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The acceptability of insulin (*Chamaecostus cuspidatus*) leaves as blended with selected cucurbits fruits puree

Chrisiel C Alivio, Sofia C Naelga
Department of Technical and Technology Education, College of Science and Technology Education, University of Science and Technology of Southern Philippines, Cagayan de Oro, Philippines

Abstract
Insulin (*Chamaecostus cuspidatus*) leaves are common good sources of anti-diabetic property. Insulin plant usually is grown as an ornamental plant and its leaves are used as a dietary supplement in the treatment of diabetes mellitus. This plant is usually found in gardens, cultivated areas, and sometimes even in the wild regions of India, Nepal, and the Philippines. In some rural areas, insulin leaves are traditionally used by chewing the leaves, as juice extraction, infusions, or teas. The purpose of the study was to use the insulin leaves as a main ingredient in making a non-alcoholic beverage or insulin juice. For sensory evaluation, the 9-point Hedonic Scale was used. The 50 evaluators, purposively chosen from faculties (5), Technology and Livelihood Undergraduate Students (40) from University of Science and Technology of Southern Philippines and from Food and Beverage Experts from Cagayan de Oro (Bugo) School of Arts and Trades (COBSAT). Means, Standard Deviation, and ANOVA were utilized as statistical tools. For sensory evaluation, the highest acceptability (75% formulation) rated, "Like Slightly" was given in overall descriptions. There is no significant difference in the level of acceptability when grouped according to formulations, insulin water, watermelon-insulin leaves puree and cucumber-insulin leaves puree. The result shows that there was a *highly significant difference* in level of acceptability when grouped according to different formulations, in over-all acceptability, as well as in each different food attributes. The results implies that the evaluators highly preferred the insulin non-alcoholic beverage.

Keywords: Insulin juice, acceptability, sensory evaluation, non -alcoholic beverage

Introduction

Diabetes is proven as a chronic disease that is increasing both in prevalence and incidence worldwide. It is considered as a major impact in third-world countries, particularly the Philippines. Tan, G.H. (2015) asserted that Asia will see greatest increase in the number of people with diabetes by year 2025 that, consequently, will increase the burden of chronic diseases in this part of the globe. The result will have a significant effect on the nations' respective health care systems, both acutely and chronically. Since the Philippines is a part of this scenario, it should require and acquire fundamental and transformative changes that will increase diabetes awareness among the people, emphasize lifestyle change while respecting cultural preferences, and promote public policy, especially regarding the health insurance system, to improve overall diabetes and its outcomes. One way of looking at this issue is to give importance on educating the population on the relationship of good nutrition and one's general health. For most diseases and illnesses (diabetes included) prevention is far better than cure. Consider, for example, the report of World Health Organization (WHO) and Food and Agriculture Organization (FAO).

A recently published article by WHO and FAO (2003) reveals that a minimum of 400 grams of fruit and vegetables per day (excluding starchy tubers like potatoes) is recommended for prevention of chronic diseases such as heart disease, cancer, diabetes, and obesity, as well as for the prevention and alleviation of several micronutrient deficiencies. It is also noted that high-fat meals (HFM) induce metabolic stress that leads to the activation of protective mechanisms, including inflammation and endogenous antioxidant defenses (Miglio C., 2014). Having discovered the value of fruits and vegetables in reducing the risk of developing the mentioned diseases, studies in different varieties of these natural sources have become widespread to discover their nutritional and medicinal properties. One study is that of Rastogi (2018) where he mentions that the juice from watermelon has several potential attributes in addition to its refreshing taste, aroma, and attractive color. It contains a good number of soluble solids that makes the concentration attractive, especially using membranes. On the other hand, the study of Gomes, *et al*., (2011) dealt with concentrated watermelon juice processed on a pilot plant scale using polyamide composite membrane at 300C and 60 bar trans membrane pressure. The results showed an increase in physicochemical properties of the concentrated juice, mainly the lycopene content and antioxidant capacity. Of interest to the present study is *Chamaecostus cuspidatus*, commonly known as spiral flag or insulin plant, because it is accepted to have an anti-diabetic property. In Southern India, it is usually grown as an ornamental plant and its leaves are used as a dietary supplement in the treatment of diabetes mellitus. Recently, a number of scientific papers and studies on the anti-diabetic property of *Chamaecostus cuspidatus* plant were carried out, and the result showed promise on the treatment for diabetes. It was found out that the plant resulted to a decrease in blood sugar levels (Shetty, 2010) [29, 30]. Given these facts, the researcher undertook this study to innovate and identify the acceptability of insulin leaves (*Chamaecostus cuspidatus)* as blended with selected cucurbits fruits puree as an alternative restorative beverage for diabetes.

