Review Article

Traditional Indonesian dairy foods

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Indonesia is the largest archipelago blessed with one of the richest mega-biodiversities and also home to one of the most diverse cuisines and traditional fermented foods. There are 3 types of traditional dairy foods, namely the butter-like product minyak samin; yogurt-like product dadih; and cheese-like products dali or bagot in horbo, dangke, litsusu, and cologanti, which reflect the culture of dairy product consumption in Indonesia.

Key Words: Indonesian dairy foods, minyak samin, dadih, dali, dangke, litsusu, cologanti

INTRODUCTION

Indonesia, characterized by its ethnic diversity, comprises several islands having individual cultures. Hence, each area has various indigenous foods and food habits.

Buffaloes have been domesticated in large numbers in Indonesia. Hence, some areas in Indonesia use buffalo milk for preparing traditional dairy products, such as minyak samin (ghee) in Aceh, Northern Sumatera; dali or bagot ni horbo in North Sumatera; dadih in West Sumatra; dangke in South Sulawesi; and litsusu and cologanti in East and West Nusa Tenggara, indicating that Indonesia has long usedmilk as a food ingredient. Rural buffaloes maintained by small farmers in Indonesia can potentially contribute to the development of the Indonesian dairy industry.

Various manufacturing methods for traditional dairy foods in Indonesia play considerable roles in preserving milk and improving nutritional value and diversification. Indonesia produces 3 types of traditional dairy foods, namely the butter-like product minyak samin; yogurt-like product dadih; and cheese-like products dali or bagot in horbo, dangke, litsusu, and cologanti.

MINYAK SAMIN (GHEE)

Minyak samin, a butter-like product produced in Aceh, Northern Sumatra, is manufactured by storing fresh buffalo milk in an earthenware jar exposed to the sun for 1 hour to separate the cream from the milk serum. A certain amount of grounded *Solanum aculeatissinum* is added to coagulate the milk, together with a certain amount of *Pandanus amarylifolius* to obtain the desired smell. The milk allowed to stand another 24–48 hours at room temperature, and the cream layer is collected and heated until the fat on the top layer becomes separable. The fat is then collected into a glass bottle or can and allowed to crystallize. Minyak samin, a type of butter oil, is white, highly viscous, and contains 99%–99.5% milk fat and <0.05% water.[1]

Minyak samin manufacturing involves an enzymatic reaction catalyzed by a proteolytic enzyme from *S. aculeatissima*, which coagulates the milk protein. However, because this process involves an incubation period, bacterial fermentation might also occur during the preparation.[2]

DADIH

Dadih, an Indonesian traditional fermented buffalo milk, is produced and consumed by the ethnic groups of West Sumatra, Minangkabau and is considered beneficial for human health.[3] It is a characteristic traditional food of the Minangkabau culture. Natives named it dadiah, and it is an extremely popular dairy product in Bukit Tinggi, Padang Panjang, Solok, Lima Puluh Kota, and Tanah Datar.[4]

Dadih, a yogurt-like product, has a distinctive thick consistency, smooth texture, and pleasant flavor and provides safety, portability, and novelty to milk nutrients for the indigenous people of West Sumatra. Dadih is typically consumed during breakfast with rice after adding sliced shallot and chili (sambal), or it is mixed with palm sugar and coconut milk and served as a topping for steamed traditional glutinous rice flakes or a corn flake-like product called ampiang dadih.[5]

The manufacturing method for dadih is similar to that of dahi in India, except for the heat treatment of raw milk and incorporation of starter cultures. For dahi preparation, raw cow, buffalo, or mixed milk is pasteurized and fermented using dahi leftover from the previous lot as a starter culture.[6] Dadih, prepared from buffalo milk, and dahi, prepared from cow milk, are Indonesian and Indian yogurts, respectively and seem to share the same root word. The body and texture of yogurt largely depend on

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the composition of milk employed in its manufacturing, which is simpler than the process used in Western countries.[7]

