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Original Article

Activity Test Of Papaya Fruit Extract And *Curcuma Mangga* As An Appetite Enhancer With Anorexia Test Model On Marshmallow Preparation Innovation

Uji Aktivitas Ekstrak Buah Pepaya Dan *Curcuma Mangga* Sebagai Peningkat Nafsu Makan Dengan Model Uji Anoreksia Pada Inovasi Produk Marshmallow

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Abstract

Feeding difficulties in children are becoming an increasing global problem. Natural alternatives such as *Carica papaya* and *Curcuma mangga* are believed to increase appetite. This study tested the combination of the two as an anorexia agent in the form of marshmallows, as an attractive, nutritious, and attractive delivery innovation for active substances that children like. The study used a combination of *Carica papaya* and *Curcuma mangga* extracts in marshmallow form to treat anorexia. The process includes extraction, phytochemical testing, rat testing, marshmallow formulation, and organoleptic evaluation, weight uniformity, and hedonic test for children and adults to assess its effectiveness and acceptability. Phytochemical screening showed *Carica papaya* and *Curcuma mangga* extracts contained alkaloids, steroids, polyphenols, and vitamin C. The anorexia test had a p-value of 0.05. The anorexia test has a p value (>0.05) so it has an insignificant value, but the extract still increases appetite. The formulated marshmallow has a chewy texture, a favorable aroma, but the taste and texture are less attractive to panelists. *Carica papaya* and *Curcuma mangga* extracts contain active compounds and showed appetite- enhancing effects although not statistically significant. Marshmallow has a vanilla aroma that is preferred, but the taste and shape are less than optimal. The study is limited in number of samples, further quantitative analysis and formulation evaluation are recommended.

Abstrak

Kesulitan makan pada anak-anak menjadi masalah global yang semakin meningkat. Alternatif alami seperti *Carica papaya* dan *Curcuma mangga* dipercaya dapat meningkatkan nafsu makan. Studi ini menguji kombinasi keduanya sebagai agen anoreksia dalam bentuk marshmallow, sebagai inovasi penyampaian zat aktif yang menarik, bergizi, dan disukai anak-anak. Studi ini menggunakan kombinasi ekstrak *Carica papaya* dan *Curcuma mangga* dalam bentuk marshmallow untuk mengobati anoreksia. Prosesnya meliputi ekstraksi, pengujian fitokimia, pengujian pada tikus, formulasi *marshmallow*, dan evaluasi organoleptik, keseragaman berat, dan uji hedonik untuk anak-anak dan orang dewasa untuk menilai efektivitas dan penerimaannya. Skrining fitokimia menunjukkan ekstrak Carica papaya dan Curcuma mangga mengandung alkaloid, steroid, polifenol, dan vitamin C. Uji anoreksia memiliki nilai p 0,05. Uji anoreksia memiliki nilai p (>0,05) sehingga nilainya tidak signifikan, tetapi ekstrak tersebut tetap meningkatkan nafsu makan. Marshmallow yang diformulasikan memiliki tekstur kenyal, aroma yang menyenangkan, tetapi rasa dan teksturnya kurang menarik bagi panelis. Ekstrak *Carica papaya* dan *Curcuma mangga* mengandung senyawa aktif dan menunjukkan efek meningkatkan nafsu makan meskipun tidak signifikan secara statistik. *Marshmallow* memiliki aroma vanila yang disukai, tetapi rasa dan bentuknya kurang optimal. Studi ini terbatas pada jumlah sampel, analisis kuantitatif lebih lanjut dan evaluasi formulasi

direkomendasikan.

