

## The Potential of Local Wisdom in *Dadio* as a Source for Biology Learning

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### ABSTRACT

Dadio is a traditional food of the Malay community in Kampar, Indonesia, made from fermented buffalo milk using bamboo as a medium. It is consumed as a supplementary food and is an essential part of traditional ceremonies, a practice that continues to this day. This study aimed to understand the dadio-making process among the Malay community in Kampar and analyze the scientific concepts embedded within it. A case study design was employed, focusing on the dadio-making process in Limau Manis Village, Kampar Regency. Data was collected through in-depth interviews, observations, and document analysis. Primary data was obtained from interviews with dadio makers and field observations. Secondary data was gathered from scientific literature to analyze the scientific concepts present in the local wisdom of dadio. Data analysis was conducted using Miles and Huberman's interactive model, encompassing data collection, reduction, display, and conclusion. The results show that the community uses buffalo milk, tipih manih bamboo (*Schizostachyum blumei*), and batu banana leaves (*Musa Paradisiaca* var. *balbisiaca* colla) to make dadio. The process begins with traditional buffalo milking and a 12-hour fermentation process. Dadio has become an identity for the Malay community in Kampar due to its use in traditional ceremonies and as a supplementary food. The community believes that consuming dadio offers health benefits such as managing hypertension and cholesterol and serving as a supplement for pregnant and lactating women. The dadio-making process involves various scientific concepts, including microbial metabolism, microbial diversity, bacterial physiology, plant anatomy and morphology, and fermentation. Thus, it holds potential as a learning resource for biology.

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## INTRODUCTION

Indonesia is rich in cultural diversity and indigenous wisdom, with over 300 ethnic groups and 1,340 tribes (BPS, 2022). This diversity encompasses language, environmental stewardship, customs, arts, and culinary traditions. Communities across the archipelago possess unique cultural systems governing natural resources, health, knowledge, law, and economics (Bennett, 2015). This cultural tapestry constitutes the nation's identity and is a vital resource for addressing global challenges. Local wisdom or traditional knowledge passed down through generations, is deeply embedded in the lives of Indonesians, fostering a strong sense of identity and community (Chan, 2022; Shore & Black, 2021). It encompasses practices and knowledge developed to adapt to the environment and overcome challenges.

Ethnoscience offers a framework for integrating culture into meaningful learning experiences. This approach optimizes integrated and contextual education by leveraging the environment as a learning resource (Forniawan, 2022; Ilhami & Yasnel, 2022). Ethnoscience represents the knowledge of a specific tribe or ethnic group (Merriam-Webster, 2024). Sudarmin, (2014) defines it as a body of scientific knowledge acquired through specific methods and procedures within an ethnic group, subject to empirical verification. Ethnoscience-based learning fosters connections between academic content and students' everyday lives (Sayekti, 2019). Indigenous or original science, rooted in local culture, reflects the worldview shaped by people's experiences. This knowledge encompasses diverse domains, including agriculture, water management, and navigation.

Riau Province, renowned for its rich cultural heritage, is home to diverse ethnic groups, with Malays constituting the majority (Diskominfo, 2020). Kampar Regency within Riau exemplifies the widespread integration of local wisdom into community life, particularly in traditional food. Often preserved in rural areas, Malay customs and traditions serve as social regulatory mechanisms. The Malay people possess a deep understanding of food-related knowledge. Examples of Riau's local food wisdom include the *manumbai* as traditional honey harvesting in Pelalawan Regency (Syafiq, Kartini, Sudrajat, & Romdania, 2023), the Sakai tribe's culinary knowledge in Bengkalis (Suwondo, Darmadi, & Yunus, 2014), the Maaowo tradition, conserving river ecosystems in Kampar (Ilhami, Syahvira, Maisarah, & Diniya, 2020), ethnoecology local communities on kasboyo lake (Ilhami, Suci, Fernando, & Pernantah, 2021), *lomang* tradition as ethnofood in Kampar (Ardana et al., 2023), and *bolu kemojo* as malay

ethnofood in Riau (Masyhuri & Ilhami, 2023). Traditional food encapsulates regional identity and reflects the local environment's potential. The Limau Manis village in Kampar Regency produces a unique fermented milk product called *dadio*.

