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DISFAVIT: ORGANIC LIQUID FOOD FOR NEUROREHABILITATION AND NUTRITIONAL FULFILLMENT IN POST-STROKE PATIENTS WITH DYSPHAGIA

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ABSTRACT

Dysphagia, or difficulty swallowing and chewing, often occurs as a result of medical conditions such as strokes that damage the cranial nerves. This condition has the potential to cause malnutrition, aspiration, and decreased quality of life, especially in the elderly. Dietary modification is important, but special products for dysphagia patients with complete nutritional content are still limited. To overcome this, DisfaVit comes as a liquid food in the form of a soluble powder that is soft, filling, high in calories, and low in sugar. Made from organic ingredients, DisfaVit uses moringa leaves, banana peels, and white snapper scales—nutrient-rich leftovers from the food industry—with the addition of soy milk powder, soy protein isolate, and guar gum. This study aims to analyze the secondary metabolite content of moringa leaves and banana peels, evaluate the characteristics, quality, and safety of DisfaVit, and identify the most in-demand formulas. Research methods include literature, experimental, and laboratory studies, with phytochemical, characteristic, safety, and organoleptic testing. The results show that DisfaVit has a high bioactive and nutrient content, is safe to consume, and the P3 formula is the most in demand. DisfaVit has the potential to be a neurorehabilitation solution and improve the quality of life of elderly post-stroke patients with dysphagia

KEYWORDS *Dysphavat, dysphagia, post-stroke, neurorehabilitation, liquid food*

INTRODUCTION

Swallowing is a complex process that involves contracting the muscles of the head and neck to move food from the oral cavity to the stomach. *Oropharyngeal dysphagia* (DO), which is difficulty swallowing and chewing in the mouth and throat, often occurs due to medical conditions such as strokes that damage the cranial nerves. This condition can cause various health problems, including decreased appetite, malnutrition, aspiration, and dehydration. *Oropharyngeal dysphagia* is more prevalent in the elderly (Gallegos et al., 2023; Kim & Kim, 2021; Marchese et al., 2022; Matar et al., 2021; Sasegbon & Hamdy, 2017).

Currently, there is an urgent need for food and beverage products specifically designed for the elderly with DO that provide complete nutritional content. Studies show that the highest prevalence of malnutrition occurs among elderly individuals with DO, reinforcing the importance of specialized nutritional products to address this problem. The products available on the market are not considered sufficient to meet the complete nutritional needs required for the recovery process, including boosting immunity, neurorehabilitation, and strengthening bones. Information about the absence of products that fully meet the nutritional needs of elderly post-stroke patients with *oropharyngeal dysphagia* was obtained through literature studies.

In response to these challenges, this research was conducted to develop healthy food by utilizing the potential of nature as the main ingredient, rich in nutrients and bioactive

compounds. DisfaVit is specifically designed to meet the nutritional needs of patients with *oropharyngeal dysphagia* in elderly post-stroke patients and to utilize organic waste materials from land and sea. Thus, DisfaVit not only improves human health but also supports efforts to preserve a beautiful and sustainable environment. In its formulation, DisfaVit utilizes three main ingredients sourced from local resources in Indonesia. In the Bali area, *moringa* plants grow abundantly in household yards, but their use is still suboptimal. In fact, *moringa* leaves are rich in vitamins B, C, D, and E, which can maintain nervous system health, as well as minerals such as protein, calcium, potassium, magnesium, iron, zinc, folate, phosphorus, and selenium, which can increase bone resistance (Anastasia, 2021; Cahaya Dipura et al., 2023). Researchers utilize this ingredient to support overall body health. *Kepok* bananas, known as nutrient-rich fruits, contain high levels of B complex vitamins, especially B1 and B12, as well as minerals such as magnesium, phosphorus, iron, and potassium. However, the skin is often considered waste, even though its content is similar (Aryani et al., 2018; Amini Khoozani et al., 2019; Maulana et al., 2022). Researchers also use this ingredient to meet the body's nutritional needs, especially in terms of nerve repair. White snapper have scales that are usually discarded immediately, but these scales are rich in collagen and hydroxyapatite (HA), as well as calcium, phosphate, and hydroxide (Soulissa and Nathania, 2018; Hariyanti et al., 2023). Researchers use this ingredient as a natural source of collagen, which plays a critical role in strengthening bones, connective tissue, and cell regeneration.

