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**Original Research**

# Lekamer Fortir Cookies as Snack Alternative for Malnourished Toddlers

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## ABSTRACT

Cookies serve as an alternative snack option and an additional food source for toddlers. This type of food is widely enjoyed due to the taste and texture. This study aimed to analyze the chemical and organoleptic quality of Lekamer Fortir cookies, made from local food ingredients consisting of catfish, forte, oyster mushrooms, and red beans. This study used an ANOVA test to analyze the chemical, physical, and sensory quality of cookies, exploring their potential to prevent malnutrition. The selected cookies, Formula D, consisted of 40 grams of red bean flour, 10 grams of oyster mushroom flour, 40 grams of catfish flour, and 10 grams of tempeh formula flour. Organoleptic test results showed an average score of 3.79, indicating a strong preference. Further examination of the nutritional composition of Formula D revealed that carbohydrates, protein, fat, and fiber were below 100% of the 2019 RDA requirement, whereas calcium, zinc, and iron content exceeded 100% of the RDA. The results of the panelists' preference for cookies using red bean flour, catfish flour, white oyster mushroom flour, and forte showed no significant differences in color, texture, and taste in each sample.

**Keywords:** Malnutrition, Cookies, Chemical Quality

## INTRODUCTION

Toddlers, particularly within the vulnerable age range of 12-59 months, face a high risk of malnutrition, both wasting and stunting. This critical period is crucial for optimal nutritional intake to support brain growth and cognitive development, as it belongs to the first 1000 days of life (1). Malnutrition, due to a deficiency in macro and micronutrients, causes children under five susceptible to illnesses and, in severe cases, can lead to mortality. The results of Basic Health Research (*Riskesdas*) for North Sumatra in 2018 indicated a stunting prevalence of 32.4% among children under five, surpassing the national incidence of 30.8%. Additionally, the incidence of malnutrition in this age group was 19.6%, significantly higher than the national rate of 13.8% (2).

Malnutrition is characterized by deficiencies in essential macronutrients such as carbohydrates, proteins, and fats. It represents a state of nutritional disorders arising from diseases and insufficient food intake, as outlined by UNICEF. Addressing and preventing malnutrition requires supplementation activities, particularly through supplementary feeding, to fulfill the nutritional requirements of toddlers. Cookies serve as an alternative snack that can contribute to meeting these needs. Cookies, a popular type of biscuit enjoyed for their delightful taste, softness, and crunchiness, offer a palatable option for toddlers. These



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foods can play a role in supporting the growth and development of toddlers. The process of making cookies follows the principle of combining food ingredients with high energy, protein, and mineral content to enhance their nutritional value. This involves substituting and adding nutrient-rich foods during the cookie-making process. To make cookies into a high-energy and protein-rich food, it is crucial to replace and incorporate ingredients that are rich in nutrients. In Indonesia, the average annual per capita consumption of cookies is reported to be 0.40 kg (3).

The high level of consumption of cookies has prompted the substitution of traditional flour with red bean flour. This innovative approach involves combining red bean flour with other food ingredients that are high in protein, calcium, zinc, and other minerals. The selected ingredients, including catfish, oyster mushrooms, and tempeh, are processed into flour and mixed to create "Lekamer Fortir Cookies." Red bean flour, used as a wheat substitute, undergoes pregelatinization to eliminate the starchy taste commonly associated with cookies (4).

Red beans (*Phaseolus vulgaris l.*) are a widely recognized legume with significant potential as a basic ingredient for healthy snacks. Despite its inherent health benefits, red beans often face consumer aversion due to an unacceptable taste (5). However, red beans have an impressive nutritional profile, containing 22.3 g of protein per 100 g of material, especially the leucine protein content at 76.16 mg (6). Additionally, red beans are rich in essential minerals, providing 502 mg of calcium and 410 mg of phosphorus per 100 grams of material. This nutritional content makes red beans a valuable alternative in meeting the dietary needs of children under the age of five (7).