*Dadio* is a traditional food made from buffalo milk using bamboo. This traditional food is made simply through fermentation in bamboo tubes, usually covered with banana leaves. The fermentation process is done by lactic acid bacteria found in buffalo milk. Local people used bamboo as a fermentation vessel (Roza et al., 2022). Usually, this natural fermentation in bamboo tubes lasts at least one to two days. The fermentation process will produce dense cream with a soft texture and a sour taste (Gemechu, 2015). *Dadio* is a traditional food and has cultural value for the Kampar community. People consider *dadio* food that must be served at weddings and traditional events (Src, 2023). It is not easy to find in every area because it depends on the presence of buffalo breeders. *Dadio* processing still uses traditional milking, so the number is relatively limited or appears more often at traditional events.

The community also uses *Dadio* as a source of economic income, so it can still be found in traditional markets. People have used traditional methods of making *dadio* for generations, and it is still a food consumed today. Research on *dadio* as a learning resource still needs to be conducted. *Dadio* scientific studies are very appropriate to be carried out as support for preserving local culture. The study is very useful in strengthening students' understanding of science concepts, especially in Riau Province. The contribution of this research is as a reference that educators can use in developing science teaching materials based on local wisdom on the theme of biotechnology. Therefore, research on *dadio* is very worthy of scientific study. This research aims to describe the process of making *dadio* and analyze the scientific concepts contained in processing *dadio* by the Kampar community.

## RESEARCH METHODS

This study employs a qualitative research approach with a case study design. According to (Yin, 2018), a case study examines a phenomenon within its real-life context when the boundaries between phenomenon and context are not evident, and multiple sources of evidence can be used. This research analyzes *dadio* processing by the local community in Limau Manis village. This village is the only remaining village that maintains its position as the central

production hub for *dadio* in the Kampar region. Almost all *dadio* found in traditional markets originate from the people of Limau Manis Village.

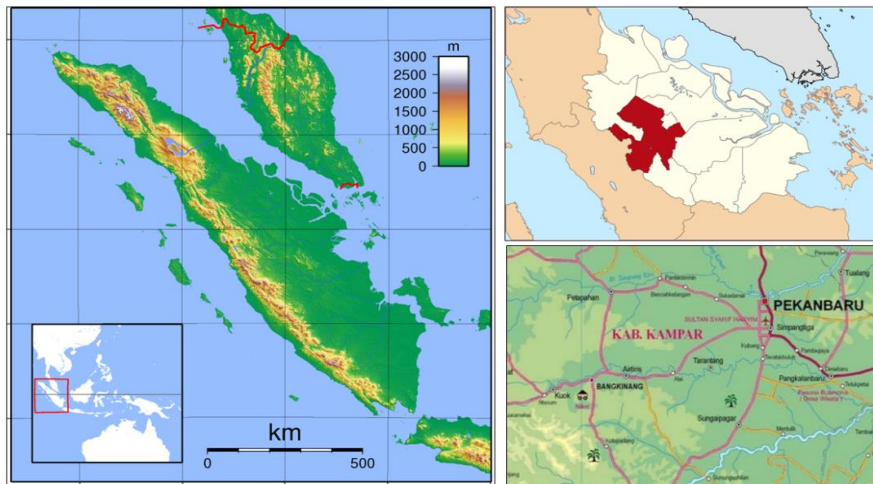


Figure 1. Kampar Regency Map

Source: <https://www.indonesia-geospasial.com/>

Data was collected using observation, in-depth interviews, and document analysis. The researcher conducted field visits to observe the *dadio*-making process, which included buffalo milk milking and the *dadio* production process. In-depth interviews were employed to obtain comprehensive information regarding *dadio* production. The informants were three *dadio* makers from Limau Manis Village. The informants were purposively selected based on their knowledge of *dadio* processing in the Kampar region. Almost all of the *dadio* sold in traditional markets in Kampar Regency is supplied by *dadio* makers from Limau Manis village. Document analysis was used to capture images of the *dadio*-making process and to utilize scientific articles to obtain research findings on *dadio*. The use of multiple methods was triangulated to ensure the validity of the qualitative data. According to Bans-Akutey & Tiimub (2021), triangulation was conducted to enhance data credibility through multiple sources, methods, or time.

