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Research Article

EFFECT OF VARIATIONS OF *BETA VULGARIS* EXTRACTS ON MASKING THE BITTER TASTE OF *MOMORDICA CHARANTIA* EXTRACT SYRUP

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ABSTRACT

Objective: This study aimed to obtain a formula with an optimal sweetener concentration of beet extract that can cover the bitter taste of bitter melon and confer optimal physical properties on the syrup.

Methods: The syrups were prepared by mixing bitter melon extract, sucrose, beet extract, sorbitol, sodium benzoate, strawberry essence, and demineralized water. The control formula and formulas 1, 2, and 3 contained beet extract at concentrations of 0% and 10%, 15%, and 20%, respectively. All formulas were evaluated to determine their physical properties, stability, and bitterness. The bitterness was tested on 30 respondents, with data being analyzed using Wilcoxon's test on SPSS software.

Results and Conclusion: Formula 3 with 20% beet extract was identified as the best formula for masking bitter taste because it had a significantly better average value than the other formulas ($p<0.05$) and the highest bitterless taste percentage (86.67%), with physical properties of a brownish-black color, odor of mixture of strawberry and dominant beet, a sweet and dominant beet taste, pH 5.46, and specific gravity of 1.228 g/mL.

Keywords: *Momordica charantia* L., Bitter melon, Formulation of syrup preparation, *Beta vulgaris*.

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INTRODUCTION

Bitter melon (*Momordica charantia* L.), a medicinal plant, is commonly used in Indonesia. It grows well in this country because it is suited to growth in the tropics, either wild or planted. It is commonly used as a food complement and has various health benefits. It contains charantins (steroidal glycosides) having hypoglycemic effects for the treatment of diabetes, catechins having antioxidant activity, cucurbitanes (triterpene glycosides) having inhibitory effects on Epstein–Barr virus, and sesquiterpenes having antimicrobial activity [1].

As a medicinal plant, bitter melon is still typically used in line with traditional practices by boiling or the production of juice. To increase the practicality of using bitter melon as a medicine without reducing its stability, it needs to be prepared in dosage forms. One of these options is a liquid dosage form, such as bitter melon extract syrup [2].

Another problem with bitter melon is its bitter taste, which is due to the presence of the bitter compound momordicin (a triterpenoid compound and derivative of cucurbitane) [3]. The bitterness is generally unpleasant for most people's palates, but it can be overcome by masking it using the addition of a sweetener in a formulation of bitter melon extract syrup. The sweetener used in this research was beet extract. On the basis of data from the US Department of Agriculture (2014), 100 g beet contains 6.76 g sugar [4], which is expected to be sufficient to mask the bitterness of bitter melon extract.

The background above prompted this research on formulations of bitter melon syrup extracts (*M. charantia* L.) with various sweetener concentrations of beet (*Beta vulgaris*) to cover the bitter melon taste; the aim was to obtain a formula with an optimal sweetener concentration of beet extract that can cover the bitter taste of bitter melon and confer optimal physical properties on the syrup.

MATERIALS AND METHODS

Materials

The tools used in this study were pH meters (Hanna Instruments, USA), an oven (Memmert, Germany), analytical scales (Adam, USA), a 10 mL pycnometer (Pyrex, USA), a refrigerator (Toshiba, Japan), a hot plate (IKA, Germany), a homogenizer (IKA, Germany), and glassware for analysis (Schott Duran, Germany). The materials used in this research were sucrose (Angel Products, Indonesia), beet extract (Indonesian Spice and Medicinal Research Institute), bitter melon extract, sorbitol (Brataco, Indonesia), sodium benzoate (Brataco, Indonesia), strawberry flavor (Symrise, Germany), and aquadest (Brataco, Indonesia).

Formulation of bitter melon extract syrup

This research included four formulations of melon extract syrup with one formulation as a control. The formulations differed from each other in terms of the concentration of sweetener used. The composition of each formula is shown in Table 1.

