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Occurrence and pathomorphology of lower respiratory system in cattle

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Abstract
The present study was conducted on 72 cattle of different age groups, sex and breeds to find out the occurrence of various pathological conditions of lower respiratory tract, and gross and histopathological alteration with reference to the type, pattern and morphology. Out of these 72 specimens, 51 samples of respiratory system suspected for abnormalities were further processed for histopathological examination. An overall incidence of various pathological conditions was seen as 70.83%. The various forms of affections were identified as pulmonary congestion and oedema (17.65%), pulmonary emphysema (13.73%), atelectasis (11.76%), interstitial pneumonia (17.65%), suppurative pneumonia (5.88%), broncho-pneumonia (13.73%), fibrinous pneumonia (5.88%), haemorrhagic pneumonia (7.84%), pleuropneumonia (1.96%) and pulmonary hydatidosis (3.92%). Sample collected for microbiological examination revealed the presence of different types of bacteria. Bacteria isolated were *E. coli* (18 samples), *Pseudomonas* (7 samples), *Klebsiella* (4 samples) and *S. aureus* (11 samples). It was observed that *E. coli* isolates belonged to different serotypes viz. O11 (20%), O26 (40%), O83 (10%), O121 (20%) and O (untypable) 10%. Antibiogram patterns of different bacterial organisms isolated from various sample of lung showed varying degree of sensitivity to the chemotherapeutic agents.Most effective/sensitive antibiotic against *E. coli* spp. *was* streptomycin followed by ampicillin, clarithromycin, ciprofloxacin, gentamicin and less sensitive towards, cefixime. *Pseudomonas aeruginosa* was found to be most sensitive to streptomycin followed by gentamicin, cefixime, ampicillin, clarithromycin and least to ciprofloxacin. *K. pneumoniae* revealed maximum sensitivity to streptomycin followed by ampicillin, clarithromycin, cefixime, gentamicin and least to ciprofloxacin.

Keywords: Cattle, respiratory system, pneumonia, histopathology

Introduction
Cattle are the pillar of agriculture and play a major role in rural economy. Respiratory system is very important system in all living individuals because it supplies oxygen to the body and removes carbon dioxide from body. Certain pathological conditions are common in lower respiratory system of cattle such as atelectasis, emphysema, bronchopneumonia, mycotic pneumonia, contagious bovine pleuropneumonia, interstitial pneumonia, pulmonary tuberculosis, and pulmonary neoplasm. Cattle are also constantly subjected to a wide variety of viral, bacterial, mycotic, parasitic and metabolic disorders but the conditions of respiratory tract are of prime importance in that they are often associated with losses due to decreased production and mortality. In Rajasthan the occurrence of respiratory problems in cattle appear to be quite common due to high temperature and drought conditions.

Materials and Methods
The specimens of respiratory system of cattle (*Bos indicus*) for the proposed investigation were collected from the carcasses of cattle irrespective of age, sex and breeds. The samples were collected from the municipal corporation of various districts of Rajasthan, mainly udaipur, chittorgarh, Rajsamand and dungarpur. The tissue samples were also collected from the carcasses of cattle, submitted to the Department of Veterinary Pathology, College of Veterinary and Animal Science, Navania Vallabhnagar Udaipur, for the routine post-mortem examinations. The samples received from the field veterinarians were also included in this study. A total number of 72 specimens of respiratory system of cattle were examined and out of these, 51 (70.83%) specimens of respiratory system suspected for abnormalities were further processed for histopathological examination. Following collection, all the samples were properly preserved in 10% formal saline.

Representative fixed tissue samples measuring 2-5 mm thickness carrying normal and affected portion were further processed by paraffin embedding using acetone and benzene technique (Lillie, 1965) [14]. The tissue sections of 4-6 micron thickness were cut and stained with haematoxylin and eosin staining method. Gross and microscopic changes were noticed and interpreted.

