

The Effect of Kefir Incorporation on the Physicochemical and Sensory Properties of Bread

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Abstract

Kefir, a fermented milk beverage from the Caucasus region, is rich in probiotic microorganisms and bioactive compounds. This study aimed to evaluate the effects of kefir incorporation on sensory properties, physicochemical and microbiological bread as most commercial bread is often produced using synthetic additives. Kefir, a fermented milk beverage rich in probiotics as a natural alternative that may enhance bread quality without the need for synthetic additives and not widely being explored. This study focuses on evaluating the suitability of kefir in bread formulations and its effects on the physical, chemical, microbiological, and sensory qualities of bread. This study used three bread formulations, formulation 1 (2.8% yeast and no kefir), formulation 2 (34% kefir and 1.2% yeast) and formulation 3 (48.5% kefir with no yeast). The sensory evaluation using hedonics and scoring indicated that Formulation 2 received the highest scores for aroma, taste, texture and overall acceptability. Physicochemical analysis revealed that this formulation produced bread with desirable textural attributes, including a mean hardness of 5.91 N and elasticity of 5.39 mm. Additionally, it exhibited the highest bread volume (1690 cm³) and specific volume (3.7 cm³/g), indicating enhanced leavening and crumb structure. The pH value of pH 4, attributed to kefir's natural acidity, contributed to improved microbial stability, with microbial counts as low as Log 2.74 CFU/mL on day 7 of storage suggesting an extended shelf life. In conclusion, the incorporation of kefir at 34% in bread formulation significantly enhances textural quality, microbial safety and sensory acceptance. Kefir presents a viable alternative to conventional fermentation agents in breadmaking. This study was awarded a Gold Medal at the Research; Innovation & Product Launching held in Politeknik Sultan Haji Ahmad Shah Kuantan in 2023. This recognition highlights the innovative potential of kefir-based bread as a functional food product with high quality and commercial viability.

1. Introduction

Kefir is a fermented dairy product distinguished by its creamy texture, white color and viscosity like that of yogurt. Originating from the Caucasus region, kefir is traditionally produced by fermenting pasteurized milk with kefir grains (Fig 1), a complex symbiotic matrix of bacteria and yeasts embedded in a polysaccharide-protein network.



Fig. 1 Kefir grain

Kefir grains primarily composed of lactic acid bacteria (LAB) such as *Lactobacillus* spp. and *Streptococcus* spp., as well as yeasts including *Candida*, *Saccharomyces* and *Zygosaccharomyces* spp. These microorganisms play a pivotal role in defining kefir's organoleptic and biochemical characteristics. LAB metabolizes lactose into lactic acid, resulting in the product's distinctive sour taste while also acting as a natural preservative through pH reduction and inhibition of spoilage microorganisms. Concurrently, yeasts contribute to the formation of ethanol, carbon dioxide and a range of bioactive metabolites such as amino acids, peptides and vitamins that enhance flavor complexity and aroma [1].

The microbial diversity of kefir is significantly higher than that of conventional yogurt cultures, with up to 60 different strains identified within kefir grains [1], [4]. This diversity is essential for the unique physicochemical and sensory properties of kefir. The metabolic processes involved, including glycolysis, proteolysis, and lipolysis, lead to the formation of various volatile compounds that are responsible for kefir's characteristic taste and aroma. The nutritional content of the milk, particularly its carbohydrate, protein and fat concentrations, play a critical role in microbial growth and metabolite production [5].

Kefir typically exhibits an acidic pH of approximately 4.6 and contains trace levels of ethanol (0.2–0.5%) due to yeast fermentation. Its proximate composition includes approximately 89–90% moisture, 0.2% fat, 3.0% protein, and 6.0% carbohydrates, in addition to measurable levels of lactic acid and alcohol [5]. Nutritionally, kefir serves as a rich source of bioavailable proteins particularly soluble casein essential vitamins, minerals (e.g., calcium, phosphorus, magnesium), and enzymes. Furthermore, it contains significant amounts of amino acids such as tryptophan, serine, and lysine, which are implicated in nervous system function, immune response modulation, and energy metabolism [3]. The unique sensory characteristics, nutritional profile and probiotic potential, kefir has garnered increasing interest in the food industry and is incorporated into a wide range of applications, including smoothies, salad dressings, and functional health beverages

