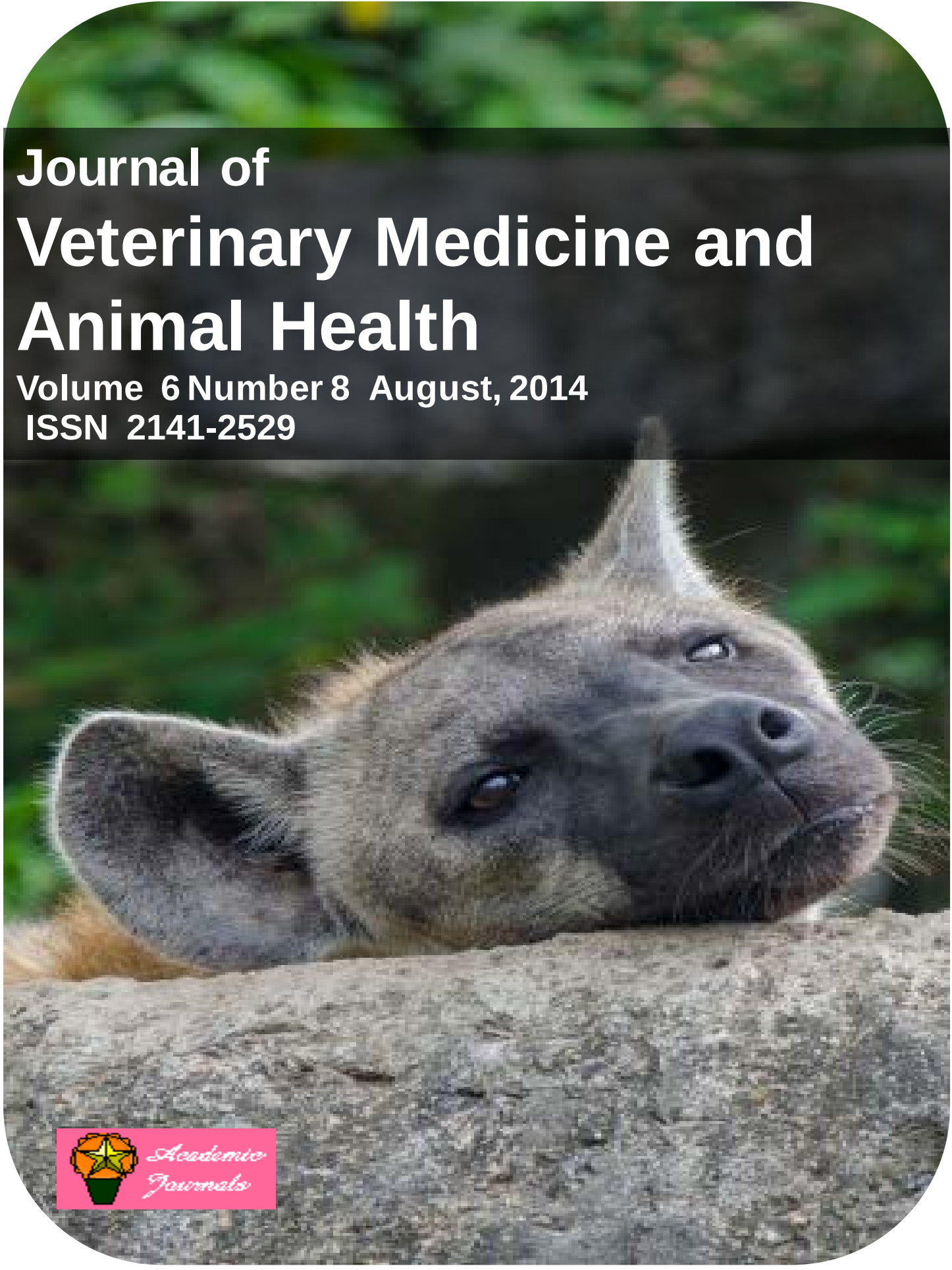

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Review

Mastitis in camels (*Camelus dromedarius*): Past and recent research in pastoral production system of both East Africa and Middle East

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Udder infection was considered as one of the main constraints for camel rearing. During the last decades the disease has been reported from a number of camels-rearing countries in Africa and Asia such as Egypt, Somalia, Sudan, Kenya, Saudi Arabia, Iraq and United Arab Emirate. An attempt was made in this paper in order to review the status of camel mastitis (*Camelus dromedarius*) research in pastoral production system of both East Africa and Middle East. This paper reviews the forms of mastitis in camel which can be a clinical mastitis (including, acute and chronic mastitis) or sub-clinical mastitis. Clinical mastitis is characterized by hardening and swelling of the udder, pain on palpation and visible alteration of the colour and consistency of milk. Thus, clinical mastitis can be detected by examination of the udder and/or of the milk. While the term sub-clinical mastitis refers to the existence of inflammation in the absence of gross signs and can be detected by indirect tests such as california mastitis test (CMT) and somatic cell count (SCC) as well as microbiological examinations. Furthermore, the major pathogens of camel mastitis are *Staphylococcus aureus*, *Streptococcus agalactiae*, *Bacillus cereus*, *Actinomyces pyogenes*, *Escherichia coli*, *Micrococcus spp*., and *Corynebacterium bovis*. Regarding the risk factors of camel mastitis, the paper reviews the most important risk factors such as the heavy tick infestation, use of anti-suckling devices, the lesions on udder or teat, and the treatment of infected quarters by cauterization. Moreover, the use of CMT, SCC and bacteriological examinations as diagnostic tools and their values for detection of camel mastitis are also reviewed. Based on the aforementioned, more epidemiological studies on camel mastitis are required in order to have a strong scientific data on the transmission of the disease, characterization of the pathogens causing the disease, other possible risk factors or diagnostic procedures, and the impact of the disease on the public health. Thus, the control strategies can be applied.

Key words: Camel mastitis, pathogens, forms, risk factors, diagnosis.

INTRODUCTION

According to Food and Agriculture Organization (FAO) (1992), consumption of livestock products increases 2 to 3 times more in developing countries as compared to developed countries. This is attributed to the high population growth and an increasing urbanization in the third world. The FAO report indicated that the food supply must be improved, both in quantity and quality. It is well known that camels play major roles in improving the socio-economic status and survival of the desert dwellers and are major sources of protein and energy for them.

This is due to a number of specific anatomical and physiological characteristics of the camel as well as low susceptibility to diseases (Schwartz and Dioli, 1992).

Schwartz and Dioli (1992) recorded that the camel milk contains the necessary proteins, sugars, fats, minerals and vitamins for the young calves and is a valuable food for the people. Beside that, camel milk is a rich source of vitamin C for the desert people who are unable to get it from other sources. On the other hand, udder infection was considered as one of the main constraints for camel rearing. For instance, it has been noticed in the slaughter houses that early culling of female camel in Iraq was attributed to chronic mastitis and infertility (Al–Ani and Al Shareefi, 1997). During the last decades the disease has been reported from a number of camels–rearing countries in Africa and Asia such as Egypt, Somalia, Sudan, Kenya, Saudi Arabia, Iraq and United Arab Emirate. An attempt was made in this paper in order to review the status of camel mastitis *Camelus dromedarius* research in pastoral production system of both East Africa and Middle East.