Result and Discussion

Table 1: Occurrence of various pathological conditions of lower respiratory tract in cattle (*Bos indicus*) in southern districts of Rajasthan

S. No.	Type of condition	Name of districts								Total no. of sample	Percentage (%)
		Udaipur (N=15)		Chittorgarh (N=16)		Rajsamand (N=20)		Dungarpuir (N=21)			
		No. of condition	%	No. of condition	%	No. of condition	%	No. of condition	%		
1	Congestion and Oedema	2	20	1	8.33	4	30.77	2	12.5	9	17.65
2	Emphysema	1	10	3	25	1	7.69	2	12.5	7	13.73
3	Atelectasis	1	10	2	16.67	2	15.38	1	6.25	6	11.76
4	Pneumonia	5	50	6	50	6	46.15	10	62.5	27	52.94
4.a	Interstitial Pneumonia	2	20	1	8.33	2	15.38	4	25	9	17.65
4.b	Suppurative Pneumonia	1	10	0	0	1	7.69	1	6.25	3	5.88
4.c	Broncho Pneumonia	1	10	2	16.67	1	7.69	3	18.75	7	13.73
4.d	Fibrinous Pneumonia	1	10	0	0	1	7.69	1	6.25	3	5.88
4.e	Haemorrhagic Pneumonia	0	0	2	16.67	1	7.69	1	6.25	4	7.84
4.f	Pleuropneumonia	0	0	1	8.33	0	0	0	0	1	1.96
5	Pulmonary Hydatidosis	1	10	0	0	0	0	1	6.25	2	3.92
Total		10		12		13		16		51	

Table 2: Serogroup of *E.coli* isolated from lung of cattle (*Bos indius*)

Serotype	Number of isolate	Percentage (%)
E. coli (O11)	2	20
E. coli (O26)	4	40
E. coli (O83)	1	10
E. coli (O121)	2	20
E. coli (Untypable)	1	10

In the present study, an overall occurrence of various pathological conditions was seen as 70.83 percent (51out of 72). The occurrence of various pathological conditions separately in Udaipur, Dungarpur, Chittorgarh and Rajsamand was observed as (10/15) 66.67%, (16/21) 76.19%, (12/16) 75% and (13/20) 65% respectively. Various studies on occurrence of various pathological conditions of lower respiratory tract in cattle have been reported in various states of India by earlier workers. Ahmed *et al.* (2013) [1] detected gross pathological lesions in 44.6% lungs. Renu *et. al.* (2021) [25] observed pulmonary lesion 47.48%, at RAJUVAS Bikaner.

Congestion and oedema

The overall occurrence of this condition was seen in 9 cases (17.65 percent) and a higher occurrence 18.1 percent was recorded by Zeryehunn and Alemu (2017) [33], 32.5 percent Mandeel *et al.* (2020) [16]. A lower occurrence 5.35 percent was recorded by Benhathat *et al.* (2017) [6]. Grossly, trachea and bronchi were congested and the involved lungs were increased in size, inflamed, bright in colour, edematous and heavier than normal.

Microscopically, trachea and bronchi were congested and in the lungs the blood vessels in the interlobular septa, interalveolar septa around bronchi and bronchioles were greatly distended and engorged with blood. These observations were similar with those described by Benhathat *et al*. (2017) [6], Zeryehunn and Alemu (2017) [33] and Mandeel *et al.* (2020) [16].

Emphysema

The overall occurrence of this condition was seen in 7 cases (13.73 percent) and A lower occurrence 3.4 percent was recorded by Tembo *et al.* (2015) [30]. A higher occurrence 17.46 percent was recorded by Benhathat *et al*. (2017) [6], 19.2% Zeryehun and Alemu (2017) [33] and 44% Mandeel *et al.* (2020) [16]. Grossly, involved areas of lung were capacious, light colour (yellow white colour) with extremely puffy consistency and widened interlobular septa filled with air. The involved areas crackled on cutting and showed dry cut surface. Microscopically, the alveoli were distended and the interalveolar septa are thinned. It is in conformity with those described by Benhathat *et al*. (2017) [6], Zeryehun and Alemu (2017) [33], Costa *et al.* (2018) [9] and Mandeel *et al.* (2020) [16].

Atelectasis

The overall occurrence of this condition was seen in 6 cases (11.76 percent) and a lower occurrence 6.4% percent was recorded by Zeryehun and Alemu (2017) [33]. A higher occurrence 11.97 percent was recorded by Benhathat *et al.* (2017) [6], 42% by Mandeel *et al*. (2020) [16]. Grossly, the involved areas of lung were collapsed, shrunken and bluish red in colour. The pleura over them were thickened and corrugated. The cut piece revealed even and dry surface, leathery in consistency and the piece sank in water. Microscopically, the compressed lung showed alveolar septa which ran parallel to each other so that the alveolar lumina appeared as small, lengthened, irregular clefts and bronchiolar walls lying in close opposition, slit like residual lumen with sharp angular ends. These finding accord well with Benhathat *et al*. (2017) [6], Zeryehun and Alemu (2017) [33] and Mandeel *et al.* (2020) [16].

