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Incidence of respiratory infections and the roles of husbandry practice on the productivity of small ruminants in Northern Cameroon

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Abstract

The role of husbandry practice and incidence of respiratory pathogens (*Mycoplasma capricolum subsp. capripneumoniae* [Mccp], *Pasteurella multocida* [MP] and *Peste des petits ruminant virus* [PPRV]) were investigated among 13 flocks consisting of 300 goats and 200 sheep in the Northern Cameroon. The variables investigated were introduction of new stock into flock, morbidity, mortality, destocking, routine tissue culture rinderpest vaccine (TCRV) vaccination and rearing of small ruminants with other animals species. Introduction of new stock was not commonly practiced by flock owners and animals in the flocks received routine TCRV vaccination. Slaughtering and sale of sick animals were the commonest means of destocking. These correlated positively with morbidity and mortality rates in all the flocks investigated. Attempts at recovery of respiratory pathogens from nasal swabs of the experimental animals revealed the following isolates: *Mycoplasma* (small colony) from 27% of goats and 0% of sheep; MP from 18% of goats and 5% of sheep; *Mycoplasma* (large colony) from 6% of goats and 10% of sheep. None of the swabs shows *peste des petit ruminants* virus (PPRV) isolate. The difference in the pathogen recovery rate between sheep and goat was significant. It has correlated positively with the occurrence of respiratory symptoms, morbidity and mortality in most of the flocks and locations studied. The occurrence of respiratory pathogens observed in the present studies may be an important factor in the production of small ruminants in northern Cameroon. This study has provided preliminary data for further investigation into the definite role of these respiratory infections of small ruminant in northern Cameroon. We therefore suggest the need to embark on a mass vaccination program campaign against this pathogen, and the need for strict control of animal movement to and from the neighboring countries and a periodic surveillance for respiratory pathogens be incorporated into a national program for the prevention and control measures against this endemic pathogen.

Introduction

Small ruminants played an important role in both subsistence and economic development of Africa. They are said to be second to cattle in order of importance as a source of meat and milk. There are about 400 million sheep and goats in the world with Africa accounting for 67% [1,2]. These animals accounts for a substantial share (16%) of the average house hold income in most parts of Africa. Small ruminants contribute to rural income, draught energy, manure for crop production. There are among the common source of food and cash security readily available to many Africans families [3]. It also serves as cultural rites and source of high quality animal protein) [1,4]. The hide and skin of these animals are used in the local instrument and contribute to foreign exchange earnings [5,6]. One of the major constraints to increase small ruminants production in Africa has been the occurrence of infectious diseases and poor management practiced in most parts of the continent [7-11]. Among such diseases is the occurrence of Pasteurellosis and Mycoplasmosis [3,8,12-15]. *Peste des petits ruminants* (PPR) is also known as 'goat plague', 'Kata', 'syndrome of stomatitis-pneumoenteritis'. It is an important infectious viral disease of domestic and wild small ruminants that threatens the food security and sustainable livelihood of farmers across Africa [2,11,16].

In the present study attempts, have been made to isolates *Mycoplasma capricolum subsp capripneumonae* and *Pasteurella multocida*. The roles of these respiratory pathogens on husbandry practices and their affects the production of small ruminants in the northern Cameroon were also determine using an incidence studies and questionnaire survey.

Materials and methods

Study area

The study was carried out in the Far-north and North provinces of Cameroon, 13 villages were visited within the two provinces during the period of the study.

Data Collection/questionnaire survey

Structured questionnaire was administered to the flock owners using randomized sampling techniques. Variables studied include the flock's history in terms of mortality, morbidity/sick animals, newly introduced stocks, history of respiratory infection and clinical investigation on respiratory infections were carried out as shown in (Tables 3 and 4). Breed of sheep and goat were also studied. Generally, there are a total of 500 animals in 13 different flocks within

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13 locations, consisted 300 goats and 200 sheep. The breed of goats includes the "Kirdi" and Bororo while the sheep included the "Kirdi" breed, the foulbe and Ouda breeds as shown in (Table 1), collection and processing of nasal swab for isolation of *Pasteurella* species and *Mycoplasma* species were also carried out.

Eighty (80) nasal swabs were collected from 38 goats and 42 sheep (showing nasal discharges). Specimens for the isolation of *Pasteurella* species were preserved in phosphate buffered saline (0.01M PBS) while those for isolation of *Mycoplasma* species were preserved in *Mycoplasma* transport media.

