

The Empowerment of Livestock Farmers in Subclinical Mastitis Test with GAMA Anti-Haptoglobin in "Sahabat Ternak" Etawah Crossbreed Goat Farm

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Abstract Sahabat Ternak is one of the Etawah crossbreed (PE) goat farm groups in Sleman. This farm group focuses on goat milk production and processed goods. Problems that commonly arise in dairy goat farms are the cases of subclinical mastitis, which are quite high. This disease may cause a decrease in milk production and quality. The mastitis subclinical detection method which is often used by the farming community is the somatic cell count (SCC) and California mastitis test (CMT). However, both tests have low accuracy. Recently, a new method named GAMA Anti-Haptoglobin, which is more accurate and can be done easily has been established by livestock farmers. This community service aims to empower livestock farmers in applying GAMA Anti-Haptoglobin as a sensitive, rapid, and accurate subclinical mastitis detection kit in Sahabat Ternak goat farm. The method used in this activity consisted of discussion, socialization, and training for livestock farmers, as well as laboratory testing, evaluation of test findings, and treatment for PE goats. After the training, the livestock farmers were able to apply GAMA Anti-Haptoglobin mastitis detection method effectively. The implementation of this easy and accurate field mastitis detection method, as well as personnel with reliable skills, will support in the decrease of mastitis cases and increase milk production and quality, as well as community welfare.

1. INTRODUCTION

According to the data by Statistics Indonesia (*Badan Pusat Statistik* or BPS), the production of national fresh milk reached 948 thousand tons in 2020. This number increased by 0.33 percent from 2019, which reached 945 thousand tons. Statistics Indonesia recorded that the milk consumption level among Indonesian people in 2020 was still around 16.27 kilograms per capita per year, which is still lower than other Southeast Asia countries. The current demand for milk in Indonesia reaches 4.3 million tons per year, while the domestic milk contribution toward the national milk demand is only around 22.7 percent. The rest of the fresh milk needs in Indonesia are still fulfilled by imported milk (Statistics Indonesia, 2021). One of the alternatives to achieve milk self-sufficiency program is to use goat's milk.

The growth of goat population in recent years has tended to increase from 12.46 million heads to 13.18 million heads (Sodiq dan Abidin, 2008). Goat milk differs from cow's milk in that the color is whiter and the milk fat globules are smaller, making goat's milk fat is easier to digest, and it can be consumed by people who are allergic to cow's milk, have lactose intolerance, or suffer from various digestive disorders (Restani et al, 2009). Goat's milk also has natural antiseptic properties and can help suppress bacterial proliferation in the body, and it does not induce diarrhea (Moeljanto dan Wiyata, 2002).

The common disease in the cultivation of Etawah crossbreed goats (PE) is mastitis, which takes form in acute clinical mastitis caused by

Staphylococcus aureus (Bleul et al., 2006). *S. aureus* is the major causative agent of mastitis in dairy cattle and goats (Agus, 1991; Barkema et al., 1998; Han et al., 2000). Mastitis in PE goats caused by *S. aureus* infection can lead to economic losses due to reduced milk production, and it can even be a cause of infant mortality during lactation (Purnomo et al., 2006). The greatest incidence of mastitis cases is subclinical mastitis, with an incidence rate of up to 90 percent and a decrease in milk production up to 30 percent (Taylor and Field, 2007). The cases of subclinical mastitis in Indonesia were recorded at around 75-83 percent until the end of 2006 (Sudarwanto et al., 2006).

Sahabat Ternak PE goat farm group in Kemirihebo village, Girikerto, Sleman, Yogyakarta, has been renowned as an animal husbandry center, milk production, organic fertilizer, cages, nurseries, animal feed, and sales of Etawah crossbreed goat since 2007. It continues to develop livestock farming business and currently reaches about 200 goats until the present day. Moreover, it has been developed into a livestock tourist attraction in Yogyakarta. This livestock group provides fresh goat's milk, frozen products, and pure milk powder that are all marketed to the public. One of the problems that PE goat farmers frequently face is the decrease in goat's milk production without clinical symptoms of disease (subclinical mastitis). Subclinical mastitis in Sahabat Ternak goat farm is mainly caused by Gram-positive bacteria (Suwito, W. et al., 2019). The attempt to improve PE goat's milk, which is extensively consumed by the community, requires assistance in goat health management so that safe, healthy, whole, and halal (ASUH or aman, sehat, utuh, halal) milk can be obtained, ensuring consumer health. The attempt to improve the quality of PE goat's milk in this farm group can be used as a model for the management of healthy PE goats by other farm groups all across Sleman.