First, bitter melon extract syrups were prepared using the above-mentioned tools and constituents. All constituents were weighed with analytical scales. Sucrose was put into a glass beaker, dissolved in aquadest over a hot plate (30°C–40°C), and then stirred using a homogenizer until reaching homogeneity. The bitter melon extract was dissolved in aquadest in a glass beaker, followed by stirring using a stirring bar until reaching homogeneity. The solution was introduced into the previous solution and then dissolved until reaching homogeneity. Sodium benzoate was dissolved in aquadest in a glass beaker and then stirred using a stirring bar until reaching homogeneity. The solution was introduced into the previous solution and then dissolved until reaching homogeneity. Sorbitol was added to the solution and then stirred until reaching homogeneity. The beet extract was dissolved in aquadest in a glass beaker using a homogenizer until reaching homogeneity and then put into the previous solution and mixed until reaching homogeneity. A strawberry flavor was added to the solution, followed by stirring until reaching homogeneity. Aquadest

Table 1: Formulas of bitter melon extract syrups

Component	Category	Control	Formula		
			1	2	3
Bitter melon extract (g)		6	6	6	6
Sucrose (g)	Sweetener	180	150	135	120
Beet extract (g)	Sweetener and food coloring	-	30	45	60
Sorbitol (mL)	Humectant	30	30	30	30
Sodium benzoate (g)	Preservative	0.6	0.6	0.6	0.6
Strawberry flavor (mL)	Flavoring agent	1.5	1.5	1.5	1.5
Aquadest	Solvent	Add 300 mL			

was also added until the desired volume of syrup was obtained, followed by stirring until reaching homogeneity. The syrup was stored in a container pack.

Evaluation of bitter melon extract syrup

Organoleptic evaluation

The organoleptic evaluation was performed with the aim of proving the esthetic value of the dosage forms before distribution to consumers, as well as to give reliable information to consumers that the product is feasible. Parameters assessed included the physical appearance, color, smell, and taste of the syrup [5].

Determination of specific gravity

Determination of the specific gravity was performed using the pycnometer. The procedure for calculating the specific gravity was based on the Pharmacopoeia Indonesia Edition V [6]. First, the pycnometer was cleaned, dried, and calibrated by determining its weight and water weight at 25°C. The test substance was inserted into the pycnometer at 25°C. The excess of the test substance was removed and weighed. The weight of the empty pycnometer was subtracted from the weight of the pycnometer that had been filled. The weight of the type was obtained by dividing the weight of the substance by the weight of water in the pycnometer. The weight of the type was calculated by dividing pcynometer weight contains a tested substance - empty weight of pycnometer with pcynometer weight contains aquadest - empty weight of pycnometer.

pH determination

The pH test was performed using a pH meter at room temperature. The electrode was calibrated with standard buffers of pH 4 and 7, and the electrode was immersed in a syrup dosage form until the pH value appeared on the screen. The pH results were recorded [6].

Physical stability test

Physical stability tests were performed at low temperature (4°C±2°C), room temperature (29°C±2°C), and high temperature (40°C±2°C). All syrup formulations were stored at all three temperatures for 6 weeks, after which organoleptic observations (discoloration, odor, and homogeneity) and pH measurements were performed. In a cycling test, the dosage forms were stored at a cold temperature ±4°C for 24 h and then removed and placed at a temperature of ±40°C for 24 h (one cycle). This experiment was repeated as many as 6 times, and then, observations and evaluations were performed for comparison with previous dosage forms [7,8].

Test of bitterness

A bitter taste test was performed on 30 respondents meeting the criteria of having no oral disorders such as canker sores, bleeding gums, and toothache and not having consumed hot or bitter food or beverages within the past 6 h. Respondents were aged from 18 to 40 years old and included both men and women. Random codes were used to identify each sample of syrup formulation and one standard for the analyses of the bitterness of bitter melon solution, to ensure that the researchers and respondents were in a blinded state (double-blind setup). The standard bitter taste was made by dissolving the *Momordica charantia* extract in the aquadest with the same extract concentration in the dosage formulas. Respondents were asked to assess the bitter taste of each preparation using the following scoring categories: 5 (very bitter), 4 (bitter), 3 (quite bitter), 2 (slightly bitter), and 1 (not bitter) [9].

