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التغيرات الاكلينيكية والدموية والاتزان الحمضي القاعدي والمصاحبة لبعض الاضطرابات التنفسية والهضمية في عجول التسمين الجاموسي

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أجريت هذه الدراسة على ١١٣ عجل جاموس تراوحت أعمارها ما بين ٨ ـ ١٨ شهرا فحصت منها ٧٤ حالة أثناء تفشي بعض الظواهر المرضية المصحوبة بأعراض تنفسية وهضمية في بعض محطات التسمين بأسيوط وأخذت ٣٩ حالة للمقارنة • وجدت أجسام مضادة لفيروس التهاب القصبة الهوائية المعدي (IBR) والاسهال الفيروسي (BVD) في نسبة كبيرة من العجول المصابة • وقد قسمت العجول المريضة الى خمسة مجموعات مرضية حسب حالتها الاكلينيكية وشدة تتابع الأعراض بها وقد لوحظ انخفاضا ملحوظا في العدد الكلي لكرات الدم البيضاء في مجموعة العجول المصابة بالتهاب حاد في القصبة الهوائية وكذلك في العجول المصابة بالتهاب رئوي معوي ومجموعة الالتهاب المعوي ، بينما لوحظ زيادة معنوية في تلك الكرات في العجول المصابة بالتهاب رئوي مزمن ومجموعة النقاهة ، ولوحظ نقصا في كرات الدم الحمراء والهيموجلوبين في اغلب المجموعات المريضة وبالنسبة لغازات الدم فلقد لوحظ نقصا في تركيز الاس الهيدروجيني مصحوبا بنقصا في تركيز البيكربونات والزيادة القاعدية في المجموعة المصابة بالتهاب رئوي ومعوي ومجموعة الالتهاب المعوي بينما لوحظ نقصا في تركيز الاس الهيدروجيني مصحوبا بزيادة في الضغط الجزئي لثاني اكسيد الكربون في مجموعة العجول المصابة بالتهاب رئوي مزمن •

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CLINICAL, HAEMATOLOGICAL AND ACID-BASE CHANGES ACCOMPANYING SOME RESPIRATORY AND ALIMENTARY MANIFISTATIONS AMONG FATTENING BUFFALOE CALVES

(With 3 Tables)

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SUMMARY

The clinical, haematological and some biochemical studies were conducted on seventy-four buffaloe calves during the prevalence of outbreaks accampanied with respiratory and alimentary manifistations. Respiratory acidosis was observed in the group of calves showing symptoms of bronchopneumonia. Metabolic acidosis was recorded in calves suffering from enteritis. However mixed acidosis (respiratory and metabolic) was noticed in the group of calves with pnumoenteritis. Leukopenia was reported at the early stage of illness, however leukocytosis was observed later on associated with lowered values of total red cell count and Hb concentration in most of diseased cases. Serological examinations revealed the presence of antibodies against IBR and MD/VD viruses in the most of diseased cases.

INTRODUCTION

Respiratory and digestive affections represent the most important and drastic upset among fattening calves and are widely spread throughout the world. These affections constitute a major causes of morbidity and mortality in feedlot cattle that results in valuable economic losses for cattle industry. The incidences of pneumoenteritis appears to increase in recent years. The development of intensive beef production may have largely contributed to the increase in the size of the problem (EL-GARHY, 1982).

Environmental stressors including hunger, thirst, extreme hoat and cold climatic temperature fear and anxiety during transport weaning, dehorning, dipping, castration and vaccination play a role in predesposing of outbreaks of respiratory and alimentary diseases (JENSEN and MACKEY, 1979).

In a survey of bovine respiratory and alimentary diseases antibodies to PI-3, adenoviruses, IBR, and MVD/BVD were demonstrated serologicaly in variable titres (HARBOURNE, 1966 and AMSTUTZ, 1982). IBR has been isolated in Belgium (LOMBA, et al. 1976) and England (WIESMAN et al. 1980). In Egypt studies indicated that IBR infection played a role in cattle and buffaloe calves (BAZ, et al. 1982). Its importancy has increased dramatically in the last few years among fattening stations at Assiut Governorate. The virus was isolated in cases associated with Pasteurella multocida in buffaloe calves (EL-SEBAIE, et al. 1984), with BVD (EL-SEBAIE and HASSAAN, 1985 and NAFIE, et al. 1984).

