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Analysis of Sensory Acceptability of Moringa Leaf Powder, Oleifera Leaf Powder and Baobab Pulp Powder (Adansonia Digitata) Pulp Powder

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Short Report

Keywords: Sensory, Acceptability, Moringa Leaf Powder, Oleifera Leaf Powder and Baobab Pulp Powder (Adansonia Digitata) Pulp Powder

Posted Date: November 6th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11637256/v1

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Additional Declarations: No competing interests reported.

Abstract

Moringa leaf powder and Baobab pulp powder are two important and nutritious crops in the human diet. To reduce perishability in these crops and add value, there is the need to process into powder and prepare a product formulation. The overarching objective of this study was to undertake a sensory analysis of baobab pulp powder with moringa leaf powder leaf powder. The discovery was laid in a completely randomized design method (CRD) with five treatments formulations with three replication each. The treatments were BPP100%+MLP0%,BPP75%+MLP25%,BPP50%+MLP50%BPP25%+MLP75%,BPP0%+MLP100%. The research outcome reveals that majority of the panelist extremely liked MLP100% at deep green as well as BPP100% at cream color. Also, the research demonstrates that majority of the panelist extremely liked MLP100% for smooth texture. Further, majority of the panelist extremely liked MLP100% for herbal and hints of green aroma whiles BPP100% was ranked extremely liked for its taste. Again, most of the higher percentage of the baobab pulp powder in the formulation resulted in most of the panelist selecting extremely liked and the higher Moringa leaf powder-based formulation resulted extremely liked. The practical implications of the study are finally outlined.

Introduction

Moringa leaf powder oleifera originally from the Indian subcontinent is a fast-growing deciduous plant that has establish rooted itself across the Africa tropic, for over thousands of years it has earned a slid trust, valued place in traditional local therapeutic and medicinal use (Ijarotimi et al., 2013). Today's laboratory analyses back that up, showing that dried moringa leaf powder leaves packed roughly 19 -30 percent of high-quality plant-based protein, a full lineup of essential and useful amino acid, and abundant beta carotene, calcium, potassium, and iron. In addition, its loaded with beneficial plant compounds like quercetin, kaempferol, and chlorogenic proton donors (Leone et al., 2015; Sik et al., 2021). Once the leaves of moringa leaf powder oleifera are shade-dried and ground into powder, they can be easily stirred and incorporated into everyday foods like soups, porridge ,beverages and baked goods without altering how people traditionally cook and eat it (Islam et al., 2021).

There is also the Adansonia digitata, the iconic baobab pulp powder tree that is spread across the African savannah .its fruit yields and produce a pulp powder with an impressive nutritional punch, boasting six to ten times more vitamin C than any citric fruit.it is also loaded and packed a heavy dose of soluble and insoluble fibre ,powerful antioxidants polyphenols, and essential minerals like calcium, magnesium, and potassium (Dossa et al., 2023). With moringa leaf powder oleifera s naturally sharp tart flavor, thanks to the high mix of citric ,malic, and tartaric aids of baobab pulp powder pulp turns out to be a great culinary partner. Recent works note that it can function as an organic masking agent, aiding to lower and tone down the grassy bitterness of moringa leaf powder leaf powder when blended together (Affonfere, 2022; Boateng et al., 2022).

The scientific logic behind mixing these two powerful powders together is hard to beat. While moringa leaf powder brings the protein ,fat that dissolve vitamins (A,E and K) , And non-heme iron that baobab pulp powder misses, baobab pulp powder steps in with a heavy dose of vitamin C. in nutritional science, that vitamin C is a game- changer because it helps the body actually absorb moringa leaf powders iron (Affonfere, 2022). The food-based fortification offers incredible promise for talking and addressing the widespread issues of iron deficiency anemia among women and children both here in Ghana and across the broader west African region Furthermore, Kornienko et al. (2025) have established that what makes these ingredients especially practical for low-resources settings is how well they hold up. They boast the longevity easy to store and ship and pack in a heavy concentration of health- boasting compounds all on their own without synthetic preservatives needed.

These bring in the issue of sensory acceptability. Sensory evaluation concerning perceptual assessment has shifted immensely in recent years. There has been tremendous change in the role of sensory evaluation over the years. In partnership with research and development as well as marketing departments it helps in the formulation of profitable strategy. In the early stages of product development, sensory testing can help to pinpoint the imperative sensory characteristics driving acceptability. It can be useful to ascertain target consumers, product competitors and assess the new ideas. Now a days, chemical and physical properties of the product driving sensory attributes are ascertained by combining data obtained from sensory and instrumental testing. Sensory evaluation can determine the impact of scaling up pilot samples to large-scale manufacture. Sensory evaluation gives assurances that inferior products are not released in the market. In most of the cases, sensory evaluation is used to estimate shelf life of the food products as sensory characteristics of the product depreciate ahead of microbial quality. Customer evaluation is extensively employed in the investigation arena. It explores new technologies for product development and understanding the consumer behavior. Proceeding from this backdrop, this study will seek to undertake a sensory analysis of Moringa Leaf Powder, Oleifera Leaf Powder and Baobab Pulp Powder (Adansonia Digitata) Pulp Powder.