In Indonesia, dadih is prepared at home by using a traditional method involving the milk of water buffaloes. The milk is neither boiled nor inoculated with any starter culture. The fresh unheated buffalo milk is placed in bamboo tubes covered with banana leaves, incubated at ambient temperature (25°C–30°C) overnight, and allowed to naturally ferment using mesophilic cultures. Fermentation takes 6–18 hours to yield a thick consistency.[3] By contrast, yogurt production involves thermophilic cultures, which grow faster at 45°C and require only a 3–4 hour fermentation time. Various indigenous lactic acid bacteria (LAB) are involved in dadih fermentation, which may vary depending on the time and place of dadih preparation because of natural fermentation.[3,7] The microbial isolates of dadih have been reported to exhibit probiotic properties. [7,8-12]

The process of dadih preparation does not involve good hygiene practices; however, no incidence of product failure or food poisoning has been reported by people who consumed dadih.[5] Instead, the older generation considers dadih consumption to be beneficial for health. The aforementioned probiotic properties of several microbial strains isolated from dadih may provide evidence that strong indigenous LAB derived from fresh raw buffalo milk aid in combating contaminants, namely spoilage bacteria and pathogens, during spontaneous fermentation.

Because heat is not applied to fresh raw buffalo milk used as the raw material in the homemade manufacturing process. Dadih does not meet any national standards such as the National Standard for Yogurt and Indonesia National Standard 2981:2009 or international standards for yogurt and fermented milk, such as the U.S. Federal Standards of Identity, the standards of the International Dairy Federation, or the Codex Standard for Fermented Milks, which require pasteurizing the milk.[5]

Dadih is prepared from buffalo milk, and it is a thick product owing to its high total solid content; buffalo milk has a higher fat and casein content than does cow milk. The higher protein content in buffalo milk results in a custard-like consistency at the end of fermentation and has characteristics between those of cultured buttermilk and unripened cheese. The texture varies from a rennet-like custard to a creamy and highly viscous liquid depending on the milk solid and fat content. Moreover, a higher fat content enriches the favor of the dadih product and contributes to a smoother body and texture. Dadih is manufactured in bamboo tubes, which are hygroscopic and prevent whey syneresis.

Comprehending the transformation of buffalo milk into dadih is necessary for understanding its nutritional and health properties. The major changes in dadih fermentation caused by LAB result in specific health benefits as shown by two probiotic strains of dadih origin. Surono et al (2011) reported *E. faecium* IS-27526 isolated from dadih (2.31×10^8 CFU/day) in 125 ml ultra-high temperature low-fat milk significantly increased total salivary secretory IgA (sIgA) level and bodyweight of the children ($p<0.05$) compared to the placebo after 90 days in underweight children and in children with normal bodyweight, respectively.[12] Surono et al (2014) also reported that a combination of probiotic *Lb. plantarum* IS-10506 at 10^{10} CFU/day and 20 mg zinc sulfate monohydrate (8 mg zinc elemental) supplementation has potential ability in improving zinc status of preschool children as shown by significant increase of humoral immune response as well as the improvement of zinc status of the young children in a 90-day randomized double blind placebo-controlled pre–post trial of children aged 12–24 months, a significant increase of fecal sIgA was observed in probiotic group, 30.3±3.32 μg/g ($p<0.01$), and in probiotic and zinc group, 27.6±2.28 μg/g ($p<0.027$), as compared to placebo group, 13.6±2.26 μg/g.[11]

Dadih is easily digestible because of the amino acids produced during fermentation. The general chemical composition of dadih is characterized by a higher protein and fat content than that of Western-style yogurt, whereas the carbohydrate and moisture content of dadih is considerably lower than that of Western-style yogurt.[13]

The changes in milk constituents during dadih manufacturing are associated with various steps during fermentation. LAB, as a natural contaminant of milk, convert the lactose into lactic acid, precipitate milk proteins, and form curd and may also produce different metabolites depending on the involved bacteria. However, the metabolite products generally provide energy for bacterial cell growth, and lactic acid or carbon dioxide and some volatile compounds are produced. The formation of lactic acid makes the dadih product sour compared with buffalo milk. Dadih, has a low lactose content because it undergoes fermentation, suggesting that many lactose-intolerant people can consume it. Lactose fermentation for forming lactic acid is crucial means of for preventing or limiting milk spoilage due to the growth of contaminating bacteria and their enzyme activity.

