Canrea Journal: Food Technology, Nutritions, and Culinary, 2023; 6 (2): 129–141 OPEN ACCESS

e-ISSN: 2621-9468

Type of the Paper (Article)

Characterization of physicochemical properties and sensory profile of red *oncom* in Dramaga District Bogor Regency

First Leisa Kurnia[1], Dase Hunaefi[1*], Nancy Dewi Yuliana[1], Philipp Fuhrmann[2], Iryna Smetanska[3], and Shin Yasuda[4]

[1] Department of Food Science and Technology – SEAFAST Center, IPB Dramaga Campus, Bogor, Indonesia
[2] Department of Food Science and Technology, University of Natural Resource and Life Science, Vienna, Austria
[3] Department of Plant Production and Processing, University of Applied Sciences, Hochschule Weihenstephan-Triesdorf, Steingruberstraße, Weidenbach, Germany
[4] Graduate School of Bioscience, Tokai University, Kumamoto, Japan

Abstract

The production methods of red *oncom* can vary between different producers, leading to differences in sensory characteristics and compounds. This study aimed to characterize the physicochemical and sensory profile of red *oncom* that are most preferred by consumers. In this study, five samples of red oncom from Dramaga Districts, Bogor Regency, were selected as raw materials for physicochemical and sensory analysis. The proximate content of the five red *oncom* samples showed high levels of moisture, ash, and fat, but protein content in samples 259, 786, 615, and 478 was low. In contrast, the carbohydrate content in sample 615 was higher than proximate of red *oncom* by the Ministry of Health Republic Indonesia in 2019. The physical characteristics of color in some samples did not significantly differ in terms of L*, a*, C*, and h*values, although all samples exhibited a significant difference in terms of b* value. The texture characteristics of the five samples showed no significant differences in terms of springiness and cohesiveness, but significant variations were observed in hardness, gumminess, and chewiness. The sensory profiling involved 30 consumer panelists and 18 attributes, with sample 259 emerging as the most preferred among consumers. The analysis of consumption patterns based on five aspects of the food model, considering age and gender categories, revealed significant differences in several aspects, mainly related to food preferences (stir-fried, *tutug* rice, sauce, and fried *oncom*), self-conditions (feeling of sadness), and environmental conditions (hot weather). However, a significant difference was observed in the ecological aspect, specifically cold temperatures, when considering the gender category.

Article History
Received May 11, 2023
Accepted November 10, 2023
Published December 29, 2023

Keywords
Red *Oncom*,
Physicochemical,
Sensory Profile,
Five Aspects Food Model.

1. Introduction

Processing is a way to increase shelf life and improve the sensory characteristics of food products (1), including fermented food products. An example of a product derived from fermentation is an online product. *Oncom* products are a potential source of nutrition because, during the fermentation process, complex chemicals undergo decomposition into simpler compounds so that they can be easily absorbed by humans. Red *oncom* is a specialty food originating in West Java. Red *oncom* is produced with raw materials such as peanut press

* Correspondence : **Dase Hunaefi** dashcbdk@apps.ipb.ac.id

ISSN 2621-9468 online, DOI 10.20956/canrea.v6i2.1013

cake, solid waste from tapioca production, and residue from soybean curd production fermented with Neurospora sitophila mold to produce red strains (2). Red *oncom* has nutritional value, when *oncom* weights 100 g, it has water of 57 g, calories of 187 g, protein of 13 g, fat of 6 g, carbohydrates of 22.6 g, calcium of 96 g, iron of 27 mg, phosphorus of 115 mg and vitamin B of 0.09 mg (3). Red *oncom* is a food product with a self-life of 1-2 days at room temperature (4).

Red *oncoms* are generally available and commercially sold as raw materials or as ready-to-consume products. Red *oncom* is produced by producers using traditional processes. However, market development has led to changes in raw material usage, technology employed during process production, and types of products that consumers will receive. The production of red *oncom* varies among manufacturers in terms of the production stages and raw materials used, which can affect the physical, chemical, and sensory characteristics of red *oncom*.

Furthermore, research related to the physical, chemical, and sensory profile of red *oncom* is minimal, so there is a need to assess this matter. Red *oncom*, a food product, cannot be consumed directly and must be cooked through roasting. The cooking process forms new compounds via chemical reactions.

Sensory is a test of product quality so that it can be developed regarding its acceptance by consumers (5) using the rate all that apply (RATA) method. According to Ares et al. (6), rate-all-that-apply (RATA) is used to group descriptors that have been determined based on their intensity. This method can identify consumer acceptance levels through sensory testing using attributes such as color, aroma, taste, texture, aftertaste, and overall liking perceived by consumers in red *oncom* obtained from several stores. This research aims to characterize the physicochemical and sensory profile of red *oncom* that are most preferred by consumers.

2. Materials and Methods

2.1. Materials and Tools

This study utilized five samples of red *oncom* obtained from five different stores in the Dramaga District of Bogor Regency. The researcher conducted sample selection in five different places to identify red *oncom* spread in Dramaga District to achieve the objectives of this research. The five samples of red *oncom* used in the research were purchased before conducting physical, chemical, and sensory analyses to ensure that the samples were in good condition and had a fermentation period of 48 h suitable for research purposes.

