Assessment of Acoustic Pulse Technology (APT-X) in the Treatment of Mastitis in Indian Dairy Cows – A Multicentered Trial Compared to Standard Antibiotic Treatment

Gabriel Leitner1*, D.N. Hegde2, Vikas Gupta3, Ragothaman S4, and Narendra Kumar R 4

*Corresponding author: Email : gabil@armentvet.com
1Armenta Ltd
2Consultant KMF, Ex- Director AH, KMF
3Advisor- Indian Veterinary Association
4Director – Regenta Biodiagnostics Private Limited

India is the world’s largest milk-producing country, with a 20% share in global production (OECD 2019) with over 193 million cattle. In India cattle are sacred, thus many states do not permit the slaughter of dairy cattle for meat production (Sharma et al., 2019). Mastitis, the inflammation of the mammary gland, is the single most important factor that imposes economic burdens on dairy farms worldwide (Halasa et al., 2007). Estimations show that 30% of dairy cattle are affected in both forms of mastitis infection, i.e., clinical (CM) and subclinical (SCM), and it is the most common reason for using antibiotics in dairy cows as preventive and treatment measures (Halasa et al., 2007; Pol and Ruegg, 2007; Saini et al. 2012). Antibiotics have been used to treat bovine mastitis for more than half a century, however, the effectiveness, financial aspects and long-term effects are debatable. Growing awareness of spread of antimicrobial-resistant (AMR) bacteria are influencing the decision-making progress of reducing antibiotics used in livestock production (Economou and Gousia, 2015; Magouras et al., 2017). Therefore, judicious use of mastitis antibiotics treatment should be evidence-based (Pyörälä, 2009). Continued use of antibiotics in the treatment and prevention of mastitis has a direct effect
on fostering AMR, which has hazardous consequences on human health (Sawant et al., 2007). Moreover, antibiotics might weaken the cows’ immune system, making it more susceptible to repeated infections (Bradley et al., 2007; Enli et al., 2019).

Acoustic pulses, also called shockwaves, are “mechanical” waves, in low instance that affect cells by mechano-transduction. The mechanical information converts it into biochemical responses, influences cellular functions such as migration, proliferation, differentiation, and apoptosis. As a result, substantial anti-inflammatory effects occur, stimulating and remodeling the growth of new arterioles. The new blood vessels improve blood supply and oxygenation of the treated area and support faster healing (Davis et al., 2009; Waugh et al., 2015). Low-intensity shockwaves have been used over the last 20 years in human healthcare (Mariotto et al., 2009; Yahata et al., 2016).

Acoustic Pulse Technology (APT) is generated by repeatedly driving a projectile using high air pressure to collide against an anvil that is connected to a treatment head (Leitner, et al., 2018). The APT-X device, developed by Armenta Ltd., Ra’anana, Israel, was specifically adopted for the treatment of dairy cows by distributing waves over a large area, thus triggering the body self-healing mechanism, and can be used regardless of the cause of infection (Leitner et al., 2018), thus, preventing the need to identify the causative bacteria. The treatment is friendly to the animal with no side effects as well as to the environment. Treatment of CM and SCM on commercial dairy farms using the APT-X has been shown to result in >70% recovery, reduce culling by >70%, and increase daily milk yield (MY), and to give similar results of bacterial cure with antibiotics. The outcome of its use was increased income from milk and reduced losses from culling (Leitner et al., 2018, 2021; Merin et al., 2021).

The aim of the study was to assess the efficacy of APT-X vs. standard use of antibiotic in the treatment of CM and SCM in Indian dairy cows, on the rate of reduction in inflammation, pain, and on the rate of milk yield post treatment.

Materials and Methods

This Multi Centre study was conducted among small holding dairy farmers in the State of Karnataka, India covering 4 Milk Unions across 4 Districts of Karnataka, namely Dakshina Karnataka, Tumakuru, Kolar and Bangalore North. These farmers are members of the Karnataka Milk Federation (KMF), and they pour their produce into BMCs (Bulk Milk Chilling units) of KMF at respective Milk Union collection centers. All these cows are treated by Veterinary Surgeons attached to the respective Milk Unions under KMF.

At time of first identification of infection, each cow was graded for clinical mastitis, the level of inflammation by California Mastitis Test (CMT), by quarter and for its daily milk yield (MY). 107 cows with one or more quarters with CMT >1 was treated with the APT-X device in all 4 quarters. In parallel to this treatment, 20 cows were conventionally treated with antibiotics (including Penicillin and its derivatives, Cephalosporins, Fluoro Quinolones, anti-inflammatory (NSAIDs like Propionic acids like Ketoprofen, Enolic acids like Meloxicam, Fenamate like Flunixin), and steroids (Prednisolone, Dexamethasone, Flumethasone) if required.

The APT protocol consists of 400 pulses, delivered extra corporeally on the infected quarter, on two sides of the teat (200 pulses each). Each course of treatment consists of one treatment a day (lasting 3 min), given for 3 days over a period of 5 to 10 days.

Following treatment, cows were observed for local clinical symptoms (swelling) and at days 1, 7 and 15, post last APT treatment, clinical mastitis grade, and quarters CMT scores were measured. Cow Milk Yield was recorded before treatment and on day 15.

