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Organoleptic qualities of kefir functional foods during different fermentations in coconut shells

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Abstract
The research aims to determine the organoleptic qualities of kefir functional food during different fermentations in coconut shells. The exotic appearance of products served in coconut shells really needs to be displayed as a diversified product. This research used fresh cow's milk, kefir grains as a starter, and coconut shells as a fermentation container. The research design using a Completely Randomized Design (CRD) with four treatments and five replications, so that there were 20 experimental units. The treatment is P_1 (functional food kefir fermented in coconut shell for 1 day), P_2 (functional food kefir fermented in coconut shell for 2 days), P_3 (functional food kefir fermented in coconut shell for 3 days), and P_4 (functional food kefir fermented in coconut shell for 4 days) and five replications. The organoleptic test results of kefir functional food during different fermentations in coconut shells gave results that were not significantly different ($p>0.05$) in all treatments (P_1, P_2, P_3, P_4). The conclusion of this organoleptic test illustrate the level of liking for the product and its packaging which is able to inspire that the product is included in the functional food category, the panelists gave a favorable response and is very suitable for consumption for health.

Keywords: Organoleptic, functional food, kefir, coconut shell

Introduction
Functional food is food with active component content, can provide health benefits, beyond the benefits provided by the nutrients contained therein. It is believed that functional foods can prevent or reduce degenerative diseases. This is caused by the physiological properties of functional foods determined by the bioactive components contained therein such as antioxidants, inulin, dietary fiber, PUFA, FOS, prebiotics and probiotics (Mejaya, *et al*. 2020) [10]. Indonesia is rich in food sources with bioactive contents that have the potential to be developed. Antioxidants are compounds that can slow down cell damage due to free radicals produced in the body due to foreign substances entering the body. Free radicals are substances produced in the body that react with the external environment. One of the functional food products, namely kefir. The kefir in this research is made from cow's milk, but milk is a food that is not optimal for health, therefore it must be processed into functional food, one of which is kefir fermented in coconut shells.

Kefir is fermented with kefir grains (starter bacteria) which consist of yeast, bacteria *Lactobacillus*, *Acetobacter* and *Streptococcus sp.* (Lengkey, *et al.* 2013) [7]. Bacteria dominate the kefir fermentation process *Lactobacillus*, *Streptococcus sp* and *Leuconostoc* which works as a fermenter which produces lactic acid, and yeast which produces carbon dioxidant and alcohol. This creates a sour taste with a hint of alcohol and soda and the combination of carbohydrates and alcohol creates a foam that creates a fizzing character in kefir. Kefir is very beneficial for health, contains fiber and antioxidants to ward off free radicals, but has the drawback of a sour taste. This sour taste is a primary product of the fermentation process of lactic acid bacteria which is also beneficial for health, but is less popular with consumers. This sour taste can be reduced through fermentation using coconut shells.

In general, the milk fermentation process is carried out in a vacuum container (Jar), but in this study, coconut shells were used as a fermentation container. Coconut contains fat, an essential amino acid which functions to repair damaged body tissue (Hieronymus, 1998) [6]. The phenolic antioxidants in coconuts can protect cells from oxidative damage to slow the aging process. Even though coconuts contain fat, the fat is in the Medium Chain Triglycerides (MCT) whose metabolic system is different from other types of fat, namely that it absorbs directly and quickly in the small intestine, is used:

1. As an energy source.
2. Increases body fat burning as a substitute for long chain saturated fats.
3. Contains the mineral manganese, supports enzyme work and fat metabolism.
4. Copper, for bone formation and heart fitness.
5. Lowers LDL and increases HDL.
6. As a diet food.