STATUS OF CAMEL MASTITIS (*Camelus dromedarius*) RESEARCH IN EAST AFRICA AND MIDDLE EAST

Udder infection of camel

Mastitis is a complex disease occurring worldwide among dairy animals, with heavy economic losses largely due to sub-clinical mastitis. There is extensive literature on bovine mastitis and to some extent on ovine and caprine mastitis. Little is known about camel mastitis. However, cases of mastitis in camel have been reported from different countries, particularly in pastoral production system of East Africa and Middle East and Egypt (Moustafa et al., 1987; Karmy, 1990), Saudi Arabia (Barbour et al., 1985; Hafez et al., 1987; Ramadan et al., 1987; Aljumaah et al., 2011), Iraq (Al-Ani and AlShareefi, 1997), Somalia (Arush et al., 1948; Abdurahman et al., 1992); Sudan (Abdurahman et al.,1995; Suheir et al., 2005), United Arab Emirate (Quandil and Ouadar, 1684), Ethiopia (Almaw and Molla, 2006; Bekele and Molla, 2001; Woubit et al., 2001; Abera et al., 2012) and Kenya (Younan et al., 2001).

PATHOGENS CAUSING CAMEL MASTITIS

Camels under traditional management are usually kept far from urban. Thus, bacteriological examination of the camel milk was considered difficult (Abdurahman et al., 1995). An assumption was made, that the major pathogens of camel mastitis were *Saphylococcus aureus*, *pyogenes*, *Escherichia coli*, *Micrococcus spp*., and *Streptococcus agalactiae*, *Bacillus cereus*, *Actinomyces Corynebacterium bovis* (Woubit et al., 2001). Almaw and Molla (20002) and Bekele and Molla (2001) have isolated other *Streptococcus* spp. and coagulase negative Staphylococi from mastitic milk of dromedary camel in pastoral production system of Ethiopia. Furthermore, *E. coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* have been isolated from both clinical and sub-clinical mastitis (Kapur et al., 1982; Quandil and Ouadar, 1984; El-Jakee, 1998; Bekele and Molla, 2001). On the other hand, relationship between occurrences of camel mastitis and the presence of *Corynebacterium spp*., *Actinomyces spp.*, and *Bacillus spp.* were reported in Iraq (Al-ani and AlShareefi, 1997), Egypt (El-Jakee, 1998) and Ethiopia (Woubit et al., 2001). Moreover, a research work from Sudan by Suheir et al. (2005) confirmed the presence of *Mycoplasm*a *arginini*, mold and yeast in mastitic milk of she-camel while in Egypt, El-Jakee (1998) stated that camel mastitis caused by anaerobic *Clostridium perfringense* was considered as a problem in the country.

RISK FACTORS OF CAMEL MASTITIS

A study in Sudan by Abdurahman et al. (1995) and Obied et al. (1996) explained that the use of devices to prevent the calves from sucking their dams, together with heavy tick infestation of the udder and the treatment of infected quarters by cauterization have been considered as predisposing factors for camel mastitis (Figures 1 and 2). Furthermore, Bekele and Molla (2001) considered that the heavy tick infestation, use of anti-suck ling devices and the thorny bushes in pastoral areas of Ethiopia might be responsible for udder abnormalities and deformities and blind teats. They also reported a positive relationship between trauma and the occurrence of camel mastitis. Younan et al. (2001) reported that the camel pox might be considered as contributing factor in the spreading of intra-mammary infection caused by *S. agalactiae* in Kenya. Recently, a study from Saudi Arabia by Aljumaah et al. (2001) confirmed that the risk of sub-clinical mastitis of dromedary camel increased significantly with breed, parity and with early stage of lactation. In contrast, Suheir et al. (2005) observed that most of mastitis cases in the camel in Sudan were recorded in the last stages of lactation period and during the fourth and fifth calving. Factors such as Age, production system, hygiene of milking process and presence of lesion on udder/teat were found significantly associated with the prevalence of camel mastitis under different production systems of

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Figure 1. Anti-sucking device (tying of teats).

Figure 2. Tick infestation.

Figure 3. Abscess on the udder.

systems of Pakistan (Ahmed et al., 2012) (Figures 3 and 4).

FORMS OF CAMEL MASTITIS

The forms of mastitis in camel can be clinical mastitis (including, acute and chronic mastitis) or sub-clinical mastitis. Clinical mastitis in camel is characterized by hardening and swelling of the udder, pain on palpation and visible alteration of the colour and consistency of milk. Thus, clinical mastitis can be detected by examination of the udder and/or of the milk (Obied et al., 1996). The term per-acute mastitis refers to severe inflammation, with swelling, heat and pain of the quarter, with a marked systemic reaction that may be fatal. The change in the mammary glands in acute mastitis is similar to those of peracute but the systemic signs are less severe (Quinn et al., 1994; Radostitis et al., 2000). In India, Kapur et al. (1982) recorded a case of peracute mastitis caused by *Klebsiella spp.* and *E. coli* that resulted from contamination during udder surgery while Quandil and Ouadar (1984) reported acute form of camel mastitis.

In Saudi Arabia, Ramadan et al. (1987) described unilateral chronic mastitis caused by *S. aureus* and *Pasteurella haemolytica* in three lactating camels due to obstruction of the teat canals by keratin. He also indicated that the camels with previous history of acute bacterial mastitis lead to chronic mastitis with subsequent fibrosis and keratinization of the udder tissue (Figure 5). Chronic cases of the camel mastitis due to *S. aureus* have also been reported in Iraq (Al-Ani and Al-Shareefi, 1997). Sub-clinical mastitis was reported in Sudan (Obied et al., 1996; Abdurahman et al., 1995) and Ethiopia (Almaw and Moll, 2000; Bekele and Molla, 2001). The same authors indicated that the term sub-clinical mastitis in camel refers to the existence of inflammation in the absence of gross signs and can be detected by indirect tests such as California mastitis test (CMT) and somatic cell count (SCC), as well as microbiological examinations.

DIAGNOSIS OF CAMEL MASTITIS

Clinical mastitis can be detected by examinations of the udder and/or of the milk, as well as using indirect tests (Obied et al., 1996). Bacteriological examinations of the milk, CMT and SCC have been used as diagnostic tools to detect sub- clinical mastitis in camels (Obied et al., 1996; Abdurahman et al., 1995; Almaw and Molla, 2000; Bekele and Molla, 2001). The value of the CMT for the early detection of mastitis in camel herds was indicated by Moustafa et al. (1987). Moreover, a study on the sensitivity and specificity of CMT in Kenya by Younan et al. (2001) has shown that the CMT can be applied as a

Figure 4. Milking machine.

Figure 5. Chronic mastitis (abscessation and fibrosis of one quarter).

Table 1. Interpretation of the CMT results.

CMT score	Average somatic count (cells per milliliter)	Description of reaction
N (negative)	100,000	No thickening, homogeneous
T (trace)	300,000	Slight thickening. Reaction disappears in 10 s
1 (+)	900,000	Distinct thickening, no gel formation
2 (++)	2,700,000	Thickens immediately, begins to gel, levels in the bottom of cup
3 (+++)	8,100,000	Gel is formed, surface elevates, with a central peak above the mass

Figure 6. California mastitis test (CMT). The CMT reagent reacts with the white blood cells and the mixture thickens or gels in proportion to the amount of the infection present.

screening test for the detection of intra-mammary infection with *S. aureus* and *S. agalactiae* in camel. This result supports that of Bekele and Molla (2001) who reported during their study on camel mastitis a positive correlation between CMT scores and bacteriological results. Furthermore, Obied et al. (1996) found a strong correlation between leukocyte counts of camel milk and the CMT scores. An increase of SCC with the degree of CMT and their value in predicting the infection status of the udder in lactating camels has also been reported by Abdurahman (1996) and Al-Ani and Al Shareefi (1997) (Table 1 and Figures 6 and 7).