Data analysis was conducted using qualitative analysis. The data was collected and analyzed using Miles and Huberman's interactive analysis model, which comprises data collection, data reduction, data display, and conclusions.

## RESEARCH RESULTS

### The Production of *Dadio* by the Limau Manis Village Community, Kampar Regency

*Dadio* is produced by milking water buffaloes that meet specific criteria. The buffaloes used are exclusively lactating females that are allowed to graze freely in pastures. The community

employs a traditional method of hand milking to extract the milk. This milk is then processed to produce the *dadio*.

*Susu kobou ajo yang bisanyo, dulu ado pona ba cubo pakai susu jawi, ndak omuo jadi lo, mungkin kandungan susu kobou jo jawi du beda, makonyo ciek susu kobou ajo yang bisa.*” (Buffalo Breeder in Kampar, Personal Communication, February 7, 2024)

Respondents reported that *dadio* is exclusively made from buffalo milk. The community had previously attempted to use cow's milk but failed to produce a similar coagulum. They hypothesize significant differences in the nutrient composition between buffalo and cow's milk. Buffalo milk is particularly suited for *dadio* production due to its higher total solids content of 18% compared to cow's milk at 10-12%, resulting in a denser and firmer *dadio* consistency and texture. Compared to *dadio* made from cow's or goat's milk, buffalo milk *dadio* exhibits higher protein and fat content (Wirawati, Sudarwanto, Lukman, & Wientarsih, 2017). Furthermore, buffalo milk *dadio* possesses superior textural qualities, including a more compact, dense structure and a smoother texture than *dadio* produced from other milk sources.

Buffaloes used for milking are typically fed solely on grass. However, the majority of buffalo herders primarily use hay as feed. The community of Limau Manis is particularly cautious about feed selection, believing it significantly impacts milk quantity and quality. They focus on ensuring that milking buffaloes produce a higher volume of milk. Farmers pre-feed the buffaloes with jackfruit and *lemang* skin (banana leaves used to wrap a type of sticky rice) to facilitate the milking process. The purpose of this pre-feeding is to calm the buffaloes during milking.

Milk obtained from milking is stored in a refrigerator to maintain its shelf life and prevent spoilage. The application of technology has aided society in prolonging milk shelf life. Before this technological advancement, communities faced challenges in stockpiling raw materials due to the short shelf life of milk at ambient temperature. Once milking is complete, the milk is stored in sealed plastic bottles. These bottles are then placed in a freezer.

The primary cause of milk spoilage is the growth of bacteria and fungi. These microorganisms can originate from various sources, such as the air, unclean equipment, or human hands. Farmers use their hands, which are highly susceptible to bacterial contamination during the milking process. Bacteria and fungi degrade lactose into lactic acid, resulting in milk's souring and rancid odour (El-Leboudy, Amer, & El-Mohsen, 2015; Gröhn et al., 2004). In addition to bacteria and fungi, temperature plays a critical role in milk spoilage. Warm ambient



temperatures ,above four °C, accelerate the growth of bacteria and fungi in milk (Deeth & Lewis, 2017). The longer milk is left at room temperature, the higher the likelihood of spoilage. Exposure to air can also lead to milk spoilage. Airborne bacteria and fungi can contaminate the milk.



**Figure 2. The fermentation process of buffalo milk to produce *dadio***

*Dadio* is a fermented dairy product traditionally prepared in bamboo tubes and covered with banana leaves. After incubation at ambient temperature ( $\pm 25^{\circ}\text{C}$ ) for one to two days, a unique fermented milk product is obtained. Buffalo milk serves as the primary ingredient in *dadio* production. Despite its long history, the manufacturing process of *dadio* remains largely artisanal, lacking standardized protocols. Consequently, variations in taste, aroma, and texture are commonly observed among *dadio* products from different regions. The absence of added skim in traditional *dadio* production contributes to preserving its characteristic sensory attributes.

