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Formulation and Physical Characterization of Chewable Gummy from Galangal Rhizome Extract (*Kaempferia galanga* L.) as a Nutraceutical Product

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ABSTRACT: The *Kaempferia* galanga L rizhome (kencur) extract, known in traditional use as an appetite enhancer, was developed into chewable gummy preparations as a nutraceutical product. Due to the taste and odor of extract from natural plants caused less preferable to consume. Therefore the formulation of chewable gummy was addressed to overcome this problem. This study formulated gummy with a concentration of 2% galangal extract and gelatin as gelling agent with concentration variations of 10% (F1), 12.5% (F2), and 15% (F3). The evaluation of the physical properties of galangal rhizome extract chewable gummy included swelling ratio, syneresis, organoleptic, weight diversity, and texture profile analysis (TPA). In addition, a hedonic test was conducted to determine the level of panelist preference. The results revealed that the higher the gelatin concentration, the more significant the changes in the physical properties of gummies. An increase in gelatin plays a crucial role in forming a denser and more stable preparation structure. This impacts the texture regarding chewiness and increase the hardness. The result of TPA showed a significant differences ($p<0.05$) in the parameters of hardness, gumminess, and chewiness between the three formulations. The results of the hedonic test showed that F3 was the most preferred by the panelists. Based on these results, a gelatin concentration of 15% is recommended for the formulation of chewable gummy galangal rhizome extract.

Keywords: **chewable gummy; galangal rizhome; kencur; formulation; characterization.**

Introduction

Nutraceuticals, originally come from the words of "nutrition" and "pharmaceuticals", are substances derived from food or parts of food that have physiological functions and provide health benefits beyond their nutritional value [1]. These products can come from natural ingredients such as plants, animals, or microorganisms, which contain bioactive compounds which have the potential to prevent and even treat various diseases, which now considered a bridge between food and medicine. Through various dosage forms such as capsules, tablets, powders, and liquids, nutraceuticals can be adjusted to individual needs and preferences. The potential of nutraceuticals in improving the quality of human life is very large, especially in the modern era [2]. Nowadays, nutraceuticals are available in market including high-dose vitamin and mineral supplements (orthomolecular), micronutrients, phytomedicines, enzymes, amino acids, and essential fatty acids. In order to meet quality standards and innovation in dosage forms, the formulation is designed to be easily accepted by the public. This is expected to increase public interest in nature-based nutraceutical products [2].

Kaempferia galanga L., commonly known as kencur, belongs to the Zingiberaceae family. Traditionally, its rhizomes have been utilized to manage hypertension and alleviate symptoms of asthma, rheumatism, fever, coughs, headaches, stomachaches, and toothaches [3]. Thus, it possess a great potential to be developed into nutraceutical products. The content of bioactive compounds in galangal, such as essential oils and flavonoids, has been empirically proven to have various Adavantages, including increasing energy, relieving various health complaints, and stimulating appetite [4,5]. By utilizing modern processing technology, galangal extract can be formulated into more practical and attractive products, such as chewable gummy. This product not only offers health benefits that are equivalent to traditional herbal medicine, but also provides a more enjoyable consumption experience, especially for children

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and adolescents.

Chewable gummy as an innovation in the drug delivery system, offers an attractive solution for certain people. Due to its texture, chewable gummy can be easily chewed and swallowed without water, even by children and the elderly who have difficulty swallowing (dysphagia) [6]. In addition, the gel matrix in chewable gummy allows the release of active drug ingredients slowly and evenly. With its ability to mask the unpleasant taste and odor of active ingredients, chewable gummy is also expected to improve patient compliance with treatment [7].

Chewable gummy is primarily composed of sucrose or syrup combined with a gelling agent such as gelatin, gum, or pectin [8]. Additional excipients, including coloring agents, flavors, and acidulants, may also be incorporated into these formulations. The formulation of chewable gummy fundamentally relies on a gelling agent, which serves as the product's primary vehicle [9]. The type and concentration of gelling agents used will significantly affect the physical properties of chewable gummy, such as elasticity, toughness, and ease of chewing. Research on chewable moringa leaf gummy shows that the use of gelatin as a gelling agent tends to produce products with a hard structure compared to using other types of gelling agents. This is due to the strong hydrocolloid properties of gelatin with water molecules, creating a stable three-dimensional structure. As a result, gelatin produces a gummy with a firm texture but remains soft and easy to chew [9]. Another study also successfully investigated the effect of gelatin and sucrose on the quality parameters of gummy candies of red beet extract powder concentration [10].