Isolation of *Mycoplasma* species

In an attempt to isolate *Mycoplasma* species, each nasal swab was incubated into heart infusion broth and heart infusion agar media. The inoculated HIB media were serially diluted up to 10^{-4} dilution and later incubate at 37°C until growth occurred (usually characterized by a slight turbidity) the growth was later confirmed by wet film examination at x 100 magnification. The inoculated media were incubated at 37°C in a 5% carbondioxide (CO_2) incubator until Mycoplasma colonies appears, in order to obtain pure cultures, three consecutive sub-culturing were made from the originally isolated colonies.

Identification of the cloned *Mycoplasma* isolates: Due to lack of facilities to identify the different types of *Mycoplasma* strains, the cloned *Mycoplasma* isolates were sent to CIRAD-EMVT, France for further identification.

Isolation of *Pasteurella multocida*

Each of the nasal swab preserved in PBS was inoculated into blood agar and incubate at 37°C for 24 hrs. for those cultures which predominate colonies showed the characteristics of Pasteurella like organisms were subjected to oxidase test and gram screening. As previously described by Carter (1984) [17]. An oxidase positive, gram negative coccobacilli were selected and subcultured in trypcase-soy-broth, McConkey agar and 0.6% meat liver agar and incubate at 37°C for 24 hours to determine their cultural characteristics, mode of respiration and motility. Those bacteria that produced small round glistening or opaque colonies gram negative, coccobacilli, positive oxidase, non-motile, facultative anaerobes were presumed to be Pasteurella species.

Biochemical test on *Pasteurella s*pecies

The pure cultures of presumed Pasteurella strains were identified using biochemical reactions carried out using the API 20 NE gallery (Ref 20050). API system S.A., Lyon, France in the analytical profile index was used in the test. Oxidase test, urea indole test and sensitivity to vibriostatic compound 0129 were carried out essentially using the method described previously by Carter (1984) [18].

Isolation and identification of *PPR* virus

The isolation of PPR virus from nasal swabs obtained from the small ruminants was carried out essentially as earlier describe using standard technique.

Data analysis

The statistical significance of the differences between variables were analyzed using the students't' test by pair-wise comparison of variable. Where appropriate the chi-square test, ANOVA and correlation analysis were also employed. They were all assessed at P≤0.05 level of statistical significance.

Table 1. Sex and Breed Distribution of Small Ruminants in Different Location Studied