Variation in the leukocyte counts of colostrums, normal milk and dry period milk from camels have been reported by Moustafa et al. (1987). There were increases in the SCC in camel milk with age, stage and number of lactations, and the results of the CMT, and these were directly correlated with the leukocyte counts (Kospakov, 1976). Abdurahman et al. (1996) in his study of sub-clinical mastitis in seven lactating bactrian camels (*Camelus bactrianus*) kept at a zoological park in Sweden showed that camels free of udder infection had a higher basal SCC than cows. The author also recorded that the cell fragments may be counted as cells in microscopic counting. Abdurahman et al. (1992) previously recorded the presence of large numbers of the nucleated cell fragments in the camel milk. Similar cell fragments in goat milk did not react with CMT reagent (Schalm et al., 1971).

Some other diagnostic tools have been used for the detection of camel mastitis. For instance, Saad and Thabet (1993) have reported a strong correlation between white side test (WST) and bacteriological result of camel milk samples. Abdurahman et al. (1995) indicated that milk samples from quarters infected with major pathogens higher values for CMT, SCC and adenosine triphosphate (ATP) than samples from quarters that were infected with minor pathogens and from not infected

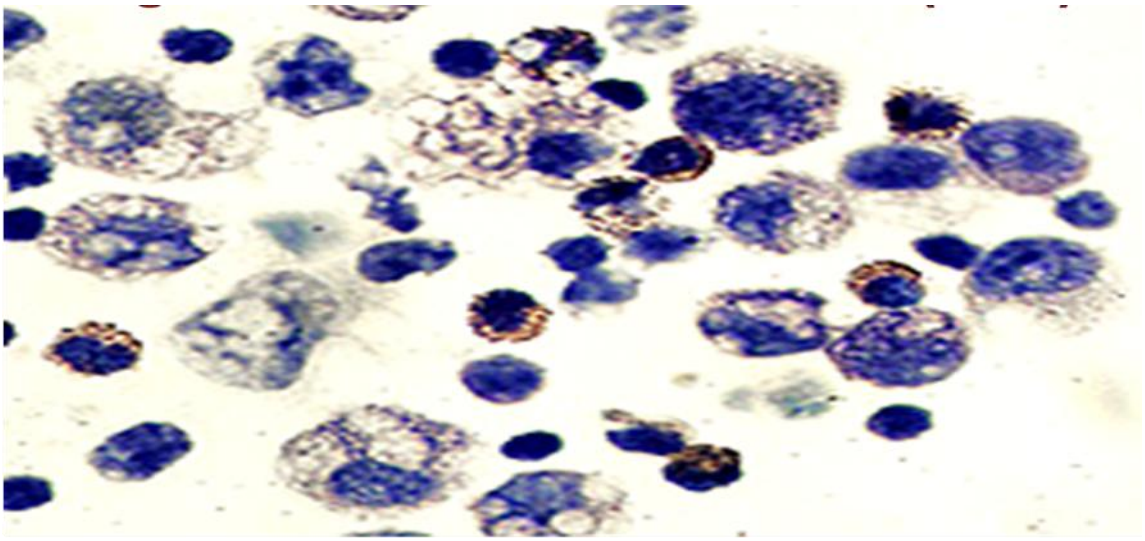

Figure 7. Somatic cell counts (SCC). Cutt-off point (critical point)= over 500,000 to be an indication of udder infection in camels.

quarters. The NAGase test has been used for predicting udder infection in cow. The test is based on measurement of a cell-associated enzyme (N-acetyl-β-D-glucosaminidase) in the milk. A high level of the enzyme indicates a high cell counts (Radostits et al., 2000). In Sudan, Abdurrahman (1995) measured the NAGase activity and concentration of serum albumin from quarter milk samples of lactating camels using both the fluoroscan method and radial immunodiffusion test. The same author indicated that the NAGase was more reliable in predicting bacteriological status of the camel udder than serum albumin. There is a direct relationship between intra–mammary infection in cows and the conductivity of the milk produced. The test is based on the increase in sodium and chloride ions, and the consequent increase in electrical conductivity, which occurs in mastitic milk (Radostits et al., 2000). The milk conductivity was measured for both normal quarter milk samples and intra-mammary infection with *S. aureus* and *S. agalactiae* in lactating camels in Kenya (Younan et al., 2001). The author explained that the conductivity reading was not diagnostic.

CONTROL OF CAMEL MASTITIS

The control of udder infection in camels was mainly based on using antibiotics (intra-mammary infusion). Oxytetracyline, tetracycline, gentamcin, chloramphenicol, pencillin G and kanamycin were effective drugs against major pathogens of camel mastitis. Resistance patterns of some mastitis pathogens of camel against commonly used anti-microbial agents can be attributed to heavy applications of these anti-microbial agents for the treatment of many infectious diseases for long time (Younan et al., 2001) (Figure 8).

CONCLUSION

Camel mastitis was considered one of the major diseases in pastoral production system of East Africa and Middle East, with a great impact on animal health as well as public health concern. There are two forms of camel mastitis; clinical mastitis which can be detected by inspection of the milk and the udder, the other one being sub-clinical mastitis which can be detected only by indirect tests. California mastitis test (CMT) together with bacteriological examinations have a great value in diagnosis of the disease. Anti–suckling devices, tick infestation, parity, stage of lactation, production system, hygiene conditions and lesions on udder or teat were responsible for spreading of intra-mammary infection in dromedary camel.

RECOMMENDATIONS

1. More epidemiological studies on camel mastitis are required in order to have a strong scientific data on the transmission of the disease, characterization of the pathogens causing the disease, other possible risk factors or diagnostic procedures, and the impact of the disease on the public health. Thus, the control strategies can be

Figure 8. Treatment of camel mastitis with antibiotics (intra mammary infusion).

can be applied.
2. The somatic cell counts (SSC) of the normal and mastitis camel milk needs further investigations.
3. An attempt should be made to increase awareness of camel owners on the importance and impact of udder infection on public health and milk yield.
4. In order to control and prevent mastitis in camels, it will be valuable to avoid risk factors of camel mastitis such as use of anti-suckling devices, tick infestation and udder lesions.
5. Monitoring of zoonotic diseases such as salmonellosis, brucellosis and tuberculosis in the camel milk herds in pastoral production system of East Africa and Middle East is required.

Conflict of Interest

The author(s) have not declared any conflict of interests.

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Full Length Research Paper

Postmortem incidence and trends of Newcastle disease lesions among chicken presented for diagnosis at Makerere University Central Veterinary Laboratory: A retrospective study

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In Uganda, endemic poultry diseases especially Newcastle disease (ND) presents an important limiting factor in the development of commercial poultry production and establishment of trade links. However, there was limited information about its incidence and trends. A retrospective study was conducted to determine incidence and trends of ND among chicken presented for post mortem diagnosis at Makerere University Central Veterinary Laboratory over a period of ten years (2002 to 2011). A total of 1,548 necropsy records were reviewed. Data was analyzed using statistical package for social sciences (SPSS-16) and Epi-info statistical packages. The total annual ND necropsy cases analysed generally increased from 2002 to 2011 with peaks in 2006 and 2011. Of the 1,548 birds presented, 362 were diagnosed with ND lesions representing an overall incidence of 23.4% over the study period. The frequency of ND was lowest (14%) in 2003 and highest in 2011 (32%). The total monthly cases peaked in the months of May and October. The wet season was possibly the most favourable for the transmission of viruses. However more studies are required to understand epidemiology of ND in Uganda.