Literature Review

Sensory Evaluation and Consumer Acceptability

The acceptability of a food in sensory terms is influenced by the intrinsic properties it possesses, that is, the appearance, aroma, flavor, texture, aftertaste, and auditory attributes of the food. The interaction between these variables is also an important consideration, and the manifestation of sensory attributes can be affected by factors such as temperature, portion size, and so on (Torico et al., 2019).

Appearance

Appearance of a food provides cues regarding its acceptability, e.g., indicating freshness or lack of (the turgid appearance of lettuce, the wrinkled skin of an apple that is past its best, the appearance of green mold on cheese), ripeness (greening in tomatoes), or skill in preparation (e.g., absence of burning,

absence of lumps in mashed potato) (Cashman, 2024). Color affects acceptability, influencing taste thresholds, taste perception, expected food pleasantness, and acceptability. For example, certain colors are associated with particular flavors so that a yellow sweet may taste 'sour' as it is associated with lemons, and foods that are intensely colored may be perceived as more intense in flavor (Cashman, 2024).

Aroma

Aroma suggests the flavor to be expected when eating foods and thereby influences acceptance (Vazquez et al., 2009). Volatile compounds are generally responsible for aroma and vary from one food to another; for example, brussel sprouts are rich in volatile sulfurous compounds that contribute to their characteristic odor and flavor, thus influencing acceptance among many consumers (Laureati et al., 2006). Aroma is also a good indicator of the freshness of a product; think of yourself sniffing a carton of milk to check the freshness before using it. In this respect, aroma can also be regarded as a 'defense mechanism,' by providing the consumer with information about the safety of a food prior to consumption (Olivares et al., 2010).

Flavour

Flavor is frequently regarded as the most influential attribute for sensory acceptance, and perception of flavor is a complex process involving the sense of smell, taste, and chemesthesis. (Vazquez et al., 2009). A distinction is often made between the terms 'taste' and 'flavor.' The former refers to the four basic tastes, sweet, sour, salty, and bitter (a fifth, umami has also been proposed), and the latter refers to a combination of 'taste' and 'aroma,' with the volatile components of the food mainly contributing to the overall perception. Other sensations such as 'chilli burn,' perceived by the trigeminal nerve, and the 'cooling' sensation of foods such as mints contribute to the overall flavor.

The acceptability of a 'flavor sensation' changes throughout life, and genetic components have been proposed for sensitivity to certain bitter compounds, e.g., phenylthiocarbamide (PTC) and 6-*n*-propylthiouracil (PROP), with consumption of bitter-tasting foods being inversely related to sensitivity. Humans are born with particular taste preferences, indicated by newborns whose facial expressions show a preference for sweet, indifference to salt, and negative reactions to bitter flavors. Evidence suggests that these are innate responses, whilst throughout the development of a child to adulthood, a combination of innate and learned responses determine food acceptability. Aging has a diminishing effect on our taste and aroma thresholds and the ability to differentiate particular flavors, and thus ultimately influences acceptability. Cultural differences in the perception of flavor have also been suggested but have yet to be proved. Flavor perception and release has been the subject of a vast amount of research in the last 10 years and is influenced very much by the food matrix and individual characteristics of the consumer (e.g., rate of saliva production in the mouth). The interaction between flavor and texture is vitally important, with the perception of a flavor changing, depending on the texture of the food. For example, the same amount of cheese flavor on a hard and crunchy corn chip will be released and perceived differently to that on a puffed (extruded) chip (Sharif et al., 2017).

Taste and Flavor Masking

Moringa leaf powder leaf powder MLP is regularly proven as having a grassy and herbal taste that can be polarizing. On the contrary, Baobab pulp powder fruit pulp BFP is engulfed by a sweet, citrussy flavor (Aduna, 2025). Research proves that a combination of BFP into Moringa leaf powder blends enhances palatability by giving natural sourness, which masks the bitterness of Moringa leaf powder (Dossa et al., 2023).

Acceptability Thresholds

Evidence shows that whilst nutritional value improves greatly at higher concentrations, sensory desirability regularly reduces when Moringa leaf powder exceeds 10% of the total blend formulation (Steiner-Asiedu, 2025). However, when blended into drinks with sweeteners like honey and stevia, Moringa leaf powder-Baobab pulp powder formulations have yielded acceptable taste scores of approximately 5.15 on a 7-point hedonic scale, significantly higher than unsweetened formulation (Steiner-Asiedu, 2025).