Location	Sex (%)						Breed (%)							Other species total (%)			
Location	Goat s			Sheep				Goats			Sheep			Cattle	Equine	Swine	Avian sp
	Male	Female	Total	Male	Female	Total	Kirdi	bororo	Total	Kirdi	Fulbe	Ouda	Total				
Adoumri	1(10)	9 (90)	10	2 (28.6)	5 (71.4)	7	10 (100)	0 (0)	10	7 (100)	0 (10)	0 (0)	7	0 (0)	1 (11.1)	0 (0)	37 (3.8)
Bokle	0 (0)	2 (100)	2	3 (8.1)	34 (92.0)	37	2 (100)	0 (0)	2	6 (16.2)	31 (83)	0 (0)	37	218 (17.8)	3 (33.3)	10 (45.5)	0 (0)
Dembo	6 (14.6)	35 (85.4)	41	2 (40)	3 (60)	5	35 (85.4)	6 (14.6)	41	5 (100)	0 (0)	0 (0)	5	63 (5.1)	0 (0)	0 (0)	141 (14.4)
Djalingo	3 (33.3)	6 (66.7)	9	1 (25)	3 (75)	4	9 (100)	0 (0)	9	4 (100)	0 (100)	0 (0)	4	19 (1.6)	0 (0)	0 (0)	13 (1.3)
Djaoli	6	59 (9.2)	65 (90.8)	0	15 (0)	15 (100)	65	0 (100)	65 (0)	15	4 (33.3)	0 (0)	15 (0)	86 (7.0)	0 (0)	0 (0)	0 (0)
Kismatari	5 (20)	20 (80)	25	1 (8.3)	11 (91.7)	12	25 (100)	0 (0)	25	8 (66.7)	0 (0)	0 (0)	12	25 (2.0)	0 (0)	0 (0)	0 (0)
Nassaro	6 (46.2)	7 (53.8)	13	2 (28.6)	5 (71.4)	7	13 (100)	0 (0)	13	7 (100)	0 (0)	0 (0)	7	0 (0)	0 (0)	0 (0)	0 (0)
Bidzar	8 (30.8)	18 (69.2)	26	4 (28.6)	10 (71.4)	14	26 (100)	0 (0)	26	0 (0)	31 (68.9)	14 (100)	14	355 (28.9)	0 (0)	0 (0)	118 (12.0)
Guider	10 (38.5)	16 (61.5)	26	8 (17.8)	37 (82.2)	45	26 (100)	0 (0)	26	10 (22.2)	0 (0)	4 (8.9)	45	445 (36.2)	0 (0)	0 (0)	209 (21.3)
Mayo-Loue	7 (25)	21 (75)	28	2 (50)	2 (50)	4	28 (100)	0 (0)	28	3 (75)	0 (0)	1 (25)	4	12 (1.0)	5 (55.6)	0 (0)	253 (25.8)
Djingliya	0 (0)	3 (100)	3	1 (11.1)	8 (88.5)	9	3 (100)	0 (0)	3	9 (100)	0 (0)	0 (0)	9	0 (0)	0 (0)	0 (0)	0 (0)
Koza	5 (17.9)	23 (82.1)	28	3 (11.5)	23 (88.5)	26	28 (100)	0 0	28	26 (100)	0 (0)	0 (0)	26	2 (0.2)	0 (0)	0 (0)	150 (15.3)
Midre	11 (25.8)	13 (54.2)	24	3 (20)	12 (80)	15	24 (100)	0 (0)s	24	15 (100)	0 (0)	0 (0)	15	3 (0.2)	0 (0)	12 (54.5)	60 (6.1)
Total	68 (22.7)	232 (77.3)	300	32 (16.0)	168 (84.0)	200	294 (98.0)	6 (2.0)	300	115 (57.5)	66 (33.5)	19 (9.5)	200	1228 (54.8)	9 (0.4)	22 (1.0)	981 (43.8)

*All flocks studied under extensive system of management

Result

Epidemiological factors affecting the incidence of *Mycoplasmosis and Pasteurellosis* among small ruminant's population in northern Cameroon were investigated. Data were obtained by structured questionnaire survey using the randomized sampling technique.

There was no significance difference (P>0.05) in the distribution of the total number of sheep and goats studied. However, significant difference (P<0.05) were noted between locations with the highest distribution observed among the goats in Djoli 65(21.7%) and Dembo areas 41(13.7%) (Table 1). Similarly, the highest numbers of sheep were studied in Guider 45(22.5%) and Bokle areas 37(13.5%). Furthermore, significant sex difference (p<0.05) were also observe among the goats and sheep population studied. The number of female was consistently higher than those of males (Table 1).

Variations between breeds were generally observed among the sheep and goats studied. The "Kirdi" breed were consistently more in number 409(82%) than other breeds. In relation to other animal species that were reared together with sheep and goats studied, cattle have the highest preponderance over other animal species such as equine, swine, and avian (Table 1). The age distribution of the animals studied ranged from 9 months and above. There was no significant difference (P<0.05) found in animals within the age group of 9 month to 3 years in Guider area, and these were found to be more in number 22(85%) than those above the age bracket of more than 3 years and beyond 4(15%). However, there was no significant different (p>0.05) in the age distribution of sheep in all different locations studied (Table 2)

The consequences of introducing new livestock on the possible manifestation of respiratory clinical signs, morbidity and mortality rates as well as other associated factors responsible for destocking in the flocks are summarized in (Tables 3 and 4). It was observed that the introduction of new stocks was not commonly practiced among farmers and therefore the practiced has negligible effect on the manifestation of clinical signs as well as on the morbidity and mortality rates.

Slaughtering and sale of sick and/or dead animals were significant means of destocking of small ruminants in a flock and there was positive correlation (r=0.665 and r=0.676 for goats and sheep respectively) between disposal rates of animals and occurrence of morbidity and mortality. High morbidity and mortality rates, were generally observed among affected animals generally, the incidence of respiratory signs: stomatitis and mucopurulent diarrhea correlated positively with morbidity rates. (r=0.559 and r=0.736 for goats and sheep respectively). In addition, the morbidity and mortality rates were highest in Adoumri area and also correlated positively with the occurrence of clinical signs in the same location.

