academicJournals

Vol. 10(40), pp. 1685-1693, 28 October, 2016
DOI: 10.5897/AJMR2016.8194
Article Number: 860A4E461330
ISSN 1996-0808

http://www.academicjournals.org/AJMR

African Journal of Microbiology Research

Full Length Research Paper

Pneumonia in Algerian Ouled Djellal sheep: Bacteriological study and macroscopic aspect of lung lesions

Kamel Akloul* and Mohammed Nabil Menoueri

Veterinary Institute, University of Blida, Algeria.

Received 4 July 2016, Accepted 15 September, 2016.

Respiratory diseases in sheep are a multifactorial etiology syndrome, causing great economic losses. This study was carried out with the aim of establishing a bacteriological diagnosis of respiratory diseases in sheep, on the basis of lungs with macroscopic lesions taken from sheep slaughtered at the Blida abattoir. A total of 150 samples (swabs and lung parenchyma) from 75 Ouled Djellal sheep, aged six to twelve months old, with pulmonary lesions, were collected to determine possible correlations between the etiological agents and the type of lesion. Hepatization (or consolidation) was the main lesion observed (70%), preferentially localized on the right apical lobe (88% of the cases). This is a special form of pneumonia called atypical pneumonia. A varied microbial flora was isolated, alone or in association, namely bacteria with respiratory tropism as well as others of secondary infection. The bacteria most frequently isolated were γ-hemolytic streptococci (18%), *Escherichia coli* (17.5%), *Micrococcus* species (14.5%), and coagulase-negative staphylococci (10.5%); the large family of Enterobacteriaceae represented nearly 43% of the isolates. The pneumotropic bacteria (*Mannheimia haemolytica* and *Pasteurella multocida*) which count for 5.6% of the isolates, turned out to be correlated with the hepatization lesions.

Key words: *Mannheimia haemolytica*, *Pasteurella multocida*, pneumonia, sheep, Algeria.

INTRODUCTION

Sheep farming in Algeria constitutes 50% of the agricultural gross domestic product. The sheep number has increased from 17.5 to 26.6 million head with an average annual increase of 4.4% over the ten-year period (2003 to 2013) (MADR, 2014). In 2003, it represented 25 to 30% of animal production and 10 to 15% of agricultural production. It provides more than 50% of the total meat needs of the country (Abdelguerfi and Ramdane, 2003). The rearing of grazing livestock in Mediterranean countries includes 13% of the world's sheep and goats (Boutonnet, 1998). Respiratory diseases in sheep are among the most frequent pathologies, with heavy health and economic impacts. They form a multi-factorial complex involving the interaction of host, environment,

*Corresponding author. E-mail: akl_kamel@yahoo.fr. Tel: +213774856703.

as well as a wide variety of pathogens. The term respiratory disease complex (RDC) is used for the condition conventionally known as bronchopneumonia. RDC is a polymicrobial infection that develops when the immune system of the animal is compromised by stress factors such as crowding, transportation, draught and inclement weather combined with increased exposure to pathogens, and may lead to respiratory infection (Asaye et al., 2015).

Environmental conditions and poor hygiene prevailing in Algerian farms are all stress causing factors that promote the onset of respiratory diseases. When they do not involve the death of the subject, they result in debilitating medical conditions and therefore a decreased carcass value. Indeed, respiratory troubles in lambs cause mortality, growth reduction and economic losses, due to drug costs and condemnations in abattoirs (Goodwin et al., 2004). The role of stress in the natural incidence of the pulmonary form of pasteurellosis is clearly highlighted by the fact that the disease onset is associated with a sudden source of stress such as exposure to an extreme temperature (hot or cold) with a high level of humidity, overcrowding, poor ventilation, bad raising practices, rough handling, transport over long distances, excessive dust, high load of internal or external parasites and the mixing of animals from different sources (Sharma et al., 1990; Martin, 1996).

Small ruminants are especially sensitive to respiratory infections, mostly as a result of deficient management practices that make these animals more susceptible to infectious agents. The tendency of these animals to huddle and group rearing practices further predispose small ruminants to infectious and contagious diseases (Chakraborty et al., 2014). In a study in Ireland, McIlroy et al. (1989) demonstrated a significant correlation between the percentage of seized sheep carcasses due to pleurisy or pneumonia and rainfall, wind, temperature as well as humidity. Galapero et al. (2016) used Bayesian networks to identify risk factors for pulmonary consolidation. The results showed that the main factors causing ovine inflammatory respiratory processes and pulmonary consolidation were temperature, relative humidity, and *Mycoplasma* species. Control of these factors may help reduce the incidence of pulmonary consolidation. In sheep, the pathogenesis of respiratory diseases is difficult to determine because of the interaction of different causative agents which may have similar pathological models (Alley, 1975). Of all the organ systems, the respiratory tract may be unique in its vulnerability to injurious agents. Nowhere else in the body, such a vast surface area (approximately 100 m^2) is directly exposed to airborne pathogens at about 20 times/min. Not only is the area and exposure extreme, but the underlying blood circulation is only two cell layers of about 0.5 nm each, removed from the alveolar surface (Asok et al., 2014).

