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HEALTH – MASTITIS

Mastitis control: a sustainable model for the developing world

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UN SDGs

SUMMARY

- **Location:** National Dairy Development Board's (NDDB) model for control of bovine mastitis titled Mastitis Control Popularisation Project (MCPP) is being implemented in more than 1500 dairy cooperative societies (DCS) across nine states in India (Figure 1) focusing on a simple, cost-effective, efficacious, environmentally friendly and sustainable approach.
- **IDF Welfare Action Area:** Animal Health management
- **Resource based measure:** (i) Reduction in treatment costs in bovine mastitis (ii) Dissemination of knowledge to the farmers, especially ethno-veterinary medicine (EVM) (iii) Management of many other common bovine ailments (other than mastitis) by EVM.
- **Animal based measure:** i) Increase in milk production (ii) High cure rates (iii) Non-invasive and therefore painless.
- **Group demographics:** Small-holder livestock farming is largely practiced in India. More than 80% of dairying activities in the household are carried out by women who also carry out measures for control and management of mastitis.

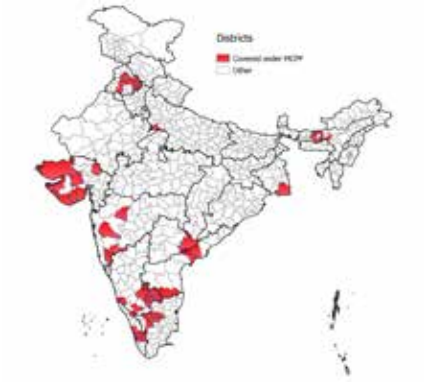

Figure 1 – MCPP implementation in 25 locations covering more than 1500 DCS across nine states in India.

INTRODUCTION

The annual losses due to mastitis in India is estimated to be INR 72 billion (USD 107 million) as per 2009 assessments. With over 70 per cent of dairy animals being maintained by the small and marginal farmers in the country, mastitis is one of the main causes of huge losses to this cross section of farmers who, more often than not, do not have the means necessary to get their animals treated.

NDDB's approach on mastitis control attempts to provide a cost-effective, efficacious and easily implementable model which would enable the farmer to manage the disease effectively, thereby making it a sustainable proposition. The use of EVM could hold the key to achieve this and also minimize the use of antibiotics. The recent report of Inter-Agency Coordination Group (IACG) on antimicrobial resistance (AMR) also focuses on creating awareness, monitoring and restrictions on the use of antimicrobials [1].

NDDB's model uses a three-pronged strategy to control mastitis in cattle and buffaloes: (i) detection of sub-clinical mastitis (SCM) and its control by use of trisodium citrate (TSC) (ii) use of alternative approaches like EVM to manage clinical cases of mastitis and reduce antimicrobial usage and (iii) identification and management of chronically infected animals.

In order to have a multifaceted analysis on the outcome of control strategy, the knowledge on the major bacterial agents associated with clinical and sub-clinical forms of mastitis in India, especially in the project implementation areas, and their AMR profile would play a pivotal role in supporting the evaluation of the efficacy of the therapeutic agents. The data generated would also aid in understanding translational outcomes and efficacy of the disease control through use of TSC and EVM.

MATERIAL AND METHODS

DETECTION AND CONTROL OF SUB CLINICAL MASTITIS (SCM)

The Dairy Cooperative Society (DCS) was the point of initiation for the mastitis control programme. Pooled milk brought to the DCS by the individual farmer was tested using the California Mastitis Test (CMT) to identify farmers with animals that have been sub-clinically infected by mastitis. The next level of CMT testing was at the farmers' homestead to identify individual animal(s) with SCM. The affected animal(s) thus identified, were provided with an oral regimen of TSC at a rate of 10 g per day for ten consecutive days given by mixing with drinking water or feed. Follow-up on the animal was done a week after completion of the oral regimen by CMT. Animals still found CMT positive were provided with a further oral regimen of TSC for ten days and retested again after a week of completion of second regimen of TSC. Animals that still remained CMT positive were then treated with antibiotics and other supportive therapy. If such animals still remained CMT positive on follow-up, they were classified as chronically infected and farmers with such animals were advised on its management, such as milking them last, not using milking machines on them and so on, to limit the spread of infection to healthy animals. The workflow adopted for detection and control of SCM is given in Figure 2.