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The acid-base balance of the body fluids is important because of the chemical reactions of the body, being controlled by enzymes, are very greatly influenced by any changes in pH (TASKER, 1969).

Serious disorders of acid-base balance occur in several clinical disorders in cattle, sheep and goat (HILLS, 1974). Acid base balance in the body is regulated by buffer sustem in addition to the respiratory and renal systems (BREAZILE, et al. 1971; FISHER, et al. 1980). Respiratory acidosis occur when Co_2 elimination is decreased and blood carbonic acid concentration and Pco_2 are increased. Such circumstances may associate obstrurtion of the airways, bronchitis, pneumonia and asthma (COLES, 1980). Metabolic acidosis occurs when there is primary deficit in Cco_3 concentration and was encountered in several disorders such as decreased food intake, systemic infection, sever diarrhoea and renal insufficiency (SRIVELY and BESHEAR, 1972 and TENNANT, et al. 1972). The aim of this investigation was to study the extent of changes in blood picture, acid-base balance parameters in association with major form of alimentary adn respiratory manifestations, in feedlot buffaloe. It was also aimed to study the role viral infection in occurrence of such diseased condition.

MATERIAL and METHODS

Animals:

The study was carried out on some fattening stations at Assiut Governorate and included 113 fattening buffaloe calves aged 8-18 month old. Animals were collected from different surrounding sale markets and dairy farms, transported by means of trucks into fattening stations. Calves were kept in houses with an open fronted shed with an access to out side yard. Hay and concentrates were the main rations offered for animals all over the period of fattening. Barseem was offered in the winter season. Seventy-four calves were examined during the prevalence of three outbreaks of respiratory and alimentary manifistations. The examined calves were classified according to the nature, severity and sequence of clinical signs into five groups. While thirty-nine animals were kept as control.

Blood samples:

Anticoagulated blood samples were collected anaerobically by means of veinpunctur into sterile plastic syringes whose deed space had previonsly filled with 1:1000 I.u/ml sodium heparinate. These samples were immediatly placed in ice water bath to avoid the metabolic changes inthe blood and were used for estimation of blood pH and blood gases as well as for haematological examination. Another blood samples were taken for the separation of serum and used for serological examination.

Blood gases and acid-base status was determined by means of Corning pH-Blood Gas Analyser model (168). The analyzer directly measured at the animals rectal temperature-blood pH, partial oxygen tension (Po2 mmHg) and partial carbon dioxide tension (Pco2 mmHg). Bicarbonate (Hco3 mmol/L), total Co2 (mmol/L) and Base excess (B.E mmol/L) were calculated automatically by means of the aparutus.

The haematological picture (RBCs T/L) WBC (G/L) and Hb (g/L) was carried out by means of Electronic Cell Counter (Cell Dyne 300 Sequoia Turnor).

P.C.V. and differential leukocytic count was estimated according to the routine methods of haematology.

Serological investigation was carried out by means of serum neutrilization test.*

RESULTS

The obtained results for clinical, haematological, acid base status and serological examination were illustrated in tables (1,2,3,). The clinical signs observed were fever anorexia, clear serous nasal dischanges frequent coughing and mild conjunctivitis. Redness of nasal mucosae, and in some cases minute abrasions of variable size were observed in both nasal and oral mucous membrane. Most of the affected animals developed diarrhaea which varied from soft passage of faeces to profuse watery greyish diarrhaea. While 5-10% of calves developed symptoms of enzootic bronchopneumonia. The main symptoms observed in the third outbreak was of alimentary disorders.

Marked leakopenia was observed in the early stages of illness (group II, III, V) while leukocytosis was observed in the group of calves showing symptoms of enzootic bronchopneumonia. Lowered values of RBCs and Hb were observed in all diseased cases (group III, IV, V). Respiratory acidosis was observed in calves with enzootic bronchopneumonia (decreased values of blood pH, and increased Pco2). Mixed acidosis (respiratory and metabolic) was observed in group of pneumoenteritis (decreased values of blood pH, lowered values of Hco3 and base excess with a little increase in Pco2 values). Metabolic acidosis was noticed in enteric calves (lowered pH values, lowered Hco3 and B.E. values). Serological investigation revealed the presence of antibodies against IBR and BVD viruses in most of the examined sera suggesting the involvement of these viruses in the occurrence of such outbreaks among fattening stations.