Previous or combined infection with some respiratory viruses may increase the susceptibility of farm animals to secondary bacterial pneumonia (Cutlip et al., 1993; Ozyildiz et al., 2013). Sheep are particularly sensitive to parainfluenza virus type 3 (PIV-3) and bovine respiratory syncytial virus (BRSV); antibodies against these viruses have been demonstrated in this species (Lemhkuhl et al., 1985; Giangaspero et al., 1997). An estimated 40% of viral respiratory infections are complicated by bacterial pneumonia (Loosli, 1968). *Pasteurella,* which is the main bacteria responsible for lung disease in sheep, acts as secondary infection agents after a viral or mycoplasma infection (Douart, 2002). Whatever the initial cause of lung damages is (environmental, viral, bacterial or parasitic), *Mannheimia haemolytica* is often found as a complicating agent. Ovine pneumonia due to *M. haemolytica* is the major cause of perinatal mortality (10 to 40%) depending on the farm type and the season (Malone, 1988). In outbreaks of acute ovine and caprine pneumonia, *Pasteurella* especially *M. (Pasteurella) haemolytica* and *Pasteurella multocida* have been isolated more than other pathogenic agents from affected lungs. About 30% of domestic animal mortality is known to be related to *Pasteurella* infection (Valadan et al., 2014).

Pasteurellosis, also called "enzootic pneumonia", does not correspond to a specific nosologic entity, but *Pasteurella*, which are the most frequently isolated pathogens, are therefore considered as the main cause of the disease (Zrelli, 1988). Atypical pneumonia is defined to distinguish a rather similar form of pasteurellosis, but without the fatal nature of this latter (Rouchy, 1992), combined with a multitude of pathogenic agents including *Mycoplasma ovipneumoniae*. Due to the high losses resulting from these pathologies and considering the importance of the national herd (over 26 million heads), it was deemed appropriate to carry out an investigation to determine a first estimate of the prevalence of pneumonia in sheep, by studying pulmonary lesions observed in the slaughter house to try and establish a link between macroscopic lung lesions and bacterial agents, especially *Pasteurella* species.

MATERIALS AND METHODS

The study focused on sample "all comers" of Ouled Djellal sheep slaughtered at Blida abattoir (Algeria) from January 2009 to April 2010. These animals came from different farms and neighboring regions of Blida (15 km from a large cattle market), where farming conditions are substantially the same. It concerned only males, aged 6 to 12 months.

Blida is located at 36°28'North and 2°49' East, at an altitude of 272 m above sea level. It extends over 1478.62 km^2. The temperatures in the area vary from 2°C in winter (January) to 45°C in summer (July) and the average annual precipitation is around 600 mm per year, reaching its peak from December to February (30 to 40% of annual precipitation).

According to the local agriculture service, the number of sheep in the study area is about 40,000 heads. Blida abattoir was selected because it is the largest in the region in terms of slaughter

Table 1. Frequency distribution of gross pathological lesions in lungs of sheep observed at Blida slaughterhouse.

Lesion	Number	%
Red hepatization	39	52.0
Grey hepatization	14	18.7
Atelectasis	10	13.3
Emphysema	8	10.7
Others*	4	05.3
Total	75	100.0

*Congestion, Abscesses.

capacities (around 500 head of sheep/day).

Macroscopic study of lung lesions

A survey sheet was established for each animal with lungs lesions. The lesions were described according to its precise location, degree of expansion, appearance (color), consistency, volume, shape and the nature of the macroscopic pathological changes.

Lesion score

For each lobe, the extent of the lung lesion was visually evaluated and measured using a 4-point scale, from score 0 (no injury), score 1 (≤ 25% of the lobe), score 2 (25 to 50%), score 3 (50 to 75%) to score 4 (> 75% of the lobe). The overall score was obtained by summing the scores for each lobe between 0 and 32.

Sample collection

A total of 75 bronchial swabs and 75 lung parenchyma were collected for bacteriological analysis. Two samples types were taken from freshly slaughtered animals with gross lesions suggesting pneumonia: a swab of the bronchi using a sterile swab after sectioning of the injured tissue, and sectioning a fragment of pulmonary fabric from the same compromised parenchyma.

These samples were placed in insulated boxes at +4°C, to be sent to the laboratory as soon as possible. For practical reasons, the samples were frozen (-20°C) in order to be exploited subsequently. Each sample, properly identified and accompanied by an identification card was placed in airtight individual packaging, which no added preservative or antiseptic.

Bacteriological analysis

The bacterial analysis carried out at the Microbiology Laboratory of the Veterinary Institute (University of Blida) focused on the isolation and identification of conventional bacteria involved in the pathological process, according to current bacteriological techniques recommended by Quinn et al. (1994).

Viruses and *Mycoplasma* were excluded from the search because they require specialized culture conditions and identification techniques. In the laboratory, the samples were thawed at ambient temperature. The surface of the lung fragment was cauterized on the surface; the parenchyma was cored with an unbuttoned Pasteur pipette and placed in nutrient enrichment broth (manufactured by Pasteur Institute of Algeria, IPA) to revitalize bacteria (37°C for 18 to 24 h), while the swabs were directly and separately placed in similar broths.

The enriched broths were seeded on agar with 5% sheep blood (IPA) incubated under aerobic conditions at 37°C for 24 h. Morphological characteristics of colonies were scored on blood agar, as well as the presence or absence of hemolysis, the type of this latter and the production of pigments and smells. After purification, Gram stain, catalase and oxidase tests were performed. The choice of the identification gallery was established from the results of these tests.

RESULTS

Prevalence of pulmonary lesions

From 1018 slaughtered and examined sheep during the survey, 194 (19%) had pulmonary lesions, isolated or in combination, of varying nature and severity. The lesions appearing to be infectious (n = 75) were sampled. The rest of the observed lesions (n=119) were either parasitic in nature or slaughter injuries and were not taken into account for the result of the investigation.

