ORIGINAL ARTICLE

Bali Medical Journal (*Bali MedJ*) 2024, Volume 13, Number 1: 619-625
P-ISSN.2089-1180, E-ISSN: 2302-2914

Sensory analysis affective test and microbiological characteristics of the development formulation drink moringa date palm water extract

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Received: 2023-10-16
Accepted: 2023-12-30
Published: 2024-01-27

ABSTRACT

Introduction: There is growing interest in the non-nutritional bioactive compounds present in food and beverages as possible "life nutrients" for preventing noncommunicable diseases. The dates moringa juice drink is a functional beverage that represents a rich source of bioactive compounds including carotenoids, phenolic acids, flavonoids, coumarins, alkaloids, polyacetylenes, saponins, and terpenoids. This study aimed to investigate the impact of incorporating various concentrations of moringa extract on the sensory quality and preference rating of date moringa juice.
Methods: The sample from the sensory test with the highest score were subsequently the color analysis was conducted using a chromameter, to perform the investigation, labels, iceboxes, mineral water, and questionnaires were used. The formulation procedure involved combining date palm juice (30%, 35%, 40%) in appropriate proportions with moringa extract.
Results: The statistical test's results for hedonic ratings revealed significant differences in dates moringa juice drink taste, aroma, and viscosity. The test also revealed that the dates moringa juice drink, Formula 1 with 30% added date palm juice, was the most favored in terms of taste of 6.38, aroma of 5.84, color of 6.23. The microbiological attributes total lactic acid bacteria (LAB) were 1.0 x 10^3 colonies/g, negativity for Salmonella, and an E. coli count 0 APM/g with a pH of 6.42 according to formula 1.
Conclusion: The most favored for water extracts of moringa and date palm treatment was the addition of 30% juice, which received a high preference rating from 35 panelists. F1 formula has a higher mean score for six sensory attributes, i.e., color, viscosity, aroma, taste, mouthfeel, and aftertaste. F1 formula has a lower mean score for the microbiological attributes.

Keywords: Functional drinks, microbiological attributes, moringa date palm water extract, sensory affective test.
Cite This Article: Yuliyana, T., Rimbawan., Damayanthi, E., Palupi, E., Iwansyah, A.C. 2024. Sensory analysis affective test and microbiological characteristics of the development formulation drink moringa date palm water extract. *Bali Medical Journal* 13(1): 619-625. DOI: 10.15562/bmj.v13i1.5032

INTRODUCTION

Moringa oleifera (MO) leaves are a dietary product rich in flavonoids and a wide range of biological activities.[1,2] The potential of moringa leaves extract in curing chronic hyperglycemia and dyslipidemia, as symptoms of diabetes and cardiovascular disease (CVD) risk have been reviewed.[3,4] Dates are a low-fat and low-cholesterol fruit, making them a healthy choice for individuals, especially those with heart conditions. Additionally, they serve as a beneficial source of fiber for the digestive system.[5] The inclusion of dates with high acceptability and optimal nutritional value can enhance functional drinks are made natural ingredients.[6] However, external sources of antioxidants are necessary to prevent oxidative damage in the human body once internal antioxidant defense systems are challenged by overexposure to free radicals and other reactive oxygen species (ROS).[7,8]

In the process of developing food products, it is crucial to acknowledge the customer's requirements, tailor the product to their needs, and effectively communicate the product's value to the consumer.[9] Consumers purchase based on factors such as image, comfort, and nutrition, as well as sensory attributes. As such, sensory properties play a vital role in the purchase decision. Why sensory methods are an important and integral tool that should be utilized in the new product development process. When designing products, the most crucial quality feature of a product is its direct correlation to satisfaction, perception, and ultimate acceptance by the consumer of the sensory qualities of the product.[10] Sensory evaluation and new product development are closely intertwined. Sensory analysis methods can be implemented throughout the design process to evaluate the quality of the product, as well as consumers' expectations and responses to it. It is vital to note that subjective evaluations should be clearly identified as such.[11] Sensory analysis methods can be implemented throughout the design process to evaluate the quality of the product, as well as consumers' expectations and responses to it. In addition, it is essential to use a clear, concise language with a logical flow of information and causal connections between statements.[12,13] Technical term abbreviations should be explained upon first use, and the language should be