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INTRODUCTION

Difficulty eating or decreased appetite is a common problem in children that has an impact on nutritional fulfillment, and is a global health issue[11]. Children who experience eating disorders usually show behaviors such as refusing to eat, choosing certain foods, eating too long, or not finishing their portion of food[15]. This problem can be experienced by anyone regardless of age, gender, or social background [30]. In the past two decades, the prevalence of eating disorders has steadily increased globally, from 3.4% in 2000 to 7.8% in 2018. A systematic review noted that between 1999-2022, approximately 22.36% of children and adolescents exhibited disordered eating behaviors[20]. In Southeast Asia, the prevalence of eating disorders reached 11.5%, and in Indonesia it was recorded at 7.4% [21].

Various efforts that have been made by every parent are making food variations, both in terms of shape and menu, to make it look more attractive; giving appetite-enhancing drugs or vitamins purchased at the pharmacy; even giving herbal medicine as a traditional medicine that is considered natural [23]. Another alternative that can be considered is taking nonpharmacological multivitamins. One source of natural multivitamins is fruits that have high nutritional value, sweet taste, affordable price, and easy to obtain, such as papaya (*Carica papaya*)[26].

Papaya (*Carica papaya*) is a tropical fruit that is widely found in Indonesia, with a sweet and refreshing taste due to its high water content[6]. This fruit is believed to help increase children's appetite and accelerate the absorption of nutrients due to its vitamin content which is important for metabolism and body growth[5]. Papaya fruit contains the enzyme papain, which has the ability to accelerate the digestion of proteins. Papain can help achieve better food digestion, thereby enhancing the immune system. stimulating the hypothalamus to increase appetite[33]. Meanwhile, *Curcuma mangga* is an annual shrub plant with bright yellow rhizomes and a distinctive aroma like mango, which is known to have benefits for increasing appetite and functions as an antipyretic, antitoxin, laxative, anticancer, and antioxidant[10]. The rhizome of mango ginger belongs to the Zingiberaceae family and contains secondary metabolites such as flavonoids and curcumin, which are polyphenolic compounds that can increase appetite[34].

Marshmallow candy is a snack that is quite popular in Indonesia and is favored by various groups, especially children1[9]. The manufacturing process does not require high temperatures, making it suitable for mixing vitamin-containing ingredients without causing nutritional damage[18]. According literature[3] showed that marshmallows can be added with functional ingredients to increase nutritional value without reducing texture and taste, making it an effective food for the delivery of active substances in a form preferred by consumers or children so that marshmallows are suitable to be added with papaya juice and *Curcuma mangga*.

Based on this background, this study aims to test the activity of a combination of papaya juice extract and *Curcuma mangga* as an anorexia agent using the anorexia test model, and develop an innovative preparation based on marshmallows as a form of active ingredient delivery. The novelty of this research lies in the combination of natural ingredients that have not been widely studied from the use of marshmallows as a natural ingredient-based orexigenic delivery medium.

METHODS

Materials

The materials used are papaya juice (Sweet Mulan), *Curcuma mangga* extract (Balitro), avicel (*Brataco Chemical*), distilled water (*Brataco Chemical*), gelatin (*Brataco Chemical*), dextrose (*Brataco Chemical*), na-cmc (*Brataco Chemical*), corn starch (*Brataco Chemical*), sucrose (*Brataco Chemical*), vanilli (koepoe-koepoe).

Research Procedure

Step I: Extraction

Making papaya juice extract begins with taking 6 kg of fruit, then washing the fruit thoroughly. Next, the papaya fruit is blended and separated with a filter. After that, freeze drying is carried out to get the extract [27]. *Curcuma mangga* extraction was carried out with water solvent and stirred at 50 rpm at room temperature. Then filtering is done with a filter cloth [28].

Step II: Phytochemical Screening

Phytochemical Screening of Papaya Extract

Alkaloids

1 gram of extract was added to enough chloroform, then added 10 mL of ammonia and 10 mL of chloroform. Then filtered into a test tube and filtrate added 10 drops of H2SO4. Then divided into two different test tubes, in test tube I plus Dragendorff reagan. Contains alkaloids if an orange precipitate is formed. After that test tube II plus Mayer reagent the formation of a white precipitate indicates the presence of alkaloids[14].