Distribution of the lesion types

Infectious pulmonary lesions can be divided into 4 categories: red hepatization, grey hepatization, atelectasis and emphysema. Pulmonary hepatization (also called consolidation injury) represented the most frequent lesion observed in the slaughter house; all forms included, it represents 70.7% of the lesions (Table 1). Considering that different lesions sometimes occur in the same lung, only the dominant one was considered.

Location of lesions

Pulmonary lesions mostly sits on the apical lobes, the right one in particular (88% of the inspected lungs), reaching either part or all of these, and sometimes extends to other lobes (Table 2). Lesion frequency is higher on the right side of the lung, with a marked laterality for apical lobes (Figure 1).

Scope of lung injury

Determining the extent of the pulmonary lesion on each lobe permits us to estimate the evolution of the pathology. The scale of lung lesions depends on the severity and extension rate of pneumonia (Table 3). We note that the apical right lobe is frequently affected in its entirety.

Lesion score

Lesions extending on small areas are the most prevailing; three quarters of the examined lungs showed a lesion

Table 2. Distribution of pulmonary lesions observed in the lobes.

Lung	Lung lobes (n=75)	Number	%
Right Lung	Right apical lobe	66	88
	Anterior medium lobe	14	19
	Posterieur medium lobe	08	11
	Right caudal lobe	07	09
	Azygos lobe	03	04
Left Lung	Left apical lobe	13	17
	Left medium lobe	09	12
	Left caudal lobe	04	05

Figure 1. Total red hepatization (or consolidation) of the apical and medium lobes of the lung, taking the color and consistency of the liver (dorsal view).

score smaller than 5/32. The average lung score was equal to 5.26 ± 5.22, while the number of animal per injured lobes was 1.82±1.63. Lung lesions extend widely over the different lobes. The perimeter areas where pneumonia is evolving are irregular.

Bacteriological analysis results

Bacteriological analysis was performed on 150 samples from 75 animals. The samples were 75 fragments of lung and 75 bronchial swabs of the same lungs with lesions. The most frequently isolated bacteria were gamma-hemolytic streptococci (18%), *Escherichia coli* (17.7%), *Micrococcus* species (14.5%) and coagulase-negative staphylococci (10.4%). The family of Enterobacteriaceae (*E. coli* included) represents nearly 43% of the isolates. *M. haemolytica* and *P. multocida* account for 5.6% of isolates.

Most bacteria isolated (71%) were either saprophytes or commensals of the upper respiratory system and represent commonplace bacteria contamination (*Bacillus*, *Proteus*, *Micrococcus*). Others (*E. coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Pseudomonas*, *Streptococcus* βeta-hemolytics) which account for 23%, are occasional specific pathogenic agents of the respiratory system, and may be pathogenic in secondary infections due to a decrease in immune defenses of the host. The role of the *M. haemolytica* and *P. multocida* (5.6%) is well known in respiratory diseases in sheep (pneumotropic bacteria) (Figure 2).

Several associations of bacterial species were isolated in the same sample (Figure 3). Out of the 150 samples (75 swabs and 75 lung parenchyma), 54 (36%) were mono-microbial, 87 (58%) indicated the association of two bacterial species and 9 (6%) showed three. All samples showed bacterial growth; none were sterile. This combination of bacteria in one sample reflects a multifactorial etiology of lung disease of sheep and explains the diversity of the observed lesions. Comparison of the results obtained by the two samples types highlights a greater number of bacterial flora, from the swabs.

According to these results, there seems to be no relationship between bacterial groups and sample type (Figure 4). Pneumotropic bacteria were isolated only in hepatization lesions (Table 4).

Despite the small number of pneumotropic bacteria (*M. haemolytica* and *P. multocida*) isolated in this study, their exclusive frequency (14/14) should be noted in the consolidation lesions (hepatization).

DISCUSSION

Sheep farming in Algeria represents the main source of income for many families in rural areas. Ouled Djellal sheep are the most common breed of sheep, accounting for more than 60% of the national herd. They provide a lot of meat, wool and leather, and are particularly suited to the arid climate. However, the important variations in temperature, ranging from hot in summer to very cold in winter, can promote the development of sheep respiratory diseases. Indeed, previous studies in France (Douart, 2002), Algeria (Belkhiri et al., 2008) and India

Table 3. Extent of lung lesions in sheep observed at the abattoir.

Extent (%)	Number of sheep (n=75)							
	Left Lung (3 lobes)			Right Lung (5 lobes)				
	Apical	Medium	Caudal	Apical	Anterior medium	Posterior medium	Caudal	Azygos
0	62	65	70	07	58	64	63	73
< 25	05	02	01	12	01	03	04	01
25-50	05	05	00	13	08	03	00	00
50-75	00	00	00	03	00	00	00	00
75-100	01	00	00	09	02	00	00	00
100	02	03	04	31	06	05	08	01

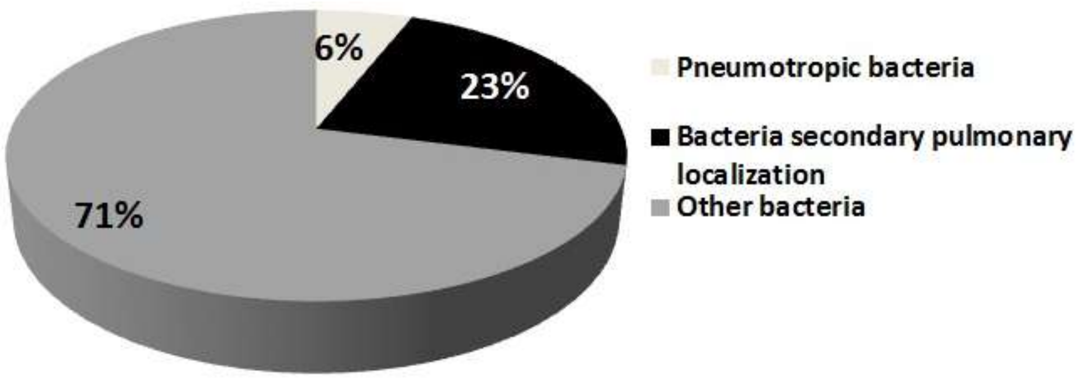

Figure 2. The prevalence of pathogenic bacteria isolated from pneumonic lungs of sheep slaughtered.

