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Characteristics of Steamed Brownies based on Fermented Coffee Fruit Skin by *Rhizopus Oryzae*

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ABSTRACT: Dry land is a landscape where water is stagnant for a long time or all the time. The use of dry land usually occurs on land, dry land, or uncultivated land. Dry land has the potential to become agricultural land, with 45% of Indonesia's territory consisting of hills and dry land, which are ideal areas for development. However, many obstacles arise in arid, dry regions. In addition to dry land, hills, or areas above ground, they have a positive impact on the agricultural system. Bajawa is a region in the Flores plateau that has a very extensive dryland area. The purpose of writing this article is to facilitate the resolution of problems or obstacles that occur in dryland and hilly areas (upland areas) with a dry climate. The method used in this research is a literature approach. (library research). Data collection in the research was conducted by reviewing and exploring several journals, books, and documents (both printed and electronic) as well as other data sources and information deemed relevant to the research or study. To support sustainable agriculture, dryland management must be sustainable. In land management, there are several issues that often arise. This includes soil fertility decline due to erosion and leaching, very steep topography, water availability, and production issues. Able to identify obstacles and determine solutions. As an alternative, one can use vegetative or mechanical soil management methods, enhance rainwater harvesting, manage water resources comprehensively, and plant drought-resistant crops.

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KEYWORDS: Characteristics, Steamed Brownies, Coffee Fruit Skin, Fermentation

INTRODUCTION

Brownies are a type of cake that is blackish brown in colour. Brownies have a harder texture than cake because brownies do not require gluten development (Fatimah, 2016). Brownies are usually made from a mixture of dough ingredients such as wheat flour, cooking chocolate, cocoa powder, eggs, and sugar. One of the raw materials for brownies is wheat flour, which is the basic ingredient for making cakes and bread. (Wahyuningtias *et al*., 2014; Peñalver *et al*., 2024; and Selvakumaran *et al*., 2019) .

To reduce the use of wheat flour and increase nutritional value and food security, wheat flour can be substituted with other ingredients, including coffee fruit skin. Coffee fruit skin is one part of the by-product of coffee beans produced in the processing of coffee beans.

The high demand for coffee leads to higher by-products. The by-product of coffee that is rarely utilized is coffee fruit skin.

One safe, relatively inexpensive coffee fruit skin waste treatment is biological processing, which is processing by utilizing microorganisms that will carry out biological processes (bioprocess) in processing unneeded compounds and obtaining desired compounds (Palinggi *et al*., 2014).

Fermentation is an oxidation or reaction in biological systems that produces energy where donors and acceptors are organic compounds produced by microorganisms (Kwartiningsih et al., 2005). One of the potential microorganisms for the fermentation process of the coffee fruit skin is *Rhizopus oryzae*. *Rhizopus oryzae* is a fungus that has probiotic potential. *Rhizopus oryzae* is a good carbohydrate-breaking mold. Fermentation products are beneficial because the mold will produce simple compounds that are more easily absorbed by the body (Safitri *et al*., 2021).

Fermentation has been shown to impart desirable aroma attributes to green coffee beans, which highlights the feasibility of fermentation as a biotechnological avenue for coffee aroma modulation. Therefore, this is the first study to characterize the

volatile and non-volatile profiles of green coffee beans and roasted coffee fermented with the commonly used food-grade fungus *Rhizopus oligosporus* with the aim to modulate the aroma of roasted coffee through biotechnological means (WL Lee *et al*., 2016).

MATERIAL AND METHODS

Materials and tools

The research design used a Complete Randomized Design (CRD) with 5 treatments and 3 replicates. The observation data was analyzed usin Anova and follow up test of Duncan's Multiple Range Test (DMRT) at the level of 1%. The treatment in this study is the comprison of substitute wheat flour with fermented coffee fruit skin flour (%) in making steamed brownies (Salihat and Putra, 2021, which is modified), namely: A = 70:30, B = 60:40, C = 50:50, D = 40:60 and e = 30:70. The mean differences among the treatments were adjudged by DMRT as laid by Gomez and Gomez (1993). Coffee fruit skins flour are fermented using *Rhizopus Oryzae* for 5 days and processed into flour (Handoyo and Morita, 2006; Palinggi *et al.*, 2014) which is processed into steamed brownies.

RESULTS AND DISCUSSION

Physical properties of steam brownies

Physical properties of substitution of wheat flour with fermented coffee fruit skin flour had a very significant effect ($P < 0.01$) on moisture content, ash content, fat content, protein content, carbohydrates, and antioxidant activity, shown in Table 1.

Table (1): Chemical characteristics of steamed brownies from five treatments.