*“Ciri khas dadio go samo ajo, mungkin di kebersihan ajo yg buek beda, tu bagai menurut langganan etek, aso dadio etek go lebih segar di bandiong dadio yang lain. nyo etek kebersihan du yang paling etek jago. Ndak banyak alat bahannyolo, kalau alat cuma teko, wadah, buluo tu kuisiok pisang, kalau untuk bahan ciek susu kobou ajo ndak ado campu lain.”* (Buffalo Breeder in Kampar, Personal Communication, February 7, 2024)

Respondents reported that the tools used were simple, such as containers, bamboo sections, and dry banana leaves, all kept clean. The community has demonstrated a literacy of hygiene for tools and materials, as it can affect product quality. Before starting the *dadio* production, tools and materials such as bamboo tubes, banana leaves, and buffalo milk were prepared.

The type of bamboo used was *Schizostachyum blumei*. The characteristics of *S. clumei* include a stem height of 3-7 meters from a short woody rhizome. The thin-walled stem can be erect or

curved, with a drooping tip; the diameter is 10-20 mm with internodes 30-60 cm long. Bamboo has a fascinating growth method. This bamboo is generally monocarpic, living for many years before flowering, then flitting profusely for 1-3 years before usually dying. The banana leaf used was from the *Musa Paradisiaca* var. *balbisiana* colla variety. This banana has very thick skin with a yellowish-green colour, and sometimes brown spots, and its flesh is sweet. *Musa Paradisiaca* var. *balbisiana* colla grows at an optimum temperature of around 27°C and a maximum temperature of 38°C. This banana has wide and thick leaves (Sinta & Hasibuan, 2023).

The production of *dadio* involves several stages that the maker must carry out to ensure the quality of the resulting product. *Dadio* is made from buffalo milk poured into bamboo tubes and left to ferment naturally at room temperature. Once solidified, the *dadio* is covered with dried banana leaves. Fresh buffalo milk is poured into the cleaned bamboo after being filtered. The bamboo is then covered with newspaper and left to ferment overnight. When the milk has coagulated, the fermentation process is complete, and the bamboo is then covered with dried banana leaves. Using banana leaves with a hard texture, such as those from the banana tree, is preferred as they are not easily torn. The community believes that the use of banana leaves can absorb evaporated water.

The community reports that *dadio* has many health benefits. *Dadio* is believed to increase male vitality, thus benefiting married couples. The community also believes that the nutritional value of *dadio* alleviates high blood pressure, increases breast milk production, and improves appetite. The fermented milk contains lactic acid bacteria (LAB) that can potentially be probiotics, which are live microorganisms that adhere to the intestinal wall and benefit the host's life and health. LAB has positive effects on health because the metabolites produced can inhibit pathogenic bacteria, have anti-mutagenic, anti-carcinogenic, and anti-vaginitis properties, improve the immune system, prevent constipation, and produce vitamin B and bacteriocins (Usmiati & Risfaheri, 2017).

### **The Scientific Concept Embedded in *Dadio* Management in Limau Manis Village, Kampar Regency**

Almerico (2014) posits that traditional food is intricately connected to socio-humanistic aspects, serving as a marker of a community's identity. Traditional culinary practices, such as the creation of *dadio*, embody scientific principles that can be validated empirically through

laboratory experimentation. While communities often rely on experiential and ancestral knowledge for these practices, Table 1 offers a scientific reconstruction of *dadio*-making processes in Limau Manis Village, Kampar Regency, demonstrating the underlying scientific rationale behind these traditional food preparations.