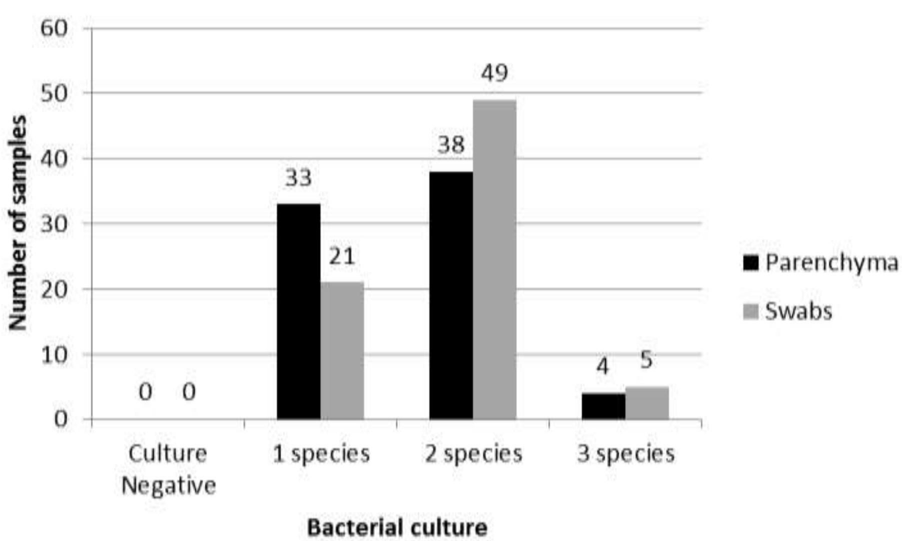

Figure 3. Bacterial associations by sampling procedure .

(Dar et al., 2012) have determined a significant incidence of lung lesion in sheep during winter. In regard to the unavailability of some laboratory techniques, the results of the investigation lack precision, particularly because of the difficulty to look for *Mycoplasma* and viruses, which are much involved in lung lesions in sheep.

The molecular diagnosis of *Pasteurella* spp. isolates

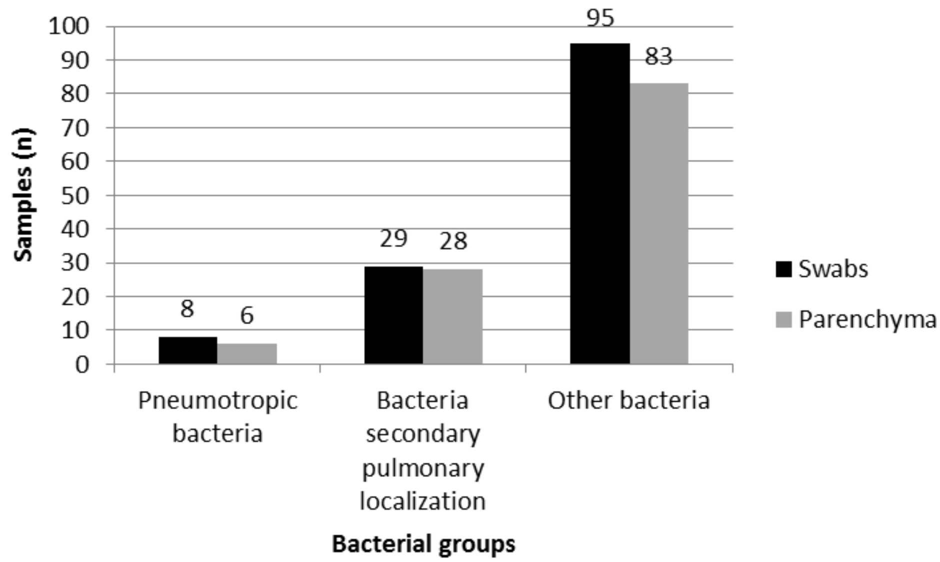

Figure 4. Distribution of bacterial groups in sheep showing lung lesions according to the sample type.

Table 4. Relationship between macroscopic lesions and the isolated bacteria of the lungs.

Lesion	Bacteria								Other*
	Pneumotropic bacteria			Bacteria secondary pulmonary localization					
	M.h.	P. m.	Past. spp	*E. coli*	SCP	Klebs. pneu.	Pseudo.	Strept. β-hemo.	
Red hepatization	**5**	**6**	2	21	6	0	1	1	93
Grey hepatization	0	3	1	8	1	0	0	0	30
Atelectasis	0	0	0	2	0	1	0	0	28
Emphysema	0	0	1	10	1	1	0	0	14
Other**	0	0	0	0	0	0	0	0	13
Total	5	9	4	41	8	2	1	1	**178**

M.h : *Mannheimia haemolytica*; P.m: *Pasteurella multocida*; Past. spp: *Pasteurella* spp.; SCP: coagulase-positive Staphylococci; Klebs. Pneu: *Klebsiella pneumoniae* ; Pseudo.: *Pseudomonas,* Strept. β-hémo.: beta-hemolytic Streptococci. Other bacteria*: Commonplace bacteria contamination (*Bacillus*, *Proteus*, *Micrococcus…*). Other lesions**: Congestion, Abscesses …

which includes analysis of nucleotide sequences of the 16S rRNA and *KMT1* genes overcame the disadvantage and limitation of phenotypic diagnosis and became a favorable technique in many international laboratories for identification and calculating the phylogenetic tree in Pasteurellaceae family. It reduces the duration of identification, allows a direct detection of organisms from clinical sample's genome, and enhances the sensitivity and specificity of the diagnosis (Hassan et al., 2016).