2.2. Sample Preparation

This study used five commercially available samples from five stores. The researchers assigned codes with random numbers, namely, 924, 259, 786, 615, and 478. In this study, a red *oncom* sample was not used as a control, because the aim was to identify the physical, chemical, and sensory profiles of each sample obtained from different stores. Physicochemical properties were characterized using raw materials from the red *oncom* samples. Subsequently, sensory profile characterization was conducted on red *oncom* samples that had been processed by roasting to ensure that no additional seasonings or ingredients were added, which could influence the sensory properties of red *oncom*.

The red *oncom* was roasted for 5 min, and all samples were uniformly treated in terms of fire intensity, pan diameter, and heating process across all samples. First, the red *oncom* was crushed and washed. Next, the pan was heated for 30 s, followed by roasting the red *oncom* for 5 min and placing it into small cups, each containing 25 g, for sensory testing.

2.3. Characterization of Physicochemical Properties

2.3.1. Chemical Properties

The chemical properties of the proximate content were analyzed using AOAC (2016). The proximate test on red *oncom* was used to calculate water content (%) and ash content (%) by the gravimetric method, fat content (%) by the Soxhlet Hydrolysis method, protein content (%) by the Micro Kjeldahl method, and carbohydrates (%) by difference. The carbohydrate content in red *oncom* was calculated using the total values of reduced protein (%), fat (%), ash (%), and water (%) from the absolute values of the sample (7).

2.3.2. Physical Properties

The physical properties in this study are the texture and color of the red *oncom*. Texture testing was performed using a probe that was appropriate for the sample type. The test was performed on five red *oncom* samples, and the average value was recorded. Based on a previous study (8) with cake samples using TA-XT (Stable Microsystems, Ltd., Surrey, U.K). An aluminum cylindrical probe with a diameter of 75 mm is used in double compression "Texture Profile Analysis (TPA)".

The sample was first cut to a size of 20x20x20 mm as the smallest sample size of the five samples was used in this study. Then, it was compressed from the initial height by 25%, with a pretest speed of 5 mm/s, a test speed of 1 mm/s, and a delay time of 5 s between the first and second compressions. The parameters used to measure the texture of red *oncom* included hardness, cohesiveness, springiness, gumminess, and chewiness. The hardness was determined to be the maximum value during the first compression. Cohesiveness was calculated based on the area of force with a positive value during the second compression compared with the first compression. Springiness was determined by comparing the length during the second compression with that during the first compression. Gumminess was calculated as the product of hardness and cohesiveness, and chewiness was derived from the multiplication of springiness, cohesiveness, and gumminess.

Color analysis was performed using a Konika Minolta CR-400 chromatometer. The DP-400 data processor and CR-400 measurements were turned on to determine the L*, a*, b*, C*, and h* values. The L* (luminance) value indicates the brightness of the color in the product, with a value of 0 (black) to 100 (white). a* indicates the green-red color, where green indicates a negative value and red indicates a positive value. b* indicates a blue-yellow color, where blue indicates a negative value, and yellow indicates a positive value (9).

2.4. Characterization of Sensory Profile

2.4.1. Panelist Screening

This study included 30 consumer panelists. The panelists who were at least 20 years old had consumed red *oncom*, lived in Dramaga District Bogor Regency, and were disposed to become panelists by following a series of testing activities until completion. These panelists also evaluated the five-aspect food model based on real-life conditions that existed in the lives of consumers when consuming red *oncom* products. This screening stage involved filling out an online questionnaire with various questions to gather demographic information from potential panelists. The questionnaire must be filled in, including panelists' backgrounds, such as name, age, gender, and medical history.

2.4.2. Focus Group Discussion (FGD)

A focus group discussion was conducted with the researcher serving as the panel leader to deliberate on the sensory attributes obtained during the research (10). Consumer panelists who had passed the screening stage then participated in the focus group discussion, which involved smelling and tasting roasted red *oncom* to discuss the dominant attributes, such as color, aroma, taste, texture, aftertaste, and overall liking. After obtaining the dominant attributes from the focus group discussion, all panelists conducted sensory evaluations using the rate all that apply (RATA) method.

2.4.3. Sensory Profile Test

A sensory profile test was performed using that apply (RATA) method. The roasted red *oncom* samples were assigned codes and presented randomly to prevent bias and minimize discussion among the panelists (11). The panelists entered their booths, where they were presented with five samples of red *oncom* and mineral water. Each time the panelist sample changes, it must be neutralized with mineral water. After tasting the sample, the panelists rated it according to the attributes listed in the questionnaire. The scale used was from to 1-5, on a scale of 1, indicating that the attribute was perceived as very weak, and a scale of 5, indicating that the attribute was perceived as very strong in the tested sample. If an attribute presented in the sample is not perceived by the panelists, they could leave that attribute blank without providing a rating (11,12).

2.5. Statistical Analysis

Statistical data processing for the characterization of physicochemical properties of red *oncom* was carried out by Analysis of Variance (ANOVA) test using IBM SPSS Statistics 25 software. For the characteristics of the sensory profile, the data from the apply (RATA) method of roasted red *oncom* were analyzed using IBM SPSS Statistics 25 and XLSTAT 2020 software. The tools used were Principal Component Analysis (PCA) consisting of a spider web, biplot, and overall liking (13) with Friedman's test. Friedman's test was used to identify significant differences in each attribute of the selected sample (14). One-way analysis of variance when the p-value <0.05, the significance is significantly different.