objective, value-neutral, and free of biased, emotional, or ornamental expressions. The formal register and grammatical correctness should be maintained throughout, and the text should be structured with consistent technical terms and common sentence structure. Lastly, the text should adhere to style guides and include regular author and institution formatting with factual and unambiguous titles. The framework highlights the significance of sensory evaluation in new product development.[14] This study aimed to investigate the impact of incorporating various concentrations of moringa extract on the sensory quality and preference rating of date moringa juice. The ultimate goal is to develop a drink using moringa and date palm water extract that can lower blood pressure in both systole and diastole, and prevent increased hypertension due to its flavonoid content, which also has anti-microbial effects.[15,16]

METHODS

The production of moringa date juice involves dried moringa leaves and Sukkari dates. The dried moringa leaves come from BLORA PT. Technical terms will be explained upon their initial use. Moringa Organik Indonesia in Central Java, while the dates are sourced from premium importers in Jakarta. The equipment used includes knives, scales, plastic measuring cups and spoons, pans, mixers, glass bottles, filter cloths, wire filters, pots, and stoves and color analysis was conducted using a chromameter.

Formulation of moringa date water extract. The process of creating moringa date water extract refers to studies conducted by Sholichah and Najjar.[17,18] To begin, Moringa date juice and date juice are produced separately through a mixture, filter, and boil process. There are three formulations for creating Moringa date juice with the addition of date juice at rates of 30%, 35%, and 40%. The resulting mixtures are then stirred for three minutes. The moringa dates water extract is stored in a sterilized glass bottle with a tight seal. Prior to the sensory affective test, the extract was frozen at minus 18°C for 16 hours. For this study, 15 liters of moringa date water extract were produced for 35 panelists. Each panelist conducted the test in individual booths and tasted each sample personally. The panel consisted of 35 untrained individuals in accordance with SNI-01-2346-2006. The ranking test and hedonic ratings were conducted simultaneously, with samples presented individually. The assessment used a scale of 1-9 with criteria ranging from "very liked" to "very disliked." Mineral water was provided as a palate cleanser. The scores were recorded on the questionnaire sheet. The data obtained were analyzed by analysis of variance (ANOVA) and continued with LSD posthoc test at a significance level of 5%. *Color Stability* The color measurement was done using a chromameter by Hunter method. The instrument was calibrated with a standard white plate (X= 82.45; Y= 84.46; Z=101.44). The color of the products was analyzed using CIE L* a* b*, where L* indicates brightness, a* indicates green (-) to red (+) while b* indicates blue (-) to yellow (+).[19]

Microbial quality analysis was conducted on the chosen formula to determine the presence of total lactic acid bacteria and contamination by Salmonella and E. coli pathogens. Identification of these bacteria was achieved through the use of specific media, namely SSA medium for Salmonella and EMBA medium for E. coli. The quantity of lactic acid bacteria present was measured in colonies/mL at the SIG Laboratory using standard SNI ISO 4833-1:2015, SNI ISO 7251:2005, IDT: Microbiology of food and feed ingredients - Horizontal technique for detecting and quantifying suspected *Escherichia coli* and SNI ISO 6579:2017, Microbiology of food and feed ingredients - Horizontal method for detection of Salmonella spp. (Amd1:2020, IDT). This standard outlines methods for detecting Salmonella, including Salmonella Typhi and Salmonella Paratyphi, in food and feed ingredients.

Microsoft Excel 2023 was used for graphic processing, data input, and analysis. The SPSS 22.0 application was used to statistically process the data from the hedonic rating test, utilizing the OneWay ANOVA test. To determine the significance of the data between treatments, LSD's further test was conducted.