Early detection of mastitis, especially subclinical mastitis, is necessary to minimize economic losses. The detection of subclinical mastitis is quite difficult since it is lack of clinical symptom, hence specific tests or assessments are necessary. The diagnosis of subclinical mastitis is often done by looking at the composition of somatic cells in the early lactation period (colostrum period). Prediction of the incidence of subclinical mastitis is conducted by comparing the general image of somatic cells during the normal lactation period (Sudarwanto & Sudarnika 2008). The method of subclinical mastitis diagnosis that is frequently employed these days is the calculation of somatic cell count (SCC) using California mastitis test (CMT). Somatic cells are white blood cells that migrate to the mammary glands in response to infection. The mastitis diagnosis method using SCC is the gold standard in diagnosing mastitis, although this approach does not apply to all dairy-producing livestock. Somatic cell count (SCC) is acceptable for dairy cows, but not for goats (Persson and Olofsson, 2011). California mastitis test (CMT) uses the principle of adding a reagent that is similar to a detergent (sodium lauryl sulfate) in a milk sample. CMT reagent will react with leukocytes, causing DNA to exit the nucleus and form a gel clot. Gel clot will only be visible

when the somatic cell concentration is 400,000 cells/ml or more, which becomes a shortcoming of this method. Besides, the interpretation of the findings can be subjective since the assessment of gel viscosity level of each examiner is different, so false positive and negative interpretations may emerge (Viguier et al., 2009).

Due to the lack of detection, it is necessary to have an appropriate biomarker that can be applied to all dairy-producing livestock. A new parameter being developed frequently for early detection of mastitis is measuring the concentration of haptoglobin (Hp). Haptoglobin is a part of the blood protein group, namely acute-phase protein (APP) (Gruys, 1994; Murata, et al., 2004; Petersen, et al., 2004). Haptoglobin is an acute-phase protein that is being developed as a biomarker for the early diagnosis of mastitis. Haptoglobin is a protein that rapidly increases in concentration if there is an inflammatory process. Haptoglobin has been effectively employed as a biosensor in the early detection of subclinical mastitis in goat's milk for faster and more sensitive mastitis detection (Salasia et al., 2016). The previous study has resulted in an anti-haptoglobin antibody named GAMA Anti-Haptoglobin, which can be used to detect fresh milk in PE goats by capturing haptoglobin in goats with clinical and subclinical mastitis.

The aim of this community service is to empower livestock farmers in applying GAMA Anti-Haptoglobin mastitis test method, which is faster and more accurate to minimize the impact of subclinical mastitis. Farmers are expected to be able to detect subclinical mastitis as soon as possible through this program, preventing a decrease in goat's milk production and quality. PE goat farmers need to get an introduction to simple, fast, and accurate technology in detecting mastitis in PE goats so that they can produce safe, healthy, whole, and halal (ASUH) quality milk, with the ultimate objective of succeeding in national milk self-sufficiency.

2. METHOD

The method employed in this activity consisted of discussion, socialization, and training for the livestock farmers, laboratory tests, evaluation of test findings, and treatment for PE goats in Sahabat Ternak PE goat farm group with a population of 200 goats.

2.1 Discussion and socialization of education on PE goat health and milking management

Discussion and socialization were conducted to identify the condition in Sahabat Ternak PE goat farm group related to milk production, both in terms of quantity and quality. Furthermore, the socialization also aims to familiarize the farmers with mastitis, its etiology, pathogenesis, and detection. They were also introduced to anti-haptoglobin GAMA and how it can be used to detect mastitis. The socialization was held before milk sampling.

2.2 Training and mentoring on the use of anti-haptoglobin GAMA for the detection of subclinical mastitis

Farmers were taught how to use GAMA anti-haptoglobin for rapid detection of mastitis.

