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ARTIKEL PENELITIAN

# Nutrient content in dadiah pudding, a potential source of probiotics from Minangkabau, West Sumatra

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## Abstrak

**Pendahuluan:** Dadiah merupakan produk susu fermentasi yang berasal dari susu kerbau rawa Sumatera Barat. Penambahan beberapa bahan dan pengubahan cairan dadiah menjadi bentuk puding dapat mempengaruhi kandungan nutrisi dan potensi sumber probiotik pada produk akhir. Penelitian ini bertujuan untuk mengevaluasi kandungan zat gizi makro dan zat gizi mikro, total kalori, dan total bakteri asam laktat pada puding dadiah. **Metode:** Pembuatan puding dadiah menggunakan susu fermentasi dadiah yang diperoleh dari Bukittinggi, Sumatera Barat. Kadar karbohidrat, protein, lemak, kalsium, seng, dan zat besi diukur sesuai Standar Nasional Indonesia, kemudian total kalori ditentukan dengan konversi 4:4:9 kkal/g. Inokulasi sampel pada agar de Man, Rogosa, dan Sharpe dilakukan untuk mengetahui jumlah total bakteri asam laktat, dan pewarnaan Gram dilakukan untuk konfirmasi morfologi lebih lanjut. **Hasil:** Hasil penelitian menunjukkan bahwa 100 g puding dadiah mengandung 6,49 g karbohidrat, 6,12 g protein, 23,31 g lemak, 260,23 kkal kalori, 276,61 mg kalsium, 3,75 mg zinc, 6,60 mg zat besi, dan $6{,}1\times10^{9}$ CFU/ml bakteri asam laktat dengan asumsi modifikasi cairan menjadi bentuk puding terbukti berdampak pada makronutrien, mikronutrien, total kalori, dan total bakteri asam laktat. **Kesimpulan:** Kandungan nutrisi pada puding dadiah yang terungkap dalam penelitian ini menunjukkan bahwa produk susu ini dapat digunakan sebagai sumber pangan lokal bergizi dan berpotensi menjadi probiotik.
**Kata kunci:** puding dadiah; susu fermentasi; gizi; probiotik

## *Abstract*

***Objective:*** *Dadiah is a fermented milk product derived from the milk of West Sumatran swamp buffaloes. Adding several ingredients and converting the dadiah liquid into pudding form may affect the nutritional content and potential source of probiotics in the final product. This study aimed to evaluate the content of macronutrients and micronutrients, total calories, and total lactic acid bacteria in dadiah pudding.* ***Methods:*** *The manufacture of dadiah pudding used dadiah fermented milk obtained from Bukittinggi, West Sumatra. Levels of carbohydrate, protein, fat, calcium, zinc, and iron were measured according to the Indonesian National Standard, then total calories were determined using 4:4:9 kcal/g conversion. Inoculation of samples on de Man, Rogosa, and Sharpe agar was performed to determine total lactic acid bacteria counts, and Gram staining was done for further morphological confirmation.* ***Results:*** *The result revealed that 100 g dadiah pudding contained 6.49 g of carbohydrates, 6.12 g of protein, 23.31 g of fat, 260.23 kcal of calories, 276.61 mg of calcium, 3.75 mg of zinc, 6.60 mg of iron, and $6.1\times10^{9}$ CFU/ml of lactic acid bacteria assuming that modification of the liquid into pudding form has been shown to impact macronutrient, micronutrients, total calories, and total lactic acid bacteria.* ***Conclusion:*** *The nutrient content in dadiah pudding revealed in this study indicates that this dairy product can be used as a nutritious local food source and a potential probiotic.*
***Keywords:*** *dadiah pudding; fermented milk; nutrient; probiotic*

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## INTRODUCTION

Dadiah also known as “dadiah” is a fermented dairy product made from the milk of West Sumatran swamp buffalo. It has become a popular food choice in Bukittinggi, Padang Panjang, Solok, Lima Puluh Kota, and Tanah Datar, providing local indigenous people with a safe, portable, and unique source of milk nutrients.[1]

Multiple studies have provided evidence of the beneficial effects of dadiah as a strategy to overcome malnutrition, highlighting its nutritional value and probiotic potential.[2] Dadiah has been shown to exhibit viability,[3] safety,[4] survival in the presence of acids and bile salts, along with the ability to adhere to the gastrointestinal mucosa, colonize the gut, and reduce pathogens.[5] Furthermore, it has demonstrated immune modulation properties[6,7] production of antimicrobial compounds, and resistance to antibiotics[8]. Dadiah’s consumption can contribute to the establishment of a healthy gut microbiome, supporting digestion and overall well-being.