After obtaining bitter taste test data from the 30 respondents, the processing of the data was performed by making the percentage of spread value of each formula, with statistical analysis being performed using SPSS software. A normality test was used to determine whether the data were normally distributed. The statistical test performed was a non-parametric statistical test, namely Wilcoxon's test, to determine whether there was a significant difference in the means between standard solutions of bitter melon extract with each syrup dosage formula. The next statistical test was the Mann–Whitney U-test to determine whether there was a significant difference in the means between each dosage sample. Furthermore, to determine whether there was a significant difference in the mean variation of beet extract concentration in the bitter taste testing of all formulas, a non-parametric test, namely Kruskal–Wallis test, was performed.

RESULTS AND DISCUSSION

Organoleptic evaluation

The results of organoleptic evaluation of each syrup formula are shown in Table 2.

The obtained results indicated that the beet extract concentration used in the dosage form of syrup affected each organoleptic parameter. The greater the concentration of extract of beet used, the darker the color of the dosage form. Moreover, the smell and taste were also increasingly dominated by the extract of the beet itself with a greater concentration of beet extract used, with the smell and taste of beet extract being more dominant in the dosage form of syrup.

Determination of specific gravity

The results of the specific gravity obtained were as follows: Control formula (1.282 g/mL), formula 1 (1.271 g/mL), formula 2 (1.259 g/mL), and formula 3 (1.228 g/mL). The weights thus decreased in order from the control formula to formula 3. A relationship between the sweetener concentration and the specific gravity was identified. The sucrose concentration influences the specific gravity of the dosage, with a lower sucrose concentration giving a smaller type weight value, so it can be seen that the sucrose concentration plays a role in adding the type weight to the syrup.

pH determination

The pH results obtained were as follows: Control formula (5.10), formula 1 (5.41), formula 2 (5.45), and formula 3 (5.46). These results show that increasing the beet extract concentration had an effect of increasing the pH of syrup. These results also show that the pH of the syrup is still in the range of pH values of syrup available on the market, namely between pH 4 and 7 [7,8,10].

Physical stability test

The results of the low-temperature physical stability test are shown in Table 3.

Table 2: Organoleptic evaluation results of bitter melon extract syrup

Parameter	Formula			
	Control	**1**	**2**	**3**
Color	Brownish-orange	Brownish-black	Brownish-black	Brownish-black
Standard of color	OS/LP 422 deep yellow	FG 77 brown	FG 77 brown	FG 77 brown
Smell	Strawberry flavor	Strawberry flavor and a little beet	Strawberry flavor and beet	Strawberry flavor and dominant beet
Taste	Sweet	Sweet and a little beet	Sweet and a little beet	Sweet and dominant beet

Table 3: Result of physical stability test at low temperature (4°C)

Dosage form	In week	Observation				
		Color	**Smell**	**Taste**	**Homogeneity**	**pH**
Control formula	0	Brownish-orange	Strawberry flavor	Sweet	Homogeneous	5.10
	1	(-)	(-)	(-)	Homogeneous	5.12
	2	(-)	(-)	(-)	Homogeneous	5.22
	3	(-)	(-)	(-)	Homogeneous	5.12
	4	(-)	Slightly reduced	Slightly reduced	Homogeneous	5.12
	5	(-)	Slightly reduced	Equal to that at 4 weeks	Homogeneous	5.12
	6	(-)	Equal to that at 5 weeks	Slightly reduced	Homogeneous	5.10
Formula 1	0	Brownish-black	Strawberry flavor and a little beet	Sweet and a little beet	Homogeneous	5.41
	1	(-)	(-)	(-)	Homogeneous	5.44
	2	(-)	(-)	(-)	Homogeneous	5.48
	3	(-)	Beet smell reduced	Slightly reduced	Homogeneous	5.50
	4	(-)	A bit of flavor and beet	Slightly reduced	Homogeneous	5.43
	5	(-)	Beet smell and flavor reduced	Equal to that at 4 weeks	Homogeneous	5.42
	6	(-)	Equal to that at 5 weeks	Slightly reduced	Homogeneous	5.40
Formula 2	0	Brownish-black	Strawberry flavor and beet	Sweet and a little beet	Homogeneous	5.45
	1	(-)	(-)	(-)	Homogeneous	5.48
	2	(-)	Beet smell reduced	Slightly reduced	Homogeneous	5.49
	3	(-)	Equal to that at 2 weeks	Equal to that at 2 weeks	Homogeneous	5.55
	4	(-)	Beet smell reduced	Slightly reduced	Homogeneous	5.34
	5	(-)	Beet smell and flavor reduced	Slightly reduced	Homogeneous	5.30
	6	(-)	Equal to that at 5 weeks	Equal to that at 5 weeks	Homogeneous	5.28
Formula 3	0	Brownish-black	Strawberry flavor and dominant beet	Sweet and dominant beet	Homogeneous	5.46
	1	(-)	(-)	(-)	Homogeneous	5.48
	2	(-)	Beet smell reduced	Slightly reduced	Homogeneous	5.57
	3	(-)	Beet smell reduced	Equal to that at 2 weeks	Homogeneous	5.62
	4	(-)	Equal to that at 3 weeks	Slightly reduced	Homogeneous	5.44
	5	(-)	Beet smell reduced	Equal to that at 4 weeks	Homogeneous	5.38
	6	(-)	Equal to that at 5 weeks	Equal to that at 5 weeks	Homogeneous	5.36

