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Development of Banana Kepok Starch Extract (Musa Pardisia) and Moringa Leaves (Moringa oleifera Lamk.) As An Adolescent Prebiotic Supplement

Fifi Luthfiyah[1], Retno Ikayanti[2], Dwi Nastiti Iswarawanti[3]
Poltekkes Kemenkes Malang, Indonesia[1,2]
Seameo Recfone[3]
E-mail: fifiluthfiyah@poltekkes-malang.ac.id

***Correspondence:** fifiluthfiyah@poltekkes-malang.ac.id

KEYWORDS
banana kepok; moringa oleifera; resistance starch; prebiotic suplement

ABSTRACT
The study aimed to determine the feasibility of kepok banana starch, Moringa leaf powder, to meet microbiological requirements as a high fe-resistant starch supplement Methode. This type of research is experimental research. The study was conducted in two stages. The first stage determines the formulation of resistant starch extract supplements to which Moringa leaf powder is added. The second stage determines the composition of vitamin C levels, fiber content, and chemical composition of the product. The third stage analyzes the product stability test by differentiating products based on storage duration and storage temperature. In this study, the type of banana used was the red kepok banana which calculated water extraction. Results: 6,679 kg of fresh kepok bananas produced 840 g of resistant starch. The yield of the material is 14.97%. 1,580 kg of fresh Moringa leaves produce 587 grams of Moringa leaf powder. material yield of 37.15%. The use of the calculated supplement is 11 grams of banana starch extract mixed with 0.5 grams of Moringa powder. The results of the microbiological examination that has been carried out on product samples show that the product is free and safe from E-coli, Staphylococcus, and Salmonella thypi bacteria and has met the microbiological quality requirements for health supplement products. There are three microbiological examinations that have been carried out on product samples, namely Salmonella Sp, E-Colli, and Staphylococcus Aureus, and have met the microbiological quality requirements of health supplement products.

Introduction

Anemia is a frequent nutritional problem in developing countries with the greatest prevalence being in children and women of childbearing age (15-49 years). The incidence of anemia in women of childbearing age (WUS) is 30 percent. The WHO target in 2025

is to reduce anemia in WUS, which is 25 percent. The incidence of anemia in WUS in Indonesia is 35.3 percent (Barretto et al., 2024). Moringa leaves (moringa oliefera) are known to have a variety of nutritional content. one of them is iron, protein, vitamin A, Vitamin C, potassium, and calcium. Moringa leaves are an alternative to overcome anemia conditions because it has an iron content of 28.2 mg. The undigested starch can also increase iron absorption in the body. While easily digestible starch can inhibit iron absorption. Iron absorption in the body according to some studies can be increased by the presence of vitamin C and also undigested starch. From the explanation above, researchers are interested to conduct research with the title Stability Test of Moringa Leaf Extract Capsules and Banana Kepok extract as an Iron supplement (Setianto et al., 2024).

Health supplements are products intended to complement nutritional needs, maintain, improve and/or improve health function, have nutritional value and/or physiological effects, contain one or more ingredients in the form of vitamins, minerals, amino acids and/or other non-plant ingredients that can be combined with plants (1).

The general objective of this study was to determine the stability of capsule extract supplements Banana Kepok starch, and Moringa leaves as prebiotic supplements and iron for teenagers (Basso et al., 2022). The results of the study are expected to be able to become preliminary research in Developed Moringa leaf extract capsules and kapok banana extract as supplements standardized. The new finding resulting from this study is the obtaining of stable data Kapok banana extract capsules and Moringa leaf extract (Johnstone et al., 2021).

Anemia in women of childbearing age (WCA) in Indonesia remains a significant health issue with a prevalence of 35.3 percent, which is higher than the global average of 30 percent. This high prevalence indicates an urgent need for effective interventions to address anemia, particularly among the vulnerable WCA group (Stefanaki et al., 2019).

One potential solution for combating anemia is through the use of iron-rich supplements. Moringa leaves (Moringa oleifera) are well-known for their rich nutritional content, including iron, protein, vitamin A, vitamin C, potassium, and calcium. With an iron content of 28.2 mg, moringa leaves offer significant potential as a natural and affordable iron supplement. Additionally, the vitamin C and undigested starch content in moringa leaves are known to enhance iron absorption in the body. Previous studies have shown that vitamin C can double the absorption of non-heme iron (Healey et al., 2020).