Flavonoids

1 mL extract plus a few drops of concentrated HCl. Then 0.2 g of Mg powder was added. Positive results are indicated by the onset of a deep red color for 3 minutes[14].

Polyphenols

1 mL extract was added with a few drops of $FeCl_3$ 10%. Positive results form a blue to purple color[29].

Vitamin C

Extract as much as 1 mL added 5 ml of distilled water shaken and then added $KMnO_4$ 1% 10 ml. If a brown color appears, it indicates the presence of vitamin C compounds[31].

Steroids

A total of 2 mL of extract was put into a test tube. Then added with 0.5 mL chloroform and 0.5 mL Liebermann Burchard reagent. If there is a brownish red or violet color change the sample contains terpenoids, while if it shows a greenish blue color change the sample contains steroids [29].

Phytochemical Screening of *Curcuma mangga* Extract

Alkaloids

A total of 2 ml of extract was added with 2 ml of HCl and 4 ml of methanol, then heated for 5 minutes, after which it was cooled and filtered. Filtrate is used for testing. Test I: 1 mL of filtrate plus 2 drops of Mayer reagent, if a white precipitate is formed, then the sample contains alkaloids. Test II: 1 mL, filtrate plus 2 drops of Dragendorff reagan, if an orange-brown precipitate forms, then the sample contains alkaloids[16].

Flavonoids

1 mL extract plus 1 mL methanol, then filter. then the filtrate is added a few drops of concentrated HCl, then add Mg metal powder and amyl alcohol. Positive results are indicated by the formation of a red/orange precipitate[16].

Polyphenols

1 mL extract is added with a few drops of $FeCl_3$ 10%. Positive results form green, blue or purple color [16].

Vitamin C

Extract as much as 1 mL added 5 ml of distilled water shaken and then added $KMnO_4$ 1% 10 ml. If a brown color appears, it indicates the presence of vitamin C compounds[31].

Steroids

A total of 1 mL of extract plus 2 drops of acetic acid anhydride and 2 drops of concentrated sulfuric acid. If a blue or green color forms, the sample contains steroids[16].

Anorexia Testing (Rattus Norvegicus)

Preparation

The study was conducted at the Pharmacy Laboratory of Muhammadiyah University of Bandung for 3 months with permission from the ethics committee of Ahmad Dahlan University with SK number 022406072. Test animals used male white rats (Rattus norvegicus) with 2-3 months of age and weights of 75-100 grams. Test animals were acclimatized for 1 week so that they could adjust to the surrounding environment[1].

Classification

The test animals were divided into three groups, each consisting of five rats. The negative control group was administered Na-CMC, while the positive control group received a suspension of cyproheptadine. The test group was treated with a suspension containing papaya fruit extract and *Curcuma mangga*.

Anorexia testing

The test animals were divided into 3 groups with each group consisting of 5 rats. Then, anorexia treatment was made by giving unlimited access to the test animals using a walking wheel and a treatment was made by limiting the rats' feeding hours for 7 days. Then, ciproheptadine suspension solution was given to the positive group, papaya and *Curcuma mangga* juice solution was given to the test group, and the negative group was only given na-cmc suspension. After that, anorexia activity was observed in the test animals for 7 days (Foldi, 2024). Data from the anorexia test were analyzed using the One Way ANOVA method with a significance value of 0.05 [22].

Formulation of Marshmallow

Table 1. Marshmallow preparation formula

No.	Formula	Concentration (%)	Usability
1.	*Carica papaya* fruit extract	33.7	Active substance
2.	*Curcuma mangga* extract	6.3	Active substance
3.	Dextrose	38.1	Filler
4.	Sucrose	4.6	Sweetener
5.	Gelatin	5	Fastener
6.	Corn starch	9.3	Lubricant
7.	Avicel	2	Fastener
8.	Vanillin	1	Flavouring

First the two extracts are heated, then add the gelatin and stir until the gelatin is soft. Add dextrose syrup 114.3 g, sucrose 13.8 g, then stir. After that the dough is poured into a mixer, beaten until fluffy. Combine starch, avicel and vanilla in the mixer container and pour the batter into the pan. Let stand at room temperature for 16 hours.