White oyster mushroom (*Pleurotus ostreatus*) has a higher nutritional content than other mushrooms. In 100 grams of dry weight, white oyster mushrooms provide 128 calories, with 27% protein, 1.6% fat, 58% carbohydrates, 51 mg of calcium, 6.7 mg of iron, and 0.1 mg of vitamin B. Notably, oyster mushrooms contain high protein, ranging from 10.5 to 30.4%, comparable to chicken meat. Oyster mushroom is a good source of minerals, such as potassium (K), sodium (Na), phosphorus (P), calcium (Ca), iron (Fe), and dietary fiber.

Catfish, widely cultivated in Indonesia with abundant production and affordable prices, can be processed into fish meal, serving as a protein fortification ingredient in various food products. Despite its high protein content of 17.5 grams per 100 grams and 14.5 grams of fat, the use of catfish flour is hindered by its strong fishy smell and taste. Nutritional content in 100 grams of catfish contains 17.5 g of protein and 14.5 grams of fat (8).

Tempeh is generally known in Indonesia, particularly tempeh from soybeans which is characterized by its yellow color, firm texture, and intricate structure, covered with a layer of white mycelium. This affordable and widely consumed tempeh variety has prompted the need for further development and diversification of tempeh products, including the creation of tempeh formulas in flour form. Typically, these formulas incorporate various food ingredients to enhance the overall quality of the end product. A tempeh formula is a processed food where tempeh serves as the primary ingredient, complemented by other supporting components to prolong its shelf life. Research conducted by the Nutrition Research and Development Center has successfully formulated tempeh into a processed food that has high energy and protein content, easy digestibility, and swallowability. Additionally, this tempeh formula has been used for feeding patients through a tube (9). Tempeh formula is also very good for children under five to improve their nutritional status.

This study aimed to assess both the chemical and organoleptic quality of Lekamer Fortir cookies, utilizing local food ingredients known for their potential to prevent malnutrition.

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## METHOD

### *Research Design*

### *Tool*

The tools used in this study were flour-making tools, namely scales, knives, basins, cabinet dryers, millers, 80 mesh sieves, and plastic jars. The tools used for making cookies were mixers, ovens, baking sheets, basins, and cookie molds.

### *Material*

The materials used for flour-making ingredients in this study were red beans, oyster mushrooms, catfish, and tempeh formula. The ingredients for the cookies were milk flour, powdered sugar, margarine, butter, baking powder, salt, egg yolks, and cornstarch.

This study is an experimental study with a completely randomized design (CRD). In this study, cookies were substituted using red bean flour for five treatments, taro flour for five treatments, catfish flour for five treatments, and tempeh formula flour for five treatments.

### *Research stages*

### *Production of Red Bean, Oyster Mushroom, Catfish Flours, and Tempeh Formula*

The selections of red beans, oyster mushrooms, catfish, and soybeans for the forte were chosen according to researcher specifications. After undergoing the process of sorting, cleaning, washing, boiling, and drying, the ingredients were subjected to food blending to obtain various flours for crafting Lekamer Forte cookies. Catfish, chosen for its stable availability and nutritional richness, is a freshwater fish with a composition of 413 kcal energy, 9 g fat, 56 g protein, and 27 g carbohydrates per 100 grams (10).

### *Cookies Making*

The cookie recipe underwent modifications, starting with homogenizing 80 g powdered sugar, 35 g margarine, 20 g butter, 15 g milk flour, and 1 egg yolk using a mixer for approximately 5-10 minutes to form a dough. Red bean flour, oyster mushroom flour, catfish flour, and tempeh formula flour were then added in specified amounts. Following this, 15 g cornstarch, 1.4 g baking soda, and 2.4 g salt were added. The dough was shaped and baked in an oven for approximately 20-25 minutes at a temperature of around 100°C. This cookie recipe contains various ingredients that were previously processed into flour, including red bean flour, oyster mushrooms, catfish, and tempeh formula. The diverse flour additions are detailed in the table below.

