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Formulation and Organoleptic Evaluation of Roselle (*Hibiscus sabdariffa*) Jamu Godog with Stability and Microbial Quality Assessment

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Abstract

Jamu is a traditional medicinal preparation proven to have many pharmacological properties and is widely used in Indonesian society. Unfortunately, many people do not like herbal medicine because of its unpleasant taste and odor. This phenomenon has driven much research in modifying the organoleptic parameters of jamu to make it more acceptable to the tongues and noses of consumers while still having a potent effect on health. This study, thus, aimed to formulate a roselle (*Hibiscus sabdariffa*)-enhanced jamu godog (traditional Indonesian herbal decoction) and evaluate its organoleptic properties, physical stability, and microbial quality. Jamu godog was prepared by sequentially boiling and mixing ground ginger, turmeric, lemongrass, roselle, rock sugar, and lime, with roselle concentrations set at 0%, 0.3%, and 0.6%. Organoleptic attributes and pH stability were assessed before and after storage at 4°C and 25°C for seven days. Microbial contamination was measured via total plate count (TPC) after storage at 4°C for three and seven days. A hedonic test with 40 participants across two age groups evaluated sensory acceptance. Results indicate that the addition of roselle at 0.3% concentration optimized taste and overall acceptability while maintaining pH stability and microbial safety within BPOM standards throughout the storage period. This formulation demonstrates potential as a palatable and microbiologically safe herbal preparation with enhanced consumer acceptance.

Keywords: herbal formulation; *Hibiscus sabdariffa*; jamu godog; microbial quality; organoleptic evaluation; sensory acceptance

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INTRODUCTION

In Indonesia, traditional medicine is divided into herbal medicine, standardized herbal medicines that have been tested preclinically, and phytopharmaceuticals whose safety and efficacy have been tested preclinically and clinically.[1] *Jamu* comes from the Javanese language, which means traditional medicine derived from plants to maintain health.[2] *Jamu* arises from past experiences and is embedded in the culture of the community and

develops along with technological advances.[3]

On the other hand, roselle flower (*Hibiscus sabdariffa*) has demonstrated strong antioxidant properties across various studies, including in vitro, in vivo, and clinical evaluations. The aqueous extract of roselle is known to inhibit xanthine oxidase activity, prevent lipid peroxidation-induced cellular damage, and enhance the activity of endogenous antioxidant enzymes such as superoxide dismutase (SOD), catalase, and glutathione peroxidase. Clinical evidence from a trial involving eight healthy individuals revealed that a single administration of roselle aqueous extract at a concentration of 50 mg/mL significantly elevated systemic antioxidant levels in plasma and urine while also promoting hippuric acid excretion and reducing urinary malondialdehyde levels.[4] According to findings by Obouayeba et al.[5], the antioxidant potential of roselle extract, assessed through the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay, demonstrated greater efficacy than vitamin C, with IC_{50} values of 0.24 mg/mL and 0.35 mg/mL, respectively. The primary bioactive constituents responsible for this antioxidant activity are anthocyanins—particularly delphinidin-3-glucoside—and protocatechuic acid.[4]

Antioxidants are either naturally occurring or synthetically derived compounds capable of mitigating oxidative stress by neutralizing physiological oxidants, such as reactive oxygen species (ROS) and free radicals—unstable molecules or ions characterized by the presence of unpaired electrons.[6] An excessive accumulation of reactive oxygen species (ROS) within the body may induce oxidative stress, a pathological condition associated with the onset of various diseases, including premature aging, cancer, obesity, diabetes mellitus, as well as dysfunctions of the liver and kidneys.[7] In addition to their detrimental effects on cellular and systemic health, oxidative reactions triggered by oxidants can also compromise the quality and stability of food, cosmetics, and pharmaceutical products. These reactions may degrade essential nutrients or active compounds, ultimately reducing nutritional value or therapeutic efficacy and shortening the shelf life of the products.[8,9]