Annotation: (-) Indicates no changes occurred

The obtained results indicate that no changes in color and homogeneity of the four dosages occurred. The smell and taste of beet in the dosage form tested at low temperatures decreased almost every week, so it can be said that the storage of the dosage at low temperature reduces the odor and taste of beet extract present in the dosage form. In the cooling process, just like food stored in a refrigerator, low temperatures can reduce or mask the odor and taste of preparation [11]. The obtained cold effects provide the first sensation when doing inspection of smell or taste so that the original smell and taste will appear shortly after the examination [12]. Furthermore, the pH measurement results are shown in Table 3. The pH changes that occurred during this low-temperature physical stability test may have been due to the occurrence of certain chemical reactions in the dosage form that affected the particular content; to clarify this, further chemical evaluations such as assays are needed [13].

The results of the physical temperature stability test are shown in Table 4. The results indicate that there is no change in the color, smell, taste, or homogeneity of the four dosages. This shows that each of the syrup dosage formulas is stable at room temperature, which is due to the manufacturing process being carried out at room temperature and the constituents contained in the syrup dosage form also being more stable at room temperature. Furthermore, from the results of pH measurement performed at room temperature as shown in Table 4, pH initially tends to be stable but begins to decrease at week 4. The decrease may occur because of the possibility of the growth of certain microbes in the preparation causing a decrease in pH, but this must be proven by microbial testing [13-15].

On the basis of the results obtained from the stability test performed at high temperature as shown in Table 5, it can be concluded that there is no change in color and homogeneity of the four dosages. The smell and taste of beets in the dosage form tested at a high temperature increased almost every week, so it can be asserted that the storage of dosages at a high temperature can increase the smell and taste of beet contained in the dosage form. This may have occurred because the substances that play a role in the emergence of the taste and smell of beet evaporated at high temperatures [16]. The results of pH measurement are shown in Table 5. A rise of pH occurred until week 3, followed by a decline beginning at week 4. The pH changes that occurred during this high-temperature stability test may have occurred because of certain chemical reactions in the dosage form affecting the particular composition. The composition may affect the pH change. To determine particular thing, further chemical evaluation such as level determination should be performed [13]. Another possibility is the growth of certain microbes in the dosage form that causes the pH to decrease; however, this must be proven by microbial testing [15].

The results of the stability test with cycling as shown in Table 6 indicate that there were no changes in color, smell, or homogeneity of the four

Table 4: Results of physical stability test at room temperature (29°C)