DISCUSSION

Under our circumstances, there are many different factors involved in the occurrence of respiratory and alimentary diseases among fattening calves. Transportation of calves to feedlot, environmental changes during transport act as stresses and predesposing factors that assist in the prevalence of outbreaks and diseased conditions supporting the provious findings of JENSEN and MACKEY (1979) and RADOSTITS and BLOOD (1985). The authors stated that transport and mixing of animals with older ones permitting the flourishing and enterchange of their microflora. The most intersted point of view is that the animals under investigation were not previously vacciously vaccinated against both (IBR) and (BVD). The association of (IBR) and (BVD) with an outbreaks of respiratory and alimentary manifistations in fattening calves was recorded (LEHMKUHL, et al. 1975). The whole population density of animals under the risk of these outbreaks was about 1300 head, the morbidity rate was about 34.33% while the mortality rate was about 3.5%. The obtained data were coincided with the epidemiological data associating outbreaks of IBR and BVD infections in fattening calves either abroad (JENSEN and MACKEY, 1979) or under Egyptian environment (NAFIE, et al. 1984).

The main clinical findings associated the first and second outbreak table (2) were respiratory manifistation accompanied by alimentary upset in most of the diseased calves simmulating

* Serological examinations were carried out in the Department of Microbiology Fac. Med. Assiut Univ.

the clinical signs observed in feedlot cattle associated with IBR virus infection (BURROUGH, 1967; HARBOURNE, 1966). The clinical signs of the third outbreak consisted mainly of alimentary disorder, profuse watery diarrhaea in some cases tinged with blood associated with variabel signs of dehydration and mild to moderate symptoms of respiratory signs were noticed in most of diseased cases. These findings were previously discussed in a simillar outbreaks of respiratory and alimentary symptoms associating mixed infection with IBR and BVD firus infection (GREIG, et al. 1981; NAFIE, et al. 1984 and EL-SEBAIE, et al. 1986).

Regarding the haemotological picture in all examined diseased group of calves (Table 2), significant (P/ 0.01) decrease in total leukocytic count was observed in the acute stage of infection (group II, III) suggesting that the primary cause of illness was viral agent which is usually accompanied by leukopenia (SCHALM, 1979 and COLES, 1980). Leukocytosis was observed associating the group of enzootic bronchophenmonia (group IV) suggesting secondary bacterial invadors (SCHALM, 1979; COLES, 1980 and EL-SEBAIE, et al. 1984). Relative lymphocytes and eosinophilic counts were found to be variably decreased while mature neutrophils were grandually increased during the course of illness. These findings were attributed to the stress to which the animals were exposed (SCHALM, 1979). Significant reduction (P/ 0.05) in total red cell count and Hb (Table 2) associated approximatly all diseased group. Simillar observation was obtained in respective diseased condition (INABA, et al. 1970 and EL-SEBAIE, et al. 1984).

Regarding the results of blood pH and acid-base status, significant decrease (P/ 0.01) in blood pH, Hco3 and Base excess (Table 3) was recorded in pneumoenteric group, while Pco2 was significantly (P/ 0.05) elevated. These obtained data agreed with the findings associating mixed acidosis (primary respiratory and primary metabolic) as described by COLES (1980). The fall in blood pH in this group of calves is usually in one side was due to the hypoventillation and interference with gaseous exchange (REYNOLDS, 1963) and in the other side due to the loss of intestinal bicarbonate ion through faeces in diarrhaeic calves (TENNANT, et al. 1972). Metabolic acidosis was found to be associating the group of enteritis (lowered values of blood pH, Hco3 and Base excess) coincided with the results obtrained by MCSCHERRY and GRINGER, (1954) and TENNANT, et al. (1972) in simillar conditions. The outhors attributed the fall in pH, Hco3 and Base excess to the loss of bicarbonate (base radicle) in faeces in diarrhaeic calves. The decreased values of Pco2 in this group of calves explain the partial compensation represented by increased respiratory cycle due to metabolic acidosis (CHEW, 1982). In enzootic branchopneumonia group of calves (Table 3), respiratory acidosis was observed (lowered values of pH and increased Pco2). This alteration could be attributed to decreased pulmonary ventillation and retention of excess of Co2 in blood and these findings were in agreement with observations of COLES (1980).