After 16 hours of standing, the marshmallows are removed from the mold. Before cutting, the marshmallows were smeared with dextrose and corn starch to prevent sticking. The marshmallow preparation is ready for evaluation test[2].

Evaluation test of Marshmallow

Organoleptic

Organoleptic tests were conducted by analyzing the shape, smell, and taste of the marshmallows.

Uniformity of Weight

10 marshmallow preparations that have been cut, weighed and calculated the average weight of each preparation, The results of weighing should not be more than two preparations with weights deviating from the average weight of column A, then there is no one preparation with weights deviating from the average weight of column B (MOH RI, 2020).

Hedonic

The study was conducted at the Pharmacy Laboratory of Universitas Muhammadiyah Bandung with permission from the Ahmad Dahlan University ethics committee with SK number 022407076. The favorability test was conducted on 10 children and 10 adult respondents with parameters including taste, aroma, and shape & texture[18].

Data Analyze

The data analysis in this study was conducted using descriptive analysis methods. For the anorexia test, the data were analyzed using the One-Way ANOVA method. Prior to performing the One-Way ANOVA, a normality test was conducted using the Shapiro–Wilk test, and a homogeneity test was carried out using Levene's test. After these assumptions were met, the One-Way ANOVA was performed using SPSS software version 22.

RESULT AND DISCUSSION

Table 2: Phytochemical Screening Results of papaya and *Curcuma mangga* fruit extracts.

No.	Phytochemical test	Papaya	*Curcuma mangga*
1.	Alkaloid	+	+
2.	Flavonoid	-	+
3.	Vitamin C	+	+
4.	Steroid	+	+
5.	Polyphenol	+	+

Phytochemical screening is the initial stage in phytochemical research which intends to provide an overview of plant compound groups[8]. This method is carried out qualitatively and quantitatively. Qualitative phytochemical screening is carried out showing color testing reactions with a color reagent, and using thin layer chromatography. Meanwhile, quantitative phytochemical screening is carried out using UV-Visible Spectrophotometry instruments[12].

The results of phytochemical screening on *Curcuma mangga* based on table 1. showed positive results in the alkaloid test with a red color change, then in the steroid test obtained the results of the formation of an orange ring, and obtained negative results in the flavonoid test with a yellow color, where the flavonoid test results will produce a positive reaction in red. This is because magnesium powder does not provide a reduction reaction of flavonoid compounds so that the test solution does not produce the desired color change[24]. Then the results of the phytochemical screening of papaya fruit show in table 1. with the alkaloid test producing a positive reaction with a red

color change, the flavonoid test produces a negative, vitamin C, steroids, and polyphenols produce a positive reaction[31].

Table 3. Anorexia Test in White Rats (*Rattus norvegicus*)

Group Animal Test	Mean ± SD	p-Value
Negative group	91 ± 13.46	
Positive group	93 ± 12.52	0,960
Testing group	92 ± 9.45	

The results of the anorexia test with the One Way ANOVA method where the results showed a p>0.05 value, so there were no significant differences with each group. This is because the three test materials used can increase appetite in test animals. The negative group given Na- CMC gave the effect of weight gain in the test animals. Na-CMC is not the main factor as an appetite enhancer, but the hungry phase due to activity-based anorexia stress as the main factor in increasing the appetite of test animals. Then in the positive group given ciproheptadine has the side effect of increasing appetite in test rats. The test group showed that *Curcuma mangga* can increase appetite due to the content of curcumin compounds in the rhizome, which Curcumin is one of the active compounds of the phenolic group with yellow pigments which are found in the rhizomes of curcuma from the Zingiberaceae family. Curcumin also has many potentials such as appetite enhancers, antioxidants, antitumors and for other body health. while papaya fruit can increase appetite due to the high content of nutrients and vitamins such as Vitamin C, Vitamin A, and Vitamin E which are very good at increasing appetite[32]. The results of the anorexia test showed no statistically significant difference between the treatment groups (p>0.05). However, descriptively, the test group given the combination of papaya and ginger extracts showed average values close to those of the positive control group. This insignificant result may be influenced by the limited number of test animals, resulting in low statistical power and greater variation in biological responses between animals. Furthermore, the activity-based anorexia model used can trigger a physiological adaptation mechanism in the form of a compensatory feeding response after the stressful phase of food restriction, resulting in all groups, including the negative control, still showing increased appetite[35].