CMT test was also performed as a comparison. GAMA anti-haptoglobin was made by mixing the haptoglobin reagent with fresh milk in a 1:1 ratio. A positive result was indicated by the formation of sand-like precipitates, while a negative result was indicated by the absence of precipitate when the reagent was mixed with milk. At the initial step, only three goats were used as samples. Furthermore, mastitis screening was performed on 25 PE goats during the lactation period. Milk samples were extracted from each right and left udder to obtain 50 milk samples. The achievement indicator was assessed from the farmer's ability to perform and interpret the results of the mastitis test with GAMA anti-haptoglobin.

2.3 Confirmation of Field Test Accuracy with GAMA Haptoglobin

Confirmation of the accuracy of the GAMA anti-haptoglobin test in the field was conducted by comparing the results of the field test with the laboratory test. The suitability of the GAMA anti-haptoglobin mastitis test results was compared with the laboratory test using ELISA and haptoglobin antibodies. GAMA anti-haptoglobin was assessed for sensitivity and specificity if the test findings matched the ELISA results.

2.4 The socialization of test results to livestock farmers and sustainable assistance

The socialization of this test results aims to inform farmers about the effectiveness of the subclinical mastitis test with GAMA anti-haptoglobin compared to CMT test and confirmed by laboratory test using ELISA. Farmers gained knowledge on mastitis-affected goats through this socialization. They were also asked to submit their comments and opinions about GAMA anti-haptoglobin compared to CMT. Evaluation and assistance for farmers were conducted to monitor the use of GAMA anti-haptoglobin. The success of GAMA anti-haptoglobin was measured by the speed of detection of subclinical mastitis, resulting in a decrease in subclinical mastitis cases, which had an impact on the amount and quality of milk production in Sahabat Ternak farm group. Meanwhile, the success of community service with GAMA anti-haptoglobin was measured from the usage of GAMA anti-haptoglobin applications by farmers and the increase in milk production and quality.

Goats that were detected to have subclinical mastitis were then treated by a veterinarian. Antibiotic injections were given periodically as the treatment. Moreover, milk produced by the goats must still be milked, but should not be consumed. After milking, the goat's nipples were cleansed and dipped in an antiseptic to prevent bacterial infection.

3. RESULT AND DISCUSSION

3.1 Discussion and socialization of PE goat health and milking management

This activity was the opening of a series of community service activities at Sahabat Ternak farm group. The major topic presented by UGM community service in this discussion was "Health Management of PE Goat's Milk

and the Application of GAMA anti-haptoglobin for Mastitis Detection". In this discussion, farmers addressed the problems they faced in the field. Based on the result of the discussion, subclinical mastitis is one of the most common problems faced by farmers. They reported a decrease in milk production, but they were not always sure what was causing it because there were no specific symptoms that appeared.

In this activity, the team from UGM introduced a fast and accurate subclinical mastitis diagnosis method compared to the existing method. Farmers expressed their interest in using the test on their PE goats.

3.2 Training and mentoring on the use of GAMA anti-haptoglobin for subclinical mastitis detection

Following up on the results of discussions with PE goat farmers in Sahabat Ternak farm group, training and mentoring on GAMA anti-haptoglobin usage was conducted. The training for PE goat farmers was conducted three times in phases. The GAMA anti-haptoglobin test required less milk volume than the CMT test for mastitis. Farmers will find it easier because it can be done rapidly and does not require large amounts of milk (Figure 1)

	Before Training	After Training
First meeting: introduction to GAMA anti-haptoglobin	Farmers have yet to know GAMA anti-haptoglobin. SSC and CMT methods are used to detect mastitis.	Farmers know and are familiar with GAMA anti-haptoglobin as an alternative to a new, fast, and accurate subclinical mastitis test.
Second meeting: training on the application of GAMA anti-haptoglobin	Farmers know about GAMA anti-haptoglobin, but have not been able to apply this method.	Farmers can apply GAMA anti-haptoglobin for early detection of subclinical mastitis under supervision.
Third meeting: field application of GAMA anti-haptoglobin	Farmers apply GAMA anti-haptoglobin under supervision.	Farmers can apply GAMA anti-haptoglobin independently and cover a bigger population of goats.

