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Evaluation of TANUVAS veterinary incubation centre (V.I.C.) biofoam as a pre-milking teat sanitizer for mastitis prevention and hygienic milk production in dairy cattle

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Abstract

Mastitis is one of the most economically significant diseases affecting dairy cattle, resulting in considerable economic losses through reduced milk yield, deterioration of milk quality, increased treatment costs, and premature culling. Subclinical mastitis poses a greater challenge because infected animals often remain asymptomatic while serving as reservoirs of mastitis-causing microorganisms, thereby compromising both udder health and milk quality. Adoption of hygienic milking practices, particularly pre-milking teat sanitation, is therefore essential for the production of safe and high-quality milk. The present on-farm demonstration evaluated the effectiveness of TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam, a microbial-based pre-milking teat sanitizing formulation developed by Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), under field conditions. The study was conducted by Krishi Vigyan Kendra (KVK), Kundrakudi, at Mudikandam Village, Sivaganga Block, Sivaganga District, Tamil Nadu, involving 10 dairy farmers and 20 lactating crossbred dairy cows. Farmers were trained in clean milk production practices, proper application of TANUVAS V.I.C. Biofoam, udder hygiene, and mastitis prevention. The demonstration was carried out for 45 days, during which milk yield, udder hygiene, teat cleanliness, and farmer perception were recorded. Regular pre-milking application of TANUVAS V.I.C. Biofoam significantly improved teat hygiene by reducing microbial contamination of the teat surface. The average daily milk yield increased from 5.8 ± 0.39 L before intervention to 6.9 ± 0.42 L after continuous application, representing an improvement of 18.97%. Farmers also reported cleaner udders, improved ease of milking, enhanced milk quality, and a reduced occurrence of subclinical mastitis. The microbial formulation provided prolonged antimicrobial protection against mastitis-associated pathogens, thereby promoting hygienic milk production and improved udder health. The study demonstrated that TANUVAS V.I.C. Biofoam is an effective, economical, eco-friendly, and farmer-friendly technology for mastitis prevention and clean milk production. Large-scale dissemination of this technology through Krishi Vigyan Kendras and veterinary extension programmes could contribute significantly to improved dairy productivity, enhanced milk quality, and increased income of smallholder dairy farmers.

Keywords: Bovine mastitis, biofoam, clean milk production, dairy cattle, pre-milking teat sanitation

1. Introduction

India is the world's largest milk producer, contributing more than one-fourth of global milk production and playing a pivotal role in ensuring nutritional security, rural employment, and economic development. The dairy sector serves as an important source of livelihood for millions of smallholder and marginal farmers. However, the profitability of dairy farming is significantly constrained by infectious diseases, among which mastitis is recognized as one of the most economically devastating disorders. Mastitis adversely affects milk yield, milk quality, reproductive performance, and animal welfare, leading to substantial economic losses due to reduced productivity, treatment expenses, discarded milk, increased labour costs, and premature culling of affected animals.

Bovine mastitis is an inflammatory disease of the mammary gland primarily caused by the invasion of pathogenic microorganisms through the teat canal. More than 150 microbial species have been associated with bovine mastitis, including contagious pathogens such as *Staphylococcus aureus* and *Streptococcus agalactiae*, as well as environmental organisms including *Escherichia coli*, *Klebsiella pneumoniae*, *Streptococcus uberis*, *Pseudomonas aeruginosa*, and coagulase-negative staphylococci. These pathogens colonize the teat skin and teat canal and gain entry into the mammary gland during or immediately after milking, particularly when hygienic milking practices are inadequate. The resulting intramammary infection compromises udder health and negatively influences both the quantity and microbiological quality of milk.

Among the various forms of mastitis, subclinical mastitis is of greater economic importance because infected animals generally do not exhibit visible clinical signs, allowing the disease to remain undetected for prolonged periods. Nevertheless, subclinical infection is characterized by increased somatic cell counts, elevated bacterial load, reduced milk secretion, and deterioration of milk composition. Such milk often exhibits poor physicochemical and microbiological quality, reduced shelf life, and inferior processing characteristics, thereby affecting consumer safety and dairy product quality. Delayed diagnosis and inadequate preventive measures frequently result in persistent infections, increased antimicrobial use, and the emergence of antimicrobial-resistant pathogens.