"With over 70 per cent of dairy animals being maintained by the small and marginal farmers in the country, mastitis is one of the main causes of huge losses to this cross section of farmers"

S K Rana

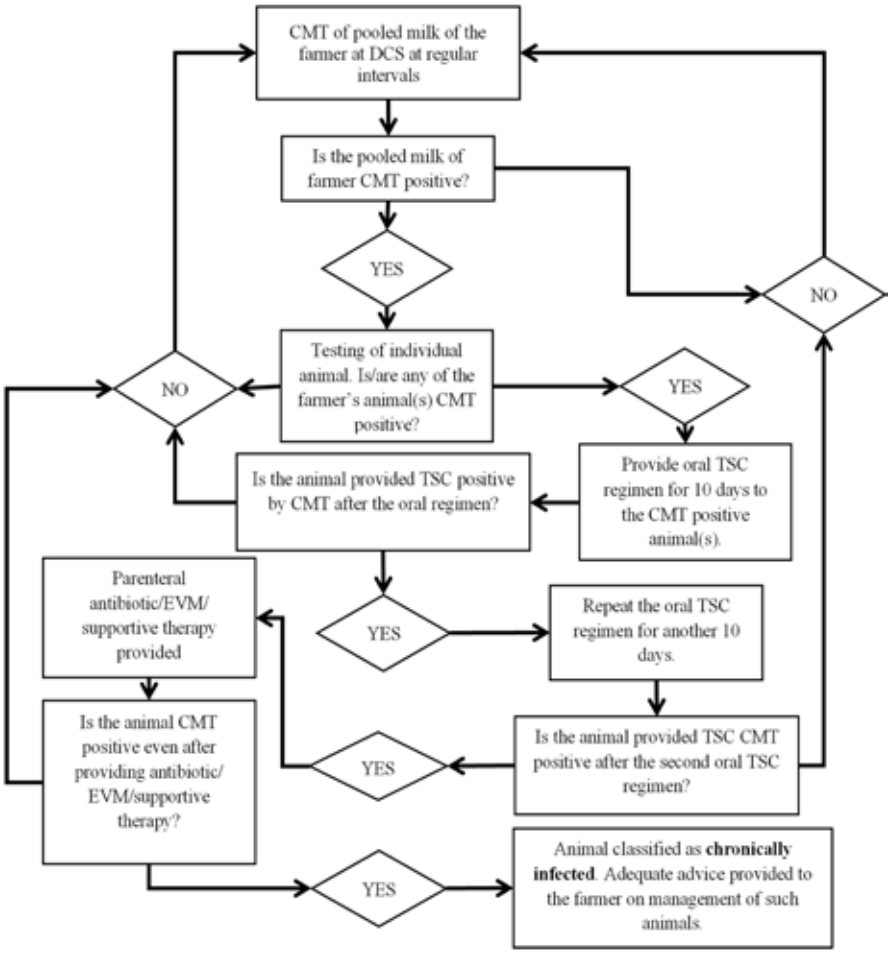

Figure 2 – Workflow adopted for detection and control of sub-clinical mastitis.

USE OF ETHNO VETERINARY MEDICINE (EVM) TO RATIONALIZE ANTIBIOTIC USAGE

EVM was used as an alternative approach to management of acute mastitis, thus avoiding the use of antibiotics. The EVM preparation for acute mastitis was done as per the procedure suggested by Punniamurthy [2] and Nair et al. [3]. This protocol has also been published by NDDB as a booklet "Ethnoveterinary Formulations for Important Ailments in Bovines" [4]. A combination of Aloe Vera (250 g) leaves, Curcuma longa (50 g) and calcium hydroxide (20 g) were blended together to form a reddish paste. One handful (approximately seventy-five grams) of this paste was mixed with 150 ml of clean water to make it thin. Udders of the affected animals were cleaned, washed with water and milk stripped out completely. The mixture was then applied topically thoroughly covering the entire udder with the firm application of palm pressure. The application was repeated 7–10 times a day for 3–5 days, prepared freshly each day.