The antioxidant potential of roselle flowers (*Hibiscus sabdariffa*) offers promising applications in formulating *jamu godog*, a traditional Indonesian herbal decoction. This preparation is typically composed of fresh or dried plant materials, or a combination of both, which are processed through a boiling preparation. *Jamu godog* is widely utilized for disease prevention, therapeutic purposes, and general health maintenance.[10] The plant parts utilized in *jamu godog* formulations may include leaves, flowers, stems, fruits, seeds, rhizomes, and roots. The herbal decoction typically comprises a combination of medicinal plants serving various roles, including primary active constituents responsible for therapeutic efficacy and secondary active compounds that enhance or support the main activity, as well as stabilizing agents and adjuncts (corrigens) to improve palatability or

formulation stability.[11] The organoleptic profile of herbal preparations is largely influenced by their constituent ingredients, which may impart bitter, sour, sweet, or fresh sensory attributes. To enhance palatability, particularly by masking bitterness, natural sweetening agents such as palm sugar, rock sugar, or honey are commonly incorporated into *jamu* formulations[12]. Accordingly, the formulation of *jamu* must be optimized to balance efficacy and safety with sensory acceptability, ensuring that the final product is both therapeutically effective and well-received by consumers.

The *jamu godog* formulation evaluated in this study comprises roselle flowers (*Hibiscus sabdariffa*), ginger rhizomes (*Zingiber officinale*), and turmeric rhizomes (*Curcuma longa*) as primary active constituents, selected for their established antioxidant properties[5,13–16]; lemongrass leaves as *corrigen odoris*; lime fruit as a stabilizer for curcumin in water that requires pH < 7[17]; and rock sugar as *corrigen saporis* (sweetener).[12] To ensure consistent quality of the produced *jamu*, particularly regarding its pharmacological activity, it is important to harvest raw materials from the same geographical location for each production batch. This consideration addresses the phenomenon of phytochemical variation, wherein differences in growing environments can lead to fluctuations in the chemical composition of plant materials, ultimately influencing the therapeutic effects of the final product.[18] This study reports the impact of varying concentrations of roselle flower (*Hibiscus sabdariffa*) in *jamu godog* formulations on the product's physical stability. Evaluated parameters include organoleptic characteristics, pH value, microbial contamination, and consumer acceptability as assessed through a hedonic test.

METHODS

Materials

The raw materials utilized in the preparation of this herbal formulation—including ginger rhizomes, turmeric rhizomes, roselle flowers, lemongrass, and lime—were sourced from the Bukoharjo region in Prambanan, Sleman, Yogyakarta, Indonesia. All herbal components were fresh and harvested at an optimal maturity stage. Specifically, the rhizomes were between 8 and 10 months old and collected from September to October, while the roselle flowers were selected at full bloom, ensuring maximum phytochemical potency.

Preparation of *jamu godog*

The formulation of *jamu godog* is detailed in Table 1. The preparation process began with burning and grinding the ginger, which was then boiled in water over medium heat for two minutes. Subsequently, crushed turmeric and lemongrass were added to the ginger infusion. Following those steps, roselle and rock sugar were incorporated, and the mixture was boiled for an additional five minutes. Lime was the final ingredient added, with the boiling continued for one more minute. The prepared decoction was then filtered, cooled, and stored in airtight bottles for preservation.

Table 1. Formulation of Roselle *(Hibiscus sabdariffa) Jamu Godog*

Composition	Concentration (%$^{b}/_{b}$)		
	Formula 1	Formula 2	Formula 3
Ginger rhizome	5	5	5
Turmeric rhizome	1	1	1
Roselle flowers	0	0.3	0.6
Lemongrass leaves	2	2	2
Lime fruit	2	2	2
Rock sugar	8	8	8
Distilled water	Ad 100	Ad 100	Ad 100

Physical stability tests

The physical stability assessment of *jamu godog* involved evaluating organoleptic properties—namely color, taste, and odor—as well as pH measurements before and after storage for seven days at refrigeration (4°C) and room temperature (25°C). The pH levels of the herbal preparation were determined by a pH meter.