Methods

Research Design: The study used experimental research design to describe the product's level of acceptability. The researcher executed the product development, product evaluation, and product assessment. On product development, various formulations for insulin water with cucumber and watermelon puree were used. To assess the product, acceptability evaluation was undertaken where the respondents evaluated the formulations using the Hedonic Scale. Product Assessment described the nutritional content, sensory evaluation, and shelf-life of the said product.

Research Setting: The setting of this study was conducted at the University of Science and Technology of Southern Philippines Culinary Arts Laboratory, Cagayan de Oro Campus, Cagayan de Oro City. The production of the treatments of juices and the product sensory attributes evaluations and acceptability test were conducted at the food laboratory facilities or technology livelihood education laboratory in the University equipped with quality food facilities.

Respondents of the Study: The respondents of this study were the consumer type who had good to excellent sensory ability for taste and smell, and preferably were free from upper respiratory conditions. As panel testers, they were expected to contribute to credible results of the product under study. The composition of the respondents was made of 50 Technology and Livelihood Education students, Food Experts, and Food Technicians from the University. In selecting the respondents of the study, purposive sampling technique was used because it did not require fundamental theories, or a set number of respondents.

Data Gathering Procedure: The researcher secured permission to administer the questionnaire from the department chairman of the school of the University. Upon approval, the researcher started with the study on an innovated Insulin-Mixed Juice product, first, by disseminating to respondents the survey questionnaire on acceptability of three different percentages of the insulin mixed juice. The questionnaire consisting of 5 questions in a 9-point Hedonic Scale was distributed to the respondents. The retrieval of the instruments was done by the researcher. After data analysis on the acceptability, the group quantified to be highest in terms of acceptability was designated the group for nutritional content. For a qualitative procedure, the researcher gathered information and data through focus group discussion (FDG) with the food industry and food experts using the questionnaire. The researcher performed the cooking procedure in the USTP culinary laboratory. Testing and evaluation were conducted in testing area of the same venue. The researcher clearly explained the objectives and purpose of the study, and personally distributed the questionnaire and the insulin juice product in different formulations following the number indicated in the master sheet. The survey questionnaire was then collected and tabulated, and the results were analyzed based on the research design employed.

The Research Instrument: The instruments used in the study were descriptive and Hedonic Scale which measured each item in the questionnaire. The acceptability and the sensory attributes of the insulin water (leaves) combined with watermelon and cucumber puree to produce a potential mixed juice were assessed. Descriptive evaluation methods are said to be more challenging to complete and interpret, but it provides more than adequate related and relevant information needed in the study. This statistical tool is supported by a quantitative measure of product characteristics that allow for comparison of intensity between products, and a means of interpretation of these results (Zoecklein *et al*. 2005). The research instrument was composed of two parts: the sensory evaluation score card, and the Hedonic Scale from the study of Naelga *et al*., (2019) for the data gathering process. The first part of the instrument was used to determine the characteristics with four formulations in terms of appearance, aroma, color, taste, and texture of the product. The respondents determined the acceptability of each attribute. The second part of the research questionnaire was the Hedonic Scale which was used to determine the general acceptability of the beverage. The verbal categories were generally assigned numerical values, ranging from 'Like Extremely' as '9' to 'Dislike Extremely' as '1' (Wichchukit & O'Mahony, 2014). The researcher briefly discussed the directions. Then the participants filled out the research instrument by writing a checkmark on the box that corresponded to the answer of their choice. In the end, tasters were encouraged to give comments and suggestions for the improvement of the product. To determine the acceptability of the product under study, the researcher made use of the standard 9-point Hedonic Scale.

Statistical Treatment of the Data: The data gathered were statistically treated using the weighted mean, frequency, and standard deviation. The computed weighted mean determined the degree of responses of the participants of the study.

For the overall acceptability of the juice in terms of color, appearance, aroma, flavor, and taste using the 9-point Hedonic Scale

Data presentation, analysis and findings

This chapter presents the results yielded by the data analyses of the study. The current study aimed to determine the level of acceptability of insulin leaves as blended with selected cucurbits fruit puree and significant difference in the acceptability according to given specific formulations.