Dosage form	In week	Observation				
		Color	Smell	Taste	Homogeneity	pH
Control formula	0	Brownish-orange	Strawberry flavor	Sweet	Homogeneous	5.0
	1	(-)	(-)	(-)	Homogeneous	5.10
	2	(-)	(-)	(-)	Homogeneous	5.10
	3	(-)	(-)	(-)	Homogeneous	5.10
	4	(-)	(-)	(-)	Homogeneous	5.04
	5	(-)	(-)	(-)	Homogeneous	5.04
	6	(-)	(-)	(-)	Homogeneous	5.02
Formula 1	0	Brownish-black	Strawberry flavor and a little Beet	Sweet and a little beet	Homogeneous	5.41
	1	(-)	(-)	(-)	Homogeneous	5.41
	2	(-)	(-)	(-)	Homogeneous	5.42
	3	(-)	(-)	(-)	Homogeneous	5.42
	4	(-)	(-)	(-)	Homogeneous	5.30
	5	(-)	(-)	(-)	Homogeneous	5.30
	6	(-)	(-)	(-)	Homogeneous	5.30
Formula 2	0	Brownish-black	Strawberry flavor and beet	Sweet and a little beet	Homogeneous	5.45
	1	(-)	(-)	(-)	Homogeneous	5.45
	2	(-)	(-)	(-)	Homogeneous	5.46
	3	(-)	(-)	(-)	Homogeneous	5.44
	4	(-)	(-)	(-)	Homogeneous	5.33
	5	(-)	(-)	(-)	Homogeneous	5.32
	6	(-)	(-)	(-)	Homogeneous	5.32
Formula 3	0	Brownish-black	Strawberry flavor and dominant beet	Sweet and dominant beet	Homogeneous	5.46
	1	(-)	(-)	(-)	Homogeneous	5.46
	2	(-)	(-)	(-)	Homogeneous	5.46
	3	(-)	(-)	(-)	Homogeneous	5.46
	4	(-)	(-)	(-)	Homogeneous	5.40
	5	(-)	(-)	(-)	Homogeneous	5.40
	6	(-)	(-)	(-)	Homogeneous	5.40

Annotation: (-) Indicates no changes occur

Table 5: Results of physical stability testing at high temperature (40 C)

Dosage form	Week number	Observation				
		Color	Smell	Taste	Homogeneity	pH
Control formula	0	Brownish-orange	Strawberry flavor	Sweet	Homogeneous	5.10
	1	(-)	(-)	(-)	Homogeneous	5.16
	2	(-)	(-)	(-)	Homogeneous	5.23
	3	(-)	(-)	(-)	Homogeneous	5.25
	4	(-)	A slight smell of bitter melon emerges	A slight taste of bitter melon emerges	Homogeneous	5.19
	5	(-)	Similar to week 4	Similar to week 4	Homogeneous	5.12
	6	(-)	Similar to week 4	Similar to week 4	Homogeneous	5.10
Formula 1	0	Brownish-black	Strawberry flavor and slight beet	Sweet and slight beet	Homogeneous	5.41
	1	(-)	(-)	(-)	Homogeneous	5.42
	2	(-)	(-)	(-)	Homogeneous	5.44
	3	(-)	(-)	(-)	Homogeneous	5.54
	4	(-)	Slightly stronger	Taste of beet slightly increases	Homogeneous	5.30
	5	(-)	Similar to week 4	Similar to week 4	Homogeneous	5.28
	6	(-)	Slightly stronger	Taste of beet increases	Homogeneous	5.22
Formula 2	0	Brownish-black	Strawberry flavor and beet	Sweet and slight beet	Homogeneous	5.45
	1	(-)	(-)	(-)	Homogeneous	5.46
	2	(-)	Slightly stronger	(-)	Homogeneous	5.48
	3	(-)	Smell of beet gets stronger	Taste of beet slightly increases	Homogeneous	5.54
	4	(-)	Smell of beet quite strong	Taste of beet slightly increases	Homogeneous	5.33
	5	(-)	Similar to week 4	Similar to week 4	Homogeneous	5.30
	6	(-)	Smell of beet gets stronger	Taste of beet increases	Homogeneous	5.26
Formula 3	0	Brownish-black	Strawberry flavor and dominant beet	Sweet and dominant beet	Homogeneous	5.46
	1	(-)	(-)	(-)	Homogeneous	5.50
	2	(-)	Slightly stronger	Taste of beet slightly increases	Homogeneous	5.57
	3	(-)	Smell of beet quite strong	Taste of beet slightly increases	Homogeneous	5.58
	4	(-)	Similar to week 3	Similar to week 3	Homogeneous	5.43
	5	(-)	Similar to week 3	Similar to week 3	Homogeneous	5.42
	6	(-)	Strong smell of beet	Taste of beet is quite strong	Homogeneous	5.38