The positive control group given cyproheptadine showed the highest increase in appetite compared to the other groups. This is consistent with cyproheptadine's mechanism of action as a serotonin antagonist that can increase eating behavior. Meanwhile, the test group given the combination of papaya and ginger extracts showed results close to those of the positive control, indicating the potential orexigenic activity of these two natural ingredients. Mango ginger is known to contain curcumin and phenolic compounds that play a role in improving digestive function, increasing bile secretion, and supporting gastrointestinal health, thus helping to increase appetite[37]. Papaya also contains vitamin C, vitamin A, antioxidants, and the enzyme papain, which aids digestion and nutrient absorption. These compounds are thought to contribute to increased metabolism and improved appetite in test animals[38]. Although statistical results did not show a significant difference, the average values of the test groups, which were close to those of the positive control, indicate that the combination of papaya and mango ginger extracts still has biological potential as an appetite enhancer. Therefore, further research is needed with a larger sample size, longer treatment duration, and measurement of additional parameters such as daily feed intake and body weight changes to strengthen these results[37].

In the Marshmallow formulation, the results of the preparation were obtained with a chewy texture, sweet taste, distinctive vanilla odor and homogeneous beige color. Gelatin has an influence on marshmallows as a gelling agent, so that the higher the concentration of gelatin, the more gel will be formed so that the texture is more chewy and elastic[2].

In the Marshmallow formulation, the results are obtained with a sweet taste, the sweet taste in marshmallows is due to the dominant sugar content in the preparation. Has a distinctive vanilla aroma, marshmallow preparations

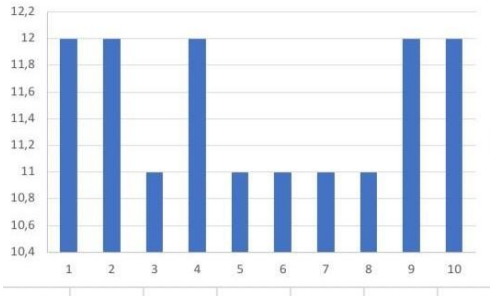


Figure 1. Weight uniformity test of marshmallow preparation

have a fragrant aroma due to the heating of sugar which is the basic ingredient of the preparation[9]. Has a beige color, due to the amount of papaya fruit extract used, the more extract, the decrease in the brightness of the preparation color[13]. This is triggered by papaya fruit which produces a yellow color[6]. And has a chewy texture, gelatin has an important role because gelatin has characteristics that depend on the concentration of gelatin used, the higher the concentration of gelatin used, the harder it is, and vice versa[13].

The weight uniformity test on marshmallow preparations aims as the main parameter to determine the uniformity of the active substance content in this context with regard to the correct and even distribution of each marshmallow[18]. Based on Figure 1. Shows the results of the evaluation of the weight uniformity of papaya extract marshmallows and *Curcuma mangga* shows that each marshmallow has a weight that meets the requirements, obtained an average weight of 11.5 gr, with a good range value in accordance with the requirements of namely, 10.64-12.36 gr[4].