3. Results and Discussion

3.1. Characteristics of Chemical Properties

This research was carried out to characterize the chemical properties of red *oncom* as raw material proximate contents as can be seen in Table 1. As shown in Table 1, the proximate content of the five red *oncom* samples showed high levels of moisture, ash, and fat, but the protein content of samples 259, 786, 615, and 478 was low. In contrast, the carbohydrate content of sample 615 was higher than that of red *oncom* by the Ministry of Health Republic Indonesia in 2019, which consists of water content, 132.56%, ash content, 3.26%, fat content, 13.95%, protein content of 30.23%, and 51.16% carbohydrate content. The production of red *oncom* generally involves the use of raw materials, such as tofu dregs, peanut press cake, and tapioca production waste, which are fermented using Neurospora sitophila mold. In particular, red *oncom* from Bogor Regency was produced using tofu dregs and tapioca production waste as the raw material.

Table 1. Proximate content of red *oncom*.

Samples	g/100g Material				
	Water Content	Ash Content	Fat Content	Protein Content	Carbohydrates
924	289.54±0.57^{e}	3.56±0.00^{d}	25.27±0.39^{b}	32.15±0.39^{a}	39.02±0.46^{e}
259	404.40±1.36^{c}	3.62±0.02^{c}	23.96±0.26^{c}	23.20±0.02^{d}	49.22±0.25^{c}
786	477.75±1.77^{a}	3.65±0.01^{b}	26.61±0.18^{a}	29.12±0.15^{b}	40.63±0.04^{d}
615	393.28±1.77^{d}	3.53±0.00^{e}	14.58±0.18^{e}	21.52±0.41^{e}	60.37±0.60^{a}
478	424.91±1.64^{b}	3.95±0.00^{a}	18.20±0.03^{d}	24.08±0.21^{c}	53.78±0.18^{b}

Numbers followed by different letters in the same column indicate that the samples are significantly different at the 5% level by Duncan's test. The values shown are the mean values of the two repetitions.

Based on the survey findings, samples 259, 786, 615, and 478 utilized tofu dregs and tapioca production waste, whereas sample 924 was made solely from tofu dregs, without tapioca sate and peanut press cake. This variation in the raw materials resulted in different proximate contents among the red *oncom* samples. The elevated water content in the five red *oncom* samples was attributed to prolonged fermentation, choice of starter, and percentage of raw materials utilized. The water content increased due to the use of Neurospora sitophila mold and tofu dregs as substrates, resulting in a red *oncom* with a wet and watery consistency (15).

The ash content of red *oncom* is influenced by the type of substrate and mold used, causing the transformation of organic material into inorganic components during fermentation (15,16). The duration of fermentation increased the activity of enzymes, including proteases, which affected the protein content of the red *oncom*. Protease enzyme levels increase when the mold is in the exponential phase. During this phase, the mold utilizes the nutrient content of substrates for growth and development, ultimately leading to the optimal conditions for producing protease enzymes, resulting in increased protein content (17). Furthermore, the protein content increases through mold growth because it produces mycelia (17). The fat content in red *oncom* decreased during fermentation because the mold utilized fat as an energy source for its growth. Carbohydrates in red *oncoms* are influenced by the percentage of water, ash, protein, and fat content.

3.2. Characteristics of Physical Properties

This study was conducted to characterize the physical properties of red *oncom* in terms of its color and texture. Color is one of the parameters used by consumers to determine the quality of food products. Color can be analyzed by determining the values of L*, a*, b*, C*, and h*, which can be obtained from a tool chromameter as follows:

Table 2. Color of red *oncom*.

Samples	L*	a*	b*	C*	h
924	74.76±2.68^{b}	11.30±1.13^{b}	44.92±3.40^{c}	46.36±3.22^{b}	75.82±1.96^{a}
259	77.61±1.32^{a}	12.48±2.22^{b}	47.00±3.10^{bc}	48.65±3.40^{b}	75.18±2.03^{a}
786	75.19±1.37^{ab}	22.86±5.90^{a}	50.27±5.47^{abc}	55.30±7.40^{a}	65.87±3.30^{b}
615	73.11±0.78^{b}	23.14±1.75^{a}	52.00±1.89^{ab}	59.93±2.26^{a}	66.03±1.28^{b}
478	72.63±1.37^{b}	22.65±1.93^{a}	54.72±4.70^{a}	59.23±2.42^{a}	67.53±1.37^{b}

Numbers followed by different letters in the same column indicate that the samples are significantly different at the 5% level by Duncan's test. The values shown are the mean values of four repetitions.

Based on Table 2, represents the results obtained from the color analysis using the Konica Minolta CR-400 chromameter. The L* values obtained ranged from 72.63 to 77.61, indicating that all samples had bright colors. When the L* value is below 50, it indicates a dark color; when it is above 50, it indicates a bright color (18). The a* values indicate the green-red color in the samples, ranging from -80 to +100.