ETIOLOGICAL BACTERIAL PROFILING

In the milk sheds, where management of SCM and clinical mastitis were undertaken using TSC and EVM respectively, a synchronised surveillance was carried out on etiological agents of mastitis and its AMR.

Bacterial agents associated with mastitis cases were established by culturing aseptically collected mastitis milk samples of affected animals using standard microbiological methods [5]. Further identification of organisms was done using automated microbial identification system (BD Phoenix-ID/AST system). Antimicrobial sensitivity/resistance against frequently used antibiotic classes (penicillins, cephalosporins, aminoglycosides, tetracyclines and sulfonamides) was established for major bacterial agents like Staphylococcus aureus (S.aureus), E. coli, Klebsiella sp, by the use of BD Phoenix-ID/AST system in accordance with the CLSI guidelines [6, 7]. Presence of specific AMR determinants in these isolates and genetic elements for other traits with relevance to biofilm and virulence was studied by molecular methods (PCR, sequencing and whole genome sequencing etc.). For agents like S. aureus reported for causing contagious mastitis, spa, MLST and agr typing were carried out to ascertain the relationship within the isolates and their evolutionary lineages [6].

RESULTS AND DISCUSSION

The strategy used for detection and management of SCM was able to reduce the incidence of CMT positivity of individual farmers' pooled milk samples from 55% at the time of initiation of the programme in Jan–Feb 2015, to 31% in Jan–Mar 2019. This 44% reduction in CMT positivity was recorded in a period of four years where the project was being implemented in around 100 DCS and, after testing a total of 285 455 pooled milk samples (Figure 3). A similar trend in reduction (45%) in CMT positivity by detection and control of SCM after testing 315 621 pooled milk samples was observed over a span of two years when this intervention was expanded to 22 milk unions covering around 1100 DCSs (Figure 4).

Around ninety per cent of the animals provided with TSC turned CMT negative after the first or second oral regimen. The cost incurred per animal was also minimal at around INR 30 (USD 0.50) for a ten-day schedule. The CMT positive animals which became negative post TSC supplementation also recorded an average increase of 10–15% in daily milk yield.

The profiling of bacterial agents associated with clinical and sub-clinical mastitis revealed the presence of *Streptococcus uberis* (19%), *Staphylococcus aureus* (14%) *St. dysgalactiae* (14%), *St. agalactiae* (4%), *Klebsiella sp* (7%), *E.coli* (5%), *S. xylosus* (4%), other *non S. aureus* (23%), *Aerococcus viridians* (2%), *S. epidermidis* (2%) etc. Further, the antimicrobial resistances (AMR) of the major bacterial agents viz., *S. aureus*, *E.coli*, *Klebsiella spp* were studied by both phenotypic and genotypic analysis. The study revealed the presence of variable degree of AMR including multidrug resistance in these bacterial agents. For instance, 30% of S. aureus isolates were found to be resistant to methicillin (methicillin resistant S. aureus, MRSA).

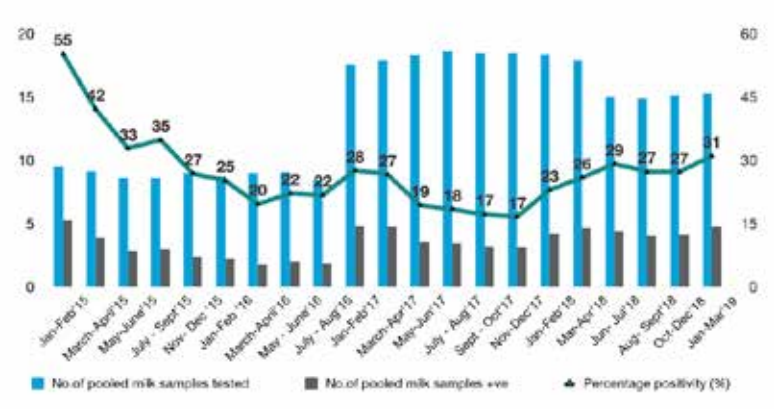

Figure 3 – Reduction in SCM as detected by CMT in 100 DCS in one milk union.