REFERENCES

Amstulz, H.E. (1982): Bovine respiratory disease, An up to date Modern Vet. Prectice, 63, 11, 804-905.

Baz, T.I.; Taha, M.M.; Zahran, M.H. and El-Dobeigy, A.I. (1982): Respiratory viral new calf disease in Egypt. Studies on the role of IBR infection and colostral antibodies. Agric. Res. Review, 60, 7, 105-121.

Breazile, J.E.; Beames, C.G.; Cardielhac, P.T. and Newcomet, W.S. (1971): Textbook of Vet. Physiology. Lea. Febiger, Philadelphia.

Burrough, A.L. (1967): Viral respiratory infection in commercial feedlot cattle A.J.V.R. 28, 365-371.

Chew, D.J. (1982): Disorder in acid-base balance in Quick Refrence in Vet. Med. William, R.F. U.S.A. Philadelphia, Toronto.

Coles, E.H. (1980): Veterinary Clinical Pathology 3rd ed. W.B. Saunders Company, Philadelphia and London.

El-Garhy, M.M. (1982): Studies on the digestive trouble of the newly born calves M.D. Thesis Cairo Univ.

El-Sebaie, A.H.; Ibrahim, A.H.; Ibrahim, A.A.; Hofmann, W. and Amer, A.A. (1984): Investigation on an outbreak of enzootic bronchopneumonia in fattening buffaloe calves in Assiut A.R.E., I. Clinical, microbiological and haematological studies. Assiut Vet. Med. J. 11, 22: 166-167.

El-Sebaie, A.H. and Hassaan, N.K. (1985): Reports on IBR and BVD virus infection in fattening calves. Assiut Vet. Med. J. Vol. 14, 27, 247.

El-Sebaie, A.; A. Bayoumi and W. Hofmann (1986): Clinical and pathological observation an spontoneous cases of IBR and BVD virus infection in fattening buffaloe calves in Egypt. World. Vet. Congres, on diseases of cattle Dublin, Ireland.

Fisher, E.W.; Sibartie, D. and Grimshow, W.T.R. (1980): A comparison of the pH, Pco2, Po2 and total Co2 content in blood from branchial and caudal auricular arteries in normal cattle. Brit. Vet. J. 136 (1) 496-499.

Greig, A.; Gibson, I.R.; Nettleton, P.E. and Herring, J.A. (1981): Disease outbreak in calves caused by a mixed infection with IBR and BVD. Vet. Rec. 108, 480.

Harbourne, J.F. (1966): Survey of bovine respiratory diseases with special refrences to the serological examination of paired serum samples Vet. Rec. 78, 22, 749-753.

Hills, A.G. (1973): Acid base balance. Chemistry, Physiology and Pathophysiology, williams, Wilkins Company Baltimore.

Inaba, Y.; Tanaka, Y.; Omori, F. and Matumoto, M. (1970): Isolation of Bovine RSV. Jpn. J. Exp. Medicine 40, 473-474.

Jensen, R.; and Mackey, D.R. (1979): Disease of feedlot cattle 3rd Ed. Lea and Febiger, Philadelphia.

Lehmkuhl, H.D.; Smith, M.H. and Dierks, R.E. (1975): A bovine adenovinus type 3 isolation, characterisation and experimental infection in calves. Arch. Virol. 48, 39-46.

Lomba, F.V.; Bienfet and G. Wellemans (1976): IBR-virus occurence of metritis at parturation in bovine Belgian Blue White Breed. Brit. Vet. J. 122, 178-181.

McScherry, B.I. and Grinyer, I. (1954): Disturbences in acid-base balance and electrolytes in calf diarrhaea and their treatment. A report of eighteen cases. A.J.V. Res. 15, 535-541.

Nafie, E.K.; El-Sebaie, A.H.; Bayoumi, A. (1984): Appearance of IBR-BVD in fattening calves at Assiut provine. Clinical, virological, pathological studies and field observation on the application of killed vaccine (Pneumovac). Assiut, Vet. Med. J. 12, 24. 1-11.

Radostits, O.M.; Blood, D.C. (1985): Herd Health. A textbook of Health and Production Management of Agricultural Animals 1st ed. W.B. Saunders company pp. 253-254.

