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Sensory Analysis of Pumpkin *(Curcubita Moschata)* and Broccoli *(Brassica oleracea L. var Italica)* Ice Cream as Functional Food

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ABSTRACT
Ice cream is a semi-solid frozen food made from a mixture of animal and vegetable fats, sugar and other permitted ingredients. Pumpkin and broccoli are ingredients with high nutritional content that can be processed into ice cream because they have nutritional content that is good for health. In addition to pumpkin, broccoli is also one of the food ingredients that contain many vitamins and minerals that can add to the nutritional content of ice cream. This study aims to determine acceptability by hedonic test of pumpkin and broccoli ice cream as functional food. This type of research is experimental with a completely randomized design (CRD), consisting of 4 levels of treatment with 3 replicates each. With concentrations of pumpkin and broccoli P0 (100%:0%), P1 (75%:25%), P2 (50%:50%), and P3 (25%:75%). Ice cream samples were tested for sensory analysis specially hedonic test. The data obtained were then statistically tested using Kruskal Wallis analysis followed by Mann Whitney to determine the differences. Panelists preferred ice cream with a higher percentage of pumpkin over ice cream with a higher percentage of broccoli.

INTRODUCTION

Functional foods not only delicious to eat, but also have sufficient nutrition and can provide health benefits due to its bioactive components (Fekete et al., 2025). Various types of food have been developed into functional food innovation, such as ice cream. Ice cream is a semi-solid frozen dessert made by a mixture of milk, fat, sugar, and stabilizers (da Silva Santos et al., 2025). The nutritional value of ice cream depends heavily on the nutritional value of its ingredients. To produce high quality ice cream, the nutritional value of the raw materials must be precisely known (Haryati, 2015). Selecting the right raw materials can enhance the nutritional content and bioactive components of ice cream.

Pumpkin is a locally abundant food and contains complete nutrients such as carbohydrates, protein, fat, minerals, and vitamins. It is also a source of dietary fiber and antioxidants, phenolic, vitamin A, vitamin B2, vitamin C, vitamin E, amino acids, flavonoids, and beta-carotene (Pujiastuti, 2022). Broccoli contains bioactive compounds including glucosinolates, anthocyanin, polyphenols, flavonoids, vitamin C, vitamin E, and fiber. Other nutrients in broccoli include water, fat, protein, carbohydrates, calcium, iron, and beta-carotene (Yang, 2021).

One of the antioxidants in pumpkin is beta-carotene, which is quite high at around 1800 IU or 2100 µg per 100 g, along with 180 IU of vitamin A and 52 mg of vitamin C (Dhiya, 2016). Meanwhile, 100 g of broccoli contains antioxidants including 20 mg of folic acid, 30 mg of tocopherol, 800 mg of beta-carotene, 123.4 mg of vitamin C, and flavonoid compounds (Andrés et al., 2025). Therefore, researchers want to innovate in making ice cream from pumpkin and broccoli as functional foods by paying attention to sensory acceptance.

MATERIALS AND METHODS

Materials

This study used UHT full cream milk (Frisian Flag) 100 ml, vanilli koepoe koepoe 10 g, pumpkin, broccoli, CMC koepoe koepoe 5 g, sugar 200 g. Material that used for analysis such are I_2, KI, H_2SO_4 2N, amylum 1%, DPPH, and methanol. The tools used in sample preparation in this study were a mixer (Philips type HR 1552, 170 W, 220 V), a blender (Philips type HR2116), a freezer, a digital scale, a pan, a steamer, a stove, a knife, a stirring spoon, a basin, an ice glass, and a label paper. The tools used for vitamin C testing were a beaker

(Iwaki Pyrex), a volumetric flask (Iwaki Pyrex), tongs, a burette (Pyrex), and a dropper. The tools used for antioxidant testing were a test tube (Iwaki Pyrex), a volumetric flask (Iwaki Pyrex), a test tube rack, a measuring pipette (Iwaki), a beaker (Iwaki Pyrex), and a spectrophotometer. While the tools used in hedonic testing were questionnaire paper and a pen.