A previous study formulated a jelly product from Alpinia galanga (L.) Willd juice using gelatin and potato starch, which exhibited high water content and limited shelf life [11]. Meanwhile, this study aims to formulate a chewable gummy with kencur rhizome extract as a nutraceutical for appetite enhancement, expected to possess longer shelf life. The formulation employed varying concentrations of gelatin as the gelling agent and an optimized level of sucrose as the sweetener. The gummies were evaluated for organoleptic properties, swelling ratio, weight variation, syneresis, texture, and hedonic acceptability.

Materials & Methods

Materials

Kencur rhizome (local market, Lubuk Buaya, Padang), gelatin (Global Capsules Limited, Bangladesh), sucrose (J.T Baker, USA), methylparaben (MedChemExpress, USA), propylene glycol (Dow Chemical Pacific, Thailand), milk essence (Pilaros, Indonesia), hydrochloric acid (Baratachem, Indonesia), ethanol 70% (Baratachem, Indonesia), toluene (Baratachem, Indonesia), and distilled water (Baratachem, Indonesia).

Methods

Extraction of Kencur Rhizome

A total of 12 kg of fresh kencur rhizomes were identified at Herbarium ANDA, Andalas University. After washing, drying, thinly slicing, and sorting, the dried simplisia was ground into powder. This powder was then macerated with 70% ethanol for 72 hours. Then, maceration filtrate was evaporated using a rotary evaporator (Büchi®, Germany) to yield a viscous extract. Subsequently, the galanga rhizomes extract was standardized, including organoleptic tests, yield, phytochemical screening, total ash content, acid-insoluble ash content, and moisture content, in accordance with the standards of the Indonesian Herbal Pharmacopoeia Edition 2nd Edition [12].

Standardization of Kencur Rhizome Extract

Organoleptic Test

Organoleptic test involved observing and evaluating physical characteristics such as shape, color, odor, and taste using human senses. This parameter aims to provide a simple and objective initial assessment.

Yield Analysis

The yield of kencur rhizome extract was determined by weighing the initial processed material as A, and the final weight of the obtained extract as B. The weight percentage (% w/w) is then calculated using the formula below. The result must be a minimum of 8.3% according to the Indonesian Herbal Pharmacopoeia 2nd Edition [12]:

$$\% \, Yield = \frac{\text{Extract Weight (g)}}{\text{Initial Sample Weight (g)}} \, x \, 100\%$$

Phytochemical Test

Total Ash Content Test

Total ash content was determined by heating three porcelain crucibles at 105°C for 30 minutes. Approximately 2-3 grams of accurately weighed and ground extract are then placed into the crucibles, leveled, and ignited in a furnace (Carbolite Gero, Germany) at 600°C for 7 hours until all charcoal is diminished. After cooling in a desiccator, the ash content (% w/w) was calculated from the air-dried material. The total ash content of the extract

Table 1. Formulation of galanga rhizome extract chewable gummy.

Materials	F1	F2	F3	Uses
Kencur Rhizome Extract	2%	2%	2%	Active Ingredient
Gelatin	10%	12.5%	15%	Gelling Agent
Methylparaben	0.1%	0.1%	0.1%	Preservative
Propylene Glycol	5%	5%	5%	Plasticizer
Sucrose	25%	25%	25%	Sweetener
Milk Flavor	8%	8%	8%	Flavoring agent
Distilled Water	Ad 100%	Ad 100%	Ad 100%	Solvent

must be at least 0.5% according to the Indonesian Herbal Pharmacopoeia 2nd Edition [12]. The formula for its determination is as follows :

$$\text{Ash Content (\%)} = \frac{W2 - W3}{W2 - W1} X\ 100\%$$

Notes:
W1: Weight of empty crucible (g)
W2: Weight of crucible + extract before ignition (g)
W3: Weight of crucible + extract after ignition (g)