RESULTS

Panelists' Level of Likeability

The preference or hedonic test is typically utilized in the development of new products. According to the acceptance rating test spider graph in figure 1, the attribute point furthest from the center in each formula is preferred to a higher degree. The scale ranges from 4 for somewhat dislike, to 5 for normal, 6 for rather like, 7 for like, 8 for like very much, and 9 for like very much.

Color and Appearance

The average liking level for each formula was 6.23 (rather like) for F1, 4.74 (somewhat dislike) for F2, and 5.54 (normal) for F3. The variance test results showed that the cutting age treatment did not have a significant effect ($p>0.05$) on the drink's color and appearance acceptability. F1 received the highest score due to its good clarity, minimal precipitate, and fairly good homogeneity. The F2 difference test revealed no significant difference ($p>0.05$) in both color acceptability and appearance. Despite panelists favoring the bright green color of the formula over the dark brown shade of F3, the average score of F2 was not significantly different from the control as it still had visible precipitate and poor homogeneity.

The Aroma

The aroma of the formulas was evaluated with an average preference score of 5.84 (rather like) for F1, 5.23 (normal) for F2, and 5.46 (normal) for F3. F1 was preferred the most among the samples, although no significant difference was observed between the formulas. The variance test results indicated that there was no significant difference ($p>0.05$) in the aroma acceptability of the formulas. This demonstrates that the cutting edge does not impact the acceptance level of product aroma parameters. Formulas generally exhibit potent grassy or leafy notes.

Viscosity

The formula with the highest acceptability and best viscosity was F3. The mean acceptance rates for F1, F2, and F3 were 6.20, 6.00, and 6.34, respectively. Based on the one-way ANOVA test, there was no significant difference in the acceptability

of the viscosity among the formulae ($p > 0.05$). LSD's further post hoc test revealed that F1 and F2 had significantly better acceptability than F3. This may arise from the marginally denser consistency of F3 relative to other formulations. The comparison of viscosity acceptability between the control and F2 indicated no significant difference, specifically 0.308 at a significance level of $p>0.05$. F3 is denser in texture in comparison to other formulations as it contains dissolved date juice, whereas F1 and F2 are considered more liquid.

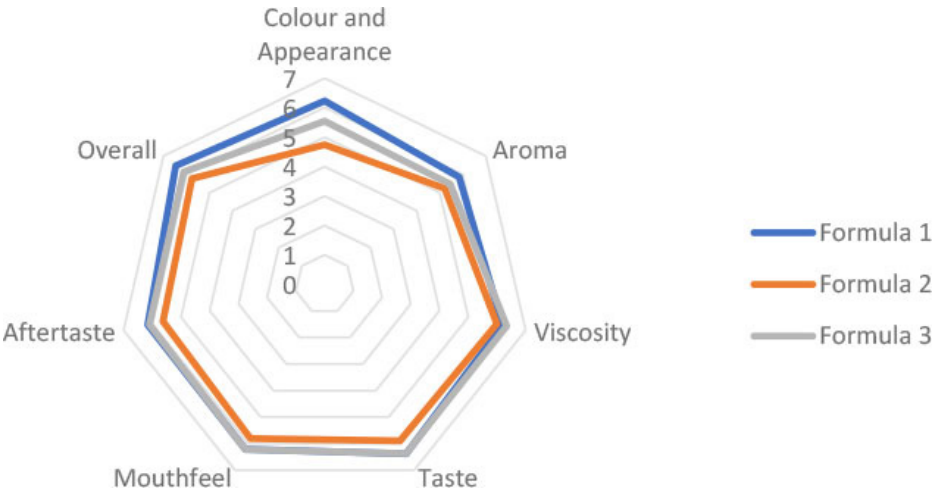

Figure 1. A spider graph featuring formulas 1, 2 and 3, The blue line indicates the acceptance rating of the panelists for formula 1.