**Table 1. Distribution Of Ingredients And Grams In The Manufacture Of Cookies**

| Formulation | Material name | | | |
|---|---|---|---|---|
| | Red bean flour (g) | Oyster mushroom flour (g) | Catfish flour (g) | Tempeh formula flour (g) |
| **A** | 25 | 25 | 25 | 25 |
| **B** | 30 | 20 | 30 | 30 |
| **C** | 35 | 15 | 15 | 15 |
| **D** | 40 | 10 | 40 | 10 |
| **E** | 45 | 5 | 45 | 5 |

Source : Food Technology Laboratory, Department of Nutrition, Poltekkes Kemenkes Medan

**Kjedhal method of protein content testing**

As much as 1 g of sample was placed into the Kjedhal flask, and the result in the form of a distillate was examined using titration with 0.1 N NaOH solution. Protein content was determined using the formula:

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$$\text{Protein content (\%}\ {}^{b}/_{b}) = \frac{V\ penitran\ (sample - blank)\ x\ N\ HCl\ x\ 14{,}008\ x\ 6{,}25}{sample\ weight\ \ x\ 1000}\ \text{x 100\%}$$

***Soxhlet method of fat content testing***

As much as 10 g of the sample was placed into a tin, and the final steaming with a rotary evaporator produced a heavy residue of fat. Fat content was calculated using the following formula:

$$\text{Fat level (\%}\ {}^{b}/_{b}) = \frac{fat\ weight}{sample\ weight}\ \text{x 100\%}$$

**Carbohydrates Content Testing**

Total carbohydrates were obtained using the formula below:

Carbohydrate content (% $^{b}/_{b}$) = 100% - % (content of protein, fat, ash, water)

***Determination of the energy value of food***

The energy value of food was determined through calculations according to the composition of carbohydrates, fats, and proteins. The determination of energy value was calculated using the following formula:

Energy = (4 Kcal/g × carbohydrate content) + (9 Kcal/g × fat content) + (4 Kcal/g × protein content)

***Sensory Test***

The sensory test evaluated cookies based on taste, aroma, color, and texture, employing a hedonic scale ranging from 1 (dislike very much) to 5 (like very much). The results of the sensory test determined the optimal formulation among the four flour ingredients. This determination was based on the average value and the percentage of acceptance from 50 trained panelists (11).

***Analysis of Data***

Data analysis was conducted using the latest version of the SPSS computer application, employing Analysis of Variance (ANOVA) followed by a Duncan test to recognize any significant differences among the formulations.

## RESULT

***Sensory Test***

The results of the cookie sensory test with the varying proportions of red bean flour, oyster mushroom flour, catfish flour, and tempeh formula flour using the hedonic scale are presented in Table. 2

Table 2 shows that through sensory assessments on color, aroma, taste, and texture, Formula D received the highest preference from panelists, achieving an average value of 3.79. This particular cookie was formulated using 40 grams of red bean flour, 10 grams of oyster mushroom flour, 40 grams of catfish flour, and 10 grams of forte flour in its preparation.

**Table 2. Distribution Of Organoleptic Test Result By Various Treatments**

| Sensory properties | Treatment | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | p-(value) |
| **Color** | 3.38 | 3.54 | 3.32 | 3.76 | 3.39 | 0.007 |
| **Texture** | 3.33 | 3.28 | 3.36 | 3.83 | 3.51 | 0.001 |
| **Taste** | 3.51 | 3.78 | 3.50 | 3.94 | 3.50 | 0.007 |
| **Aroma** | 3.38 | 3.37 | 3.34 | 3.62 | 3.49 | 0.240 |
| **Average** | 3.40 | 3.49 | 3.38 | 3.79 | 3.47 | |

Source : Food Technology Laboratory, Department of Nutrition, Poltekkes Kemenkes Medan

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### *Chemical Quality and Nutrient Analyses and Compliance with 2019 RDA*

The analysis of chemical quality involved various methods adapted to the examination of nutrient content, including carbohydrates, protein, fat, calcium, zinc, and iron. Table 3 illustrates the protein content analysis for Formula D.

Table 3 shows the results of the examination of Formula D in determining the nutrients it contains and the contribution of nutritional needs for children under five within the age range of 12-59 months. The contribution of minerals, calcium, zinc, and iron exceeded 100% of the 2019 Recommended Daily Allowance (RDA). Conversely, for macronutrients such as carbohydrates, protein, and fat, the contribution was below 100% of the 2019 RDA.