Lactose is the major carbohydrate in buffalo milk. A consortium of LAB, which could be homofermentative and heterofermentative natural starter cultures producing lactic acid, with the involvement of beta-galactosidase from lactic starter cultures; as a consequence, coagulates buffalo milk from pH values lower than 5.0, which is optimum at pH 4.6. The texture, body, and acidic flavor of dadih are attributed to the lactic acid produced during fermentation.

Lactic acid has two critical functions in dadih manufacturing: facilitating the destabilization of casein micelles and affording the dadih its distinctive and characteristic sharp and acidic taste.

Most of the buffalo milk in West Sumatra and nearby areas is produced in villages by farmers with small land holdings and by landless agricultural laborers mostly in small quantities of 2–4 L per day and by small and marginal farmers in numerous and widely scattered villages.[14,15] Conditions under which milk is produced in the villages are not satisfactory, mainly because of the low economic status of the farmers. Hence, a considerable portion of the milk is immediately fermented into traditional dadih because of a lack of refrigeration and transportation facilities.

The water buffalo, as a domesticated cattle animal of the bovine subfamily, is fed with natural feed grass free from antibiotics. Hence, buffalo milk contains no antibi-

otic residue, which may inhibit the growth of the natural starter and cause product failure, and no antibiotic resistance of indigenous LAB occurs.

DALI OR BAGOT NI HORBO

Dali or bagot ni horbo is a cheese-like traditional Batak dish from Tapanuli, North Sumatra, with a yellowish white appearance, tofu-like texture, and milky flavor. According to the language of the ethnic groups of Batak, bagot, ni, and horbo mean "milk," of and "buffalo," respectively. Its commercial name is dali or dali ni horbo. Manufacturing dali is simple; fresh buffalo milk is slowly boiled in a pan, with continuous stirring, and a certain amount (approximately 5.0%–6.0%, v/v) of fresh pineapple juice or papaya (*Carica papaya*) leaf juice is added to the boiled milk and continuously stirred until the milk is coagulated. The whey is then removed.[16] Natives of Tapanuli use fresh unripe pineapple juice as a coagulant because it yields yellowish white dali, whereas papaya leaf juice yields greenish white dali having a slightly bitter taste.

Milk may coagulate because of both the action of proteolytic enzymes of pineapple juice and acidity of the unripe pineapple. Bromelain is a proteolytic enzyme of pineapple, and the pH of pineapple juice is 3.2–3.5. The moisture content of dali is higher than that of dangke because after milk coagulation, a pressing procedure is not performed.[17]

The tradition of processing buffalo milk into dali is considered to be started by the ancestors of the Batak community. In restaurants in Batak, dali is the main dish on the menu. Natives consume dali after boiling and mixing it with seasoning ingredients, such as salt, turmeric, onion, and chili. Some people also cook dali with cassava leaves, and some fry it.

DANGKE

Dangke, a buffalo milk product from South Sulawesi, is a traditional cheese produced since 1905.[1] It is mainly produced in the Enrekang, Baraka, Anggeraja, and Alla districts of South Sulawesi.[16]

The name dangke is derived from "dank u wel," which in Dutch means "thank you very much." According to local stories, natives presented this product to the Dutch on their first visit to South Sulawesi and subsequently said "dank je," a shortened form of "dank u wel."

Dangke is processed by heating freshly drawn buffalo milk in a small fire until it boils. A certain amount of sliced leaves, stems, or unripe fruits of the papaya is then added; the mixture is stirred for approximately 15 minutes, and consequently, the milk protein clots. The clot is kept in a mold made of a coconut shell and pressed to separate the liquid. Adding an excessive amount of leaves, stems, or unripe fruits of the papaya confers a strong bitter taste to dangke due to small peptide generation.

