Microbiological profile of fresh goat milk: Impact of goat farmer practices in “Taruna Mukti” goat farmer group, Sragen, Central Java

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Abstract. Goat milk is susceptible to be contaminated by many microorganisms including microbial pathogens responsible for causing diseases. Various contaminations come from every stage of goat milk produce including feeding, milking, and milk treatments. The aim of this study was to assess the practice of dairy goat farmer and evaluate the microbiological profile of raw goat milk in dairy goat farmer group. The study showed that raw milk had high total plate count (7.8x10^6 CFU/ml). Thus, Coliform and E. coli were detected in the samples of fresh goat milk. Overall, it can be seen that fresh goat milk was relatively poor hygienic quality and was not conformed to the Indonesian Nasional Standard.

1. Introduction
Dairy goats are important groups of milk producing animals throughout the world and 80% majority of the milk goat is produced in developing countries [1]. Dairy small ruminants especially goats approximately 52.1% of total goats in the world are spread in Asia, and producing 8.04 Mt or 52.7% of world’s goat milk [2]. Goats, mainly located in subtropical-temperate areas of Asia, Europe, and Africa, are concentrated in low-income, food deficit countries [3]. The demand of dairy goats’ milk is increasing because of the growing population of people, the increasing awareness of medicinal and nutritional status associated with goat milk, and also the special interest in goat milk products, especially cheeses and yoghurt, in many developed countries which has led to increasing levels of disposable incomes [4,5]. As the demand of row milk and dairy products continue to grow with an increasing population, there is a great pressure to maintain the quality of the products especially in microbe quality because total viable bacterial count is considered as one of the acceptance criteria for categorizing milk for human consumption and processing for dairy products [6].

The contamination of Campylobacter, Salmonella, Escherichia coli and Staphylococcus aureus in milk can occur at different stages in the milking procedure and from different sources, mainly from the external surface of the udder and teats, from the surface of the milking utensils, storage equipment, and transport [7–9]. Milk contaminated with high level of spoilage bacteria often becomes unsuitable for further processing [10]. Thus, ensuring supply of safe food has been one of the major challenges and concerns for producers, consumers and public health officials in the world. This is because foods excessively contaminated with pathogenic and spoilage microorganism are undesirable and can cause food borne illnesses [11].

Microbiological quality of goat milk from dairy goat farm has received a big attention to date. Potential health hazards transmissible through milk and milk products were started from the farm. Therefore, the study concentrated on dairy goat farmer group must be carried out, because it is facing hygiene and safety problems in all stages of food production. This study focused on assessment of...
practice of dairy goat farmer and evaluation of the microbiological profile of raw goat milk in dairy goat farmer group.

2. Materials and Methods
The study was conducted in Dairy Goat Farmer “Taruna Mukti” located in village of Purworejo, Gemolong, Sragen, Central Java. The materials of this study consisted of lactating dairy goats, questionnaires, milking and storage equipments, and milk samples. The hygienic practices of dairy goat farmers were evaluated by observation included milking process and milking handling. Researchers conducted an assessment using Yes or No to express the suitability of hygienic practices in dairy goat farmer group by interviewing farmers using questionnaires consisted of the farm characteristics. Milk Samples were taken from the dairy goat in the existing condition with 2 replications. Milk was collected aseptically in bottle for analysis of microbiological profile included total plate count, E. coli, and Coliform in Laboratory of Veterinary and Animal Health Center of Boyolali District.

