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Estimation of Probability of a Particular Milch Animal to Pick Up Mastitis

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ABSTRACT

Mastitis is the most important and expensive disease of dairy industry. The aim of this study was to investigate management and animal level risk factors that favour occurrence of bovine mastitis. The identification of risk factors is important for the design of mastitis control programs in dairy herds. The present study was conducted at the Large Animal Clinic of Madras Veterinary College (MVC) Hospital, Chennai. Out of two hundred and eighty milch animals examined during the study period, sixty cows were affected by mastitis. Binary logistic regression analysis was employed to estimate the probability of a particular milch animal to pick up mastitis and to model the relationship of incidence of mastitis with other explanatory variables. Results obtained revealed that increase in unit change of milk yield (one litre) would increased the incidence of mastitis by 1.658 times. The chance of getting infected by mastitis would be reduced by 2.5 times when the mastitis affected cows were milked last. Incidence of mastitis in non-hygienic farms were 11.675 times more when compared to farms maintained in hygienic manner. Overall, binary logistic model was 84.6 percent accurate in predicting the occurrence and non-occurrence of mastitis. Incidence of mastitis, having been associated with a variety of factors inherent in animals and factors resulting from improper farming practices, appeared to decrease when the management practices are proper and scientific. Well knit extension program is the need of the hour to effectively communicate the farming group about the importance of mastitis control strategies in dairy farming.

Keywords: Bovine mastitis, Binary logistic regression analysis, Risk factor, Incidence

During last several decades mastitis has become very expensive disease in dairy cows (Bennett *et al*., 1999; Fourichon *et al*., 2001; Kelmus *et al*., 2006; Sharif and Muhammad, 2009). Mastitis is characterized by physical, chemical and bacteriological changes in the milk and pathological changes in the glandular tissue of the udder (Sharma *et al*., 2011). Inflammation can be caused by many types of injury including infectious agents and their toxins, physical trauma or chemical irritants. In the dairy cow, mastitis is always caused by micro-organisms, usually bacteria that invade the udder, multiply in the milk-producing tissues, and produce toxins that are the immediate cause of injury. Elevated leukocytes or somatic cells produced by inflammatory response cause a reduction in milk production and alter milk composition. These changes in turn adversely affect quality and quantity of dairy products.

The dairy industry is facing a great set back due to high prevalence and incidence of mastitis in milch animals. Mastitis is often the end result of the interaction of several factors such as man, cow, environment, microorganisms and management. Effective mastitis control strategies depend on early and accurate detection, since proactive management of the condition can reduce the negative effects of the disease and achieve higher cure rates (Fricke, 2002; Deluyker *et al*., 2005). The efficiency of mastitis control can be improved by using information about cow-specific risk factors. This information allows farmers to identify the cows that have a higher risk of mastitis and to subsequently provide a higher level of care for these cows.

The aim of this study is to investigate management and animal level risk factors that favour occurrences of mastitis. The identification of risk factors is important for the design of mastitis control programs in dairy herds.

MATERIALS AND METHODS

The present study was conducted at the Large Animal Clinic of Madras Veterinary College (MVC) Hospital, Chennai. The primary data were collected from milch cows presented in outpatient ward of the MVC hospital. In addition, farm visit of the respective farmers were made to obtain the additional information on bovine management practices followed by the selected farmers.

Out of two hundred and eighty milch animals examined during the study period, sixty cows were affected by mastitis. Pre-tested questionnaire was prepared and detailed information about mastitis infected animals were collected from the farmers. Total farm details including details of barn, management aspects, previous history of disease aspects if any and hygienic aspects were collected through personal interview method.

Collected data were subjected to preliminary, exploratory and descriptive analysis. Binary Logistic regression analysis was used to model the relationship of incidence of mastitis with other explanatory variables. Logistic regression analysis were performed by using IBM® SPSS® 20.0 for windows®. In the present study, it was employed to estimate the probability of a particular milch animal to pick up mastitis. The purpose of this model was to determine the probability that an individual animal with a given set of attributes would pick up the infection or not. Logistic regression had been studied recently in different scientific fields such as medicine, economics and agriculture (Eyduran *et al.,* 2005).

