Original Research Article

**Sensory Evaluation of Value Added Products of Cashew (*Anacardium occidentale* L.) apple**

.

**ABSTRACT**

|  |
| --- |
| **Aims:** The cashew apple is the fleshy part of the cashew fruit that is attached to the cashew nut. It is considered as a nutritional powerhouse but is often discarded during the processing of nut. Cashew, *Anacardium occidentale* L., belongs to the *Anacardiaceae* family. It is an evergreen tree native from northeast region of Brazil that expanded spontaneously in South American countries. This study aims at the sensory analysis of the value added product made by incorporating the extract of the cashew apple, since cashew apples are left unused, discarded as waste or feed animals. Sensory attributes such as appearance, texture, taste, aroma and overall acceptability of total 6 value added samples were performed by total number of 25 semi trained panel members.  **Methodology:** The proposed study was conducted in the Department of Food Science and Nutrition at the College of Community Science, Tura, West Garo Hills district, Meghalaya. This study is a descriptive experimental design. 9 point hedonic rating scalewas used to check the acceptability of the products. Descriptive statistics and kruskal-wallis test were used to analyze the data  **Results:** There is a significant (*P*=0.05) difference in the samples in their appearance, texture, aroma and taste. The significant difference of the sensory attributes shows that there is a difference in their scores. Homogenity of the samples subset 1 and subset 2 in cashew apple cake and cashew apple cookie has no influence on each other. However, each subset samples are important to one another.  **Conclusion:** Sensory evaluation indicates that 10% of cashew apple powder added to the cookie was the most acceptable product where in cakes 15% of addition dehydrated cashew apple powder shows the dominant result of acceptance comparing to the other samples. According to the experiment, it has been found out that the formulation of addition of cashew apple powder enhance acceptability product. |

*Keywords: Cashew apple, value addition, acceptability, sensory evaluation, mean scores, kruskal-wallis test*

**1. INTRODUCTION**

Cashew, *Anacardium occidentale* L., belongs to the *Anacardiaceae* family. Cashew apples are elongated, round and pear-shaped fibrous fruit. The fully matured fruits are soft, full of moisture and turns into red or yellow fruit when they are ripe. It is a non-climacteric fruit that can be consumed raw as well as processed goods due to its fleshy pulp, and high sugar content [1]. It has a unique flavor and odor. The tannin present in cashew apple gives unpleasant and astringency in taste that limits the proper utilization of fruit in value addition[2]. The first nation to engage in the global cashew trade was India. Approximately 1.14 million tones of cashew were processed nationwide in 3650 cashew processing mills. Significant rise of mills from 170 in 1959 have grown to 3500 cashew processing mills in 2008 [3]. Under Meghalaya, the major cultivation of cashew trees is grown mostly in the district of West Garo Hills and South Garo Hills. Meghalaya registered 8.580 hectares of cashew crop land during the 2017-2018 fiscal year with a total production of 6.120 MT and 686 kg/ha of average productivity [4].Despite being one of the regions for the cultivation of varieties of cashews in West Garo Hills district, lack of proper training, knowledge and skills results in the wastage of the pseudo fruit.

Cashew apple leaves, stems and bark extracts have been long used alleviate colonic discomfort, diarrhea and dysentery. According to the reports it contains analgesic nature, antibacterial, anti-diabetic and anti inflammatory properties [5].The cashew apples are underutilized despite of high nutrient content and therapeutic properties. The assessment of evaluation of anti-inflammatory, antinociceptive and antioxidant activity in mouse models shows the doses of 25mg/kg of anacardic acid that proves to decreases edema and prevents relocation of leukocytes and neutrophils to intraperitoneal cavity. The results signifies in reducing licking, abdominal writhing and latency to thermal stimulation, proclaiming the actions of anacardic acid encouraging to be used in pharmaceutical field [6].

Food product development requires a measure whether certain product formulation is accepted by the consumer. Nine points hedonic is a part of rating scales developed for measuring degree of product in terms of like or dislike in sensory evaluation. It helps to understand and to control the important factor of consumer acceptance of the product [7].

The potential of cashew apple fiber in enriching wheat flour for the production of acceptable cake was attempted. Wheat and cashew apple fiber composite flours were produced by substituting wheat flour with 5-30% cashew apple fiber while 100% wheat flour was used as control. Sensory acceptability of the cakes produced were examined and it was found out that cakes produced from wheat flour substituted with 5-10% cashew apple fiber compared favorably with flour cake [8]. Enrichment of cereal extrudates was done by supplementing rice flour with cashew apple pomance powder (CAPP) at the rate of 0-25 percent and it was found to improve their biological properties. Sensory scoring using mime-point hedonic scale indicated that CAPP can be incorporated in the range of 5-15 percent for the snack purpose [9].