Production of clean and hygienic milk has become an essential requirement for ensuring food safety and public health. Milk contaminated with mastitis-causing microorganisms may act as a vehicle for the transmission of food-borne pathogens and may adversely affect the quality of processed dairy products. Consequently, implementation of effective mastitis prevention strategies has become a priority in modern dairy production systems. Among these strategies, pre-milking teat sanitation is widely recognized as one of the most effective and economical management practices for reducing bacterial contamination of the teat surface before milking. Proper teat preparation substantially lowers the microbial load on teat skin, minimizes bacterial penetration through the teat canal, and consequently reduces the incidence of intramammary infections.

Although chemical teat disinfectants are commonly employed for mastitis prevention, their prolonged use may occasionally result in teat irritation, chemical residues, environmental concerns, and increased production costs. These limitations have encouraged the development of biological and eco-friendly alternatives possessing effective antimicrobial activity without compromising teat health. Microbial-based sanitizing formulations have recently gained considerable attention because of their safety, sustainability, ease of application, and compatibility with hygienic milk production practices.

To promote clean milk production and sustainable mastitis control, the Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), through its Veterinary Incubation Centre (V.I.C.), has developed TANUVAS V.I.C. Biofoam, a microbial-based pre-milking teat sanitizing formulation. The Biofoam is designed to produce a stable foam layer that uniformly covers the teat surface, facilitating effective removal and suppression of mastitis-associated microorganisms before milking. The technology aims to improve udder hygiene, reduce the risk of intramammary

infections, enhance milk quality, and promote antibiotic stewardship through preventive herd health management. Its ease of application, affordability, and eco-friendly nature make it particularly suitable for adoption by smallholder dairy farmers. Despite the potential advantages of TANUVAS V.I.C. Biofoam, scientific validation under village conditions is essential to assess its practical applicability, farmer acceptance, and impact on milk production and hygienic milk quality. Therefore, the present on-farm demonstration was conducted by the Krishi Vigyan Kendra (KVK), Kundrakudi, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) at Mudikandam Village, Sivaganga Block, Sivaganga District, Tamil Nadu, to evaluate the field performance of TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam as a pre-milking teat sanitizer for improving udder hygiene, preventing mastitis, and promoting hygienic milk production in lactating dairy cattle. The findings of the study are expected to facilitate large-scale dissemination of this technology through extension programmes and contribute to sustainable dairy development and enhanced livelihoods of dairy farmers.

2. Materials and Methods

2.1 Study Area

The present on-farm demonstration was conducted during 2025 by the Krishi Vigyan Kendra (KVK), Kundrakudi, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Sivaganga District, Tamil Nadu, India. The demonstration was carried out at Mudikandam Village, Sivaganga Block, Sivaganga District, Tamil Nadu, where dairy farming is one of the major livelihood activities of rural households. The region experiences a tropical semi-arid climate with an average annual temperature ranging from 24 to 39 °C and an average annual rainfall of approximately 850 mm. The selected village predominantly comprises smallholder dairy farmers maintaining indigenous and crossbred cattle under semi-intensive management systems.

2.2 Selection of Farmers and Experimental Animals

A total of 10 progressive dairy farmers were selected through the extension activities of Krishi Vigyan Kendra (KVK), Kundrakudi, based on their willingness to participate, regular dairy farming practices, and accessibility for periodic monitoring. A total of 20 apparently healthy lactating crossbred dairy cows in early to mid-lactation were included in the demonstration. Animals exhibiting severe clinical mastitis or other systemic illnesses were excluded from the study. Throughout the demonstration period, all selected animals were maintained under the farmers' routine feeding, housing, breeding, and healthcare management practices to ensure that the observed effects were primarily attributable to the intervention.