The description of the variables used for logistic regression were given in Table 1. Mastitis affected animals were labeled as 1 and non-affected animals as 0 for the dependant variable. In the case of independent variables, those variables who got P value greater than 0.5 during binary logistic regression analysis were excluded and repeated the analysis for the better results.

Table 1: Consideration of model variables

Factors	Definition
V_1	Average daily milk yield obtained
V_2	Stage of lactation (1 –first, 2 –second, 3- third)
V_3	Lactation number (1-one, 2-two, 3-three, 4-four, 5- five and above)
V_4	Farming system (0- no grazing, 1- grazing)
V_5	Floor space provided per animal (0- not adequate, 1-adequate)
V_6	Milking mastitic cow at last or not (0 –No, 1- Yes)
V_7	Udder and leg hygiene score (1- slightly dirty, 2-moderately dirty, 3- very dirty)
V_8	Hygiene of the farm (0- poor, 1-good)
V_9	Injury to the udder prior to mastitis (0 – No, 1- Yes)
V_{10}	Hand pre-washing prior to milking (0- without soap, 1- with soap)
V_{11}	History of retained placenta (ROP) in current calving (0 – No, 1- Yes)
V_{12}	Breed of the animal (1- Jersey cross, 2- HF cross, 3- Non descript)
V_{13}	Age of the animal
V_{14}	Type of milking methods adopted (1- full hand milking, 2- stripping, 3- knuckling, 4- machine milking)
V_{15}	Udder drying after washing of udder (0 – No, 1- Yes)
V_{16}	Bedding material provided or not (0 – No, 1- Yes)

Dependant Variable : Mastitis affected animal = 1 ; Non affected = 0

RESULTS AND DISCUSSION

Results of binary regression analysis are given in Table 2. Mastitis affected animals were labeled as 1 and non-affected animals as 0 for the dependant variable. A total of sixteen independent variables were included. Chi-square goodness of fit test rejected the null hypothesis, intercept and all coefficients are zero (model χ^2 value = 97.624 **). Cox & Snell R square and Nagelkerke R square are methods of calculating the explained variation, which were 29.4 and 45.5 percent respectively. These values are sometimes referred to as pseudo R square. The Hosmer-Lemeshow statistic indicates a poor fit if the significance value is less than 0.05. In the results obtained, significant value is 0.435 so that the model adequately fits the data.

The variables V_1 (milk yield), V_3 (lactation number), V_6 (whether milking mastitic cow last or not), V_7 (udder hygiene), V_8 (farm hygiene) and V_{11} (History of retention of placenta) were found to be significant (P<0.05). Among the significant variables, V_1 (milk yield), V_8 (farm hygiene) were highly significant (P<0.01). Abebe *et al.* (2016) found milk yield, stage of lactation, udder and leg hygiene and order of milking mastitis cow as significantly associated with the incidence of mastitis.

In the case of binary logistic regression, exponential value of the co-efficient of the independent variable [Exp(B)], the odds ratio is used for interpretation. Results obtained from the logistic regression revealed that in the case of milk yield (V_1), increase in unit change of milk yield (one litre) would increased the incidence of mastitis by 1.658

Table 2: Results of binary logistic model

Variable ID	Variable name	Co-efficients (γ_i)	Wald	Sig.	Exp(B)
V_1	Milk yield	.506	11.963	.001	1.658
V_2	Stage of lactation	-0.518	3.277	0.070	0.596
V_3	Lactation number		9.499	.050	
	Lactation number (1)	-4.471	5.247	.022	.011
	Lactation number (2)	-2.387	2.420	.120	.081
	Lactation number (3)	-2.510	4.645	.031	.092
	Lactation number (4)	-1.137	1.358	.244	.321
V_4	Farming system	-.676	2.326	.127	.509
V_5	Floor space	.694	1.719	.190	2.002
V_6	Mastitic cow last	.903	4.230	.040	2.468
V_7	Udder hygiene		5.433	.066	
	Udder hygiene (1)	-.892	3.270	.071	.410
	Udder hygiene (2)	-1.089	4.642	.031	.337
V_8	Farm hygiene	2.457	28.187	.000	11.675
V_9	Udder injury	-.912	3.129	.077	.402
V_{10}	Hand pre-washing	.711	2.875	.090	2.037
V_{11}	ROP	-.961	4.742	.029	.383
V_{12}	Breed	0.199	0.605	.437	1.220
V_{13}	Age	-.342	2.013	.156	.710
V_{14}	Milking method	0.238	0.895	.344	1.269
V_{15}	Udder drying	.949	4.276	.069	2.583
V_{16}	Bedding material	.560	1.421	.233	1.750
	Constant	-.839	.067	.796	.432