Treatments	Parameters					
	Moisture	**Ash**	**Crude Protein**	**Fat**	Carbohydrate	**Antioxidant**
	(%)	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**
A	$20.72^{a} \pm 0.27$	$1.41^{a} \pm 0.08$	$11.23^{a} \pm 0.13$	$5^{a} \pm 1.14$	$30.39^{a} \pm 1.24$	$24.36^{a} \pm .0.56$
B	$21.81^{ab} \pm 1.12$	$1.58^{ab} \pm 0.09$	$15.48^{b} \pm 1.10$	$1^{b} \pm 0.44$	$29.94^{a} \pm 0.73$	$25,80^{a} \pm 0..55$
C	$22.99^{bc} \pm 0.71$	$1.65^{b} \pm 0.10$	$18.09^{c} \pm 1.04$	$28^{c} \pm 0.64$	$27.97^{a} \pm 0.19$	$30.61^{b} \pm 0.56$
D	$24.22^{c} \pm 1.54$	$2.63^{c} \pm 0.11$	$20.06^{d} \pm 0.13$	$32^{d} \pm 1.57$	$26.77^{b} \pm 1.42$	$41.51^{c} \pm 1.01$
E	$26.45^{d} \pm 1.65$	$2.87^{d} \pm 0.13$	$20.72^{e} \pm 0.13$	$34^{e} \pm 0.92$	$26.61^{b} \pm 1.13$	$50.80^{d} \pm 1.21$
Sign	**	**	**		**	**

Numbers in the same column followed by different superscript letters indicate significantly differences in the DMRT test at $\alpha = 0.01$

Moisture content

The moisture content of steamed brownies ranged from 20.72% - 26.45%. The lower the percentage of wheat flour and the higher the percentage of fermented coffee fruit skin flour, the higher the water content. This is because the water content of fermented coffee fruit skin flour is higher than the water content of wheat flour. The high water content in steamed brownies is due to the use of fermented coffee fruit skin flour. During the fermentation process, microorganisms use carbohydrates as an energy source that can produce water molecules and CO2, most of the water will remain in the product and some will come out of the product. The water left in the product causes the moisture content to be high and the dry ingredients to become wet (Yessirita, 2016). The moisture content obtained meets the quality standard of sweet bread (SNI 101-3840-1995) of a maximum 40%.

Ash content

The ash content of steamed brownies ranged from 1.41% - 2.87%. The lower the percentage of wheat flour and the higher the percentage of fermented coffee fruit skin flour, the higher the ash content. Increasing the use of fermented coffee fruit skin flour in making steamed brownies causes an increase in the ash content of the steamed brownies produced. This is due to the higher mineral content of fermented coffee fruit skin flour compared to wheat flour, so the resulting ash content will be higher (Salman *et al*., 2022). The ash content of coffee fruit skin flour is 1.27% while the ash content of wheat flour is 0.70% (Sitohang *et al*., 2021). Based on SNI 101-3840-1995, steamed brownies substituted with fermented coffee fruit skin flour have met the predetermined quality standard of a maximum of 3%.

Fat content

The fat content of steamed brownies ranged from 21.34% - 36.25%. The lower the percentage of wheat flour and the higher the percentage of fermented coffee fruit skin flour, the lower the fat content. The increased use of fermented coffee fruit skin flour

in making steamed brownies resulted in decreased brownie fat content. The high-fat content in steamed brownies is caused by the use of margarine and eggs as raw materials. The fat content of coffee fruit skin flour is lower than the fat content of wheat flour (Sitohang *et al*., 2021). The fat content in coffee fruit skin flour is 0.67%, while the fat content in wheat flour is 1.0-3.0% (Salihat & Putra, 2021). Based on the research that has been done, the steamed brownies produced have not fulfilled SNI- 101-3840-199, which is a maximum of 3%.

Protein content

The protein content of steamed brownies ranged from 11.23% - 20.72%. The lower the percentage of wheat flour and the higher the percentage of fermented coffee fruit skin flour, the higher the protein content. This increase is due to the high protein content in fermented coffee fruit skins, because the microbes in the fermentation process are able to produce protein-breaking enzymes (protease). During the fermentation process the microbes will be lysed or die, the dead cells are counted as proteins so that they increase the protein content of the fermented material. The protein content of coffee fruit skin is 13.20%, while the protein content in wheat flour is 11.5% (Juwita *et al*., 2017).

Carbohydrate content

The carbohydrate content of brownies ranges from 26.61-30.39%. The more the addition of fermented coffee fruit skin flour in making steamed brownies, the lower the carbohydrate content of the steamed brownies produced. The carbohydrate content is determined by difference, which is the result of subtraction from 100% with water, ash, protein and fat content. The calculation of the carbohydrate value obtained is a proportion of the overall proximate calculation. The carbohydrates in wheat flour are 52.17% (Arif, 2019) while carbohydrates in coffee fruit skin flour are 35% carbohydrates (Nurhayati, 2020). This is to the research that has been done, the less the use of fermented coffee fruit skin flour, the higher the carbohydrates in steamed brownies.

