Chemical analysis and consumer acceptance of oyster mushroom (*Pleurotus ostreatus*) rendang as a typical West Sumatra culinary innovation

HESTY PARBUNTARI[1], FAJRIAH AZRA[1*], PRIMA KURNIATI HAMZAH[2], FITRI AMELIA[1], IKA PARMA DEWI[3] , AND MAHMUD[4]

[1]Department of Chemistry, Universitas Negeri Padang, Padang, Indonesia
2 Department of Islamic Guidance and Counselling, Universitas Islam Negeri Imam Bonjol, Padang, Indonesia
3 Department of Electrical Engineering, Universitas Negeri Padang , Padang, Indonesia
4 Department of Islamic Elementary School Teacher Education, Universitas Islam Negeri Imam Bonjol, Padang,Indonesia

* Corresponding author: bunda_syasfa@yahoo.com

Data of the article

First received : 06 February 2023 | Last revision received : 19 May 2023
Accepted : 10 August 2023| Published online :29 August 2023
DOI : 10.17170/kobra-202210056950

Keywords

oyster; mushroom; rendang; consumer; acceptance.

Rendang is one of the typical foods of the Minangkabau people in West Sumatra. The cooking process takes about 6-7 hours at a temperature of 80-90°C, which decreases the nutritional level. This long process enables the perfect cooking of the meat. White oyster mushrooms can be used as a substitute for rendang meat because the vegetable protein contains lots of fibre, and the texture is similar to meat. Based on the results of the hedonic test on 72 respondents under and above 45 years old, the oyster mushroom rendang cooked for 7 hours was the most acceptable. This cooking time variant had the highest customer acceptability for flavour, colour, fragrance, and texture. Additionally, the t-test analysis with the significance number corroborated this conclusion. Furthermore, a chemical comparison of white oyster mushroom rendang and beef rendang showed that white oyster mushroom rendang had less FFA and moisture content.

1. Introduction

Meat-based foods should be processed before consumption to destroy pathogens or microbes. The processing can also affect the nutrition and the level of toxicity (Kondjoyan et al., 2014). Most consumers select a cooking method that produces high-quality meat products with preferred textures and flavours (King & Whyte, 2006). The physical properties and quality are influenced by temperature and cooking time. The United States Department of Agriculture (USDA) recommends internal temperatures for several types of meat such as 62.8°C for steaks, roasts, and fish, 71.1°C for ground beef, 76.7 °C for chicken breast, and 82°C for whole chickens (King & Whyte, 2006).

During the cooking process, the properties of the typical meat protein and the structural profile of the texture are changed. This results in shrinkage of flesh fibres, damage to cell membranes, aggregation and gelling of myofibrillar and sarcoplasmic proteins, as well as shrinkage and dissolution of connective tissue

(Lorenzo & Domínguez, 2014)(Adeyeye, 2017). Excessive use of heat also results in unwanted changes in meat quality, such as loss of nutritional value due to oxidation and lipid changes in some segments of protein fractions (Lorenzo & Domínguez, 2014).

Rendang is one of the typical foods of the Minangkabau people in West Sumatra. The processing takes about 6-7 hours at 80-90°C (Rini, Azima, Sayuti, & Novelina, 2016). This long process is influenced by the amount of meat used (Yenrina, Andhika, Ismed, Rasjmida, & Triyani, 2015). Therefore, the meat, coconut milk, and spices should also be adjusted and this greatly affects the length of processing time (Tornberg, 2005). The long process of making beef rendang at high temperatures also has an effect on changes in the nutrition of the fresh beef itself, especially beef fatty acids. There was the highest increase in saturated lauric acid and the lowest increase in arachidic acid. Total trans fatty acids also increase during the rendang cooking process (Yenrina et al., 2015).

Mushrooms have been consumed for a long time in Ancient Greece to provide strength for soldiers in battle, and were claimed to be "Food Gods". For centuries, China appreciated the properties of healthy food referred to as "the elixir of life." In conclusion, mushrooms are part of human culture for thousands of years and are quite in demand because of their sensory characteristics, recognized as culinary ingredients (Chang & Miles, 2004; Smith, Rowan, & Sullivan, 2002).

Currently, mushrooms are popular because of their reduced calories, carbohydrates, fats, sodium and absence of cholesterol. Besides, they contain essential nutrients, such as riboflavin, selenium, vitamin D, protein, potassium, niacin, and fibre. Furthermore, they have nutraceutical properties such as prevention or treatment of Parkinson's, Alzheimer's, hypertension, and for those at high-risk stroke. Mushrooms act as antibacterial, lowering agents' cholesterol, and immune system boosters for the body. Besides, they are an important source of bioactive compounds used as a dietary supplement (Valverde, Hernández-pérez, & Paredes-lópez, 2017). In developing countries, mushrooms are an alternative protein food which makes them play an important role in fighting food insecurity. In the world of the food and drug industry, knowledge of these fungi can help identify new food sources or products and their use in traditional medicine. Therefore, further exploration of the use of mushrooms as a functional food ingredient is needed for socio-economic growth (Hussain et al., 2023).