-2 Log likelihood = 193.341; Cox & Snell R Square = 0.294; Nagelkerke R Square = 0.455

Model χ^2 value = 97.624 **;

Hosmer and Lemeshow test: χ^2 value = 7.822

Dependant Variable : Mastitis affected animal = 1 ; Non affected = 0; * - P<0.05 ** - P<0.01

Table 3: Classification Table

Observed		Predicted: Incidence of mastitis in relation with explanatory variables		Percentage
		Not affected	Affected	
Incidence of mastitis in relation with explanatory variables	**Not affected**	208	12	94.5
	Affected	31	29	48.3
Overall Percentage				84.6

times. Result is in agreement with Rahman *et al.* (2009). They stated that udder cleanliness, milk yield and peri-parturient diseases significantly ($P<0.01$) increased the risk of mastitis. Similar results were obtained to Sanotharan *et al.* (2016) also.

Coming to the number of lactations (V_3), one significant point that would be noted is that the chi-square analysis explained only the dependency of incidence of mastitis with total lactation number as a whole. Over and above, apart from the total significance, individual significance of binary logistic regression coefficients indicated that lactation number one and three were significant at five percent level of probability.

Getahun *et al.* (2008) pointed out that among the risk factors considered, presence of teat lesion, stage of lactation and parity number had significant effect on the prevalence of subclinical mastitis using univariate logistic regression. They further performed multivariate analysis and found out that only presence of teat lesion and stage of lactation had significant effect.

Among the categorical variables, last value was taken as the reference category for interpretation. Among the different number of lactations (V_3), incidence of mastitis was 0.321 times in fourth lactation when compared to lactation number five and above. Madut *et al.* (2009) in their result showed that age, stage of lactation, teat lesion could be a risk factors for presence of bovine mastitis (Odds Ratio = 1.34, 1.59 and 7.31 respectively).

Order of milking the mastitis animal (V_6) had got significant effect in reducing the incidence of mastitis. The odds ratio revealed that chance of getting infected would be reduced by 2.5 times when the mastitis affected cows were milked last. In the case of udder and leg hygiene (V_7), animals maintained in a very dirty manner were more prone to mastitis. Animals maintained in a 'slightly dirty manner' had got less chance of infection (0.41 times) when compared to the 'very dirty' class. Risk factors for mastitis that evaluated by Iraguha *et al.* (2015) included teat-end condition, cow dirtiness, breed, parity, age and stage of lactation.

One of the most relevant information obtained was the relationship between incidence of mastitis and farm hygiene (V_8) maintained. Incidence of mastitis in non-hygienic farms were 11.675 times more when compared to farms maintained in hygienic manner. Santhoran *et al.* (2016) did a similar study on Batticaloa district in Sri Lanka and concluded that incidence of mastitis in non-hygienic farms were 12.61 times more when compared to farms maintained in hygienic manner. Retention of placenta in the current calving had got significant influence in the incidence of mastitis. Results revealed that animals with retention of placenta in the current calving were more prone to mastitis (61.7 per cent) when compared to animals with normal calving.

Category prediction about mastitis occurrence and non-occurrence were given in classification table (Table 3). Overall correctness of the prediction obtained was 84.6 percent. Out of 220 non-affected animals, 208 animals were correctly predicted by the model. (94.5 per cent). Out of 60 mastitis affected animals, only 29 were predicted correctly (48.3 per cent).