**Table 3. Analysis of chemical quality and contribution of nutrients to cookies based on RDA 2019**

| Nutritional check | Unit/100g | Requirement | Nutrient content | %Akg |
|---|---|---|---|---|
| Carbohydrates | g | 217.5 | 52.31 | 24,05% |
| Fat | g | 22.5 | 13.46 | 59,82% |
| Protein | g | 47.5 | 22.64 | 47,66% |
| Calcium | mg | 825 | 6459.46 | 782,96% |
| Zinc | mg | 4 | 19.07 | 476,75% |
| Fe | mg | 8.5 | 57.87 | 680,82% |
| Fiber | g | 19.5 | 6.44 | 33% |

Source: M Brio Food Laboratory Bogor 2021

## DISCUSSION

### *Color*

Cookies with Formula D displayed a light brown color, which matches the standard color of cookies. The panelists evaluated the cookies visually, emphasizing the critical role of formulation in product development, as consumers often form their initial judgments based on visual appeal.

According to Winarno, as cited in Hapsari (2018), several factors contribute to the attractive color of food ingredients, including natural pigments such as chlorophyll, carotene, and myoglobin, as well as processes like caramelization and the Maillard reaction. Caramelization, initiated by heating sugar during the baking process, is a key contributor. The protein content in the red bean puree facilitates color changes in the cookies. The heating process activates amino acids in the protein, enabling them to react with the reducing sugar component, ultimately resulting in the formation of a brownish-yellow pigment (12). Moreover, the browning reaction in cookies can be influenced by organic compounds reacting with air, leading to an oxidation reaction. The use of high temperatures in oven processing opens the bonds in amino acids, enabling them to react with the reducing sugar component. This reaction is facilitated by the composition of the cookie ingredients.

### *Texture*

The sensory test results for texture revealed a notable average score of 3.83, indicating a strong preference for Formula D. Cookies in Formula D exhibited a distinctive texture characterized by crispness and completeness, making them resistant to easy crushing (13). Texture creates a pressure sensation that can be felt when the cookie is introduced into the mouth, involving biting, chewing, and swallowing. Additionally, the assessment also involved the examination of hardness, elasticity, and crispness through touch (14). The crisp and crunchy attributes observed in Formula D cookies can be attributed to the presence of fiber in red beans, forte, and oyster mushrooms. These fibers can absorb water, disrupting the gelatinization process and preventing the cookies from becoming overly brittle. Consequently, the resulting product not only possesses a crunchy texture

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but also shows sturdiness and strength, enhancing its resistance to breakage and ensuring a prolonged shelf life (15)

Fiber, a polysaccharide known for its water-absorbing capacity, contributes to the firm and robust texture of the product, making it harder. As the fiber content increases, the product attains a greater degree of firmness and strength (16). Moreover, the notable levels of protein in red beans, catfish, and forte, coupled with the substantial carbohydrate content in oyster mushrooms, synergistically bolster the integrity of the cookies (17). Andarwulan et al (2011) stated that the crispness of cookies is influenced by the content of protein, amylose, and amylopectin (18).

***Flavor***

The sensory test results for taste indicated an average score of 3.78, signifying a strong preference for Formula D. Cookies in Formula D delivered a delectable combination of savory and slightly sweet flavors. Taste is an important element in gauging preference levels, where a good taste gains acceptance from panelists and consumers alike (10). The taste of food is a multifaceted aspect, intricately linked to its appearance. Visual stimuli from the presentation of the food activate nerves, inviting the appetite for a flavorful experience. Subsequently, the taste experience unfolds as a harmonious interaction between the stimulation of the sense of smell and taste. Flavor, as a crucial component, emerges from the collaboration of various senses, including sight, smell, hearing, and touch. According to Farida in 2021, taste is the most important factor in determining a decision for consumers to accept or reject a food product.

***Aroma***

Based on the sensory test on aroma acceptance, it is known that the average score of 3.62 indicates a strong preference for Formula D. The distinctive aroma of Formula D is attributed to the mix of eggs, margarine, and milk flour, which causes a fragrant and delicious aroma when baked at a high temperature.