White oyster mushrooms can be used as a substitute for meat in rendang because of the vegetable protein that contains lots of fibre (Wardani & Widjanarko, 2013). The fibre in mushrooms is good for obese sufferers and can be used as an alternative to fibre in green vegetables which children do not like and even vegetarians can eat. Even white oyster mushrooms are safe for consumption by diabetics, hypertension, or the elderly. Recent studies have proved that oyster mushrooms could be a protein-based meat analogue that mimics the aesthetic quality (structure, taste, and appearance) of animal meat (Mazlan et al., 2020). Besides, white oyster mushrooms have a delicious and savoury taste that is close to the taste of meat. The fibrous texture of white oyster mushrooms will be similar to meat fibres when cooked properly. Another plus is the beta-glucan content, which can boost immunity in humans (Baeva et al., 2019).

Based on the reduction of eleven sensory attributes by PCA (Principle Component Analysis), there are new sensory characteristics of rendang of West Sumatra that can be distinguished by a group of attributes such as the aroma, cooking time, spices ingredients, and flavours. This study results in the effect of cooking time on sensory qualities (Rini et al., 2016). The innovations in making rendang are currently very diverse, such as lokan rendang, chicken rendang, and egg rendang. However, for vegetarians and people with degenerative diseases, innovations in making rendang are also needed which are safe for their consumption. Therefore, this study is focused on determining the best cooking time based on consumer acceptance of oyster mushroom rendang and evaluating the chemical analysis between white oyster mushroom rendang and beef rendang. So, it will be possible to create a new West Sumatra culinary invention.

2. Materials and Methods

The research was conducted in Padang, West Sumatra, Indonesia according to the established COVID-19 standards. Padang is the capital of the West Sumatra Province and has many traditional food centres. Moreover, the population in Padang is more heteroge-

ISSN-Internet 2197-411x OLCL 862804632
UniKassel & VDW, Germany- November 2023

neous compared to other cities in West Sumatra. It has several stages, namely the rendang processing stage and the consumer acceptance testing phase.

2.1 Production of oyster mushroom rendang

Producing mushrooms and meat rendang is quite different because the main ingredient has been replaced. Therefore, all ingredients should be accurately formulated to give the best mushroom rendang (Schifferstein, Kudrowitz, & Breuer, 2020). The process is carried out with a basic formula, and the processing stages are as follows. The quantity of mushroom is considered to be the quantity of the protein and the lowest level of coconut oil that could be used and the sensory characteristics are as similar as possible to beef rendang. 1 gram of oyster mushroom contains 10-30% of protein but beef alone contains a maximum of 19% of protein.

2.1.1 Tools and ingredients preparation

Tools are the most important thing to support the process of making rendang, and they should be kept dry to avoid contamination. Cleaning and drying tools follow the instructions of helpful food hygiene information for daily life. The equipment used were bowls, cutting boards, a spatula, a knife, a pan, a digital scale, and a food processor. The ingredients used to make rendang should be fresh and good, and the list is given in Table 1. The fresh ingredients were bought from the first-hand seller, and the identification was conducted through colours, smells, and textures. All tools and ingredients were cleaned with running water and all tools were sterilized first with sterilizer and steam stations.

2.1.2 Weighing

The process of weighing the ingredients was carried

Table 1. The basic ingredient formulation (proportion) of rendang

Ingredients	Quantity(g)	Baker Percent (%)
Fresh oyster mushrooms	500	100
Chile	100	26.80
Shallot	43.2	11.57
Garlic	31.6	8.46
caraway	2	0.53
Coriander	13	3.48
Peppers	10	2.68
Galangal	64.9	17.39
ginger	54.5	14.60
Salt	15	4.02
Turmeric leaves	12	3.21
Lime leaves	2.2	0.58
Bay leaves	2.7	0.72
Lemongrass	20	5.36
Tamarind	2	0.53
Grilled roasted coconut	80	21.44
coconut milk	1200	321.62

Note: The percentage is counted based on Baker Percent. The Bakers Percent method is a calculation method that uses the main ingredient as a comparison.

out to obtain the appropriate amount of raw material for making mushroom rendang. The weighing of materials was conducted using digital scales to obtain precise and accurate results. Digital scales can weigh down to the smallest (1 gram) to be more accurate. In weighing the materials, the condition of the scale should still be fit for use and should follow the recipe to give the best flavour. Table 1 gives the specific units of measurement of each ingredient. The accurate measuring of ingredients should be performed to maintain consistency and achieve the desired flavour profile.