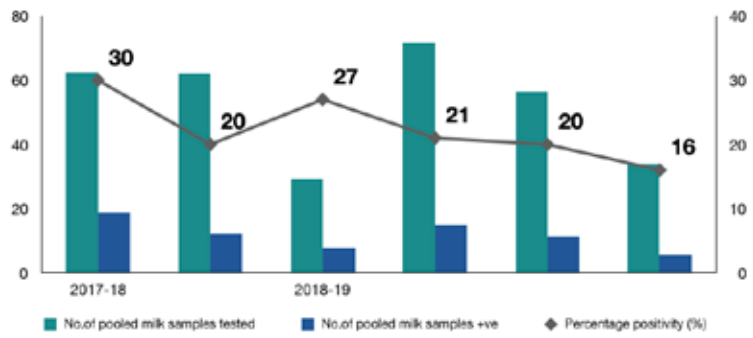

Figure 4 – Reduction in SCM as detected by CMT in 1100 DCS in 22 milk unions.

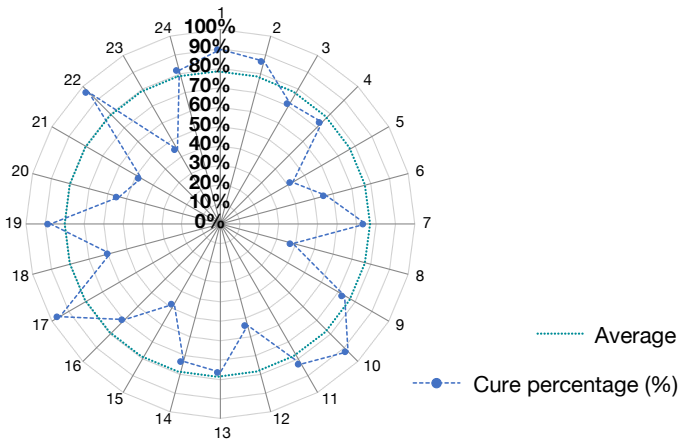

Figure 5 – The recovery rates of acute mastitis cases treated by EVM in 24 milk unions.

Similarly, 14% of *S. aureus*, 18% of *E. coli* and, 50% of *Klebsiella spp*. isolates exhibited multidrug resistance to various classes of antimicrobials like penicillins, cephalosporins, tetracyclines, gentamicin, trimethoprim/sulfamethoxazole etc. Thus, in many instances, these agents result in development of multidrug resistant mastitis. Typing of *S. aureus* isolates (n=30) revealed the presence of 6 spa, 8 MLST and 2 agr (I&III) types. No specific pattern of geographical distribution of these isolates could be observed and typing results also indicated the likelihood of inter-species transmission of the same *S. aureus* types [6]. A higher percentage of *S. aureus* isolates harboured most of the genes involved in biofilm production, which might also be responsible for securing the organisms from antimicrobials, making antibiotic treatment ineffective in many instances.

EVM provided a cost effective and efficacious alternative to conventional allopathic treatment which has helped in significantly reducing the use of antibiotics [6, 7]. A total of 48 469 of acute mastitis cases in 24 milk unions were treated using EVM alone of which 78% (38 045) reported complete clinical recovery (Figure 5). Antimicrobial activity of EVM preparation and probable mode of action have also been reported elsewhere [8, 9]. The cost for a complete treatment course was around INR100 (USD 1.5). Wherever the procedures for preparation and application were followed judiciously, the success rates were above 90%. Lower success rates could be attributed to improper preparation and application procedures and use of inferior quality ingredients.