The results in this study show a* values ranging from 11.30 to 23.14, indicating that all samples have a red color. b* values indicate a blue-yellow color, ranging from -70 to +70. A positive b* value implies a yellow color, whereas a negative b* value implies a blue color (19). The range b* from samples red *oncom* 44.92-54.72, which indicates that the color of the samples is yellow. The C* value for all samples red *oncom* is positive, which indicates a bright color, while h* values represent the color in a range of 0° until 360° consisting of red, yellow, green, cyan, blue, and magenta. The h* values for all red *oncom* samples ranged from 67 to 75, which indicates a yellow color consistent with the b* values.

The differences in L*, a*, b*, C*, and h* values of the red *oncom* color were influenced by the duration of fermentation and the distribution of spores produced by the *Neurospora sitophila* mold. Food products fermented using Neurospora sitophila mold typically exhibit cream, orange, and brown colors (15). Alterations in the physical properties and chemical composition can also affect the color of food products (20). The color of red *oncom* was further affected by β-carotene as a pigment responsible for the reddish-yellow color, which exhibited a positive correlation with the concentration of *Neurospora sitophila* mold during the fermentation process (21).

Table 3. Texture of red *oncom*.

Samples	Hardness	Springiness	Cohesiveness	Gumminess	Chewiness
924	424.90±11.17^b	0.83±0.01^a	0.58±0.00^a	245.11±6.19^c	203.83±9.48^c
259	336.85±22.13^c	0.89±0.01^a	0.58±0.00^a	195.22±11.67^d	173.16±9.21^d
786	544.00±21.92^a	0.85±0.05^a	0.59±0.02^a	319.30±0.76^a	269.83±15.33^a
615	465.80±17.96^b	0.86±0.01^a	0.59±0.00^a	273.13±9.67^b	235.39±5.10^b
478	152.00±29.98^d	0.84±0.01^a	0.61±0.02^a	91.20±14.86^e	76.75±14.20^e

Numbers followed by different letters in the same column indicate that the samples are significantly different at the 5% level by Duncan's test. The values shown are the mean values of four repetitions.

Based on Table 3, the texture of red *oncom* as a raw material was analyzed using a Texture Analyzer-XT instrument. The first parameter is hardness, which represents the ability of the product to change its shape and is obtained from the maximum value of the first compression. Springiness occurs when the product returns to its original shape after the first and second compressions (22). Based on Table 3, springiness was not significantly different among the five samples.

Cohesiveness refers to the area under the curve from the second to the first compression (23). Based on Table 3, cohesiveness values did not differ significantly among the five samples. Gumminess is a characterizes a semi-solid food substance with low hardness and high cohesiveness, resulting in lower gumminess values (22). The gumminess value refers to the energy required to chew the red *oncom* until it can be swallowed. Based on Table 3, all red *oncom* samples displayed significant differences. The last category of texture is chewiness, which represents the effort required to chew semi-solid food. Based on Table 3, the chewiness values varied significantly among all samples.

Texture is one of the attributes used to assess food product quality, taste, nutrition, and appearance (21). The texture of red *oncom* is influenced by fermentation time and raw materials, including solid waste from tapioca production. Solid waste from tapioca production can improve the texture of red *oncom* produced during fermentation. Based on a survey of the producer, the red *oncom* used in this research was fermented for 48 h at room temperature using the back-slopping method as a starter, which significantly affected the texture of red *oncom* (24). The texture increased and became more compact, tender, mold, pH, and reducing sugar. The duration of fermentation of red *oncom* is also suspected to be positively correlated with increased hardness, springiness, and chewiness, possibly due to the influence of filamentous fungus content and degradation in supporting structures such as fibers (21).

3.3. Characteristics of Sensory Profile Red Oncom

Sensory profile testing was conducted to determine the preferred attributes and samples of the red *oncom*. The research commenced with screening panelists who filled out a questionnaire that had been validated and tested for reliability using Google forms. A total of 37 respondents participated in the questionnaire; 30 respondents completed it online, and seven respondents completed it offline. Five respondents did not pass the screening phase to fail to meet the researcher's criteria, and two qualified respondents passed but did not participate in the subsequent rate of testing.

The data consisted of 30 panelists, comprising 8 males and 22 females. The eligible panelists participating in the testing were aged between 20-25 totaling 24 panelists, whereas six panelists were age range–26-30. After gathering the 30 panelists, a focus group discussion was initially held, attended by 10 representatives with 18 attributes.

The sensory attributes to be evaluated in the sensory test, based on the outcomes of the focus group discussion (FGD), encompass attributes generated by the roasted red *oncom*. These attributes include aroma (beany, musty, fermented, and sourness), color (golden yellow, brownish yellow, and blackish brown), and texture (juicy, chewiness, soft, and fibrous). The attributes taste, namely savory/umami, bland, bitter, and sourness, and aftertaste, namely bitterness, sourness, and tartness. The subsequent step involved the sensory profiling of red *oncom* using the rate all that apply (RATA) method, utilizing the principal component analysis (PCA) tool as can be seen in Figure 1.