Methods

The method for making pumpkin and broccoli ice cream is based on a modified method by Ratna (2018) and Mahrita et al. (2022), formulation can be seen on Table 1. UHT milk is placed in a container. Vanilla, sugar, and CMC are added. Then, the mixture is pureed using a mixer. Pour the mixture into a container. Then, the mixture is frozen for 24 hours at 4°C. The pumpkin is peeled and the seeds are removed. Then, it is cut into pieces to reduce the size and facilitate steaming. After that, the pumpkin is washed thoroughly. Next, the pumpkin is steamed until soft at 100°C for 15 minutes. Then, it is pureed with a blender to obtain a smooth pumpkin. Broccoli is cleaned under running water to separate it from dirt. Then, it is cut, after which the broccoli is briefly boiled over boiling water at 95°C for approximately 2 minutes to prevent overcooking. Then, it is pureed with a blender to obtain a smooth broccoli. Then, the pureed pumpkin and broccoli are added to the previously mixed ice cream mixture. After mixing, the mixture was stirred again until it reached a homogeneous consistency. Then, the mixture was frozen for 24 hours at 4°C. After 24 hours, the mixture was removed and stirred to soften it, this step was carried out up to 3 times to avoid ice crystallization. For sensory analysis, this study used ethical permission issued by the research ethics committee of the Faculty of Medicine, Sebelas Maret University, Surakarta based on No. 54/un27.0611/KEP/EC/2023. This study has been reviewed and declared ethical and declared ethically feasible to be carried out. Organoleptic quality testing used the hedonic test method by tasting samples, 4 samples in different cups were presented to the panelists, then the panelists were asked to provide responses regarding their liking for the ice cream they tasted by filling out a questionnaire that had been provided previously. To determine the level of liking for ice cream, a scale with a score of 1-4 was used in the following order: Dislike (1), somewhat like (2), like (3), very like (4). The number of panelists in this study was 30 people with a semi-trained category. These panelists have received training to determine certain sensory properties. From the results of the experimental research carried out sensory analysis in the form of hedonic test. Data were analyzed by Kruskal Wallis analysis followed by Mann Whitney to determine the differences.

Table 1. Ice Cream Formulation

Material	P0	P1	P2	P3
Pumpkin	250 g	200 g	125 g	50 g
Broccoli	-	50 g	125 g	200 g
UHT full cream milk	1000 ml	1000 ml	1000 ml	1000 ml
Sugar	200 g	200 g	200 g	200 g
Vanillin	10 g	10 g	10 g	10 g
CMC	5 g	5 g	5 g	5 g

Table 2. Hedonic Test Results as a Parameter of Consumer Acceptance

Parameter	P0	P1	P2	P3
Texture	2,87 ± 0,730[a]	2,73 ± 0,691 [a]	2,60 ± 0,770 [a]	2,60 ± 0,814 [a]
Aroma	2,87 ± 0,629 [a]	2,27 ± 0,583 [b]	2,10 ± 0,662 [b]	2,03 ± 0,669 [b]
Taste	3,03 ± 7,18 [a]	1,77 ± 0,774 [b]	1,57 ± 0,728 [b]	1,73 ± 0,868 [b]
Overall	3,10 ± 0,712 [a]	2,13 ± 0,681 [b]	1,97 ± 0,556 [b]	2,10 ± 0,845 [b]

Note: Similar letter notation means there is no significant difference. P0 (Sample with 100% pumpkin, 0% broccoli formula), P1 (Sample with 75% pumpkin, 25% broccoli formula), P2 (Sample with 50% pumpkin, 50% broccoli formula), P3 (Sample with formula Pumpkin 25%, broccoli 75%). Hedonic Scale: 1. Dislike, 2. Somewhat Like, 3. Like, 4. Very Like