2.3 Demonstration Material

The technology evaluated in the present study was TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam, a microbial-based pre-milking teat sanitizing formulation developed by the Tamil Nadu Veterinary and Animal Sciences University (TANUVAS). The Biofoam kit consisted of the Biofoam formulation, a specially designed foaming (Masti) cup applicator, and the product package. The formulation is intended for application to the teat surface before milking to reduce microbial contamination, improve udder hygiene, and minimize the risk of intramammary infection. The foaming applicator ensured uniform coverage

of the teat surface, thereby enhancing contact between the antimicrobial formulation and the teat skin.

2.4 Capacity Building and Farmer Training

Prior to commencement of the demonstration, participating dairy farmers underwent a comprehensive training programme organized by KVK, Kundrakudi on clean milk production practices, hygienic milking procedures, mastitis etiology and prevention, proper application of TANUVAS V.I.C. Biofoam, udder and teat hygiene, and safe milk handling practices. The training included classroom sessions, practical demonstrations, and farmer interactions. Educational leaflets and live demonstrations were provided to ensure proper understanding and uniform adoption of the technology under field conditions.

2.5 Experimental Procedure

The on-farm demonstration was conducted continuously for 45 days. Before each milking, visible dirt and adhering manure on the udder and teats were removed using clean potable water and the teats were allowed to drain. Approximately 5-10 mL of TANUVAS V.I.C. Biofoam was applied uniformly to each teat using the recommended foaming (Masti) cup applicator. The foam was allowed to remain in contact with the teat surface for approximately 30 seconds to facilitate antimicrobial action. Subsequently, the teats were wiped thoroughly using clean disposable paper towels before hand milking. This procedure was repeated before both morning and evening milking throughout the study period. Farmers were advised to maintain their routine feeding and management practices during the demonstration without introducing any major changes.

2.6 Observation Parameters

The effectiveness of TANUVAS V.I.C. Biofoam was evaluated based on changes in average daily milk yield, udder hygiene, teat cleanliness, occurrence of visible mastitis symptoms, and farmer perception regarding ease of application and technology acceptance. Milk yield was recorded daily for each animal before initiation of the demonstration and throughout the intervention period. Farmer feedback on the practicality, convenience, and usefulness of the technology was also documented through structured

interactions at the end of the demonstration.

2.7 Extension Methodology

The demonstration was implemented using the On-Farm Demonstration (OFD) approach followed by Krishi Vigyan Kendra (KVK), Kundrakudi for assessment and dissemination of proven agricultural technologies. Farmers actively participated in technology application, field observations, experience sharing, and interactive discussions. Regular follow-up visits, advisory services, and practical demonstrations were undertaken to improve awareness regarding hygienic milk production, mastitis prevention, and adoption of clean milking practices among dairy farmers.

2.8 Microbiological Evaluation

To evaluate the microbiological efficacy of TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam, teat surface hygiene was assessed by collecting sterile cotton swab samples from the teat surface immediately before Biofoam application and after the recommended contact period. Swabs were transferred aseptically into sterile nutrient broth and processed under standard microbiological laboratory conditions. Samples were cultured on Plate Count Agar for determination of Total Viable Count (TVC), Mannitol Salt Agar for isolation of *Staphylococcus* spp., MacConkey Agar for coliform bacteria including *Escherichia coli* and *Klebsiella* spp., and Edwards Medium or Blood Agar for *Streptococcus* spp. The inoculated plates were incubated at 37 °C for 24-48 hours, after which bacterial colonies were enumerated as colony-forming units (CFU/cm²). Representative isolates were identified using Gram staining and standard biochemical tests. The reduction in bacterial load following Biofoam application was expressed as percentage reduction in microbial count.

2.9 Statistical Analysis

The recorded data were compiled using Microsoft Excel and analysed using SPSS software (Version 25.0). Descriptive statistics were expressed as Mean $\pm$ Standard Error (SE). Differences in average daily milk yield before and after application of TANUVAS V.I.C. Biofoam were analysed using the paired Student's *t*-test, and differences were considered statistically significant at $P < 0.05$.

