Research

GERMINATED BLACK RICE (GEMAR) FUNCTIONAL BEVERAGE POWDER: A POTENTIAL ANTIOXIDANT FOR MANAGING DIABETES MELLITUS

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ABSTRACT

Background Diabetes mellitus (DM) is a degenerative disease and a leading global cause of death, often linked to increased oxidative stress and free radicals. Prolonged DM can lead to various complications, including kidney issues, heart problems, vision impairment, and more. Dietary regulation is a recommended approach to managing DM. GEMAR beverage powder, derived from germinated black rice and mung bean, holds the potential as a source of antioxidants and is beneficial for individuals with DM due to its rich phytochemical content.

Objective This study aims to determine the yield and antioxidant activity of GEMAR powder beverage as a therapy for DM.

Methods This is a quantitative research study employing a true experimental design, which will be analyzed descriptively. The ingredients GEMAR beverage powder germinated black rice, germinated mung bean, tempeh, red spinach, skimmed milk, soy protein isolate, and maltodextrin. The GEMAR beverage powder production includes sorting, mixing, roasting, drying, milling, and filtration stages. The GEMAR beverage yield value was obtained by comparing the final powder weight and the initial powder weight. Analysis of the antioxidant activity of GEMAR beverage powder using the DPPH method.

Results The yield of GEMAR beverage powder was 41.6% and the antioxidant activity of GEMAR powder beverage was 24.30±0.07%.

Conclusion This study concluded that GEMAR beverage powder is a functional beverage that has antioxidant activity and has the potential to be used as a therapy for DM.

Keywords: antioxidants; functional beverages; black rice; diabetes mellitus.

INTRODUCTION

Diabetes mellitus (DM) is a chronic condition characterized by elevated blood glucose levels surpassing normal thresholds. This results from the body's inability to produce adequate quantities of insulin or its inefficiency in utilizing insulin.¹

DM stands as one of the ten prominent causes of global mortality. The International Diabetes Federation (IDF) has documented an escalating prevalence of DM worldwide. In 2021, The IDF estimates that 536.6 million people were living with diabetes (diagnosed or undiagnosed) in 2021, and this number is projected to increase by 46%, reaching 783.2 million by 2045.²³

Most of the rise in DM cases have been observed in developing nations. DM is frequently initiated by excessive dietary intake, leading to the excessive accumulation of glucose and fat within the body. Prolonged
hyperglycemic conditions result in an elevation of oxidative stress levels and the generation of free radicals.\textsuperscript{4–6}

In the context of DM, there is an excessive production of superoxide within the mitochondria, alongside the generation of nitric oxide (NO). These two molecular species possess the capability to stimulate the enzymatic activities of nitric oxide synthase (iNOS) and endothelial nitric oxide synthase (eNOS). The heightened presence of NO can significantly impact the generation of elevated quantities of the oxidant peroxynitrite. This particular circumstance harbors the potential to inflict damage upon the structural integrity of DNA and induce disturbances in endothelial cell function, ultimately leading to complications in individuals afflicted with DM.\textsuperscript{7}

The impact of DM, if not treated immediately, affects many body systems and has the potential to result in various health problems including damage to kidney function, heart health, vision problems, polyneuropathy and many more.\textsuperscript{8–10}

The recommended approach in managing DM currently is dietary regulation (consuming foods high in antioxidants), physical activity and the simultaneous use of medication.\textsuperscript{5,11}

Beverage powder Germinated Black Rice (GEMAR) is a functional beverage made from germinated black rice and germinated mung bean. GEMAR beverage powder, a product derived from foundational research by researchers, has yet to undergo commercialization and serves as the primary focus of ongoing investigation. The sustained innovation within the beverage sector has garnered increased attention, particularly concerning health benefits and consumption convenience. The selection of GEMAR beverage powder as a research subject stem from the demand for products that not only offer health advantages but are also practical for consumption in the modern era.