DisfaVit presents an innovative solution to overcome the shortcomings of existing products on the market. By combining these three organic wastes, DisfaVit is created as a product that synergistically meets the nutritional needs of elderly post-stroke patients with *oropharyngeal dysphagia*, thereby aiding the recovery process. DisfaVit is a liquid food with a soft, chewy, and delicious texture derived from a dissolved powder. This product is filling, high in calories, but low in sugar. In addition to the three main ingredients, DisfaVit is also enriched with soy milk powder and soy protein isolate as its base ingredients, which provide vegetable protein and have the potential to support tissue regeneration and muscle function.

Based on this background, this study was formulated to answer several key questions: whether *moringa* leaf extract and *kepok* banana peel contain secondary metabolite compounds beneficial for neurological, bone, and immune health; what are the characteristics and quality of DisfaVit made from a combination of *moringa* leaves, *kepok* banana peels, and white snapper scales based on the Total Plate Count (TPC) test; and which formula is most preferred by the audience. The purpose of this study includes analyzing the content of secondary metabolites, characteristics, and quality of DisfaVit, as well as identifying the best formula that suits audience preferences. Practically, this study aims to provide a solution in the form of nutrient-rich liquid food products that are efficient and practical for patients with *oropharyngeal dysphagia* in elderly post-stroke patients, while optimizing the use of local resources such as *moringa* leaves, *kepok* banana peels, and white snapper scales, thereby helping to reduce organic waste. Theoretically, this research contributes to enriching scientific insights related to alternative therapies for patients with *oropharyngeal dysphagia*, increasing

creativity in scientific writing, and providing references for complete nutritional solutions for elderly post-stroke patients.

RESEARCH METHODS

Time and Place of Research

This research started from August 1, 2024 to September 25, 2024. The locations where the researcher's research is conducted are:

1. Jalan Gandapura IIIF No. 12, Denpasar, Balu (Team member's house)
2. SMA Negeri 1 Denpasar on Jalan Kamboja No. 4, Denpasar, Bali (School)
3. Pharmacy Laboratory - Faculty of Mathematics and Natural Sciences - Udayana University (UNUD) on Jalan Kampus Bukit Jimbaran, Badung, Bali (Place to dry materials)
4. Laboratory of Analysis - Faculty of Agriculture - Warmadewa University at Jl. Terompong No.24, Denpasar, Bali (Testing site)

Data Acquisition Methods

In this study, the data acquisition methods used are literature studies, experiments, laboratory studies, and observations. We apply 3 treatments with different ingredient compositions to each treatment, including the following:

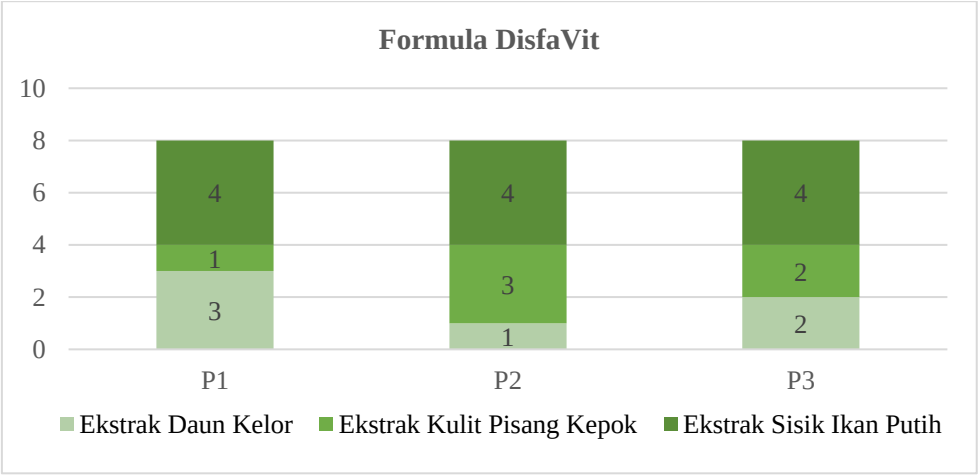

Figure 1. Difference in Ratio of Main Ingredient Composition in DisfaVit Formula

This formula was chosen to compare the quality of moringa leaf extract and kepok banana peel extract which both have an important role in nerve regeneration. The data sources in this study are primary data and secondary data. The primary data of this study are in the form of phytochemical tests of moringa leaf extract and kapok banana peel, physical and chemical characteristics of DisfaVit, safety test of DisfaVit, and organoleptic test of DisfaVit. Secondary data of this study are in the form of information on post-stroke diseases, oropharyngeal dysphagia, main and basic ingredients, current condition data, related previous research, standardization of food and beverage products, processing procedures for ingredients and products, and testing procedures.

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Data Processing and Analysis Methods

In this study, the researcher used quantitative and qualitative data analysis techniques in processing the data obtained. Quantitative data analysis techniques are in the form of numerical data such as numbers and numbers. Meanwhile, qualitative data analysis techniques are in the form of non-numerical data such as letters and words. The researcher also conducted several trials that became parameters for the success of the research, including: (1) Extract Phytochemical Test; (2) Physical Properties Characteristic Test: soluble time test, viscosity test (viscosity test), and moisture content test; (3) Chemical Properties Characteristic Test: antioxidant capacity test (IC 50), total phenol, vitamin C, beta carotene, and pH levels; (4) Safety Test: microbial analysis (TPC/*Total Plate Count*); and (5) Organoleptic Test: aroma, color, texture, and taste.

Research Variables

Independent variable: the composition of moringa leaf extract and kepok banana peel extract had different ratios in each treatment. Control variables: composition of white snapper scale extract, soy milk powder, soy protein isolate, guar gum, water, extraction time, and drying time of ingredients. Bound variables: the content of secondary metabolites of moringa leaf extract and banana peel of Kepok, as well as the characteristics, content, and quality of DisfaVit.

Tools and Materials

Research tools, consisting of: containers, digital scales, spoons, blenders, pots, stoves, water thermometers, gauze, strainers, spoons, & *drying oven binders*. The research materials consisted of: banana peel, moringa leaves, white snapper scales, soy milk powder, soy protein isolate, guar gum (thickener), & water.

Manufacturing Procedure

Here are the details of the composition of the materials for making DisfaVit as a whole:

Table 1. Composition of Materials for Making DisfaVit

No.	Material	Composition (gr)*
1.	Main Ingredients	12 g
2.	Soy milk powder	9 g
3.	Soy protein isolate	2.5 g
4.	Guar gum	2.5 g

Here are the manufacturing steps of the DisfaVit product:

A. Preparation of tools and materials.
B. Drying of the material to remove moisture content.
C. Cutting moringa leaves and kepok banana peels to small sizes and then smoothing the process by blending, as well as the process of smoothing white snapper scales by mashing.

D. The process of extracting moringa leaves and kepok banana peels is by boiling the ingredients using water solvents. The ratio of material and water use is 1:10 respectively. The extraction process is carried out for 15 minutes.
E. Filtering the extract using a sieve in the form of gauze.
F. Thickening of the extract by evaporation.
G. The addition of raw materials and basic materials according to the dosage per treatment.
H. Mixing the ingredients until homogeneous.
I. Dry the mixture of ingredients with a *drying oven* for ± 2 days.
J. Smoothing the mixture of dried ingredients to make a powder.
K. DisfaVit is also finished with a dosage of 26 grams/package.