Problem 1: What is the level of acceptability of Insulin Leaves as Blended with Selected Cucurbits Fruits Puree in terms of:

a. color
b. appearance
c. aroma
d. flavor, and
e. taste?

Table 1: Frequency distribution in terms of Food Attributes for Different Formulation

Food Attributes	Blended with Selected Cucurbits Fruits Puree Formulation			Blended with Cucurbits Fruit Puree Formulation			Blended with Watermelon Fruit Puree Formulation			Insulin Water
	25%	50%	75%	25%	50%	75%	25%	50%	75%	100%
Color	8.38	7.96	6.34	6.30	6.32	6.60	7.18	7.36	7.98	6.16
Appearance	8.24	7.78	6.26	6.04	6.04	6.42	6.80	7.50	7.74	6.26
Aroma	7.50	6.84	6.10	5.40	5.60	5.92	5.96	6.90	7.16	5.16
Flavor	7.28	6.68	4.88	5.30	4.96	5.36	6.10	6.66	7.20	4.32
Taste	5.40	6.78	4.92	4.90	4.84	4.82	5.96	7.24	7.20	4.18
Overall	7.36	7.21	5.70	5.59	5.55	5.82	6.40	7.13	7.46	5.22

Table 1 shows the frequency distribution in terms of food attributes for different formulation. In terms of color, appearance and flavor, 25% blended with selected cucurbits fruits puree formulation was the highest among the different formulation for the evaluators with a mean of 8.38 rate as "Like very much" for color, mean of 8.24 rate as "Like very much" for the appearance, for the aroma with a mean of 7.50 rate as "Like very much", and lastly, for the flavor, with a mean of 7.28 rate as "Like moderately". For taste, 50% blended with watermelon fruit puree formulation was the highest rate among the formulation with mean of 7.24 rate as "Like moderately.

Table 2: Distribution of overall mean, standard deviation, and rating description for different formulation

Formulation	Mean	Standard Deviation	Description
25% Formulation Insulin Leaves as Blended with Selected Cucurbits Fruits Puree.	7.36	0.84	Like very much
50% Formulation Insulin Leaves as Blended with Selected Cucurbits Fruits Puree.	7.21	1.10	Like moderately
75% Formulation Insulin Leaves as Blended with Selected Cucurbits Fruits Puree.	5.70	1.84	Like slightly
25% Insulin Water and Cucumber Mixture.	5.59	1.82	Like slightly
50% Insulin Water and Cucumber Mixture.	5.55	1.51	Like slightly
75% Insulin Water and Cucumber Mixture.	5.82	1.69	Like slightly
25% Insulin Water and Watermelon Mixture.	6.40	1.61	Like slightly
50% Insulin Water and Watermelon Mixture.	7.13	1.33	Like moderately
75% Insulin Water and Watermelon Mixture.	7.46	1.68	Like very much
100% Insulin Water	5.22	1.98	Neither like nor dislike

Table 2 presents the distribution of mean, standard deviation, and rating description for different formulation. 75% Insulin water and watermelon mixture was the highest mean among the different formulation with a mean of 7.46 rate as "Like very much" which next by the 25% formulation insulin leaves as blended with selected cucurbits fruits puree with a mean of 7.36 rate as "Like very much" as well. Followed by 50% formulation insulin leaves as blended with selected cucurbits fruits puree with a mean of 7.21 rate as "Like moderately". Among the different formulation, 100% Insulin Water was the lowest rate with a mean of 5.22 rate as "Neither line nor dislike". The standard deviations indicates that the responses from the evaluators varied a lot from each other.

Problem 2: Is there a significant difference in the acceptability according to formulations such as:

a. Insulin water,
b. Watermelon-insulin leaves puree, and
c. Cucumber-insulin leaves puree?