Reynolds, S.O.R. (1963): Brit. Med. J. 1192 (Cited by Verhoeff et al. 1985. Vet. Rec. 117, 202-204.

Schalm, O.W. (1979): Veterinary haematology 4th Ed. Bailliere, Tindall and Cassel Ltd, London.

Srively, W.D. and Beshear, D.R. (1972): Textbook of pathophysiology. 1st Ed. pp. 151-152. J.B. Lippincott company. Philadelphia and Toronto.

Tasker, J.B. (1969): Fluid electrolyte and acid-base abnormalities in cattle J.A.V.M.A., 155 (12) 1906-1909.

Tennant, B.; Harrold, D. and Reina-Guerra, M. (1972): Physiological and Metabolic factors in the pathogenesis of neonatal enteric infection in calves J.A.V.M.A. 161, 999-1007.

Wiesman, A.; Msolla, P.M.; Selman, I.E.; Allan, E.M. and Pirie, H.M. (1980): Clinical and epidemiological feature of 15 incidents of severe IBR. Vet. Rec. 107, 436-441.

Table (1)

Mean values of P.C.V., RBCs, Hb., WBCs, and differnitial leukocytic count in all examined groups

Group No.	Clinical status	No	Mean + SD	P.C.V. %	RBCs (T/L)	Hb g /L	WBCs G/L	Differential leukocytic count (D.L.C)					
								Band. %	Neut. %	Lymph. %	Mono. %	Eos. %	Baso. %
I	Clinically healthy	34	$\bar{x}$	35.2	9.54	145	9.14	2.32	29.5	62.1	3.2	1.22	0.25
			SD	6.5	1.7	25	3.4	1.88	8.6	9.2	2.5	0.94	0.57
			range	(28-48)	(5.2-12.8)	(101-195)	(5-16.4)	(0-8)	(15-45)	(45-80)	(1-10)	(0-3)	(0-2)
II	Acute upper respiratory tract infection	10	$\bar{x}$	33.5	8.232	148.4	4.32**	1.3 *	36.0	56.6	4.7	0.4 *	0
			SD	5.98	1.35	38.66	1.2	2.16	8.84	8.88	2.54	0.84	0
			range	(28-42)	(5.74-9.8)	(73-185)	(3.1-6.3)	(0-5)	(25-48)	(46-70)	(1-10)	(0-2)	0
III	Pneumoenteritis	18	$\bar{x}$	35.83	7.55*	123.4*	6.47*	5.73**	31.8	56.6	4.75	1.25	0
			SD	4.8	2.0	24.0	3.15	3.44	10.5	12.9	2.62	1.0	0
			range	(28-45)	(4.3-10.1)	(83-158)	(2.4-15.3)	(0-10)	(16-53)	(30-75)	(3-12)	(0-3)	0
IV	Enzootic bronchopneumonia	17	$\bar{x}$	32.11	7.75*	120.0**	11.9*	2.24	41.82*	50 *	4.3	1.0	0.12
			SD	6.2	2.48	26.0	5.8	3.3	16.7	14.76	3.8	1.06	0.50
				(19-42)	(3.57-11)	(6.5-15.0)	(4.9-26.3)	(0-10)	(14-73)	(29-70)	(1-15)	(0-3)	(0-2)
V	Enteritis	18	$\bar{x}$	39.6*	6.76**	133.0*	6.43*	6.4	35.2	49.2 *	5.7	1.05	0
			SD	5.3	2.3	29.0	2.55	5.0	10.35	16.8	4.24	1.32	0
			range	(28-50)	(2.76-10.15)	(50-169)	(3.3-11.3)	(2.6-11.3)	(22-59)	(25-70)	(2-15)	(0-5)	0
VI	Convalescent	11	$\bar{x}$	32.5	8.64	139.8	11.53*	2.8	22.9	67.63*	4.54	1.27	0
			SD	4.03	1.35	16.46	3.92	2.6	5.7	7.99	2.98	1.27	0
			range	(25-38)	(6.4-11)	(101-156)	(6.3-16.6)	(0-7)	(15-30)	(55-78)	(1-10)	(0-3)	0

n = number of examined cases.

$\bar{x}$ = mean value

SD = standard deviation

* = significant at ($P < 0.05$)

** = highly significant at ($P < 0.01$)

T/L (terra/liter) = 10^{12}/liter.

