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# THE EFFECT OF ADDING KENIKIR LEAF POWDER (*Cosmos caudatus Kunth*) ON THE PROTEIN CONTENT OF FUNCTIONAL DRINKS BASED ON GOAT MILK POWDER

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## ABSTRAK

Salah satu variasi minuman fungsional yang bermanfaat untuk tubuh adalah susu kambing bubuk dengan penambahan bubuk daun kenikir (*Cosmos caudatus* Kunth). Daun kenikir selain memiliki kandungan senyawa bioaktif sebagai antioksidan, anti-inflamasi, dan anti-mikroba, juga mengandung protein, fenolat, karbohidrat, vitamin, dan mineral yang tinggi. Sehingga daun kenikir dimanfaatkan sebagai komponen untuk menambah kadar protein dalam minuman fungsional untuk menambah asupan protein harian yang direkomendasikan (0,8 gram/kg berat badan). Pengaruh penambahan bubuk daun kenikir dalam minuman fungsional terhadap kadar protein ini menggunakan metode Kjedahl dengan formulasi sampel yaitu MF(F0), MF(F1), dan MF(F2). Dari hasil uji dengan metode Kjedahl diperoleh persen kadar protein tertinggi pada sampel MF(F2) sebesar 3,58%, sedangkan pada sampel MF(F1) didapatkan persen kadar protein 3,07%, dan sampel MF(F0) 2,49%. Hal ini membuktikan bahwa penambahan daun kenikir meningkatkan kadar protein dalam minuman fungsional.

Kata kunci: daun kenikir, minuman fungsional, protein, susu kambing.

## ABSTRACT

One variation of functional beverages that is beneficial for the body is powdered goat milk with the addition of kenikir leaf powder (*Cosmos caudatus Kunth*). Kenikir leaves not only contain bioactive compounds that act as antioxidants, anti-inflammatory agents, and antimicrobials, but they also have high levels of protein, phenolic compounds, carbohydrates, vitamins, and minerals. Therefore, kenikir leaves are utilized as a component to enhance protein content in functional beverages, supporting the recommended daily protein intake (0.8 grams/kg body weight). The effect of adding kenikir leaf powder to functional beverages on protein content was assessed using the Kjeldahl method, with sample formulations labeled MF(F0), MF(F1), and MF(F2). The results from the Kjeldahl method showed that the highest protein content was found in the MF(F2) sample at 3.58%, while the MF(F1) sample had a protein content of 3.07%, and the MF(F0) sample had 2.49%. This demonstrates that the addition of kenikir leaves increases the protein content in functional beverages.

Keywords: kenikir leaves, functional beverages, protein, goat milk.

## INTRODUCTION

*Cosmos caudatus Kunth*, commonly known as kenikir leaves, is a dicotyledonous plant species belonging to the Asteraceae family. This plant has a wide distribution in tropical regions, including Indonesia, and is often found growing wild in various habitats, from roadsides to secondary forests (Saraswati & Restuti, 2020). Kenikir leaves are typically consumed as vegetables, to stimulate appetite, strengthen bones, and can treat gastritis (Dwiyanti et al., 2014). Phytochemical tests on kenikir leaves have shown the presence of active compounds such as flavonoids, terpenoids, saponins, tannins, and essential oils that act as antimicrobials (Dwiyanti et al., 2014; Bunawan et al., 2014; Abas et al., 2003; Hassan et al., 2012). Researchers who have studied kenikir leaves indicate that they can improve nutritional value due to their content of bioactive compounds such as protein, carbohydrates, phenolics, vitamins, and minerals (Abas et al., 2003). Additionally, their antioxidant content also serves to combat free radicals (Pamungkas et al., 2019).

The pharmacological potential of kenikir leaves (*Cosmos caudatus Kunth*), which are rich in bioactive compounds, has been recognized for various biological activities, including significant antioxidant, anti-inflammatory, immunomodulatory, and antimicrobial properties. Based on the promising phytochemical profile of kenikir leaves, the idea has emerged to integrate kenikir leaf extract into a nutrient-rich powdered functional beverage matrix, such as powdered goat milk from goat fresh milk.

Fresh milk is a complex colloidal system with high water activity, neutral pH, and rich in nutrients. This unique chemical composition makes it susceptible to microbial contamination and enzymatic activity. Microbial growth can lead to various chemical and physical changes in milk, such as the formation of lactic acid, gas production, and protein coagulation. As a result, milk becomes sour, unpleasant in odor, and unsafe for consumption. To address these issues, the food industry has developed various milk processing technologies, such as pasteurization, UHT (Ultra High Temperature), and drying, aimed at inactivating pathogenic microorganisms and extending the shelf life of products (Agustina, 2020). Milk, whether from cows or goats, is a significant source of nutrients, including protein, fat, lactose, vitamins, and minerals. However, the nutritional composition of both types of milk shows significant differences. Goat milk generally has smaller fat particle sizes, making it easier to digest and less likely to cause digestive issues such as bloating in some individuals. Additionally, goat milk contains casein proteins with a different structure compared to cow's milk, making it easier to digest and more hypoallergenic.