Key words: Newcastle disease, postmortem prevalence, lesions, trends.

INTRODUCTION

Rural households in Uganda have kept poultry for many years basically on scavenging system of management. About 40% of the rural households keep chicken or other poultry in Uganda and rely on this for a significant portion of the dietary proteins in form of eggs and meat. On average, households keep flocks of between 6 and 20

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Table 1. Yearly incidence of ND.

Year	Samples analysed	ND (Incidence, %)
2002	159	24 (15)
2003	140	20 (14)
2004	160	25 (16)
2005	167	41 (25)
2006	156	44 (28)
2007	218	44 (20)
2008	172	50 (29)
2009	101	30 (30)
2010	114	33 (30)
2011	161	51 (32)
Total	1548	362 (23.4)

chickens excluding chicks and growers, with very few keeping over 50 birds. The total poultry population in Uganda was projected to be about 32.6 million birds in 2007 (Byarugaba, 2007). However, rearing losses are very severe. It is estimated that mortality of indigenous poultry under scavenging conditions is 70% and above in chicks up to 8 weeks of age (Kirunda and Mukiibi-Muka, 1992). In Uganda, endemic poultry diseases especially Newcastle disease (ND) presents an important limiting factor in the development of commercial poultry production and establishment of trade links (Ojok, 1993; Mukiibi-Muka, 1992; Byarugaba, 2007; Kugonza et al., 2008).

Newcastle disease is a viral poultry disease with perhaps the greatest economic impact world over (Hassanzadeh and Bozorgmeri, 2004). The ND viruses are in genus Avulavirus of family Paramixoviridae (Saiif et al., 2003). It is a zoonosis of domestic and wild avian species (Goff et al., 2012). Transmission can be incipient or through contaminated feeds, hatcheries, vectors and even humans (Katunguka, 2008). Viruses shed from chicken readily aerosolize to favour air borne transmission as well (Li et al., 2009). ND virus is highly transmissible in poultry with low antibody titer; herd immunity requires 85% coverage with a high antibody titre after vaccination (Van Boven et al., 2008). In most areas of Uganda, vaccination is haphazard, power supply is unreliable and yet the market has thermal unstable vaccines which depend on a cold chain. Newcastle disease, now endemic in most parts of Uganda, wipes out 60 to 100% of the birds when it strikes. Outbreaks continue even in vaccinated areas possibly because coverage is too low or the vaccination does not provide perfect immunity which could arise due to antigenic divergence between the vaccine strains and the circulating field strains (Van Boven et al., 2008; Dortmans et al., 2012). Farmers therefore sell many of the birds prior to such disease occurrence in order to avoid losses from the outbreaks. However, there is limited information about their prevalence and trends of ND in Uganda.

The aim of this study was to determine incidence and trends of ND among chicken presented for post mortem diagnosis at Makerere University Central Veterinary Laboratory over a period of ten years (2002 to 2011).

MATERIALS AND METHODS

Data on necropsy cases of diseases of poultry presented to the Makerere University Central Veterinary Laboratory for ten years (2002 to 2011) were considered for this study. ND was diagnosed based on flock history, clinical signs and post-mortem findings and histopathology. Figures recorded in the study period were obtained from 1,548 case files/registers and post-mortem reports of diagnosis of ND. The following clinical signs, based on history and observation, were considered: Greenish-dark diarrhea, edema of the head, especially around the eyes usually not involving the comb, a dark ring appearance around the eye ("black eye") especially in white chickens, drooping wings, torticollis, ataxia and sudden death. These postmortem findings were considered diagnostic of ND: Edema of the interstitial tissue of the neck, especially near the thoracic inlet; straw colored fluid in the trachea and esophagus; congestion and occasional hemorrhage in the trachea generally corresponding to the rings of cartilage; petechial and small ecchymotic hemorrhages on the mucosa of the proventriculus, usually at the base of the papillae and concentrated around the posterior and anterior orifices; edema, hemorrhage, necrosis and ulceration of peyers patches; edema, hemorrhage and degeneration of ovaries; severe atrophy of the bursa, spleen and thymus. Histopathological sections of lymphoid organs that showed necrosis and depletion of lymphocytes were diagnostic of ND. All the ND cases recorded exhibited lesions of the velogenic viscerotropic pathotype, the only pathotype reported in Uganda. The data was entered in Excel spread sheets awaiting further analysis. The distribution pattern of ND in those ten years was analyzed using descriptive statistics and statistical package for social sciences (SPSS-16) and Epi-info.

RESULTS

The total annual chicken necropsy cases analysed generally increased from 2002 to 2011, with peaks in 2006 and 2011 (Table 1). Of the 1,548 birds presented, 362 were diagnosed with ND lesions representing an overall incidence of 23.4% over the study period. The frequency of ND was lowest (14%) in 2003 and highest in 2011 (32%). The total monthly cases peaked in the months of May and October (Table 2).

DISCUSSION

The results indicated a gradual rise in total annual necropsy cases from 2002 to 2011 (Figure 1). This could most probably be attributed to the increasing trends of chicken production in Uganda (Byarugaba, 2007). In Uganda, there has been a rapid rise in poultry population

Table 2. Number of ND cases per month.

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
2002	01	00	03	01	00	01	00	05	04	06	03	00	24
2003	01	01	00	04	02	02	04	00	01	01	02	02	20
2004	05	01	01	03	02	01	00	03	03	03	03	00	25
2005	01	02	04	03	03	02	02	04	05	05	06	04	41
2006	05	07	03	02	06	04	02	04	01	07	01	01	43
2007	00	06	01	03	05	03	06	01	05	04	05	05	44
2008	01	04	04	06	05	01	02	04	06	10	06	01	50
2009	00	02	03	05	04	03	02	01	03	03	01	03	30
2010	02	00	02	01	03	03	00	04	03	04	06	05	33
2011	10	03	08	04	06	02	04	03	01	04	03	03	51
Total	26	26	29	32	36	22	22	29	32	47	36	24	361

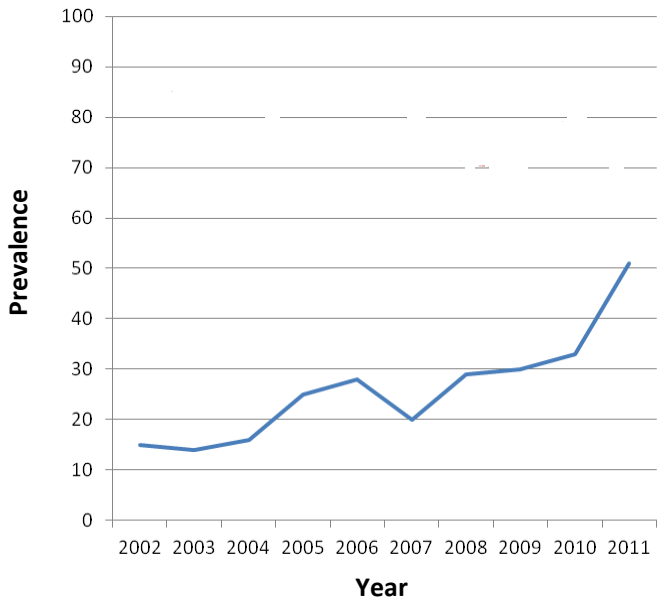

Figure 1. Trends in prevalence of Newcastle disease lesions among chicken presented for diagnosis in Makerere Veterinary diagnostic laboratory.