Lindawati *et al.* (2019) [9] reported that Kefir is antimicrobial and useful for body health by reducing high blood pressure/hypertension. There is antimicrobial activity fermented in coconut shells against bacteria Staphylococcus aureus and *Escherichia coli* indicated by forming a clear zone diameter of 10.50-11.30 mm, and a total of 14.3 x 10 lactic acid bacteria 6 CFU/g (Yuniarti, *et al.*, 2021) [15]. The fermentation process in a coconut shell container can influence the taste of a product, where cow's milk kefir is incubated in a jar and in a light green coconut shell (*Cocos nucifera* L. var. viridis Hassk) with and without coconut meat, panelists gave a numerical scale response of 3.25 (Ginting *et al.*, 2022) [4].

Based on the description above, this research really needs to be carried out to determine the panelists' level of preference for the diversification of functional food products with exotic and traditional product packaging as the packaging appearance that people want as a form of obtaining natural products without the addition of chemicals as preservatives as well as coconut shells. As a fermentation container and packaging for this kefir functional food product.

Materials and Methods

The research was carried out in the Animal Products Technology and Microbiology Laboratory, Faculty of Animal Husbandry, Udayana University for 3 months. The materials used in this research were 20 liters of cow's milk, 1 liter of kefir seed starter, and 20 coconut shells. The tools used in making kefir include pans, jars, stoves, measuring cups, aluminum foil, label paper, tissue, stirring spoons, thermometers, insulation/duct tape, and machetes. The tools used for organoleptic testing are small plastic cups, writing utensils, spoons, paper plates, test formats, and semi-trained panelists. This research used a Completely Randomized Design (CRD) consisting of 4 treatments with 5 replications to obtain 20 experimental units. Each experimental unit uses one liter of fresh milk. The treatments in this study were as follows: (P_1) Functional food kefir fermented in coconut shell for 1 day, (P_2) Functional food kefir fermented in coconut shell 2 days, (P_3) Functional food kefir fermented in coconut shell 3 days, (P_4) Functional food kefir fermented in coconut shells for 4 days.

The process of making kefir follows Lindawati *et al.* (2015) [8], by pasteurizing 500 ml of cow's milk at 85 ºC for 30 minutes, the aim is to kill pathogenic bacteria. Then the temperature of the milk is lowered to room temperature ± 25 ºC. Milk is inoculated with kefir grains as a starter at 3% (w/v) and homogenized. Next, the milk is poured into the container provided according to the treatment (P_1, P_2, P_3 and P_4). The variable observed in this research is an organoleptic test based on the hedonic test (liking level test). The test includes color, aroma, texture, taste and overall acceptability following the method (Soekarto, 1985) [11]. The hedonic scale used is: 1 = strongly dislike; 2 = don't like; 3= neutral; 4= like; and 5 = really like it. The organoleptic test used 20 semi-trained panelists.

Statistical analysis

The data obtained in this study was analyzed using Kruskal Wallis to determine the differences among treatment. If differences, were found (p<0.05), then further analysis was performed with the Mann-Whiteney Test (Steel and Torrie, 1995) [13]

Results and Discussion

Result

The results obtained from the organoleptic test for the level of liking (color, taste, aroma, texture and overall acceptability) of kefir functional food fermented at different times in coconut shells can be seen in Table 1 below:

Table 1: Organoleptic qualities of functional food kefir during different fermentations in coconut shell

Variable	Treatment [1]				SEM [3]
	P_1	P_2	P_3	P_4	
Color	3,40$^{a2)}$	3,16^a	3,36^a	3,36^a	0,13
Taste	3,12^a	3,08^a	3,16^a	3,16^a	0,14
Aroma	3,84^a	3,36^a	3,60^a	3,52^a	0,18
Texture	3,08^a	3,08^a	3,32^a	3,20^a	0,14
Total Receipts	3,24^a	3,04^a	3,36^a	3,20^a	0,16