Table 3: Distribution of statistics Analysis of Variance (ANOVA) on Level of acceptability when grouped according to formulation

Food Attributes	100% Insulin Water	75% Insulin water with Watermelon Puree	75% Insulin water with Cucumber Puree	f-value	p-value
Color	6.16	7.98	6.60	11.80	0.0000177
Appearance	6.26	7.74	6.42	8.06	0.0005
Aroma	5.16	7.16	5.92	10.62	0.00004
Flavor	4.32	7.20	5.36	17.96	0.000000105
Taste	4.18	7.20	4.82	20.43	0.0000000147
Overall	5.22	7.46	5.84	20.96	0.00000000978

Table 3 shows the distribution of statistics Analysis of Variance (ANOVA) on level of acceptability according to formulations, insulin water, watermelon-insulin leaves puree and cucumber-insulin leaves puree. There were three groups being compared, namely: 100% insulin water, 75% insulin water with watermelon puree, 75% insulin water with cucumber puree. The null hypothesis, "There is no significant difference in the level of acceptability when grouped according to formulations, insulin water, watermelon-insulin leaves puree and cucumber-insulin leaves puree" is *rejected*. The result shows that there was a *highly significant difference* in level of acceptability when grouped according to different formulations, in over-all acceptability, as well as in each different food attributes.

Table 4: Summary of Average Mean and Standard Deviation of Insulin Leaves as Blended with Selected Cucurbits Fruits Puree by Percentage Formulation

Formulation Percentage	Mean	Standard Deviation	Description
Twenty Five Percent (25%)	7.72	0.84	Like Very Much
Fifty Percent (50%)	7.21	1.10	Like Moderately
Seventy Five Percent (75%)	5.70	1.84	Like Slightly

Table 4 presents the mean and standard deviation with its corresponding description for each formulation percentage of insulin leaves blended with different percentages of selected cucurbits fruits puree, that is, the cucumber and watermelon puree. Among the formulation percentage, the highest acceptability mean is 25% with a mean of *M = 7.72, SD = 0.84*, indicating that the respondents like very much the product, followed by 50% with a mean of *M = 7.21, SD = 1.10* that suggests like moderately, and lastly, 75% with a mean of *M = 5.70, SD = 1.84* that represents a like slightly response. According to the food experts that evaluated the insulin juice, the 25% formulation has the possible highest acceptability as reflected in Table 27, due to its sweetness, aroma and flavor, and its appearance attributed to the watermelon. Based on the study conducted by Mashilo, *et al*., (2022) [16, 24], the sweetness effect of watermelon is coming from the phytohormones and phytochemical compounds that affects the fruit quality in watermelon due to its sugar composition such as sucrose synthase and sucrose phosphate synthase (Yative, *et al*., 2010; Guo *et al*.,2015) [8], amino acids like citrulline (Joshi *et al*., 2019 [10]; Zhong *et al*., 2019) [32], organic acids composition such as malic, quinic, citric, oxalic, and tartaric acids (Liu *et al*., 2012 [14]; Gao *et al*., 2018) [7]. The red color appearance of the watermelon is due to its carotenoid's contents, and lycopene (Tadmor, *et al*., 2005) [32]. Lastly, the aroma and flavor are due to their volatile compounds (Dima, *et al*., 2014 [5]; Fredes *et al*., 2017 [6]; Bianchi *et al*., 2020) [3]. It was also discussed by Ramirez, *et al*., (2020) and Mandha, *et al*., (2021) [22] that flavor is revealed from the sensory evaluation, as a vital fruit quality attribute to the refreshing perception of watermelon which attribute is linked to volatile compounds. The sweetness is also an indicator of glycemic index which is supported by the study of Argiana, *et al*., (2020) [1] and Venditti, *et al*., (2020) [33]. The watermelon puree can be considered as a sweetener for the insulin juice due to its glycemic index of 48% (Sabeetha, *et al*., 2018) [28] which value is considered as low glycemic index food, and therefore, viable for people who have diabetes. However, the evaluators and the food experts from the food industry suggested that for production and testing of the product, it should be the 75% formulation of insulin juice where the ingredient value is 300 mL of insulin water because insulin leaves were the primary raw ingredient of the beverage product. The suggestions from the evaluators were accepted and agreed by the researcher and research adviser.

Summary of findings, conclusion and recommendation

Findings of the Study: The study on the acceptability of insulin (*Chamaecostus cuspidatus*) leaves as blended with selected cucurbits fruits puree yielded the following findings shown and discussed below.