Acid-Insoluble Ash Content Test

Acid-insoluble ash content test was determined by boiled total ash with 25 mL hydrochloric acid for 5 minutes. The acid-insoluble ash was then collected, filtered using ash-free filter paper, and washed with water. Then, the ash was ignited in a crucible to constant weight at 800 ± 25°C. The acid-insoluble ash content was calculated based on the weight of the test material (% w/w). This content must be at least 0.2% according to the Indonesian Herbal Pharmacopoeia 2nd Edition [12], which determined as follow:

$$\text{Acid} - \text{Insoluble Ash Content (\%)} = \frac{B - C}{B - A} X\ 100\%$$

Notes:
A: Weight of the tared crucible (g)
B: Weight of crucible + initial sample (g)
C: Weight of crucible + final sample (g)

Moisture Content Test

Moisture content of the extract was determined using the azeotropic method (toluene distillation) with water-saturated toluene as the reagent. A precise amount of sample (containing 1-4 mL of water) is accurately weighed and transferred into a dry flask along with approximately 200 mL of water-saturated toluene, and the apparatus was assembled. The flask was carefully heated for 15 minutes [8]. Distillation was initially set at a rate of approximately 2 drops/second until most of the water has distilled over, then increased to 4 drops/second. After all the water has distilled, the inside of the condenser was washed with water-saturated toluene. Distillation was continued for another 5 minutes. The water content is calculated as % v/w. According to the Indonesian Herbal Pharmacopoeia 2nd Edition, the minimum water content of the extract must be 10% [12]. The water content of the extract is calculated using the following formula:

$$\text{Moisture Content (\%)} = \frac{B - C}{B - A} X\ 100\%$$

Notes:
A: Weight of the tared crucible (g)
B: Weight of crucible + initial sample (g)
C: Weight of crucible + final sample (g)

Formulation of Kencur Rhizome Extract Chewable Gummy

Prior producing the chewable gummy, the concentration of sucrose was optimized as a sweetener. The optimal experimental design for choosing the sucrose as sweetener was in range of 0 up to 35% . The results of the optimization will be applied to all other formulations.

Chewable gummies are prepared by a pour molding method [9] and the formulation is shown in Table 1. Firstly, sucrose was dissolved in warm distilled water and added gelatin to swell for 10 minutes until a clear yellowish

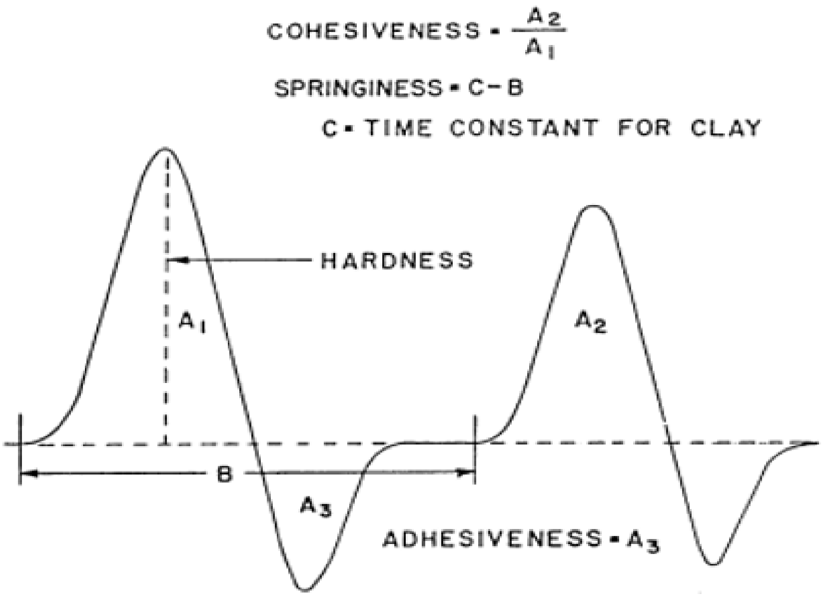

Figure 1. *Texture profile analysis* formulas.