Polymerase Chain Reaction (PCR) is a sensitive and rapid diagnostic procedure for the early diagnosis of *Mycoplasma* infection. *M. ovipneumoniae* has been isolated and detected through PCR from the nasal swab samples and from pneumonic sheep lungs (Amin et al., 2016).

In Algeria, Kabouia (2005) highlighted the association of *Mycoplasma* with different types of lung lesions in 21% of sheep samples. *Mycoplasma capricolum* alone or in combination with other mycoplasmas (*Mycoplasma agalactiae* and *M. ovipneumoniae*, *Mycoplasma arginini*) and other bacteria are responsible for ovine respiratory diseases. In Richard et al. (1986) in France, isolated *M. ovipneumoniae* in more than half of pneumonia lesion samples from sheep.

Statistically highly significant difference (Fisher's exact test P ≤ 0.0001) in the isolation of *M. ovipneumoniae* between healthy and respiratory distressed sheep breeds in Balochistan (Pakistan) was found (Amin et al., 2016). The sampling is not random because it is not based on any lot. It is not representative of the ovine population, at least that of the Blida region. Despite this lack of representativeness, the results identified in this study make it possible to learn about relationships that may exist between the lesions and pneumotropic bacteria. The selected animals cannot be considered as representative of the sheep population of the study area, given that the only criterion for inclusion is that the animal, regardless of age or sex, arriving at the slaughterhouse showed macroscopic lung lesions, infectious and non-parasitic. Moreover, we had no information about their mode of rearing or any recent antibiotic treatments. The examined animals were all males, 6 to 12 months. For practical reasons, the samples had to be frozen pending their exploitation, despite the fact that some works showed a deleterious effect of freezing on the number of species isolated in the pulmonary bacteriology (Menoueri, 1985; Cadoz, 2000). The effect of freezing can be ambivalent; it can be negative by reducing the probability to isolate *Pasteurella* and even completely eliminate it, including the pneumonia principal agent; on the other hand, it can be beneficial by preventing the development of bacteria that proliferate in the post mortem process.

Our study showed a prevalence of 19% lung lesions. In the large scale study of Goodwin-Ray et al. (2008) carried out on about 2 million lambs slaughtered in three abattoirs in New Zealand, the prevalence of pneumonia ranged from 7 to 13% per slaughter house. An abattoir survey realized by Brunet and Fontaine (1980) in France showed that on more than 25,000 inspected lambs, 35% had pulmonary lesions. In other countries, the prevalence of pneumonia in not frozen samples was found as follows: 15.28, 22.48 and 18.93% in India, respectively in 2013, 2014 and 2016 (Priyadarshi et al., 2013; Asok et al., 2014; Amaravathi et al., 2016); 7.8% in Tanzania (Mellau et al., 2010); 4.2% in Iran (Azizi et al., 2013), 27.84% in Algeria (Belkhiri et al., 2014). Pneumonia lesions observed in our study, affected preferentially apical lobes (88% of the cases). The predominance of the lesions in cranioventral portions of lung has been attributed to shortness and abrupt branching of air ways, greater deposition of infectious organisms, inadequate defense mechanisms, reduced vascular perfusion, gravitational sedimentation of exudates and regional differences in ventilation (Dar et al., 2013).

In most domestic animal species, the right cranial lobe is ventilated down by the cranial bronchus, with the exception of ruminants and pigs lobe where it is ventilated by an additional bronchus which lies just before the tracheal bifurcation (Nickel et al., 1973). The higher frequency of lesions on the right side of the lung and the increased vulnerability of apical and cardiac lobes are similar to those described by Alley (1975), Haziroglu (1994), Ozyildiz et al. (2012) and Dar et al. (2014); this is a special form of pneumonia called chronic or atypical pneumonia.

Bacteriological results showed a diverse bacterial flora in the lungs as well as in the bronchial liquid, predominantly gram positive, similar to the results of Garedew et al. (2004) in Ethiopia. The results indicated in this study, including the relatively small number (5.6%) of *Pasteurella* isolation are to be kept with a sense of proportion. It is possible that these results were due to the fragility of the bacteria that have not withstood the samples storage conditions. As concerns in pneumonic lungs, the results of isolates of *M. haemolytica* (without freezing) were the following: 21. 96% (Marru et al., 2013), 34.1% (Demissie et al., 2014), and 14.7% (Asaye et al., 2015) in Ethiopia; 22.20% (Kaoud et al., 2010) and 14.3% (Saed et al., 2015) in Egypt, respectively.

According to Cadoz (2000), *M. haemolytica* was isolated twice as often when there was no freezing, while most of the bacteria resist, at least partially, freezing. According to Meyer et al. (2004), freezing has no real bactericidal effect; for the most sensitive microorganisms (gram-negative), the population is reduced by a power of 10 by freezing (that is 90% destroyed) and again the power of 10 during prolonged storage. If the population is large at the time of freezing, it will be so after storage and thawing.