Product Usage Procedure

The following is the procedure for using DisfaVit products:

A. Prepare 1 package of DisfaVit powder measuring 26 grams and 200 ml of water (200 ml of water is used to obtain a honey-like texture. However, the amount of water can be adjusted to obtain the desired texture).
B. Pour 26 grams of DisfaVit powder into a glass or container, then slowly add 200 ml of water (Water can be hot or cold, but it is recommended to use cold water because it dissolves faster and evens out and reduces the risk of clotting).
C. Stir the mixture until dissoluble and homogeneous. After reaching the desired texture, the product is ready for consumption.

RESULTS AND DISCUSSION

Research Results

Results of Phytochemical Tests of Extracts (Harborne, 1992)

Table 1. Results of Phytochemical Tests of Moringa Leaf Extract and Kepok Banana Peel Extract

Chemical Group	Results & Reactions	
	Moringa Leaf Extract	**Banana Peel Extract**
Alkaloid (Metode Mayer)	- No methanol-soluble (negative) deposits	- No methanol-soluble (negative) deposits
Flavonoid (method Wilstater)	+ Red color (positive for flavone compounds)	+ Red color (positive for flavone compounds)
Chapnin (Uji Fromth)	- No stable foam formed in the test tube (negative)	- No stable foam formed in the test tube (negative)
Tannins	+ Violet color	+ Green color
Kuinon	-	-
Triterpenoid/ Steroid (Liebermann Burchard)	+ Purple color	+ Purple red color

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	(triterpenoid positive)	(triterpenoid positive)

Identification of secondary metabolites in the form of alkaloids, flavonoids, saponins, quinones, tannins, triterpenoids/steroids from moringa leaf extract and kepok banana peel was carried out by being given their respective reactants. The test results in the table show that the two extracts, namely moringa leaf extract and kepok banana peel extract, are positive for flavonoids, tannins, and triterpenoids, but negative for alkaloids, saponins, and quinones.

Results of Physical Trait Characteristics Test

Table 2. Results of the Physical Properties Characteristic Test of DisfaVit

Treatment	Test Parameters		
	Dissolution Time (minutes)	Up to Air (%)	Viscosite (m.Pa.s)
P1	4,5	3,471	7.800
P2	4	3,529	10.600
P3	3	1,906	10.300

The first physical property characteristic test is the dissolution time test. This test aims to determine the length of time it takes for DisfaVit to dissolve in water without leaving clumps. It can be stated that the three Disfavit formulas are able to meet the quality requirements of the dissolution time test because a good instant powder drink has a dissolution time of less than five minutes (Noerwahid, 2016). However, it can be seen that P3 has a faster dissolution time than other DisfaVit formulas with a dissolution time of 3 minutes.

The second test is moisture content. Moisture content is an important indicator in determining the stability of a product, especially in powder form. Too high a moisture content can affect the shelf life and texture of the product. Researchers used the quality standard of powdered skim milk as a reference for the maximum limit of moisture content (SNI 01-2970-2006). Based on the data obtained, it can be concluded that all formulas meet the moisture content requirements, which is less than 5% moisture content.

The third test is viscosity/viscosity. In this test, we chose honey as a product reference in terms of texture because of its texture that is not too thick or liquid. According to SNI, honey is known to have a maximum standard of viscosity, which is 115 poise (11500 mPa.s) and the minimum standard, which is 10 poise (1,000 mPa.s) (Aprilyani, 2020). Based on table 2, it is known that the viscosity level of DisfaVit is still included in the honey viscosity category because the results are in the range of 10-115 poise. The higher the viscosity of a product, the higher the viscosity level. Thus, P1 with the smallest result, which is 7,800 mPa.s, is the best treatment. This is because if liquid food is too thick, elderly patients after stroke with oropharyngeal dysphagia can choke, while if it is too liquid, patients can experience respiration. In order to minimize the risk of both problems, it would be better if the liquid food had a viscosity close to the middle value of the viscosity of honey.