Taste

The average preference score for the control and formula was 6.38 (rather like) for F1, 5.89 (rather like) for F2, and 6.37 (rather like) for F3. F1 had the highest acceptance rate compared to the other samples. All formulas were well accepted because they had a mildly sweet taste. The variance test results showed no significant difference ($p>0.05$) in taste acceptance; therefore, it can be concluded that the treatment did not affect the taste parameters. Several panelists noted that the F1 provided a pleasing sensation on the taste buds due to its lighter texture.

Mouthfeel

The mean values for the mouthfeel attribute of the control and the formula were 6.21 (rather like) for F1, 5.80 (rather like) for F2 and 6.19 (rather like) for F3. The results of the analysis of variance on the formula showed that there was no significant difference ($p>0.05$), namely 0.307 in the mouthfeel parameter. The

Table 1. Mean results of acceptance rating for moringa date palm water extract

Formula	Colour and Appearance	Aroma	Viscosity	Taste	Mouthfeel	Aftertaste	Overall
F1	6.23±1.77^{b}	5.84±1.55^{a}	6.20±1.41^{a}	6.38±1.54^{a}	6.21±1.48^{a}	6.16±1.43^{a}	6.12±1.63^{a}
F2	4.74±1.77^{ab}	5.23±1.79^{a}	6.00±1.42^{a}	5.89±1.81^{a}	5.80±1.80^{a}	5.63±1.64^{a}	5.76±1.68^{a}
F3	5.54±1.59^{ab}	5.46±1.85^{a}	6.34±1.05^{a}	6.37±1.63^{a}	6.19±1.55^{a}	6.10±1.63^{a}	4.63±1.20^{a}
Sig.	0.002	0.332	0.550	0.377	0.460	0.314	0.161
Mean±SD	5.50±1.71	5.51±1.73	6.18±1.30	6.21±1.66	6.08±1.61	5.96±1.57	6.11±1.52

a, b, c: different test results based on LSD test.
Different letters in the same row indicate significant differences ($p<0.05$)

Table 2. Color characteristics of developed products

Parameter	Formulation (ratio of moringa and date palm sukkari)		
	F1 (30%)	F2 (35%)	F3 (40%)
Color Characteristics			
L*	20.05±0.00^{a}	20.98±0.00^{c}	21.79±0.00^{b}
a*	-5.68±0.00^{c}	-5.4±0.00^{b}	-5.2±0.00^{a}
b*	3.40±0.00^{a}	30.8±0.00^{c}	30±0.00^{b}
Color image			
Product image			

*one-way ANOVA ($P<0.05$ statistically significant) with LSD test
*Same letter indicates no significant difference

level of acceptability of F2 was significantly different from F3, while it was not significantly different from F1.

Aftertaste

The average level of liking for the aftertaste parameters across all formulas is somewhat positive, with F1 receiving a score of 6.16, F2 receiving a score of 5.63, and F3 receiving a score of 6.10. F1 is favored the most, but there are no significant differences from F2 and F3. Analysis of various formulas indicates no significant difference ($p>0.05$) in the aftertaste parameter, namely 0.193. The entire formula produces a pleasant aftertaste and is slightly astringent.

Overall

The average rating for the three successive formulas was 6.12 (rather like) for F1, 5.76 (rather like) for F2, and 4.63 (somewhat unfavorable) for F3. According to one way ANOVA analysis, there was no significant difference ($p<0.05$) in the assessment of the formulas as a whole. All sensory attributes were deemed acceptable (>5.50). However, panelists noted that F1 had an excessive amount of date juice, resulting in an unpleasant aroma, taste, and aftertaste.

Color Analysis

The color analysis was conducted using a chromameter, which measures the color of the samples based on the Hunter's Lab Colorimetric System. This system provides color measurement results expressed in L*, a*, and b* values, representing lightness, redness (blue-red), and yellowness (blue-yellow) can be shown in table 3. The different superscript letters in a row are significantly different at p-value <0.05 based on the *oneway* ANOVA with LSD post hoc test.