Pneumonia

Interstitial pneumonia

The overall occurrence of this condition was seen in 9 cases (17.65 percent) and a lower occurrence 0.08 percent was recorded by Ola *et al.* (2020) [20]. Grossly, the lung showed dark red areas of solidify with discrete lobar distribution. Microscopically, sections of lung typically showed widening of interalveolar septa due to collection of serous or sero-fibrinous exudate with infiltration of predominently mononuclear cells. It is in conformity with the findings of Coelho *et al.* (2017) [8], Amoroso *et al.* (2020) [2], Ola *et al.* (2020) [20] and Batmaz and cangul (2021) [5].

Suppurative pneumonia

The overall occurrence of this condition was seen in 3 cases (5.88percent).Grossly, small nodular abscess throughout the surface of the lobules. The cut surface was moist, greasy and was filled with casseated pus. Microscopically, presence of ghost like remnants of the alveolar architecture in which maximum cells were necrotic. Acute bronchiolitis with various degrees of alveolitis, suppurative exudate rich in neutrophils were filled in the lumen and aggregation of polymorphonuclear cells in alveoli and bronchioles with obliteration of lumen. These findings concur well with those of Maeda *et al.* (2003) [15], Scott (2013) [27] and Narang (2017) [19].

Bronchopneumonia

The overall occurrence of this condition was seen in 7 cases (13.73 percent). and a lower occurrence 8.68 percent was recorded by Puri *et al.* (2018) [22] and 0.65 percent by Ola *et al.* (2020) [20]. Grossly, patchy to scatter area of consolidation were seen in affected lobes. The pleura were greyish yellow over the affected portion. Microscopically, bronchiolitis was the main lesion. The bronchi and bronchiolar lumen were filled with exudate made up of polymorphonuclear cells, mononuclear cells, denuded bronchiolar cells and mucus leading to their partial or complete obliteration. These findings were in close approximation to the finding recorded by Margineda *et al.* (2017) [17], Puri *et al.* (2018) [22] and Ola *et al.* (2020) [20].

Fibrinous pneumonia

The overall occurrence of this condition was seen in 3 cases (5.88 percent). Grossly, in many cases the affected areas of the lung were showed dark red in colour, moderately firm in consistency and fibrin accumulation beneath the pleura. Microscopically, the most characteristic feature was the predominance of the fibrinous exudates in the alveolar spaces which was visualised as accumulation of fibrinous strands intermingling with inflammatory cells comprising of mononuclear cells, polymorphonuclear cells and macrophages. The interalveolar septa were markedly thickened due to infiltration of such exudate with inflammatory cells. The recorded gross and microscopic observations are well accordance those described by Schiefer *et al.* (1978) [26], Martin *et al.* (1980) [18] and Taylor *et al.* (1998) [29].

Haemorrhagic pneumonia

The overall occurrence of this condition was seen in 4 cases (7.84 percent) and a lower occurrence 2.36 percent was recorded by Rani (2017) [23]. A higher occurrence 17.39 percent was recorded by Islam *et al.* (2015) [13]. Grossly, the affected lungs showed patchy haemorrhage and congestion. The lesions appeared bright to dark red in colour. Microscopically, the alveoli were partly or completely filled with erythrocytes and some amount of serous fluid mixed with some leucocytes and macrophages. These observations are in agreement with the earlier findings of Islam *et al.* (2015) [13] and Rani (2017) [23].

Pleuropneumonia

The overall occurrence of this condition was seen in 1 case (1.96percent).Grossly, lungs were capacious and showed no tendency to collapse, excessive serous fluid was in the pleural cavity compressing the lungs. Inter lobular septa were markedly thickened due to oedema fluid and proliferation of septal cells. Microscopically, the interlobular septa were markedly thickended by superabundant edema, eosinophilic beaded fibrillar material, necrotic debris and infiltration of large number of degenerative neutrophils and fewer macrophages and viable neutrophils. The recorded gross and microscopic observations are well accordance those described by Attoh-Kotoku *et al.* (2018) [4] Di Provvido *et al.* (2020) [11] and Di Teodoro *et.al.* (2020) [12].