The germination process is one method that can be used to increase the content of bioactive compounds, because the germination process causes physiological changes in black rice and mung beans.\textsuperscript{12,13}

Several studies have proven that the germination process can increase bioactive compounds.\textsuperscript{14–16}

Germinated black rice has a dark purple color indicating the high content of phytochemicals, namely anthocyanins. Apart from that, germinated mung beans are one of the nuts that contain isoflavones.\textsuperscript{13,14} Anthocyanin and isoflavone compounds are a class of antioxidants which are known to have benefits for DM sufferers.\textsuperscript{17}

The antioxidant properties of anthocyanins and isoflavones can contribute to reducing free radicals. This condition can improve cell function disorders, control blood glucose levels and prevent complications in DM sufferers.\textsuperscript{18,19} Therefore, it is important to consume foods high in antioxidants, such as brightly colored foods such as germinated black rice and germinated mung bean. This makes GEMAR powder have the potential to be a functional beverage. If there is sufficient antioxidant activity, then GEMAR Beverage powder could be used in DM therapy.

Research examining the antioxidant activity and yield of GEMAR beverage powder has never been conducted. Therefore, researchers aim to determine the antioxidant activity and yield of GEMAR beverage powder as a therapy for DM.

METHODS

Research Types and Designs

This type of research is quantitative research. The study design used is true experimental. The research results are analyzed descriptively, this type of research is used to analyze data by describing the data that has been collected.

Tools and Materials

The main ingredients for making GEMAR beverage powders are germinated black rice, germinated mung bean, tempeh, red spinach, skim milk, soy protein isolate and maltodextrin. The tools used in making GEMAR beverage powders are basins, flannel cloth, baking sheets, 80 mesh sieves, disk mills, cabinet dryers, blenders, thermometers, mixers and digital scales.

GEMAR Beverage Powder Procedure

The germination process for black rice and green beans refers to the research results of Pasaribu et al., (2022) and Pasaribu et al.,
The process of making GEMAR beverage powders goes through the stages of sorting ingredients, mixing ingredients, drying, flouring and filtering.

**The Yield**
The yield value of the GEMAR beverage powder is calculated using the following formula:

\[
Yield = \frac{\text{Weight } B_2}{\text{Weight } B_1} \times 100\%
\]

Information:
B1: Materials GEMAR
B2: GEMAR beverage powder after filtering

**Antioxidant Activity Analysis**
The method for analyzing the antioxidant activity of GEMAR beverage powders used is DPPH which consists of:

1. Preparation of reagent solution for blank grating 0.5 mM DPPH Weigh 20 mg of DPPH powder (1,1-diphenyl-2-picrylhydrazyl) then dissolve in methanol to a volume of 100 mL.
2. Preparation of blank solution C = 50 μg/ml 1 mL of 0.5 mM DPPH solution was pipetted, then put into a 5 mL volumetric flask, then the volume was filled with methanol to the mark line to obtain a concentration of 50 μg/mL.
3. Measurement of the maximum absorption wavelength of DPPH (1,1-diphenyl-2-picrylhydrazyl) The DPPH solution with a concentration of 50 μg/ml was homogenized with a vortex and its absorption was measured at a wavelength of 400-800 nm, which is the wavelength of visible light.
4. For antioxidant testing, 0.1 gram of sample was dissolved in 10 ml of Aquades. Pipette 0.6 ml then put into a 5 ml volumetric flask. Into each volumetric flask, 1 ml of 0.5 mM DPPH (1,1-diphenyl-2-picrylhydrazyl) solution was added, then filled with methanol to the mark line, homogenized with a vortex, then left for 30 minutes, then the absorption was measured using Uv-Visible Spectrophotometer at a wavelength of 516 nm.

5. The percentage measurement of % total antioxidant activity is calculated using the equation:

\[
\% \text{ Total Antioxidant Activity} = \left(\frac{A_0 - A_1}{A_0}\right) \times 100\%
\]

Information:
A0: Control Absorbance
A1: Sample Absorbance

**RESULTS**
**Yield of GEMAR Beverage Powder**
GEMAR beverage powder ingredients that have been dried are used in the powder manufacturing process disk mill. The resulting coarse powder is then continued with filtration using an 80-mesh sieve. The result of the filter will be a fine powder of the GEMAR beverage powder. The yield results of the GEMAR beverage powder obtained can be seen in Table 1.