The process of making powdered milk involves evaporating water from fresh milk until its moisture content is significantly reduced. By lowering the moisture content, the water activity in the milk also decreases, thereby inhibiting microbial growth. Furthermore, the drying process can inactivate most of the enzymes present in the milk, preventing chemical reactions that could compromise the quality of the milk (Cyrilla et al., 2015).

Cow's milk dominates global milk consumption compared to goat's milk due to its wider availability, affordability, and a greater variety of product forms such as cheese, butter, yogurt, and kefir (Nurhasanah et al., 2019). This has made cow's milk more popular in various countries, including Indonesia (Nayik et al., 2022).

Goat milk offers significant benefits for bodily conditions, including enhancing reproductive capacity, supporting fetal development, improving the quality of breast milk, maintaining ideal body weight, boosting immune function, and more. Goat milk is believed to be capable of healing various types of diseases (Dewi, 2018). It is rich in antioxidants, making it useful for combating free radicals. Additionally, goat milk has superior nutritional content compared to cow's milk. The fat and protein in goat milk are also easier to digest, and the vitamin B1 content is higher than that found in cow's milk (Rokhayati et al., 2022). The average macronutrient composition of pure goat milk can be seen in Figure 1.

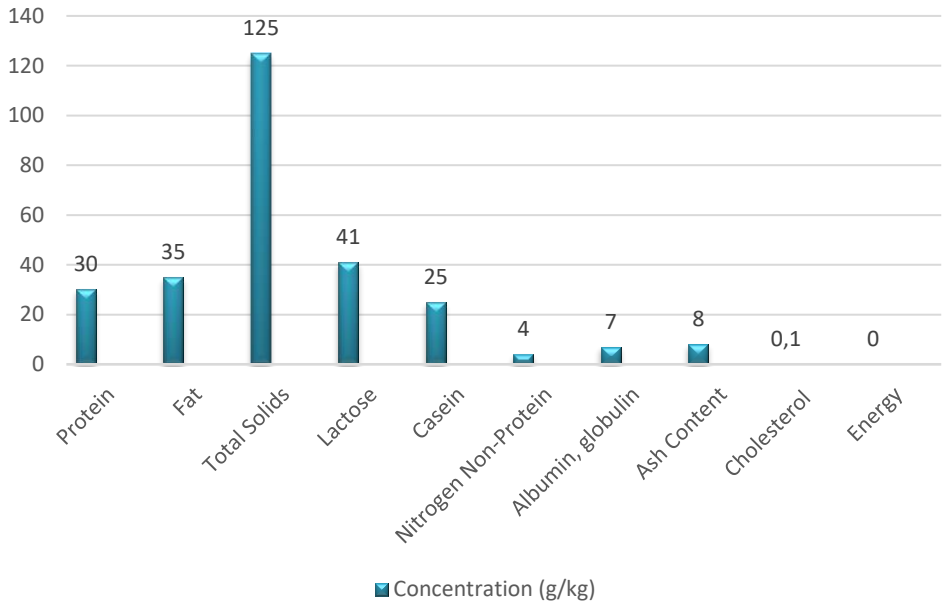


**Figure 1.** Averages Macronutrient Compound of Goat Milk.
(Nayik et al., 2022).

Due to its advantages, goat milk is increasingly being developed into various types of food and beverage products that are accepted by the community, one of which is creating

functional beverages rich in protein with the addition of kenikir leaf powder (*Cosmos caudatus Kunth*).

## METHOD

### Tools and Materials

The primary instrument used in this research is a set of Kjeldahl test apparatus. The main materials utilized are powdered goat milk, kenikir leaf powder, and protein testing reagents using the Kjeldahl method.

### Procedure

This functional beverage-based study utilizes samples of powdered goat milk and kenikir leaf powder (*Cosmos caudatus Kunth*), with a total of three formulations. The formulations of the functional beverage made from powdered goat milk and kenikir leaf powder are presented in Table 1.

**Table 1.** Composition of the Functional Beverage Sample

| Sample | Powdered Goat Milk (gr) | Kenikir Leaf Powder (gr) |
|---|---|---|
| MF(F0) | 25 | 0 |
| MF(F1) | 25 | 1 |
| MF(F2) | 25 | 2 |

The functional beverage based on powdered goat milk and kenikir leaf powder was tested for protein content using the Kjeldahl method. This test was conducted to determine the effect of adding kenikir leaf powder, which is known for its high protein content.