Farmers could apply GAMA anti-haptoglobin after three rounds of training and mentoring. They could do sampling quickly and easily and interpret test results with GAMA anti-haptoglobin well. After they were skilled in applying GAMA anti-haptoglobin, the screening process was conducted on a bigger goat population in the herd. After that, the results of the test using GAMA anti-haptoglobin were obtained. From a total of 50 samples, four of which had subclinical mastitis,

as evidenced by the formation of sand-like precipitates when the milk was mixed with reagents in a 1:1 ratio (Figure 2). Three of the milk samples tested positive for mastitis using CMT. These results were then compared to the results of a laboratory identification test to determine the accuracy and precision of GAMA anti-haptoglobin test. The incidence of subclinical mastitis in Sahabat Ternak farm group has also been reported previously by Suwito et al. (2019). The majority of subclinical mastitis is caused by Gram-positive bacteria. According to the results of GAMA anti-haptoglobin test, the prevalence of mastitis in Sahabat Ternak farm group was 16 percent. This prevalence is lower than the study conducted by Koop G. et al. (2010), which stated that the decrease in goat milk production due to subclinical mastitis was in the range of 37-60 percent.



Figure 1. Goat's milk sampling process



Figure 2. GAMA anti-haptoglobin test

3.3 Confirming the accuracy of GAMA anti-haptoglobin field test

Preliminary tests on the sensitivity and specificity of GAMA anti-haptoglobin were conducted before this test was introduced to the farmers. However, field samples obtained from Sahabat Ternak farm were still subjected to laboratory identification. It was done to convince farmers about the accuracy of GAMA anti-haptoglobin test, so they will be more likely to use it in the future. Based on the result of the laboratory test, four samples that tested positive for mastitis using GAMA anti-haptoglobin also tested positive using ELISA. It proves that GAMA anti-haptoglobin test is more sensitive than the CMT test. The sensitivity of CMT compared to GAMA anti-haptoglobin was 75:100 when compared to the CMT test performed in the field (Table 1). Based on these results, it is evident that GAMA anti-haptoglobin is a fast and accurate diagnostic kit for detecting subclinical mastitis in the field.

3.4 Socialization of test results to farmers and sustainable assistance

The socialization of test results comparison in the field and laboratory to farmers was conducted to give information about the accuracy of GAMA anti-haptoglobin test.

Farmers agreed that GAMA anti-haptoglobin test is relatively easy and fast for early detection of the subclinical test. The community service team continued to assist the farmers. Evaluation and assistance were conducted to monitor the use of GAMA anti-haptoglobin. Moreover, goats with mastitis were given treatment by veterinarians to minimize the economic losses due to the decrease in milk production decrease (Figure 3). Goats can produce 1-1.5 liters of milk per day, and the market price of pure goat's milk is IDR 30,000 per liter, so, economically, preventing mastitis per one goat can save farmers between IDR 30,000-45,000 per head per day. If whole milk is processed further, the losses that can be prevented will increase. Furthermore, the successful introduction of GAMA anti-haptoglobin method and farmers' empowerment in its use in Sahabat Ternak PE goat farm group will be a highly valuable asset in disseminating the application of the method to other livestock groups. As a result, subclinical mastitis cases in dairy goat farms can be quickly and effectively reduced and handled, leading to increased milk production, quality, and economy of PE goat farmers.

Table 1. The results of subclinical mastitis test in the field using CMT and GAMA anti-haptoglobin compared to the laboratory test using ELISA method.

	Positive	Negative	Sensitivity
ELISA	4	46	100%
CMT	3	47	75%
GAMA anti-haptoglobin	4	46	100%



Figure 3. Discussion and mentoring with the farmers

4. CONCLUSION

Farmers at Sahabat Ternak PE goat farm have good awareness and attitude to detect and treat mastitis in goats. They are able to apply GAMA anti-haptoglobin mastitis detection method well. The availability of an easy and accurate field mastitis detection method, and personnel with reliable skills, will support the decrease of mastitis incidence and increase milk production and quality, as well as community welfare. The limitation of this program was not all of the farmers actively participated in the scheduled discussion and training. Better coordination to set up the schedule with the farmers is needed in the future.

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