Microbial contamination test

Determination of microbial contamination was carried out by analyzing with the total plate count (TPC) method. A total of 1 mL of herbal medicine sample was diluted with sterile saline solution until a sample level of 10^{-1} to 10^{-3} dilution was obtained. A number of 500 µL each dilution series were inoculated in Plate Count Agar (PCA) media by the spread plate method, then incubated at 37°C for 18-20 hours[19]. This test was carried out on *jamu godog* before storage and continued after storage at 4°C and room temperature (25°C) for 3 and 7 days.

Hedonic test

A hedonic evaluation was performed involving 40 participants, divided into two age groups: 20 individuals aged 18–40 years and 20 individuals aged 41–65 years. Each participant was provided herbal medicine samples and requested to complete a questionnaire assessing sensory attributes, including taste, color, and odor, for each formulation. Taste preferences were quantified using a hedonic scale with numerical scores (like: 4, neutral: 3, somewhat like: 2, dislike: 1) to identify the most favored formulation. This study has received ethical approval from the Medical and Health Research Ethics Commission of the Faculty of the Islamic University of Indonesia, under Ethical Clearance certificate number 34/Ka.Kom.Et/70/KE/V2023.

RESULT AND DISCUSSION

The production of herbal medicines has expanded to an industrial scale, enabling distribution to a broad consumer market. Collaboration among the Indonesian government, industry stakeholders, and researchers plays a crucial role in advancing the development of these traditional herbal formulations, ensuring their safety and therapeutic effectiveness.[20] *Jamu godog* is a traditional herbal preparation composed of various fresh or dried plant materials boiled in clean water. This boiling process functions as an extraction method to release phytochemical compounds from the plant roots, enabling their consumption and

providing health benefits, including disease prevention and treatment.[10]

In this research, the researchers used several medicinal plants proven as traditional medicine. As the main ingredient, roselle flower (*Hibiscus sabdariffa*) has been demonstrated as a potent antioxidant through in vitro, in vivo, and clinical studies. Aqueous extracts of roselle flowers inhibit xanthine oxidase activity, protect cells against lipid peroxidation, and enhance the activity of endogenous antioxidant enzymes such as superoxide dismutase, catalase, and glutathione peroxidase. Clinical trials involving eight healthy subjects revealed that a single administration of roselle water extract (50 mg/mL) significantly elevated systemic antioxidant levels in plasma and urine, while promoting hippuric acid excretion and reducing malondialdehyde concentrations in urine. Additionally, roselle flowers contain organic acids—including hydroxycitric acid, hibiscus acid, hibiscus glucoside, and hibiscus 6-methyl ester—that contribute to the pH modulation and characteristic sour taste of the *jamu godog* formulation.[4] The second herb the researchers used was the rhizome of ginger (*Zingiber officinale*), which exhibits antioxidant properties attributed to its bioactive constituents, including zingerone, 6-gingerol, and 6-shogaol. These compounds have been shown to inhibit xanthine oxidase, an enzyme involved in generating reactive oxygen species (ROS). Zingerone, in particular, demonstrates protective effects against oxidative damage induced by ROS, thereby preventing DNA damage in small intestinal muscle cells in vitro.[13,21] Furthermore, 6-gingerol and 6-shogaol effectively scavenge free radicals, as evidenced by DPPH assays, with IC_{50} values of 4.85 ± 0.58 µg/mL and 7.61 ± 0.81 µg/mL, respectively.[22]

As a famous medicinal plant researched intensively, turmeric rhizome (*Curcuma longa*) is reported to have free radical scavenging activity (DPPH) with an IC_{50} value of 8.33 µg/mL.[23] Turmeric rhizomes contain curcuminoid compounds, which are known to be potent as free radical scavengers due to the presence of phenolic hydroxy groups in their active compounds.[24] As an additive material, lemongrass leaves (*Cymbopogon citratus*) have a distinctive aroma from their essential oil component, citral, a cyclic monoterpene,[25] while lime fruit (*Citrus aurantifolia*) contains many organic acids and ascorbic acid (vitamin C). Using lime juice in *jamu godog* ingredients can provide an acidic atmosphere (pH < 7) to prevent the precipitation of water-insoluble curcumin to increase the stability of *jamu godog* preparations.[26] Meanwhile, rock sugar comes from a liquid sucrose solution that is precipitated or crystallized to produce hard, rock-like sugar. Rock sugar can be an alternative sweetener with a maximum dose of 50 g per day. The composition of active substances and the function of each ingredient used in this *jamu godog* preparation can be seen in Table 2 below.