RESULTS AND DISCUSSION

Based on table 2, pumpkin ice cream shows that there was no significant difference on texture in the four treatments. Aroma, taste, and overall parameter had no significant different between P1, P2, and P3 sample, but had significant different with P0. Texture is a crucial parameter determining the quality of ice cream. Ice cream texture is influenced by water content, non-fat solids, fat content, and gelatin content. The higher the water content, the denser the texture (Mahrita et al., 2022). Fiber can increase the solids content of ice cream batter, causing it to thicken. Fiber binds water, lowering the water content and thickening the ice cream. The batter's consistency can affect the softness of the ice cream. The thicker the batter, the less creamy the texture (Nurwahidah et al., 2024).

The content of compounds in an ingredient dissolved in water or fat can produce aroma. The sense of smell functions to detect aromas that evaporate with compounds in the air. The aroma of milk generally has a

distinctive aroma that can change when exposed to certain compounds or objects. Aroma emitted by food is a very strong attraction and is able to stimulate the sense of smell, thereby stimulating the appetite (Mahrita et al., 2022). Things that affect the taste of food consist of three aspects, namely odor, taste, and oral stimulation. The addition of a certain percentage of broccoli can affect the level of panelists' liking for the aroma of ice cream, because broccoli gives a very strong aroma in each formulation. According to the results of the data analysis on aroma in the hedonic test, the formula most favored by panelists is formulation P0, and the formulation least favored by panelists is formulation P3. The P3 formulation has a stronger broccoli aroma than the other formulations, this is because the percentage of broccoli addition is higher more than in the other formulations, so panelists dislike the aroma of the P3 formulation.

Taste is crucial in the creation of a product. The taste of a food is influenced by the use of basic ingredients. A product can be accepted by consumers if it has the desired taste (Rosida et al., 2020). According to the results of the research analysis, the most preferred formulation was P0 with the addition of 100% pumpkin and the formulation that was disliked by the panelists was P2. Ice cream with the addition of more broccoli was least preferred by the panelists because it had a slightly bitter aftertaste. The level of acceptance of the ice cream with a percentage of pumpkin addition showed that this was the formulation most preferred by the panelists. The detected tastes were sweet from sugar and pumpkin. A high percentage of pumpkin addition resulted in a sweet taste in the ice cream. However, when the percentage of broccoli was high, it would eliminate the milk and pumpkin tastes in the ice cream because the broccoli taste was more dominant than the milk and pumpkin. Pumpkin and broccoli, in various concentrations, will change the taste of the resulting ice cream, and increasing the pumpkin concentration will further increase the sweetness of the ice cream (Kartika et al., 2025). The same applies to the addition of broccoli, the higher the concentration of broccoli, the more bitter the aftertaste after consuming broccoli, because broccoli contains glucosinolates, which contribute to its bitter taste (Putri et al., 2025).

The results of the hedonic test analysis of the overall panelist acceptance of pumpkin and broccoli ice cream showed the highest average value at P0 with a value of 3.10. P1 had a value of 2.13, P3 had a value of 2.10 and the least preferred was P2 with an average of 1.97. This shows that the addition of different concentrations of pumpkin and broccoli has a large influence on panelist acceptance because the acceptance of pumpkin and broccoli ice cream varies. Formulation P0 has a higher level of liking than other formulations in terms of texture, aroma, and taste. Ice cream with the addition of pumpkin and a higher percentage of broccoli has a higher level of liking than ice cream with the addition of broccoli and a higher percentage of pumpkin. The overall level of panelist acceptance of ice cream increases with the increase in the percentage of pumpkin and the overall level of panelist acceptance of ice cream decreases with the increase in the percentage of broccoli.

CONCLUSIONS

Based on the results of the hedonic test, ice cream with a higher percentage of pumpkin added was preferred by the panelists compared to ice cream with a higher percentage of broccoli added.

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