This study investigates the suitability of incorporating kefir into bread production. The goal is to explore its potential to diversify the use of kefir in baked goods, improve the final product's texture without the need for additional enzymes and extend the bread's shelf life. This research aims to achieve three main objectives. First, to determine the optimal percentage of kefir for use in the bakery product. Second, to evaluate the acceptance level of the kefir bread among consumers through sensory evaluation using hedonic and scoring tests. Third, to analyze the chemical (pH), quality (texture, bread weight, and volume) and microbiological properties of the finished product. This study aims to determine the use of kefir milk as a leavening agent in bread products. The research will utilize commercially processed kefir milk rather than traditional fermentation methods that require a multi-day process with kefir grains. The study will test three different formulations: Formulation 1, which contains 2.8% yeast; Formulation 2, which is a combination of yeast and kefir, containing 34% kefir and 1.2% yeast; and Formulation 3, which contains 48.5% kefir.

2. Methodology

2.1 Materials

The bread was prepared using a standard list of ingredients, including high-protein flour, sugar, vegetable fat, eggs, skim milk, salt and water. Three formulations were developed, a control bread (Formulation 1) using 2.8% yeast, a combination bread (Formulation 2) containing 34% kefir and 1.2% yeast and a final bread (Formulation 3) that relied solely on 48.5% kefir. The dry ingredients (flour, yeast, sugar, salt, bread improver) were first mixed. It is important to add salt at the end to avoid deactivating the yeast. Wet ingredients (kefir milk, eggs, filtered water) were then added and the dough was mixed for 20 minutes until it reached a developed stage. The dough underwent two proofing stages: a first rest for 30 minutes and a second for 10 minutes. The dough was then shaped, proofed for 45 minutes at 37°C, and baked.

2.2 Bread Processing Method Using Kefir

The bread-making process began by mixing the dry ingredients that are high-protein flour, yeast, sugar, bread improver and raising agents until it is well combined. It is crucial to add salt only after the other dry ingredients have been incorporated, as it can deactivate the yeast. Using high-protein flour helps create a lighter, more flavorful bread. Next, the wet ingredients like kefir milk, eggs and water were added and mixed for 20 minutes until the dough was fully developed. The dough was then covered with plastic wrap and given a first proofing of 30 minutes and allowed to rest for another 10 minutes to expand further.

After proofing, the bread was baked. The kefir-only bread was baked at 200°C for 20 minutes, while the yeast-only and yeast-kefir breads were baked at 180°C for 15 minutes. The finished loaves were light and golden brown. To ensure they were cooked through, the crust was tapped; a hollow sound indicated they were ready [24]. Finally, the baked bread was left to cool to room temperature to prevent the crust from becoming soggy.

2.3 Hedonic test

Hedonic test was conducted to perform a sensory evaluation of the bread, including a control sample without kefir. A panel of 30 participants was enlisted to rate the bread's texture, taste, color, and aroma using a 7-point scale that ranged from 1 (dislike extremely) to 7 (like extremely). This type of organoleptic analysis is used to determine the magnitude of quality differences among similar products and is essential for gauging consumer preference, which can inform marketing strategies and guide future product improvements before a new item is launched.

2.4 Scoring test

A scoring test was conducted to quantitatively evaluate specific characteristics of the bread samples using a panel of 30 participants. Unlike a hedonic test, which measures general liking, this method assigned a score to each attribute based on a set of predefined criteria. The panelists used a 7-point scale to assess four specific properties: texture (ranging from very hard to very soft), taste (from very sour to less sour), color (from very dark to very light) and aroma (from very sour-smelling to less sour-smelling).

2.5 Microbiological Analysis

Microbial analysis was conducted using the total plate count method to determine the microbial load of the bread samples. Potato Dextrose Agar (PDA) and Peptone water were used. A six-series dilution was performed for each of the three samples: yeast bread, kefir bread and yeast & kefir bread and incubated for 24-72 hours at 37°C.

2.6 Texture Determination

The texture of the bread samples was evaluated using a Brookfield Texture Analyzer with a cylindrical aluminum probe. The results focused on parameters such as hardness, springiness and chewiness.

2.7 Volume Determination

The volume of the bread was determined using the seed displacement method, as described by [24]. This technique requires a wide-volume loaf pan, mustard seeds, a graduated cylinder and a ruler. The volume of the loaf pan was first determined by filling it completely with mustard seeds and then pouring them into a graduated cylinder. Next, the bread was weighed (w) before being placed into the pan. The pan was then filled with mustard seeds to about a quarter of its volume, the bread was centered inside, and the remaining space was filled with seeds until they overflowed. After leveling the seeds with a ruler, the bread was removed, and the volume of the

remaining seeds in the pan (v) was measured with a graduated cylinder [5]. The specific volume of the bread was then calculated using the formula v/w (volume of seeds remained in ml / weight of bread in g).