Table 2. Ingredients Profile and Functional Roles in Roselle *Jamu Godog*

No	Composition	Position of ingredients	Active compounds	Efficacy
1.	Roselle flowers (*Hibiscus sabdariffa*)	The main active ingredient	Anthocyanins (delphinidin-3-glucoside) and protocatechuic acid	Antioxidant
2.	Ginger rhizome (*Zingiber officinale*)	The main active ingredient	Zingerone, gingerol, shogaol	Antioxidant
3.	Turmeric rhizome (*Curcuma longa*)	The main active ingredient	Curcumin	Antioxidant
4.	Lemongrass leaves (*Cymbopogon citratus*)	Additional ingredients	Citral	*Corrigen odoris*
5.	Lime fruit (*Citrus aurantifolia*)	Physical stabilizer	Ascorbic acid (vitamin C)	Antioxidant and provides pH < 7 conditions to prevent curcumin precipitation.
6.	Rock sugar	Additional ingredients	Sucrose	*Corrigen saporis*

Physical Stability Test Results

The present study evaluated the organoleptic properties and pH values of *jamu godog* formulations with varying concentrations of roselle (*Hibiscus sabdariffa*). Sensory assessment is a critical component in herbal product development, as consumer acceptance hinges not only on therapeutic efficacy but also on favorable taste, aroma, color, and texture profiles. The organoleptic evaluation revealed that *jamu godog* exhibits a balanced flavor profile characterized by sweetness, mild spiciness, and sourness, along with a distinctive aroma combining ginger, lemongrass, lime, and roselle, and a reddish-yellow color (Table 3). Increasing the roselle concentration resulted in enhanced acidity, a more pronounced roselle aroma, deeper red coloration, and increased viscosity. These findings corroborate previous research by Ananta et al.[27] which demonstrated that higher roselle content in moringa herbal syrup intensified sourness, aroma intensity, redness, and viscosity. Furthermore, pH analysis indicated that roselle addition lowered the pH of *jamu godog*, maintaining it below 7, thereby preventing curcumin precipitation from turmeric.[17] This acidic environment is instrumental in preventing the precipitation of curcumin from turmeric, thereby preserving its bioavailability and therapeutic potential. Moreover, maintaining a pH below 7 contributes to microbial safety by inhibiting the growth of spoilage organisms and pathogens, an essential consideration for liquid herbal

preparations with limited shelf life. The modulation of organoleptic characteristics via roselle addition offers a practical strategy to optimize both sensory acceptance and physicochemical stability, key factors influencing the commercial viability of traditional herbal beverages.

Balancing sensory quality and product stability is paramount in developing *jamu godog*, as consumer preferences directly impact adherence and continued usage. Future investigations should consider integrating natural preservation techniques, such as antioxidant additives or microencapsulation of volatile compounds, to extend shelf life without compromising sensory appeal or bioactivity. Overall, this study highlights the importance of formulation adjustments to enhance both the palatability and stability of herbal decoctions, supporting their broader acceptance and efficacy in traditional and complementary medicine.

Table 3. Organoleptic Properties and pH Values of *Jamu Godog* Formulations with Varying Roselle Concentrations

Parameters	**Formula 1** (without roselle)	**Formula 2** (roselle 0.3%)	**Formula 3** (roselle 0.6%)
Odor	The characteristic odor of ginger and lemongrass, with no sour smell from lime.	The characteristic odor of ginger and lemongrass, and the sour smell of citrus and roselle wafts in.	The characteristic smell of ginger and lemongrass, the sour smell of citrus and roselle.
Taste	Sweet, slightly spicy	Sweet, slightly spicy, sour taste	Sweet, slightly spicy, and more sour taste
Color	Light yellow	Deep yellow	Reddish yellow
Consistency	Dilute	Slightly viscous	Viscous
pH value	4	3	3