Note

1. **Treatment P_1:** The functional food kefir is fermented in coconut shells for 1 day.
   Treatment P_2: Kefir functional food was fermented in coconut shells for 2 days.
   Treatment P_3: The functional food kefir is fermented in coconut shells for 3 days.
   Treatment P_4: The functional food kefir is fermented in coconut shells for 4 days.
2. Values with the same letter in the same row are statistically not significantly different (p>0.05).
3. SEM: Standard Error of the Treatment

Table 2: Organoleptic quality of functional food kefir

Variable	Response	
	Like	Do not like
Panelists' responses to coconut packaging	3,40^a	3,16^a

Note

1. Values with the same letter in the same row are statistically not significantly different (p>0.05).

Color: The analysis results obtained from the organoleptic quality test for the level of preference showed that the panelists' preferences for the color of the functional food kefir fermented differently in coconut shells showed that the results were not significantly different (p>0.05) between treatments P_1, P_2, P_3 and P_4. The numerical scale for color preference levels in this study ranged from 3.16 to 3.40 with criteria leading to liking (Table 1).

Taste: The research results (Table 1) show that the level of panelists' preference for the taste of the functional food kefir is not significantly different (p>0.05) in all treatments P_1, P_2, P_3 and P_4. The numerical scale for the level of liking for the taste of this research ranges from 3.08 to 3.16 with the criteria leading to liking.

Aroma: The results of statistical analysis (Table 1) of the level of liking obtained from the organoleptic quality test show that the panelists' liking for the aroma of the functional food kefir fermented in coconut shells showed results that were not significantly different (p>0.05) between treatments P_1, P_2, P_3 and P_4. The numerical scale for the level of liking in this study ranged from 3.36 to 3.84 with the criteria leading to liking.

Texture: The research results (Table 1) show that the level of panelists' preference for the texture of cow's milk kefir is not significantly different (p>0.05) between treatments P0, P_1 and P_2. The numerical scale for the level of liking in this study ranged from 3.08 to 3.32 with the criteria leading to liking.

Overall Acceptance: The results of statistical analysis (Table 1) of the level of liking obtained from the organoleptic quality test show that the panelists' liking for the overall acceptance of kefir functional food fermented in coconut shells showed results that were not significantly different (p>0.05) between treatments P_1, P_2, P_3 and P_4. The numerical scale for the level of liking in this study ranged from 3.04 to 3.36 with the criteria leading to liking.

Discussion

Color: Color is an objective result of the sense of sight in observing and evaluating a product. Organoleptically, color assessment uses the sense of sight. One of the factors determining consumer acceptance of food products is color. This is supported by Amrulloh *et al*., (2017) [1] that color is one of the parameters used to assess and can support the quality of a food product. The analysis results obtained from the organoleptic quality test for the level of preference showed that the panelists' preferences for the color of the functional food kefir fermented differently in coconut shells showed that the results were not significantly different (P>0.05) between treatments P_1, P_2, P_3 and P_4. The numerical scale for the level of color preference in this study ranges from 3.16 to 3.40 with the criteria leading to liking and can be seen more clearly in Table 1. The color of kefir obtained from all treatments P_1, P_2, P_3 and P_4 is yellowish white. The color seen by the panelists in the functional food product kefir is because the basic ingredient in making kefir is cow's milk which is yellowish white in color. This is supported by Christi *et al*. (2022) [2] reported that the color of milk is bluish white and golden yellow which is caused by fat globules, while the blue color of milk is caused by the protein content being higher than the fat content. The fat in milk will be degraded by lactic acid bacteria which produces a yellowish white kefir color. Apart from lactic acid bacteria, the lipase enzyme also plays a role in breaking down fat. This is also supported by Srianta *et al*. (2015) [12] who stated that the sensory characteristics of kefir are yellowish white in color with a typical yeasty aroma and sour taste. In all treatments it was suspected that the lipase enzyme was not working optimally because the pH produced by fermented milk was relatively low (acid), so that in all treatments P_1, P_2, P_3 and P_4 it gave the same relatively yellowish white color. This is supported by Yuniarti *et al*. (2021) [15] that the pH of cow's milk kefir incubated with green coconut meat obtained a pH value of (3.95-4.38).