The principle of the Kjeldahl method involves the destruction of protein and organic content in the sample, followed by distillation, and the final step is titration with a strong acid. The protein test using the Kjeldahl method is performed in three stages of process:

1. Destruction

In this stage, the sample is heated with concentrated sulfuric acid to break down the protein into elements such as C, N, O, H, and S.

2. Distillation

In this stage, $(NH_4)_2SO_4$ is decomposed into $NH_3$ (ammonia) by adding NaOH until the solution becomes basic, and then heated until the ammonia completely evaporates. The distillation product is collected in an Erlenmeyer flask containing 50 mL of 0,1 N HCl solution and 1% phenolphthalein.

3. Titration

In the titration stage, the product from the distillation phase is then titrated with 0,1 N NaOH solution until a constant color change occurs..

## RESULT AND DISCUSSION

### Results of Protein Content Testing in Functional Beverages Using the Kjeldahl Method

The physical form of the powdered sample before analysis using the Kjeldahl method can be observed in Figure 2. The results of the protein content test for the functional beverage mixture of powdered goat milk and kenikir leaf powder are presented in Table 2, and the graphical visualization is shown in Figure 2.


**Figure 2.** Functional Beverage Sample (a. MF(F0) Powdered Goat Milk, b. MF(F1), c. MF(F2), and d. Kenikir Leaf Powder)

**Table 2.** Results of Protein Content Testing in Functional Beverages

| No. | Test Sample | Sample Color | Protein Content (%) |
|---|---|---|---|
| 1 | MF(F0) | Milky White | 2,49 |
| 2 | MF(F1) | Pale Green | 3,07 |
| 3 | MF(F2) | Pale Green | 3,58 |

Protein content testing of functional beverages made from powdered goat milk and kenikir leaf powder has been conducted. Samples were obtained through random sampling. The Kjeldahl method was used in this study to determine the protein content of the functional beverages in accordance with SNI 2970:2015. This method offers several advantages in protein testing, including being selective, accurate, andpractical (requiring minimal reagents).

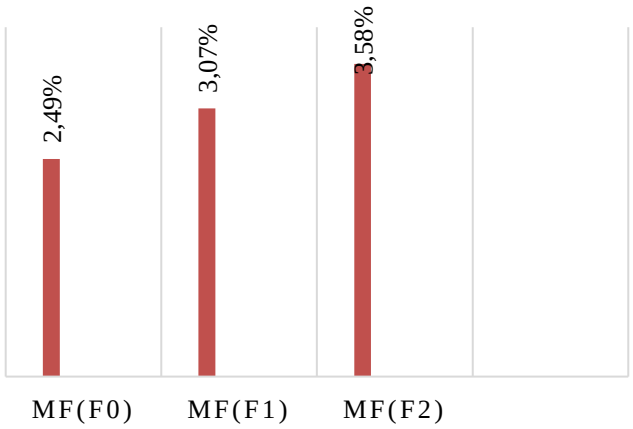


**Figure 3**. Percentage of Protein Content in Functional Beverage Samples

Protein content determination in functional beverages was carried out with three repetitions. The purpose of these repetitions is to ensure accuracy in the analysis process. The protein content analysis using the Kjeldahl method is divided into three stages: destruction, distillation, and titration.

The addition of concentrated sulfuric acid during the destruction stage aims to break down the protein into its constituent elements. The use of a catalyst is intended to increase the boiling point of the acid so the process can proceed more quickly. This is followed by direct heating at a temperature of 370-410 °C. The reaction that occurs is:

$$NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4 \quad (1)$$

Ammonia formed during the destruction process is then distilled by an acid solution. This solution captures the ammonia to be titrated with a standard HCl solution using phenolphthalein as the indicator until a color change occurs, indicating the endpoint of the titration. This process involves two reactions that take place:
Reaction 1 (neutralization):

$$(NH_4)_2SO_4 + 2NaOH \rightarrow 2NH_4OH + Na_2SO_4 \quad (2)$$

Reaction 2:

$$NH_4OH + HCl_{excess} \rightarrow NH_4Cl + HCl \quad (3)$$

The titration stage is a quantitative test used to determine the nitrogen content in the sample. The results obtained from the quantitative protein test are then analyzed to calculate the nitrogen (N) value from the protein, which is multiplied by a conversion factor.