2.1.3 Refinement stage

The main spices were refined using a food processor, including garlic, shallot, chilli, galangal, pepper, coriander, ginger, and salt. Before adding the seasonings, the food processor was designed to slice and chop the dry and hard food ingredients to create a smooth, thick blend. This phase was completed at a medium speed (approximately 1700 rpm) for 5 to 10 minutes.

2.1.4 Season stir

The primary seasoning in the stirring process was kept at a medium heat of 200 to 300°F to cook the spices without burning spices. All the spices were mashed except for the lemongrass. Then, it was stir-fried in a modest amount of oil. The oyster mushrooms were added after the spices produced a pleasant aroma, but the water content of the oyster mushrooms was first reduced manually by pressing them. All of this was combined, followed by the addition of coconut oil and grilled roasted coconut.

2.1.5 Cooking rendang

The prepared rendang seasoning was simmered with fresh oyster mushrooms over different cooking durations for 5, 6, and 7 hours on low heat, about 113 to 180°F, and was stirred frequently. The heat source was provided by a gas stove. To avoid overcooking the spice of rendang, it was stirred once every 10 minutes while cooking. The texture and colour of the rendang were evaluated to ensure it was cooked adequately.

2.2 Sample and Participant Characterization

The three different rendang samples (RJ5, RJ6, and RJ7) were assigned to participants by purposive sampling technique. Participants met the criteria for the distribution of age, gender, and knowledge regarding rendang, including taste, aroma, texture, and basic ingredients. The evaluation was carried out through random interviews according to the criteria. Respondents were about 72, including 46 females and 26 males. The distribution based on age was 41.67% of respondents aged less than 45, and 58.33% who were more than 45 years old. The samples (RJ5, RJ6, and RJ7) distributed to respondents had three processing time variants (5, 6, and 7 hours, respectively). All samples were given to all respondents in order to measure their preferences for texture, aroma and taste.

2.3 Data collection

2.3.1 Sample serving procedures

The first step in delivering samples is to establish a sensory evaluation approach tailored to meet individual requirements. This task was performed by a sensory specialist in the research team. Except for the variable(s) being evaluated, the serving methods and sample preparation processes were standardised. According to the Schifferstein et al (2020) study, the sensory specialist was instructed to pay careful attention when writing the test protocols. Additionally, they were asked to choose the serving containers and the number of samples to be served.

A standard size of one tablespoon was determined by providing samples from the same cooking process, hence the visual appearance and serving temperature are similar. Plastic serving containers measuring 10 x 15 cm were utilized for the experiment. During the organoleptic test, two enumerators were also present to state the requirements.

2.3.2 The organoleptic and overall acceptance test

This study performed ordinal scale and best-worst rank. The ordinal scale allowed one to determine the order in which the consumers ranked the items for the most accepted (the most liked) and the least accepted (the least liked) product out of the three available. Responses were then converted into individual scales for each sample: (1) the number of times a specific sample

ISSN-Internet 2197-411x OLCL 862804632

was indicated as the most accepted and the number of times it was considered as the least accepted were counted; (2) these numbers were subtracted (the most accepted were subtracted by the least accepted)(Pimentel, Gomes da Cruz, & Deliza, 2015).

The organoleptic test used the scoring analysis on taste, colour, texture, and aroma while the overall acceptance was determined by the hedonic test (Kristanti & Herminiati, 2019). The organoleptic assessment was carried out by 72 respondents which included 46 females and 26 males.

The hedonic test was performed to describe the degree of consumer acceptance and satisfaction with rendang. In order to classify the food processing time and age, the hedonic attribute scale with very like, like, ordinary, less like, and no like is used.

2.3.3 Methods of Scaling: category scales

Several different scaling methods were used to apply numbers to sensory experience, as shown in Table 2. This method involved the selection of discrete response possibilities to signify the sensation intensity or the degree of liking and preferences.

2.4 Moisture content analysis

Water content analysis was carried out by comparing two types of rendang, beef rendang and oyster mushroom rendang. The drying method is done using an oven. Both samples were put in a porcelain and labelled BR (Rendang Beef) and OMR (Oyster Mushroom Rendang). The first stage was tool sterilization. The porcelain was then baked in an oven at about 105°C for 1 hour, placed in a desiccator for 15 minutes, and then weighed. After the tool is sterile, about 3 grams of sample were added and heated for 6 hours at a temperature of around 105°C before being placed in a desiccator for 30 minutes or until the temperature reached room temperature. This was done to maintain the constant weight of the sample). The percentage of humidity was calculated by the following formula.

$$\text{Moisture content (\%)} = \frac{\text{Sample initial weight} - \text{Sample final weight (g)}}{\text{Sample initial weight (g)}} \times 100\%$$

2.5 Fat content analysis

The reflux method was used to analyse beef rendang and oyster mushroom rendang. The boiling flask was sterilized by placing it in the oven at 105°C for 1 hour, then cooling it in a desiccator for 15 minutes and weighing (A g). The sample weighed around 2-3 g (X g). The sample was then placed in a filter sheet which can be made of filter paper wrapped with fat-free cotton. The filter sleeve was finally inserted into the socket, and the condenser was installed according to the size of the socket used.