**Table 1. Reconstruction of Scientific Knowledge in the Making of *Dadio* by the Kampar Community**

Aspect	Local community knowledge	Scientific knowledge
<b>Preparation of making <i>dadio</i></b>	The raw material for <i>dadio</i> is exclusively buffalo milk and not cow's milk.	Buffalo milk exhibits a higher total solids concentration of 18% compared to cow's milk at 10-12%, resulting in a denser consistency and texture of the resulting <i>dadio</i> . Buffalo milk's protein content is greater than cow's milk's (Salman et al., 2014)
	Buffalo milk is refrigerated to inhibit spoilage	A temperature of 0°C significantly inhibits bacterial metabolism. Enzymes, the proteins essential for bacterial metabolism, cannot function optimally at low temperatures. This slowed metabolism means that bacteria cannot generate energy or reproduce normally (Asiah, Cempaka, Ramadhan, & Matatula, 2020). The bacterial cell membrane is composed of lipids. A drastic decrease in temperature affects the lipid structure, causing it to become rigid and fragile. So, it can lead to membrane leakage and damage, resulting in the loss of essential cellular components and cell death (Luscher, Schlüter, & Knorr, 2005)
	The addition of palm sugar and coconut rice ( <i>lemang</i> ) can increase buffalo milk production.	The incorporation of palm sugar into the diet of water buffaloes can significantly enhance milk quality. Palm sugar is a rich source of essential minerals and vitamins directly transferred into the milk. Its lower glycemic index compared to white sugar offers additional nutritional benefits (Pontoh, Gunawan, & Fatimah, 2011). Lemang contains 23.45% carbohydrates, 3.98% protein, and 4.93% fat. Additionally, it is a source of several minerals, including calcium, phosphorus, and iron (Yunita & Nuraini, 2018).
<b>Making of <i>dadio</i></b>	The buffalo milk underwent a traditional process involving containment in a bamboo tube and sealing with newspaper to induce coagulation	The production of <i>dadio</i> involves the fermentation of buffalo milk by lactic acid bacteria (LAB) such as <i>Lactococcus</i> and <i>Lactobacillus</i> (Sukma et al., 2018). <i>Lactobacillus plantarum</i> and <i>Lactobacillus lactis</i> have also been identified as prevalent strains in this process (Amelia, Philip, Pratama, & Purwati, 2021). Bamboo, serving as a fermentation medium, facilitates the growth and activity of LAB. The inner wall of bamboo aids in the dispersion of LAB, contributing to the fermentation process. LAB primarily employs aerobic respiration to generate energy. Nevertheless, LAB resorts to lactic acid fermentation under anaerobic conditions as an alternative energy source. This metabolic pathway results in the production of lactic acid as the final product (Roza et al., 2022).



Aspect	Local community knowledge	Scientific knowledge
	The <i>dadio</i> -making process requires one night.	Buffalo milk's fermentation duration can vary from 4 to 48 hours, producing lactic acid. This process depends on several factors, such as temperature and type of buffalo milk. The optimal temperature for buffalo milk fermentation is between 20°C and 30°C (Gemechu, 2015). Lower temperatures will slow down the fermentation process, while higher temperatures can kill lactic acid bacteria. Buffalo milk from different buffalo species has varying fat and protein contents, influencing fermentation duration (Bevilacqua, Regueira, Mauricio-Iglesias, Lema, & Carballa, 2020).
	The closure of the <i>dadio</i> with dried banana leaves can facilitate water absorption	BAL is categorized as a facultative anaerobic microorganism. Aerobic respiration in BAL produces H <sub>2</sub> O gas, subsequently forming water molecules (Pedersen, Gaudu, Lechardeur, Petit, & Gruss, 2012). Dried banana leaves possess a porous structure characterized by numerous small interstices on their surface. These interstices facilitate the entry and entrapment of water within the leaf. The dried leaves contain hydrophilic substances, including cellulose, hemicellulose, and lignin. These hydrophilic substances exhibit a strong affinity for water molecules, enabling them to attract and bind water (N. Abdullah, Sulaiman, & Taib, 2013)
	The bamboo used in the production of <i>dadio</i> is <i>tipih manih</i> bamboo.	<i>Schizostachyum blumei</i> , commonly known as <i>tipih manih</i> bamboo, is characterized by its relatively short, woody rhizome and stems reaching 3-7 meters. The culms or stems are typically thin-walled and may exhibit erect or curved growth habits, often terminating in drooping tips. Culm diameters range from 10 to 20 mm, with internodes measuring 30 to 60 cm long (Deeth & Lewis, 2017). This species is notable for its lactic acid bacteria (LAB) content, contributing to fermentation processes (Patel & Mehta, 2021). Moreover, <i>tipih manih</i> bamboo possesses a superior water absorption capacity, resulting in a denser texture of the resulting <i>dadio</i> product (Tropical, 2023).
	<i>Dadio</i> will not retain its freshness if left open for 2-3 days as it will develop an acidic taste	The increase in acidity during milk fermentation is attributed to bacterial activity that breaks down lactose into lactic acid. As fermentation time increases, the number of bacterial colonies also increases to break down lactose. Milk casein becomes unstable and coagulates, forming a gel. Contaminant bacterial colonies include <i>Enterococcus</i> , <i>Klebsiella</i> , and <i>Leuconostoc</i> (Sukma et al., 2018)
<b>Utilization of <i>Dadio</i></b>	<i>Dadio</i> is believed to be a healthy food.	Bacteria isolated from <i>L. fermentum</i> yogurt have been shown to reduce inflammation associated with diabetic complications. This study observed a decrease in the expression of NF- $\kappa$ B antibody, a pro-inflammatory biomarker that increases with hyperglycemia. <i>L. fermentum</i> exhibited the most significant impact, with a comprehensive composition and a greater effect on biomolecular and clinical outcomes. These findings suggest that yogurt plays a role in lowering cholesterol (Amelia