Color and Appearance

The intense green chlorophyll of Moringa leaf powder significantly changed the appearance of domestic staple foods such as maize, yogi, and pearl millet porridge. Studies prove that consumers generally like lower substitution levels below 10% to maintain a familiar appearance and taste (Longdom, 2025).

Methodology

Research Study Area

All laboratory work towards this study was undertaken at the Department of Horticulture, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana

Study Materials and Their Sources

Fresh baobab pulp powder and fresh moringa leaf powder leaves were obtained from the KNUST Department of Horticulture. It was then dried under controlled heating at 105°C for 3 hours at KNUST Department of Horticulture Laboratory, after which it was ground using a plate miller and sieved to obtain a fine powder. Fresh moringa leaf powder leaves were sorted to remove damaged and diseased ones. It was then washed and drained to remove excess water and dried indoors to prevent loss of nutrients. It was then ground to obtain fine powder.

Weighing scale, miller, disposable spoon, and plate, Ziplock bags, fine-mesh sieve, bowls, masking tape, measuring cups, and spoons. The weighing scale was used to measure the ingredient samples in their

proportions. The fine-mesh sieve was used to sift the flours of the sample ingredients. The wooden spatula was used for stirring the powder during preparation. The oven was used for drying samples at the laboratory. The food miller was used to process the baobab pulp powder pulp into powder.

Experimental Design

A Completely Randomized Design (CRD) was adopted for the experiment, comprising five treatments each replicated three times. Table 3.1 illustrates the treatments used for this study.

Table 1: Formulation Matrix for Product Treatments

Treatment	Baobab pulp powder (BPP)	Moringa leaf powder Leaf Powder (MLP)	Total
TTM 1	100%	00%	100%
TTM2	75%	25%	100%
TTM 3	50%	50%	100%
TTM 4	25%	75%	100%
TTM 5	00%	100%	100%

Data Collection

Sensory Determination

A trained panelist of forty (40) assessors evaluated the sample treatment of baobab pulp powder and moringa leaf powder leaf powder using a questionnaire built on a five-point hedonic scale to assess color, appearance ,taste ,flavor and over all acceptability . the ranges from 1(extremely dislike),2(dislike),3(neutral),4(like),5(extremely like). A 100g of each treatment samples were served on a disposable plate. Panelists record their assessment of taste, color,flavor, appearance, and overall acceptability by marking their observations and ticking their corresponding score for each parameter across all the formulation

Validity and Reliability

Contrary to sensory gadgets, psychological or physiological factors can easily affect human decisions. In order to diminish or eradicate such biasness, Hough (2010) suggests that panelists should pick right protocols and experimental design (Hough 2010). The expectation error was also addressed. In general, it has been argued that the information about the samples to be assessed or objectives of the investigation can influence the decision of the panelists because assessor inclined to find what is desirable. Therefore, during this study, the researcher tried to avoid including such persons in the panel

who are familiar with the product. More so, the study was carried out in a laboratory. Generally, the main advantages of sensory laboratory include easy accessibility, carefully controlled atmosphere, prompt analysis of results and evaluation of relatively large number of samples in a session (Hough, 2010).

Data Analysis

Mineral composition and proximate analysis results from all the treatment were subjected to one way Analysis of variance(ANOVA) so to compare treatments means and standard deviations with statistical significance set at probability less than 0.001. Questionnaire responses were first entered unto Microsoft excel (2022 version) before being transferred into statistical package for social science (SPSS) descriptive analysis for the treatment.

Results and Discussions

Consumer Acceptability

Effects of baobab pulp powder and moringa leaf powder leaf powder on Color

Table 2 shows that based on the shades, majority of the panelists which is 50% extremely like pure moringa leaf powder .

Table 2: Distribution of Sensory Evaluation on Color

Treatment	Extremely Dislike	Dislike	Neutral	Like	Extremely Like	Total
Baobab pulp powder 100:0	2(5%)	0(0%)	7(17.5%)	14(35%)	17(42.5%)	40(100%)
Baobab pulp powder 75% Moringa leaf powder 25%	0(0%)	4(10%)	12(30%)	16(40%)	8(20%)	40(100%)
Equal 50:50	0(0%)	3(7.5%)	12(30%)	20(50%)	5(12.5%)	40(100%)
Moringa leaf powder 75% Baobab pulp powder 25%	0(0%)	8(20%)	11(27.5%)	13(32.5%)	8(20%)	40(100%)
Moringa leaf powder 100%	3(7.5%)	6(15%)	7(17.5%)	4(10%)	20(50%)	40(100%)

Based on the appearance ,most of the panelist prefer 100% baobab pulp powder at 37.5% while 100% moringa leaf powders is extremely dislike by the panelist.