Taste: Taste is one that plays an important role in determining preference for a product using the sense of taste. The taste is formed as a result of the taste receptor cells coming into contact with the upper oral cavity, the cells that provide the taste sensation are transmitted to the brain cells. Consumers' preferences for a food ingredient are greatly influenced by the taste, aroma and feelings that arise after consuming a product (Srianta, 2015) [12]. The results of the organoleptic test on the level of panelists' liking for the taste of the functional food kefir showed that the results were not significantly different (p>0.05) in all treatments P_1, P_2, P_3 and P_4 with a numerical scale ranging from 3.08 to 3.16 with the criteria leading to liking. Panelists responded to the taste of all treatments P_1, P_2, P_3 and P_4, namely sour taste. The sour taste that is formed occurs due to the activity of lactic acid bacteria (Streptococcus) biodegrading lactose into glucose, then broken down into pyruvic acid and lactic acid, resulting in a sour taste in the functional food kefir. Lindawati *et al*. (2019) [9] reported the results of their research that the sour taste of kefir occurs due to a decrease in pH caused by the activity of lactic acid bacteria (Streptococcus) which biodegrades lactose, giving rise to a sour taste. At this time Lactobacillus appears at the same time as yeast to biodegrade glucose in milk, and at the same time it is thought that yeast biodegrades glucose in coconut as well. This is supported by Hawusiwa *et al*. (2015) reported that yeast will break down glucose to form pyruvic acid, then the pyruvic acid is broken down into acetaldehyde which then undergoes dehydrogenation to become alcohol, causing the kefir to taste fizzing. The sour taste of milk fermented with lactic acid bacteria was visible during 24 hour incubation (P_1). Fermentation in kefir is slightly different from yogurt. This is because in the kefir fermentation process the lactic acid bacteria consist of homofermentative and heterofermentative. Homofermentative bacteria will break down sugar into 85% lactic acid, while heterofermentative bacteria will break down sugar into lactic acid, acetic acid and ethanol (Widodo, 2003) [14]. The standard requirement for lactic acid levels for fermented milk is a minimum of 0.3% (Codex, 2003) [3].

Aroma: Aroma is a combination of taste and smell that is inhaled when tasting something using the sense of smell. The results of the organoleptic quality test showed that the panelists' preference for the aroma of the functional food kefir fermented in coconut shells showed results that were not significantly different (p>0.05) between treatments P_1, P_2, P_3 and P_4 on a numerical scale ranging from 3.36 to 3.84. With neutral criteria towards liking. The aroma of milk is influenced by various things, including the fatty acids contained in milk. This is supported (Sulmiyati *et al*. 2016) that the smell of milk is more specific because of the high fat content. In the 1 day fermentation treatment (P_1), the panelists gave a relatively high favorable response, namely the neutral aroma of milk, this indicates that the aroma has not been mixed optimally with the typical coconut aroma because the fermentation time tends to be short. This is supported by Devianti *et al*. (2018) reported that the nature of the fat in cow's milk generally easily absorbs aromas from the surrounding environment. As the functional food kefir ferments for a long time by the lactic acid bacteria in the coconut shell, it will give rise to a sour aroma mixed with coconut. This is supported by Rohman *et al*. (2019) reported that lactic acid bacteria will produce lactic acid so that the aroma that appears in kefir is sour Whichcaused by the presence of volatile compounds, which can be captured by the sense of smell. The number of volatile compounds such as lactic acid, acetic acid, and ethanol formed during fermentation can also influence how sharp the aroma of the kefir functional food is, thereby influencing the hedonic results (panelists' level of preference). The number of lactic acid bacteria will greatly influence the volatile compounds that cause the sour aroma in kefir. This is supported by Yuniarti *et al*. (2021) [15] reported that the total lactic acid bacteria of kefir fermented with green coconut shell meat was 14.3 x 106 CFU/g. So that the aroma produced in all treatments (P_1, P_2, P_3 and P_4) is the same acid.