About 100 mL of hexane was added to the boiling flask (pyrex) and refluxed (pyrex) and refluxed with a reflux condenser (pyrex) for about 5 hours until the colour of the last drop indicated no colour (resulting in a clear drop). The extract obtained was placed into an oven at 105°C for 1 hour or more until the mass remained constant. The flask was cooled in a desicca-

Table 2. Example of category scales in the questionnaire

Organoleptic properties	Levels of pleasure	RJ 01	RJ 02	RJ 03
Taste	very like likes Ordinary Less like No Likes			

tor for 30 minutes and then weighed and labelled "B". The percentage of fat content was estimated using the equation below.

$$\text{Fat content (\%)} = \frac{B-A}{X} \times 100\%$$

2.6 Free fatty acids (FFA) analysis

3 grams of sample was weighed into a 25 ml Erlenmeyer flask, followed by the addition of 5 ml of 95% ethanol, and 3-5 drops of pp indicator (phenolphthalein). It is finally titrated with 0.1 N NaOH standard solution until the colour changed to pink (no changes were observed for 15 seconds). Three tests were performed. The percentage of free fatty acid content was calculated as follows:

$$\% \text{ FFA} = \frac{\text{mL NaOH x Fatty acid molecular weight x 100\%}}{\text{Sample weight x 1000}}$$

3. Results

Table 3 shows the hedonic test results of the three samples (RJ5, RJ6, and RJ7).

The participants (aged 45 and above) were more inclined to make food choices based on health considerations. On the contrary, those under the age of 45 were less concerned with this correlation and were more focused on the concern of food preparation and knowledge, prices, and time (Chambers, Lobb, Butler, & Traill, 2008), as seen in Table 4.

Table 5-7 shows the results of the organoleptic test on taste variations in cooking time. Variations occurred because varied cooking significantly influences the flavour of the finished product. As a result, organoleptic testing on the flavour of rendang at various cooking durations was an essential element to analyse.

The colour of rendang also changes with variations in cooking durations £. Furthermore, food colour can affect the choice of food by consumers (Clydesdale, 1993). But, in this study, the rendang receipt was same for RJ5, RJ 6, and RJ7 but the cooking durations were different Table 8-10 shows the organoleptic results of colour variations in cooking time.

The texture also has a significant influence on the choice of food. The texture of the oyster mushroom should be precisely defined. It is estimated that the mushroom will be softer than the meat due to the replacement with oyster mushrooms of higher texture. Table 11-13 shows the organoleptic test results on texture variations in cooking time.

The smell of food is another important factor affecting consumer acceptance of food. The distinctive aroma of oyster mushrooms may or may not be liked by consumers. However, using the same spices can balance the aroma of oyster mushrooms and beef rendang for all the samples. Table 14-16 shows the organoleptic results on texture variations.

Tables 17 and 18 show the overall data analysis of the organoleptic test and the significant differences in the mean.

Table 3. Respondents' choice of rendang

Sample	Respondents	Percentage (%)
RJ5	13	18.06
RJ6	15	20.83
RJ7	44	61.11
Total	72	100

Table 4. Choice of respondents based on age

Age	RJ5	RJ6	RJ7
Adults (<45)	9	9	12
Elderly people (≥45)	4	6	32
Total	13	15	44

ISSN-Internet 2197-411x OLCL 862804632

Table 5. Respondent's choice of taste for 5 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	10	13.89
likes	48	66.67
Ordinary	14	19.44
Total	72	100

Table 6. Respondent's choice of taste for 6 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	12	16.67
likes	19	26.39
Ordinary	41	56.94

Table 7. Respondent's choice of taste for 7 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	43	59.72
likes	17	23.61
Ordinary	12	16.67
Total	72	100

Table 8. Respondent's choice of colour for 5 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	11	15.28
likes	46	63.89
Ordinary	15	20.83
Total	72	100

Table 9. Respondent's choice of colour for 6 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	13	18.06
likes	17	23.61
Ordinary	42	58.33
Total	72	100

Table 10. Respondent's choice of colour for 7 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	45	62.50
likes	14	19.44
Ordinary	13	18.06
Total	72	100

Table 11. Respondent's choice of texture for 5 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	10	13.89
likes	47	65.28
Ordinary	15	20.83
Total	72	100

Table 12. Respondent's choice of texture for 6 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	14	19.44
Likes	16	22.22
Ordinary	42	58.33
Total	72	100