Chemical Properties Characteristic Test Results

Table 3. Results of the Chemical Properties Characteristic Test of DisfaVit

Treatment	Test Parameters				
	IC 50 (ppm)	Total Fenol (mg GAE/g)	Vitamin C (AAE mg/g)	Beta Karoten (mg/g)	pH
P1	1413,87	17,179	10,622	4,16	6,44
P2	2303,79	8,614	9,023	3,31	6,39
P3	1893,40	10,135	10,902	5,89	6,43

Antioxidant activity can indicate the product's ability to fight free radicals. Antioxidants are categorized as very strong if the IC50 value is less than 50 ppm, strong if 50-100 ppm, medium if 100-150 ppm, and weak if 151-200 ppm (Nasution et al., 2015). The lower the value, the stronger the antioxidant activity. Based on table 4.3, it is known that P1 has the strongest antioxidant activity with the lowest test result, which is 1413.87 ppm, followed by P3, and P2. P1 is thought to have better antioxidant activity because it contains more moringa leaf extract which has high antioxidant properties. However, overall, the antioxidant activity of DisfaVit is still in the weak category, so more research is needed.

Based on table 3, it is known that the three DisfaVit formulas have an average vitamin C level of around 10.182 AAE mg/g which means that each gram of the DisfaVit formula contains ±10.182 mg of vitamin C. According to halodoc.com, elderly women and men need vitamin C intake ± 75 mg and 90 mg per day, respectively (Fadli, 2021). With the results of the vit C level test ranging from 9,023-10,902 AAE mg/g, each DisfaVit formula that contains high vitamin C, is considered to be able to meet the needs of vitamin C in the elderly, especially for post-stroke patients with oropharyngeal dysphagia. Among the three formulas, P3 is the best treatment with the highest levels of vitamin C.

In table 3, the results are obtained that the three Disfavit formulas have a fairly high average total phenol level, which is 11.976 mg GAE/g. The higher the total phenol level, the better it will be because the DisfaVit formula means that it has a secondary metabolite content with high antioxidant and anti-inflammatory activity. Thus, this result can also strengthen the evidence of antioxidant activity in DisfaVit. Among the three formulas, P1 was the best treatment with the highest total phenol levels, which was 17.179 mg per gram of use, followed by P3, and finally P2.

In table 3, the test results show that there are variations in beta-carotene content. This result is suspected to have been obtained because moringa leaves and kepok banana peels both contain beta-carotene. Moringa leaves are known to have more beta-carotene content than the skin of a kepok banana. However, P3 with the same composition of moringa leaf extract and kepok banana peel is the best treatment. This suggests that the two extracts can work synergistically. Previous studies also support that the combination of kepok banana peel and moringa leaves can provide a good synergy in increasing nutritional value, especially the content of antioxidants and provitamin A (Rahman et al., 2021).

Based on the test results, the three formulas (P1, P2, P3) have an average pH of 6.42 which is in accordance with the BPOM standard (2014), which is between 6-7. This pH value

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is close to neutral pH, which indicates that the product is safe to consume, does not cause irritation, and is convenient for the digestive tract. In addition, according to saka.co.id, dairy products and most food products have an ideal pH between 5-7 (Anonymous, 2020)