Food aromas can also be generated using natural or synthetic aromas. According to Farida in 2021, aroma is an odor resulting from steam produced during food processing. It is influenced by volatile compounds and major components of ingredients, as well as cooking methods. Aroma serves as a critical parameter in determining the overall appeal and palatability of a food item. The Maillard reaction, a chemical reaction between amino acids and reducing sugars during heating, contributes to the aroma of food. This reaction involves the transformation of carbohydrates, free amino acids, peptides, nucleotides, and organic acids into flavorful and aromatic compounds, shaping the overall sensory experience of processed foods (13).

The distinctive aroma is attributed to the amino acids in white catfish flour, namely glutamic acid, lysine, aspartic acid, leucine, and alanine. These amino acids undergo reactions with sugar during the baking process at temperatures ranging from 190 to 210 °C, resulting in the development of a distinctive and appealing aroma.

***Protein content***

The protein content of Formula D, determined using the Dumas method, was found to be 13.4 grams. This protein content, originating from wheat flour, forte flour, and white oyster mushroom flour, constitutes 59.8% of the nutritional requirements for children under five. Protein, a vital macronutrient, plays a crucial role in the body, primarily serving as a building block for tissues. It is an essential component for daily bodily functions. Catfish protein can also produce antibodies, hormones, enzymes, and the formation of collagen needed for tissue repair in toddlers. Moreover, protein facilitates the transportation of bone growth hormone IGF-1 and enhances the potential for peak bone mass.

The combination of both vegetable and animal proteins positively influences the improvement of protein quality. These two types of proteins complement each other in terms of amino acid content, enhancing the overall nutritional profile (10). During the heating process, proteins undergo denaturation, resulting in changes to their molecular structure without breaking

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covalent bonds (10). However, heating during the production process can increase protein digestibility and protein storage capacity (20). Utilizing local food ingredients, such as catfish, in food processing not only increases the value of these ingredients but also improves the nutritional content of the final product. Oyster mushrooms, another component of Formula D, contain 19-35% protein, encompassing essential amino acids like lysine, methionine, tryptophan, thionine, valine, leucine, isoleucine, histidine, and phenylalanine (21). Proteins play a crucial role in maintaining tissues, influencing body composition, and facilitating the formation of new tissues.

***Carbohydrate content***

The carbohydrate content of Formula D was found to be 52.3 grams. This carbohydrate content, sourced from wheat flour, forte flour, and white oyster mushroom flour, constitutes 24% of the nutritional requirements for children under five (22). Adequate carbohydrate consumption as an energy source is crucial in preventing malnutrition in young children, subsequently reducing the risk of infectious diseases and averting issues like undernutrition and obesity. According to Hardinsyah, as cited in Katmawanti (2021), states that energy for growth and development can only be obtained from carbohydrates, proteins, and fats present in food and stored in the human body (23).

According to Sugito and Ari H in Nurlita (2017), the carbohydrate content is influenced by other nutritional components, the lower the other nutritional components, the higher the carbohydrate content, and vice versa. Meeting the carbohydrate intake requirement fulfills its crucial role as the primary energy producer, thereby preventing malnutrition, undernutrition, and obesity in children (24).

***Lipid content***

The lipid content of Formula D, determined by the Soxhlet method and chosen by the panelists, was 22.6 grams. This lipid content, sourced from red beans, catfish, margarine, butter, milk flour, forte flour, and egg yolks, constitutes 47.6% of the nutritional requirements for children under five. The fat content in cookies is a result of the composition of various food ingredients. Oyster mushrooms, for example, contain 86% unsaturated fat and 14% saturated fatty acids, while red beans contain 15.8% fat (25). Fat is an essential component needed by children under five as it serves the purpose of providing energy and contributing to the formation of fat cells crucial for a child's growth and development. Adequate fat intake ensures the maintenance of catabolic processes using energy sources other than noncarbohydrates (26).