In their study, Tehrani et al. (2004) attributed *M. haemolytica* low isolation either to antibiotic treatment or to the development of other bacteria such as *Proteus* species and *Bacillus* species which would mask the presence of *Pasteurella* or chronic lesions that would promote growth of other bacteria. Bacteria similar to those identified in our study were isolated from sheep with pneumonia. This is the case of Richard et al. (1986) in France; Al Sultan (1995) in Iraq; Barbour et al. (1997) in Saudi Arabia and Yimer and Asseged (2007) in Ethiopia, with substantially similar proportions. The distribution of different bacterial groups is relatively similar to that found by Menoueri (1985) in France on housed lambs with the difference that he studied in addition with the presence of *Mycoplasma* spp. (12%).

The isolated bacteria from the diseased lungs of the animals studied were dominated by streptococci gamma-hemolytic and *E. coli* which are opportunistic pathogens and develop in parallel to primary pathogens during an infectious phenomenon (Richard et al., 1986). Streptococci were isolated in 18% of the cases. They are part of the normal flora of the upper respiratory tract and are considered opportunistic pathogens (Kaoud et al., 2010). *Escherichia coli* is extremely widespread in the environment, developing more whenever there is contamination of the sample. Its presence in the lungs can possibly result from the evolution of septic processes. In our study, the predominance of *E. coli* was also highlighted by Mohammed (1999). Robbins et al. (1981) reported that *S. aureus* colonizes the upper respiratory tract, become involved in the disease process when stress conditions prevail.

According to Richard et al. (1986), the greater concentration of the bacterial flora obtained from the swabs (132 species isolated against 117 for parenchyma) could be explained by the presence of bacteria in the open air, which are absent from the lung parenchyma or contamination during handling. Swabs appear much more polluted with contaminants such as the common *Micrococcus, Proteus* and *Bacillus.* The isolation of *M. haemolytica* and/or *P. multocida*, specifically the correlation between these bacteria and lung injury called consolidation (hépatization) corroborate the findings of Sharp (1978), Jones et al. (1982), Pfeffer (1983) or Daniel et al. (2006).

For Cadoz (2000), the involvement of *M. haemolytica* increases with further damages. According to Garedew (2004), a strong correlation was observed between the presence of *Pasteurella* and the development of pneumonia in sheep. Moreover, according to Kaoud et al. (2010), *M. haemolytica* plays a more important role in respiratory diseases of sheep and goats (14%) than in cattle (3.6%).

Our study aimed to determine the situation of sheep, sacrificed at the slaughterhouse of Blida, vis-à-vis respiratory diseases based on pathological and bacteriological investigations. The infection rate found reached the considerable figure of 20% of the total slaughtered animals. Bacteriological results showed the presence of a wide variety of bacteria, including pneumotropic germs (*M. haemolytica* and *P. multocida*), isolated up to 5.6% and strongly correlated to hepatization which represents 70% of lesions on lungs. The low percentage of isolation of these bacteria is probably due to the freezing of the samples. These germs caused pneumonia in young animals (under one year), primarily localized on the apical right lobe (88% of cases). It was also noted that the nature of isolated germs is independent from the sample type. These results reflect the existence of atypical pneumonia in sheep populations in Algeria; this pathology should be taken into consideration, because of its harmful impact on the health and growth performance of young animals. Further studies aiming to know the different serotypes of these agents that prevail in the country will allow the development of a vaccine. Research of *Mycoplasma* and viruses, including parainfluenza, which are very involved in respiratory diseases, is strongly recommended too.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES

Abdelguerfi A, Ramdane SA (2003). Bilans des Expertises sur La Biodiversité importante pour l'agriculture en Algérie. MATE-GEF/PNUD.Projet ALG/97/G31, 231.

Alley MR (1975). The bacterial flora of the respiratory tract of normal and pneumonic sheep. New Zealand Vet. J. 23(6):113-118.

Al Sultan II (1995). Bacterial isolation from pneumonic lungs in sheep. Iraqi J. Vet. Sci. 8:213-215.

Amaravathi M, Satheesh K, Annapurna P, Subramanyam KV (2016). Incidence of spontaneous lung lesions in slaughtered sheep. Int. J. Adv. Res. Biol. Sci. 3(2):269-271.

Amin S, Rahman S, Hussain I, Muhammad G, Awan MA, Ahmad Z, Tariq MM, Ullah MI, Kakar MA (2016). Bimolecular identification of *M.ovinpeumoniae* from nasal swab samples of sheep from various districts of Balochistan, Pakistan. Int. J. Adv. Biol. Biomed. Res. 4(1):32-39.

Asaye M, Biyazen H, Bezie M (2015). Isolation and Characterization of Respiratory Tract Bacterial Species from Domestic Animals with Pneumonic Lungs from Elphora Abattoir, Ethiopia. Int. J. Microbiol. Res. 6(1):13-19.

Asok Kumar M, Kumar R, Varshney KC, Nair MG, Lakkawar AW, Sridhar BG, Palanivelu M (2014). Pathomorphological studies of lung lesions in sheep. Indian J. Vet. Pathol. 38(2):75-81.

Azizi S, Korani FS, Oryan A (2013). Pneumonia in slaughtered sheep in south-western Iran: pathological characteristics and aerobic bacterial aetiology. Vet. Italiana 49(1):109-118.

Barbour EK, Nabbut NH, Hamadeh SK, Al Nakhli HM (1997).Bacterial identity and characteristics in healthy and unhealthy respiratory tracts of sheep and calves. Vet. Res. Commun. 21:421-430.

Belkhiri M, Tlidjane M, Meziane T (2008). Fréquence des lésions pulmonaires des bovins et ovins de Tiaret et Batna. Rencontre autour des Recherches sur les Ruminants 15, 68 p.