Table 3: Distribution of Sensory Evaluation on Appearance

Treatment	Extremely Dislike	Dislike	Neutral	Like	Extremely Like	Total
Baobab pulp powder 100:0	3(7.5%)	0(0%)	6(15%)	16(40%)	15(37.5%)	40(100%)
Baobab pulp powder 75% Moringa leaf powder 25%	0(0%)	4(10%)	12(30%)	19(47.5%)	5(12.5%)	40(100%)
Equal 50:50	1(2.5%)	4(10%)	16(40%)	14(35%)	5(12.5%)	40(100%)
Moringa leaf powder 75% Baobab pulp powder 25%	2(5%)	8(20%)	8(20%)	16(40%)	6(15%)	40(100%)
Moringa leaf powder 100%	8(20%)	8(20%)	3(7.5%)	12(30%)	9(22.5%)	40(100%)

Figure 4.4.3 illustrate the effect of baobab pulp powder and moringa leaf powder leaf powder on taste. Most of the panelist choose pure baobab pulp powder at 100% as their favorite and sweet taste while 100% pure moringa leaf powder is extremely dislike dues to the bitter taste by the panelist.

Table 3: Distribution of Sensory Evaluation on Taste

Treatment	Extremely Dislike	Dislike	Neutral	Like	Extremely Like	Total
Baobab pulp powder 100:0	0(0%)	4(10%)	10(25%)	12(30%)	14(35%)	40(100%)
Baobab pulp powder 75% Moringa leaf powder 25%	3(7.5%)	1(2.5%)	12(30%)	18(45%)	6(15%)	40(100%)
Equal 50:50	3(7.5%)	5(12.5%)	16(40%)	13(32.5%)	3(7.5%)	40(100%)
Moringa leaf powder 75% Baobab pulp powder twenty-five%	3(7.5%)	15(37.5%)	18(45%)	3(7.5%)	1(2.5%)	40(100%)
Moringa leaf powder 100%	14(35%)	9(22.5%)	14(35%)	2(5%)	1(2.5%)	40(100%)

The aroma of the five treatments were extremely liked by 35% of the panelist choosing T1 while T4 recorded the highly dislike with 10%

Table 4: Distribution of Sensory Evaluation on Flavor

Treatment	Extremely Dislike	Dislike	Neutral	Like	Extremely Like	Total
Baobab pulp powder 100:0	0(0%)	5(12.5%)	11(27.5%)	10(25%)	14(35%)	40(100%)
Baobab pulp powder 75% Moringa leaf powder 25%	3(7.5%)	3(7.5%)	11(27.5%)	19(47.5%)	4(10%)	40(100%)
Equal 50:50	4(10%)	5(12.5%)	16(40%)	11(27.5%)	4(10%)	40(100%)
Moringa leaf powder 75% Baobab pulp powder 25%	2(5%)	15(37.5%)	15(37.5%)	7(17.5%)	1(2.5%)	40(100%)
Moringa leaf powder 100%	17(42.5%)	6(15%)	7(17.5%)	8(20%)	2(5%)	40(100%)

Formulations with the highest overall acceptability was rated at 35% as pure baobab pulp powder while equal value dislike pure moringa leaf powder

Table 5: Distribution of Sensory Evaluation on Acceptability

Treatment	Extremely Dislike	Dislike	Neutral	Like	Extremely Like	Total
Baobab pulp powder 100:0	2(5%)	0(0%)	3(7.5%)	21(52.5%)	14(35%)	40(100%)
Baobab pulp powder 75% Moringa leaf powder 25%	3(7.5%)	1(2.5%)	3(7.5%)	25(62.5%)	8(20%)	40(100%)
Equal 50:50	2(5%)	4(10%)	14(35%)	15(37.5%)	5(12.5%)	40(100%)
Moringa leaf powder 75% Baobab pulp powder 25%	2(5%)	9(22.5%)	15(37.5%)	13(32.5%)	1(2.5%)	40(100%)
Moringa leaf powder 100%	14(35%)	2(5%)	11(27.5%)	19(25%)	3(7.5%)	40(100%)

Table 6: ANOVA on Consumer Acceptability

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Color — Between Groups	7.330	4	1.832	1.646	.164
Color — Within Groups	217.150	195	1.114		
Color — Total	224.480	199			
Appearance — Between Groups	15.900	4	3.975	3.151	.015
Appearance — Within Groups	245.975	195	1.261		
Appearance — Total	261.875	199			
Taste — Between Groups	80.580	4	20.145	20.504	.000
Taste — Within Groups	190.606	194	.983		
Taste — Total	271.186	198			
Flavor — Between Groups	56.520	4	14.130	11.741	.000
Flavor — Within Groups	234.675	195	1.203		
Flavor — Total	291.195	199			
Acceptability — Between Groups	57.034	4	14.258	12.376	.000
Acceptability — Within Groups	223.509	194	1.152		
Acceptability — Total	280.543	198			