Security Test Results

Table 4. DisfaVit Security Test Results

Total Mikroba (cfu/g)	Treatment		
	P1	P2	P3
	2,8 x 10^4	2,3 x 10^3	2,4 x 10^4

Total Plate Count (TPC) is a method that shows the number of microbes contained in a product with a mechanism for calculating the growth of microorganism colonies. The media used is agar media. This test is important as a quality test of the product. (Gunawan, 2023; Rizki et al., 2022). The researcher associated the DisfaVit product with the specification of the quality requirements for the maximum limit of microbial contamination in powdered milk, which has a measurement value limit of 5 x 10^4 (SNI, 2005). Based on the test results, it is known that P1 is worth 2.4 x 10^4, P2 is worth 2.3 x 10^3, and P3 is worth 2.8 x 10^4. The results showed that P2 with a ratio of moringa leaf extract, banana peel extract, and white snapper scale flour 1:3:4 had the safest quality because the level of microbial contamination was the lowest. It is assumed that P2 manages to be the best sample due to the higher extract of kepok banana peel. The peel of the kepok banana is known to contain antioxidants in the form of carotenoids and polyphenols that play a role in inhibiting the growth of microbes (Aryani et al., 2018).

Organoleptic Test Results

Table 5. Results of the Organoleptic Test of DisfaVit

Test Parameters	Treatment		
	P1	P2	P3
Aroma	4	3	4
Color	4	3	4,5
Texture	3	3	4
Taste	3	4	3,5

Description: (1) strongly disliked, (2) disliked, (3) liked enough, (4) liked, (5) liked very much

Through the scoring results obtained, it is known that each DisfaVit formula has a fairly good score. In terms of aroma, P1 and P3 have the highest average score with scents that are not as sharp as other formulas. There are several different opinions from respondents regarding the aroma of DisfaVit, including scented ones, such as seaweed, *matcha*, and soybeans. In terms of texture, P3 is the best treatment with the most suitable viscosity almost resembling honey and has the highest average score. Meanwhile, P1 and P2 have a slightly less thick texture and slightly thicker than P3, respectively. In terms of color, P3 was the best treatment with the highest score. P3 has a softer color and is not as intense as other formulas. In terms

of taste, P2 is the best treatment, followed by P3, and finally P1. Most respondents think that the flavor of DisfaVit is dominant like soy milk. However, there are also those who feel a little bitterness from moringa leaves and kepok banana peels.

Discussion

The test results obtained show that DisfaVit has the potential to play a role as a neurorehabilitation as well as a bone booster that helps the recovery process of post-stroke elderly patients with complications of oropharyngeal dysphagia. The content of secondary metabolites in the form of flavonoids and tannins, antioxidants, as well as vitamin C and beta carotene levels owned by DisfaVit, has been proven to be beneficial in maintaining nerve and immune health through research that has been conducted. These contents can fight free radicals that trigger strokes, protect cells, and delay aging effectively (Cui *et al*., 2020). In addition, vitamin C plays a role in producing collagen and can increase bone density (Nareza, 2020).

In each test, a different DisfaVit formula is the best treatment. However, among the three formulas, P3 with the ratio of the composition of moringa leaf extract, banana peel extract, and white snapper scale flour was 2:2:4, respectively, to be the superior treatment because the test results were more dominant. The difference in composition between moringa leaf extract and kepok banana peel extract in the three Disfavit formulas apparently affected the results in this study. However, from the results obtained, the two extracts can be said to be able to work synergistically.

CONCLUSION

Based on the research, DisfaVit, made from *moringa* leaf extract (*Moringa oleifera*), *kepok* banana peel extract (*Musa paradisiaca*), and white snapper scale flour (*Lates calcarifer*), contains ingredients that play an important role in maintaining nervous, bone, and immune health, and exhibits good physical and chemical characteristics according to standards. The safety of consumption of this product has also been confirmed through the Total Plate Count (TPC) test. Formula P3, with an ingredient ratio of 2:2:4, is the most preferred formula. This study demonstrates the potential of DisfaVit as an innovative solution to meet nutritional needs and support nerve regeneration in elderly post-stroke patients with *oropharyngeal dysphagia*. However, further research is needed to optimize the formula, particularly regarding texture and nutritional content, as well as to conduct wider clinical trials, starting with tests on experimental animals such as mice, to confirm its benefits as part of neurorehabilitation for these patients.

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