Aspect	Local community knowledge	Scientific knowledge
		et al., 2021)
	<i>Dadio</i> is utilized for the treatment of hypertension	<i>L. plantarum</i> bacteria isolated from <i>dadio</i> exhibited immunomodulatory capabilities. When administered to Wistar strain <i>L. novergicus</i> rats, it significantly increased the levels of immunoglobulin A (IgA) in the gastrointestinal tract (small intestine) of hypertensive rats (D. Abdullah, Poddar, Dewi, & Pratama, 2023)
	<i>Dadio</i> is consumed to increase breast milk production in lactating mothers	Fermentation of buffalo milk has been proven to possess high concentrations of calcium, zinc, and iron while maintaining total LAB. This food has been found to contain $6.4 \times 10^9$ CFU/ml of LAB. Therefore, <i>Dadio</i> can be a good choice as a functional food supplement for prenatal supplementation and a dietary supplement for pregnant women (Taufiq, Chandra, Helmizar, Lipoeto, & Hegar, 2021) <i>L. plantarum</i> isolated from fermented buffalo milk increases folate levels (Purwandhani, Utami, Millati, & Rahayu, 2017).

## DISCUSSIONS

The fermentation of *dadio* requires tools and materials, including bamboo, banana leaves, and buffalo milk. Bamboo contains several microbes, including lactic acid-forming microorganisms, protein degraders, and spore formers. Bamboo is a versatile and durable plant closely related to LAB (Patel & Mehta, 2021). LAB are naturally found on the inner surface of bamboo—the presence of LAB benefits both bamboo and humans. LAB carries out fermentation, resulting in a sour taste. The increase in acidity during milk fermentation is due to the activity of bacteria in converting lactose into lactic acid. As fermentation time increases up to a certain point, the number of bacterial colonies increases to break down lactose. Milk casein becomes unstable and coagulates to form a gel (Sukma et al., 2018).

LAB is the primary microorganism involved in the production of *dadio*. The presence of LAB in fermented milk can occur spontaneously and has been practiced in traditional fermented milk products for years. The types of LAB from buffalo milk fermentation can vary depending on the inoculation area. The dominant LAB genera identified in *dadio* are primarily from the *Lactobacillus*, *Leuconostoc*, *Lactococcus*, *Streptococcus*, and *Enterococcus* (Roza et al., 2022). The characteristics of fermented milk products produced through fermentation are highly dependent on the conditions of the location where the product is made. The isolation results of LAB in

*dadio* consist of 36 strains of the genera *Lactobacillus*, *Streptococcus*, *Leuconostoc*, and *Lactococcus* (Sisriyenni & Zurriyati, 2018).