Based on Figure 1, the relationship between samples, where the proximity of samples suggests similar or almost identical attributes, whereas samples located in opposite quadrants imply differences in attributes (10). The F1 and F2 values accounted for 78.67% of the variability in the data, signifying that F1 and F2 adequately explained the attributes. The percentages of F1 and F2 were influenced by the positioning of the red lines and the points associated with each attribute. The greater distance between the red and central points indicated improved explanatory power of F1 and F2. When the lines with red points were situated close to the central point, it suggested that panelists perceived the attribute as similar across all samples.

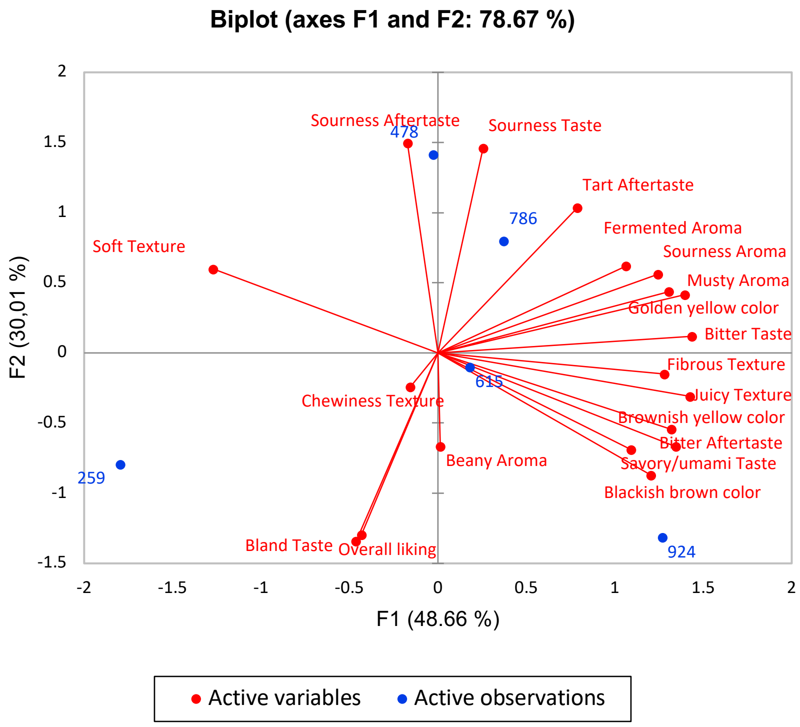

Figure 1. Biplot Principal component analysis of roasted red *oncom*.

In Figure 1, it is evident that the roasted red *oncom* with sample code 786 (quadrant I) displayed dominant attributes, including sourness and bitterness in taste, tartness aftertaste, fermentation, musty, sour aroma, and golden yellow color. On the other hand, samples with codes 615 and 924 (quadrant II) exhibited similar sensory attributes at both occupied quadrants, featuring dominant characteristics such as fibrous and juicy texture, yellow-brown and dark-brown color, bitter aftertaste, beany aroma, and savory/umami taste. Sample 259 (quadrant III) was characterized by sensory attributes such as chewiness, texture, and bland taste, yet it stood out as the most preferred sample overall. Meanwhile, sample 478 (quadrant IV) displayed dominant sensory attributes, such as a sour aftertaste and soft texture. The characteristics of the sensory profile of roasted red *oncom* also resulted in overall liking or consumer preference for all samples, as shown in Figure 2.

Based on Figure 2, the intensity of the sensory attributes for each sample is detailed. The evaluation used a 1-5 intensity scale, where higher scores (5) indicate a stronger perception of the attribute. The results showed that the intensity of the sensory attributes perceived by panelists varied among the roasted red *oncom* samples (Figure 2). This variation is affected by factors such as microorganisms, substrate, pH (acidity), temperature, oxygen, and water activity (aw) (25). As a result, a food product's chemical composition can differ, and often fermentation products are not stable and vary from one another (26).

Based on Figure 2, it was evident that sample 259 emerged as the preferred choice among all panelists. Sample 259 boasted the dominant attributes with the highest intensity ratings, particularly in terms of chewiness in texture, bland taste, and beany aroma. Furthermore, sample 259 exhibited the lowest intensity ratings for sensory attributes such as bitter taste and aftertaste, sour taste and aftertaste, musty and fermented aroma, and sourness compared to the other samples.