Belkhiri M, Benhathat Y, Tlidjane M (2014). Classification and frequency of ovine pulmonary lesions in Tiaret's slaughterhouse. Res. J. Pharma. Biol. Chem. Sci. 5(2):1181-1188.

Boutonnet JP (1998). Spécificité et diversité des filières viandes rouges en Méditerranée, CIHEAM- Options Méditerranéennes, pp. 31-37.

Brunet J, Fontaine M (1980). Essai d'estimation des pertes par maladies dans le troupeau ovin du sud-est de la France à travers une enquête en abattoir. Bulletin de l'Office International des Epizooties 92:355-369.

Cadoz MO (2000). Contribution à l'étude des broncho-pneumonies du chamois. Analyse de 368 rapports d'autopsie et examens bactériologiques. Thèse de doctorat vétérinaire, ENV Lyon. Thèse n ° pp. 81-144.

Chakraborty S, Kumar A, Tiwari R, Rahal A, Malik Y, Dhama K, Pal A, Prasad M (2014). Advances in Diagnosis of Respiratory Diseases of Small Ruminants. Veterinary Medicine International, Article ID 508304, 16 p

Cutlip RC, Lehmkuhl HD, Brogden KA (1993). Chronic effects of coinfection in lambs with parainfluenza-3 virus and *Pasteurella haemolytica*. Small Rum. Res. 11:171-178.

Daniel JA, Held JE, Brake DG, Wulf DM, Epperson WB (2006). Evaluation of the prevalence and onset of lung lesions and their impact on growth of lambs. Am. J. Vet. Res. 67:890-894.

Dar LM, Darzi MM, Mir MS, Rashid A, Abdullah S, Hussain SA (2012). Prevalence and pathological studies on ovine pneumonic pasteurellosis in Kashmir valley, India. Eur. J. Vet. Sci. 28(4):199-203.

Dar LM, Darzi MM, Mir MS, Kamil SA, Rashid A, Abdullah S (2013). Prevalence of lung affections in sheep in northern temperate regions of India: A postmortem study. Small Rum. Res. 110:57-61.

Dar LM, Darzi MM, Mir MS, Kamil SA, Rashid A, Abdullah S, Hussain SA, Rather FA, Parihar S (2014). Histopathological and histoenzymatic studies on bronchopneumonia in sheep .J. Appl. Animal Res. 42(3):289-296.

Demissie T, Dawo F, Sisay T (2014). Biochemical and Antigenic Characterization of *Mannheimia*, *pasteurella* and *Mycoplasma* Species from Naturally Infected Pneumonic Sheep and Goats, Bishoftu, Ethiopia. Afr. J. Basic & Applied Sciences 6(6):198-204.

Douart A (2002). Les pasteurelloses des petits ruminants. Le Point Vétérinaire 33:86-89.

Galapero J, Fernández S, Pérez CJ, Calle-Alonso F, Rey J, Gómez L (2016). Identifying risk factors for ovine respiratory processes by using Bayesian networks. Small Rum. Res. 136:113-120.

Garedew L, Avelet G, Yilma R, Zeleke A, Gelaye E (2004). Isolation of diverse bacterial species associated with visna-maedi infection of sheep in Ethiopia. Afr. J. Microbiol. Res. 4(1):14-21.

Giangaspero M, Vanopdenbosch E, Nishikawa H, Tabbaa D (1997). Prevalence of antibodies against respiratory viruses (Parainfluenza virus type 3, respiratory syncytial virus, reovirus and adenovirus) in