Vaccination of small ruminants with tissue culture rindepest vaccine (TRCV) was not generally practiced by the livestock farmers but the use of antibiotics (tetracycline's) and antihelminthics (levamisole hydrochloride) were generally adopted by the livestock farmers and this practiced was highest in Bidzar area which recorded relatively higher morbidity and mortality rates when compared with other locations (Table 3 and 4).

Retrospective analysis of the morbidity and mortality rates in the flocks of goats studied indicated significant difference (p<0.05) in the morbidity and mortality rates among locations in the previous 3 months (October- December) during this study. Morbidity rate was significantly highest (73%) in Adoumri area when compared with other locations. (Table 3) which correlated positively (r=0.599) with higher mortality rate and prevalence of mycoplasma species small colony (50%) observed in the same location (Table 5). Similar pattern of morbidity and mortality profiles were observed in sheep flocks studied (Table 4) however, highest morbidity rate (52%) was detected in midre area which correlated positively (r=0.732) with relatively higher mortality rate (17%) detected in the same location.

Attempt at the recovery of possible causative agents of respiratory infection from clinical samples in goats revealed a relatively higher rate of *Mycoplasma* species small colony (27%), followed by *Pasteurella multocida* (18%) and *Mycoplasma* species large colony (6%) in decreasing order of recovery of microorganisms from nasal swabs tested (Table 5). Recovery of causative agents from clinical specimen among sheep revealed significantly higher isolation of mycoplasma species large colony (10%) when compared with other isolates. *Mycoplasma* species small colony (0%) and *Pasteurella multocida* (5%) (Table 6).

However, no *Peste des petits ruminants virus* (PPRV) was isolated from all nasal swabs tested from both species (Table 5 and 6).

Discussion

Small ruminants account for over 50% of the livestock population in Cameroon and played important role in the socio-economy livelihood of rural dwellers especially women. In spite of these

Table 2. Age distribution of small ruminants in different locations studies

Goats				Sheep		
Location	Age group (%)			Age group (%)		
	9 months -3 years	>3 years	Total	9 months -3 years	>3 years	Total
Adounmri	4(40)	6(60)	10	4(57.1)	3(42.9)	7
Bokle	2(100)	0(0)	2	18(48.7)	19(51.4)	37
Dembo	24(58.5)	17(41.5)	41	1(20.0)	4(80.0)	5
Djalingo	4(44.4)	5(55.5)	9	2(50.0)	2(50.0)	4
Djaoli	35(53.8)	30(46.2)	65	11(73.3)	4(26.7)	15
Kismatari	14(56)	11(44)	25	8(66.7)	4(33.3)	12
Nassarao	7(53.8)	6(46.2)	13	2(28.6)	5(71.4)	7
Bidzar	16/61.5)	10(38.5)	26	5(35.7)	9(64.3)	14
Guider	22(84.6)	4(15.4)	26	17(376.8)	28(62.2)	45
Mayo-loue	18(64.3)	10(35.7)	28	3(75.0)	1(25.0)	4
Djingliya	1(33.3)	2(66.7)	3	6(66.7)	3(33.3)	9
Koza	13(46.4)	15(53.6)	28	16(61.5)	10(38.5)	26
Midre	15(62.5)	9(37.5)	24	10(66.7)	5(33.3)	15
Total	175(58.3)	125(41.7)	300	103(51.5)	97(48.5)	200