<table>
<thead>
<tr>
<th>Sample</th>
<th>B1</th>
<th>B2</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEMAR Beverage Powder</td>
<td>4,233 g</td>
<td>1,764 g</td>
<td>41.6%</td>
</tr>
</tbody>
</table>

Information:
B1: Materials GEMAR
B2: GEMAR beverage powder after filtering

Table 1 displays that the GEMAR beverage powder has a yield percentage of 41.6% from an initial weight of 4,233 g. Following the filtration process, 1,764 g of finely powdered GEMAR was obtained. This quantity is achieved during the drying phase of the material formed by the combination of various components. The drying process, leading to the formation of powder, is influenced by various factors, including the filler components, drying temperature, drying technique, and drying duration.

**Antioxidant Activity of GEMAR Beverage Powder**
The antioxidant activity of GEMAR beverage powder was analyzed using the DPPH-Free Radical Scavenging Assay with parameter %. Table 2 below shows that the highest analysis
The analysis of antioxidant activity examination was repeated three times. Based on this analysis, it is evident that the antioxidant content remains consistent. The lowest analysis of antioxidant activity was in the first and third repeat analyses at 24.26%. The analysis of antioxidant activity in GEMAR Beverage Powder was in the second repeat analysis, namely 24.39%, while the lowest analysis of antioxidant activity was in the first and third repeat analysis at 24.26%.

Table 2. Antioxidant activity in GEMAR Beverage Powder

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Antioxidant Activity</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis 1</td>
<td>24.26 %</td>
<td></td>
</tr>
<tr>
<td>Analysis 2</td>
<td>24.39 %</td>
<td>24.30±0.07%</td>
</tr>
<tr>
<td>Analysis 3</td>
<td>24.26 %</td>
<td></td>
</tr>
</tbody>
</table>

Oxidative stress is induced by chronically elevated blood glucose levels. This condition will cause glucose toxicity, increase in free radicals, decrease in antioxidant capacity. Increased ROS results in damage to cell lipids, proteins, DNA and decreased insulin production. In addition, glucose toxicity can disrupt GLUT 4 transport, reduce IRS-1 activity, and lead to insulin resistance. Therefore, DM sufferers must carefully consider the optimal diet. In addition to tailoring food choices to individual needs, individuals with DM should also prioritize the selection of food ingredients rich in antioxidants as a strategy to mitigate oxidative stress. The consumption of antioxidant-rich food can also contribute to protecting pancreatic β cells, increasing insulin sensitivity, inhibiting gluconeogenesis, and reducing inflammation in DM sufferers.

The potential of GEMAR beverage powder for controlling blood glucose levels in individuals with DM through antioxidant mechanisms is noteworthy. The phytochemical potential present in GEMAR beverage includes antioxidant and antidiabetic compounds such as phenols, flavonoids, anthocyanins, and Gamma Aminobutyric Acid (GABA). Several studies have demonstrated that germinated black rice extract contains phenolic content of 2269 mg/g, flavonoids of 2.08 mg QE/g ± 0.01, and anthocyanins of 48.68 mg/g ±
1.56. Additionally, germinated black rice exhibit a GABA content of 9.39 mg/100 g in their dried form. Mung beans also contain phenols at a concentration of 26.7 ± 1.4 mg GAE/g extract, and germinated mung beans have a flavonoid content of 1.25 g/100 g.

However, before its application in therapy, it is imperative to conduct preclinical research using animal models of DM. So, the effects of GEMAR functional beverage on diabetes mellitus can be known.

CONCLUSION
Based on the results and discussion of this research, it can be concluded that GEMAR functional beverage powder has a yield value of 41.6% and an antioxidant activity of 24.30%. Beverage powder GEMAR holds potential as an adjuvant for DM due to its high antioxidant activity. Therefore, it is necessary to conduct preclinical research using animal models of diabetes to investigate the effects of GEMAR beverage powder.

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CONFLICT OF INTEREST AND FUNDING RESOURCES
None of the authors have any financial or personal conflicts of interest related to this paper.

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