Figure

Figure 1. *Jamu Godog*

Following storage at 4°C and 25°C for three days, the pH values of *jamu godog* remained stable, comparable to initial measurements, demonstrating its physicochemical stability within the common shelf life of liquid herbal products. Nonetheless, organoleptic evaluations indicated perceptible alterations at both temperatures after the fourth day, notably a reduction in the characteristic flavors associated with key herbal constituents, as summarized in Table 4. This decline is attributable to the natural volatilization of essential oils, such as those derived from ginger and lemongrass, which are known for their high vapor pressures and susceptibility to evaporation during storage. The loss of these volatile aromatic compounds contributes to diminished flavor intensity, as evidenced by the reduced ginger aroma detected after extended storage. These findings highlight the importance of optimized storage conditions and potential formulation strategies, such as encapsulation or antioxidant additives, to preserve herbal decoctions' sensory qualities and therapeutic efficacy over time.

Moreover, the degradation of bioactive compounds during storage can affect not only the sensory profile but also the pharmacological potency of the preparation. Oxidative reactions facilitated by exposure to oxygen, light, and temperature fluctuations may accelerate the breakdown of phenolic compounds and essential oils, thus compromising antioxidant activity and other health benefits. Therefore, maintaining an appropriate storage environment and incorporating stabilizing agents can play a critical role in extending the shelf life and ensuring consistent therapeutic outcomes. Advanced preservation techniques, including microencapsulation and the use of natural antioxidants, have shown a promising protection of sensitive phytochemicals from degradation, thereby enhancing both product stability and consumer acceptability. Future research, as such, should focus on evaluating these strategies in *jamu godog* and similar herbal formulations to optimize their quality and efficacy during storage.

Table 4. Organoleptic Stability of Roselle *Jamu Godog* at 4°C and 25°C for 7 Days

Formula	Changes occurring during storage *		
	Days 1 to 3	Day 4	Days 5 to 7
F1 (without roselle)	Stable	Ginger flavor begins to diminish, odor and color stable.	More sour taste, tasteless ginger, less lime smell, stable color
F2 (roselle 0.3%)	Stable	Ginger flavor begins to diminish, odor and color stable.	Taste sourer and fizzy, pungent sour smell, stable color.
F3 (roselle 0.6%)	Stable	Ginger flavor begins to diminish, odor and color stable.	More sour and fizzy taste, pungent sour smell, stable color

*The changes that occurred during storage at 4°C and 25°C were the same.

The quality and safety of traditional herbal preparations such as *jamu godog* are critically dependent not only on their physicochemical properties but also on their microbiological status. In this study, microbial contamination was assessed by the Total Plate Count (TPC) method, which serves as a comprehensive indicator of the overall aerobic mesophilic bacterial load. Maintaining microbial counts below the regulatory threshold (5×10^7 CFU/g or mL) is essential to ensure product safety and prevent spoilage, thereby protecting consumers from potential health hazards.[28] [29]

The formulation of *jamu godog*, particularly incorporating acidic ingredients like roselle and lime, plays a pivotal role in influencing microbial stability. The observed reduction in pH values below neutrality creates an inhospitable environment for many spoilage and pathogenic microorganisms, thus contributing to microbial inhibition. This acidic condition, combined with the inherent antimicrobial properties of phytochemicals present in ginger, turmeric, and lemongrass, synergistically enhances the product's microbiological safety.

Furthermore, the physicochemical stability observed during storage at both refrigeration (4°C) and room temperature (25°C) conditions supports the maintenance of microbial quality over the product's typical shelf life. Despite stable pH and microbial counts during initial storage, organoleptic changes attributed to the volatilization of essential oils may indirectly affect microbial dynamics by altering substrate availability or product consistency. Such changes underscore the need to carefully optimize storage conditions and packaging to preserve sensory attributes and microbial safety.