Besides moringa leaves, banana kepok also has beneficial nutritional properties. Banana kepok contains resistant starch that is not easily digestible, functioning as a prebiotic and promoting gut health (de Freitas et al., 2018). This resistant starch can also aid in increasing iron absorption in the body, making the combination of moringa leaf extract and banana kepok extract a potential supplement for combating anemia (Ligezka et al., 2021).

Therefore, this research is expected to make a significant contribution to efforts in addressing anemia among WCA in Indonesia and achieving the WHO target of reducing anemia prevalence by 2025. The findings from this study could also serve as a foundation for the development of more effective and sustainable supplement products to improve public health (Rianda et al., 2019).

Furthermore, the global health community, including the World Health Organization (WHO), has set ambitious targets to reduce anemia, particularly in vulnerable populations such as WCA. The WHO aims to achieve a 25 percent reduction in anemia prevalence among WCA by 2025 (Luzzi et al., 2024). Meeting this target requires innovative and effective solutions, such as the development and implementation

of nutrient-dense supplements like those derived from moringa leaves and banana kepok (Jeon et al., 2021).

The current study also addresses the challenge of ensuring bioavailability and stability of iron in supplement form. Iron supplements often face issues related to bioavailability, where the body may not absorb the iron efficiently, and stability, where the nutritional content may degrade over time (Mohammadi et al., 2019). By investigating the stability and bioavailability of moringa leaf and banana kepok extracts, this research aims to contribute valuable insights into how these natural ingredients can be formulated into effective supplements.

Additionally, the socio-economic implications of anemia in WCA are profound. Anemia can lead to decreased productivity, impaired cognitive and physical development, and increased maternal and infant mortality rates. Therefore, finding cost-effective and accessible solutions to prevent and treat anemia can have far-reaching benefits for public health and economic development, particularly in developing countries like Indonesia

Ultimately, this research aims to provide a comprehensive evaluation of the potential of moringa leaf extract capsules and banana kepok extract as iron supplements. The findings could pave the way for new dietary recommendations and public health policies aimed at reducing the burden of anemia. By leveraging locally available and nutritionally rich resources, such as moringa leaves and banana kepok, this study seeks to offer sustainable solutions to improve the health and well-being of WCA in Indonesia and beyond.

The study aimed to determine the feasibility of kepok banana starch, Moringa leaf powder, to meet microbiological requirements as a high fe-resistant starch supplement Methode. The research on developing Banana Kepok Starch Extract (Musa paradisiaca) and Moringa Leaves (Moringa oleifera Lamk.) as an adolescent prebiotic supplement aims to enhance gut health among young adults. This study could lead to the creation of natural, effective, and sustainable dietary supplements that promote beneficial gut bacteria growth. It also seeks to expand options in natural health supplements, potentially benefiting adolescents' overall well-being and development.

Research Methods

Research Design

This type of research is experimental research. The study was conducted in two stages. The first stage determines the formulation of resistant starch extract supplements to which Moringa leaf powder is added. The second stage determines the composition of vitamin C levels, fiber content and chemical composition of the product. The third stage analyzes the product stability test by differentiating products based on storage duration and storage temperature.

Research Subjects

In this study, the type of banana used was the red kepok banana which calculated water extraction and Moringa leaves.

Data Collection/Materials and Tools

Data collection techniques/procedures in this study is physical stability observed by organoleptic observation, chemical stability observed by measurement of vitamin C levels, and microbiological stability observed by microbiological tests. This research will be carried out in September-November 2021 at Chemical Laboratory Poltekkes Kemenkes Malang, Maxzlab Malang, Nutrition Laboratory FKM Universitas Airlangga Surabaya.

This test is an organoleptical test which is one of the requirements of capsule-shaped health supplements, namely observation of shape, taste, smell and color (2). Banana starch extraction using bananas that are old but still hard peeled, soaked in water for 5 minutes, cut into thin strips and crushed with a blender into fruit pulp by adding water ratio 1: 1 (b / v), then filtered with a filter cloth to separate starch and pulp, into the pulp added water again in a ratio of 1 : 1 (b / v) while kneading to remove the remaining starch, then filtered again. The filtering process is carried out repeatedly depending on whether or not the amount of starch until the filter results appear clear. The result of the filter is allowed to stand for about 12 hours so that it settles. After settling the clear part is discarded. The precipitate is dried in a 40oC oven for 12 hours or until dry.