Pulmonary hydatidosis

The overall occurrence of this condition was seen in 2 cases (3.92 percent). A higher occurrence was recorded 35 percent by Anwar *et al.* (2000) [3], 49.1 percent by Yildiz *et al.* (2005) [32], 38.3 percent by Daryani *et al.* (2007) [10], 32.1 percent by Berhe (2009) [7], 36.9 percent by Regassa *et al.* (2010) [24], 6.73 percent Singh *et al.* (2014) [28] and 3 percent by Vaidya *et al.* (2018) [31]. Grossly, the lung had many thick, opaque, hard, fluid filled hydatid cyst. The Cut surface showed a broad meshwork containing irregular chamber. Microscopically, the histopathological section of the affected lungs revealed laminated hyaline layer infiltrated with leucocytes and surrounded by thick coat of granulation tissue causing fibrosis. The recorded gross and microscopic observations are well in conformity with those described by Anwar *et al.* (2000) [3], Yildiz *et al.* (2005) [32], Daryani *et al.* (2007) [10], Berhe (2009) [7], Regassa *et al.* (2010) [24], Singh *et al.* (2014) [28], Vaidya *et al.* (2018) [31] and Patel *et al.* (2019) [21].

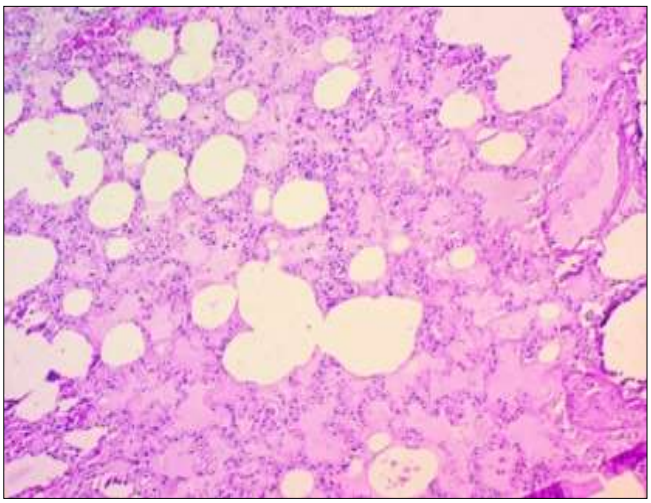

Fig 1: Microphotograph of lung tissue showing oedema, the alveoli containing pink stained homogeneous serous fluid H&E 10X

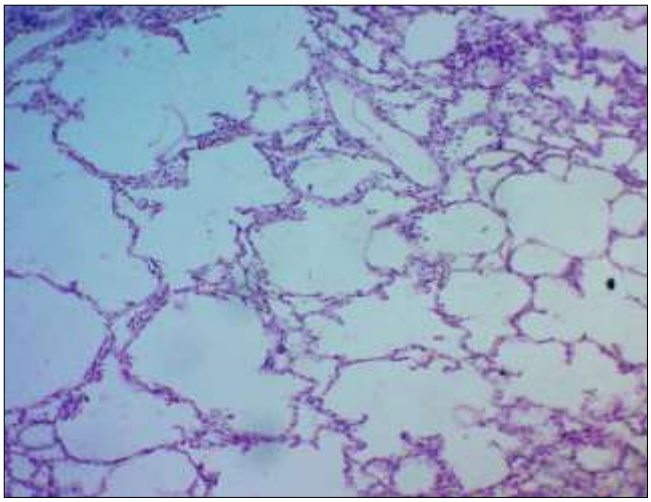

Fig 2: Microphotograph of lung showing emphysema distended alveoli, thin walled and formation of bullae. –H&E, 10X