CONCLUSIONS

The success of antibiotic treatment depends on various factors viz. form of mastitis, extent of pathological damage to the udders, type of pathogen involved, drug sensitivity pattern etc. The multi-etiological nature of mastitis and presence of AMR is the main constraint in the development of an efficacious control strategy. Etiological profiling of mastitis in the present study revealed the association of several bacterial agents with variable degrees of AMR, including multidrug resistance. On the basis of limited studies, it is felt essential to reinforce the effort of minimizing the use of antibiotics in treatment and control of mastitis.

The mastitis control model rationalizing the use of antibiotics through alternative approaches being propagated by NDDB is a cost-effective and efficacious proposition for controlling this scourge in developing countries like India, where the resources with the stakeholders are limited. Transferring this EVM knowledge to the farmer would empower them to manage mastitis and other important ailments which dent their already meagre income at minimal costs. This would also help to drastically reduce the usage of antibiotics, thereby stalling the emergence of AMR. The use of TSC and EVM was also found to be an effective alternative for treating SCM and clinical mastitis, irrespective of the etiological agent(s) which had varying degrees of antimicrobial resistance and virulence.

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Control of Streptococcus agalactiae to reduce subclinical mastitis in pastoralist dairy camel herds in Kenya

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SUMMARY

- **Location:** Isiolo and Laikipia county, Kenya
- **IDF Welfare Action Area:** Health management
- **Resource based measure:** Milking hygiene, watering intervals, supplementary feeding, frequency of changing of enclosure.
- **Animal based measure:** Udder condition, body condition, somatic cell count, inflammatory markers in milk, milk production, intramammary infection, tick infestation

INTRODUCTION

Camels are vital for the subsistence of pastoralists inhabiting arid and semi-arid regions in Africa, the Middle East and Asia. Due to their unique adaptations to harsh climate, the camel is an important production animal, providing milk, meat, hair, hides and a means of transport. The camel population in Kenya is estimated to be approximately 1 million and the majority are kept under traditional management. Camel milk calculates for 70% of all milk consumed by pastoralists in northern Kenya as well as 40% of their daily calorie intake [1]. Mastitis is a common problem among dairy camels [2, 3] and is an important constraint to milk production, with implications for animal welfare, household economy and public health [4]. Symptoms of clinical mastitis (CM) are well-known by the herders, whereas subclinical mastitis (SCM) is difficult to assess without relevant diagnostic tools. Consequently, camel herders are less aware of the occurrence of SCM. The prevalence for SCM in dairy camels in reports from Sudan and Somalia has been calculated to 16-44% 2]; however, in a study from Kenya, the SCM prevalence was 87.3% [5]. A mastitis pathogen commonly isolated from dairy camels in the region is Streptococcus (Str.) agalactiae, which severely reduces milk production and is likely to develop into a chronic infection. A joint project between research partners from Kenya and Sweden targets the issue of SCM in pastoralist dairy camels in Kenya, with a special focus on Str. agalactiae. The aim of the project is to extract a work package tailored to pastoralist conditions in order

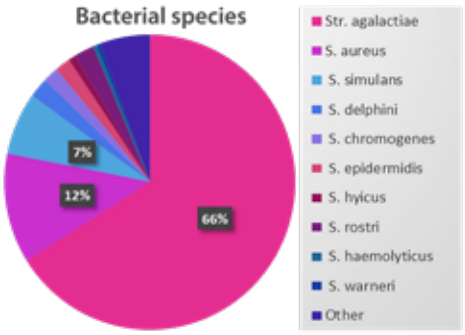

Figure 1 – Bacteria isolated from milk from dairy camels (n=93) in Isiolo, Kenya. Numbers are the percentages based on the total of isolated bacterial specimen (n=233).

Level	Subclinical mastitis	Total
Herd	100% (n=20)	**20**
Camel	46% (n=95)	**206**
Quarter	26% (n=207)	**804**

Table 1 – Prevalence of subclinical mastitis, defined as a California Mastitis Test score ≥3 and the absence of clinical symptoms of the udder, in 20 dairy camel herds in Isiolo, Kenya.