Microbiological quality is seen in the presence of microbial contamination in supplements and the presence of pathogens in supplements using cup count and microbiological culture. Determination of Total Plate Number (ALT) of bacteria made dilution of 1/10.

Determination of vitamin C levels with a UV-Vis spectrophotometer. Determination of sample levels from a mixture of banana kepok starch extract and Moringa leaves was carried out by removing the powder from the capsule shell, then homogenized using mortar and stamoer, and weighed a total of 100 mg samples. The sample is then dissolved using aqueous and filtered then pipettes of 0.5 mL, after which the filtrate is inserted into a 100 mL measuring flask. Filtrate is added aquades until the boundary mark is then homogenized. Furthermore, absorption is measured at a maximum wavelength of 265 nm. Vitamin C levels are obtained from sample absorbance plots obtained against the standard vitamin C standard curve equation.

The physical stability data obtained will be presented descriptively as stability testing data. If the preparation is still stable, the research is continued until the expiration of the expiration period of the Moringa leaf extract capsule product and kapok banana extract. Tests were carried out on finished products in the form of capsules with storage temperatures of 30º, 40ºC, and 50ºC.

Data Analysis

Contains an explanation of the authors regarding the analysis procedure performed, the determination of significance and p-value, and the statistical software used in the study. Contains an explanation of the authors regarding the analysis procedure performed, the determination of significance and p-value, and the statistical software used in the study. Contains an explanation of the authors regarding the analysis procedure performed, the determination of significance and p-value, and the statistical software used in the study. Contains an explanation of the authors regarding the analysis procedure performed, the determination of significance and p-value, and the statistical software used in the study.

Results and Discussions

Preparation of starch extract and Moringa leaf extract, preliminary research by conducting an analysis of making supplement formulations, and the main research conducted organoleptic, microbiological, vitamin C and supplement stability analysis.

Sub results 1

The implementation of sensory tests on resistant starch extracts of Moringa leaves kapok bananas is only seen from the color and aroma. No sensory tests were carried out on taste and texture (Abrams et al., 2005).. This is because the resulting product preparation will be given through capsules. So for taste and texture is ignored. Based on

sensory testing of colors from 15 panelists who stated the color was good (liked) 12 people and 3 people really liked. Meanwhile, in terms of smell, all panelists answered that they didn't like it.

Microbiological quality test is one of the tests carried out to determine the quality of food or beverage products based on the presence of a microorganism. Microbiological quality tests on supplements can be done through the type of examination, namely calculating the number of plates, total (ALT) bacteria (SNI 3545, 2013). The media used is NAP media for determining the Total Plate Number (ALT) of bacteria.

Sub results 2

Supplements consisting of banana kepok starch extract and moringa leaves have been made from banana kepok extracted with water and moringa leaves made in the form of simplisia powder to maintain the presence of vitamin C needed to increase iron absorption. Then the powder is encapsulated and immediately analyzed for vitamin C content initially (0 days). Then the capsule will be stored in a climatic chamber for accelerated stability tests at a constant temperature of 40°C ± 2°C/ 75% RH ± 5% for 3-6 months.

Sub results 3

To be able to analyze the stability of resistant starch in the finished product, a method of analyzing resistant starch levels itself is needed. The reagent used is K-RAPRS 11/19 which is a method development of AOAC 2002.02 and AACC 32.40. The reagent is manufactured by Megazyme and purchased directly from Ireland (attached). The separation of liquid from bananas with banana starch takes 5-7 hours. Further determining the level of resistant starch takes 3-5 hours. To obtain product stability, this study has been observed and examined for 30 days, starting from October 16 – November 22, 2021. The chemical components in the stability test examination are vitamin C, resistant starch and microbiological levels. Based on the standard method for determining product stability, the inspection is carried out every 5 days of storage time (based on time) and at different temperatures of 30°C, 40°C and 50°C.

Discussion

The results of the stability test of the Resistant Starch Extract supplement product with a mixture of Moringa Leaf Powder are an increase in resistant starch levels in the finished product due to storage with high temperatures above room temperature, namely temperatures of 30, 40, and 50 degrees Celsius.

Sub Discussion 1

The material used is pisang kepok which calculates as much as 6,679 kg. Bananas were chosen that are calf (raw) because based on research (Freijy et al., 2023). Banana kepok mengkal is obtained from the Kepanjen area, Malang regency. For the collection of research materials, bananas, kepok mengkal and Moringa leaves, a permit to take research materials has been included which includes information related to the type, variety, location of collection and identity of the research material taker. The letter was asked for approval from the local village head. Then the research materials will be brought to the LIPI Plant Research Institute in Purwodadi Botanical Garden to obtain information on plant determination.