Table 7: Means and Tukey Grouping

Treatment	n	Appearance	Grp	Taste	Grp	Flavor	Grp	Acceptability	Grp
T1	40	4.0000	A	3.9000	a	3.8250	a	4.1250	a
T2	40	3.6250	ab	3.6154	a	3.4500	a	3.8718	a
T3	40	3.4500	ab	3.2000	b	3.1500	a	3.4250	b
T4	40	3.4000	ab	2.6000	bc	2.7500	b	3.0500	bc
T5	40	3.1500	B	2.1750	c	2.3000	b	2.6500	c

Means ± SD. Values sharing the same letter within a column are not significantly different (Tukey HSD, α=0.05).

Sensory evaluation is necessary for food acceptance and cherished by consumers. Sensory evaluation is a statistical analysis method derived from human sensory perception that are mostly subjective to individual opinion about food. Sensory evaluation can measure and detect food aroma, color ,taste ,texture surface features (de Albuquerque et al.,2022)

Consumer acceptability

Sensory attributes did not show any significant variation across the groupings, baobab pulp powder achieved the strongest positive reception, with baobab pulp powder leading at 87.6% total acceptance, followed by 82.5% for T2 while moringa leaf powder T5 recorded 35% extremely dislike rating.

Recommendations

1. It is recommended that 100%mlp should be used to improve the nutritional formulations.

2. Further research work should focus on the shelf life and microbial load in various storage devices of the baobab pulp powder and moringa leaf powder leaf powder blend.

3. Research should be conducted on formulation of powder of both baobab pulp powder and moringa leaf powder on different organs such as their flower and seeds.

