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UTILIZING CHEESE WHEY AS A KEFIR DRINK: REVIEW

Kurniawan[13], Tiana Milanda[2]

[1]Department of Pharmacist Professional Program Department of Pharmacy, Fakultas Ilmu Kesehatan, Universitas Darussalam, Gontor Ponorogo Indonesia
[2]Department of Biological Pharmacy, Faculty of Pharmacy, Universitas Padjadjaran, Bandung Indonesia
[3] Department of Pharmacy, Fakultas Ilmu Kesehatan, Universitas Darussalam, Gontor Ponorogo Indonesia

kbinakrom@unida.gontor.ac.id

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ABSTRACT
Whey is a by-product of the cheese industry that is rich in lactose, protein, and minerals, but is often considered as waste. The use of whey as a basic ingredient for kefir drinks is an innovative solution that not only reduces environmental impacts but also produces functional food products with high added value. This article reviews the potential of cheese whey as a substrate in kefir fermentation, including the chemical characteristics of whey, the kefir whey production process, the health benefits of the resulting bioactive compounds, and the challenges and prospects for its development. Studies have shown that whey fermentation with kefir culture can produce probiotic drinks with beneficial effects on gastrointestinal health, the immune system, and lipid and glucose metabolism. By optimizing fermentation technology and adding complementary nutrients, whey kefir can be an alternative functional drink that is economical, nutritious, and environmentally friendly

Keywords: Whey, Milk kefir, fermentation, functional drink.

1. INTRODUCTION

The dairy industry produces various processed products such as cheese, yogurt, and butter. One of the by-products of cheese making is whey, a yellowish liquid that remains after the casein coagulation process. Whey has long been considered waste, but it contains high nutrients such as lactose, whey protein, minerals, and vitamins (Smith et al., 2020). One effort to utilize whey is to process it into kefir drinks, traditional milk fermentation known for its probiotic benefits (Farnworth, 2005).

Whey consists of two types, namely sweet whey (the result of making hard cheese using rennet) and acid whey (from making sour cheese). Whey contains lactose (4.5 - 5%), protein (0.6 - 0.9%), and important minerals such as calcium and phosphorus (Pescuma et al., 2010). Whey protein has high biological value and functions as a prebiotic and immunomodulator (Marshall, 2004).

Kefir is made through fermentation by lactic acid bacteria and yeast, using kefir grains (Magalhães et al., 2011). Whey fermentation involves pasteurization, addition of starter culture, and incubation for 18–24 hours. Because whey protein content is lower than milk, skim milk or maltodextrin is often added as an additional nitrogen source (Liu et al., 2019).

Kefir whey contains probiotics that balance the gut microbiota and improve the immune system (Leite et al., 2013). Fermentation also increases antioxidant activity and produces bioactive peptides (Otles & Cagindi, 2003). Studies have shown that kefir can lower LDL cholesterol levels and improve insulin sensitivity (St-Onge et al., 2002). Kefir also helps detoxify and protect the liver (Rodrigues et al., 2005).

The main challenge is the low whey protein content, which requires supplementation (Liu et al., 2019). Kefir whey products have a short shelf life and need to be packaged properly. In terms of the environment, whey fermentation can reduce waste with high BOD that pollutes the environment (Prazeres et al., 2012). The trend of functional foods and healthy lifestyles is a great opportunity for the development of kefir whey drinks in the global market..

2. METHOD

This research method is a review article of several studies that utilize whey as a substrate material other than milk involved in the fermentation process. The kefir fermentation process is a complex biochemical change, involving close interactions between various microorganisms. In general, kefir is made using kefir grains, which consist of lactic acid bacteria, yeast, and polysaccharides. These constituent microorganisms are not only responsible for the formation of the distinctive taste and aroma of kefir, but also play a role in converting lactose into lactic acid, ethanol, and carbon dioxide. This process takes place in two stages, which are also seen in the microbial growth pattern and chemical characteristics of the final product (Fiorda, 2017).

During the initial fermentation phase, lactic acid bacteria such as Lactobacillus and Leuconostoc multiply, utilizing lactose as the primary energy source. This process increases the levels of lactic acid, which gives kefir its acidic and natural preservative properties. Furthermore, yeasts such as Saccharomyces and Kluyveromyces contribute to the production of ethanol and carbon dioxide, which create a unique blend within kefir. The accumulation of carbon dioxide also produces bubbles that give kefir its refreshing hue when drunk. In addition, polysaccharides produced by the bacteria in kefir grains provide viscosity and structure to the liquid, which adds visual and textual consistency (Anumudu, 2024).