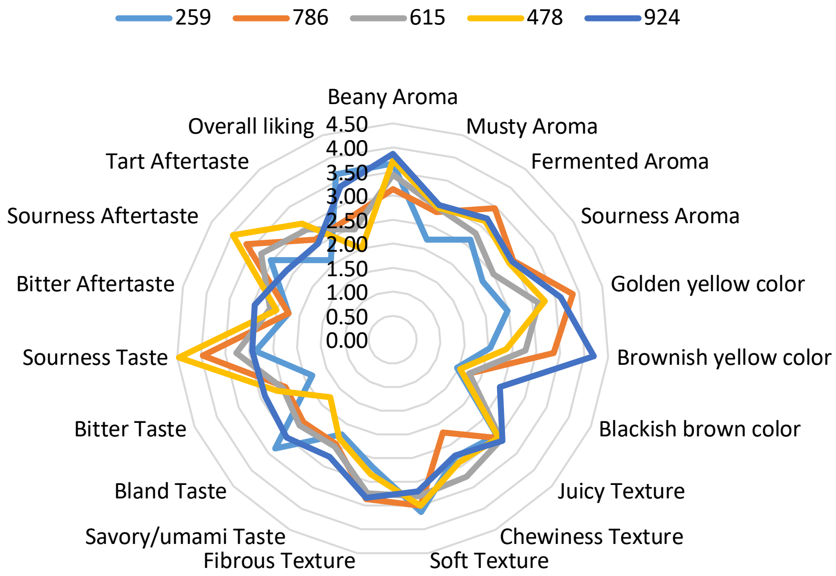

Figure 2. Spider web of roasted red *oncom.*

These attributes are believed to be less preferred by panelists if they are excessively pronounced in roasted red *oncom*, which is why panelists rated sample 259 as the most preferred. The sensory attributes observed in all red *oncom* samples in this study were suspected to be affected by the fermentation time and the choice of raw materials used. The duration of fermentation of food products can influence taste development (27). Fermentation can result in increased acidity; therefore, an extended fermentation period may result in a stronger sour taste due to elevated levels of alcohol and total acid. When total acidity rises, the resulting red *oncom* will likely have a sour taste and aftertaste, which panelists may favor less. Therefore, we focus on the fermentation duration and choice of raw materials in red *oncom* production that aligns with consumer preferences.

Sensory profiling was also conducted using a five-aspect food model for roasted red *oncom* under real conditions. At this time, in conducting sensory evaluation, it is not enough just to perceive it, but there is a need for evaluation in real conditions (28). This study was conducted by distributing a questionnaire that contained questions related to the consumption patterns of red *oncom*. The respondents to this survey were panelists who had been selected during the sensory evaluation. The questionnaire included several question categories grouped into five main aspects as can be seen in Table 4.

Table 4. Five aspects food model of red *oncom* in real condition.

Aspect		Age		p-value	Gender		p-value
		20-25	26-30		Male	Female	
Food	Stir-Fried	3.52±1.02	4.33±0.82	0.076	3.63±1.19	3.67±1.00	0.922
	Tutug Rice	3.00±1.13	4.17±0.98	0.026	3.13±0.99	3.22±1.25	0.842
	Sauce *Oncom*	3.23±0.90	4.50±0.84	0.003	3.50±0.76	3.40±1.08	0.823
	Fried *Oncom*	3.04±1.05	4.17±0.98	0.021	3.38±1.06	3.19±1.14	0.678
	Combro	3.45±1.27	4.00±1.26	0.340	3.63±0.92	3.52±1.37	0.838
	Lontong	3.38±1.18	3.33±1.21	0.931	3.75±1.16	3.26±1.16	0.302
Environment	Hot Weather	2.48±0.83	3.83±1.60	0.004	2.25±0.46	2.85±1.20	0.178
	Rainy Weather	3.52±1.02	3.00±0.89	0.780	3.75±0.71	3.33±1.07	0.312
	Hot (°C)	3.86±1.06	4.00±1.26	0.780	3.63±1.06	3.96±1.09	0.444

	Room (°C)	3.07±0.80	3.33±1.21	0.505	3.13±0.64	3.11±0.93	0.969
	Cold (°C)	1.97±1.09	1.50±1.22	0.355	2.50±0.93	1.70±0.93	0.073
With Whom	Family	3.87±0.92	3.83±1.47	0.950	3.75±0.71	3.89±1.09	0.737
	Friends	3.52±1.09	3.00±1.67	0.342	3.50±1.07	3.41±1.25	0.851
	Alone	3.10±1.08	3.83±1.47	0.166	3.00±0.53	3.30±1.30	0.536
Self-Condition	Ordinary	3.24±0.79	3.00±0.89	0.508	3.50±0.53	3.11±0.85	0.231
	Sad	1.48±0.78	2.33±1.21	0.036	1.63±1.06	1.63±0.88	0.990
	Better	2.97±0.82	2.83±0.98	0.731	2.88±0.64	2.96±0.90	0.799
Time & Place	Breakfast	3.52±1.27	2.83±1.47	0.250	3.50±1.41	3.37±1.31	0.810
	Lunch	3.76±1.21	4.17±0.75	0.437	4.00±0.93	3.78±1.22	0.638
	Dinner	2.97±1.24	3.83±1.33	0.132	3.13±1.25	3.11±1.31	0.979
	Home	3.72±1.03	4.00±0.63	0.535	3.63±1.06	3.81±0.96	0.635
	Tegal Stall	3.31±1.23	3.50±1.52	0.742	3.50±1.07	3.30±1.32	0.694
	Restaurant	3.17±1.54	3.83±1.83	0.359	3.00±1.69	3.37±1.57	0.569

Based on Table 4, the consumption patterns of red *oncom* products were identified using five main aspects: food, environment, with whom, self-condition, time, and place. The data were obtained through a survey of 30 respondents. The two categories differentiate consumption patterns based on age and gender. The p-value serves as a significant indicator of whether the differences in consumption patterns are significant.