solution formed. Methylparaben and propylene glycol were then added and stirred at 80°C until dissolved. The galanga rhizome extract was incorporated and stirred until homogeneous, followed by the addition of milk essence. After homogenization, the gummy mass was poured into silicone molds with final weight of approximately three gram per gummy. The gummies were allowed to harden for one hour at room temperature (25-30°C), then removed from the molds. Finally, the gummies were packaged in aluminum foil and airtight containers, then stored at room temperature.

Evaluation of Kencur Extract Chewable Gummy Preparations

Organoleptic Evaluation

Kencur rhizome extract chewable gummies were evaluated organoleptically, taste, shape, and texture. The specific texture parameters observed were chewiness (elasticity), stickiness level, and surface roughness of the gummy [9].

Swelling Ratio Evaluation

The swelling ratio was measured to determine the water absorption capacity of the chewable gummy within its gel structure. The procedure involves weighing the initial weight (W_d), immersed the gummy in 100 mL of purified water for 10 seconds at room temperature, removed, and cleaned the gummy's surface from residual water. The swelling ratio was calculated using an equation that will compare the difference in weight before and after immersion (W_s) with its initial weight [9]:

$$Swelling\ Ratio = \frac{Ws - Wd}{Wd}\ x\ 100\%$$

Notes:
W_s: Weight of chewable gummy after immersion
W_d: Weight of chewable gummy before immersion

Weight Variation Evaluation

Weight variation is determined by weighing 10 individual gummy units. The acceptance value is calculated and compared against the maximum limit of 15.0 required by the Indonesian Pharmacopoeia 6th edition [13].

Syneresis Evaluation

Syneresis occurs when water molecules separate from the chewable gummy gel during storage, which can predict gel stability and contraction. A higher percentage of syneresis indicates faster texture softening and a decrease in product quality. Syneresis test was performed at 25 ± 5°C by attaching filter paper to the entire surface of the gummy. The final weight of the gummy after contact with the filter paper was weighed, then compared to its initial weight. The percentage of syneresis is calculated according to the following equation [9]:

Table 2. Hedonic test panelist questionnaire.

Specifications	Score	Likert Response		
		Formula 1	Formula 2	Formula 3
Likely Extremely	9			
Like Very Much	8			
Like Moderately	7			
Like Slightly	6			
Neither like Nor Dislike	5			
Dislike Slightly	4			
Dislike Moderately	3			
Dislike Very Much	2			
Dislike Extremely	1			

$$Percent\ Syneresis = \frac{A - B}{A}\ x\ 100\%$$

Notes:
A: Initial weight of the chewable gummy preparation
B: Final weight of the chewable gummy preparation

Texture Profile Analysis Evaluation (TPA)

Texture testing was performed using a TA1 Series Texture Analysis Machine (AMETEK Llyod, UK) supported with Texture Analyzer software. Gummy samples had a uniform thickness of 0.7 mm. A cylindrical probe with a diameter of 5 cm was selected to cover the entire sample surface. The test was conducted with a probe speed of 60 mm/minute and a penetration depth of 7 mm. Compression force was applied in two cycles (50% and 75%) to determine hardness. From the curve data as seen in Figure 1, chewiness and gumminess were then calculated using the specified formulas [14].

Hedonic Test

To measure the level of preference, a hedonic test was conducted on 30 adult panelists. The inclusion criteria were age 18-40 years, willing to consume gummies, no allergy to kencur, normal sense of taste, willing to participate in the test. Meanwhile exclusion criteria were diabetic patient, consumed of taste-altering medication, active smoker/excessive consumption of strong-flavored foods, pregnancy/lactation, or has very strong preference for kencur. The hedonic test has been approved by ethics committee of Faculty of Pharmacy (No. 22/UN.16.10.D.KEPK-FF/2025). Before the test, panelists were provided a detailed explanation of the design, procedure, risks, and benefits to the panelists, then signed an informed consent form. Each panelist evaluated three gummy formulations with different gelling agent concentrations.