Table 13. Respondent's choice of texture for 7 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	44	61.11
likes	17	23.61
Ordinary	11	15.28
Total	72	100

Table 14. Respondent's choice of aroma for 5 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	10	13.89
likes	48	66.67
Ordinary	14	19.44
Total	72	100

ISSN-Internet 2197-411x OLCL 862804632

Table 15. Respondent's choice of aroma for 6 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	12	16.67
likes	16	22.22
Ordinary	44	61.11
Total	72	100

Table 16. Respondent's choice of aroma for 7 hours of cooking

Levels of pleasure	Respondents	Percentage (%)
very like	45	62.50
likes	15	20.83
Ordinary	12	16.67
Total	72	100

Table 17. Organoleptic test data analysis

Organoleptic components	RJ5		RJ6		RJ7	
	Means	SD	Means	SD	Means	SD
Taste	1.055556	0.578704	1.402778	0.7628657	0.5694444	0.7659366
Colour	1.055556	1.055556	1.402778	1.402778	0.5555556	0.5555556
Textures	1.069444	1.069444	1.388889	1.388889	0.5416667	0.5416667
Aroma	1.055556	1.055556	1.444444	1.444444	0.5416667	0.5416667

Table 18. T-test analysis

Organoleptic components	Comparison of RJ5 with RJ6		Comparison of RJ5 with RJ7		Comparison of RJ6 with RJ7	
	Q	Value	Q	Value	Q	Value
Taste	-2.5838	0.0118*	3.7925	0.0003**	5.0356	0.0000**
Colour	-2.5838	0.0118*	3.8549	0.0003**	5.1320	0.0000**
Textures	-2.3353	0.0224*	4.1686	0.0001**	5.1320	0.0000**
Aroma	-2.8815	0.0052*	3.9623	0.0002**	5.6113	0.0000**

**p<0.01

Table 19. The comparison of chemical characteristics between beef rendang and oyster mushroom rendang

	Water content (%)	Fat content (%)	Free Fatty Acids (%)
Beef Rendang	38.51	17.88	4.3
Oyster Mushroom Rendang	26.99	27.03	0.8

4. Discussion

4.1 Consumer acceptance

The duration of cooking greatly affects the nutritional value of food (Fabbri & Crosby, 2016). The boiling process can reduce nutritional value because food ingredients directly exposed to boiled water will reduce nutrients, especially water-soluble vitamins (such as vitamin B complex and vitamin C) and protein. In contrast, the frying process uses high temperatures above 160°C, which can reduce fat content and destroy vitamins and minerals. The weight of food after processing decreases ice due to the heat treatment, which reduces the volatile components.

Frying and roasting can reduce the weight of fresh food at a temperature of 90°c to 100°C more than cooking and boiling, more than 100°C. Weight loss occurs in foodstuffs undergoing a cooking process. The tested food showed a decrease in weight (cooking loss), and the highest loss occurred in frying (Pathare & Roskilly, 2016)(Tornberg, 2005).

Processing food using high temperatures can cause water evaporation. The higher the temperature, the more water molecules come out of the surface and become gas. Some nutrients were lost, and food tastes were improved. The cooked food was free from certain toxic substances, especially vegetable ingredients. Different diseases were avoided since cooking can kill germs found in foodstuffs (Pathare & Roskilly, 2016) (Tornberg, 2005).

According to Tables 3 and 4, the mushroom rendang cooked for 7 hours was the most liked by respondents, with a percentage of about 61.11%. Respondents who were aged 45 and above have a higher percentage of likeness, naming around 72.72%. The age of 45 years and over is considered to have the potential to suffer from diabetes mellitus, hypertension, and heart disorders, especially those with an unhealthy lifestyle.

In addition to serving as an alternative to typical West Sumatra food, this oyster mushroom rendang is also safe for people aged 45 years and over compared to beef (Hou et al., 2019); (Sulistiyowati & Senewe, 2014). The plant-based foods, including fresh fruits and vegetables, whole grains, legumes, seeds, and nuts and lower animal-based foods, particularly fatty and processed meats could be healthier alternative diets (Cena & Calder, 2020). A higher intake of red meat or preserved meat in midlife is associated with a higher risk of having cognitive impairment in later life (Baleato, Ferguson, Oldmeadow, Mishra, & Garg, 2022; Jiang et al., 2020). Furthermore, many studies have concluded that oyster mushrooms can be a source of dietary fibre with a texture similar to meat.

Tables 5-16 explain that when further analysed, oyster mushroom rendang cooked for 7 hours is superior in terms of taste and colour, texture, and aroma. This is evidenced by the high choice of respondents, namely 62.5% and 61.11% selected to like the colour and texture of mushrooms cooked for 7 hours. The tendency to select this was because mushroom rendang resembled meat rendang in terms of its dark brown colour, texture, and aroma. Any limitations or potential biases in this sensory evaluation process were avoided by giving a piece of beef rendang for comparing the colour, texture, and aroma.