Dadiah has higher energy and protein content than yogurt produced from cow’s milk.[9] This is attributed to the chemical composition of buffalo milk, particularly its protein, fat, lactose, and water content, which influences the nutrition profile of dadiah. The fermentation process of dadiah introduces changes to its nutrition profile.[9] Additionally, dadiah is a good source of micronutrients such as calcium, iron, zinc, iodine, and several B vitamins. As a probiotic product, dadiah contains $6.4 \times 10^9$ CFU/ml total lactic acid bacteria,[10] of which cover FAO/WHO requirements of 106 CFU/ml (FAO/WHO, 2002). Lactic acid bacteria were obtained mainly from raw fresh buffalo milk, bamboo tubes, or banana leaves[11] and produced different enzymes that affect nutritional content.[10,12] Beta-galactosidase, complex proteolytic systems, and the natural lipase of lactic acid bacteria from raw buffalo milk contribute to its metabolism. All of this provides a food product that is more nutritious and easier to metabolize than fresh buffalo milk. Different sources of milk, animal feed, and the fermentation process caused different amounts of lactic acid bacteria contained in dadiah.

Dadiah was produced traditionally, without meeting national standards[13] or

international standards[14] for yogurt and fermented milk. Made from fresh swamp buffalo milk, dadiah undergoes a natural fermentation process using indigenous lactic acid bacteria which mainly come from buffalo milk, bamboo tubes, or banana leaves. This fermentation process results in a distinct tangy flavor and creamy texture, reminiscent of yogurt. Indigenous people of West Sumatra usually serve dadiah at weddings and traditional ceremonies. They generally eat dadiah both as a nutritious snack and as an ingredient in various dishes within the Minangkabau culinary tradition such as 'Ampiang dadiah', a mixture of dadiah with traditional rice flakes, or 'Ketan dadiah', a mixture of dadiah with sticky rice and palm sugar. Dadiah is cherished for its cultural significance. It has become popular among those seeking traditional fermented dairy products.

Dadiah is stable for only three days at room temperature for optimal nutritional value and probiotic properties. Storage at lower temperatures will slow the fermentation process, extending its shelf life.[15] Our previous research modified the dadiah into dadiah pudding. Dadiah pudding was found to be more tolerant for consumption due to its reduced acidity and milder aroma compared to the dadiah. It has been proven that dadiah provides important micronutrients for pregnant women, and its lactic acid bacteria, as probiotic substances, are beneficial for maternal gastrointestinal health.[10] However, it is not yet known whether the macronutrient profile consisting of carbohydrates, protein, fat, total calories, micronutrients, and total lactic acid bacteria in dadiah pudding can be maintained through the addition of ingredients and processes during its manufacture. In addition, this study will also enrich data on the macronutrients and total calories of dadiah pudding due to regional differences and the source of buffalo milk as the main ingredient for making dadiah. This study aimed to evaluate the macronutrients, micronutrients, total calories, and total lactic acid bacteria in dadiah pudding due to the addition of various substances and processes during making dadiah pudding using dadiah Bukittinggi.

## METHODS

The Bukittinggi dadiah sample used was taken from Bukittinggi, West Sumatra. It was prepared in a traditional method by pouring fresh, unheated swamp buffalo milk into a bamboo tube. The local community in West Sumatra commonly utilizes bamboo gombong (Gigantochloa verticillata) for this fermentation process, as its hygroscopic nature and bitter taste help protect against ants. The bamboo tube was then covered with banana leaves, which naturally contain lactic acid bacteria, and left to ferment naturally at 28°C-30°C for 48 hours.



**Figure 1.** Traditional manufactured of dadiah (Surono, 2015a; Rawie & Alfred, 2019)

There was no boiling, pasteurization, or starter culture inoculation involved in the dadiah production process.1

The dadiah pudding sample was prepared following the recipe used in our previous study. The pudding mixture was made by cooking 15 g of pudding powder with 50 ml of water until it reached boiling point. The Bukittinggi dadiah was then added to the pudding mixture which had been cooled to approximately ±60°C–70°C. The dadiah pudding was poured into molds and refrigerated until it was ready to be served. The entire process is illustrated in Figure 2.[10]