Texture: Textural consistency (viscosity) is a physical characteristic that must be considered in determining the quality of fermented milk. Textural elements are felt in the mouth, assessed through sight and touch with the fingers. The texture produced by kefir is slightly thinner than yogurt. The organoleptic test results showed that the level of panelists' liking for the texture of cow's milk kefir was not significantly different (P>0.05) between treatments P0, P_1 and P_2 with a numerical scale ranging from 3.08 to 3.32 with the criteria leading to liking. The use of coconut shells in the kefir fermentation process does not have a real effect on the texture of kefir functional foodthis cow's milk. The texture of cow's milk kefir fermented in coconut shell with 3 day fermentation (P_3) is slightly thicker than 1 and 2 day fermentation (P_1, P_2). This can be caused by the glucose in the coconut shell being broken down by lactic acid bacteria into lactic acid which causes protein coagulation to increase. This is supported by research by Widodo (2003) [14] who reported that lactic acid bacteria (Lactobacillus) breaks down lactose into lactic acid which coagulates proteins. Total lactic acid is greatly influenced by the number of lactic acid bacteria contained in a food. Yuniarti *et al*. (2021) [15] reported the pH value of kefir fermented without and with light green coconut meat ranging from 3.95-4.11. Lindawati *et al*. (2019) [9] also reported the pH value of kefir whey is 3.95 with a total acid value of 2.52%. The consistency of food products will influence the level of consumer acceptance, where the taste, color and consistency of kefir has a thinner texture and softer milk gum (Haryadi, *et al*., 2013) [5]. This statement is in accordance with this research where the consistency of the texture is slightly thickened as indicated by the panelists' score towards liking with a value of 3.32 at a fermentation time of 3 days (P_3).

Overall Acceptance: Overall acceptance is a combined assessment of color, aroma, taste and texture/viscosity. The results of the organoleptic test on the level of liking for the overall acceptance of the functional food kefir during different fermentations in coconut shells showed that the results were not significantly different (p>0.05) with a numerical scale of 3.04-3.36 with neutral to liking criteria (Table 1). The assessment of the level of liking is subjective depending on the panelist's response where a product can be liked but not nutritious or vice versa, something that is highly nutritious may not be liked by the panelists (Amrulloh *et al*., 2017) [1]. The use of coconut shells in the long process of fermentation of the functional food kefir did not provide a significant effect (p>0.05) between treatments based on the panelists' assessment. However, the use of coconut shells in the fermentation process has added value, because there are bioactive compounds in coconut which causes this food to be classified as a functional food. This was reported by Yuniarti *et al*. (2021) [15] that the antimicrobial activity of cow's milk kefir fermented with meat in green coconut shells is higher than the control, as evidenced by the formation of a clear zone diameter in inhibiting bacterial growth Staphylococcus and *Escherichia coli*. Based on the panelist response data (Table 2.) towards coconut packaging when served during the organoleptic test, it shows a liking direction with a numerical scale of 3.40. The use of coconut shells as a container for kefir fermentation is appropriate because the panelists have an interest in consuming it because it is served directly in coconut shells. Apart from that, this product is classified as a functional food product that is beneficial for health, namely a drink containing probiotics, antioxidants and containing bioactive content.

Conclusion

Based on the results of this study, it can be concluded that functional food kefir during different fermentations in coconut shells does not affect the organoleptic quality of kefir (color, taste, aroma, texture and overall acceptability). The functional food kefir was fermented for 1, 2, 3 and 4 days in coconut shells. The panelists responded favorably with a numerical scale of 3.06-3.36. The panelists' response to serving kefir with coconut packaging gave a response towards liking with a numerical scale of 3.40.

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Conflict of interest declaration

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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