Annotation: (-) Indicates no changes occur

Table 6: Results of physical stability cycling test

Dosage form	Cycle number	Observation				
		Color	Smell	Taste	Homogeneity	pH
Control	0	Brownish-orange	Strawberry flavor	Sweet	Homogeneous	5.10
	6	(-)	(-)	Slight bitter taste emerges	Homogeneous	4.46
Formula 1	0	Brownish-black	Strawberry flavor and slight beet	Sweet and slight beet	Homogeneous	5.41
	6	(-)	(-)	Taste of bit increases	Homogeneous	4.63
Formula 2	0	Brownish-black	Strawberry flavor and beet	Sweet and slight beet	Homogeneous	5.45
	6	(-)	(-)	Taste of beet increases	Homogeneous	4.79
Formula 3	0	Brownish-black	Strawberry flavor and dominant beet	Sweet and dominant beet	Homogeneous	5.46
	6	(-)	(-)	Taste of beet increases	Homogeneous	4.89

Annotation: (-) Indicates no changes occur

dosages. However, there were changes in the taste of the dosage form, with formulas 1, 2, and 3 being associated with increases in the taste of beets. This decreased the sweet taste of the dosage formulas, while in the control formula, slight bitterness of the bitter melon extract emerged. Furthermore, regarding the results of pH measurement, a decrease in pH of the four dosage formulas was observed, with an average decrease of 0.66. The substantial pH changes occurring during the cycling stability test showed that changing temperatures can lower the pH of the dosage form. This can occur because of certain chemical reactions in the dosage that affects a particular composition; the speed of the chemical reaction itself is affected by the temperature. This chemical reaction can affect the pH change, but clarification of this issue in the current context requires further chemical evaluations such as assays [13].

Bitter taste test

Bitter taste test data were obtained from 30 respondents who completed the bitter taste test questionnaire. The percentage of distribution results from the bitter taste test toward the standard bitter taste and the four other formulas is shown in Table 7.

The results obtained from bitter taste test revealed that, for the bitter standard, the largest proportion of respondents gave a bitter taste score of 3 (quite bitter), with a percentage of 33.33%. For the control, the majority of respondents gave a bitter taste score of 1 (not bitter), with a percentage of 63.33%. For formula 1, the majority of respondents gave a bitter taste score of 1 (not bitter), with a percentage of 66.67%. For formula 2, the majority of respondents gave a bitter taste score of 1 (not bitter), with a percentage of 50.00%. For formula 3, the majority of respondents gave a bitter taste score of 1 (not bitter), with a percentage of 86.67%.

On the basis of the distribution of results from the bitter taste test, it can be seen that formula 3 is the dosage form with the least bitter taste; specifically, the percentage giving a score of 1 (not bitter) is greater than for the other dosage forms and none of the respondents gave a score of 5 (very bitter).

The data were also analyzed using SPSS software. The first data analysis involved a normality test to determine whether the data to be tested are normally distributed, specifically the Shapiro–Wilk test.

On the basis of the results obtained from the normality test as shown in Table 8, the analyses for the five groups of samples gave $p<0.05$, indicating that the bitter taste test data were not normally distributed. As such, the data processing was performed using a non-parametric test.

Wilcoxon's test is the non-parametric statistical text used here, as it should be used for non-normally distributed data. This test was used to determine whether there was a significant difference between the averages of two paired samples, just like the paired sample t-test.

On the basis of the results for the four samples, a $p<0.001$ was obtained. As this value is <0.05, it can be concluded that there is a statistically significant difference in bitterness among the four dosage formulas with a bitter taste standards using bitter melon extract solution.