In organoleptic sensory analysis, the hedonic test determines the extent of the quality difference between a number of comparable products by providing an evaluation of specific product attributes to ascertain the degree of popularity of the product. Sensory techniques are mainly used in quality control, product development and research. It indicates the acceptance of the product and adds to the value to the assessment of the quality [10]. Therefore, the major objective of the study was to develop value added products from cashew apple powder and to assess overall acceptability, from the cashew apple found in Meghalaya.

**2. material and methods**

The proposed study was conducted in the Department of Food Science and Nutrition at the College of Community Science, Tura, West Garo Hills district, Meghalaya. The development of the products was done in Food Science and Nutrition laboratory and Food Analysis Lab was used for the biochemical analysis. For the development of the value added product, the process of dehydration of the cashew apple powder were performed to get the most suitable powder. Three different methods of dehydration process were standardized to convert cashew apple pulp to powder form for product development. The products such as cashew apple cake and cashew apple cookie were developed from cashew apple powder. Cashew apple cake and cookie were formulated, one control of each product and replication of three each which was made with incorporation of cashew apple powder. After undergoing the different methods of dehydration process, the cashew apple powder was incorporated in percentage of 5, 10 and 15 for the replications.

**2.1 Procurement of Ingredients**

The fresh cashew (*Anacardium Occidentale* L.) apples used for this research study were collected from Wakagre, Garobadha and Darengre, under the West Garo Hills district of Meghalaya state. The other ingredients which are used along with the cashew apples were being procured from the local market of Tura under the same district of Meghalaya state.

**2.2 Sample Preparation of the cashew apple powder**

In order to make the cashew apple powder, three different methods of dehydration process were used. Sorting and cleaning were done in all the three methods in the same way but the pretreatment process acquiring the powder form differs in its own way.

**Method I:** In this method of dehydration process, the cashew apples are sorted, washed with clean water. 1kg of cashew apple was soaked in 2 to 10 percent of salt solution for 5 days. On the sixth day it was washed and sliced. The apples are blanched for 30 minutes, then the excess water is removed and it is solar dried for 6 hours each day for a week. After solar dehydration it was powdered and sieved and stored for product development.

**Method II:** The cashew apples are washed and sorted out for the pretreatment for 3 days in 5 percent salt solution. Then they are further treated in KMS for 2days more. After two days, they are washed and sliced and are blanched for 20 minutes and solar dry for 3days. Further, it has been dried in convection oven for 8 hours at 150°C. The dried slices are then made into powder in blender and are sieved.

**Method III:** 1kg of fresh cashew apple is washed, soaked in 2 percent salt solution for 10 minutes. The process involves rinsing, surface dry and slicing of the apples. Then the samples are pressure cooked and sulphuring was done. Blending of cashew apples and straining of juice were done before solar drying for 3days. Once dried it was powdered and sieved.

Among all above methods powder prepared by adopting method 1 was taken for product formulation since the color and flavor was more acceptable and no chemical treatment was given.

**2.3 Formulation of value added product**

This study was designed to assess the consumer acceptability of cashew apple powder in different products. The product which is prepared without the involvement of cashew apple powder is known as control. The replications were being made into three different percentage of incorporation of cashew apple powder.

The flow chart of standardization of cashew apple cake is presented in fig 1 and table 1 draw the variety of percentage of incorporation of cashew apple in powder form at 5, 10 and 15 percent marking up to the total of 3 formulated aliquots.

Preheat the oven for 10 minutes at 180°C

Beat sugar and butter together till it is soft and fluffy

Beat the egg till it form foam and mix the mixture of butter and sugar with egg foam

Add the vanilla essence to the mixture

Sieve refined wheat flour, cashew apple powder and baking powder and mix all the ingredients together

Bake the cake batter in the preheated oven at 180°C

**Fig 1. Formulation of cashew apple cake.**

**Table 1: Ingredients used for the formulation of cake with different proportion**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Ingredients (g)** | **Control** | **5%powder** | **10%powder** | **15%powder** |
| Refine wheat flour  Cashew apple powder  Sugar | 100  -  50 | 95  5  50 | 90  10  50 | 85  15  50 |
| Egg  Baking powder | 3no.s  2.5 | 3no.s  2.5 | 3no.s  2.5 | 3no.s  2.5 |
| Vanilla essence | 2drops | 2drops | 2drops | 2drops |
| Butter | 100 | 100 | 100 | 100 |

The fig 2., depicts the procedure that involved in the formulation of cashew apple cookie for the developed product and table 2 draw the different segment of incorporation of cashew apple in powder form at 5, 10 and 15 percent for the total 3 developed cookies.