The obtained results consist of values for L, a, and b. The L value indicates the brightness parameter, which ranges from 0 (black) to 100 (white). A positive a value indicates that the product has a red color, while a negative a value indicates that the food has a green color. The notation a represents the chromaticity value of the red and green mixture. A positive a value indicates that the product has a red color, while a negative a value indicates that the food has a green color. The value b represents the chromatic value of the blue and yellow mixture, with a positive b value indicating yellow and a negative b value indicating blue. The sample with the highest lightness value is F3, a date palm juice drink with 40% added date palm juice, with a value of 21.79. The *one-way* ANOVA analysis shows that there is no significant effect ($p<0.05$) of adding date palm juice on the lightness level. The formula is not very bright due to the addition of date palm extract, which has a slightly dark brown color. A negative value of a/b indicates that the food has a green color. All samples have a negative value of a/b ratio. Based on the *one-way* ANOVA analysis, it was found that the addition of date palm extract did not have a significant effect on the overall color of the food. The highest green color intensity was observed in F1 with a 30% addition of date palm extract. Green color can be produced by adding food ingredients to beverages, such as moringa extract. The analysis results showed that the color of the moringa and date palm extract beverage was not affected by the addition of date palm extract. The green color comes from a higher level of moringa extract.

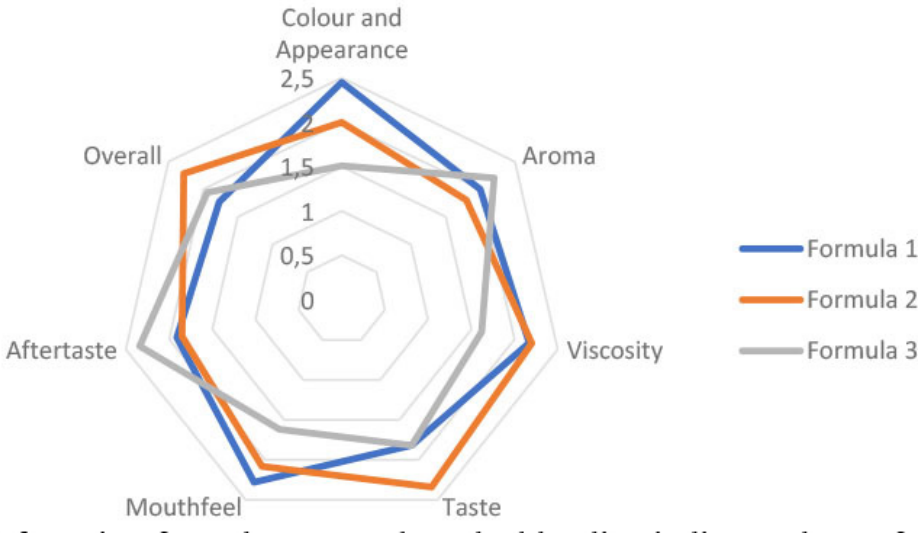

Figure 2. A spider graph featuring formulas 1, 2 and 3, The blue line indicates the preference rankings of the panelists for formula 1.

Ranking Test

One of the different tests involved sorting the attributes of the sample according to the panelists' level of preference. This was done for each attribute and for the overall assessment of the sample using a ranking system. The sample that was considered more preferable or acceptable by the panelists received Rank 1, while the sample with a level of preference or acceptance that was not as good as the other two samples received up to Rank 3. According to the preference rankings spider graph in figure 2, the attribute point furthest from

Table 3. Mean result preference rankings for water extracts of moringa and date palm