density which could have led to the increase in disease spread. This agrees with (Tarwater, 1999) who showed that the number of new infections is strongly related to the distribution of susceptible contacts. It is possible for the many apparently healthy birds to be carrying and spreading the various virus strains of ND (Iroegbu and Amadi, 2004). Mixed poultry keeping involving ducks and pigeons which are potential reservoirs of ND, free movement of birds by subsistence farmers and dealers without permits, lack of biosecurity measures in hatcheries, poor scheduling of vaccination programmes or even vaccine failure could be playing a significant role in epidemiology of ND in Uganda (Capua et al., 2002; Otim et al., 2006). It has been noted that the scheduling of vaccination determines the grade of protection against ND (Sheela and Rao, 2002). Worse still, even successful vaccinations may not guarantee protection against ND infection (Zhao et al., 2001). Birds may show high antibody titres and still succumb to infection for unknown reasons. Liberalization of drug import and use in Uganda could have resulted in haphazard handling of vaccines resulting in vaccine failure. Increased ND could also arise from vaccination against other diseases. Presence of antibodies against infectious bronchitis virus has been shown to reduce the immune response to Newcastle disease vaccine (Bunaciu et al., 1986; Sadrzadeh et al., 2007).

There was a rapid increase in ND cases observed from 2005 to 2006 and from 2010 to 2011. The signifi-cance of this finding is probably uncertain. However, the isolation of NDV from wild and migratory birds elsewhere (Alexander et al., 1989; Thomazelli et al., 2010) could point to introduction of the virus into the poultry popula-tion. This is particularly so because the necropsy cases were mainly from Kampala, Wakiso and Mokono which are located at the shores of L. Victoria, known for multiple species of wild and migratory birds. Recently, Kasozi et al., (2014) found a positive though not significant associa-tion between presence of migratory wild birds and risk for ND. These peaks also coincide with the period when presidential, parliamentary and local council national elections were held. Alesina et al. (1996) showed that political interferences increase the prevalence of poultry diseases. Therefore, it is plausible to argue that there could have been laxity in the vaccination programs due to political excitation.

Generally, ND vaccination levels are very low in Uganda. Despite the fact that 93.3% of smallholder poultry

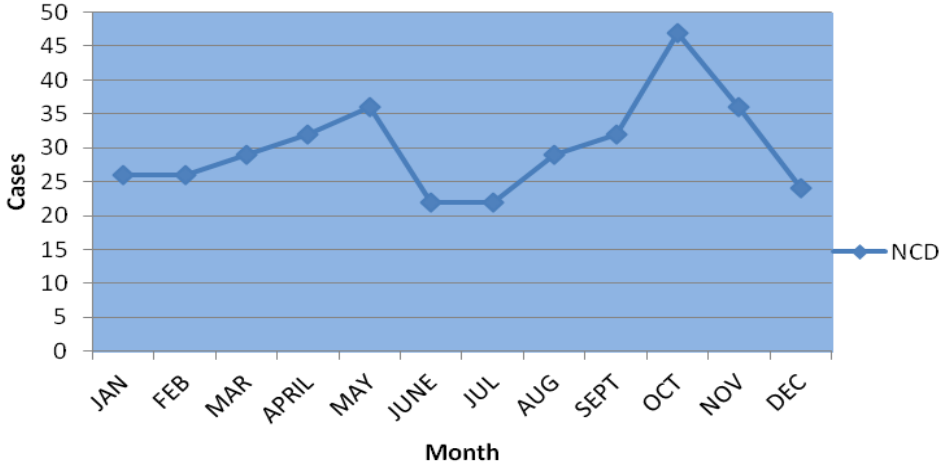

Figure 2. A graph showing total number of NCD cases per month.

poultry producers still keep their chicken under the free-range system, Amoki et al. (2009) revealed that only 28.2% of households vaccinated against ND.

Results showed that ND cases generally peaked up twice in the year in the months of May and October (Figure 2). It should be noted that Uganda experiences a climate pattern with two peaks of the wet season, the first from March to June and the second from August to November (RoU, 2007). Both ND peaks occurred in the wet season with high humidity and this could have been the cause of high cases observed. ND occurrence is reported to be higher during the rainy season (Yunus et al., 2009). Higher prevalence in the wet season could be associated with increased fly populations since flies can also transmit ND (Barin et al., 2010). However this result contradicts with Adamu et al. (2009) who reported highest disease occurrence in the dry season, this was possibly because of the longer survival time in the dry season (Otim et al., 2007). The results also contradict with Otim et al. (2007) who found no significant differences between the incidences in the rainy and dry seasons.

In conclusion, ND remains endemic in areas of Uganda with the incidence in an increasing trend. There is therefore need to do more study on the factors that could be influencing this observed pattern.

Conflict of interest

Authors do not have any conflict of interest.

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Short Communication

Risk management of importation of day old chicks in Khartoum State, Sudan

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The present study was carried out in Khartoum state comprising three towns namely Khartoum, Omdurman and Khartoum North and was aimed of identifing, analyzing and dealing with risks related to importation of day old chicks in order to minimize risk impact and to develop systemic approach for approving or rejecting imported day old chicks according to processes of import policy and procedures. Data was obtained from Ministry of Animal Resources, Fisheries and Rangelands (MARFR), Sudanese Standards and Metrology Organization (SSMO), quarantine at the air port as well as from commercial companies which import day old chicks to Khartoum state. The respondents were decision markers and veterinarians who were working in these areas. Data about risk management related to importation of day old chicks was collected by means of questionnaires. The total respondents by questionnaire were 60 veterinarians. Data was analyzed using SPSS frequencies and percentages. The results showed that 75% of the respondents at Khartoum International Airport (KIAP) explained that there was no updating for their knowledge as well as there was no source for getting information 55 % responded that internet access was very limited. Most of them (80%) gave negative responses for the issue of submission of the samples to the laboratory. It was found that in the M A R F R the respondents confirmed the presence of import regulations but the implementation was good to some extent, as well as the quarantine measures at the airport were less than adequate. Veterinarians belonging to SSMO confirmed the presence of standards. In contrast, they were not convinced with the proper implementation of the Sudanese standards. Quarantine measures and laboratory diagnosis at the airport were less than perfect. The results showed that 85% of respondents in the companies knew about risk, 60% updated their knowledge, 100% confirmed of mortality causes and 75% related the risk to laboratory procedures.

Key words: Risk management, importation, day old chicks, Sudan.

INTRODUCTION

In the recent past, the poultry industry in Sudan has greatly expanded and became an economically important

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source of income for many people in the country. Sudan recognized the potential of poultry industry in the early fifties of the last century. Imported breeds were brought to Sudan by both government and the private sector and subsequently farmers recognized the potential of including poultry production in their farms; this was further accelerated by urbans after the country's independence in 1956. As a result, importing of day old chicks dramatically increased in recent years. For instance, in the last four years the number of imported day old chicks has been estimated to be 30,000 chicks from eight countries. Hence, the poultry industry sector has become very crucial to domestic growth product (DGP) of the country, with its considerable participation in food security which has depended mainly on livestock and poultry.