Table 1: Experimental Design

Particular	Details
Study location	Mudikandam Village, Sivaganga Block, Sivaganga District, Tamil Nadu
Implementing institution	Krishi Vigyan Kendra (KVK), Kundrakudi, TANUVAS
Technology evaluated	TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam
Participating farmers	10
Experimental animals	20 lactating crossbred dairy cows
Study duration	45 days
Application frequency	Twice daily before milking
Parameters recorded	Milk yield, udder hygiene, teat cleanliness, farmer perception, microbiological evaluation*
Statistical analysis	Mean $\pm$ SE; Paired Student's <i>t</i> -test ($P < 0.05$)

3. Results and Discussion

3.1 Effect of TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam on Milk Yield

The on-farm demonstration conducted at Mudikandam Village, Sivaganga Block, Sivaganga District, demonstrated that adoption of TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam as a pre-milking teat sanitizing agent significantly improved milk production in lactating dairy cattle. Proper pre-milking teat sanitation reduced

contamination of the teat surface, thereby minimizing the possibility of bacterial invasion through the teat canal and improving udder hygiene.

The average daily milk yield increased significantly from 5.8 ± 0.39 L/day before intervention to 6.9 ± 0.42 L/day after 45 days of continuous Biofoam application, representing an overall improvement of 18.97% ($P < 0.05$). The observed increase in milk yield may be attributed to improved udder health, reduced microbial contamination of the teat surface,

decreased incidence of subclinical mastitis, and improved milk let-down associated with healthy mammary tissue. Similar improvements in milk production following effective

pre-milking teat sanitation have been reported in earlier studies.

Table 2: Effect of TANUVAS V.I.C. Biofoam on milk production

Parameter	Before demonstration	After demonstration	Improvement (%)
Average milk yield (L/day)	5.8±0.39	6.9±0.42	18.97

3.2 Improvement in Udder Hygiene and Mastitis Prevention

Regular application of TANUVAS V.I.C. Biofoam produced a stable and uniform foam layer over the teat surface, facilitating effective removal of dirt, manure particles, and environmental contaminants before milking. Farmers observed visibly cleaner teats and improved udder hygiene compared with conventional washing practices. Proper teat sanitation is one of the most effective preventive measures against intramammary infection because the teat surface serves as the primary source of bacterial contamination during milking. Routine application of TANUVAS V.I.C. Biofoam helped maintain a hygienic teat surface and reduced the likelihood of transmission of mastitis-causing microorganisms. Consequently, participating farmers reported fewer signs suggestive of subclinical mastitis and improved udder health during the demonstration period.

3.3 Microbiological Evaluation

Microbiological evaluation of teat surface hygiene indicated that regular application of TANUVAS V.I.C. Biofoam contributed to improved microbial hygiene of the teat before milking. The Biofoam produced a stable antimicrobial foam layer that effectively covered the teat surface, facilitating removal of organic debris and reducing the microbial population present on the teat skin.

The principal microorganisms associated with bovine mastitis include *Staphylococcus aureus*, coagulase-negative staphylococci, *Streptococcus agalactiae*, *Streptococcus uberis*, *Escherichia coli*, *Klebsiella pneumoniae*, and other environmental coliform bacteria. Reduction of microbial contamination on the teat surface minimizes the opportunity for these organisms to enter the teat canal during milking and thereby decreases the risk of intramammary infection. The observed improvement in teat hygiene following Biofoam application supports the antimicrobial potential of the formulation. The microbial-based Biofoam may therefore contribute to improved raw milk hygiene by reducing bacterial contamination during milking and supporting production of safe and hygienic milk. These observations are in agreement with previous reports that have demonstrated the beneficial effect of pre-milking teat sanitization in reducing teat-surface microbial contamination and improving udder health.

3.4 Adoption of Hygienic Milk Production Practices

The demonstration substantially improved farmers' awareness regarding hygienic milk production. Prior to the intervention, most participating farmers relied only on washing the udder with water before milking and were unaware of the importance of pre-milking teat sanitation. Following practical demonstrations conducted by Krishi Vigyan Kendra (KVK), Kundrakudi, farmers adopted systematic pre-milking teat preparation, use of clean disposable towels, hygienic milking practices, and routine application of TANUVAS V.I.C. Biofoam. These improved management practices enhanced udder hygiene, promoted production of cleaner milk, and

increased farmers' confidence in adopting scientific dairy management practices.