Analyses included recovery of clinical mastitis grade, quarters CMT scores and changes of MY before treatment and 15 days afterwards.

Results

In 64% (69/107) cows treated with APT, clinical symptoms (mastitis grade) were recorded > 1,
and of those, 18 cows showed clinical symptoms in more than 1 quarter before treatment. At day 7, only 12 cows still had mastitis grade >1 and all were zero on day 15 after treatment. The other 36% (38/107) cows did not show clinical symptoms, where clinical mastitis grade was zero and remain as such up to day 15. CMT score ≥ 1 was in 86.9% (93/107) cows and of those 74 cows were CMT positive in more than 1 quarters before treatment. At day 7 only 32 cows still had CMT >1 and on day 15, 4 cows (20%) were still CMT positive (Table 1). Milk yield on time before treatment was 8.55 kg/d (0-15) on average and total milk of the 107 cows was 914.5 kg/d. At day 15, total milk increased to 1239 kg/d, representing a 35.4% increase (Fig 1). The median of milk increase was 30 % reneging from 0 to >400 %.

In 65% (13/20) of the cows treated with antibiotics, clinical symptoms (mastitis grade) were recorded > 1, in 7 cows and they showed clinical symptoms in more than 1 quarter before treatment. At day 7 only 1 cow still had mastitis grade >1 and all were zero on day 15 after treatment. CMT score ≥ 1 was in 80% (16/20) of the cows and out of those 10 cows were CMT positive in more than 1 quarters before treatment. At day 7 only 8 cows still had CMT >1 and on day 15, 4 cows (20%) were still CMT positive (Table 1). Milk yield on time before treatment was 8.7 kg/d (0-21) on the average and the total milk of the 20 cows was 174 kg/d. At day 15, total milk increases to 182 kg/d, representing a 4.6% increase with increasing of (Fig 1) median of milk increased was 0% ranged from -7 to 300%. Comparing the recovery success, it was found that there was no difference at 7 days after treatment but after 15 d all the APT treated cows recovered whereas in the antibiotics group 20% cows still did not recover. There was a significant difference in milk yield, when on the average the 107 cows that were treated with APT produce 35.4% on day 15 compared to only 4.6% of the antibiotics treated cows. Moreover, because during the 10 d, the time of antibiotic treatment, 1740 kg of milk were discarded (loss).

The average percentage milk gain per cow over 3 months period in APTx group (inclusive of both CM and SCM) was 43% whereas under the antibiotic group it was -7% (inclusive of discarded milk).

Discussion

Results show that at time 0 and 15 d after APT treatment, total milk production of all cows treated with APT increased on an average by 35.4%, compared to the cows treated with antibiotics, which increased only by 4.6%. Moreover, during the course of antibiotics treatment the farmer lost revenue of 10 days when the milk was discarded. Previously, the effect of the period in lactation at which the cows were infected and treated was tested, (Leitner et al., 2021). Three periods of days in milk (DIM) were tested: parturition to 50 days, 51 to 120 days and 121 and 220 days postpartum for daily MY from treatment

<table>
<thead>
<tr>
<th>Cows</th>
<th>CMT positive (%)</th>
<th>Recovery success (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time 0</td>
<td>7d post</td>
<td>15d post</td>
</tr>
<tr>
<td>APT treatment</td>
<td>107</td>
<td>86.9 (93)</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>20</td>
<td>80% (16/20)</td>
</tr>
</tbody>
</table>

Gabriel Leitner et al.
Assessment of Acoustic Pulse Technology ...  

and up to 60 days after. The result of period 1 (DIM <50) of the APT treated cows increased by an average of 7.6% in comparison to the not treated cows, which on the average maintained a stable milk level. In period 2 (DIM 51-120), MY of the APT cows was higher compared to the not treated cows by 8.9%. In period 3, the difference was negligible. Thus, if infection occurred early in the lactation and treated with APT the long-term effect will be more notable.

Current APT treatment protocol was designed to treat mastitis that is affecting 1 to 2 quarters simultaneously. In this study, high portion of the cows were inflamed (CMT>1) in more than 1 quarter, suggesting that some of the quarters were in a chronic stage. However, the result on day 15 of all the 107 cows, regardless of the number of inflamed quarters before treatment, were CMT negative, indicating that the decision to treat the 4 quarters/cow paid off. Alternately, 20% of the cows treated with antibiotics remained with mastitis on day 15. Antibiotic mode of action was directed to slow growth or kill the bacteria. Therefore, evaluation of success of antibiotics is actually cure from the photogene following treatment. Thus, although highly important for the process of healing the damaged mammary gland tissues, in many cases it failed, and the inflammation remained and cows produced lesser milk with lower quality. On the contrary, APT triggers a large udder area for self-healing, help regenerate the damaged tissues and thus, the helping the cow’s immunity and elimination of the pathogens.

Conclusion

APTx treatment appears to be a promising option to manage bovine mastitis in Indian Scenario without antibiotics both in CM and SCM as we could observe there was significant reduction in inflammation, pain and improvement in udder health and significant improvement in milk yield. APTx treatment helps in the welfare of the cow, improved udder health, increased milk yield with no reported side effects or adverse effects and thus offers an opportunity to produce an antibiotic free milk.

References