The material used for making Moringa leaf powder is fresh Moringa leaves as much as 950 grams. Medium leaves are selected (not too old, and not too young), from the green Moringa type and separated from yellow stalks and leaves.

The results of the research in the form of resistant starch extract from kepok bananas, namely from 6.679 kg produced 840 grams of resistant starch, so that the yield

of the material was 14.97%. For Moringa leaves, preliminary weighing has been carried out, namely the weight of fresh Moringa leaves 1,580 kg produces 587 grams of Moringa leaf powder, so that the yield of the material is 37.15%. The calculation of the supplement mixture of the two ingredients is 11 grams of banana starch extract mixed with 0.5 grams of moringa powder.

Sub Discussion 2

Determination of the growth of Escherichia coli bacteria after food and beverages are inoculated on LB medium, based on fermentation reactions and group formation in Durham tubes after incubation for 1x24 hours at a temperature of 37ºC and the formation of metallic green color on EMBA medium.

Determination of the Salmonella typhosa Bacteria Test was carried out after food and beverages were inoculated on SCB medium, based on turbidity in the medium after incubating for 1x24 hours at a temperature of 370C and the formation of yellow zone black colonies on SSA medium after incubating for 1x24 hours at a temperature of 37ºC. Determination of Staphylococcus aureus Bacteria Test was carried out after food and beverages were inoculated on PW medium, based on turbidity in the tube after incubation for 1x24 hours at a temperature of 37C and the formation of yellow zone black colonies on VJA medium after incubation for 1x24 hours at a temperature of 37ºC.

The presence of microbes in food supplem ents is certainly not desirable because it will cause organoleptic changes in preparations, especially if these foods and drinks will enter the body (Holmes et al., 2020).. Both pathogenic and nonpathogenic microbes when present in large quantities will be very dangerous for the body. Similarly, with food or beverages derived from natural ingredients, the possibility of contamination can be caused at the time of processing through hands, or non-sterile equipment, or through raw materials. Therefore, the microbiological quality of food and beverages is an important issue and needs attention.

The output results of this study on microbiological levels are: There are three microbiological examinations that have been carried out on product samples, namely Salmonella Sp, E-Colli, and Staphylococcus Aureus, and have met the microbiological quality requirements of health supplement products.

Sub Discussion 3

Stability is defined as the ability of a product to survive within established limits and throughout the period of storage and use, i.e. its shelf life, properties and characteristics are the same as those it had at the time the product was made. Each ingredient in a dosage form, whether efficacious active or inactive therapy can affect stability. Major environmental factors that can decrease stability such as exposure to adverse temperatures, light, oxygen, carbon dioxide and humidity. Likewise, the main dosage form factors that affect drug stability such as particle size (especially in emulsions and suspensions), pH, solvent system composition (e.g. water percentage and polarity), suitability between anions and cations, ion strength of solution, main container, presence of specific chemical additives, molecular bonding, drug diffusion and presence of fillers. In medicinal preparations, the following reactions usually lead to a reduced content of the active substance and these changes are usually not visually visible.

In the 2nd sample (with resistant starch content 13.42) showed the best Vit C content at 300C during the storage period of 5 days. While in the storage period of 10 days vit levels. C has degraded despite being stored at the same temperature. The stability test of the Kepok Banana Resistant Starch Extract supplement product with a mixture of

Moringa Leaf Powder is that there is an increase in resistant starch levels in the finished product due to storage with high temperatures above room temperature, namely temperatures of 30, 40, and 50 degrees Celsius.

Conclusion

Extracts of resistant starch from banana kepok from 6.679 kg produce 840 grams of resistant starch, so the yield of the material is 14.97%. For Moringa leaves, preliminary weighing has been carried out, namely the weight of fresh Moringa leaves 1,580 kg produces 587 grams of Moringa leaf powder, so that the yield of the material is 37.15%. The calculation of the supplement mixture of both ingredients is 11 grams of banana starch extract mixed with 0.5 grams of moringa powder.

Based on sensory testing of colors from 15 panelists who stated the color was good (liked) 12 people and 3 people really liked. Meanwhile, in terms of smell, all panelists answered that they didn't like it

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