Table 3. Common Clinical Sign and Management Patterns in Goats Studies

Location	Introduction of new stock in the last 3 months no (%) total introduced	Destocking number (%)			Clinical signs number (% total)				Medication Total (%) respondents				
		Slaughtered	Sold	others	Morbidity rate (%) in the last 3 months	Mortality rate (%) in the last 3 months	Respiratory signs and pyrexia	Respiratory signs pyrexia stomatitis, mucopurulent diarrhoea	Vaccination	Antibiotics		Antihelmintics	Others
									**TCRV	Tetra	Pen	Levamisole	Trad
Adouri	0/180 (0)	29/180 (16.1)	9/180 (5.0)	0/180 (0)	131/180 (72.8)	74/180 (41.1)	8/10 (0)	0/10 (0)	0/10 (0)	1/10 (10)	0/10 (0)	1/10 (10)	0 (0)
Bokle	0/117 (0)	0/117 (0)	2/117 (1.7)	0/117 (0)	67/117 (57.3)	57/117 (48.7)	0/2 (0)	0/2 (0)	0/2 (0)	2/2 (100)	0/2 (0)	0/2 (0)	0 (0)
Dembo	0/416 (0)	27/416 (6.5)	57/416 (13.7)	0/416 (0)	73/416 (17.3)	14/416 (3.4)	4/41 (9.8)	4/41 (9.8)	0/41 (0)	12/41 (29.3)	0/41 (0)	7/41 (17.1)	0 (0)
Djoali	0/971 (0)	72/971 (7.4)	0/127 (0)	0/971 (0)	65/127 (51.2)	28/127 (22.0)	0/9 (0)	7/65 (10.8)	0/9 (0)	0/9 (0)	1/9 (11.1)	3/9 (33.3)	0 0
Kismatari	0/296 (0)	19/296 (6.4)	102/971 (10.5)	10/296 (0)	208/971 (28.8)	129/971 (13.3)	7/65 (10.8)	5/25 (20.0)	0/65 (0)	0/65 (0)	0/65 (0)	0/65 (0)	(0) (0)
Nassarao	0/145 (0)	15/145 (10.30)	9/296 (3.0)	0/145 (0)	141/296 (47.6)	78/26 (26.3)	5/25 (20.0)	6/13 (46.2)	0/25 (0)	0/25 (0)	0/25 (0)	0/25 (0)	0 (0)
Bidzar	5/263	17/263	9/145	0/263	69/145	33/145	6/13	0/26	0/13	0/13	0/13	0/3	0
	(1.9)	(6.5)	(3.0)	(0)	(47.6)	(22.7)	(46.2)	(0)	(0)	(0)	(0)	(0)	0
Guider	0.293 (0)	19/293 (6.5)	34/293 (11.0)	0/2293 (0)	154/263 (58.6)	53/263 (20.1)	0/26 (0)	0/26 (0)	0/26 0/	16/26 (61.5)	0/26 (0)	14/26 (53.8)	0 (0)
Mayo-loue	0/393 (0)	29/393 (7.4)	51/393 (13.0)	0/393 (0)	60/293 (20.5)	13/293 (4.4)	0/26 (0)	1/28 (3.6)	0/28 (0)	11/26 (43.3)	0/26 (0)	0/28 (0)	0 (0)
Djingliya	0/45 (0)	5/45 (11.1)	8/45 (17.8)	0/45 (0)	190/393 (48.3)	76/393 (19.3)	1/28 (3.6)	0/3 (0)	0/3 (0)	0/28 (0)	0/28 (0)	0/3 (0)	0 (0)
koza	0/295 (0)	24/295 (8.1)	16/295 (5.4)	0/295 (0)	18/45 (40.0)	76/295 (25.8)	0/28 (00	0/28 (0)	0/28 (0)	0/3 (0)	0/28 (0)	0/28 (0)	0 0
Midre	0/325 (0)	17/325 (5.2)	10/235 (3.1)	0/235 (0)	177/295 (48.0)	68/325 (20.9	0/24 (0)	0/24 (0)	0/24 (0)	0/24 (0)	0/24 (0)	17/24 (70.8)	0 0
Total	5/3866 (0.1)	274/3866 (7.1)	316/3866 (8.2)	0/3866 (0)	1581/3866 (41.0)	11/3866 18.4)	23/300 (7.7)	56/300 (18.7)	0/300 (0)	42/300 (14.0)	3/300 (1.0)	56/300 (18.7)	0 (0)

*All flocks studied under extensive system of management ** Tissue culture rinderpest vaccines, Trad =traditional; Pen=penicillin Tetra=tetracycline

significant socio-economic contribution to rural economy and food security, their productivity is increasing been threaten and hampered by infectious diseases such as Contagious Caprine Pleuropneumonia (CCPP) due to *Mccp* and PPRV [2,11,16]. In addition to the deleterious effects of infectious diseases, other factors affecting the production of small ruminants have been attributed to poor animal husbandry [8]. In this study, attempt have been made to identify the respiratory pathogens commonly encountered in the study area among small ruminants population, as well as other management practices affecting the production of this group of animals. The study was design to approximately choice the same number of randomly selected sheep and goats with no difference in age distribution of the animals. However, significant differences were noted among villages and sex of the animal selected for the study. This might be attributed to regular destocking of male animals for sale, consumption and sacrifice, when compared with female animals which are usually retained in the flock for breeding purposes (as shown in Tables 1,3 and 4)

