiling technique, the state of the rice is changed through two main stages of soaking and pressurized steaming. During soaking, the rice grains become hydrated, making vitamins and minerals easily soluble into the endosperm. In the next stage, the rice is pressure steamed, exposing the husk and pores of the endosperm. Vitamins and minerals are absorbed into the endosperm as well as other compounds present in the bran, thus making the bran nutrients enter the rice (Kumar et al., 2018).

In addition, in the parboiling process, pressurized steaming causes changes to the starch in the rice as an energy source. The process of changing starch, which consists of amylose and amylopectin, is known as gelatinization. Gelatinization causes the structure of rice to become softer, gentler, and slower to digest glucose. Starch is classified into three types during the gelatinization process, namely resistant starch (RS), slow-digesting starch (SDS), and fast-digesting starch (RDS). Regardless of the classification, parboiled rice shows lower RDS and increased SDS and RS. This is an advantage of parboiled rice as it makes the body's absorption of carbohydrates balanced. Parboiled rice contains starch that is slower to digest, leading to a slower and more stable absorption of blood sugar by the body.

At the grain milling stage, vitamins, minerals, and other compounds do not disappear because they have been absorbed into the rice during soaking and pressure steaming. Finally, the rice is fortified, a technique that incorporates polyphenol extracts and other essential nutrients to lower the glycemic index of the rice. By combining parboiling and fortification methods, the glycemic content of the rice is lower than that of parboiled rice that is not fortified, and significantly lower than untreated rice that is not parboiled. The transition from untreated rice to rice processed using this technique demonstrates superiority in improving the quantity and nutritional quality of rice and provides additional benefits to consumer health both regionally and globally.

4. CONCLUSION

The rice milling process reduces the availability of vitamins and minerals, but rice bran offers a solution with its high content of bioactive compounds. Parboiling and fortification methods can achieve a low glycemic index and optimal nutrient content. Parboiling allows effective absorption of rice bran into the rice, while fortification increases the nutrient content of rice and lowers the glycemic index level of the rice. The results show that fortified parboiled rice has a lower glycemic index than regular rice. This approach promises to improve the nutritional quality of rice, lower the glycemic index, and prevent obesity, type-2 diabetes, and its health complications.

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