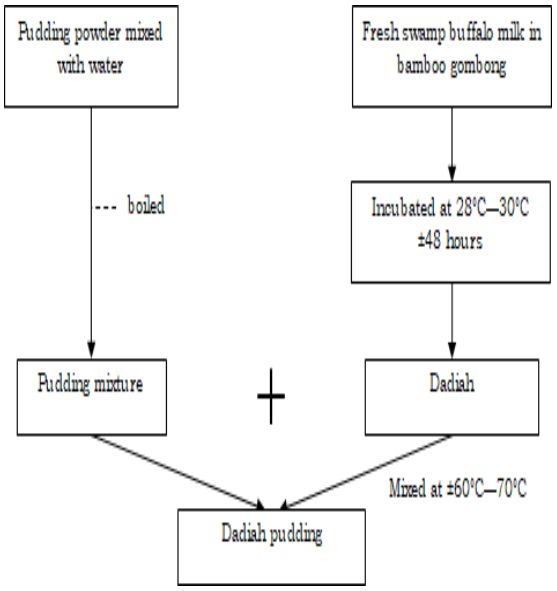



**Figure 2.** Material production process

The levels of carbohydrates, protein, and fat contents were evaluated following the Indonesian National Standard (SNI) 01-2891-1992, 9; 01-2891-1992, 7.1; and 01-2891-1992, 8.1;

respectively, in the Central Laboratory of Research and Industrial Standardization (Baristand), Padang, West Sumatra.

The total calories in dadiah pudding were determined by applying the conversion factors for carbohydrates, protein, and fat. These conversion factors represent the number of calories per gram for each macronutrient. The 4:4:9 kcal/g conversion was used, where carbohydrates and protein contribute 4 calories per gram, while fat contributes 9 calories per gram.

The level of micronutrients such as calcium, zinc, and iron levels were assessed following the Indonesian National Standard (SNI) 01-2896-1998. The analysis was conducted at the Industrial Research and Standardization Centre (Baristand) Laboratory located in Padang, West Sumatra.[10]

The morphology was confirmed through Gram staining, and the total lactic acid bacteria was determined by inoculating samples onto de Man, Rogosa, and Sharpe agar with serial dilutions.[10]

## RESULT AND DISCUSSION

The dadiah has a white, smooth, and creamy texture with a sharp sour taste and a milky aroma. However, when modified into dadiah pudding, it changes color, consistency, viscosity, taste, and aroma from the dadiah. The dadiah pudding has a peach color, a watery and gritty texture, a mango flavor, and a milk aroma. Additionally, it also has a different macronutrient content compared to dadiah. Table 1 presented the macronutrient profiles and total calorie contents of the dadiah from Bukittinggi, dadiah pudding, dadiah from Agam and Tanah Datar[16], and yogurt made from cow's milk[9].

The transformation of the Bukittinggi dadiah into dadiah pudding resulted in a higher calorie content of 260.1 kcal compared to the Bukittinggi dadiah's calorie content of 216.4 kcal. This calorie amount was also the highest among the total calorie content of dadiah from Tanah Datar (160.62 kcal) and Agam (237.68 kcal) as well as yogurt (50.0 kcal) as shown in Table 1.

**Table 1.** Macronutrient profiles and total calorie contents of the dadiah, dadiah pudding, and yoghurt

| *Macronutrient profiles* | *Carbohydrates (g)* | *Protein (g)* | *Fat (g)* | *Calories (kcal)* |
|---|---|---|---|---|
| Dadiah | | | | |
| Agam | 8.0 | 10.9 | 18.0 | 237.6 |
| Tanah Datar | 14.9 | 12.4 | 5.7 | 160.5 |
| Bukittinggi | 2.1 | 7.9 | 19.6 | 216.4 |
| Dadiah Pudding | 6.49 | 6.1 | 23.3 | 260.2 |
| Yoghurt | 4.0 | 3.3 | 2.5 | 50.0 |

In 100 mg of dadiah pudding, the calcium (Ca) content was 276.61 mg, zinc (Zn) content was 3.75 mg, and iron (Fe) was 6.60 mg. When comparing these values to the Bukittinggi dadiah, there was a decrease of 20.5% in calcium content and a decrease of 22.9% in zinc content.[10] However, there was a slight increase of 1.1% in iron content.