Formula	Color and Appearance	Aroma	Viscosity	Taste	*Mouthfeel*	*Aftertaste*	Overall
F1	2.45±0.78^{c}	2.00±0.72^{ab}	2.17±0.82^{b}	2.34±0.76^{b}	2.28±0.78^{b}	1.91±0.65^{b}	2.28±0.82^{b}
F2	2.00±0.68^{b}	1.80±0.83^{a}	2.20±0.75^{b}	1.82±0.89^{a}	2.08±0.78^{b}	1.85±0.91^{ab}	1.77±0.87^{a}
F3	1.51±0.74^{a}	2.20±0.86^{b}	1.62±0.77^{a}	1.82±0.70^{b}	1.62±0.77^{a}	2.34±0.83^{a}	1.94±0.68^{b}
Sig.	0.000	0.125	0.004	0.009	0.002	0.027	0.027
Mean±SD	1.97±0.82	1.98±0.82	1.98±0.82	1.98±0.82	1.98±0.82	2.01±0.83	1.97±0.82

a, b, c: different test results based on LSD test.
Different letters in the same row indicate significant differences ($p<0.05$)

the center in each formula is preferred to a higher degree. The impact of the treatment on the ranking for each sensory attribute and as a whole is indicated by the superscript and is presented in detail in Table 2.

The sample's value weight is 3 for rank 1, 2 for rank 2, and 1 for rank 3. A higher rank is attributed to a larger sample with a higher mean score. The Friedman test revealed that the treatment significantly affected the ranking when ordering formulas from most to least preferred. F1 shows a higher average score (mean score) on six sensory attributes, including Colour, Viscosity, Aroma, Taste, Mouthfeel, and Aftertaste, compared to F2 and F3 samples. F2 receives the lowest rating on all sensory attributes, including Colour, Viscosity, Aroma, Taste, Mouthfeel, and Aftertaste. On the attribute of aroma, sample F3 has a higher mean score and is significantly different from F1, but not significantly different from F2. On the taste attribute, the sample of F1 has the highest average score and is significantly different from F2 and F3. Aroma and taste are the most crucial sensory attributes for beverages made from moringa and dates, particularly to assure good acceptance levels and the formulation selected in this study. The average F1 score, which surpasses that of F2 and F3, effectively demonstrates the impact of strong aroma and taste attributes on the overall rating of the formula. These findings align with the level of acceptance observed in the hedonic test, indicating that F1 has superior acceptance levels relative to F2 and F3 in aroma, taste, and overall assessment.

Microbiological Quality

Formula 1 contains fewer lactic acid bacteria (LAB) than SNI due to the high concentration of flavonoid compounds in Moringa and date palm juice, which have antibacterial properties. Additionally, Formula 1 contains tannins. E. coli is present in Formula 1 at a level of 0 APM/g, indicating that it is not contaminated with Salmonella.

This research is limited by its use of a simple extraction method. Further innovations are needed to increase the drink's durability without reducing its nutrients. Additionally, future research should explore alternative combinations to reduce the bitter taste of moringa leaves in functional drinks, beyond the use of dates.

DISCUSSION

Color plays a crucial role in the visual acceptance of a product. A food product that is visually unappealing or has off-coloring will not be accepted by consumers, even if it has a delightful flavor. The quality of a product is often determined by its color, as it is the first impression that consumers have. Additionally, color can indicate the taste of a food product, even if the color is not always identical to the taste. Deviation in the color of food products from the commonly available ones may result in consumer rejection, even if they are perfectly safe to consume. During product evaluation sessions, color is used as a benchmark for quality attributes, identity, and consumer appeal. The color can influence whether consumers accept or reject food products.[20] The study found that the color of date juice becomes darker with an increase in the concentration of moringa extract used in its preparation. Additionally, the color becomes more intense with an increase in the volume of moringa leaf juice used.[21] This is due to the high concentration of chlorophyll in moringa leaves, which contributes to the color. Moringa leaves contain a high concentration of chlorophyll, which gives them their green color. It is important to note that chlorophyll is a green pigment commonly found in green vegetables. In fact, dried moringa leaves contain as much as 162 mg of chlorophyll per 8 grams, and 30 grams of moringa extract contains 4,860 mg (or 4.9 g) of chlorophyll.[22] This is also consistent with research that there is no effect of different variations in the addition of Moringa leaves according to the panelists' preference for product color, Moringa leaves added with insignificant amounts and not much different additions do not affect the color quality of the product.[21] The color contained in food ingredients can be caused by several sources, namely the presence of pigments, caramelization, Mailard reaction and mixing of additional ingredients.[20] This is supported by the responses of panelists who stated that the overall color is almost the same and there is not much difference.