3. Result & Discussion

3.1 Hedonic Test

Table 1 Hedonic test results

Attribute	R (Control)	F1 (Yeast)	F2 (Yeast & Kefir)	F3 (Kefir)
Aroma	5.63± 0.96 _b	5.13± 1.10 _b	6.40 ± 0.56 _c	3.63 ± 1.49 _a
Taste	5.80± 0.96 _c	5.03 ± 0.99 _b	6.16 ± 0.53 _c	3.30 ± 1.66 _a
Texture	5.23± 1.16 _b	5.63 ± 1.03 _b	6.50 ± 0.50 _c	3.06 ± 1.68 _a
Color	5.73± 0.94 _b	5.56 ± 0.97 _b	4.53 ± 1.56 _a	6.16 ± 0.53 _b
Overall Acceptance	5.56± 1.07 _b	5.20 ± 0.99 _b	6.43 ± 0.50 _c	3.30 ± 1.57 _a

The sensory evaluation showed clear differences in acceptance among the three bread formulations (Table 1). Formulation 2, which contained both yeast and kefir, received the highest scores for aroma (6.40), taste (6.16), and texture (6.50). This suggests that the combination of yeast and kefir improved the flavor and texture of the bread, making it more appealing to the panelists. In contrast, Formulation 3 (kefir only) was the least liked, with low scores for aroma (3.63 ± 1.49), taste (3.30 ± 1.66), and texture (3.06 ± 1.68). This may be because too much kefir, without yeast, caused the bread to taste sour and have a less pleasant texture. Compared to the control bread (R) and Formulation 1 (yeast only), Formulation 2 showed similar acceptance in most attributes and was rated higher overall. These results indicate that using both yeast and kefir together creates bread with better sensory qualities and higher consumer acceptance as shown in Fig. 2.

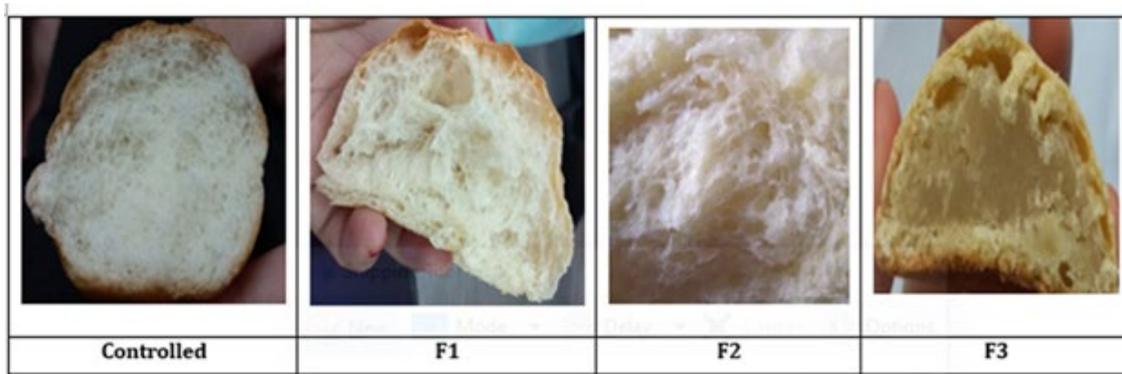


Fig. 2 Bread texture from controlled, F1, F2 and F3 formulation

3.2 Scoring Test

Table 2 Scoring test results

ATTRIBUTE	R (Control)	F1 (Yeast)	F2 (Yeast & Kefir)	F3 (Kefir)
AROMA	5.96± 1.15 _b	5.53 ± 1.00 _b	5.70 ± 0.79 _b	3.20 ± 1.76 _a
TASTE	5.83± 1.41 _c	4.70 ± 1.36 _b	5.90± 0.54 _c	2.16 ± 1.17 _a
TEXTURE	4.66± 1.51 _b	5.56± 1.02 _c	6.36 ± 0.66 _c	2.53 ± 1.50 _a
COLOR	6.03± 0.99 _b	4.60 ± 1.00 _a	6.33 ± 0.47 _b	4.30 ± 1.48 _a