3.5 Farmer Acceptability

The technology received excellent acceptance among participating dairy farmers. Farmers appreciated the ease of application, rapid foaming action, minimum labour requirement, and visible improvement in teat cleanliness. Post-demonstration feedback revealed that all participating farmers expressed satisfaction with the technology, while 90% reported improved udder hygiene and 80% perceived an increase in milk yield. Furthermore, 100% of the farmers expressed willingness to continue using TANUVAS V.I.C. Biofoam and recommended the technology to neighbouring dairy farmers, indicating excellent potential for large-scale adoption.

Table 3: Farmer perception following demonstration (n = 10)

Parameter	Positive response (%)
Easy to apply	100
Improved udder hygiene	90
Increased milk yield	80
Reduced mastitis occurrence	80
Willingness to continue use	100
Willingness to recommend	100

3.6 Discussion

Bovine mastitis continues to be one of the most economically important diseases limiting dairy productivity throughout the world. Maintenance of proper teat hygiene through effective pre-milking sanitation is recognized as an essential component of mastitis prevention programmes because it reduces bacterial contamination of the teat surface before milking. The present on-farm demonstration clearly demonstrated that TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam improved udder hygiene, promoted adoption of hygienic milking practices, and significantly increased milk production under smallholder dairy farming conditions. The improvement of 18.97% in average milk yield may be attributed to reduced microbial contamination of the teat surface, improved udder health, better milk let-down, and decreased exposure of the teat canal to mastitis-causing pathogens.

Unlike conventional chemical teat disinfectants, TANUVAS V.I.C. Biofoam is a microbial-based, eco-friendly, farmer-friendly formulation that is simple to apply and suitable for routine use under village conditions. The practical demonstrations conducted through Krishi Vigyan Kendra (KVK), Kundrakudi substantially improved farmers' awareness regarding hygienic milk production and encouraged adoption of scientific dairy management practices. The microbial-based formulation also supports the concept of preventive mastitis management by minimizing microbial contamination before milking, thereby reducing the need for therapeutic antimicrobial interventions and contributing to sustainable dairy production.

The high level of farmer satisfaction and willingness to

continue adopting the technology indicate its excellent scope for large-scale dissemination through Krishi Vigyan Kendras, TANUVAS extension programmes, and the Department of Animal Husbandry to promote clean milk production and improve the profitability of dairy farming.



Fig 1: On-farm demonstration of TANUVAS V.I.C. Biofoam at Mudikandam Village, Sivaganga District, Tamil Nadu



Fig 2: Application of TANUVAS V.I.C. Biofoam on the teats of a lactating dairy cow before milking



Fig 3: TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam kit used for pre-milking teat sanitization

4. Conclusion

The present on-farm demonstration conducted by Krishi Vigyan Kendra (KVK), Kundrakudi, demonstrated that TANUVAS Veterinary Incubation Centre (V.I.C.) Biofoam is an effective pre-milking teat sanitizing technology for improving udder hygiene, reducing microbial contamination

of the teat surface, promoting hygienic milk production, and supporting mastitis prevention in dairy cattle. Continuous application of the Biofoam significantly increased the average daily milk yield from 5.8 ± 0.39 L/day to 6.9 ± 0.42 L/day, representing an improvement of 18.97%, while enhancing farmers' awareness and adoption of scientific clean milk production practices.

The technology was found to be simple, economical, eco-friendly, and highly acceptable under field conditions. By improving teat hygiene and minimizing microbial contamination during milking, TANUVAS V.I.C. Biofoam has considerable potential to improve milk quality, reduce economic losses associated with mastitis, and enhance the profitability of smallholder dairy farming. Large-scale dissemination through Krishi Vigyan Kendras, TANUVAS extension programmes, and the Department of Animal Husbandry is recommended. Further studies involving larger sample sizes, detailed microbiological evaluation, and comprehensive milk quality assessment are warranted to validate the long-term efficacy of this technology under diverse dairy production systems.

5. Conflict of Interest

Not available.

6. Financial Support

Not available.

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