CONCLUSION

Incidence of mastitis, having been associated with a variety of factors inherent in animals and factors resulting from improper farming practices, appeared to decrease when the management practices are proper and scientific. Well knit extension program is the need of the hour to effectively communicate the farming group about the importance of mastitis control strategies in dairy farming. Similar studies might be conducted in veterinary dispensaries and clinics and the results obtained might be compared.

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REFERENCES

Bennett, R.M., Christjansen, K. and Clifton-Hadley, R.S. 1999. Estimating the costs associated with endemic diseases of dairy cattle. *J. Dairy Res*., **66**: 455-459.

Deluyker, H.A., Van Oye, S.N. and Boucher, J.F. 2005. Factors affecting cure and somatic cell count after Pirlimycin treatment of sub-clinical mastitis in lactating cows. *J. Dairy Sci*., **88**: 604–614.

Eyduran, E., Ozdemir, T., Cak, B. and Alarslan, E. 2005. Using of logistic regression in Animal Science. *J. Appl Sci.*, **5**: 1753-1756.

Fourichon, C., Beudeau, F., Bareille, N. and Seegers, H. 2001. Incidence of health disorders in dairy farming systems in Western France. *Livest. Prod. Sci*., **68**: 157-70.

Fricke, P.M. 2002. Scanning the future-Ultrasonology as a reproductive management tool in dairy cattle. *J. Dairy Sci.*, **85**: 1918–1926.

Getahun, K., Kelay, B., Bekana, M. and Lobago, F. 2008. Bovine mastitis and antibiotic resistance patterns in Selalle small holder dairy farms, central Ethiopia. *Trop. Anim. Health Prod.*, **40(4):** 261-268.

Halasa, T., Nielen, M., De Roos, A.P.W., Van Hoorne, R., De Jong, G., Lam, T.J.G.M., Van Werven, T. and Hogeveen, H. 2009. Production loss due to new sub-clinical mastitis in Dutch dairy cows estimated with a test-day model. *J. Dairy Sci.*, **92**: 599–606.

Iraguha, B., Hamudikuwanda, H. and Mushonga, B. 2015. Bovine mastitis prevalence and associated risk factors in dairy cows in Nyagatare District, Rwanda. *J. S. Afr. Vet. Assoc.,* **86(1)**: 1-6.

Kelmus, P., Viltrop, A., Aasmae, B. and Kasr, K. 2006. Occurence of clinical mastitis primiparous Estonian dairy cows in different housing conditions. *Acta. Vet. Scand*., **10**. 1186/1751-0147-48-21.

Madut, N.A., Gadir, A.E.A. and El Jalii, I.M. 2009. Host determinants of bovine mastitis in semi-intensive production system of Khartoum state, Sudan. *J. Cell Anim Biol.,* **3(5)**: 071-077.

Rahman, M.A., Bhuiyan, M.M.U., Kamal, M.M. and Shamsuddin, M. 2009. Prevalence and risk factors of mastitis in dairy cows. *Bangladesh Vet.*, **26(2)**: 54-60.

Sanotharan, N., Pagthinathan, M. and Nafees, M.S.M. 2016. Prevalence of Bovine Subclinical Mastitis and its Association with Bacteria and Risk Factors in Milking Cows of Batticaloa District in Sri Lanka. *Int. J. Sci. Res. Innov. Technol.,* **3(6)**: 2313-3759.

Sharif, A. and Muhammad, G. 2009. Mastitis control in dairy animals. *Pakistan Vet. J.*, **29(3)**: 145-148.

Sharma, N., Gautam, A., Upadhyay, S.R., Hussain, K., Soodan, J.S. and Gupta, S.K. 2006. Role of antioxidants in udder health: a review. *Indian J. Field Vet*., **2(1)**: 73–76.

Sharma, N., Gupta, S.K., Sharma, U. and Hussai, K. 2007. Treatment of clinical mastitis in buffalo-A case report. *Buffalo Bull*., **26(2)**: 56–58.

Sharma, N., Singh, N.K. and Bhadwal, M.S. 2011. Relationship of somatic cell count and mastitis: An overview. *Asian-Aust. J. Anim Sci.*, **24(3)**: 429–438.