Husbandry practice of introducing new animal stocks that could easily facilitate the transmission of foreign pathogen /disease to the susceptible flocks were rarely practiced by the stock owners. The introduction of new stock of animals had negligible effect on the manifestation of clinical sign, morbidity and mortality rates observed in this studies. However, significant destocking of flock by slaughtering and sale of sick animal and/or dead animals were observed. High mortality and morbidity rates could also be attributed to lack of vaccination of the flock against endemic viral diseases. The exemption of tissue culture rinderpest vaccine (TCRV) vaccination from husbandry practice must have increased the incidence of PPRV which could be partly responsible for high morbidity and mortality observed in the present study and this finding is in agreement with previous works by [2,8,16,19].

The questionnaire survey carried out in the previous three months October-December revealed high morbidity and mortality this could be partly attributed to the period of study which coincided with the prolong dry, dusty harmattan weather in northern Cameroon which probably facilitate the spread and transmission of respiratory pathogens such as *Mycoplasma* and *Pasteurella species*. The present study therefore suggests the possible role of dry, dusty harmattan weather in the epidemiology of respiratory pathogens *Mycoplasma and Pasteurella multocida* among small ruminants in Cameroon this finding agrees with the work of [9,10,14].

Furthermore, the present studies have also revealed the evidence of isolation of *Mycoplasma capricolum subsp capripneumonae* (Mccp), the causative agent of contagious caprine pleouro pneuminiae (CCPP) among the goat population in the study area, previous studies had

Table 4. Common Clinical Sign and Management Patterns* in Sheep Studies

Location	Introduction of new stock in the last 3 months no (%) total introduced	Destocking number (%)			Clinical sign number (% total)				Medication respondents total (%)				
		Slaughtered	Sold	others	Morbidity rate (%) in the last 3 months	Mortality rate (%) in the last 3 months	Respiratory signs and pyrexia	Respiratory signs pyrexia stomatitis, mucopurulent diarrhoea	Vaccination	Antibiotics		Antihelmintics	Others
									**TCRV	Tetra	Pen	Levamisole	Trad
Adouri	0/134 (0)	19/134 (14.2)	18/134 (13.4)	0/134 (0)	57/134 (42.5)	26/134 (19.4)	0/7 (0)	4/7 (57.2)	0/7 (0)	1/7 (14.3)	0/7 (0)	1/7 (14.3)	0 (0)
Bokle	0/428 (0)	19/842 (2.3)	38/842 (4.5)	0/842 (0)	215/842 (25.6)	66/842 (13.7)	4/37 (10.8)	021/37 (56.8)	0/37 (0)	13/37 (37.1)	0/37 (0)	0/37 (0)	(0) (0)
Dembo	0/82 (0)	10/82 (12.2)	11/82 (13.4)	0/82 (0)	11/82 (13.4)	3/82 (3.7)	0/5 (0)	0/5 (0)	0/5 (0)	0/5 (0)	0/5 (0)	4/5 (80.0)	0 0
Djalingo	1/5 (2.3)	0/56 (0)	1/54 (1.9)	0/54 (0)	24/54 (44.4)	9/54 (16.7)	0/4 (0)	3/4 (75)	0/4 (0)	0/4 (0)	0/4 (0)	2/4 (50.0)	
Doali	1/54 1.8	0/52 (0)	7/154 (14.5)	0/154 (0)	38/154 (24.6)	13/154 (8.4)	1/15 (6.7)	1/15 (6.7)	0/15 (0)	0/15 (0)	0/15 (0)	0/15 (0)	(0) (0)
Kismatari	0/154 (0)	25/154 (61.2)	2/137 (1.5)	0/137 (0)	37/137 (27.0)	9/137 (6.6)	3/12 (25)	6/12 (50)	(0) (0)	(0) (0)	(0) (0)	(41.7) (41.7)	(0) (0)
Nassarao	0/137 (0)	3/137 (12.2)	0/88 (0)	0/88 (0)	33/88 (37.5)	15/88 (17.0)	0/7 (0)	3/7 (42.9)	0/7 (0)	0/7 (0)	0/7 (0)	0/7 (0)	0 (0)
Bidzar	0/88 (0)	2/88 (62.3)	29/242 (12)	0/242 (0)	109/242 (45.0)	29/242 (12.0)	0/14 (0)	4/14 (28.6)	0/14 (0)	13/14 (92.6)	0/14 (0)	11/14 (78.6)	0 (0)
Goidre	0/242 (0)	14/241 (9.9)	67/774 (8.6)	0/774 (0)	262/774 (33.9)	89/774 (11.5)	2/85 (4.4)	23/45 (52.1)	0/45 0/	25/45 (55.5)	0/45 (0)	28/45 (12.2)	0 (0)
Mayo-loue	0/774 (0)	64/774 (8.3)	11/83 (13.2)	0/83 (0)	44/83 (53.0)	12/83 (14.5)	0/4 (0)	2/4 (50)	0/4 (0)	0/4 (0)	0/4 (0)	2/5 50	0 (0)
Djingliya	2/83 (2.4)	4/83 (4.8)	1/86 (1.1)	0/86 (0)	8/86 (9.3)	2/86 (2.3)	0/9 (0)	0/9 (0)	0/9 (0)	0/9 (0)	0/9 (0)	5/9 (55.5)	0 (0)
Koza	0/86 (0)	3/86 (3.5)	9/306 (3.0)	0/306 (0)	104/306 (34.0)	37/306 (12.1)	0/26 (0)	4/26 (15.4)	0/26 (0)	0/26 (0)	6/26 (23)	0/26 (0)	0 (0)
Midre	0/306 (0)	17/125 (13.6)	10/125 (13.6)	0/125 (0)	65/125 (52.0)	21/125 (16.8)	0/15 (6.7)	1/15 (0)	0/15 (0)	0/15 (0)	0/15 (66.7)	10/15 (0)	0 (0)
Total	3/2747 (0.1)	201/2747 (7.3)	204/2727 (7.4)	0/2727 (0)	107/2727 (36.7)	331/2727 (12.0)	10/2009 (5.0)	53/200 (26.5)	0/200 (0)	52/200 (26.0)	8/200 (4.0)	66/200 (33.0)	0 0