Antioxidant activity

The antioxidant activity of brownies ranged from 24.36-50.80%. The more coffee fruit skin flour added, the higher the antioxidant value of the brownies. This is due to the high antioxidant content in coffee fruit skin flour, compared to wheat flour. Antioxidants are substances needed to neutralize free radicals and prevent damage by complementing the lack of electrons possessed by free radicals and inhibiting the chain reaction of free radical formation that can cause oxidative stress (Parwata, 2015). The high antioxidant level in treatment E is due to the higher antioxidant level of coffee fruit skin flour than wheat flour. Coffee has a high content of phenol compounds, and the main constituents of phenol components in coffee skin are chlorogenic acid and caffeic acid (Wijayanti & Anggia, 2020). Chlorogenic acid content has a high concentration, which is 90% of the total phenols contained in coffee.

Organoleptic test

The Organoleptic test was conducted through sensory assessment by 25 untrained panelists, namely by observing the texture, aroma, color and taste of steamed brownies, shown in Table 2.

Table 2. Recapitulation of steamed brownies organoleptic assessment.

Treatments	Values					Information
	Aroma	Color	Taste	Texture	Average	
A	6.28	5.92	6.56	5.88	6.16	very like
B	5.16	5.29	5.48	5.24	5.29	like slightly
C	4.92	4.82	4.76	5.04	4.82	like slightly
D	4.64	4.67	4.44	4.88	4.67	like slightly
E	4.28	4.25	4.12	4.48	4.25	neither like nor dislike

The evaluation was identified using a 7-point hedonic scale (1=dislike extremely, 2=dislike moderately, 3=dislike slightly, 4=neither like nor dislike, 5=like slightly, 6=like moderately and 7=like extremely).

Flavour

The most preferred assessment and taste of steamed brownies was found in treatment A (the ratio of wheat flour to fermented coffee fruit skin flour 70:30), namely 6.56 (very like). While the lowest assessment of steamed brownies was in treatment E (the ratio of wheat flour to fermented coffee fruit skin flour 70:30), namely 4.12 (rather like). Based on the results obtained, it can be concluded that the higher the addition of fermented coffee fruit skin flour, the taste of the steamed brownies produced will be more bitter and less preferred by panellists. This means that the panellists have liked the taste of the steamed brownies. This is

supported by research (Salihat & Putra, 2021) which states that the taste of the organoleptic results of steamed brownies is a sharp brown taste.

Aroma

The highest aroma assessment of steamed brownies is in treatment A (the ratio of wheat flour to fermented coffee fruit skin flour 70:30), namely 6.28 (very like), with the aroma of coffee skin that is not too pungent, while the lowest assessment of steamed brownies is in treatment E (the ratio of wheat flour to fermented coffee fruit skin flour 30:70), namely 4.28 (rather like). The formation of the aroma of steamed brownies is in the main ingredients (fermented coffee fruit skin flour, wheat flour, granulated sugar, cocoa) there are volatile components that function as aroma precursors. The aroma produced from steamed brownies has a distinctive coffee aroma, this distinctive coffee aroma is produced from caffeoil compounds and other compounds such as acetone, furfural, trimethylamine, formic acid, and acetic acid (Bernoulli *et al*., 2021).

Texture

The highest texture, which is very like, is found in treatment A (the ratio of wheat flour substitution to fermented coffee fruit skin flour 70:30), namely 5.88 (very like) while the lowest texture, which is rather like, is found in treatment E (the ratio of wheat flour substitution to fermented coffee fruit skin flour 30:70), namely 4.48 (rather like), which means that the level of acceptance of panelists is on a scale of ordinary to very like. The texture of steamed brownies made from wheat flour substituted with fermented coffee fruit skin flour has a soft and slightly porous texture. So t the quality of steamed brownies is in the good category. Sani *et al*. (2019) stated that the characteristic of steamed brownies is a soft and porous texture. Wheat flour steamed brownies substituted with fermented coffee fruit skin flour have a soft and porous texture in accordance by the criteria for steamed brownies.

Color

The highest assessment of the color of steamed brownies was found in treatment A (ratio of wheat flour substitution to fermented coffee fruit skin flour 70:30), namely 5.92 (very liked), while the lowest assessment was found in treatment E (ratio of wheat flour substitution to fermented coffee fruit skin flour 30:70), namely 4.12 (somewhat liked). The dark brown or black colour of the brownies is like the typical colour of fermented coffee fruit skin powder. The process of color according to Arsa (2016) is the result of the caramelization process of sugar resulting in a dark brown or black color.

The difference in the color of the resulting steamed brownies is influenced by the ratio of the use of fermented coffee fruit skin flour to wheat flour. The more fermented coffee fruit skin flour is added, the darker the color, while with reduced use of fermented coffee fruit skin flour, the color is light brown.

CONCLUSIONS

(1) The comparison of wheat flour substitution and fermented coffee fruit skin flour in making steamed brownies has a very significant effect on water content, ash content, fat content, protein, carbohydrate content and antioxidants, with a composition of water content (20.72%), ash content (1.41%), fat content (36.25%), protein content (11.23%), carbohydrates (30.39%) and antioxidant activity (24.36%).

(2) Based on the organoleptic test results, the best-steamed brownies on a very like scale are in treatment A (the ratio of wheat flour substitution to fermented coffee fruit skin flour 70:30) with taste (6.56), aroma (6.28), texture (5.88), color (5.92).

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