Panelists were instructed to chew each formulation to evaluate their preference. After each gummy, they rinsed their mouths and consumed a palate cleanser, then filled out a questionnaire assessing chewiness and preference. The panelists' subjective preference for taste and texture were the main observation parameters. A nine-point rating scale (1: extremely disliked – 9: extremely liked) was used as seen in Table 2, in accordance with the National Standardization Agency's standards [15]. The calculation of the average quality score interval for panelists was performed using the formula.

$$P\left(\bar{x} - \left(1{,}96.\frac{s}{\sqrt{n}}\right)\right) \le \mu \le \left(\bar{x} + \left(1{,}96.\frac{s}{\sqrt{n}}\right)\right) \cong 95\%$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$S^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$$

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}}$$

Notes:
n: Number of panelists
S^2: Variance of quality scores
1.96: Standard deviation coefficient at 95% confidence level
$\bar{x}$: Average quality score
x_i: Quality score from the i-th panelist, where i = 1, 2, 3...n
s: Standard deviation of quality scores

Statistical analysis

Hardness, gumminess, and chewiness data of the chewable gummies were analyzed using one-way ANOVA (95% confidence level) with SPSS 17th ed. This analysis aims to determine the significant effect of different gelatin concentrations on the physical properties of the gummy. If ANOVA shows a significant difference, a Duncan test will be performed. Meanwhile, the results of the panelist questionnaires were tabulated, and the quality scores were calculated as an average for each panelist at a 95% confidence level.

Result and Discussion

From 12 kg of kencur rhizomes approximately 1000 g of simplicia powder was obtained and continued to extraction process by cold maceration technique. This method benefits due to its ease of implementation, efficiency in yielding high concentrations of active compounds, and ability to protect secondary metabolites from heat degradation [16]. 70% ethanol is an ideal solvent due to its ability to wet the simplicia, dissolve both polar and nonpolar compounds, and has low toxicity [17]. After maceration, the extract was separated from the residue by filtration to obtain a clear filtrate. The filtrate was then concentrated with a rotary evaporator, yielding 85 grams of a brownish, concentrated extract with a strong aroma and the characteristic pungent-bitter taste of Kaempferia galanga as seen in Figure 2.

Phytochemical screening identified the presence of flavonoids, alkaloids, and steroids in the extract, but phenolics and triterpenoids were not found as shown in Table 3. This secondary metabolite profile is consistent with previous research [18]. The concentrated Kaempferia galanga extract was standardized to ensure its quality in accordance with the Indonesian Herbal Pharmacopoeia 2nd Edition.

After the extraction process, the concentrated Kaempferia galanga extract was weighed to determine the yield, which was 8.5%. This result exceeds the minimum limit set by the Indonesian Herbal Pharmacopoeia Second Edition (8.3%), indicating extraction efficiency. Yield value is influenced by the particle size of the simplicia, the type/polarity of the solvent, and the duration of maceration. The organoleptic test of the extract showed physical characteristics (viscous form, dark brown color, characteristic kencur odor, pungent and thick taste) that comply with the standards of the Indonesian Herbal Pharmacopoeia. The moisture content of the extract was determined using the azeotropic method (toluene distillation) to avoid measurement errors due to essential oils, yielding 6.189%. This value meets the requirements of the Indonesian Herbal Pharmacopoeia, which sets a maximum limit of 10%. The total ash content (0.35%) and acid-insoluble ash content (0.17%) were also measured. Both values are below the maximum limits of the Indonesian Herbal Pharmacopoeia (0.5% and 0.2% respectively), indicating good mineral quality of the extract

Figure 2. Concentrated kencur rhizome extract.

Table 3. Phytochemical test results of kencur extract.

Phytochemical Test	Results
Flavonoid Reagent : Mg Powder + Concentrated HCl Observation : The Solution turned orange Result : positive (+)	
Alkaloid Reagent : Mayer Observation : A White precipitate formed Result : positive (+)	
Phenolic Reagent : 5% $FeCl_3$ Observation : The solution turned green Result : negative (-)	
Steroid Reagent : Acetic Anhydride + Sulfuric Acid Observation : A green ring formed Result : positive (+)	
Terpenoid Reagent : Sulfuric Acid Observation : A red ring formed Result : negative (-)	

Figure 3. Chewable gummy kencur rhizome extract.