***Calcium content***

The calcium content of Formula D, determined by flame atomic absorption spectrometry and selected by the panelists, was 6459.4 mg. This calcium content, sourced from wheat flour, catfish meal, milk flour, eggs, forte flour, and white oyster mushroom flour, contributes a significant 782.9% to the nutritional needs of children under five. Calcium plays a crucial role in mineralizing the new bone deposit matrix and supporting osteoblast function, thereby facilitating the process of height increase. Collaborating with vitamin D, calcium helps establish serum calcium homeostasis, maintaining extracellular calcium ion levels within the normal range and facilitating the transport of calcium to and from bone reservoirs.

Calcium deficiency will cause metabolic disorders, including inflammatory cytokine regulatory systems that directly affect chondrocytes and the process of bone formation (19). Calcium is also a major component of bone and tooth formation, playing an important role in regulating cell functions, such as nerve transmission, muscle contraction, and maintaining cell membrane permeability. Meeting calcium needs helps prevent malnutrition in toddlers, particularly in the prevention of stunting (26).

***Zinc content***

The zinc content of Formula D, determined using the flame atomic absorption spectrometry and selected by the panelists, was measured at 19 mg. This content,

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derived from wheat flour, flour, red beans, catfish, forte flour, and white oyster mushroom flour, fulfills 476.7% of the needs of toddlers. Zinc in cookies is essential for osteoblastic activity, collagen synthesis, and alkaline phosphatase function. As a component of the enzyme system in the body, zinc is also useful in the process of replacing the bone matrix (27). Additionally, zinc acts as a cofactor in stimulating protein synthesis, regulating cellular activity, and facilitating the impact of vitamin D on bone metabolism by promoting DNA formation in bone cells (19). Therefore, zinc is closely related to bone metabolism and becomes very important in the stages of growth and development (17).

***Iron (Fe) content***

The iron (Fe) content in Formula D, determined through flame atomic absorption spectrometry and selected by the panelists, was 57.8 mg. This iron content is sourced from wheat flour, red beans, catfish, forte flour, and white oyster mushroom flour, contributing significantly to 680.8% of the nutritional needs of children under five. Beyond its contribution, iron plays a crucial role in carrying oxygen and nutrients to cells throughout the body. In cases where iron intake is reduced, children under five may experience anemia, impacting their growth activities (28). Consuming Fe sources derived from animal foods will facilitate the absorption process thereby providing a faster contribution to the process of HB formation in children aged 5 years. Iron together with zinc has the potential to prevent children under five from infectious diseases (29).

***Fiber content***

The D formula chosen by the panelists contained 6.4 grams of fiber content sourced from wheat flour, red beans, catfish, forte flour, and white oyster mushroom flour and contributes 33% of the needs of children under five. The dietary fiber contained in cookies helps expedite the transit time process of metabolic results in the colon. Moreover, fiber has the capacity to bind excess fat and glucose, thereby helping toddlers avoid obesity (26). Higher fiber content is advantageous for digestion, as research developments indicate that, despite lacking nutrients, fiber performs a unique role in triggering physiological and metabolic conditions. This function is irreplaceable by other substances and provides protective benefits for the health of the digestive tract, particularly the small intestine and colon (30,31).

## CONCLUSION

The analysis results of panelists' preference level for cookies composed of red bean flour, catfish flour, white oyster mushroom flour, and forte showed no significant differences in color, texture, and taste in each sample. However, a noticeable difference was observed in aroma across the samples. Formula D was selected and preferred based on color, taste, aroma, and texture, with an average value of 3.79 (like very much). Furthermore, Formula D showed a composition of 24.05% carbohydrates, 59.8% protein, 47% fat, and 33% fiber, all of which are below the Recommended Daily Allowance (RDA) requirements. Conversely, the nutritional contents of calcium, zinc, and iron (Fe) exceed 100% of the 2019 RDA requirements.

### Author contributions

GS is responsible for writing articles, analyzing data, processing data, and correspondence with journal managers. NT did the data processing and helped to provide material input. IRS is responsible for finance and assisting in data processing.

### Declaration of Conflict of Interest

There is no conflict of interest regarding this article.

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**Data availability**

The data used and/or analyzed in the study are available https://shorturl.at/aoNY0

**Ethical clearance**

This research has received ethical approval from the Health Polytechnic Ministry of Health Ethics Commission No.01.0184/KEPK/POLTEKKES KEMENKES MEDAN 2022

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