*All flocks studied under extensive system of management ** Tissue culture rinderpest vaccines, Trad =traditional; Pen=penicillin Tetra=tetracycline

Table 5. Evidence of Mixed Infections of Respiratory Pathogens in Goats Studied

Goats			Number/ Total Number Positive (%)				
Location	Mccp/Mycoplasmosis only	PPRV only	Pasteurella infection only	Mccp + PPRV	Mccp + Pasteurella infection	PPRV + pasteurella infection	Mccp + Pasteurella + PPRV
Adounmri	0/6(0)	5/6(83.3)	1/6(16.67)	0/6(0)	0/6(0)	0/6(0)	0/6(0)
Bokle	0/2(0)	1/2(50)	0/2(0)	1/2(50)	1/2(0)	1/2(0)	0/2(0)
Dembo	5/13(38.5)	4/13(30.8)	0/13(0)	3/13(23.1)	3/13(0)	3/13(0)	1/13(7.7)
Djalingo	1/5(20)	3/5(60.0)	0/5(0)	0/20(0)	0/5(0)	0/5(0)	0/5(0)
Djaoli	15/20(75)	0/20(0)	4/20(20.0)	0/20(0)	1/20(5)	0/2(0)	0/20(0)
Kismatari	8/22(36.4)	7/22(31.8)	0/22(0)	7/22(40.0)	0/22(0)	0/22(0)	0/22(0)
Nassarao	1/10(10)	5/10(50)	0/10(0)	4/10(40.0)	0/10(0)	0/10(0)	0/100(0)
Bidzar	4/6(66.7)	2/6(33.4)	0/6(0)	0/6(0)	0/6(0)	0/6(0)	0/6(0)
Guider	0/13(0)	13/13(100)	0/13(0)	0/13(0)	0/13(0)	0/13(0)	0/13(0)
Mayo-loue	2/13(15.4)	11/13(84.6)	0/13(0)	0	0	0	0
Djingliya	0	0	0	0	0	0	0
Koza	0/4/(0)	4/4(100)	0/4(0)	0/4(0)	0/4(0)	0/4(0)	0/4(0)
Midre	5/6(83.4)	0/60(0)	0/6(0)	1/6(16.7)	0/60(0)	0/6(0)	0/4(0)
Total	41/120 (34.2)	55/120 (45.8)	5/12 (4.2)	1/120 (0.8)	17/120 (14.2)	0/120 (0)	1/120 (0.8)