As a consequence, this allowed the importation of huge numbers of poultry and poultry products in the country. However, this may increase the possibility of importing infectious trans-boundary diseases or any other diseases to the country. A list of several diseases has been identified by the World Organization for Animal Health (OIE), particularly diseases imported by day old chicks. However importation of day old chicks involved a degree of disease risk to the importing country (OIE, 2010). Therefore, knowledge of import risk analysis is necessary to provide importing countries with an objective and defensible methods for assessing the risks associated with the importation of day old chicks. This information is required for exporting country in order to set certain conditions for accepting or refusing the imported poultry or poultry products (OIE, 2011). To achieve this, well trained personnel as veterinarians are essential to investigate and respond to new threats and meet the global, regional and national levels (OIE, 2009).

Ensuring entry of healthy birds following rigorous inspection in an importing country will protect the country from significant economic losses. For instance, the case of the avian influenza outbreak that happened in the Sudan which was claimed to be spread from the neighboring countries that caused heavy losses in the poultry industry for many poultry companies and individuals. Thus, risk management of day-old chicks imported as a preventive measure to provide the importing country and importers with information to avoid financial losses applied according to global and local laws is necessary. This study aims to:

1. Identify major risks related to importation of day old chicks in Khartum;

2. Analyze importance of these risk factors and;
3. Develop a system for approving or rejecting importation of day old chicks in terms in line with existing policy and procedure in the country.

MATERIALS AND METHODS

Study site

The study was conducted in Khartoum state which comprised three towns namely; Khartoum, Omdurman and Khartoum north. The source of data of current research work was as follows.

Khartoum International Airport (KIAP)

KIAP is the main international airport in Sudan which is situated in 15° 35' 22" north (latitude) and 32° 33' 11" East (longitude) and elevation of 1255 (386 m) about sea level. KIAP is used for both civil and military purposes. The Ministry of Animal Resources, Fisheries and Rangelands (MARFR) is responsible for national animal health matters including quarantine, disease control, reporting, and import and export certification of animals and their products, while Sudanese Standards and Metrology Organization (SSMO) is a scientific monitoring body which coordinates inspection of the imported consignments of hatching eggs and day old chicks.

Questionnaire survey

Data was obtained from the MARFR and SSMO, as well as from private commercial companies which import day old chicks. Data about risk management related to importation of day old chicks was collected by means of a questionnaire.

Target respondents

Responses to questionnaire were obtained from decision markers in MARFR, the veterinarians who are working in the quarantine at KIAP, veterinarians who are working at SSMO and veterinarians who are working with commercial companies which import day old chicks in Khartoum state. Target respondents are presented in Table 1.

Sampling strategies

Data was collected from non-probability sampling methods based on willingness and support of respondents (that means not all the veterinarians in the study site had the same chance for being selected for responding to the questionnaire.

Data analysis

Data related to risk management was analyzed using IBM SPSS statistics version 20. Descriptive statistic such as frequency (count) and percentage was used and presented either in table or bar chart. No analytical statistic was done for data because there was no standard or basic variable for making such analysis as well as some time the required sample size was too low. This method of analysis was selected as statistical descriptive proportion to the small size of the sample under study and the lack of statistical distribution. The sampling is not valid compared to the value calculated and the theoretical value, as in the case of Chi-Square test descriptive method which relies on the study of fact or phenomenon, as this kind of surveys is the appropriate style to gather information about the problem or what its purpose and the

Table 1. Description of the target respondents such as veterinarians in the study site. Their level of education and professional experience is observed.

Unit	Target respondent veterinarian	
	Frequency	**Percentage**
Ministry of Animal Resources, Fisheries and Rangelands (MARFR)		
A. Qualification		
Bachelor of sciences	6	42.9
Master sciences	8	57.1
PhD	0	0
Sub-total	14	100
B. Experience		
< 5 years	1	7.1
5-10 years	3	21.4
>10 years	10	71.4
Sub-total	14	100
Khartoum International Airport (KIAP)		
A. Qualification		
Bachelor of sciences	14	70
Master of sciences	6	30
PhD	0	0
Sub-total	20	100
B Experience		
< 5 years	2	10
5-10 years	11	55
>10 years	7	35
Sub-total	20	100
Sudanese Standards and Metrology Organization (SSMO)		
A. Qualification		
Bachelor of sciences	2	33.3
Master of sciences	4	66.7
PhD	0	0
Sub-total	6	100
B. Experience		
< 5 years	1	16.7
5-10	3	50
>10	2	33.3
Sub-total	6	100
Companies which imported day old chicks		
A. Qualification		
Bachelorof sciences	16	80
Master of sciences	4	20
PhD	0	0
Sub-total	20	100
B. Experience		
< 5 years	8	40
5-10	7	35
>10	5	25
Sub-total	20	100

Table 2. Questionnaire survey responses related to knowledge of risks by Veterinarians at Khartoum International Airport.

Unit	Veterinarian	
	Frequency	Percentage
Updating of the knowledge		
Yes	5	25
No	15	75
Source of the knowledge		
References and journals	1	5
Internet	6	30
Reports	2	10
Nothing	11	55
Frequency for updating of the knowledge		
1-Daily	5	25
2-Weekly	1	5
3-Monthly	5	25
4-More than one month	9	45
Availability of internet at work		
Yes	4	20
No	16	80
Constrains for getting information		
Yes	13	65
No	7	35
Time for last training		
Last month	1	5
Last three month	0	0
Last year	8	40
Nothing	11	55
Participation in conferences		
Local	0	0
International	2	10
Nothing	18	90
Presence of regulation		
Yes	18	95
No	1	5
Knowledge about regulation		
Yes	17	85
No	3	15

The total number of respondents were 20. There was one missing value.

strengths and weaknesses in order to reach conclusions about the validity of this situation to reach partial or radical changes.

RESULTS

The study was conducted in Khartoum state for the purpose of risk management related to import of day old chicks. The methodology was mainly based on collection of data by means of questionnaire using non-probability sampling methods. Respondent veterinarians who were working at KIAP explained that there was no updating for their knowledge 75% (n = 15) as well as there was no source for getting information 55% (n = 1), and internet access was very limited. However, they confirmed that the presence of regulation related to importation of day old chicks the rest of the results are presented in Table 2. Most of them gave negative response for the issue of submission of the samples to the laboratory 80% (n = 16).

All respondents stated that the presence of good laboratories for doing research, leaflets and training were the best solution against the hazards associated with importation of day old chicks (Table 3). Information with regard to precautions for consignments and transportation and the role of SSMO are presented in Figures 1 to 3. On the other hand, the decision makers in MARFR confirmed the presence of regulations and continuous updating 100% (n = 14) while implementation of the regulations were acceptable to some extent 64.3% (n = 9), as well as quarantine measures at airport were less than average 42.9% (n = 6). Information associated with knowledge and training are shown in Table 4. Most of the decision makers 92.9% (n = 13, out of 14) considered that co-ordination and communication between were very important, however, they did not give attention for monitoring commercial companies. Furthermore, the veterinarian of SSMO confirmed the presence of standards 100% (n = 6). In contrast they did not consider implementation of the Sudanese standards, quarantine measures and laboratory diagnosis at the airport (Table 5) as adequate. All of them 100% (n = 6) stated that more attention should be given to the presence of good laboratory work, training and implementation of standards which are important. The rest of the information on risk management that is associated with importation of day old chicks is presented in Table 6.

