MUSIC- A NONCHEMICAL METHOD OF MILK PRODUCTION ENHANCEMENT IN DAIRY CATTLE

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ABSTRACT

The present study was conducted to evaluate the effect of music on milk production in dairy cattle and extent of stress reliever. The experiment was carried out in the semi-intensive farming system with 30 numbers of cross breed Jersey animals which were categorized into 3 groups viz. Group I as early lactation phase, Group II as mid -lactation phase and Group III as a late milking phase. The study was conducted for a total of 90 days - 45 days with light instrumented music and 45 days without any music. All the groups were exposed to this music therapy for 45 days and the effect was also observed without the therapy parameters like milk production, serum cortisol level, Somatic cell count, udder health, economic assessment of the effect of music was studied. Music had a direct bearing on increasing milk production, Udder became more healthy and congenial and stress reduced significantly.

KEYWORDS: Dairy Cattle, Music, Milk Production, Stress, Udder Diseases & Profitability

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INTRODUCTION

The effect of music therapy has been studied in several areas such as mental health, special education, rehabilitation and social development (Jayamala *et al.*, 2015) in human beings. Music when scientifically applied has been shown to relieve human suffering (Landreth *et al.*, 1974 and Willard *et al.*, 1952). Literature revealed that most of the work that has been conducted in animals are on the adoption behavior of dairy animals with Automatic milking system (AMS) (Uetake *et al.*, 1997), the behavioral and physiological response of dairy heifers to tape-recorded milking facility noise with and without a pre-treatment adaptation phase (Arnold *et al.*, 2007), Bioacoustics tools for enhancing animal management and productivity (McCowan *et al.*, 2002).

To date, numerous experiments have been conducted to alleviate stress on dairy animals to keep them in physiologically and socially happy condition. Stress is the body's way of responding to any kind of demand or threat. When any living individual sense danger—whether it's real or imaginary—the body's defense mechanism goes into high gear in a rapid, automatic process known as the “fight-or-flight” reaction, or the stress response. During stress, a number of hormones are released to cope up with the adverse situation. Steroid hormone (Cortisol), is one such stress hormone which plays a pivotal role and is released routinely to bring some adaptive

changes in the body (Bristow *et al.*, 2007). Animals can be stressed by physical stress (hunger, thirst, fatigue, injury or extremes of temperatures) or psychological stress (Restraint, handling, and separation, an introduction of new animals to new farmyard). Forceful restraining and milking in dairy cows often generate fear in them. The amygdala in the brain, which is probably the central fear system, is involved in both fear behavior and the acquisition of conditioned fear (Davis, 1992). Detail study upon cats revealed that electrical stimulation of the amygdala is responsible to increase plasma corticosterone (Setekleivet *et al.*, 1961 and Matheson *et al.*, 1971).

Hence, the present study was conducted to evaluate the effect of music on milk production and the extent of stress reliever in dairy cattle along with other benefits in terms of reduction of disease incidence and profit maximization from its farming.

MATERIALS AND METHODS

The experiment was carried out on the Ramkrishna Ashram KVK dairy farm in South 24 Parganas district of West Bengal, India during the colder months of winter (November, 2016-January- 2017). A total of 30 animals (all of the cross breed Jersey strain) was selected and divided into three groups according to their lactation phase. A group I was considered for those animals in early lactation phase, Group II- in their mid -lactation phase and Group III for late milking phase. All the animals were housed, groupwise, in the open paddock with double -sloped roof and bricked floor and each having two water troughs (1.828m × 0.609m × 1.066m). Cows were milked twice a day (at 5.00 hrs and 15.30hrs) with Milking machine. The ration for the animals comprised of feed concentrate, straw and green fodder applied twice a day. Feed and fodder were provided during the milking time. All the animals were made habituated with milking machine in any time of their milking phase and all of them were allowed to the paddock area all the time except during milking.

Light instrumental music (Rabindrasangeet) was used for the experimentation. No loud and hard music was considered as cows prefer country music to rock 'n roll to adopt the same (Albright *et al.*, 1992 and Wisniewski, 1977). Music was played for 10 minutes before and until the completion of milking. Amplifiers were used approximately 1.5 M above the headline of the cows. When music was started most of the animals used to be in the milking stall. Thereafter, the feed and fodder were provided in the individual feeding trough. Sound volume levels were expressed throughout as decibels with respect to an o dB level of 20 μNm^{-2} (Uetake *et al.*, 1997).

The animals, group-wise, were studied for a total of 90 days, out of which 45 days were “off –music” and rest 45 days were considered for “on-music” study. In experiments with and without music, total milk production, serum cortisol level and Somatic cell count (SCC) in milk sample were studied. Besides, udder health as perceived by the milkmen and economical assessment of the effect of music was also studied.