Production of Formulation 1 Insulin Water with Fruit Cucurbits Puree: The ingredients needed for the Formulation 1 of insulin mixed juice varied in three different formulations, namely: (a) 25% insulin mixed juice formulation of 100 grams of insulin water, 280 grams of watermelon puree with 20 grams of cucumber puree; (b) 50% insulin mixed juice formulation of 200 grams of insulin water, 180 grams of watermelon puree with 20 grams of cucumber puree, and (c) 75% insulin mixed juice formulation of 300 grams of insulin water, 80 grams of watermelon puree, and 20 grams of cucumber puree.

Production of Formulation 2 Insulin Water with Fruit Cucurbits Puree. The ingredients for the Formulation 2 of insulin mixed juice varied in six different formulations, namely: (a) 25 % watermelon-insulin leaves puree of 100 grams of insulin water and 300 grams of watermelon puree; (b) 50% watermelon-insulin leaves puree of 200 grams of insulin water and 200 grams of watermelon puree; (c) 75% watermelon-insulin leaves of 300 grams of watermelon and 100 grams of insulin water; (d) 25 % cucumber-insulin leaves puree of 100 grams of insulin water and 300 g cucumber; (e) 50 % cucumber-insulin leaves puree of 200 grams of insulin water and 200 grams of cucumber; and (f) 75 % cucumber-insulin leaves puree of 300 grams of insulin water and 100 grams of cucumber.

Result of the Study

The findings of the study led to the following results.

An interesting finding of this study was the fact that among the different formulations, the highest acceptability came out to be the 75% insulin water formulation, although the level of acceptability varied depending on the type of ingredients added to the formulation. Mixing it with other ingredients also generate variations on the level of acceptability. However, it did not mean that the lesser percentage of insulin water would generate higher acceptability. The study also showed that there was a highly significant difference in level of acceptability when grouped according to different formulations, in the overall acceptability, and in each different fruit attributes.

Conclusions: In the light of the summary of findings and results of the study, the following conclusions are drawn.

Insulin-water as a sole ingredient had low level of acceptability. However, mixing it with other ingredients generated variations in level of acceptability, but it did not mean that a lesser percentage of insulin water generated a higher acceptability. In fact, 75% insulin water formulation gained the highest acceptability. But the level acceptability also varied with the type of added ingredients. This research was very successful in identifying the best type of formulation to be added with insulin water. With this, the use of insulin leaves and insulin water as a beverage could be utilized and maximized for greater health benefits.

Recommendation: Considering the overall results of the study, the following recommendations are presented. The Local Food Producers and Young Entrepreneurs may consider the insulin juice as a good source of livelihood and

could double their marketability since the raw material is locally available, and that it is known to be essential for healthy living. Suggestion for incorporation of the identified best type of formulations into product development should be considered. Furthermore, these formulations, taking into consideration the factors such as taste, aroma, and overall sensory experience to enhance consumer acceptance, should be experimented and refined. The potential for diversifying the product line by introducing variations of the insulin water beverage should be explored based on the identified formulations. This could include different flavors, blends, or supplementary ingredients to cater to diverse consumer preferences. Consumers could enjoy the insulin juice for its health benefits since its had been proven to contain exceptional nutrition combination that is beneficial to the human body. If the insulin water beverage becomes a regular part of the diet, consumers are encouraged to integrate it into a balanced and varied eating plan. This ensures that nutritional needs are met through a diverse range of foods and beverages. If the insulin water beverage is prepared at home, consumers should educate themselves on the proper preparation and storage methods to maintain both acceptability and safety. These include understanding shelf-life considerations and optimal storage conditions. Investors may consider the innovation a potential investment in the future, particularly in the food industry, where the insulin with cucurbits fruits could be developed into fruit juice as a delicious and nutritious fruit drink. Future researchers may find this study useful as references in pursuing further studies of utilizing insulin leaves as raw materials for developing similar juices or drinks.