According to Table 17, the mean (average) and SD (standard deviation) ranges for the taste, colour, texture, and aroma of rendang cooked at 5, 6, and 7 hours do not exceed the number (minus). This is also supported by the results of the t-test in Table 18, explaining the differences in taste, colour, texture, and aroma between rendang cooked for 5 and 6 hours, 5 and 7 hours, as well as 6 and 7 hours with a value of <0.05 each. The t-test showed that the different treatment or cooking process affects consumer acceptance of oyster mushroom rendang.

4.2 Chemical analysis

The water content in food can differ from one another even though these foods are both similar types of food, such as beef rendang and oyster mushroom rendang. The water content in the food was analysed to determine the stability and quality of the two rendang. The presence of water in the meal can affect the resistance of rendang. If the water content is low, the growth of microorganisms in the food will be slow, which will result in the food being more durable. Based on the data in Table 19, it can be seen that the moisture content of oyster mushroom rendang was smaller than beef rendang.

ISSN-Internet 2197-411x OLCL 862804632

The water content in oyster mushroom rendang is lower than in beef rendang. The low moisture content of oyster mushroom rendang is due to the slow cooking process of making rendang and drying the oyster mushrooms before cooking so that the rendang becomes dry, besides that the oyster mushroom rendang cooking process also takes hours, which causes the liquid in the rendang to blend with various spices until it becomes dry (Nurmufida, Wangrimen, Reinalta, & Leonardi, 2017). Cooking beef rendang in this study took about 3 hours, with a temperature of around 80-93°C, while cooking oyster mushroom rendang took around 7 hours. In fresh conditions, the water content of beef is 60-70% while the water content of oyster mushrooms is 90% (Elattar, & Awd-Allah, 2019).

The long cooking process causes the moisture content of rendang to decrease. The longer the food is exposed to heat, the less water will be in the rendang, this is due to the evaporation process. In terms of texture, aroma, colour, and taste between oyster mushroom and beef rendang, there were no significant differences but in the quality between these two rendang, the oyster mushroom is characteristically low-water-activity foods and might not support the growth of vegetative pathogens such as Salmonella (Liu, Roopesh, Tang, Wu, & Qin, 2022).

Fat is a source of energy needed by the body besides carbohydrates and proteins. Fat provides about 9 kcal/gram for the body. Based on the data obtained in Table 19, it can be seen that the average fat content of beef rendang is smaller than that of oyster mushroom rendang. Long cooking time also affects the fat content of rendang. The long cooking of beef rendang causes coconut milk to release oil and increases the fat content of rendang. Therefore, the fat in the oyster mushroom rendang is higher than the rendang fat (Faridah & Holinesti, 2021). Even so, the fat content in the oyster mushroom is still within the Indonesian national standard range, which is a maximum of 30%. Free fatty acids are values that indicate the amount of free fatty acids present in the fat after hydrolysis. The hydrolysis reaction can be caused by the amount of water, the activity of microorganisms, or the presence of enzymes. FFA is the result of the degradation of triglycerides as a result of oil defects.

The resulting FFA value is used to determine the degree of defect of the fat. Table 19 showed the average range of FFA content of beef rendang was 43% while the FFA content of oyster mushroom rendang was only 0.8%. The low FFA is related to the water content of the oil. If the water content in the oil is high, a hydrolysis reaction will occur which can increase the FFA level, and vice versa. The fat hydrolysis reaction can occur in the presence of water and heating. Fat hydrolysis can occur in saturated fat or unsaturated fat. At first, the fat will be hydrolysed to form glycerine and free fatty acids, then a further reaction will occur which causes the breakdown of glycerine and free fatty acid molecules. By triggering the heating process, the fat (triglycerides) is hydrolysed to form free fatty acids and glycerol. At heating temperature, fats (triglycerides) are hydrolysed into free fatty acids and glycerol. At too high a heating temperature, the bonds in glycerine can break, causing the release of two water molecules and the formation of acrolein compounds. Acrolein is volatile and forms fumes that can irritate the eyes. For edible foods with a high concentration of fat or oil, the maximum FFA is 2%.

The higher the FFA, the more food product has signs of fat defects. The high concentration of FFA in fats/oils in food indicates that the food is damaged, where at maximum levels the food is not suitable for consumption. Damage to fats and oils from hydrolysis will cause rancidity (Ramadhani, Widati, & Rosyidi, 2022). Rancidity will certainly affect the aroma and flavour of the rendang product. Moreover, the previous study explained that high amounts of FFA may have adverse effects on qualities of taste, colour, and shelf life, and may also cause significant levels of refining loss (Shi et al., 2018).