Table 6. Evidence of Mixed Infections of Respiratory Pathogens in Sheep Studied

Goats			Number/ Total Number Positive (%)				
Location	Mccp/Mycoplasmosis only	PPRV only	Pasteurella infection only	Mccp + PPRV	Mccp + Pasteurella infection	PPRV+ Pasteurella infection	Mccp + Pasteurella + PPRV
Adounmri	0/2(0)	1/2 (50)	1/2 (50)	1/2 (0)	1/2 (0)	1/2 (0)	1/2 (0)
Bokle	0/36(0)	36/36(100)	36/36(0)	0/36(0)	0/36(0)	0/36(0)	0/36(0)
Dembo	0/2(0)	1/2 (50)	1/2 (50)	00/2 (0)	00/2 (0)	00/2 (0)	00/2 (0)
Djalingo	0/3(0)	3/3/(100)	0/3/(0)	0/3/(0)	0/3/(0)	0/3/(0)	0/3/(0)
Djaoli	0	0	0	0	0	0	0
Kismatari	0/10(0)	10/10(100)	0/10(0)	0/10(0)	0/10(0)	0/10(0)	0/10(0)
Nassarao	0/6(0)	6/6(100)	0/6(0)	0/60(0)	0/6(0)	0/6(0)	0/0(0)
Bidzar	0/1/(0)	1/1/(100)	0/60/(0)	0/1/(0)	0/10/(0)	0/1/(0)	0/1/(0)
Guider	0/20(0)	20/20(100)	0/20(0)	0/20(0)	0/20(0)	0/20(0)	0/20(0)
Mayo-loue	0/1(0)	1/1(100)	0/1(0)	0/1(0)	0/1(0)	0/1(0)	0/1(0)
Djingliya	0	0	0	0	0	0	0
Koza	0/10(0)	1/1(100)	0/1(0)	0/1(0)	0/1(0)	0/1(0)	0/1(0)
Midre	0/3(0)	3/3(100)	0/3(0)	0/3(0)	0/3(0)	0/3(0)	0/3(0)
Total	0/85(0)	83/85(97.7)	83/85(97.7)	2/85(2.4)	0/85(0)	0/85(0)	0/85(0)

failed to sufficiently established the presence of Mccp in the study area [12,13]. this however, led to the assertion that Mccp might have been long existed in the area, since the introduction of new flocks was not a common practice among the farmers, there is high tendency to incriminate the uncontrolled animal movement between northern Cameroon and the neighboring countries in the east and west, particularly with those in the east Africa where CCPP is common. However, Mccp has been isolated in countries such as Tchad and thus, could be partly responsible for high mortality [8,11,19,20]. Other possible means of introduction of the disease in the flock could be through carrier animals due to in- contact sheep, bovine and some members of the order Acarina [20,21]. Since mixed flock rearing were commonly practiced among studied animals.

In spite of the wide use of antibiotic by stock owners observed, the number of *Pasteurella multocida* isolates obtained justifies their importance as a causative agent of respiratory diseases among small ruminants in the study area. This finding is consistent with a previous study which also indicated considerable activities of *pasteurella* infections among small ruminant populations [8,22].

This study has provided preliminary data for further investigation into the definite role of this bacterium and Mycoplasma in respiratory infections of small ruminant in northern Cameroon. We therefore suggest the need to embark on a mass vaccination program against this pathogen, and the need for strict control of animal movement to and from the neighboring countries and a periodic surveillance for respiratory pathogens and their isolation be carried out as a gold standard in diagnosis, and such practice be incorporated into a national program for proper planning of preventive and control measures against this endemic animal pathogens. This study has also provided sufficient data to conclude that respiratory pathogens *Mycoplasma capricolum subsp capripneumonae*, *Pasteurella multocida* and other management practices by stock owners are very important factors in the establishment of high morbidity and mortality rate, observed among flock of small ruminants population in northern Cameroon.

The failure to isolate the PPR virus from the nasal swab obtained from animals showing clinical sign of PPR -Like diseases may not necessarily exonerate PPR virus as the etiological agent of the disease. It is possible that the PPR virus particle was very low amount in the clinical specimens analyzed for virus isolation. Besides, other factors including filtration of swab suspension before inoculation, transportation of sample over long distance to the laboratory and the lack of adequate storage facilities might have been responsible for the poor virus recovery from the clinical specimens.

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