Sieve the flour and cashew apple powder, and leave aside

Mix the sugar and butter until fluffiness

Mixture of sugar and butter is mixed with flour and milk powder.

Knead the dough till it hold together

Keep the dough inside the refrigerator for 15 minutes

Roll out the dough and cut into shapes

Bake the cookie for 30 minutes at 150°C

**Fig. 2. Formuation of cashew apple cookie.**

**Table 2: Ingredients used for the formulation of cookie with different proportion**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Ingredients (g)** | **Control** | **5%powder** | **10%powder** | **15%powder** |
| Refine wheat flour  Cashew apple powder  Milk powder  Sugar | 100  -  5  50 | 95  5  5  50 | 90  10  5  50 | 85  15  5  50 |
| Butter | 80 | 80 | 80 | 80 |

**2.4 Sensory Analysis**

The value added product such as cashew apple cookie and cashew apple cake were evaluated to determine the consumer acceptance of the samples. The incorporation of cashew apple powder was taken by considering several trials done to achieve desirable product. The cashew apple powder was incorporated in cakes and cookies at 5g, 10g and 15g. The samples were being assessed by twenty-five numbers of semi-trained panel members from Food Science and Nutrition Department, Community Science College, Tura. The panel members carried out the five major sensory attributes such as appearance, texture, taste, aroma and overall acceptability. Each sample was coded randomly. A nine-hedonic rating test was used to measure the acceptability of the product on a scale that consist of nine points ranging from nine that denotes like extremely and one referring to dislike extremely.

**2.5 Statistical Analysis**

The summarization of the sensory analysis data were analyzed by using Microsoft Office Excel 2007. The comparison of the data of the samples were depicted by Kruskal-Wallis test. The statistical significance is p<0.05 level.

**3. results and discussion**

**3.1 Sensory Evaluation**

The organoleptic characteristics of the cashew fruit products were evaluated using hedonic rating scale of nine where the mean score is treated as the acceptability of the products. The presentation of the mean score for the acceptability of products are given in the table 3, 4 and 7.

**Sensory evaluation of the cashew apple powder**: In table 3, the sensory scores of the cashew apple powder is depicted. For the formulation of value added products, three different of processing of dehydration were used. An alternative way to increase the shelf life of fruits is dehydration where the fruit is dried and made into powder to improve storage life that leads to value addition of product. The standardization of the methods used for processing of powder to be incorporated in value added products is being selected by sensory mean scores given in table 3. Pre-treatments and drying conditions influence changes in the sensory attributes of the sample. According to table 3, appearance wise method III has the lowest approval rating by the panel members. Method II is satisfactory as compared to method III. Among the different methods of treatment, method I was the most acceptable processing of powder based on the sensory evaluation given in table 3.

**Sensory evaluation of the cashew apple cake:** Sensory characteristics of formulated products are important quality attributes to be considered. The mean scores of sensory attributes of cashew apple cake are summarized in table 4. The table 4 clearly shows that 15g of cashew apple incorporated in the cake is the most acceptable product. It shows that it is highly palatable according to the sensory evaluation where control product is the least palatable according to the overall acceptability. Appearance wise 10 per cent of cashew apple powder is the least acceptable where as aroma wise both the control and 5g cashew apple powder are at the least according to the semi –trained panel members.

**Sensory evaluation of the cashew apple cooki**e: Sensory scores of cashew apple incorporated cookie are depicted in table 7. Mean scores of the samples revealed that 10g of cashew apple powder added reducing the content of refined wheat flour to 90g show the most acceptances in appearance, texture, taste, aroma and overall acceptability of the product. The least acceptance of the product in table 7 points at 5g of the cashew apple powder addition in aroma, where as 15g of cashew apple cookie shows the least acceptability as overall and in appearance in cookie due to its dark brown color appearance.