relation to productivity in Syrian Awassi sheep. Trop. Anim. Health Prod. 29:83-91.
Goodwin KA, Jackson R, Brown C, Davies PR, Morris RS, Perkins NR (2004). Pneumonic lesions in lambs in New Zealand: patterns of prevalence and effects on production. New Zealand Veterinary Journal 52:175-179.
Goodwin-Ray KA, Stevenson M, Heuer C, Pinchbeck G (2008).Hierarchical and spatial analyses of pneumonia-lesion prevalence at slaughter in New Zealand lambs. Preventive Vet. Med. 83:144-155.
Hassan GM, El-Feky ZA, Eissa EA, Teleb AA (2016). Rapid diagnosis of virulent *Pasteurella multocida* isolated from farm animals with clinical manifestation of pneumonia respiratory infection using 16S rDNA and *KMT1* gene. Asian Pac. J. Trop. Dis. 6(1):21-26.
Haziroglu R, Diker KS, Gulbahar MY, Akan M, Guvenc T (1994). Studies of the pathology and microbiology of pneumonic lungs of lambs. Deutsche Tierarztliche Wochenschrift 101:441-443.
Jones GE, Field AC, Gilmour JS, Rae AG, Nettleton PF, McLauchlan M (1982). Effects of experimental chronic pneumonia on bodyweight, feed intake and carcasse composition. Veterinary Record 110:268-273.
Kaoud H, El Dahshan AR, Zaki MM, Shimaa AN (2010). Occurrence of *Mannheimia haemolytica* and *Pasteurella trehalosi* among ruminants in Egypt. N. York Sc. J. 3(5):135-141.
Kabouia R (2005). Etude épidémiologique des mycoplasmes des petits ruminants. Application de l'immunoblot à l'étude des sérums de moutons infectés expérimentalement par *Mycoplasma agalactiae*. Thèse de Doctorat d'Etat, Université des frères Mentouri, Constantine, Institut des sciences vétérinaires, P 116.
Lemhkuhl HD, Cutlip RC, Bolin SR, Brogden KA (1985). Seroepidemiologic survey for antibodies to selected viruses in the respiratory tract of lambs. Am. J. Vet. Res. 46:2601-2603.
Loosli CG (1968). Synergism between respiratory viruses and bacteria. Yale J. Biol. Med. 40:522-540.
McIlroy SG, Goodall EA, McCracken RM, Stewart DA (1989). Rain and wind chill as factors in the occurrence of pneumonia in sheep. Vet. Rec. 125:79-92.
MADR (Ministry of Agriculture and Rural Development) (2014). Agricultural Statistics (areas and productions serie B,). Algiers.
Malone FE, McCullough SJ, McLoughlin MF, Ball HJ, O'Hagan J, Neill SD (1988). Infectious agents in respiratory disease of housed fattening lambs in Northern Ireland. Vet. Record 122(9):203-207.
Marru HD, Anijajo TT, Hassen AA (2013). A study on Ovine pneumonic pasteurellosis: Isolation and Identification of *Pasteurellae* and their antibiogram susceptibility pattern in Haramaya District, Eastern Hararghe, Ethiopia. BMC Vet. Res. 9:239.
Martin WB (1996). Respiratory infections of sheep. Comparative Immunol. Microbiol. Infect. Dis. 19(3):171-179.
Mellau LSB, Nonga HE, Karimuribo ED (2010). A slaughterhouse survey of lung lesions in slaughtered stocks at Arusha, Tanzania. Preventive Vet. Med. 97:77-82
Menoueri MN (1985). Ecopathologie des pneumopathies ovines. Contribution à l'étude des affections pulmonaires chez les agneaux de bergerie. Maîtrise Ès sciences vétérinaires, ENV Lyon, P 66.
Meyer A, Deiana J, Bernard A (2004). Cours de microbiologie générale: avec problèmes et exercices corrigés. Edition Doin. P 430.
Mohammed R (1999). Bacteriological and histological examinations of pneumonic lungs of small ruminants slaughtered at Hashime Nure export abattoir. Debre Zeit. Ethiopia DVM thesis, AAU, FVM. Debre Zeit, Ethiopia, pp. 1-21.
Nickel R, Schummer A, Seiferle E (1973). Respiratory System, The viscera of the domestics animals. New York, NY, Springer-Verlag, P 245.
Ozyildiz Z, Tel OY, Yilmaz R, Ozsoy SY, Keskin O (2013). Pathological and Microbiological Investigations of Pneumonic Pasteurellosis in Sheep. Kafkas Üniversitesi Veteriner Fakültesi Dergisi 19(1):103-108.
Pfeffer A, Thurley DC, Boyes BW, Davies GB, Price MC (1983). The prevalence and microbiology of pneumonia in a flock of lambs. New Zealand Veterinary J. 31(11):196-202.
Priyadarshi BH, Joshi DV, Patel BJ,Raval SH, Patel HA (2013). Pathomorphology of spontaneously occurring pulmonary lesions in sheep (*Ovis aries*). Rum. Sci. 2(1):31-35.
Quinn PJ, Carter ME, Markey B, Carter GE (1994). Bacterial pathogens: Microscopy, culture and identification. In: Clinical Veterinary Microbiology. Wolfe Publishing, London, pp. 21-60.
Richard Y, Menoueri MN, Guigen F, Favier C, Borges E, Fontaine M, Oudar J., Brunet J, Pailhac C (1986). Pneumopathies de l'agneau de bergerie. Etude bactériologique sur des poumons prélevés à l'abattoir. Rev. Méd. Vét. 137(10):671-680.
Robbins SL, Angell M, Kumar U (1981) The respiratory system in basic pathology. 3rd edition, Philadelphia, PA, USA, WB Saunders, pp. 369-420.
Rouchy S (1992). Diagnostic différentiel des affections respiratoires chez les ovins. Thèse pour le doctorat vétérinaire, ENV Alfort, p88.
Saed M, Khaliel S, Abd El-Mageed A, Khalifa E (2015). Genome Sequences of Gcp Gene of *Mannheimia haemolytica* Serotypes A1 and A2 Associated with Respiratory Manifestation of Ruminant in Egypt. Global Vet. 14 (1):142-148.
Sharma R, Woldehiwet Z (1990). Increased susceptibility to *Pasteurella haemolytica* in lambs infected with bovine respiratory syncytial virus. J. Comp. Pathol. 103:411-420.
Sharp JM, Gilmour NJ, Thompson DA, Rushton B (1978). Experimental infection of specific pathogen-free lambs with parainfluenza virus type 3 and *Pasteurella haemolytica*. J. Comp. Pathol. 88:237-243.
Tehrani AA, Ras MB, Niazy H (2004). Isolation and identification of *Pasteurella haemolytica* biotype A from sheep in Urmia, Iran. Iranian Journal of Veterinary Research, University of Shiraz. 5(2):1383, 105-109.
Valadan M, Jabbari AR, Niroumand M, Tahamtan Y, Bani Hashemi SR (2014). Isolation and Identification of *Pasteurella multocida* from Sheep & Goat in Iran. Arch. Razi Inst. 69(1):47-55.
Yimer N, Asseged B (2007). Aerobic bacteria flora of the respiratory tract of healthy sheep slaughtered in Dessie municipal abattoir, north eastern Ethiopia. Rev. Méd. Vét. 158(10):473-478.
Zrelli M, Haddad N, Bouzouaia M (1988). La Pasteurellose. In : Fassi-Fehri M, Les maladies infectieuses du mouton. Tome 1, Actes éditions, pp. 206-229.