During this study, serum cortisol level of the milking animals in two different conditions viz. Cortisol level during milking music and the same without music was assessed. The serum cortisol level of all the animals was assessed in every three day interval and a total of 30 numbers of assessments was conducted in the three month trial period. All the animals selected for this trial were clinically fit for the entire period, having an average body weight of 275 ± 50 kg as observed during regular monitoring of body weight at 30 days interval. Other physiological parameters like rectal temperatures, ruminal motility, respiration and pulse rate were recorded daily and were found within the normal limits. Just after completion of milking, 10 ml of blood from coccygeal artery was collected by vacuum blood tubes (B.D. Bioscience, India) for subsequent cortisol analysis. Environmental temperature was recorded each day during the time of blood

collection (early morning at 5hrs.), which was found to be $21\pm 2^{\circ}\text{C}$ during the study period November to January. The samples were centrifuged (Remi centrifuge, India) at 2500 rpm for 20 min at controlled temperature condition within 45 minutes of collection and the serum was divided into aliquots which were immediately frozen at -20°C for later processing in the Institutional Sample analysis Unit.

For evaluation of SCC, milk from each animal was collected aseptically. First, the udder of the animal was rinsed with 2% potassium permanganate solution and then with fresh water. Next, each udder was dried by using separate paper towels. Teat canals were disinfected by using 70% ethanol. 10 ml of milk sample was collected in a sterile container after discarding the first jet of milk. Milk samples were distributed in an 0.0001 m^2 area after diluting it with water at 1:1 ratio (Gomes *et al.*, 2011). Thereafter, the slides were dried at room temperature for 24 hrs, followed by methanol fixation and staining of slides (Rosenfeld *et al.*, 1947). Samples for SCC were collected at every three day interval.

STATISTICAL ANALYSIS

Experimental data were statistically analyzed using Paired Samples Test at the significance level 0.01.

RESULTS

Every group of data on milking was found to be significant (Significant level enhance 0.01) with music and without music. It seems that in each and every case, the milk value with music was significantly higher than the milk value without music (Table 6, 7 and 8.). It has also been observed that the milk production increased in all the groups exposed to music compared to the group without music exposure (Table 1, Figure 1-3.).

Percent increase in milk production was found to be highest in Gr-I (21.47), followed by Gr-III (20.99) and Gr-II (15.1). A qualitative study of udder health was performed based on the views and opinion of the milkmen over the period of 90 days. The average of “with-music” and “without-music” parameters was recorded and was converted to a 10 point

scale by the milkmen themselves. As per the score obtained by “with-music” groups (40.6), it is clear that playing music keep the udder more healthy and congenial for increased milk production when compared to “without-music” group (Table 2, Figure 4.).

Figure 4

Interestingly, it has been found that all the animals showed the reduction of stress as observed by a reduced cortisol level when music was played as compared to the cortisol level of the animals when music was not played (Table 3, Figure 5.). It was also observed that SCC was reduced in all the animals, reflecting better internal wellbeing of the udder (Table 4, Figure 6.). Moreover, it was found that the additional average income by playing music in different groups was Rs.3578-6622 (Table 5, Figure 7.) within the observation period of only 90 days.

Figure 5

Figure 6

Figure 7

CONCLUSIONS

Customary playing of music during milking has the stimulatory effect on a voluntary approach of cows to the holding areas and influence on the behavioral readiness of cows to enter the milking machine (Uetake *et al.*, 1997). However, the change of behavior is also accompanied by diminished anxiety as found especially in human patients (Jayamala *et al.*, 2015). Listening to music strongly modulates activity in a network of mesolimbic structures namely nucleus accumbens (NAc) and the ventral tegmental area (VTA), which are involved in reward processing. Also, the activity is modulated in hypothalamus and insula, which are thought to be involved in regulating autonomic and physiological responses to rewarding and emotional stimuli (Menon *et al.*, 2005). Very few studies have addressed the influence of music therapy on milk production (Jayamala *et al.*, 2015). A detailed study on the effect of playing music on milk production in dairy animals is not yet done so far literature are concerned. The present study was thus conducted to assess the effect of music therapy in dairy cattle. The results of numerous studies in a meta-analysis show that music therapy can reduce stress (Pelletier, 2004); therefore, it is possible that music may help mothers of premature infants relax, resulting in an increased production of breast milk. In this study, it was also observed that there is a reduction of cortisol level indicating the reduction of stress due to music therapy. Additionally, it is also seen that udder health condition improves due to listening to music which may be attributed to more relaxed condition, more secretion of oxytocin, a lesser stressed condition of the udder reflecting reduced SCC in music treated animals. Pollack and Hurnik, 1978 found an increase in milk production during the milking in which playbacks were conducted, but according to Brendue *et al.*, 2002, the increase does not occur during the playback phase rather the enhancement of milk production was observed in next milking.