**Table 3. Sensory Evaluation of Cashew apple powder (n=25)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Appearance** | **Texture** | **Taste** | **Aroma** | **Overall Acceptability** |
| Method I  Method II  Method III | 8.6±0.34  8.3±0.66  8±0.32 | 8.8±0.35  8.2±0.33  7.7±0.3 | 7.9±0.31  7.6±0.3  7.3±0.29 | 9±0.36  8.4±0.33  8.2±0.33 | 8.6±0.7  8±0.32  8±0.32 |
|  |  |  |  |  |  |

**Table 4. Sensory Evaluation of Cashew apple cake (n=25)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Appearance** | **Texture** | **Taste** | **Aroma** | **Overall Acceptability** |
| Control  5g cashew apple powder  10g cashew apple powder  15g cashew apple powder | 8.2±0.33  8±0.32  7.9±0.3  8.4±0.33 | 8±0.33  8±0.12  8.1±0.32  8.6±0.34 | 8.4±0.33  8.2±0.33  8.2±0.33  8.6±0.34 | 7.9±0.29  7.9±0.32  8.2±0.32  8.6±0.35 | 8±0.32  8.1±0.32  8.3±0.34  8.6±0.34 |

**Table 5. KW Significance Test for cashew apple cake**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Median Ranks** | **KW Statistics** | **Significance** |
| Control  5g cashew apple powder  10g cashew apple powder  15g cashew apple powder | 8  8.2  8  8.5 | 66.534 | ˂0.05 |

**Table 6. Homogenity Test for cashew apple cake**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Subset** | |  | |  | |
| **Sample** |  | | **1** | | **2** | |
|  | | 5%  10%  Control  15% | | 216.936a  220.300ab  225.488abc | | 339.276d | |

**Table 7. Sensory Evaluation of Cashew apple cookie (n=25)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Appearance** | **Texture** | **Taste** | **Aroma** | **Overall Acceptability** |
| Control  5g cashew apple powder  10g cashew apple powder  15g cashew apple powder | 8±0.32  8±0.32  8.5±0.31  7.5±0.3 | 8.2±0.33  8.1±0.32  8.6±0.34  8.6±0.32 | 8±0.32  8.1±0.32  8.9±0.36  8.1±0.32 | 8.1±0.32  7.9±0.29  8.6±0.34  8.1±0.32 | 8±0.33  7.7±0.32  8.8±0.35  7.5±0.3 |

**Table 8. KW Significance Test for cashew apple cookie**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Median Ranks** | **KW Statistics** | **Significance** |
| Control  5% cashew apple powder  10% cashew apple powder  15% cashew apple powder | 8  8  8.8  8 | 138.268 | ˂0.05 |

**Table 9. Homogenity Test for cashew apple cookie**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Subset** | |  | |  | |
| **Sample** |  | | **1** | | **2** | |
|  | | 15%  5%  Control  10% | | 195.408a  213.184ba  216.100abc | | 377.308d | |

**3.2 Statistical Analysis**

The data analysis for the formulated cashew apple samples is given table 5, 6, 8 and 9. Table 5 and 8 represents the statistical analysis of the data from the formulate cashew apple cake and cookie acquired by using kruskal-wallis test respectively. Table 5 and 8 shows the significant (*P*=.05) difference in terms of appearance, color, texture and aroma. The significant difference of the sensory attributes shows that there is a difference in their scores. As shown in table 5, 10g addition of cashew apple powder to cake has the highest median rank among the samples. Similarly in table 8 given for the cashew apple cookie, 10g addition of cashew apple powder cookie has the highest median rank. The study carried out between two samples, sample (A) a fruit jam as control and sample B that is cashew apple jam. The sensory scores revealed that the analysis ranges from 7.20-8.60 using a 9-point hedonic rating score card. The significant difference (p<0.05) is observed which indicates the sample was highly acceptable by the consumers [11]. The bread was prepared from refined wheat flour and cashew apple powder composite as A(95:05%), B(90:10%) and C (85:15%). The mean score of the overall acceptability of the bread prepared by osmo dried cashew apple powder blends were significantly affected by overall acceptability at p<0.05. The bread type B (90:10%) wheat flour and cashew apple powder showed significantly higher (8.52) for overall acceptability followed by type A(95:05%) that scored 7.68 in rating scale [12]. Similarly, in other report it revealed that the substitution (10-30%) of cashew apple fiber in wheat flour significantly (p<0.05) affected the overall acceptability of the product. Cashew apple powder substitution of 30% in wheat flour is highly acceptable for cake production enhancing the nutritional property of the product. However, 5 and 10% cashew apple fiber substituted wheat cakes were comparable with the control, i.e.100% wheat cake [13].

Samples denoted by one or more alphabetical letters are used to identify the product according to the number of samples. In every subset, all of the samples in that subset share a single alphabet signifying the resemblance to one another. As shown in table 6, the subset 1 (5g, 10g and control) and subset 2 (15g) had no bearing on one another when evaluating the homogeneity of the samples which shows that 15g of cashew apple powder incorporation is the most acceptable product comparing to 5g and 10g of substitution of cashew apple powder. However, each subset samples are important to one another. Also in table 9, when assessing the homogeneity of the samples subset 1 (control, 5g and 15g) and subset 2 (10g) has no influence on each other. According to the tests, out of all the samples prepared 10g of substitution of the cashew apple powder is the most acceptable product.