Integrating natural antimicrobial agents or employing advanced preservation techniques such as microencapsulation of

volatile bioactive compounds could further enhance the shelf life and microbiological quality of *jamu godog*. These strategies not only help retain the therapeutic efficacy and sensory qualities but also align with consumer demand for minimally processed, additive-free herbal products. Overall, ensuring microbiological quality through effective formulation and controlled storage is paramount for traditional herbal medicines. This holistic approach supports regulatory compliance, consumer safety, and product acceptance, thereby facilitating the sustainable development and commercialization of herbal decoctions such as *jamu godog*.

The microbial quality of *jamu godog* formulations was systematically evaluated via Total Plate Count (TPC) prior to and following storage at controlled temperatures of 4°C and 25°C for durations of 3 and 7 days (Table 5). Initial microbial loads across all formulations were markedly low, indicating stringent hygienic processing conditions and effective initial microbial control. Throughout storage, a predictable increase in aerobic mesophilic bacteria was observed, which is common in liquid herbal preparations due to nutrient availability and water activity conducive to microbial growth. However, these increases remained below regulatory thresholds, confirming the products' microbiological safety and stability during the typical shelf-life period.

Table 5. Total Plate Count (TPC) of Roselle *Jamu Godog* Formulations Before and After Storage

Formula	TPC values (CFU/mL)				
	Before storage	After 4°C storage		After 25°C storage	
		Day 3	Day 7	Day 3	Day 7
F1 (without roselle)	4.52×10^2	1.20×10^4	1.26×10^4	1.20×10^4	2.32×10^4
	p-value	0.007	0.002	0.002	0.001
F2 (roselle 0.3%)	1.08×10^3	2.87×10^3	1.25×10^4	6.57×10^3	1.63×10^4
	p-value	0.002	0.002	0.000	0.024
F3 (roselle 0.6%)	3.87×10^2	4.99×10^3	1.53×10^4	1.98×10^3	2.54×10^4
	p-value	0.001	0.026	0.001	0.035

The results revealed that the concentration of roselle flowers in the herbal drink formulation influenced the microbiological stability of the product. Formula F2 containing 0.3% roselle showed the best stability at cold storage temperature (4°C), with a p-value that remained at 0.002 both on the third and seventh days. In contrast, formula F3 with a roselle concentration of 0.6% displayed an increase in the number of microbes on the seventh day, both at 4°C and room temperature (25°C), as indicated by an increase in the p value to 0.026 and 0.035,

respectively. Meanwhile, formula F1, which did not contain roselle, exhibited the lowest p-value across all temperature and storage time conditions, indicating that the addition of roselle contributed as an antimicrobial agent. In addition, storage time was also shown to affect microbial growth. All formulas experienced an increase in the number of microbes on the seventh day compared to the third day, with the most significant increase occurring in formula F3. This denotes that adding roselle, especially in high concentrations, is not effective enough in suppressing microbial growth in longer storage periods. On the other hand, storage temperature of 4°C proved more effective in suppressing microbial growth than room temperature, as indicated by the low p-value in formulas F2 and F3 on day 3 when stored in cold conditions.

Overall, this study's results confirm that adding roselle flowers to the herbal drink formulation provides a significant antimicrobial effect. This can be seen from the p-values in formulas F2 and F3, which are consistently higher than formula F1, which does not contain roselle at cold and room temperatures. Between the two formulas, the roselle concentration of 0.3% (F2) showed the best microbiological stability, especially when stored at 4°C, indicating that this concentration is the most optimal composition in suppressing microbial growth. In addition, storage temperature plays an important role in maintaining the microbiological quality of the product; cold temperatures (4°C) have been demonstrated to be more effective than room temperature (25°C) in inhibiting the growth of microorganisms. However, storing the product for more than three days still carries the risk of increasing microbial contamination, even though roselle has been added to the formulation. Therefore, it is recommended that herbal drink products formulated with roselle be stored in cold conditions and consumed within a short time to maintain the stability and safety of the product microbiologically.