The scoring test results (Table 2) support the findings from the hedonic test. For **aroma**, Formulation 2 and the control bread scored higher than Formulation 3, which was least liked. For **taste**, Formulation 2 scored the highest ($5.90 \pm 0.54c$), followed by the control bread, while Formulation 3 scored the lowest ($2.16 \pm 1.17a$). For **texture**, Formulation 2 again received the highest score ($6.36 \pm 0.66c$), while Formulation 3 had the lowest ($2.53 \pm 1.50a$) because its texture was dense compared to the soft and fluffy texture of Formulation 2. For **color**, Formulation 2 scored the highest ($6.33 \pm 0.47b$), while Formulation 1 and 3 scored lower because of their slightly darker color. **Overall**, kefir alone (Formulation 3) produced bread with the lowest acceptance, while the combination of yeast and kefir (Formulation 2) gave the best results for aroma, taste, texture, and color, comparable to the control bread. This indicates that using both yeast and kefir creates bread that is more acceptable to consumers.

3.3 Microbiological Analysis

Table 3 Microbiological analysis

Leavening Agent / Day	Yeast (F1)	Kefir (F2)	Yeast & Kefir (F3)
Day 3	5.17	6.42	3.40
Day 7	6.81	5.36	2.74
Day 14	8.26	7.31	6.96

The microbial load of the bread samples was evaluated using the pour plate method on Days 3, 7 and 14 of storage. On Day 3, the highest microbial count was observed in the bread made with kefir only (F2), with a log value of 6.42 CFU/mL, followed by the yeast-only formulation (F1) with 5.17 CFU/mL and the lowest count was recorded in the yeast and kefir formulation (F3) at 3.40 CFU/mL.

By Day 7, microbial growth had increased across all samples. The yeast-only bread (F1) showed the highest microbial count at 6.81 CFU/mL, indicating accelerated microbial activity. The kefir-only sample (F2) followed with 5.36 CFU/mL, while the combined yeast and kefir bread (F3) continued to demonstrate the lowest microbial presence at 2.74 CFU/mL. On Day 14, a significant increase in microbial counts was observed. The yeast-only sample (F1) reached the highest level at 8.26 CFU/mL, followed by the kefir-only bread (F2) at 7.31 CFU/mL, and the yeast and kefir sample (F3) at 6.96 CFU/mL. The results suggest that the bread formulated with yeast only (F1) exhibits a shorter shelf life, as indicated by the higher and more rapid microbial growth over time. In contrast, the combined yeast and kefir formulation (F3) showed the lowest microbial growth throughout the storage period, indicating better microbial stability. This suggests that incorporating kefir, particularly in combination with yeast, may enhance the shelf life of bread by slowing down microbial proliferation.

3.4 Texture Determination

Table 4 Results of texture analysis

Formulation	Hardness (N)	Springiness (mm)	Chewiness (mj)
1	5.89	4.98	14.60
2	5.91	5.39	12.6
3	5.84	5.14	22.9

Table 4 presents the hardness, springiness and chewiness values for Formulations 1, 2, and 3. The texture analysis of the three bread formulations showed distinct differences in hardness, springiness, and chewiness. Formulation 1 used yeast only, Formulation 2 combined yeast and kefir and Formulation 3 used kefir only. Hardness measures how firm the bread is, and the results indicated that Formulation 3 was the softest with the lowest hardness value, while Formulations 1 and 2 were firmer. Springiness, which reflects how well the bread returns to its original shape after being compressed, was highest in Formulation 2, indicating better elasticity, and lowest in Formulation 3. Chewiness, or the energy required to chew the bread, was greatest in Formulation 3, making it the toughest to chew, whereas Formulation 2 had the lowest chewiness, indicating a softer texture. Overall, Formulation 2, which combined yeast and kefir, had the most balanced texture, offering moderate softness, good springiness, and low chewiness, while Formulation 3 was softer but tougher, and Formulation 1 was firmer with moderate chewiness.

3.5 Volume Determination

Table 5 Volume determination

Formulation	Bread Weight (g)	Bread Volume (cm ³)	Specific Volume (cm ³ /g)
1	48	1700	3.33
2	46	1690	3.7
3	42	1790	1.67

Table 5 shows that formulation 1 had the heaviest bread at 48 g, while Formulation 3 was the lightest at 42 g. Formulation 2 had the smallest bread volume (1690 cm³), but the highest specific volume (3.7 cm³/g), meaning it was lighter and had more air pockets. Formulation 3 had the largest volume (1790 cm³) but the lowest specific volume (1.67 cm³/g), indicating it was denser and heavier per gram. The differences are likely due to the amount of kefir used and the bread's protein content, which affects how much the bread rises and its texture.