The results indicated that most aspects of the red *oncom* consumption pattern did not differ significantly, as they had a p-value greater than 0.05. However, some aspects showed significant differences (p-value <0.05) based on age. These included the food aspect, which involved processed *oncom* types such as stir-fried, *tutug* rice, sauce, and fried *oncom*; the self-condition aspects, particularly the feeling of sadness experienced by all panelists at a significance level of 0.036; and the environmental aspect with hot weather showing a significance level of 0.04. Different consumption patterns based on sex were observed in the environmental aspect, specifically regarding cold temperature, with a p-value of 0.073. These variations in red *oncom* based on age and gender are believed to be influenced by the emotions and physical conditions of the panelists during the sensory evaluation of red *oncom* products.

4. Conclusions

The results of this study indicated that red *oncom* in the Dramaga District of Bogor Regency exhibited levels of water, ash, and fat but lower protein content in samples 259, 786, 615, and 478. Sample 615 had a higher carbohydrate content, while the remaining samples had a lower carbohydrate content than the proximate content specified by the Indonesian Ministry of Health (2019). The physical characteristics of color in some samples did not differ significantly in terms of L*, a*, C*, and h* values, although all samples exhibited a significant difference in terms of the b* value. No significant differences were observed in springiness and cohesiveness among the samples; however, they were significantly different for all texture categories.

Sensory profiling of red *oncom* was conducted using 30 consumer panelists, identifying 18 sensory attributes and overall liking. Sample 259 was the most preferred among the samples, as it exhibited the lowest sensory attributes for bitter and sour tastes, bitter and sour aftertastes, and sour aroma. Furthermore, the analysis of consumer consumption patterns for red *oncom* in real-life conditions was conducted using the five aspects of the food model, which included categories such as food, environment, with whom, self-condition, time, and place, categorized by age and gender. The results revealed significant differences in several aspects, including categories such as food (stir-fried, *tutug* rice, sauce, and fried *oncom*), self-condition (sadness), and environment (hot weather). However, in the gender category, a significant difference was observed in the aspect of environment (cold temperatures).

Acknowledgements

The authors gratefully acknowledge the support from The Ministry of Research and Technology, IPB University, to all the panelists and parties involved in this research.

Author Contributions

D.H. and N.D.Y designed and performed the experiments; F.L.K., D.H., N.D.Y., P.H, I.S., and S.Y. analyzed the data and wrote the paper; D.H and N.D.Y are the supervising lecturers.

Funding

This research was supported by the Ministry of Research and Technology/National Research and Innovation Agency, Republic of Indonesia with Young Lecturer Research scheme 2023, grant number 11410/IT3/PT.01.03/P/B/2023.

Institutional Review Board Statement

The human research protocol was approved by the IPB University's Commission on Research Ethics Involving Human Subjects (number 860/IT.3). KEPMSM-IPB/SK/2023.

Data Availability Statement

Available data was presented in the manuscript.

Conflicts of Interest

Authors may declare no conflict of interest.

References

1. Owolabi IO, Kolawole O, Jantarabut P, Elliott CT, Petchkongkaew A. The importance and mitigation of mycotoxins and plant toxins in Southeast Asian fermented foods. NPJ Sci food. 2022;6(1). Available from: 10.1038/S41538-022-00152-4.
2. Mulyani S, Wisma RW. Analisis Proksimat dan Sifat Organoleptik "Oncom Merah Alternatif" dan "Oncom Hitam Alternatif. JKPK (Jurnal Kim dan Pendidik Kim. 2016;1(1):41. Available from: 10.20961/jkpk.v1i1.39428.
3. Zamakhsyari I, Alsuhendra A, Ridawati R. Pengaruh teknik pemanasan basah dalam pembuatan oncom instan terhadap kualitas tumis oncom. J Sains Boga. 2018;1(1):18–22. Available from: 10.21009/JSB.001.1.03.
4. Alsuhendra A, Ridawati R. Pengaruh perlakuan awal terhadap karakteristik kimia, mikrobiologi, dan organoleptik tepung oncom merah. Sebatik. 2019;23(2):505–12. Available from: 10.46984/sebatik.v23i2.806.
5. Meilgaard MC, GV C, Thomas CB. Sensory evaluation techniques. In: US : CRC Press. 2016.
6. Ares G, Picallo A, Coste B, Antúnez L, Vidal L, Giménez A, et al. A comparison of RATA