Somatic cells are mainly milk-secreting epithelial cells that have been shed from the lining of the mammary gland and white blood cells (leukocytes) which render the mammary gland to respond to any injury or infection (18). Somatic cell count (SCC) is a useful indicator of intra-mammary infection (IMI) that includes leucocytes (75%) i.e. neutrophils, macrophages, lymphocytes, erythrocytes and epithelial cells (25%). Leucocytes increase in response to bacterial infection, tissue injury and stress as these cells are mainly associated with body defense mechanism and the fight against the infectious organism. An increase in the number of SCC has a negative effect on the normal physiology of udders. It has been observed in different studies by different workers that somatic cells are indicators of both resistance and susceptibility of cows to mastitis and can be considered to monitor the level or the occurrence of subclinical mastitis in herds or individual cows. SCC is a useful predictor and therefore, an important component of assessment of milk with respect to quality, hygiene and mastitis control (Sharma *et al.*, 2011). In the current study the total somatic cell count of freshly drawn milk from the udder was determined in two different conditions, viz., and enumeration of SCC of milk with music and without music.

Pain is another important factor for productivity and welfare of the animals. The measurement and evaluation of animal well fare and pain are really troublesome and subjective. Pain always results in changes of behavioral pattern and psychological status towards adaptive changes. Pain -free environment or perception of pain in lesser magnitude or higher tolerance of painful stimuli will definitely improve the well-being of animals as well as increase the productivity. Music has long been established as a therapy to reduce the pain, especially in human patients (Jayamala *et al.*, 2015 and Beck, 1991). In the present study, the increase in milk production may additionally be attributed to a more pain tolerance and reduction of anxiety associated with environmental, physiological and psychological perspectives.

Moreover, the average income from the farming was observed to increase substantially which is due to increased milk production, reduced disease incidence of udder and overall well-being of the animals due to reduction of stress. Hence, it is very much pertinent to implement music therapy in organized dairy farm to augment more milk production, to keep the dairy animals socially and psychologically happy resulting in maximization of profit from farming. Though this acoustic tool proved to increase milk production, further research is needed to evaluate potentially beneficial and possible negative psychological changes due to play back by monitoring and evaluating behavioral changes. Additionally effect of this playback on the farm workers, mental status and workability remains to be evaluated.

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Table 1: Group-Wise Graphical Representation of Total Milk Production with Percentile Increase

Category	Gr-I	Gr-II	Gr-III
Average milk production with music (lit)	7.852	8.412	11.677
Average milk production without music (lit)	6.464	7.308	9.651
Percentage increase of milk production	21.47	15.1	20.99

Table 2: Udder Health Study as Perceived by the Milkmen (10 point Scale)

Parameters (Over 45 Days Observation)- Average Score (10 Point)	Without-Music	With-Music
Udder texture (more hardness having minimum score)	6.1	7.5
Ease of milk flow (more flow more score)	6.6	8.4
Visible cast/debris/blood etc (absence of any have more score)	5.2	6.9
Udder temperature (more the temperature –lesser the score)	6.3	8.6
Perception of pain by the animals (more the pain-less the score)	5.3	9.2
50	29.5	40.6

Table 3: Estimation of Serum Cortisol Level in Different Groups

Category	Without music	With music	% reduction
Gr I	10.383	8.711	16.1
Gr II	10.602	9.692	8.58
Gr III	10.284	9.3	9.57

Table 4: Somatic Cell Count in Milk of Different Groups

Category	Without music(×100000/ml)	With music(×100000/ml)
Gr I	1.4	1
Gr II	1.3	0.6
Gr III	1.2	0.7

Table 5: Effect of Music on Economic Benefit

Group	Additional Average Income/Day/Animal	Total Additional Income /90 days Observation Period/Animal
Gr-I	49.81	6622.2
Gr-II	39.76	3578.4
Gr-III	73.58	4482.9

Table 6: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	With	7.3076	45	.02813	.00419
	Without_1	7.8480	45	.12502	.01864
Pair 2	With_2	9.6763	45	.07992	.01191
	Without_2	8.4121	45	.02244	.00335
Pair 3	With_3	11.9111	45	.28780	.04290
	Without_3	11.7201	45	.15684	.02338

Table 7: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	With & Without_1	45	-.010	.947
Pair 2	With_2 & Without_2	45	-.175	.249
Pair 3	With_3 & Without_3	45	.594	.000

Table 8: Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	With music - Without_1	-.54044	.12842	.01914	-.57903	-.50186	-28.231	44	.000
Pair 2	With_2 - Without_2	1.26420	.08671	.01293	1.23815	1.29025	97.802	44	.000
Pair 3	With_3 - Without_3	.19098	.23188	.03457	.12131	.26064	5.525	44	.000