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Figures

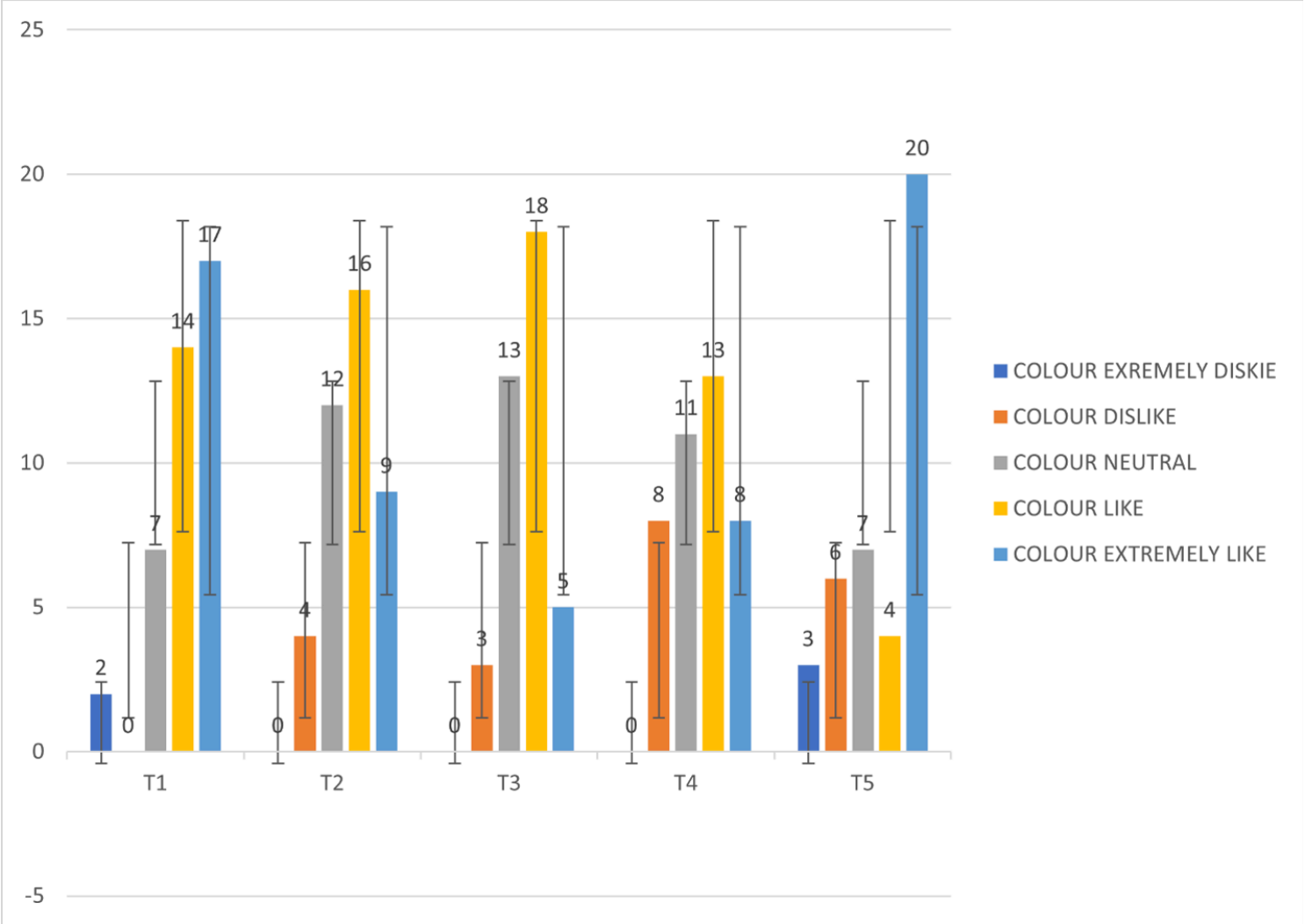


Figure 1

Effect of baobab pulp powder and moringa leaf powder leaf powder on Appearance

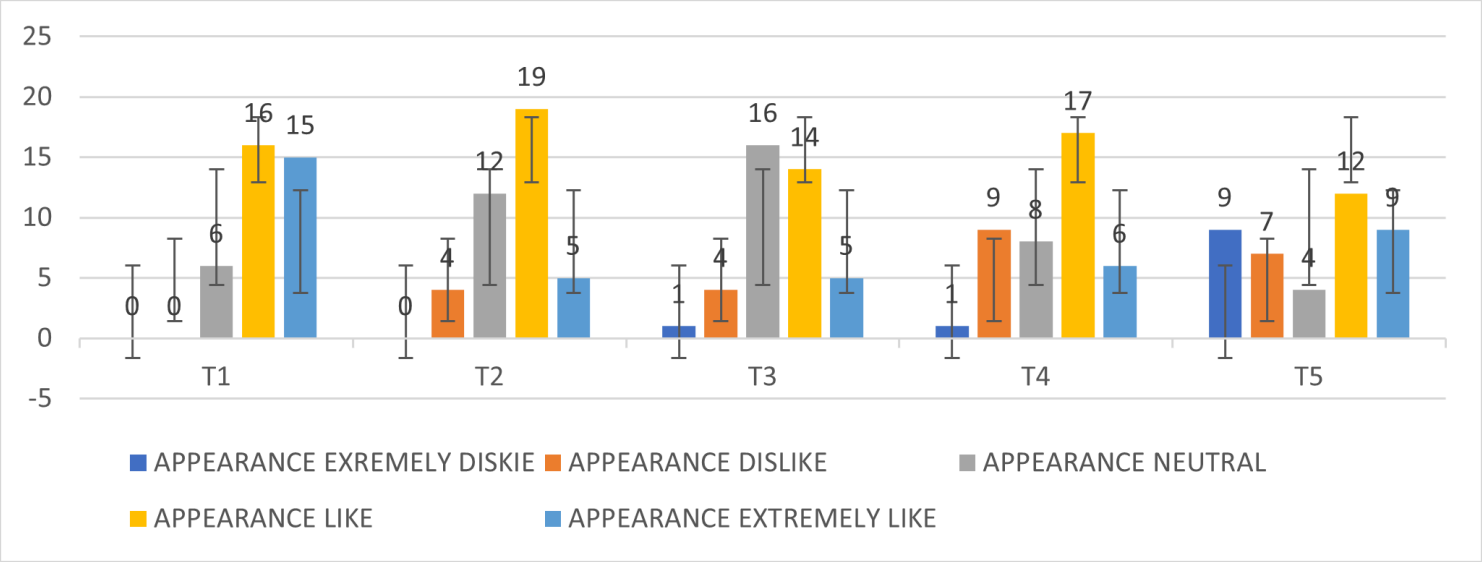