Notably, the roselle-containing formulations (F2 and F3) consistently demonstrated lower TPC values than the control formulation without roselle (F1), underscoring roselle's role as a natural antimicrobial agent.[30] This inhibitory effect can be primarily attributed to the presence of organic acids, anthocyanins, and phenolic compounds in roselle, which are known to exert bacteriostatic or bactericidal activities by disrupting microbial cell membranes and interfering with metabolic processes.[31] The acidic environment created by roselle addition further contributes to microbial growth suppression by lowering pH to levels unfavorable for many spoilage and pathogenic bacteria.

The low TPC value is also influenced by the boiling process in making *jamu* so that it can kill the microbes contained in it. The existence of microbes that still grow after the boiling process is highly possible to come from endospores that do not die with ordinary boiling. Meanwhile, *jamu* that is not boiled beforehand (*jamu perasan*) often contains high TPC values and sometimes does not meet the requirements.[32,33]

Moreover, the combined effect of other herbal constituents such as ginger, turmeric, and lemongrass, which possess inherent antimicrobial phytochemicals like gingerol, curcumin, and citral, may have synergistically enhanced microbial inhibition, thus improving overall product safety. The stability of microbial counts at both refrigeration and ambient temperatures suggests that the formulation not only benefits from natural preservative effects but is also resilient under typical storage and distribution conditions, which is essential for commercial viability.

The hedonic test was conducted by 40 respondents giving scores to each formula for each organoleptic parameter (Table 6). For respondents aged 18-40 years, formulas 1-3 received high total scores and differed by 15% compared to formula 3, which contained much roselle (0.6%), so it tasted the sourest. Meanwhile, respondents aged 41-65 tended to choose herbs that did not contain roselle (formula 1) and contained roselle with a medium content among the existing formulas (formula 2, containing 0.3% roselle). When viewed from the total score of all respondents, formula 1 (without roselle) and formula with low roselle (formula 2) were chosen as the most popular preparations because the taste, color, and aroma were more acceptable to respondents.

These findings highlight the significant influence of age-related sensory preferences on the acceptance of herbal formulations. Younger respondents appeared more tolerant of stronger sour flavors associated with higher roselle content, while older individuals preferred milder taste profiles, reflecting potential variations in taste sensitivity or cultural preferences. Such demographic considerations are crucial when developing herbal products for broad consumer bases, as sensory appeal directly impacts adherence and continued use. Moreover, the hedonic scores emphasize the need to balance functional ingredient concentration, such as roselle, with sensory acceptability to optimize both efficacy and consumer satisfaction. Future formulation efforts might explore tailored products or adjustable concentrations to accommodate diverse target populations, thereby enhancing market penetration and user compliance.

Table 6. Hedonic Test Scores of *Jamu Godog*

Parameters	Total Score from Respondents					
	18-40 years old (20 respondents)			41-65 years old (20 respondents)		
	F1	F2	F3	F1	F2	F3
Taste	73	73	57	73	73	68
Color	73	72	62	71	73	68
Odor	72	70	63	70	73	66
Total	**218**	**215**	**182**	**214**	**219**	**202**

Jamu godog is reported to be a more desirable herbal preparation than pressed herbal medicine and can be stored longer because microbes that may be present in the raw materials of herbal ingredients can be killed due to the boiling effect.[34] In addition, the community also considers that making *jamu godog* is not difficult and can be done at home.[35] The presence of essential ingredients (such as ginger and lemongrass) is also reported to be of interest to the public due to its refreshing effect.[36] Another ingredient that makes this *jamu godog* much in demand by respondents is turmeric, which has a distinctive, refreshing taste and is believed to have potent pharmacological effects.[37]

CONCLUSION

The *jamu godog* formulation developed in this study demonstrates potential as a viable alternative herbal preparation for promoting community health. The product incorporates readily accessible ingredients and exhibits sensory attributes—taste and aroma—that consumers will readily accept. Moreover, it maintains satisfactory physicochemical and microbiological stability throughout a one-week shelf life. For broader adoption and integration into public health practices, further efforts involving governmental support and healthcare professionals are essential to facilitate dissemination and acceptance within larger populations.

CONFLICT OF INTEREST

There is no potential for conflict of interest with the research, authorship, and/or article publication.

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