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Evaluation of the physical quality of kefir with goat milk powder as raw material

Eka Wulandari*, Wendry Setiadi Putranto, Andry Pratama
Department of Livestock Product Technology, Faculty of Animal Husbandry, Padjadjaran University, Jl. Raya Bandung, Sumedang, Jatinangor, West Java, Indonesia

Abstract
Kefir is product fermentation made from fermented milk raw material with adding kefir grains (kefir seeds) which are symbiosis between bacteria sour lactate (BAL) with yeast. The use of milk as material standard can in the form of fresh milk or powdered milk. The purpose from study This is learn quality physical kefir with use material goat milk raw material powder. Research done in a way experiment with using goat milk powder by 12% as material standard. Research This use method descriptive data analysis quantitative. Research results obtained quality of kefir with use material goat milk raw material Still The same with kefir made from fresh milk with pH 3.8 ± 0.010, syneresis 37.55 ±0.02% and water holding capacity 55.30 ±± 0.07%.

Keywords: Kefir, fermented milk, Goat milk powder, kefir grains, lactic acid bacteria, yeast

Introduction

The diversification of goat milk-based fermented food products as functional foods needs to be continually encouraged to increase goat milk production and its processed derivatives. Therefore, efforts are needed to modify goat milk into a form of food product that appeals to consumers, one of which is kefir. Challenges include the low preference of panelists for the product and the detection of "goaty" flavor (goaty aroma). To address this, the first step taken is producing goat milk powder to reduce the "goaty" aroma and extend the shelf life of goat milk.

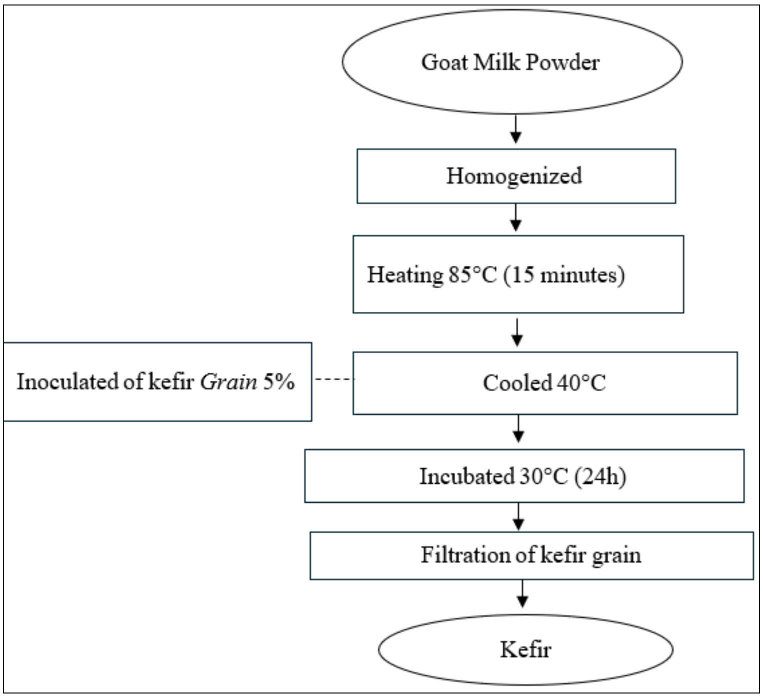
Kefir is a type of fermented milk originating from the Caucasus Mountains, characterized by its sour, slightly alcoholic taste, creamy consistency, and slight effervescence. It has been widely consumed in several Asian and Scandinavian countries. Kefir is easier to digest for individuals with lactose intolerance because lactose is broken down into glucose and galactose by lactase enzymes from the starter microbes.

The composition that serves as a standard for kefir includes fat content (·%) of less than 10%; protein (%) of at least 2.7%; total lactic acid (·%) of at least 0.6%; a minimum bacterial count of 10^7 cfu/gram; and a minimum yeast count of 10^4 cfu/gram. The chemical components and composition of kefir vary, influenced by the type of starter microbes, fermentation temperature and duration, and the raw materials used.