5. Conclusion

This study showed that the cooking time of oyster mushroom rendang affects the consumer's acceptance of texture, aroma, taste, and colour. The mushroom cooked for 7 hours is the most preferred by respondents, with a percentage of about 61.11%. From the distribution that likes mushroom rendang cooked for 7 hours, respondents over 45 years old have a higher percentage around 72.72% or 32 individuals.

Conflict of interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analysis, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results

Acknowledgments

The authors would like to thank Lembaga Penelitian dan Pengabdian Masyarakat Universitas Negeri Padang for funding this work with a contract number 1436/UN35.13/LT/2020

References

Elattar, A. M., Hassan, S., & Awd-Allah, S. F. A. (2019). Evaluation of oyster mushroom (Pleurotus ostreatus) cultivation using different organic substrates. Alexandria Science Exchange Journal, 40(5), 427–440. doi: 10.21608/asejaiqjsae.2019.49370

Adeyeye, S. A. O. (2017). Effect of Processing Methods on Quality and Safety of Suya, a West African Grilled Meat. Journal of Culinary Science and Technology, 15(2), 158–170. doi: 10.1080/15428052.2016.1225536

Baeva, E., Bleha, R., Lavrova, E., Sushytskyi, L., Čopíková, J., Jablonsky, I., Klouček, P., & Synytsya, A. (2019). Polysaccharides from Basidiocarps of Cultivating Mushroom Pleurotus ostreatus: Isolation and Structural Characterization. Molecules, 24(15), 2740. doi: 10.3390/molecules24152740

Baleato, C. L., Ferguson, J. J. A., Oldmeadow, C., Mishra, G. D., & Garg, M. L. (2022). Plant-Based Dietary Patterns versus Meat Consumption and Prevalence of Impaired Glucose Intolerance and Diabetes Mellitus: A Cross-Sectional Study in Australian Women. Nutrients, 14(19), 4152. doi: 10.3390/nu14194152

Cena, H., & Calder, P. C. (2020). Defining a healthy diet: Evidence for the role of contemporary dietary patterns in health and disease. Nutrients, 12(2), 334. doi: 10.3390/nu12020334

Chambers, S., Lobb, A., Butler, L. T., & Traill, W. B. (2008). The influence of age and gender on food choice: A focus group exploration. International Journal of Consumer Studies, 32(4), 356–365. doi: 10.1111/j.1470-6431.2007.00642.x

Chang, S. T., & Miles, P. G. (2004). Mushrooms: Cultivation, nutritional value, medicinal effect, and environmental impact (2nd ed.). Boca Raton: CRC Press.

Clydesdale, F. M. (1993). Color as a factor in food choice. Critical Reviews in Food Science and Nutrition, 33(1), 83–101. doi: 10.1080/10408399309527614

Fabbri, A. D. T., & Crosby, G. A. (2015). A review of the impact of preparation and cooking on the nutritional quality of vegetables and legumes. International Journal of Gastronomy and Food Science, 3, 2–11. doi: 10.1016/j.ijgfs.2015.11.001

Faridah, A., & Holinesti, R. (2021). Evaluation of Nutritional Content of Beef Rendang Using Wet and Dry Seasonings. IOP Conference Series: Earth and Environmental Science, 810(1), 012055. doi: 10.1088/1755-1315/810/1/012055

Hou, Y., Dan, X., Babbar, M., Wei, Y., Hasselbalch, S. G., Croteau, D. L., & Bohr, V. A. (2019). Ageing as a risk factor for neurodegenerative disease. Nature Reviews Neurology, 15(10), 565–581. doi: 10.1038/s41582-019-0244-7

Hussain, S., Sher, H., Ullah, Z., Elshikh, M. S., Al-Farraj, D. A., Ali, A., & Abbasi, A. M. (2023). Traditional Uses of Wild Edible Mushrooms among the Local Communities of Swat, Pakistan. Foods, 12(8). doi: 10.3390/foods12081705

Jiang, Y. W., Sheng, L. T., Pan, X. F., Feng, L., Yuan, J. M., Pan, A., & Koh, W. P. (2020). Meat consumption in midlife and risk of cognitive impairment in old age: the Singapore Chinese Health Study. European Journal of Nutrition, 59(4), 1729–1738. doi: 10.1007/s00394-019-02031-3

King, N. J., & Whyte, R. (2006). Does it look cooked? A review of factors that influence cooked meat color. Journal of Food Science, 71(4), R31–R40. doi: 10.1111/j.1750-3841.2006.00029.x

Kondjoyan, A., Kohler, A., Realini, C. E., Portanguen, S., Kowalski, R., Clerjon, S., Gatellier, P., Chevolleau, S., Bonny, J.-M., & Debrauwer, L. (2014). Towards models for the prediction of beef meat quality during cooking. Meat Science, 97(3), 323–331. doi: 10.1016/j.meatsci.2013.07.032