Based on the results obtained from the protein content test of the functional beverage, as shown in Table 2 and Figure 3, MF(F0), which is pure powdered goat milk without the addition of kenikir leaf powder, had a protein content percentage of 2.49%. The MF(F1)

formulation, with 1 gram of kenikir powder added, showed a protein percentage of 3.07%. The MF(F2) formulation, with 2 grams of kenikir powder added, had a protein content percentage of 3.58%. From this data, it is evident that the MF(F2) formulation has a higher protein content compared to MF(F1), due to the greater addition of kenikir leaf powder, and is significantly higher than MF(F0), which had no kenikir leaf powder added.

Fresh goat milk is known for its higher protein content compared to fresh cow milk, with a variation ranging between 4.17-4.56% (Rangkuti, 2011). However, several studies have suggested that the heating and drying processes involved in the production of powdered goat milk can cause interactions between proteins and phenolic compounds, which may affect the bioactive and antioxidant properties of the proteins (Milincic et al., 2021).

Powdered goat milk generally retains most of its macronutrient content, including protein, although the quality of the protein may be altered due to denaturation during the drying process (Nayik et al., 2022). The composition of goat milk can be seen in Figure 1. Figure 1 shows the average macronutrient composition of fresh goat milk (Haenlein, 2001). The macronutrient composition of goat milk is influenced by several factors such as genetics, environment, physiology, and general handling (Mayer & Fiechter, 2012).

According to SNI 2970:2015 on powdered milk, the minimum protein content required for powdered milk, including powdered goat milk, is 24%. However, based on the results of the Kjeldahl test in this study, the percentage of protein content obtained was below the standard. This could be due to several factors, including errors during production, the quality of raw materials, and inaccurate testing, leading to protein content results that are significantly below the required standard. Alternative methods that may be used to prevent a significant reduction in the protein content of milk include avoiding high or excessive heating during the evaporation process. Using drying techniques such as spray drying and freeze drying is also one of the evaporation techniques that help maintain the protein structure from denaturation. Nevertheless, this study successfully demonstrated the effect of adding kenikir leaf powder, a vegetable group with relatively high protein content. Kenikir leaves are known to contain 3.7% protein, 0.4% fat, 5.8% crude fiber, and 450 Kcal/kg of ME (energy) (Utomo & Risyani, 2020).

The addition of kenikir leaf powder to powdered goat milk proved to increase the protein content in the powdered goat milk. For the MF(F1) formulation, with the addition of 1 gram of kenikir leaf powder, the protein content increased by 0.58% compared to the pure powdered goat milk MF(F0). Meanwhile, for the MF(F2) sample, with the addition of 2 grams of kenikir leaf powder, the protein content increased by 1.09% compared to the pure powdered goat milk MF(F0). These results indicate that the addition of kenikir leaf powder to powdered

goat milk can effectively increase its protein content. Functional beverages are a type of food designed to enhance the body's immunity with ingredients that can combat free radicals, promote overall health, and slow down the aging process (anti-aging) (Agusthi, 2023). There is a wide variety of formulations, such as functional beverages made with kenikir leaves and starfruit extract (Batubara et al., 2021), jelly drinks from sappan wood and red ginger extract (Agusthi & Romadhan, 2023), yogurt enriched with black rice beverages (Atwaa et al., 2024), and functional drinks based on a blend of ginger, lemongrass, sappan wood, nutmeg, cloves, and cardamom (Masnar & Pinandoyo, 2020). These references demonstrate that people today are paying increasing attention to healthier lifestyles.

To support the increasingly demanding activities of today's society, food and beverage products are needed that are not only healthy but also quick to serve (Agusthi et al., 2023). Ready-to-drink beverages that have gained popularity among the public often contain refined sugars and preservatives, which can lead to health problems, particularly diabetes mellitus. For this reason, there is a need for functional food and beverage products containing natural ingredients as a healthier alternative, free from refined sugars and with detoxifying properties (Amran et al., 2024).

One example of functional beverage blends is an instant drink made from powdered goat milk and kenikir leaf powder, which has the potential to be popular among various groups, especially working adults. This functional drink is expected to become a preferred choice, allowing individuals to maintain a high level of activity while keeping their health in check through the product's beneficial nutritional content.

## CONCLUSION

Based on the research findings on the production of functional beverages combining powdered goat milk and kenikir leaf powder, it can be concluded that the functional beverage samples successfully increased the protein content of pure powdered goat milk. The test sample MF(F2), with the addition of 2 grams of kenikir powder, resulted in a protein increase of 1.09% compared to the test sample MF(F1), which only achieved a 0.58% protein increase over MF(F0), the pure powdered goat milk. With further and in-depth research, functional beverages based on kenikir leaves and goat milk could become an alternative drink for individuals with high activity levels who are aware of the importance of a healthy lifestyle in today's era, due to their beneficial nutritional content.

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