LAB in *dadio* is believed to benefit human health. In addition to being probiotics, LAB produces various bioactive components with different physiological effects (Wirawati et al., 2017). *Dadio* is rich in protein (6.30%), fat (6.73%), and vitamin A (80 IU). Through the fermentation process, there are beneficial physical and chemical changes such as flavor, aroma, texture, digestibility, and shelf life (Chalid & Hartiningsih, 2017). LAB are generally classified into two groups based on their optimal growth temperature. Mesophilic LAB has an optimal growth temperature of 20-30°C, while thermophilic LAB has an optimal growth temperature of 30-45°C. Microflora of traditional fermented milk products from tropical and subtropical regions will be dominated by thermophilic LAB, namely the *Lactobacillus* and *Streptococcus* genera. Meanwhile, in temperate regions, the microflora of traditional fermented milk is dominated by mesophilic LAB, namely the genera *Lactococcus* and *Leuconostoc* (Wirawati et al., 2017).

*Dadio* has a distinctive flavor combining bamboo and milk aroma and a clean white color. The *dadio* the community prefers is white, with a soft texture and a specific aroma. The production process greatly influences the taste, aroma, color, and texture of *dadio*. The production of *dadio* requires discipline, hygiene, and sanitation because it involves bacteria in the production process. The LAB found in *dadio* can adhere to the intestinal walls and benefit the host's life and health. LAB has beneficial effects on health because the metabolites produced can inhibit pathogenic bacteria, have anti-mutagenic and anti-carcinogenic properties, improve the immune system, prevent constipation, and produce vitamin B and bacteriocins (Isazadeh et al., 2020; Sharifi et al., 2017). The mechanism of the anti-mutagenic effect occurs due to the binding of mutagens or carcinogens to peptidoglycan found in the cell wall of LAB in *dadio*. Mutagens and carcinogens bound by these bacteria are excreted through feces and urine (Ślizewska, Markowiak-Kopeć, & Ślizewska, 2020).

*Dadio* from the Kampar community has great potential to improve food security and realize the SDGs. *Dadio* contains protein, calcium, vitamin A, and B12, which are important for public health and nutrition. This food becomes a local food product that is easy to process and access for the community, especially in rural areas. *Dadio* helps increase the economic value of milk and empowers buffalo farmers (Helmizar, Setyaka, & Susmiati, 2022). *Dadio* can contribute to the issue of hunger and malnutrition by providing an easily accessible source of protein and

nutrients. Proactive efforts continue to be made to ensure the sustainability of *dadio*. Studies on *dadio*, both from a specific conceptual review, must be carried out to improve the quality and diversification of *dadio* products. The empowerment of farmers is also important, as increasing training and market access for dairy buffalo farmers will increase production and the quality of *dadio*. The community needs to be educated about the benefits of *dadio* for health and food security so that local wisdom is maintained.

## CONCLUSION

*Dadio* is a traditional food of the Kampar community that is a must-have at every customary event. *Dadio* is a product of water buffalo milk that is naturally fermented for 12 hours in a bamboo container at room temperature. *Dadio* fermentation is carried out by microbes originating from water buffalo milk and bamboo. Bamboo sections contain a number of microbes, including lactic acid-forming microorganisms, protein-degrading microorganisms, and spore-forming microorganisms. The type of bamboo commonly used by the Limau Manis village community for making *dadio* is the *tipih manih* bamboo (*Schizostachyum blumei*). For the cover, dry banana leaves (kosiok) from the *Musa Paradisiaca var. balbisiana colla* banana species are used. Banana leaves actually have a lot of parenchyma tissue, which allows water to be stored in the intercellular spaces. Thus, banana leaves are effective in absorbing water.

The process of making *dadio* involves scientific concepts such as microbial metabolism, microbial diversity, bacterial physiology, plant anatomy and morphology, and fermentation. In the study of microbial metabolism, LAB converts food into energy and other products. LAB can utilize various food sources, including organic compounds and inorganic compounds (lactic acid). There are various types of LAB, including the genera *Lactobacillus*, *Streptococcus*, *Leuconostoc*, and *Lactococcus*. Fermentation by LAB shows a microbial metabolic process in which sugar is converted into lactic acid. Bacterial physiology shows the growth of LAB and the pathogenesis of pathogenic bacteria found in *dadio*, such as *Enterococcus* and *Klebsiella*. The use of bamboo and banana leaves is related to the tissue structure and morphology of plants, which are related to the process of making *dadio*. Therefore, the traditional food *dadio* is very relevant to be used as a material for biology learning, especially in learning based on local wisdom.

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