Good responses were recorded by veterinarians in companies with regard to knowledge about risk 85% (n = 17, out of 20) and those that wish to update their knowledge 60% (n = 12, out of 20). The same responses were obtained for determination of mortality causes and confirmation of the risk using laboratory procedure (100 and 75%, n = 20 and15, out of 20, respectively (Table 7). The rest of the results are summarized in Figures 1 to 3.

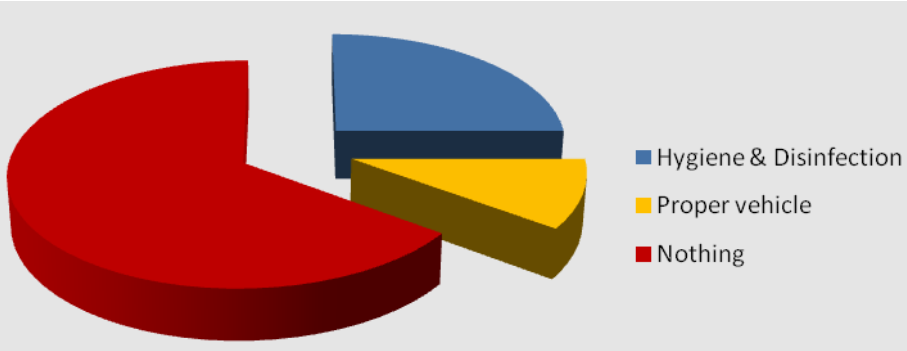

Figure 1. Questionnaire survey responses related to transportation responses by Veterinarians at Khartoum International Airport.

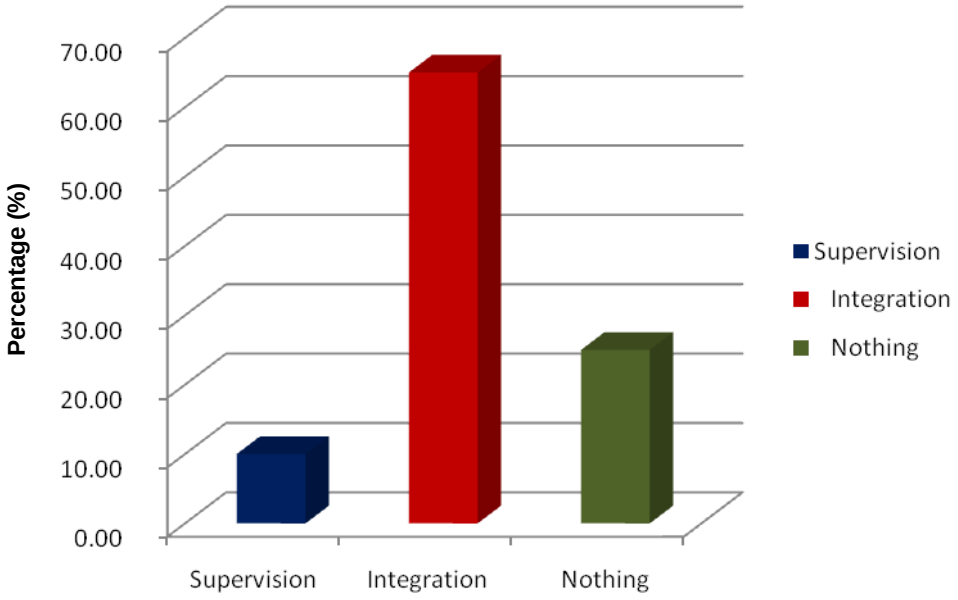

Figure 2. Questionnaire survey responses related to relationship between Sudanese Standards and Metrology Organization and Veterinarians in the quarantine at Khartoum International Airport.

DISCUSSION

This study was designed to identify, analyze and plan response to risks related to importing day old chicks in order to minimize risk impact and to develop systematic approach for approving or rejecting imported day old chicks according to regulation. Khartoum International Airport is the only entrance of the day old chicks and it can be controlled easily. Risk management is based on prevention strategy. The correction of such risks will cause major losses. The results of a quarantine at air port showed that 100% of the respondents release imported chicks without follow up. The chicks must be kept in the vicinity of the quarantine premises, and buildings and management must be of a high standard according to Ashton (1984).

For considering the development and implementation as legislation of the OIE tool for the evaluation of performance of veterinary services OIE (2010), we found that Ministry of Animal Livestock results showed that 57.1% of the respondents had no obligation for quarantine. According to Berier and Abdelgadir (2011) who stated that the SSMO has standards for day old chicks, these have not observed scientific measures based on risk

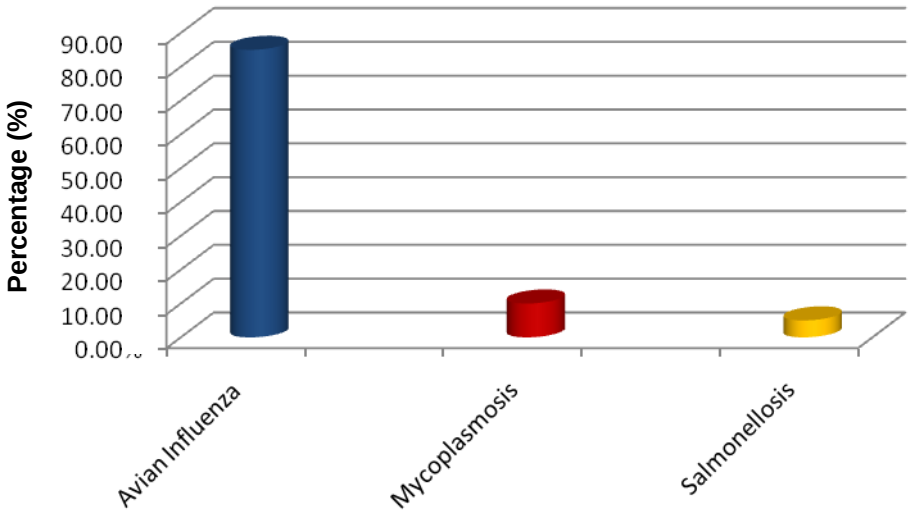

Figure 3. Questionnaire survey responses related to imported diseases by Veterinarians at Companies importing chicks.

Table 3. Questionnaire survey responses by decision makers with regard to the regulations of importation of day old chicks.

Unit	Veterinarian	
	Frequency	Percentage
Presence of regulations		
Yes	14	100
No	0	0
Implementation of regulations		
Excellent	2	14.3
Good	10	71.4
Acceptable	2	14.3
Poor	0	0.0
Updating of regulations		
Yes	14	100
No	0	0
Quarantine measures at airport		
Yes	6	42.9
No	8	57.1
Quarantine measures related to suspected cases		
Yes	11	78.6
No	3	21.4
Strategies for dealing with risks		
Yes	8	57.1
No	6	42.9

Table 4. Questionnaire survey responses by decision makers regarding knowledge and training at MARFR.

Unit	Veterinarian	
	Frequency	Percentage
Availability of training		
Yes	5	35.7
No	9	64.3
Availability of conferences		
Yes	1	7.1
No	13	92.9
Efforts for providing information		
Yes	7	50
No	7	50
Periodical meeting of related committee		
Yes	14	100
No	0	0
Presence of reporting system		
Yes	8	57.1
No	6	42.9

Table 5. Questionnaire survey responses by veterinarian of Sudanese Standards and Metrology Organization (SSMO) regarding importation of day old chicks.