Figure 2

Effect of baobab pulp powder and moringa leaf powder leaf powder Taste

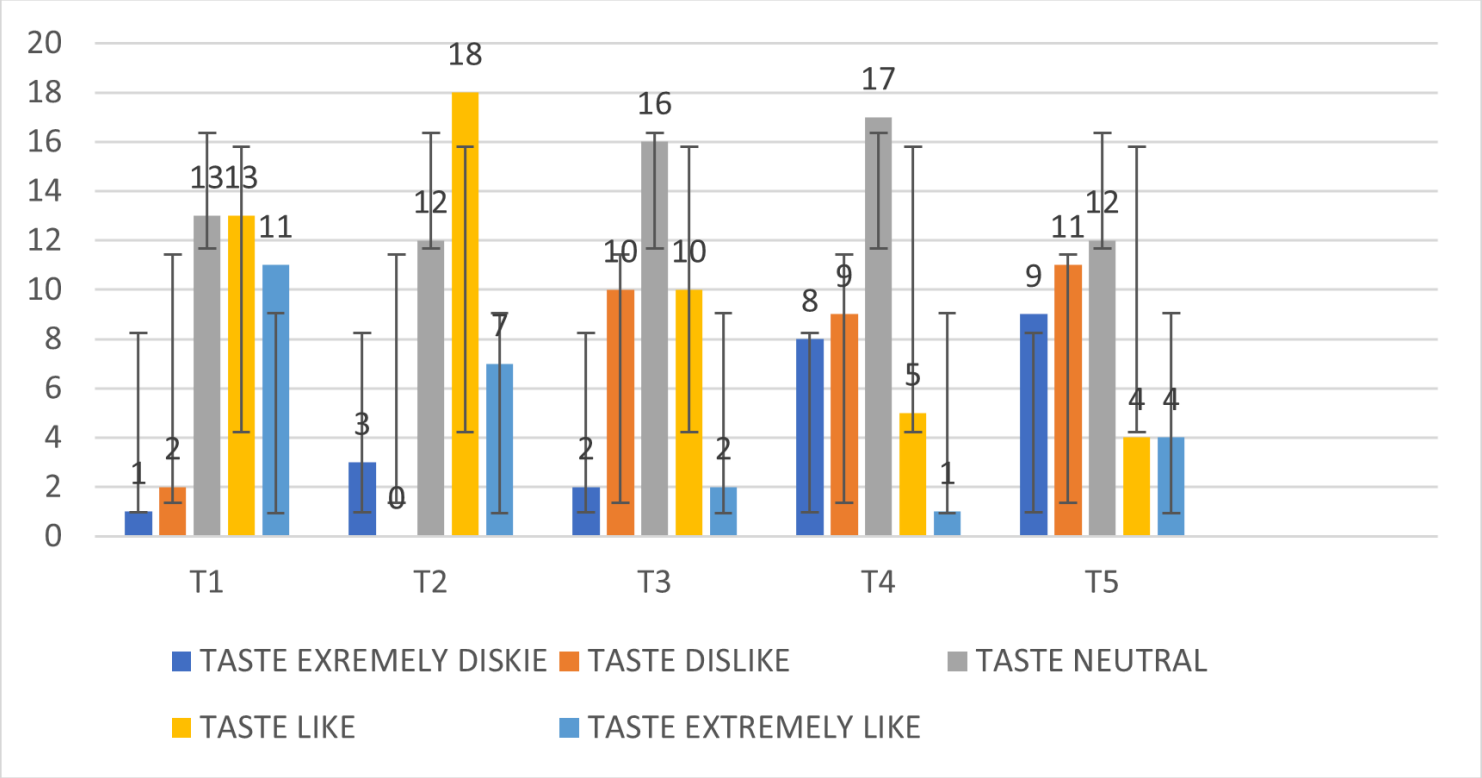


Figure 3

Effect of baobab pulp powder and moringa leaf powder leaf powder flavor

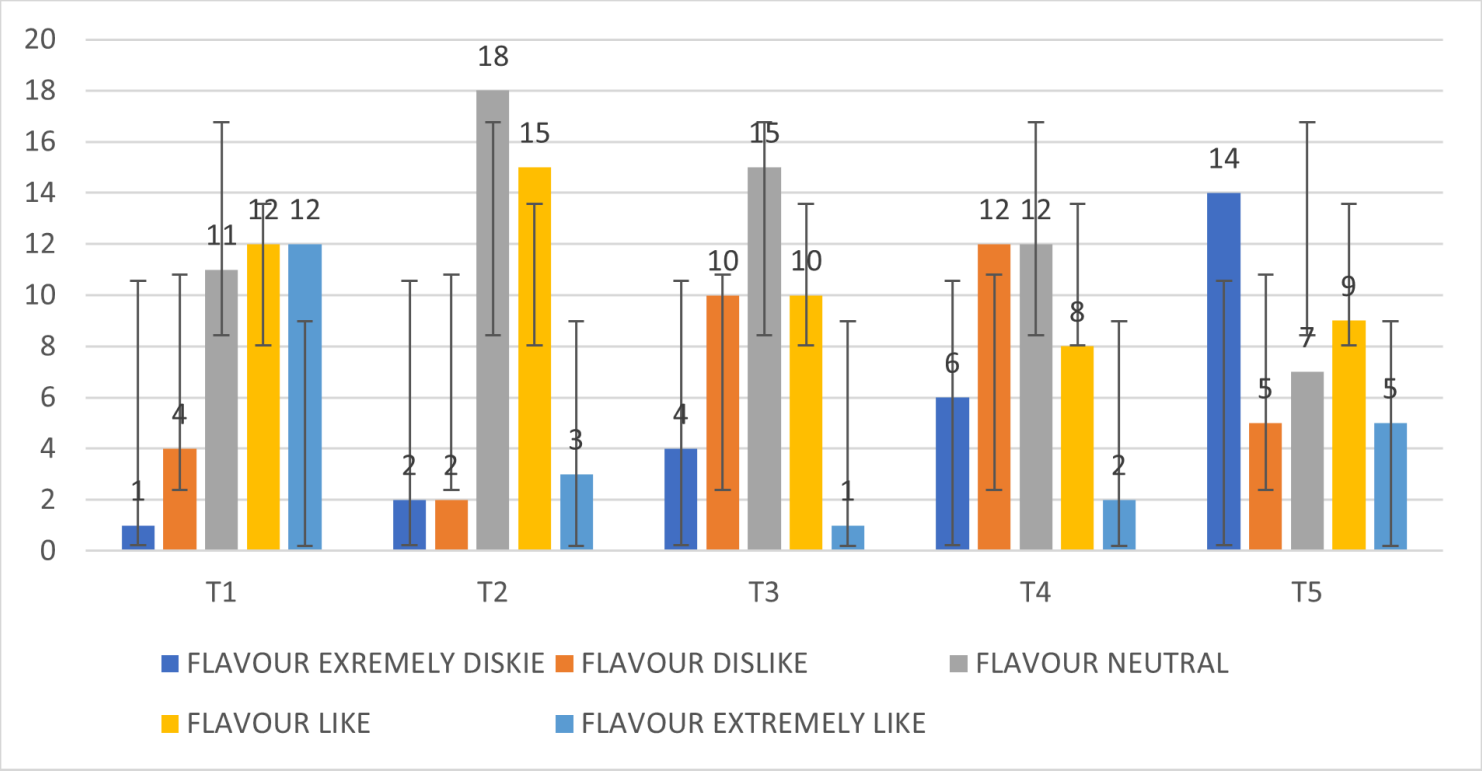