4. Conclusion

In conclusion, the kefir bread produced using Formulation 2 (which incorporated 34% kefir and 1.2% yeast) was the most preferred by sensory panel members. This formulation was found to be the most suitable for bread production due to its balanced performance in terms of texture, taste, and aroma. In terms of physical quality, the texture analysis showed a springiness average of 5.39 mm, hardness of 5.91 N, and chewiness of 12.6 mJ. The bread had a weight of 46 g, a specific volume of 3.7 cm³/g, and a microbial count of Log 2.74 CFU/ml on Day 7, which was the lowest among all formulations tested. These results demonstrate that the bread produced using Formulation 2 was of high quality, with good volume, soft texture, and extended shelf life. Therefore, it has the potential to be developed into a Malaysian-made bakery product that is both nutritious and durable. Kefir contains lactic acid bacteria, which enhance yeast activity. This means that bread using kefir as a leavening ingredient rises better and develops a softer texture. Kefir also has a distinct tangy flavour, adding a unique dimension to the taste profile of the bread. Moreover, kefir is a natural source of probiotics, which support gut health by maintaining a healthy balance of beneficial bacteria in the digestive system. Additionally, kefir is rich in essential nutrients such as protein, calcium, and B vitamins, thereby improving the nutritional value of the bread when incorporated.

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Conflict of Interest

There is no conflict of interest regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Tengku Norhidayati; **data collection, analysis and interpretation of results:** Afiza, Tengku and Shahiza; **draft manuscript preparation:** Afiza. All authors reviewed the results and approved the final version of the manuscript.

References

- [1] Braley Gentry, Patricia Cazon, Keely Obrien, (2023) A comprehensive review of the production, beneficial properties, and applicatios of kefir, the kefir grain exopolysaccharide, International Dairy Journal, Vol 14. <https://doi.org/10.1016/j.idairyj.2023.105691>
- [2] Zuzana Matejcekova, Lubomir Valik [2025] Kefir alternative, an innovative source of probiotics: Microbiological, technological, and therapeutical properties, Applied Food Research 5,1 00775. <https://doi.org/10.1016/j.afres.2025.100775>
- [3] Arslan, S. (2014). A review: Chemical, microbiological and nutritional characteristics of kefir. *CyTA - Journal of Food*, 13(3), 340–345. <https://doi.org/10.1080/19476337.2014.981588>