The lack of significant differences in the aroma of organoleptic drinks may be attributed to the similarity in the aroma of all treatments and the addition of an acceptable amount of date juice. Additionally, no other ingredients containing volatile compounds were added. The addition of moringa leaves is insignificant and does not affect the

Figure 3. Various formulations provided to 35 panellists.

Table 4. Quantity of lactic acid bacteria and pathogen contamination in the products developed

Formula	Total lactic acid bacteria (LAB) colony/g	Maximum limit (LAB) colony/g	Salmonella MPN/g	E. coli /25 g
F1	1.0×10^3	1×10^5	negativity	0
F2	1.1×10^3	1×10^5	negativity	0
F3	1.1×10^3	1×10^5	negativity	0

*Moringa date juice drink with the addition of 45 ml of date juice (F1), 52.5 ml of date juice (F2) and 60 ml of date juice (F3)

aroma quality. This is supported by the panelists' responses, which stated that the addition of moringa leaf powder did not significantly affect the aroma of moringa jelly candy. However, the aroma of jam without moringa leaf extract was preferred by panelists when compared to the control jam formula (0% moringa leaf extract).[23] The presence of volatile odor substances causes the emergence of aroma or odor. It is important to note that this process is purely chemical and not influenced by personal preference or opinion. When heat is applied, proteins in the material break down into amino acids. The reaction between amino acids and sugar produces aroma, while the heat also oxidizes and breaks down the fat in the material, generating some active ingredients. These active ingredients then react with amino acids and peptides to produce aroma.[24]

The addition of date extract affects the taste of the drink. Tannins can cause an astringent taste because they form cross-links when consumed. If date extract is not added, moringa leaves have a distinctive taste due to the presence of tannins. Tannins are commonly found in nature and are present in every part of plants, especially in tropical plants, in leaves and bark. The interaction between tannins and proteins or glycoproteins in the oral cavity causes a dry and puckered sensation or astringency.[25] Adding more Moringa oleifera leaf powder results in a stronger taste and aroma.[23]

Antibacterial agents are either chemical or biological compounds that can inhibit the growth and activity of pathogenic bacteria. Pathogenic bacteria, such as *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus* and *Salmonella typhimurium*, contaminate food and pose a threat to human health as they can cause foodborne illnesses and reduce the quality of food.[26] Lactic acid bacteria require a source of nutrition for their growth. Dates contain high amounts of sugar, which will later be used by lactic acid bacteria as a carbon (C) source for growth. However, the carbon content in dates is too high and must be diluted with a specific water ratio. Additionally, sugar levels surpassing 15% in bioproducts raise the osmotic pressure in the substrate medium, which ultimately inhibits the growth of lactic acid microorganisms.[27]

CONCLUSION

The most favored for water extracts of moringa and date palm treatment was the addition of 30% juice, which received a high preference rating from 35 panelists. F1 formula has a higher mean score for six sensory attributes, i.e., color, viscosity, aroma, taste, mouthfeel, and aftertaste.

ACKNOWLEDGEMENTS

All of the work regarding this study was supported by personal funds and had no conflict of interest in many ways that may influence the research's conduct or presentation.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding this study.

FUNDING

None.

AUTHORS' CONTRIBUTION

TY and R contribute to study conceptualization, methodology, manuscript writing and reviewing. ED and EP contribute to data collection, analysis, and manuscript writing. TY and ACI contribute to manuscript editing and reviewing.

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