The Gram stain analysis revealed the presence of Gram-positive, non-motile rod and coccus bacteria in the dadiah pudding sample, which was consistent with the bacteria found in the Bukittinggi dadiah. However, there was a 4.6% decrease in the total count of lactic acid bacteria in the dadiah pudding compared to the Bukittinggi dadiah sample. The LAB count in the dadiah pudding was determined to be $6.1 \times 10^9$ CFU/ml.[10]

A high-quality dadiah is characterized by its firm uniform consistency, creamy-white color, pleasant aroma, and acidic taste. Its surface is smooth and glossy, and the cut surface is neat without any cracks or air bubbles.[17] However, the traditional method of preparing dadiah can result in variations in texture, quality, flavor, and overall acceptability due to the lack of regulation.[17] Despite the absence of pasteurization in buffalo milk used for dadiah production, there have been no negative impacts or diseases reported among people who consumed dadiah. Minangkabau people believe that consuming dadiah can have advantages for their health. The study reported that Lactococcus sp. (52%-83%), a probiotic bacteria, still dominated in non-pasteurization fermented dadiah although used slopping Klebsiella, a pathogenic bacteria, in pasteurization products.[18] It is important to note that whether pasteurized or not, both types of dadiah undergo a spontaneous fermentation

process without the use of starters during production.

The manufacturing process of dadiah pudding involved a combination of ingredients and steps that resulted in variations in color, consistency, viscosity, taste, and aroma. These variations were attributed to the generation of essential compounds through processes such as carbohydrate fermentation, lipid metabolism, and proteolytic enzyme activities.[16] One important factor in the production of dadiah pudding was the addition of pudding powder, which contributed to an increase in carbohydrates (sugar and fiber) and fat content. However, this addition led to a slight reduction in protein compared to dadiah. Furthermore, the heating process used during the production of dadiah pudding activates proteolytic enzymes to a greater extent than the non-boiling condition used in the preparation of the dadiah. As a result, the protein content of the dadiah pudding was reduced.[19] It is important to note that the carbohydrate and protein content of the dadiah pudding in this study was found to be lower than that of those of dadiah from Tanah Datar and Agam, indicating potential variations in the nutritional composition among different dadiah products.[16]

According to the Indonesian Recommended Dietary Allowances (RDA), consuming 100 g of dadiah pudding daily for adults can contribute to meeting a portion of the daily carbohydrate requirement, providing approximately 1.6–1.8% of the total daily carbohydrate intake. Carbohydrates serve as the primary source of energy for the body. In buffalo milk, lactose is the main carbohydrate, which can be hydrolyzed by beta-galactosidase from LAB present in dadiah. This hydrolysis process converts lactose into glucose and galactose, which is beneficial for lactase deficiency conditions. It means that dadiah is particularly good for lactose-intolerant people. Glucose was then fermented and metabolized into fructose 6-phosphate during the glycolysis then produced lactic acid as the end-product which plays an important role in making the texture, body, and sour taste of dadiah. Lactic acid also acted as a preservative and helped prevent or limit milk spoilage by inhibiting the growth of

contaminating bacteria and their enzyme activity.[1]

Protein is essential for the synthesis and repair of tissue in the body. Dadiah pudding contained a significant amount of protein, almost equivalent to the protein content of eggs of the same weight. It can fulfill approximately 10% of the daily protein intake requirement. The protein in dadiah consists of essential and non-essential amino acids. Lysine is the highest essential amino acid, while glutamic acid is the highest non-essential amino acid in dadiah. Glutamic acid contributes to forming a sour taste in dadiah. Since the human body cannot produce essential amino acids, dadiah can be a good source of isoleucine, leucine, methionine, phenylalanine, threonine, valine, lysine, histidine, and arginine as part of essential amino acids.[20] Adequate protein intake is important for supporting the growth and maintenance of structural components in the body. In comparison to the dadiah, dadiah pudding has a more watery and gritty consistency. This difference in consistency can be attributed to the lower protein content in dadiah pudding and the involvement of heat during the manufacturing process, particularly when adding the pudding mixture to the dadiah at temperatures ranging from approximately 60°C to 70°C. The higher protein contributed to its custard-like consistency.[9,16] The thickening, gelation, and coagulation of milk albumins and globulins in buffalo milk occur naturally when the fresh unheated milk is kept overnight at room temperature. During the fermentation of dadiah, a complex proteolytic system of LAB which consists of proteinases, peptidases, and the transport system is responsible for the uptake of small peptides and amino acids. The spontaneous fermentation allows for protein degradation catalyzed by native proteases of LAB, without the need for a thermal denaturation process. The hydrolysis of protein in buffalo milk supports the growth of LAB, which was fastidious in terms of nutritional requirements. This process results in the production of more nutritious dadiah, which is easily digested as compared to fresh raw buffalo milk.[1]

In addition to carbohydrates and protein, dadiah pudding also contributes to the daily fat intake which is important as an

energy source and for providing essential fatty acids. Buffalo milk, which is used to make dadiah, contains higher levels of butterfat compared to cow milk. This higher fat content results in creamy textures, rich flavor profiles, and increased calorie content in dadiah. The natural lipase present in buffalo milk may participate in the metabolism of lipids.[1]

Consuming dadiah pudding can cover approximately 34% of the recommended daily fat intake.[21] By including dadiah pudding in the diet, individuals can obtain a balanced combination of carbohydrates, protein, and fats, which are all necessary for a well-rounded and nutritious diet.