The kefir fermentation process takes place optimally at temperatures between 20 and 30 degrees Celsius, with a fermentation duration varying between 12 and 48 hours depending on the type of microorganism and environmental conditions. During this period, there is a significant change in pH, where the initially neutral pH changes to acidic, creating an environment that does not support the development of pathogenic bacteria. After the fermentation process is complete, kefir is produced with unique taste, aroma and texture characteristics, making it one of the fermented drinks that contribute to health. Thus, a deep understanding of the kefir fermentation process is important not only for producers but also for consumers who want to get the health benefits of this product (Yeboah, 2023).

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3. RESULT AND DISSCUSION

The main challenge is the low whey protein content, so supplementation is needed (Liu et al., 2019). Kefir whey products have a short shelf life and need to be packaged properly. In terms of the environment, whey fermentation can reduce waste with high BOD that pollutes the environment (Prazeres et al., 2012). The trend of functional foods and healthy lifestyles is a great opportunity for the development of kefir whey drinks in the global market. Whey is a rich supply of water and minerals that are good for microbial development, making it an appealing option for fermented beverage manufacturing. However, the production process is challenging due to quick microbiological decomposition, scaling of processing equipment, taste flaws, and instability of the finished product.

Cheese whey is a waste product in cheese processing containing 4–5% lactose. Having a high carbon source, this material can be a potential fermentation medium for kefir grains. During the fermentation of kefir grains, alcohol, lactic acid and exopolysaccharides (kefiran) are produced. Fermentation of kefir grains is also affected by nitrogen sources. Therefore, the effects of different lactose compositions and nitrogen sources (including yeast extract, urea and mung bean sprout extract) on fermentation

The results of Utami's study, 2017, showed that after 24 hours of incubation, the biomass of kefir grains reached 21.30-27.15 g (dry weight, g/250mL of media) from 25 g of initial kefir grain biomass. The fermentation broth showed a pH value ranging from 3.49–3.94; alcohol content ranging from 0.11-0.31%; and lactic acid content ranging from 0.49–1.47%. The total kefiran extracted from kefir grains and fermentation broth ranged from 0.63-1.76 g/L. This study shows that cheese whey can be used as a fermentation medium to produce alcohol, lactic acid and kefiran by kefir grains. The highest kefiran production was achieved in media containing 1.2% whey lactose and 4% mung bean sprout extract. Cheese whey is a waste product from the cheese processing industry that still contains 4-5% lactose, so it can be used as a carbon source in kefir grain fermentation media. During kefir grain fermentation, alcohol, lactic acid and exopolysaccharides commonly called kefiran are produced. Kefir grain fermentation is also influenced by nitrogen sources. Furthermore, the composition of the fermentation media was varied in the concentration of whey lactose and the composition of nitrogen sources (yeast extract, urea and mung bean sprout extract) for kefir grain fermentation. The results showed that after 24 hours of fermentation, the biomass of kefir grains ranged from 21.30-27.15 g; pH values ranged from 3.49-3.94; alcohol content ranged from 0.11-0.31%; lactic acid content ranged from 0.49-1.47%; and total kefiran ranged from 0.63-1.76 g/L. The composition of the fermentation medium that produced the highest total kefiran was 1.2% whey lactose and 4% mung bean sprout extract as a nitrogen source.

one of the most important residues after the separation of cheese obtained from milk is whey, which has organic pollution caused by the high content of protein and lactose. Since the disposal of the released whey causes significant loss of nutrients, it is important to provide biological conversion to prevent nutrient loss instead of wastewater treatment.

Whey is a by-product product derived from cheese processing which still has a high lactose content of 5-6%. *Whey* can also form during the kefir manufacturing process. The microbes found in kefir produce acids and enzymes that will separate milk into curds and a clear liquid called *whey*. *Whey* has a calorie content of 320 kcal / L and protein as much as 0.8-1%, beta-lactoglobulin 65%, alpha-lactalbumin 25%, immunoglobulin, and brucine serum albumin 8%. The content of vitamins contained in *whey* includes vitamins B_{16}, B_12, pantothenic acid, riboflavin, and thiamin.

Another benefit of *whey* is in brightening the skin. The higher the concentration of *whey* used, the better it will be in inhibition of melanin pigment synthesis. This way of working can be helped by the content of polysaccharide compounds, peptides, and organic acids in kefir which are effective in overcoming damage due to free radicals

4. CONCLUSION

Cheese whey has great potential as a base ingredient for functional kefir drinks. With the right fermentation approach, whey can be processed into products with high economic and health value. Further development is needed to optimize formulation, production technology, and market education.

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