questions with descriptive analysis: Insights from three studies with complex/similar products. J Sens Stud. 2018;33(5):1–11. Available from: 10.1111/joss.12458.
7. Ramadhan K, Huda N, Ahmad R. Physicochemical and sensory characteristics of burger made from duck surimi-like material. Poult Sci. 2012;91(9):2316–23. Available from: 10.3382/PS.2011-01747.
8. Majzoobi M, Ghiasi F, Habibi M, Hedayati S, Farahnaky A. Influence of soy protein isolate on the quality of batter and sponge cake. J Food Process Preserv. 2014;38(3):1164–70. Available from: 10.1111/jfpp.12076.
9. Doymaz I, Kipcak AS, Piskin S. Microwave drying of green bean slices: Drying kinetics and physical quality. Czech J Food Sci. 2015;33(4):367–76. Available from: 10.17221/566/2014-CJFS.
10. Setianingsih D, Apriyantono A, Puspita Sari M. Analisis sensori untuk industri pangan dan argo. Bogor: IPB Press; 2010. 180 hlm.
11. Adawiyah DR, Tjiptoputri OM, Lince L. Profil sensori sediaan pemanis dengan metode rate-all-that-apply (RATA). J Mutu Pangan Indones J Food Qual. 2020;7(1):38–45. Available from: 10.29244/jmpi.2020.7.1.38.
12. Meyners M, Jaeger SR, Ares G. On the analysis of rate-all-that-apply (RATA) data. Food Qual Prefer. 2015;49:1–10. Available from: 10.1016/j.foodqual.2015.11.003.
13. Ferrão LL, Ferreira MVS, Cavalcanti RN, Carvalho AFA, Pimentel TC, Silva R, et al. The xylooligosaccharide addition and sodium reduction in requeijão cremoso processed cheese. Food Res Int. 2018;107:137–47. Available from: 10.1016/j.foodres.2018.02.018.
14. Ares G, Bruzzone F, Vidal L, Cadena RS, Giménez A, Pineau B, et al. Evaluation of a rating-based variant of check-all-that-apply questions: Rate-all-that-apply (RATA). Food Qual Prefer. 2014;36:87–95. Available from: 10.1016/j.foodqual.2014.03.006.
15. Budiyanto B, Suryapratama W, Rahayu S. Efek Inkubasi Aerob Fakultatif terhadap Kualitas Organoleptik, Fisik, dan Nutrisi Ampas Tahu Difermentasi Kapang Neurospora sitophila dan Trichoderma viridae sebagai Pakan Ternak. J Peternak Indones. 2021;23(2):136–43. Available from: 10.25077/jpi.23.2.136-143.2021.
16. Haddadin MSY, Haddadin J, Arabiyat OI, Hattar B. Bioresource Technology Biological conversion of olive pomace into compost by using Trichoderma harzianum and Phanerochaete chrysosporium. Bioresour Technol. 2009;100(20):4773–82. Available from: 10.1016/j.biortech.2009.04.047.
17. Yohanista M, Sofjan O, Widodo E. Evaluasi nutrisi campuran onggok dan ampas tahu terfermentasi Aspergillus niger, Rizhopus oligosporus dan kombinasi sebagai bahan pakan pengganti tepung pakan pengganti tepung jagung. J Ilmu-Ilmu Peternak [Internet]. 2014;24(2):72–83.
18. Hunterlab. Hunter L, a, b, vs CIE L*, a*, b*: measuring color using hunter L, a, b, versus CIE 1976 L*, a*, b*. Hunter Associates Laboratory Inc; 2012.
19. Permatasari AA, Sumardianto S, Rianingsih L. Perbedaan konsentrasi pewarna alami kulit buah naga (Hylocereus polyrhizus) terhadap warna terasi udang rebon (Acetes sp.). J Teknol Has Pertan. 2018;11(1):39. Available from: 10.20961/jthp.v11i1.29094.
20. Chen PC, Lin C, Chen MH, Chiang PY. The micronization process for improving the dietary value of okara (soybean residue) by planetary ball milling. J LWT–Food Sci Technol. 2020;132:1–6.
21. Qiu Y, Li C, Dong H, Yuan H, Ye S, Huang X, et al. Analysis of key fungi and their effect on

the edible quality of HongJun tofu, a Chinese fermented okara food. Lwt. 2022;172:1–11. Available from: 10.1016/j.lwt.2022.114151.
22. Indiarto R, B N, E S. Kajian karakteristik tekstur dan organoleptik daging ayam asap berbasis teknologi asap cair tempurung kelapa. J Teknol Has Pertan. 2012;5(2):106–16.
23. Iswara JA, Julianti E, Nurminah M. Karakteristik tekstur roti manis dari tepung, pati, serat dan pigmen antosianin ubi jalar ungu. J Pangan dan Agroindustri. 2019;7(4):12–21. Available from: 10.21776/ub.jpa.2019.007.04.2.
24. Sastraatmadja DD, Tomita F, Kasae T. Production of High-Quality Oncom, a Traditional Indonesian Fermented Food, by the Inoculation with Selected Mold Strains in the Form of Pure Culture and Solid Inoculum. J Grad Sch Agr Hokkaido Univ [Internet]. 2002;70:111–27.
25. Afrianti LH. Teknologi pengawetan pangan. Bandung: Alfabeta; 2013.
26. Adi Wira Kusuma GP, Ayu Nocianitri K, Kartika Pratiwi IDP. Pengaruh Lama Fermentasi Terhadap Karakteristik Fermented Rice Drink Sebagai Minuman Probiotik Dengan Isolat Lactobacillus sp. F213. J Ilmu dan Teknol Pangan. 2020;9(2):181. Available from: 10.24843/itepa.2020.v09.i02.p08.
27. Fahmi N, Nurrahman. Kadar Glukosa, Alkohol Dan Citarasa Tape Onggok Berdasarkan Lama Fermentasi. J Pangan dan Gizi. 2013;2(3):25–42. Available from: https://doi.org/10.26714/jpg.2.1.2011.%25p.
28. Colla K, Keast R, Mohebbi M, Russell CG, Liem DG. Testing the validity of immersive eating environments against laboratory and real life settings. Food Qual Prefer. 2022;103:1–11. Available from: 10.1016/j.foodqual.2022.104717.