Figure 4

Effect of baobab pulp powder and moringa leaf powder leaf powder on Acceptability

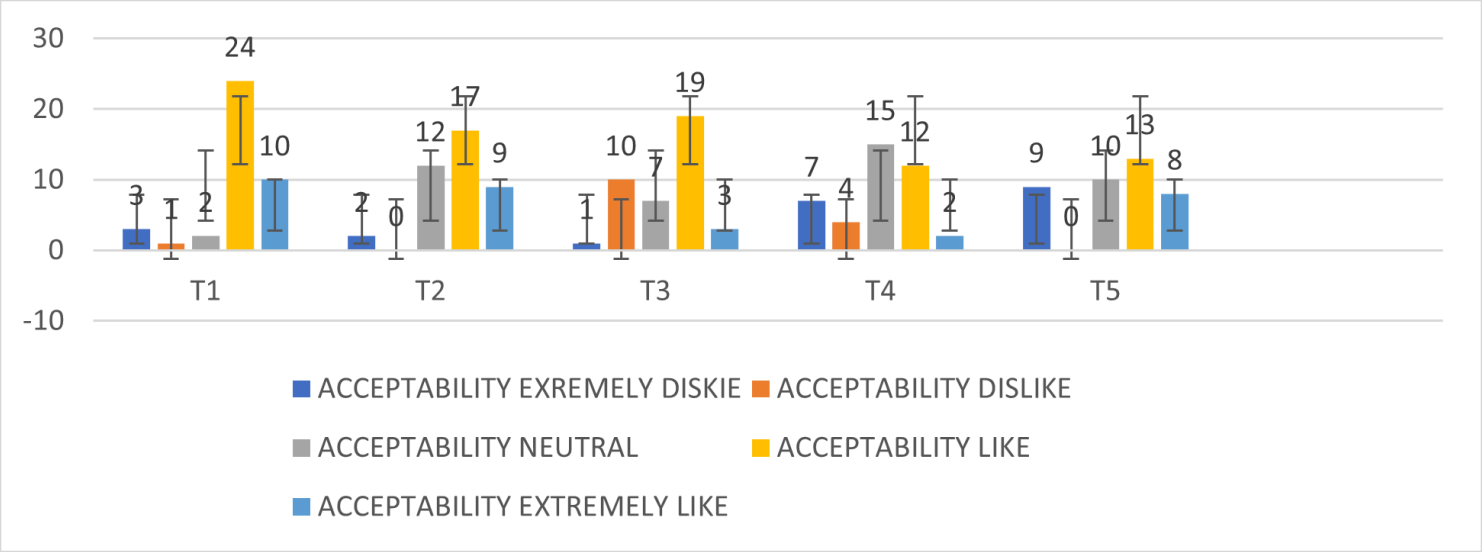


Figure 5

Effect of Baobab pulp powder And Moringa leaf powder Leaf Powder On Consumer Acceptability