The higher calorie content of dadiah pudding highlights its potential as a more energy-dense option compared to dadiah and other related dairy products. This increase in calories can be attributed to the specific ingredients and processes involved in the preparation of dadiah pudding which contributed to its enhanced nutritional profile.[18] The total of calories fulfilled a general guideline for a snack portion, making it a suitable choice for a nutritious snack option. Whether consuming the dadiah or dadiah pudding, both options can be a good choice as a nutritious snack, providing a combination of essential nutrients in a convenient and enjoyable form.

The analysis of dadiah pudding revealed higher levels of calcium compared to a previous study on dadiah from the Agam and Tanah Datar districts in West Sumatra. Dadiah Agam contained 190.54 mg of calcium, Tanah Datar had 247.93 mg of calcium, and dadiah pudding had even higher levels. This indicated that dadiah pudding can be a good source of dietary calcium. However, the zinc levels in the dadiah pudding were found to be lower than those found in the previous study. Dadiah Agam had 0.7 mg of zinc, dadiah Tanah Datar had 0.9 mg of zinc, and dadiah pudding exhibited lower levels.[20] This suggests that the processing or additional ingredients used in making the dadiah pudding might have influenced the zinc content. Unfortunately, data on iron concentrations in Agam and Tanah Datar dadiah were not available.

Consuming 100 g of dadiah pudding daily can provide a substantial contribution to the daily intake of calcium, zinc, and iron for adults. It can cover approximately

27.6%, 34.1-46.9%, and 36.7-73.3% of the daily calcium, zinc, and iron requirement, respectively.[21] This highlights the potential of dadiah pudding as a nutritious food choice that can help fulfill these important needs in the diet.

Although there was a slight reduction in LAB count compared to the Bukittinggi dadiah sample, the dadiah pudding still demonstrated a significant presence of beneficial lactic acid bacteria (LAB). The LAB count in the dadiah pudding remained higher than the levels found in the dadiah from Tanah Datar (1.9 × 107 CFU/g) and dadiah from Agam (4.6 × 106 CFU/g).[16] Previous studies have reported varying levels of LAB in dadiah, ranging from 1.42 × 108 to 3.80 × 108 CFU/g in dadiah from Bukittinggi and Padang Panjang[22], and 7.1 × 1010 CFU/ml in total LAB of the dadiah from Lintau, West Sumatra.[12] These findings indicate that the dadiah pudding retains a considerable population of LAB, which contributes to its potential as a probiotic food product.

The differences in macro- and micronutrient content, as well as the total lactic acid bacteria, can be caused by differences in milk sources and regions producing milk as the main ingredient in the production of dadiah, various steps during the fermentation process, or different enzymes produced by LAB present in milk that affect the nutritional content.[10,12] The nutrition given to buffalo, which produces the milk of dadiah, plays a role in the quality of the milk and subsequently the dadiah product.[16] Tanah Datar buffaloes were nourished by supplements that contain calcium carbonate ($CaCO_3$). On the other hand, buffaloes from Agam consumed cogon grass (Imperata cylindrica) which contains various acidic substances. These differences in diet can impact the composition of the milk and the subsequent dadiah products.

However, both dadiah pudding and dadiah have a higher nutritive value and density than yogurt produced from cow's milk. This is because buffalo milk has a higher chemical and lower water content compared to cow's milk.[9,16,20] These factors contribute to the overall nutritional superiority of dadiah and its potential as a nutrient-dense food option.

## CONCLUSION

The addition of several ingredients and the application of specific heating treatment during the preparation of dadiah pudding improved macronutrients and micronutrients, total calorie content, as well as the total lactic acid bacteria. These dairy products provide not only a tasty snack but also contribute essential nutrients to one's overall nutritional intake. Considering its nutrient composition, probiotic properties, and cultural significance, consuming dadiah pudding in this study has the potential to be a nutritious snack that utilizes local food sources and serves as a potential probiotic.

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Nothing.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest

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