

I. INTRODUCTION

1.1. Background

Diabetes Mellitus (DM) is a metabolic disorder characterized by the presence of chronic hyperglycemia accompanied by greater or lesser impairment in the metabolism of carbohydrates, lipids, and proteins. According to the population studied, the global population of people aged 20 and up with diabetes mellitus reached 463 million in 2019, accounting for 9.3 percent of the world's population. Meanwhile, with a prevalence of 10.9 percent, Indonesia is the sixth-highest ranked country in terms of people with diabetes mellitus (Kamilah et al., 2021).

Food intake has already been highly related to diabetes, not only in terms of volume but also of diet composition and quality. Consumption of red meat, sweets, high carbohydrates, and fried foods tends to increase the risk of developing insulin resistance and type 2 diabetes mellitus (T2DM) (Sami et al., 2017). Limiting carbohydrate intake frequently leads to improvement in glucose control. Instead of focusing on specific micronutrients, macronutrients, or specific meals, the American Diabetes Association (ADA) encourages diabetics to develop a healthy balanced diet. Furthermore, the ADA encouraged that carbohydrates in a diet be sourced primarily from legumes, fruits, vegetables, dairy (yogurt and milk), and the whole grains, with highly processed foods and sweet beverages avoided (Awuchi et al., 2020). Consumption of whole grains is chosen since it contains high dietary fibers, vitamins, antioxidants, and phytochemicals such as phenolic compounds, beta-glucan, and lignans, which have been shown to protect against a variety of metabolic diseases including type 2 diabetes mellitus (Xu et al., 2021).

Brown rice, as well known as cargo rice, is paddy rice that has only had the husk removed but has not been polished further, preserving the rice bran. Whole-grain consumption lowers the risk of T2DM by lowering energy intake, preventing weight gain, and increasing insulin sensitivity (Aune et al., 2013). According to a study conducted by Abdul et al. (2021), a brown-rice diet

substantially decreased body weight when compared to a white-rice diet. However, there are also several challenges in developing brown rice-based products because brown rice is much more costly compared to white rice, may not be as readily available, has such a shorter life span, and becomes rancid if kept for more than 4–6 weeks due to a high-fat content within bran, has such a rough texture and a bad appearance, is vulnerable to a storage insect pest, and requires more cooking process (Selvam et al., 2017). Therefore to extend the shelf life, the brown rice was divided into small packaging and undergoes vacuum packaging. In addition, the quality of brown rice could also be maintained by keeping it in the refrigerator (Selvam et al., 2017).

On the other hand, oyster mushrooms are members of the genus *Pleurotus*, which is the easiest fungus to grow and requires the least amount of production technology (Jongman et al., 2018). Oyster mushroom is a high-nutritional-value food that is high in vitamin, iron, protein, and non-starchy carbohydrate (Hilal et al., 2012). Oyster mushrooms have low-calorie content as well as a high protein, mineral, and dietary fiber content (Beluhan and Ranogajec, 2011). Oyster mushrooms are high in Vitamin C, B complex, and mineral salts that the human body requires (Randive, 2012). A study conducted by Khatun et al. (2007) stated that oyster mushrooms may increase bile acid secretion and cholesterol loss through stool. As a result, oyster mushrooms reduced cholesterol and triglycerides and blood glucose, and blood pressure in diabetic participants, despite no change in weight or HDL.

Ready-to-eat food (RTE) is defined as food that is provided or attributed for sale without further food preparation, is stored on the premises where it is sold, and is ready for consumption. Ready-to-eat (RTE) foods are becoming progressively popular with consumers, attributed to their simplicity of preparation and storage, as well as consumer appeal factors such as simplicity, quality, overall appearance, and texture (Gupta & Dudeja, 2017). One of the most common RTE food is snacks. Snacking is generally described as eating foods and drinks during a regular diet; although, the definition differs slightly, with some research determining specific amounts of time following a meal and some others defining the portions of food (e.g., smaller portion sizes than

normal meals) or calories ingested. Regardless of the differences in definitions of snacking, it is critical to distinguish between snacks and meals to investigate their distinct role in daily energy consumption and influence on health (Njike et al., 2016). Nonetheless, there is agreement that nutrient-deficient and energy-dense snacking must be avoided. Snacks are considered healthy if its contents are compatible with recognized dietary recommendations and standards, which support diets high in fruit, vegetables, and whole grains and low in total fat (particularly solid fats), salt, and refined sugars. Nonetheless, despite widespread public interest in eating healthier foods and snacks, ready-to-eat highly processed snacks are becoming more commonly available (Njike et al., 2016). Therefore, the development of ready-to-eat food products with the addition of nutritional value and health benefits might be accepted in the RTE market (Hillier-Brown et al., 2017). There is currently limited information available on specialized products designed for diabetes.

Brown rice as product development with the addition of oyster mushroom may give significant nutrients, including an adequate number of essential amino acids, fiber but with low-fat content, and significant levels of vitamins (C, D, E, B1, B2, and B12). In terms of diabetic prevention, the inclusion of oyster mushrooms may minimize the risk of diabetes due to its low carbohydrate and fat content (Majeed et al., 2017). Puffed brown rice with the addition of oyster mushroom flavoring was chosen as an anti-diabetic snack. As a result, the incorporation of brown rice into this sort of snack product in this project will provide a familiar taste and feel to Indonesian foods and can be accepted in the market.

1.2. Objective

- a. To analyze the effect of puffed brown rice after soaking with different concentrations of brine solutions and different oyster mushroom powder ratios on the nutritional properties of the puffed brown rice, such as ash, carbohydrate, mineral, fat, moisture, and protein content.

- b. To analyze the effect of puffed brown rice after soaking with different concentrations of brine solutions and different oyster mushroom powder ratios on the nutritional properties of the puffed brown rice, such as potassium, magnesium, and manganese.
- c. The changes in physicochemical properties of puffed brown rice after soaking with different concentrations of brine solutions and different oyster mushroom powder ratios, including texture, color, expansion volume, puffed yield, and bulk density.

1.3. Scope of research

Product development of puffed rice prototype foods based on brown rice and oyster mushroom food product development for blood glucose control. Conduct a pilot study to define the product that was used as the final product. This food product development also included physicochemical such as texture, color, expansion volume, expansion ratio, bulk density, and puffed yield and proximate analysis such as carbohydrate, mineral, lipid content, and protein content of food products.

1.4. Hypothesis

- a. H_0 : Puffed brown rice with a higher oyster mushroom powder ratio will produce no difference in nutritional value compared to the control (Puffed brown rice).
 H_1 : Puffed brown rice with a higher oyster mushroom powder ratio will produce different nutritional values compared to the control (Puffed brown rice).
- b. H_0 : The addition of different brine solution concentrations while soaking the rice for puffed brown rice and different oyster mushroom powder ratios shows no changes for several parameters (texture, shape, taste, and color).
 H_1 : The addition of different brine solution concentrations while soaking the rice for puffed brown rice and different oyster mushroom powder ratios shows significant changes in several parameters (texture, shape, taste, and color).