Table 7: Results of distribution percentage values of bitter taste test

Bitter parameter score	Sample percentage (%)				
	Bitter standard	Control	F1	F2	F3
Not bitter (1)	20.00	63.33	66.67	50.00	86.67
Slightly bitter (2)	13.33	23.33	13.33	33.33	6.67
Quite bitter (3)	33.33	10.00	10.00	13.33	3.33
Bitter (4)	16.67	3.33	6.67	0.00	3.33
Very bitter (5)	16.67	0.00	3.33	3.33	0.00

Table 8: Results of Shapiro–Wilk normality test

Group	n	p value
Bitter standard of bitter melon extract	30	0.008
Control formula	30	<0.001
Formula 1	30	<0.001
Formula 2	30	<0.001
Formula 3	30	<0.001

Table 9: Results of Kruskal–Wallis Test

Group	n	Mean±SD	Minimum–Maximum	p value
Control formula	30	1.53±0.82	1–4	<0.048
Formula 1	30	1.67±1.12	1–5	
Formula 2	30	1.73±0.94	1–5	
Formula 3	30	1.23±0.68	1–4	

SD: Standard deviation, $p<0.05$ (statistically significant)

To discover whether the variation of beet extract concentration had any effect on the bitter taste, the data were analyzed by the Kruskal–Wallis test, which is a non-parametric statistical test used to analyze non-normally distributed data. This test aims to determine whether there is a statistically significant difference between two or more groups. In this study, the authors wanted to determine whether there was a difference in the average bitterness values among the four dosage forms with different beet extract concentrations: Control formula with 0% beet extract, formula 1 with 10% beet extract, formula 2 with 15% beet extract, and formula 3 with 20% beet extract.

The results of the Kruskal–Wallis test shown in Table 9 reveal a p-value (Asymp. Sig.) of 0.048; since this value is <0.05, it can be concluded that there is a statistically significant difference in the variation of the concentration of beet extract toward bitter taste in dosage form of bitter melon extract syrup. As such, it can be asserted

Table 10: Results of Mann–Whitney U-test among samples for best formulation among all dosage

Group	Significance			
	Control	F1	F2	F3
Control	-	1.000	0.340	0.049*
F1	1.000	-	0.391	0.065
F2	0.340	0.391	-	0.004*
F3	0.049*	0.065	0.004*	-

*Statistically significant with p<0.05

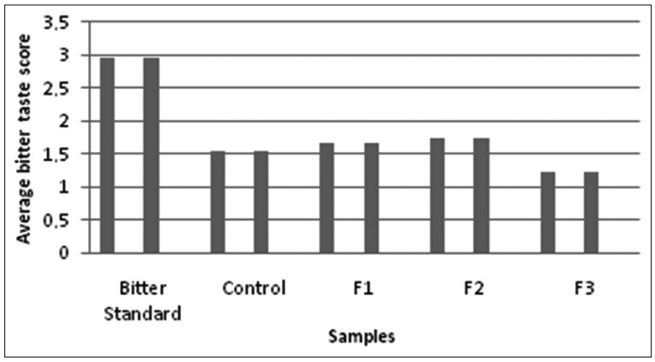

Fig. 1: Average dosage forms' bitter taste of bitter melon extract syrup

that the concentration of beet extract affects the bitter taste of the syrup dosage form.

The graph as shown in Fig. 1, based on the average bitter taste score of each preparation, suggests that the order of preparations from the least bitter to most bitter is as follows: F3, F2, F1, control, and bitter standard.

To determine the best formulation among all dosage forms, data were analyzed by the Mann–Whitney U-test to examine the significance of differences in the means among the samples.

The results of the Mann–Whitney U-test for analyzes among the dosage forms are shown in Table 10. They reveal that formula 3 has a significantly different mean from the other dosage forms, with p=0.049, 0.065, and 0.004. As such, it can be concluded that the syrup of formula 3 is the best bitter melon syrup dosage form.

CONCLUSION

The results of tests performed in this study revealed that the best formula for masking the bitterness of bitter melon extract is formula 3, which contains a concentration of sweetener extract of beets of 20%. This has the physical properties of a brownish-black color, a smell featuring a mix of strawberry and dominant beet, a sweet taste dominated by beets, pH 5.46, and weight of 1.228 g/mL. Further research regarding the stability of dosage forms should be conducted by determining the levels and microbial limit tests of each formulation.

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CONFLICTS OF INTEREST

The authors have no conficts of interest.

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