[8].

As a preliminary step before formulating the chewable gummy, sucrose concentration was optimized as a sweetener to determine the ability in masking the bitter taste of the kencur rhizome extract. Based on the assessment, formulation with 25% sucrose was chosen as the optimal sweetener concentration. This result in accordance with the research by Rani et al. (2022) [18]. This 25% sucrose concentration will then be applied to all chewable gummy formulations. Moreover, the concentration of Kaempferia galanga rhizome extract in the gummy was based on previous research [19,20].

Organoleptic evaluation is very important for consumer acceptance and part of identification, where a good preparation must be attractive, identifiable, and free from defects and contamination [21]. All chewable gummy formulations (F1-F3) in this study successfully produced hexagonal-shaped preparations for better visual appeal and acceptance as seen in Figure 3. Base on organoleptic tests showed that all formulations had a light brown color and a distinctive kencur aroma. The results of organoleptic test can be seen in Table 4.

The difference in water content across each formula directly affected the resulting gummy texture variations. An increase in gelatin concentration correlated with a decrease in water content, which explains F3 (highest gelatin) had a chewy but hard texture due to its low water content. As the gelatin concentration increases, the gel strength also rises because a greater amount of gelatin promotes more extensive intermolecular bonding, including formation of a denser three-dimensional network structure among gelatin molecules [22,23].

Swelling ratio was evaluated to measure the expansion capacity of the chewable gummy in an aqueous medium [9]. This reflects the percentage of water absorbed into the hydrogel structure, where the influx of water increases the solution's entropy, triggering diffusion. This swelling rate is highly dependent on the type and concentration of the hydrogel-forming polymer in the formulation [24]. The result of swelling ration is described in Table 5. Data indicates that the swelling capacity of chewable gummies is directly proportional to the concentration of gelatin

Table 4. Organoleptic results of kencur extract chewable gummy.

Organoleptic ResultS	F1	F2	F3
Shape	Hexagonal	Hexagonal	Hexagonal
Color	Light brown, typical of kencur	Light brown, typical of kencur	Light brown, typical of kencur
Aroma	Milk	Milk	Milk
Taste	Sweet but slightly punguent on the tongue	Sweet but slightly punguent on the tongue	Sweet but slightly punguent on the tongue
Texture	Chewy, easily fragile, slightly sticky	Perfectly chewy, not easily fragile, slightly sticky	Slightly hard chewy, slightly sticky

Table 5. Physical characteristic results of kencur extract chewable gummy.

Physical Characteristic	F1	F2	F3
Swelling Ratio (%)	2.737% ± 0.006	2.841 ± 0.007	3.435 ± 0.006
Average gummy weight (g)	2.9416	2.9935	3.0153
Average active substance per gummy unit (%)	2% ± 0.0005	2% ± 0.0006	2% ± 0.0004
Acceptability value (NP)	0.0013	0.0016	0.0011
Syneresis (%)	1.846% ± 0.007	1.533% ± 0.001	1.271% ± 0.002
Hardness (N)	36.9122 ± 1.1699	55.5461 ± 11.3601	72.9012 ± 12.7228
Gumminess (N x mm)	25.5215 ± 0.9295	37,7987 ± 6,0508	50.6640± 7.2940
Chewiness (N x mm)	30.7518 ± 2.0514	43.8222 ± 6.2999	59.0871 ± 8.1903

used. This is due to the amphiphilic nature of gelatin, which is rich in hydrophilic amino acids, enabling it to bind and retain 5-10 times its own weight in water. As a result, an increase in gelatin traps more water within the 3D gel structure, increasing the swelling index. Higher gelatin concentrations also strengthen polymer interactions, forming a denser network [25].