G/L (giga/liter) = 10^{9}/liter.

g/L (gram/liter)

Table (2)

Mean values of blood pH, Pco_2, Po_2, Hco_3, Tco_2 and Base excess in all examined group

Group No.	Clinical status	Number of animals	Mean ±S.D.	pH	Pco_2 mm Hg	Po_2 mm Hg	Hco_3^- m mol/L	Tco_2 m mol/L	B.E m mol/L
I	Clinically healthy	36	$\bar{x}$	7.360	46.72	28.0	26.26	27.9	0.62
			SD	0.037	3.85	6.1	2.02	2.2	2.09
			range	(7.255-7.453)	(38.1-55.1)	(17.4-43.1)	(22.8-32.0)	(24.2-33.1)	(-4.4-(5)
II	Acute upper respiratory tract infection	10	$\bar{x}$	7.371	49.39	25.75	28.46	30.06	2.83
			SD	0.06	4.683	3.134	2.736	2.995	3.683
			range	(7.224-7.464)	(42.5-68.4)	(20.0-36.4)	(22.6-39.3)	(24.7-36.8)	(-1.5-(10.6)
III	Pneumo enteritis	18	$\bar{x}$	7.235**	49.3*	33.92	21.5**	23.2*	-5.44**
			SD	0.074	4.14	6.19	2.12	2.36	4.2
			range	(7.019-7.317)	(44.2-59.5)	(20.9-44.7)	(16.5-25.0)	(18.1-26.9)	(-13.4-(1.4)
IV	Enzootic broncho pneumonia	17	$\bar{x}$	7.231**	60.15**	28.76	27.164	28.53	-0.494
			SD	0.068	7.039	6.76	2.5	2.538	2.303
			range	(7.013-7.351)	(50.7-75.1)	(13.6-88.5)	(23.7-29.5)	(25.3-32.2)	(-3.8-2.8)
V	Enteritis	18	$\bar{x}$	7.230**	42.5*	34.62	17.5**	18.8**	-8.23**
			SD	0.093	3.42	7.317	3.49	3.47	3.36
			range	(7.029-7.362)	(36.4-47.7)	(22.4-46.4)	(10.9-21.8)	(12.2-23.2)	(-15.1-(-2.7)
VI	Convalescent	11	$\bar{x}$	7.387	47.08	24.8	30.65*	31.99*	3.56**
			SD	0.052	4.75	7.97	4.4	4.0	3.3
			range	(7.321-7.464)	(41.9-57.9)	(14.1-29.5)	(24.6-38.7)	(26.1-39.1)	(-2.6-(10)

$\bar{x}$ = mean value

S.D = standard deviation

* = significant at ($P < 0.05$)

** = highly singificant at ($P < 0.01$)

Table (3)

Serological investigation in all examined groups of calves

Clinical status	Serial No.	Antibodies IBR	Antibodies BVD	Clinical status	Serial No.	Antibodies IBR	Antibodies BVD
Clinically healthy	1	–	–	Enzootic broncho-pneumonia	1	+	+
	2	–	–		2	+	–
	3	–	–		3	–	–
	4	–	–		4	+	–
	5	–	–		5	–	–
	6	–	–		6	+	+
	7	–	–		7	+	+
	8	–	–		8	–	+
	9	–	–		9	+	+
	10	–	–		10	+	–
	11	–	–		11	–	–
	12	–	–		12	–	–
					13	+	–
Acute upper respiratory tract infection	1	+	+	Enteritis	1	–	–
	2	–	–		2	–	–
	3	–	–		3	–	+
	4	–	–		4	–	+
	5	–	–		5	–	–
	6	–	–		6	+	+
	7	+	–		7	–	+
	8	–	–		8	+	–
	9	–	–		9	–	+
	10	–	–		10	–	+
					11	–	–
					12	+	–
					13	+	+
Pneumo-enteritis	1	+	+	Convalescent	1	+	+
	2	–	–		2	–	–
	3	–	–		3	+	–
	4	+	+		4	+	–
	5	+	+		5	+	–
	6	+	+		6	–	–
	7	+	+		7	–	–
	8	–	–		8	–	–
	9	–	–		9	+	–
	10	–	+		10	+	–
	11	+	–		11	–	–
	12	–	–				

IBR = infectious bovine rhino tracheitis

BVD = bovine viral diarrhoea.