Therefore, to improve the storage duration and sensory qualities, dangke is typically soaked in a brine solution overnight before being wrapped with banana leaves for masking the bitter taste caused by the addition of papaya leaves. Surono et al (1983) reported that because dangke is manufactured at 90 °C, at which the proteolytic activity which produce small peptide is relatively low and the milk clotting activity which promote coagulation is at the maximum, it does not develop a strong bitter taste, on the addition of an appropriate amount of papaya leaves.[16]

Amri and Amboya (2012) reported that heating at low temperature for long time (65°C, 30 min) with the addition of 5 g papain in manufacturing dangke resulted in bitterness.[18]

Fresh dangke is white and has an elastic texture when prepared from buffalo milk. To increase the curd yield, tapioca, rice, or wheat flour is added, resulting in pale yellow dangke with no elastic texture. The moisture content of dangke is lower than that of dali because the whey is removed from the curd by strongly pressing it in the coconut shell. Hence, dangke has a longer storage duration (3 days) than does dali (12 hours) with the addition of salt, at room temperature.

COLOGANTI AND LITSUSU

In East and West Nusatenggara, natives have used various coagulants from tropical plants for manufacturing traditional cheese, and enzymes from the litsusu tree are the most commonly used because they are extremely effective in coagulating milk.[19]

In West Nusatenggara, a cheese-like product called cologanti is traditionally manufactured from buffalo milk.

Each district has a different name for cologanti; in East Lombok, it is called perah, and in the Bima district, it is called cologanti, susu kaya, segan jadi, or pesjadi. In West Nusatenggara area, cattle is more extensively bred than it is in other districts because of the severe tropical climate and for combating dryness throughout the year. Therefore, manufacturing litsusu is a daily task and extremely crucial for providing a proteinous food source for the natives.

Cologanti manufacturing entails using various coagulants from tropical plants, such as papaya leaves, unripe pineapple juice, Ficus sp, latex from *Calotropis gigantea* (rembega), bark from *Calotropis mangkas* (ridi tree), latex from *Planconella oxinela* (jeliti tree), *Solanum melongena* extract, *Solanum torvum* juice, and *Mimosa pudica* leaf extract.

Natives of East Nusa Tenggara observed that the bark of *Wrightiana calysina*, called pohon litsusu (the litsusu tree), produces ample latex and effectively coagulates milk. In Timor island, cologanti is manufactured in the following manner: the bark of pohon litsusu is added to 2–3 L of milk in bamboo tubes at less than 40°C and allowed to stand for 2–3 hours. After milk coagulation, the whey is removed by squeezing the curd with the fingers. The curd is then molded into a hemispherical shape and dried in the sun for 1 hour. The dried curd is called litsusu.

Cologanti and litsusu manufacturing may involve microbes derived from bamboo tubes, plant proteolytic enzymes from the litsusu tree, and other plant coagulants. Khusniati et al (2004) reported that increasing litsusu enzyme concentrations increased the weight of the curd but reduced the whey. Moreover, increasing litsusu enzyme concentrations reduced the coagulation activity of litsusu. Adding 1 g/50 mL litsusu tree enzyme yielded litsusu with the desired physical and chemical characteristics.[20]

Hosono et al (1983) reported that 6.0 and 70°C were the optimum pH and temperature, respectively, for milk coagulation, suggesting that enzyme activity results in milk coagulation.[19] Moreover, acidic curd has a coarser structure than do curds prepared by coagulating milk with either rennet or litsusu extracts, as observed through scanning electron micrography.

AUTHOR DISCLOSURES

The author declares that there is no conflict of interest.

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傳統印尼乳製品

印尼是全球最大的群島，具有最豐富的生物多樣性國家之一，並擁有最多元的料理及傳統發酵食物。印尼有三種傳統的乳製品，名為類奶油製品 minyak samin；類優格製品 dadih；及類起士製品 dali 或 bagot in horbo（水牛奶）、dangke、 litsusu 及 cologanti，這些反映出印尼乳製品消費特有的文化。

關鍵字：印尼乳製品、minyak samin、dadih、dali、dangke、litsusu、cologanti