- [4] Bengoa, A. A., Iraporda, C., Garrote, G. L., & Abraham, A. G. (2018). Kefir micro-organisms: Their role in grain assembly and health properties of fermented milk. *Journal of Applied Microbiology*, 126(3), 686–700. <https://doi.org/10.1111/jam.14107>
- [5] Nwosu, U. L., Elochukwu, C. U., & Onwurah, C. O. (2014). Physical characteristics and sensory quality of bread produced from wheat/African oil bean flour blends. *African Journal of Food Science*, 8(6), 351–355. <https://doi.org/10.5897/ajfs2013.1079>.
- [6] Bursa. Ankara Üniv Vet Fak Derg, 59: 217-221[11] Chen, C.; Chan, H.M.; Kubow, S. Kefir extracts suppress in vitro proliferation of estrogen-dependent human breast cancer cells but not normal mammary epithelial cells. *J. Med. Food* 2007, 10, 416–422.
- [7] Dos Reis, S.A.; da Conceição, L. L.; Dias, M.M.; Siqueira, N.P.; Rosa, D.D.; de Oliveira, L.L.; da Matta, S.L.P.; Peluzio, M.D.C.G. Kefir reduces the incidence of pre-neoplastic lesions in an animal model for colorectal cancer. *J. Funct. Foods* 2019, 53, 1–6.
- [8] Gorsek, A. and Tramsek, M. (2007). Quantitative examination of process parameters during kefir grain biomass production. *Int. J. Chem. React. Eng.* 5:1–8.
- [9] Guzel-Seydim, Z., Wyffels, J. T., Seydim, A. C., Greene, A. K. (2005). Turkish kefir and kefir grains: microbial enumeration and electron microscobic observation. *Int J Dairy Technol*, 58 (1), 25-29.
- [10] Karaçalı, R.; Özdemir, Ni.; Çon, A.H. (2018). Aromatic and functional aspects of kefir produced using soya milk and Bifidobacterium species. *Int. J. Dairy Technol.* 71, 921–933.
- [11] Kivanç, M.; Yapıcı, (2016). E. kefir as a probiotic dairy beverage: Determination lactic acid bacteria and yeast. *ETP Int. J. Food Eng.* 1, 55–60
- [12] Anon. (2021, September 8). *Bread Volume Measurement: Baking Processes*. BAKERpedia. Retrieved December 15, 2022, from <https://bakerpedia.com/processes/bread-volume-measurement>
- [13] Christensen, E. (2022, December 7). *3 ways to tell when bread is done*. Kitchn. <https://www.thekitchn.com/fresh-baked-how-to-tell-when-b-106715>
- [14] Jessica Ball Jessica Ball, M. S. (2022). *Is sourdough bread healthy?* EatingWell. December 7, 2022. <https://www.eatingwell.com/article/7904008/health-benefits-of-sourdough-bread-according-to-a-dietitian>
- [15] Aidalu Hernandez-Martinez, Carlos Jimenez-Perez, Alma Cruz-Guerrero, Jont F.Trant and Sergio Alatorre Santamaria [2025], Production of Exopolysaccharides Through Fermentation of Secondary Whey with Kefir Grains, Biology and life Science Forum. <https://doi.org/10.3390/blsf2024040044>
- [16] Beto, J. A. (2015, January). *The role of calcium in human aging*. Clinical nutrition research. Retrieved December 7, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4337919>
- [17] Cockayne S; Adamson J; Lanham-New S; Shearer MJ; Gilbody S; Torgerson DJ; (2006). *Vitamin K and the prevention of fractures: Systematic review and meta-analysis of randomized controlled trials*. Archives of internal medicine. <https://pubmed.ncbi.nlm.nih.gov/16801507>
- [18] Ahmed, Z., Wang, Y., Ahmad, A., Khan, S.T., Nisa, M., Ahma, H. and Afreen A. (2013). Kefir and health: a contemporary perspective. *Critical Reviews in Food Science and Nutrition*. 53, 422-434.
- [19] Cetinkaya, F., Elal Mus, T. (2012). Determination of microbiological and chemical characteristics of kefir consumed in milk.
- [20] Prado, M.R.; Blandón, L.M.; Vandenberghe, L.P.S. (2015). Milk kefir: Composition, microbial cultures, biological activities, and related products. *Front. Microbiol.*, 6, 1177–1186.
- [21] D.M. Beshkova et al. Pure cultures for making kefir *Food Microbiology* (2002)
- [22] Farag, M. A., Jomaa, S. A., Abd El-Wahed, A., & R. El-Seedi, H. (2020). The many faces of kefir fermented dairy products: Quality characteristics, flavour chemistry, nutritional value, health benefits, and safety. *Nutrients*, 12(2), 346. <https://doi.org/10.3390/nu12020346>
- [23] Lau, S. W., Chong, A. Q., Chin, N. L., Talib, R. A., & Basha, R. K. (2021). Sourdough microbiome comparison and benefits. *Microorganisms*, 9(7), 1355. <https://doi.org/10.3390/microorganisms9071355>
- [24] Nurhidayah Follow Working at Universiti Pendidikan Sultan Idris, S. (2014, May 28). *Roti*. Share and Discover Knowledge on SlideShare. <https://www.slideshare.net/sitinurhidayahmohdshadid/roti-35224163>
- [25] John., J. & Deesenthum., S. (2015). *(PDF) properties and benefits of kefir - a review - researchgate*. research gate. https://www.researchgate.net/publication/282711403_Properties_and_benefits_of_kefir_-_A_review

- [26] Mistry, V.V., (2004). Fermented liquid milk products. In: Hui, Y.H., Meunier-Goddik, L., Hansen, Ö.S., Josephsen, J., Nip, W., Stanfield, P.S., Toldra, F. (Eds.), Handbook of Food and Beverage Fermentation Technology. Marcel Dekker, NewYork, pp: 939-957
- [27] Motaghi, M., Mazaheri, M., Moazami, N., Farkhondeh, A., Fooladi, M.H., Goltapeh. (1997). E.M. Short Communication: Kefir production in Iran, World J Microbiol Biotechnol, 13: 579-581
- [28] Richards, L (2021, May 20). *Is sourdough bread healthy?* Medical News Today. Retrieved December 7, 2022, from bread#easy-to-digest