Kefir made from goat milk powder in Indonesia has not been widely studied, thus motivating the authors to examine the physical properties of kefir made using goat milk powder.

Method

Preparation of kefir form goat milk powder



Goat milk powder weighed 120g mixed with then 1 liter of distilled water heated with temperature 85°C for 15 minutes and cool until temperature 40°C (Suhartatik *et al.*, 2019) [10]. Inoculation with kefir grains as much as 5% of the total mixture (Triwibowo *et al.*, 2020) [11], Then incubation at 30 °C for 24 hours (Rossi *et al.*, 2016) [8]

pH Measurement

The pH testing process was conducted using an electronic pH meter. Before measuring the pH value, preparation was required to ensure the pH meter's accuracy. This involved rinsing the cathode tip of the pH meter with distilled water (aquades) and drying it with tissue. The cleaned cathode was calibrated by immersing it in buffer solutions with pH values of 4 and 7 (Wahyudi, 2006). After calibration, the cathode tip was immersed in a 25 ml sample of yogurt mixed with black cumin oil. The measurement results were displayed on the pH meter.

Water Holding Capacity (WHC)

Water Holding Capacity (WHC) was calculated to determine kefir's ability to retain water within protein structures during centrifugation. The WHC of kefir was measured following the procedure by Berlianti *et al*. (2022) [3] with slight modifications:

1. Take 2 ml of the sample using a micropipette and place it into pre-weighed and labeled Eppendorf tubes.
2. Weigh the sample to determine its initial weight.
3. Centrifuge the sample at 3000 rpm for 10 minutes at room temperature.
4. Weigh the separated whey for each sample, and calculate WHC using the formula:

$$WHC\ (\%) = \frac{Initial\ weight - \text{Weight of Whey}}{Initial\ weight}\ X\ 100\%$$

Syneresis Measurement

Syneresis assesses kefir's physical stability and its protein network's ability to retain water. The process follows Berlianti *et al*. (2022) [3] with modifications:

1. Place 10 ml of sample into jars with filters.
2. Leave for 30 minutes.
3. Measure remaining kefir and calculate syneresis percentage.

$$\text{Syneresis}\ (\%) = \frac{B}{A}\ x\ 100$$

Information:

A = Initial Weight
B = Weight of Whey (Separating liquid)

Syneresis

The syneresis calculation was conducted to evaluate the physical stability of kefir, which reflects the protein network's ability to retain water. Syneresis was measured using a drainage method based on the procedure by Berlianti *et al*. (2022) [3] with slight modifications:

1. Pour 10 ml of the sample into a small jar equipped with a funnel and filter paper.
2. Leave the sample for 30 minutes.
3. Measure the remaining kefir, and calculate syneresis using the formula:

$$\text{Syneresis}\ (\%) = \frac{B}{A}\ x\ 100$$

Information:

A = Initial Volume
B = Whey Volume (Separating liquid)

Data obtained processed use analysis statistics descriptive to quality physical kefir with calculate average and standard deviation.

Discussion

Organoleptic evaluation

The color of kefir is white due to the base ingredient, goat milk powder, which is naturally white. According to Muchtadi and Sugiyono (1992) [7], fresh milk ranges from bluish-white to yellowish-white (golden yellow) and contains protein and fat granules. The fat in milk is degraded by lactic acid bacteria, resulting in the yellowish-white color of kefir. This is supported by Srianta *et al*. (2015) [12], who stated that kefir's sensory characteristics include a yellowish-white color, a distinctive yeast aroma, and a sour taste. Apart from lactic acid bacteria, lipase enzymes also play a role in fat breakdown.