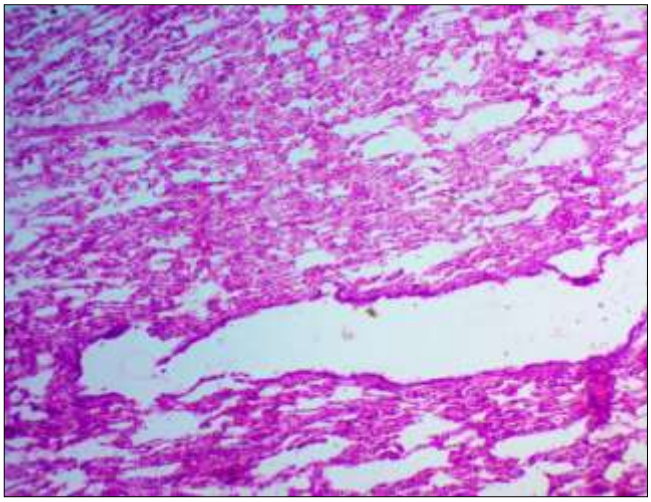

Fig 3: Microphotograph of lung showing atelectasis, congested alveolar wall lying in close apposition with slit like residual lumen and having sharp angular ends H&E, 10X.

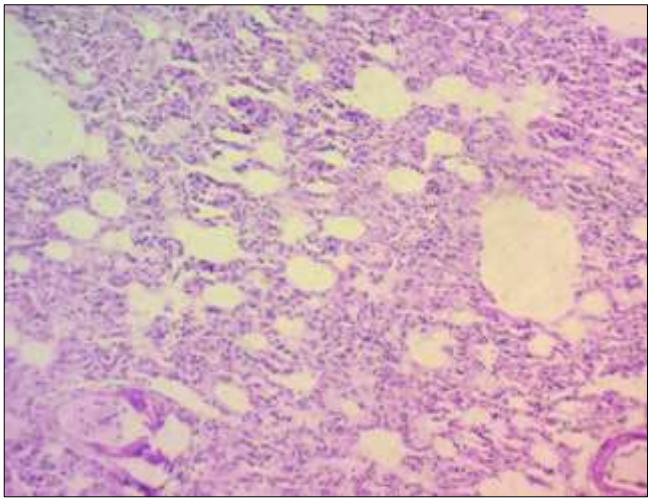

Fig 4: Microphotograph of lung showing interstitial pneumonia, lymphocytic infiltration in the alveolar wall and in the small lobule H&E, -10X

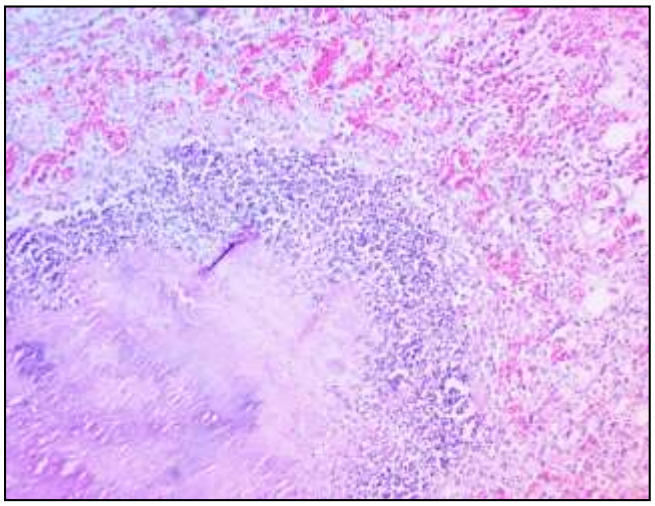

Fig 5: Microphotograph of lung showing abscess. -H&E, 10X.

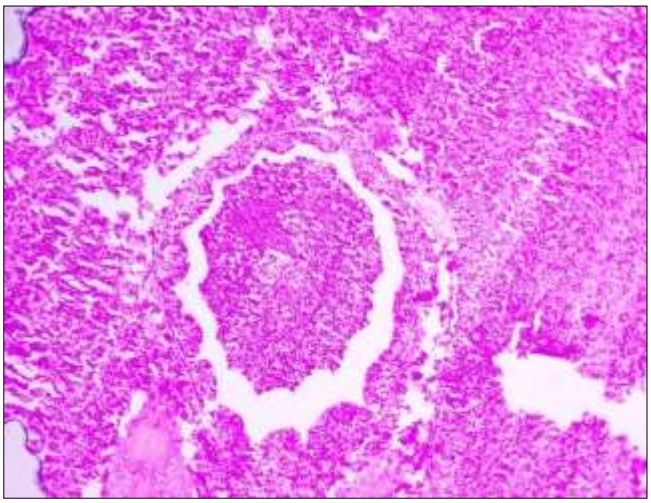

Fig 6: Microphotograph of lung showing bronchopneumonia, peribronchial and bronchial lumen is filled with exudate composed of polymorphonuclear cells, mononuclear cells, and denuded bronchiolar cells H&E, 10X.