3. Result and discussion
3.1 The existing condition of dairy goat farmer group
The supply chain of fresh goat milk in Sragen district was generally produced by local farmer group with small scale dairy goat who have not considered to aspects of food safety. One of goat milk producer in Sragen comes from “Taruna Mukti” dairy goat farmer group. The group has has 10 members with 15 lactating dairy goats consisted of Etawah crossbred and Sanen with milk production between 0.5 - 1.5 per head / liter / day. Dairy goat is a type of goat that produces milk at the rate exceeding the needs of their kids. The typical dairy goats raised by farmers in Indonesia predominantly was Etawah crossbred because it has long period adaption to tropical condition and capable to produce milk [12]. Milk production of Etawah crossbred goat ranged between 0.5–1.2 L/head/day. The developing Saanen goat in Indonesia leads to generate crossbred goats, such as Sapera, a result of crossing between female Etawah crossbred and Saanen buck [13]. Purebred exotic dairy breeds and their crosses were mostly found in commercial dairy farms. Milk production of Sapera goat was observed to range between 0.8-1.2 L/day [14]. The existing condition in Sragen was less resources during the dry season especially water. This condition causes a lack of water supply for drinking and sanitation. The supply of forage was lacking so farmers use dry forage feed. Likewise, feeding activity in farmer group still use traditional animal feeding. Only small amount of concentrates was given to the dairy goat without considering feed requirements.

3.2 Practices of milking process
The existing condition of milking practices was counted to be poor because farmers did not apply hygienic practices in milking process such as cleaning goats udder with warm water, dipping the teats, using a washcloth to dry the udder, discarde first milk flow, and using good milking equipments (Table 1.). Good hygienic quality of milk for consumers requires good hygienic practices, such as clean milking utensils, washing milker’s hands, cleaning udder, and use of individual towels during milking and handling, before delivery to consumers or processors [15]. The practical milking preparation caused undetectable of milk abnormality [16]. The prevalence of mastitis is higher in dairy cattle with poor hygiene of the milking process than in dairy cattle with good hygiene of milking process [17]. Before milking starts, the cow should be as clean as possible. It is not advisable to rinse the cow since this will only dissolve the dirt and make it pour down along the skin and accumulate on the udder [18]. A statistically significant association between the use of udder-towel and the occurrence of subclinical
mastitis. It is known that failure in hand washing and in cleaning of the udder exposes the udder and milk to microbiological contamination [19,20].

### Table 1. Practices of milking process in existing dairy goat farm

| Activities                                      | Responses of milking process |
|-------------------------------------------------|-----------------------------|
| Milking frecuency per day                        | 2                           |
| Streamed floor with clean water before and after milking | Yes                        |
| Washing a dairy goat before milking              | No                          |
| Cleaning goats udder with warm water             | No                          |
| Dipping teats into the disinfectant before and after milking | No                          |
| Provide a washcloth to dry the udder before and after milking | No                          |
| Washing milk milking equipment using hot water   | No                          |
| Using milking equipments made of stainless steel | No                          |
| Discarded first milk flow                        | No                          |
| Hand milking until the milk in the udder has run out | Yes                       |

According to [7], teat dipping after milking can reduce the numbers of bacteria on the teat skin, help to protect the stressed teat orifice after milking and also prevent bacteria from entering the teat canal. Teat dipping should be practiced according to national recommendations and regulations [21]. Higher bacterial counts when the same towel was used for drying multiple cows after washing the udder compared to using a single towel for each cow [18,22]. The equipment that is used must be suitable for effective cleaning and sanitization [9]. Buckets should be non-corrosive and easy to clean and disinfect [23]. Thus materials that are non-absorbent and non-corrosive with smooth surfaces, minimal joints and free from dents are recommended [9,23]. Plastic equipment will become scratched on the surface after some time, be nearly impossible to clean and is therefore not advisable [9]. A clean brush with good bristles, hot water and a detergent should be used during washing. The equipment should be rinsed with clean water and dried immediately, preferable upside down and in the sun. [24] reported that, besides udder infection and water quality, hygienic behavior with respect to hand washing, containers cleaning and disinfection are the key areas that need hygiene intervention.