Thohari (2012) [13] reported that the sour taste in kefir results from a pH decrease caused by lactic acid bacteria metabolizing lactose, increasing acidity. The acidic conditions formed by Streptococcus inhibit its own growth, allowing Lactobacillus to emerge alongside yeast. Yeast degrades glucose in milk, possibly also metabolizing glucose present in coconut. This is supported by Hawusiwa *et al*. (2015), who reported that yeast breaks down glucose to form pyruvic acid, which is subsequently degraded into acetaldehyde and then dehydrogenated to alcohol.

Goat milk powder processing

The quality of goat milk is critical to ensure the quality of milk products, including hygienic sanitation. One way to preserve milk is by drying it into powder, as milk is highly perishable. Spray drying is a commonly used, inexpensive, and straightforward method for microencapsulating food materials, converting milk from liquid to dry form (Gabites *et al*., 2010). However, the high drying temperatures used in spray drying are unsuitable for all food products.

The process of producing powdered goat milk involves several steps, including concentration, atomization, droplet-air contact, droplet drying, and separation. According to Callaghan and Cunningham (2005), drying is a crucial stage in milk powder production that determines its quality. Processing goat milk has been shown to reduce its goaty odor and extend its shelf life, making it more appealing to consumers (Park, 2000). Spray drying produces goat milk powder but can impact its nutritional content and reconstitution properties, such as solubility, dispersibility, and sinking rate.

Table 1: Physical Quality Parameters of Kefir Made from Goat Milk Powder

No.	Parameter	Values
1	pH	3.8 ±0.010
2	Syneresis	37.55 ±0.02%
3	WHC	55.30 ±0.07%

According to Adesokan *et al*. (2011) [1], pH levels are strongly related to the amount of acid produced. The increase in acid levels and the decrease in pH during milk fermentation with lactic acid bacteria cultures can already be observed during 24 hours of incubation. The fermentation process converts lactose in milk into glucose and galactose through the activity of starter cultures, which helps reduce digestive disturbances when consumed. Fermented milk products are classified based on the type of lactic acid bacteria used. Lactic acid bacteria hydrolyze lactose in milk into various simpler carbohydrate compounds. The fermentation process results in increased microbial activity, a decrease in pH, and an increase in acid levels in fermented products.

The ideal pH range for high-quality fermented milk is 3.8–4.6. If significant acidification occurs due to lactic acid bacteria activity, the pH of milk can decrease. Helferich and Westhoff (1980) [5] also noted that lactic acid formation from lactose serves as a source of energy and carbon during bacterial growth in the fermentation process, leading to a decrease in pH, which can inhibit the growth of harmful microbes in fermented products. A drop in pH causes the taste to become sour due to the formation of lactic acid, which is the main metabolic product of lactic acid bacteria (Winarno, 2007) [14]. From Figure 1, it is evident that pH levels begin to decrease with sugar concentrations of 0–10% during 12–24 hours of incubation. Therefore, the lower pH levels are due to the influence of sugar addition and incubation time during the fermentation process. pH levels are strongly related to the amount of acid produced, with increased acid levels and decreased pH being observable after 24 hours of fermentation with lactic acid bacteria cultures.

Syneresis refers to the percentage of water released due to the reduced binding capacity of protein networks during treatment using the drainage method.

Water holding capacity is greatly influenced by the protein and fat content in milk, meaning that using different types of milk can affect the water holding capacity of kefir. The extent of kefir syneresis can be affected by several factors. According to Krisnaningsih *et al.* (2018) [6], factors influencing kefir syneresis include acidity, pH, and water-binding capacity. Setyawardani *et al.* (2020) also stated that syneresis is influenced by the total solids in milk composition.

Water holding capacity (WHC) is the ability of kefir to retain water within protein networks during treatment, such as centrifugation. The higher the WHC value, the better the quality of kefir. This aligns with Aloğlu and Öner (2013) [2], who stated that higher WHC values improve product quality by retaining more free water and enhancing texture and stability.

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