References

1. Argiana V, Kanellos PT, Eleftheriadou I, Tsitsinakis G, Perrea D, Tentolouris NK. Low-Glycemic-Index/Load Desserts Decrease Glycemic and Insulinemic Response in Patients with Type 2 Diabetes Mellitus. Nutrients,2020:12(7):2153. doi: 10.3390/nu12072153.
2. Bahri S, Zerrouk N, Aussel C, Moinard C, Crenn P, Curis E, *et al*. Citrulline: from metabolism to therapeutic use. Nutr J,2013:12:47. doi: 10.1186/1475-2891-12-47.
3. Bianchi G, Provenzi L, Rizzolo A. Evolution of volatile compounds in 'Cuoredolce®' and 'Rugby' mini-watermelons (Citrullus lanatus) in relation to ripening at harvest. J Sci Food Agric,2020:100:945–952. doi: 10.1002/jsfa.10023.
4. CRC Press. Handbook of Food Science and Technology,2nd ed. ISBN: 978-1-4822-1690-5.
5. Dima G, Tripodi G, Condurso C, Verzera A. Volatile constituents of mini-watermelon fruits. Essent Oil Res,2014:26:323–327. doi: 10.1080/10412905.2014.933449.
6. Fredes A, Roselló S, Beltrán J, Cebolla-Cornejo J, Pérez-de-Castro A, Gisbert C. Fruit quality assessment of watermelons grafted onto citron melon rootstock. J Sci Food Agric,2017:97:1646–1655. doi: 10.1002/jsfa.7915.
7. Gao L, Zhao S, Lu X, He N, Liu W. 'SW', a new watermelon cultivar with a sweet and sour flavor. J Am Soc Hortic Sci,2018:53:895–896. doi: 10.21273/hortsci12857-18.
8. Guo S, Sun H, Zhang H, Liu J, Ren Y, Gong G, *et al*. Comparative transcriptome analysis of cultivated and wild watermelon during fruit development. PLoS One,2015:10(7):e0130267. doi: 10.1371/journal.pone.0130267.
9. How To Grow Insulin Plants At Home To Cure Diabetes. Retrieved from https://www.floweraura.com/blog/how-to-grow-insulin-plants-at-home-to-cure-diabetes?fbclid=IwAR29eez_Z9tF8O7LLd6qUtWV0dqkEoClkKfKwYbQGbK48ZAFcp712QpqmpI.
10. Joshi V, Joshi M, Silwal D, Noonan K, Rodriguez S, Penalos A. Systematised biosynthesis and catabolism regulate citrulline accumulation in watermelon. Phytochemistry,2019:162:129–140. doi: 10.1016/j.phytochem.2019.03.003.
11. Journal of Plant Foods for Human Nutrition. Diabetes: Eating Cucumber Regularly May Help Reduce Blood Sugar Levels. Retrieved from https://www.ndtv.com/food/diabetes-eating-cucumber-regularly-may-help-reduce-blood-sugar-levels-1884961.
12. Kang B, Zhao W, Hou Y, Tian P. Expression of carotenogenic genes during development and ripening of watermelon fruit. Sci Hortic,2010:124:368–375. doi: 10.1016/j.scienta.2010.01.027.
13. Lawless HT, Heymann H. Sensory Evaluation of Foods: Principles and Practices,2nd ed. ISBN: 978-1-4822-1690-5.
14. Liu C, Zhang H, Dai Z, Liu Y, Deng X, Chen F, *et al*. Volatile chemical and carotenoid profile in watermelon with different flesh colors. Food Sci Biotechnol,2012:21:531–541. doi: 10.1007/s10068-012-0068-3.
15. Lopez – Vito TJ. A shelf life guide to the foods in your fridge. Retrieved from https://www.canstarblue.com.au/appliances/shelf-life-guide-foods-fridge/.
16. Mashilo J, Shimelis H, Ngwepe RM, Thungo Z. Genetic Analysis of Fruit Quality Traits in Sweet Watermelon (Citrullus lanatus var. lanatus): A Review. Front Plant Sci,2022:13:834696. doi: 10.3389/fpls.2022.834696.
17. Meilgaard M, *et al*. Sensory Evaluation Techniques. 5th ed. ISBN: 978-1-4822-1690-5.
18. Mihafu FD, Issa JY, Kamiyango MW. Implication of Sensory Evaluation and Quality Assessment in Food Product Development: A Review. Curr Res Nutr Food Sci,2020:8(3). doi: 10.12944/CRNFSJ.8.3.03. Retrieved from https://www.foodandnutritionjournal.org/volume8number3/implication-of-sensory-evaluation-and-quality-assessment-in-food-product-development-a-review/.
19. Milczarek RR, Olsen CW, Sedej I. Quality of Watermelon Juice Concentrated by Forward Osmosis and Conventional Processes,2020. doi: 10.3390/foods9121777.
20. Perkins-Veazie P, Collins JK, Davis AR, Roberts W. Carotenoid content of 50 watermelon cultivars. J Agric Food Chem,2006:54(7):2593-7. doi: 10.1021/jf052066p.
21. Handbook of Food Science and Technology. In: Sharif MK, Butt MS, Sharif HR, Nasir M, editors. Sensory Evaluation and Consumer Acceptability. Retrieved from