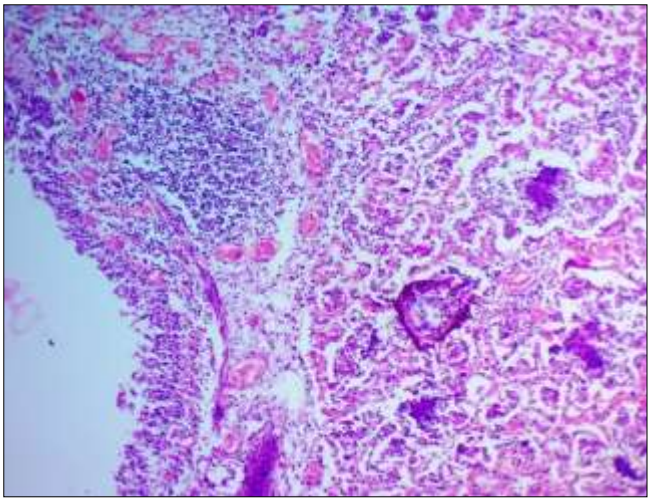

Fig 7: Microphotograph of lung showing suppurative Pneumonia, alveoli and bronchioles lumen are completely obliterated with inflammatory exudate. H&E,10x.

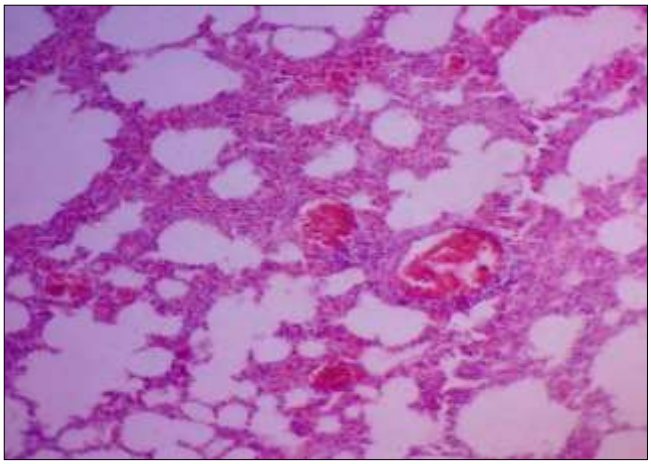

Fig 8: Microphotograph of lung showing interstitial pneumonia, metaplacia of alveolar epithelium it becomes cuboidal and prominent, infiltration of macrophages and lymphocytes into the alveolar wall. H&E- 10x

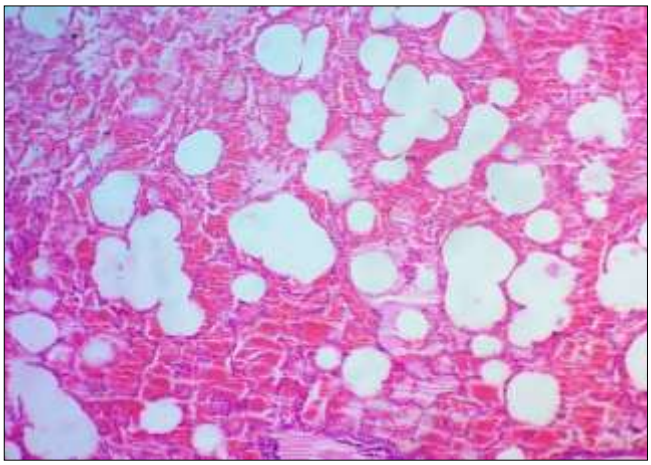

Fig 9: Microphotograph of lung showing haemorrhagic pneumonia , diffuse accumulation of bright red erythrocyte in alveolar and interstitial tissue admixed with mononuclear cells and polymorphs. H&E, 10x.

Conclusion

There are some factors which responsible for causing respiratory disorders in cattle such as poor management and abrupt feeding transitions are particularly disturbing for dairy or suckling cows. The more they are stressed and exhausted the more these animals are vulnerable to bacteria and viruses which lead to development of several kinds of pneumonia and other respiratory disorders. Therefore, proper management practices and balanced nourish in cattle can help to control these disorders.

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