Kristanti, D., & Herminiati, A. (2019). Characteristics of physical, chemical, and organoleptic properties of inulin-enriched pudding as a complementary food. IOP Conference Series: Earth and Environmental Science, 251(1). doi: 10.1088/1755-1315/251/1/012032

Liu, S., Roopesh, M. S., Tang, J., Wu, Q., & Qin, W. (2022). Recent development in low-moisture foods: Microbial safety and thermal process. Food Research International, 155, 111072. doi: 10.1016/j.foodres.2022.111072

Lorenzo, J. M., & Domínguez, R. (2014). Cooking losses, lipid oxidation and formation of volatile compounds in foal meat as affected by cooking procedure. Flavour and Fragrance Journal, 29(4), 240–248. doi: 10.1002/ffj.3201

Mazlan, M. M., Talib, R. A., Chin, N. L., Shukri, R., Taip, F. S., Nor, M. Z. M., & Abdullah, N. (2020). Physical and Microstructure Properties of Oyster Mushroom-Soy Protein Meat Analog via Single-Screw Extrusion. Foods, 9(8), 1023. doi: 10.3390/foods9081023

Nurmufida, M., Wangrimen, G. H., Reinalta, R., & Leonardi, K. (2017). Rendang: The treasure of Minangkabau. Journal of Ethnic Foods, 4(4), 232–235. doi: 10.1016/j.jef.2017.10.005

Pathare, P. B., & Roskilly, A. P. (2016). Quality and Energy Evaluation in Meat Cooking. Food Engineering Reviews, 8(4), 435–447. doi: 10.1007/s12393-016-9143-5

Pimentel, T. C., da-Cruz, A. G., & Deliza, R. (2015). Sensory Evaluation: Sensory Rating and Scoring Methods. In Caballero, B., Finglas, P. M., & Toldra, F. (1st ed.), Encyclopedia of Food and Health. Elsevier.

Ramadhani, A. A., Widati, A. S., & Rosyidi, D. (2022). Chemical Characteristics of Beef Rendang from the Results of Coconut Milk Substitution with Fibercreme. Jurnal Ilmu Dan Teknologi Hasil Ternak, 17(2), 94–102. doi: 10.21776/ub.jitek.2022.017.02.4

Rini, Azima, F., Sayuti, K., & Novelina. (2016). The Evaluation of Nutritional Value of Rendang Minangkabau. Agriculture and Agricultural Science Procedia, 9, 335–341. doi: 10.1016/j.aaspro.2016.02.146

Schifferstein, H. N. J., Kudrowitz, B. M., & Breuer, C. (2020). Food Perception and Aesthetics - Linking Sensory Science to Culinary Practice. Journal of Culinary Science and Technology, 20(4), 293-335. doi: 10.1080/15428052.2020.1824833

Shi, L., Zheng, L., Zhao, C., Huang, J., Jin, Q., & Wang, X. (2018). Effects of deacidification methods on high free fatty acid containing oils obtained from sea buckthron (Hippophaë rhamnoides L.) berry. Industrial Crops and Products, 124, 797–805. doi: 10.1016/j.indcrop.2018.08.059

Smith, J. E., Rowan, N. J., & Sullivan, R. (2002). Medicinal mushrooms: A rapidly developing area of biotechnology for cancer therapy and other bioactivities. Biotechnology Letters, 24(22), 1839–1845. doi: 10.1023/A:1020994628109

Sulistiyowati, N., & Senewe, F. P. (2014). Pattern of Cause of Death At The Productive Age (15-54 Years Old) ("Further Analysis of "The Development of the Registration of Death and Cause of Death in Districs in Indonesia in 2012"). Indonesian Journal of Reproductive Health, 5(1), 36–46.

Tornberg, E. (2005). Effects of heat on meat proteins - Implications on structure and quality of meat products. Meat Science, 70(3), 493–508. doi: 10.1016/j.meatsci.2004.11.021

Valverde, M. E., Hernández-pérez, T., & Paredes-lópez, O. (2017). Inside Front Cover (Editorial Board). Phytochemistry Letters, 20(1).

Wardani, N. A. K., & Widjanarko, d. S. B. (2013). Potential of Oyster Mushroon (Pleurotus ostreatus) and Gluten in the Production of Artificial Meat with High Fiber Content. Jurnal Teknologi Pertanian, 14(3), 151–164.

Yenrina, R., Andhika, D., Ismed, Rasjmida, D., & Triyani, P. (2015). The effect of repeated heating on fatty acid profile of beef and spices of Rendang. International Journal on Advanced Science, Engineering and Information Technology, 5(2), 75–79. doi: 10.18517/ijaseit.5.2.489

ISSN-Internet 2197-411x OLCL 862804632