### 3.3 Practices of milking handling

Milk is one of the most common food sources in the human diet and is also a product that is directly available for consumption [25]. Being a nutritious food, it is an excellent growth medium for bacteria. Being a nutritious food, it is an excellent growth medium for bacteria, originating from either mastitis or from contamination of the milk with environmental spoilage as well as pathogenic microorganisms during milking or milk handling process [26]. Due to the highly perishable nature of milk and mishandling, the amount produced is subjected to high post-harvest losses. Post harvest losses up to 40% of milk and its derivatives have been reported from milking to consumption [27]. Further losses incurred are quality losses by storing in unclean storage utensil, which is prone to high microbial contamination. The equipment used for milking, transportation and storage determine the quality of milk and milk products. Types of milk containers determine the qualities of milk, especially during transportations of milk to the selling point. Milk storage and transportation are aimed at having good quality milk available where and when needed for processing [28]. Therefore, producers need to pay particular attention for the type as well as cleanliness of milk equipments. The use of plastic containers was associated with high coliform counts in raw milk [29]. Plastic containers are not recommended for
handling milk as they are known to be vulnerable to bacterial contamination. Milk handling problems coupled with lack of quality assurance of milk delivered to most of the retailers and household consumers pose potential sources of public health risks to consumers [30].

Table 2. Practices of milking handling in existing dairy goat farm

| Activities                              | Responses of milking handling |
|-----------------------------------------|------------------------------|
| Filtering milk harvest                  | Yes                          |
| Using milking equipments made of stainless steel | No                           |
| Using personal hygienic tool for milking handling | No                           |
| Milk was directly pasteurized           | No                           |
| Milk was directly stored in the freezer | Yes                          |
| Need more than 30 minutes to store the milk | Yes                          |

Milk products are generally more stable than fresh milk because they are more acidic and/or contain less moisture [20], so milk should be harvested and stored under hygienic conditions. Equipment used to harvest and store milk should be suitable and well maintained [23]. Milk cooling and refrigerated storage are necessary after milking to reduce bacterial growth rates [31]. Pasteurized milk stored in cold temperatures can inhibit the growth of microorganisms. Pasteurisation significantly decreases the amount of available nutrients and the second is that this decrease negatively impacts an individual’s nutrient intake [32]. Coliform bacteria usually cannot survive at the pasteurization temperature [33].

3.4 Microbiological profile of goat milk

Microbiological quality of goat milk in dairy goat farmer group must be improved. It can be showed by result of microbes analysis including total plate count, E. Coli, and Coliform. The importance of udder cleanliness for psychrotolerant spore contamination of raw milk is logical, as spore forming bacteria have been found throughout the dairy farm environment, including in bedding, feed, manure, soil, and water [34,35]. Cleaning the udder of cows before milking is one of the most important hygienic practices required to ensure clean milk production [20]. A study found that poor teat end cleanliness was associated with higher bacteria counts in bulk tank milk [36]. Further, adopting the hygienic practice of cleaning teats with moist paper towels reduced the number of Clostridia tyrobutyricum spores isolated from raw milk [37].

Table 3. Microbiological profile of goat milk in existing dairy goat farm

| Microbiological analysis | Number of microbes (CFU/ml) |
|--------------------------|-----------------------------|
| Total plate count        | 7.8x10⁶                     |
| E. coli                  | 7                           |
| Coliform                 | 93                          |

Besides udder infection and water quality, hygienic behavior with respect to hand washing, containers cleaning and disinfection are the key areas that need hygiene intervention [24]. Coliform and E. Coli can find in milk, water and on milking equipment [21]. Degree of cleanliness of milking equipments depends on the procedure which is adopted for cleaning and sanitizing. The microbiological quality of the water supply at the farm could be improved by addition of chlorine or by boiling the water [21,38].
4. Conclusion

Overall, fresh goat milk was relatively poor hygienic quality and was not conformed to the Indonesian Nasional Standard due to unhygienic conditions at dairy goat farm. Improving milking and milk handling practices by providing information, education and guidance of hygienic practices to the farmers will be able to increase microbiological quality of milk.

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