Unit	Veterinarian	
	Frequency	Percentage
Presence of standards		
Yes	6	100
No	0	0.0
Quarantine measures at airport		
Yes	0	0.0
No	6	100
Laboratory diagnosis		
Yes	0	0.0
No	6	100
Handling of imported chicks		
Release	6	100
Release and follow-up	0	0.0
Implementation of Sudanese standards		
Yes	4	66.7
No	2	33.3
Role of veterinarians regarding standards		
Implementation of standards	6	100
Supervision	0	0.0

Table 6. Veterinarian responses to possible identification and management of the risk related to importation of day old chicks at SSMO.

Unit	Veterinarian	
	Frequency	Percentage
Presence of risk by Avian Influenza (AI)		
Yes	6	100
No	0	0.0
Risk determination by laboratory		
Yes	4	66.7
No	2	33.3
Importance of transportation		
Yes	6	100
No	0	0.0
Responsibility for risk management		
Only Government	0	0.0
Co-ordination with others	6	100

Tools and aids for controlling risk (Lab, Training, and Implementation of standards) 6 (100%).

Table 7. Questionnaire survey responses by veterinarians at commercial companies related to identification and management of risk.

Unit	Veterinarian	
	Frequency	Percentage
Updating of knowledge		
Always	12	60
Sometimes	4	20
Nothing	4	20
knowledge about risk		
Yes	17	85
No	3	15
Dealing with risk		
Control without notification	15	75
Co-ordination with authority	5	25
Determination of mortality causes		
Yes	20	100
No	0	0.0
Confirmation of the risk by laboratory		
Yes	15	75
No	5	25
Consideration of transportation		
To some extend	5	25
Using special vehicle	15	75
Nothing	0	0.0
Monitoring of chicks in farms		
Yes	20	100
No	0	0.0

estimations and sentry measures in place and are less stringent to achieve the appropriate level of protection. It was found that 100% of SSMO had limited standards for chicks importation, while the standards stated that samples should be taken from every consignment to monitor the immune response against only two diseases (Salmonellosis and Mycoplasmosis). OIE listed many other diseases, for example avian influenza (AI), etc. It was also found that 100% of the respondents stated that no lab diagnosis exists. The chicks were released without follow up and all respondents stated that AI is considered to be a high risk and did not list it in the Sudanese standard risk list.

According to the results, 55% of the airport quarantine staff received no training, in addition to 64.3% from the decision makers for Ministry of Livestock, Fisheries and Rangelands which stated that no strategic training was available, in spite that the training of veterinarians must have a high level of quality. There is need to train veterinarians to respond to new threats and to meet the new societal expectations at global, regional and national levels (OIE, 2011).

A quarantine station is very important at Khartoum airport with a lab for sample collection and testing and to compel the companies to put their consignments in it and should provide special transportation for the chicks to avoid disease spread by air. They must use air filters on vehicles and allow follow up by veterinarians working in the airport quarantine to visit importation sites and make sure shipments are disease-free before they distribute chicks to farms scattered in the capital, to avoid becoming a means for the transfer and spread of the disease. 85% of quarantine airport staff agrees with this suggestion.

CONCLUSION AND RECOMMENDATIONS

1. Regulations on chick importation should be made effective
2. The quarantine station and setup laboratory units and professional jobs in the quarantine of Khartoum international air port should be provided.
3. Staff of veterinarians at the airport quarantine should be trained and information on the issue provided.
4. Opportunities for veterinarians to participate in conferences to gain new experiences to develop the work should be provided.
5. Communication and coordination between the different parties or various bodies responsible for risk awareness and management should be provided.
6. Intersectoral approach should be to minimize disease risk.
7. A follow up and reporting system should be created.

Conflict of Interest

The author(s) have not declared any conflict of interests.

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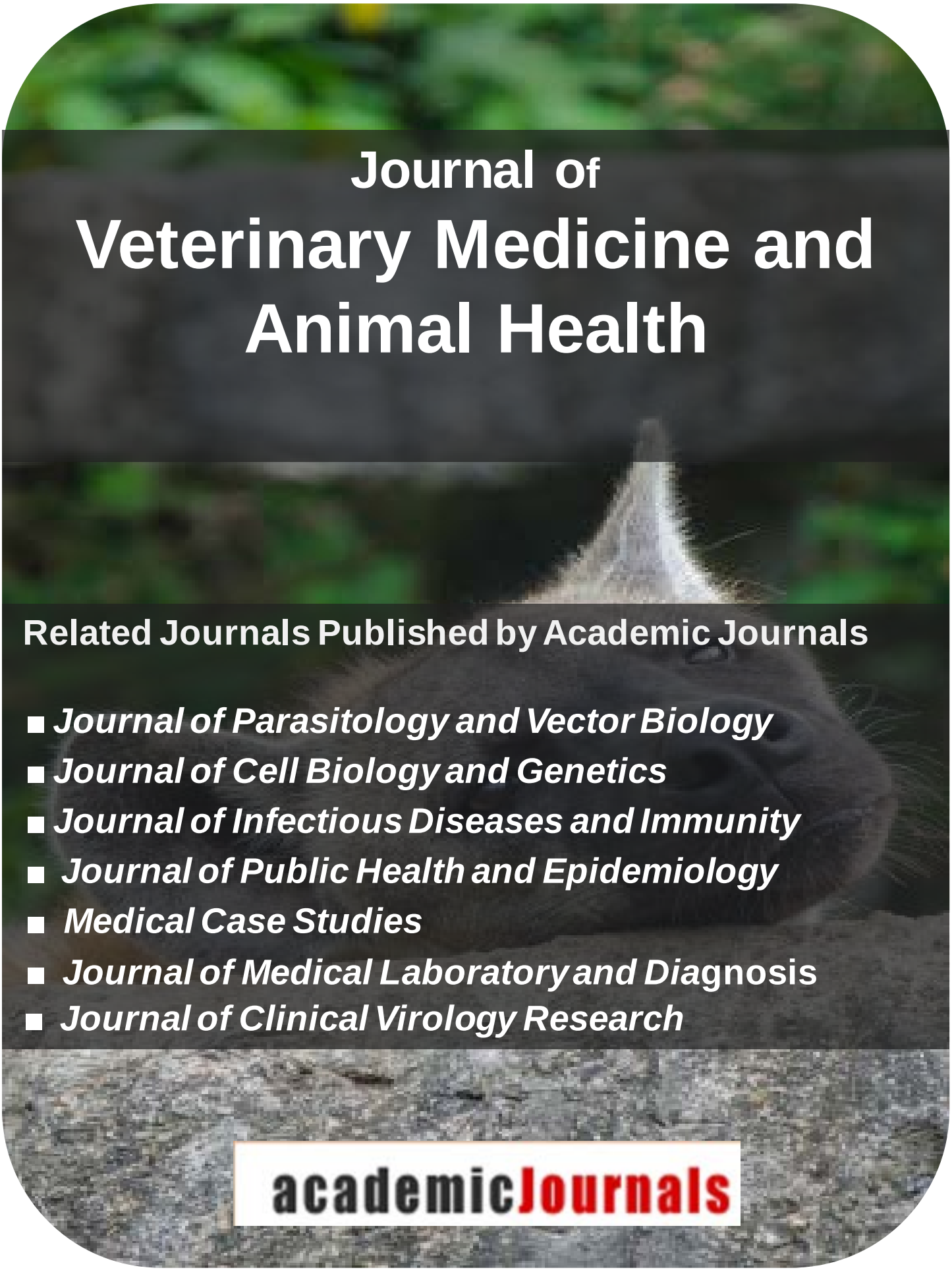

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