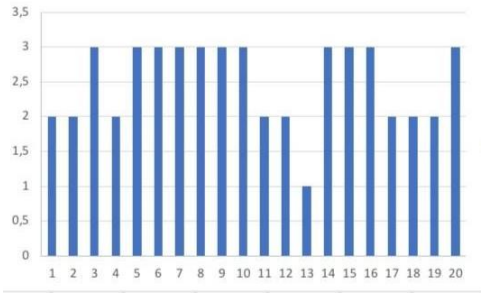


Figure 2. Hedonic test of aroma parameters of marshmallow preparations

Furthermore, the hedonic test was conducted using aroma parameters, where the aroma hedonic test is an organoleptic assessment method used to determine the level of preference or acceptance of the panelists towards the aroma of a product. This test uses a rating scale with a value of 1-3. Based on Figure 2, the results of the hedonic test conducted on 20 panelists, the average numerical value for aroma was obtained at 2.5 which can be concluded

that the panelists liked the aroma of marshmallows, this is because the marshmallow preparation made has a distinctive vanilla aroma so that the aroma of *Curcuma mangga* which is not preferred is covered by the vanilla aroma. Then the aroma that the panelists liked is thought to come from the addition of vanillin which provides a sweet and distinctive aroma so that it is able to cover the natural aroma of *Curcuma mangga* which tends to be sharp and not preferred. The use of vanilla flavor is known to increase the sensory acceptance of the product because it gives the impression of a softer, sweeter, and familiar aroma to consumers, especially children. In addition, aroma is one of the important parameters in determining the level of acceptance of a food product through the hedonic test. In addition, the heating process of sucrose and dextrose during marshmallow formulation also produces a distinctive sweet aroma that supports the increase in panelists acceptance of the product[35]. The combination of vanilla aroma and sugar components creates a more appealing aroma characteristic, thus increasing the acceptability of marshmallow preparations as a delivery medium for active herbal ingredients. These results indicate that the aroma formulation in marshmallows is quite successful in reducing the herbal aroma characteristics of papaya and mango ginger extracts without losing the product's identity. Other studies have also shown that aroma attributes have a significant influence on panelists' preference for marshmallow products and other functional foods.

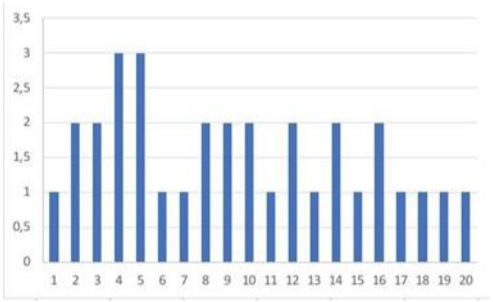


Figure 3. Hedonic Test of Flavor Parameters of Marshmallow preparations.

A hedonic test was then conducted using taste parameters. The hedonic taste test is a method for measuring the level of preference or acceptance of a product's taste by panelists or consumers. This test uses a rating scale of 1-3. Based on Figure 3, the taste parameter had an average score of 1.6, indicating that the panelists disliked the taste. This is because the gelatin taste was unpleasant and too sweet, leading respondents to dislike the product. This low preference rating is thought to be due to the overly sweet taste resulting from the use of relatively high amounts of sucrose and dextrose in the formulation. Furthermore, the distinctive flavors of the turmeric extract and gelatin may also have influenced panelists acceptance of the product. Herbal extracts generally have a distinctive aftertaste, which can reduce sensory acceptance if the flavor formulation is not properly optimized[36].

Taste parameters are a key factor in determining consumer acceptance of functional food products. Panelists tend to prefer products with a balanced taste, not too sweet, and without an aftertaste. In this marshmallow formulation, the combination of the sweetness of sugar and the herbal flavor of ginger may produce a taste sensation unfamiliar to panelists, especially children. Furthermore, the use of gelatin in certain concentrations can also produce a distinctive taste that affects consumption. Therefore, further formulation optimization is needed, such as reducing the sugar content, adding natural flavors, or using masking agents to improve the acceptability of the marshmallow flavor.