https://www.researchgate.net/publication/320466080_Sensory_Evaluation_and_Consumer_Acceptability.
22. Mandha J, Shumoy H, Devaere J, Schouteten JJ, Gellynck X, de Winne A, *et al*. Effect of lactic acid fermentation of watermelon juice on its sensory acceptability and volatile compounds. Food Chem,2021:358:129809. doi: 10.1016/j.foodchem.2021.129809.
23. Marengo K, Frothingham S. Is Cucumber Good for Diabetes? Retrieved from https://www.healthline.com/health/is-cucumber-good-for-diabetes.
24. Mashilo J, Shimelis H, Ngwepe RM, Thungo Z. Genetic Analysis of Fruit Quality Traits in Sweet Watermelon (Citrullus lanatus var. lanatus): A Review. Front Plant Sci,2022:13:834696. doi: 10.3389/fpls.2022.834696.
25. Sharif MK, Butt MS, Sharif HR, Nasir M. Sensory Evaluation and Consumer Acceptability. In: Handbook of Food Science and Technology,2017. Pages 362-386. Retrieved from https://www.researchgate.net/publication/320466080_Sensory_Evaluation_and_Consumer_Acceptability.
26. Phelamei S. Type 2 diabetes: Drink cucumber detox water to reduce blood sugar and manage symptoms. [Internet],2019 [cited 2024 Mar 11]. Available from: https://www.timesnownews.com/health/article/cucumber-water-benefits-type-2-diabetes-this-refreshing-summer-detox-drink-can-help-lower-blood-sugar-levels/390866
27. Ramirez JL, Du X, Wallace RW. Investigating sensory properties of seven watermelon varieties and factors impacting refreshing perception using quantitative descriptive analysis. Food Res Int,2020:138:109681. doi: 10.1016/j.foodres.2020.109681
28. Sabeetha S, Barakatun Nisak MY, Amin I. Glycemic index of selected watermelon (Citrullus lanatus). Int Food Res J,2018:25(6): (41). Available from: http://www.ifrj.upm.edu.my/25%20(06)%202018/(41).pdf
29. Shetty AJ, Parampalli SM, Bhandarkar R, Kotian S. Effect Of The Insulin Plant (Costus Igneus) Leaves On Blood Glucose Levels In Diabetic Patients: A Cross Sectional Study. J Clin Diagnostic Res,2010:4(3):2617–2621. Available from: https://www.jcdr.net/article_fulltext.asp?id=766
30. Shetty AJ, Choudhury D, *et al*. Effect of the insulin plant (Costus igneus) leaves on dexamethasone-induced hyperglycemia. Int J Ayurveda Res,2010:1(2):100–102. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2924971/
31. Sogi D, *et al*. Effect of Particle Size, Temperature, and Total Soluble Solids on the Rheological Properties of Watermelon Juice: A Response Surface Approach. Int J Food Prop,2010:13(6):1207–1215. doi: 10.1080/10942910903013373
32. Tadmor Y, King S, Levi A, Davis A, Meir A, Wasserman B, *et al*. Comparative fruit colouration in watermelon and tomato. Food Res Int,2005:38:837–841. doi: 10.1016/j.foodres.2004.07.011
33. Venditti C, Musa-Veloso K, Lee HY, Poon T, Mak A, Darch M, Juana J, Fronda D, Noori D, Pateman E, Jack M. Determinants of Sweetness Preference: A Scoping Review of Human Studies. Nutrients,2020:12(3):718. doi: 10.3390/nu12030718
34. Yativ M, Harary I, Wolf S. Sucrose accumulation in watermelon fruits: genetic variation and biochemical analysis. J Plant Physiol,2010:167:589–596. doi: 10.1016/j.jplph.2009.11.009
35. Zhong Y, Shi J, Zheng Z, Nawaz MA, Chen C, Cheng F, *et al*. NMR-based fruit metabonomic analysis of watermelon grafted onto different rootstocks under two potassium levels. Sci Hortic,2019:258:108793. doi: 10.1016/j.scienta.2019.108793