Weight variation was evaluated to ensure the uniformity of kencur extract content in each chewable gummy unit. Results showed that gummies with gelatin had a weight variation between units ranging from 2.94 to 3.01 grams as shown in Table 5. An acceptance value of 0.001 for each formulation, all of formula is well below the maximum limit [10], and meet the required standards.

Syneresis is the release of water due to gel contraction, serving as an indicator of the physical stability of chewable gummies during storage. If the gel is less capable of retaining water, water will seep out [26]. A higher percentage of syneresis indicates faster texture softening and an overall decrease in the quality of the preparation [27]. The results are shown in Table 5. It indicated that syneresis in galanga rhizome extract chewable gummies is influenced by concentration of the gelling agent, gelatin. A low concentration of gelatin tend to experience more syneresis because their gel structure is less capable of retaining water, causing water to migrate to the surface [27]. In contrary, an increase in gelatin concentration reduces the percentage of syneresis. This happens because the polymer network becomes denser, allowing the gummy to better retain water molecules [28].

Texture Profile Analysis (TPA) was used to assess flexibility of galanga extract chewable gummies. This method simulates the chewing process by applying two compression cycles to the gummy samples [29]. The analysis results were then correlated with sensory texture parameters such as hardness, gumminess, and chewiness is shown in Table 5. Based on the results of the one-way ANOVA statistical test, the hardness, gumminess and chewiness parameter were $p < 0.05$ which indicated that the percentage of gelatin influence the texture parameter analysis significantly. Hardness in chewable gummies refers to the force required for permanent deformation, or the maximum force needed to compress the gummy between the teeth during chewing [9]. Hardness is influenced by the concentration of the gelatin gelling agent; the higher the concentration, the harder the gummy, because the molecular interactions forming the gel structure are more rigid [27]. Gumminess reflects the interaction of hardness and cohesiveness. It's influenced by both cohesive forces (maintaining compactness) and adhesive forces (causing

Table 6. Hedonic test results of kencur extract chewable gummy.

Formulation	Likert Responses
1	$P(6 \leq \mu \leq 7) \cong 95\%$
2	$P(6 \leq \mu \leq 7) \cong 95\%$
3	$P(7 \leq \mu \leq 8) \cong 95\%$

stickiness upon touch or to packaging) [9]. Increased hardness was observed to correlate with increased gumminess. Chewiness is the mechanical energy required to chew until the gummy is ready to be swallowed, as well as the elastic resistance during chewing [29]. Although difficult to quantify because it involves complex mechanisms in the mouth [30], this research shows that chewiness increases with an increase in the concentration of the gelatin gelling agent.

Hedonic testing is a subjective product quality evaluation that uses human senses to assess appearance, aroma, taste, consistency, and texture [15]. This study involved 30 adult panelists who evaluated three formulations of kencur extract chewable gummies based on taste, color, aroma, and shape, using a scale of 1 (strongly dislike) to 9 (strongly like). The questionnaire results were tabulated and the average quality scores were calculated at a 95% confidence level [12]. Complete hedonic test data is seen in Table 6. Based on the results, panelist preferences for the kencur extract chewable gummies show that formulations 1 and 2 received scores ranging from "moderately like" (6) to "like" (7). In contrast, formulation 3 achieved higher ratings, between "like" (7) and "very much like" (8). Referring to the National Standardization Agency guidelines, which take the lowest value as a representation, thus Formula 3 with 15% gelatin was the most preferred by the panelists. The higher consumer acceptance observed for formulation F3 may be attributed to its favorable textural characteristics, particularly its greater hardness and chewiness, which likely enhanced the overall sensory experience. However, this finding contrasts with a previous study reporting that formulations with lower hardness and chewiness were more preferred [11]. This discrepancy highlights that hedonic evaluation is inherently subjective, as consumer preferences can vary widely among individuals.

Conclusion

Galanga (kencur) rhizome extract was successfully prepared into chewable gummy which formulated using sucrose as sweeting agent and gelatin at different concentration as gelling agent. The chewable gummy at concentration of gelatin 15% has highest swelling but lowest syneresis ratio. The hardness, gumminess and chewiness of F3 were the greatest among other formula, which was also the most preferred by the panelists.

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