These results align with several previous studies that suggest that the addition of herbal ingredients or natural active ingredients to food products often affects sensory characteristics, particularly taste parameters. The

stronger the flavor of the active ingredient used, the lower the panelists preference level can be if not balanced with the addition of appropriate additives[7].

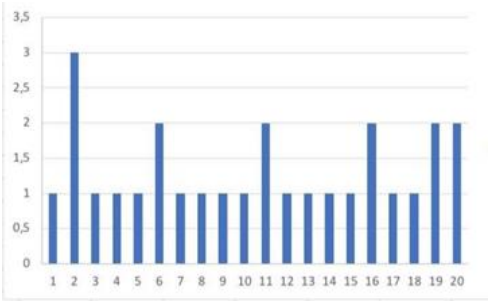


Figure 4. Hedonic Test of Shape & Texture Parameters of Marshmallow preparation.

A hedonic test was then conducted using shape and texture parameters. The hedonic test for shape and texture is a sensory evaluation used to measure consumer preference for a product's shape and texture. This test uses a rating scale of 1-3. Based on Figure 4, for the taste parameter, the average shape and texture score was 1.35, indicating that the shape and texture were less appealing to panelists. This is because panelists disliked the appearance of marshmallows, which had a less appealing color, making them less appealing to them. The low panel preference rating is thought to be influenced by the marshmallow's less appealing beige-brown color, resulting from the addition of a significant amount of papaya and mango extract. The color of a food product is one of the initial factors that attracts consumer interest before trying the product, especially marshmallows, which are generally associated with bright colors and are attractive to children.

In addition to color, the texture of the marshmallow also influenced panelists acceptance. The resulting marshmallow had a chewy texture due to the use of gelatin as a gelling agent. Gelatin has the ability to form an elastic gel and maintain the marshmallow's structure. Therefore, the higher the gelatin concentration used, the denser and chewier the product texture will be. However, a texture that is too dense or elastic can cause discomfort when chewing, thus decreasing panelists' preference. Furthermore, the use of Avicel and corn starch in the formulation can also affect the texture characteristics, making it denser and less soft.

A less uniform marshmallow shape may also influence panelists' assessment of the product. An unattractive physical appearance can reduce visual appeal and affect consumers' perceptions of the product's overall quality. Therefore, optimization of the formulation and molding process is necessary to produce a more attractive shape, brighter color, and a softer and more elastic texture to increase panelists' acceptance of this herbal extract-based marshmallow.

The results of this study align with several previous studies that have shown that visual and textural attributes are important factors in hedonic testing of food products. Products with textures that are too hard, too chewy, or less attractive in color tend to receive lower preference ratings than products with better sensory characteristics[17].

LIMITATION

The researcher acknowledges that there are still many limitations in this study, including the anorexia test results, which showed no significant differences, and the flavonoid test results on papaya fruit, which yielded a

negative reaction. The author hopes that future research will produce better results than those obtained in the present study.

CONCLUSION

Based on the results obtained, it shows that both extracts contain active compounds such as alkaloids, vitamin C, steroids, and polyphenols. The anorexia test did not show significant differences between groups ($p > 0.05$), but the combination of extracts still showed a positive effect comparable to the positive control. The marshmallow preparation has a chewy texture and a flavourable vanilla aroma, but is still lacking in terms of taste and shape. Limitations of this study include the limited number of test animals and panelists and no quantitative analysis of active substances. Suggestions for further research can be done by observing specific eating behavior, daily food intake, as well as optimizing formulations and further effectiveness tests, including quantitative analysis of active substance content.

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AUTHOR CONTRIBUTION STATEMENT

RM: wrote the results and discussion sections, **RRHS**: wrote the methods section and references, **RIH**: wrote the introduction and conclusion sections, **RB**: wrote the results and discussion sections, **Z**: supervised the research and the writing of the scientific article, **FNS**: supervised the research and the writing of the scientific article.

CONFLICT OF INTEREST DECLARATION

The authors declare no conflict of interest.

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