**4. Conclusion**

Sensory qualities were used to evaluate the formulated products of cashew apple powder samples. The result indicates that cashew apple cake with 15g of cashew apple powder incorporation and 10g of cashew apple cookie is the most desirable product. Among the cake, control was the least acceptable product compared to control, 5g and 10g cashew apple powder incorporation. However, 5g cashew apple cookie shows comparatively good acceptance compared to other two samples and in the variety of cookie sample control, 5g and 15g are least desired. The significant (*P*=.05) difference in terms of appearance, color, texture and aroma. The significant difference of the sensory attributes shows that there is a difference in their scores. According to the experiment, it has been found out that the formulation of addition of cashew apple powder enhance the taste and quality of the products.

In general, cashew apples are not a popular fruit in Meghalaya. In cashew growing tracts, cashew apple processing can be profitable business where women self help group can successfully take up the enterprise and support the cause of women’s empowerment specially in a matrilineal society. Cashew apple is a high dense nutrient fruit. To make use of this nutrient-dense fruit, efforts should be made to analyzed the biochemical makeup, formulate and market food products that have high nutritional value. There are windows of opportunity to improve the public acceptability, consumption and to produce variety of products.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**References**

1. Aluko A, Makule E and Kassim N. (2023). Current Research in Nutrition and Food Science www.foodandnutritionjournal.org Underutilized Cashew Apple Fruit: Its Utility and Development as a Source of Nutrients and Value Added Products in Tanzania. Current Research in Nutrition and Food Science., **11**(1):719-734.
2. Bulugahapitiya VP and Samarasekra HKS. (2020). Preparation and quality evaluation of Ready-To-Serve beverage from cashew apple. International Journal of Minor Fruits, Medicinal and Aromatic Plants.,**6** (2) : 102-109.
3. Walavalkar SG. (2022).The study of the cashew industry in India. International Research Journal of Modernization in Engineering Technology and Science., **4**(05):1020-1025.
4. Sangma ASR, Choudhury A, Rani PMN, Singh R and Sethi B. (2020). Value addition of cashew nut in Meghalaya: a case study of B.R. industries. Indian Journal of Hill Farming., **33** (2):294-298.
5. Kunjumon D and Shenoy MA. (2022). Anacardium occidentale (Linn): A Brief Review. Int. J. Pharm. Sci. Rev. Res., **75**(1):6-9.
6. Da Silva J, De Brito, ES and Ferreira SRS. (2023). Biorefinery of cashew by-products: Recovery of value-added compounds. Food and Bioprocess Technology, **16**(5), 944-960.
7. Sirangelo TM. (2019). Sensory descriptive evaluation of Food Products: A review. Journal of Food Science and Nutrition Research, 2(4):345-363. DOI: 10.26502/jfsnr.2642-11000034.
8. Adegunwa MO, Kayode BI, Kayode R. M. O, Akeem SA, Adebowale AA and Bakare HA. (2020). Characterization of wheat flour enriched with cashew apple (Anacardium occidentale L.) fiber for cake production. Journal of Food Measurement and Characterization.,**14**:1998-2009.
9. Preethi P, Mangalassery S, Shradha, K, Pandiselvam R, Manikantan MR, Reddy SVR et al. (2021). Cashew apple pomance powder enriched the proximate, mineral, functional and structural properties of cereal based extrudates. LWT-Food Science and Technology., **139**:110536.
10. Sirajuddin S, Masni M and Salam A. (2021).The Level of Preference of Instant Rice Bran Milk Products Innovation with Various Flavor Variants as Functional Food. Maced J Med Sci., **9**(A):567-571.
11. Kolo SI, Snehu AA, Jubril B, Maude MM, Abdulkadir F and Saidu B. et al. (2023). Production and evaluation of the nutritional properties of cashew apple jam for consumer acceptance. Lapai Journal of Applied and Natural Sciences.,**7**(1): 70-73 .
12. Salve VA, Swami SB, Khandetod YP and Shahare YU. (2024).Evaluation of bread supplemented with osmo dried cashew apple powder. J. Agric. Res. Technol., 49 (3) : 451-456.
13. Adegunwa MO, Kayode BI, Kayode RMO, Akeem SA, Adebowale AA and Bakare HA. (2020). Characterization of wheat f lour enriched with cashew apple (Anacardium Occidentale L.) fiber for cake production. Journal of Food Measurement and Characterization., **14**(4):1998–2009.