A REVIEW OF RABBIT DISEASES IN EGYPT

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ABSTRACT

Promising approaches of the Egyptian governmental as well as non-governmental society to rabbit industry to overcome the unemployment of youth in the society required more efforts from scientific institutes to help in development of such industry. Epidemiological studies are of outmost importance to highlight disease nature and to help in meantime implement of successful preventive and control measures. The aim of this paper is to review the situation of rabbit diseases of economic impact in Egypt (1952 to 2013). The review will highlight the viral infection of rabbit hemorrhagic disease, bacterial disease of colibacillosis, clostridiosis, salmonellosis, pasteurellosis, staphylococcosis and listeriosis and parasitic infection of coccidiosis and mange.

Key words: Rabbit, disease, bacteria, viral infection

ABSTRAK

TINJAUAN PENYAKIT KELINCI DI MESIR

Pendekatan yang menjanjikan dari pemerintah Mesir maupun non-pemerintah untuk industri kelinci dalam mengatasi pengangguran anak muda di masyarakat memerlukan lebih banyak upaya dari lembaga ilmiah untuk membantu pengembangan industri tersebut. Studi epidemiologis merupakan hal penting untuk menyoroti sifat penyakit dan membantu keberhasilan penerapan langkah-langkah pencegahan dan pengendaliannya. Tujuan dari makalah ini adalah untuk meninjau situasi penyakit kelinci yang memberikan dampak ekonomi di Mesir (1952-2013). Tinjauan ini akan menyoroti infeksi virus penyakit hemorrhagic kelinci, penyakit bakteri colibacillosis, clostridiosis, salmonellosis, pasteurellosis, staphylococcosis dan listeriosis, serta infeksi parasit dari coccidiosis dan kudis.

Kata kunci: Kelinci, penyakit, bakteri, infeksi virus

INTRODUCTION

There is a strong and continuing interest in the development of rabbit industry in Egypt. Rabbit industry as one of the small livestock has a unique commercial that can play a role in solving the shortage in the meat after poultry industry.

The most breeds that are reared in Egyptian rabbit farms are floundering, Belgian, French, Erks, Hi-plus, Native, New Zealand, Chinchilla, Gabali and Moshtohor. The system of housing of rabbits was battery and ground breeding systems (Khelfa et al. 2012).

Rabbit farming enterprises in Egypt are still unstable because they have experienced serious problems and the great attention is directed to the diseases causing economic losses to this industry (Saif-Edin et al. 1994; Diab et al. 2003).

Rabbits as other animals are exposed to several infection (bacterial, viral, parasitic and mycotic) and non-infection (toxins, stress, genetic and metabolic) agents resulting in various disease problems and economic loss (Ghanem and Ismail 1992; Eid and Ibraheem 2006).

Obviously the disease problem of rabbits differs greatly according to the age of the animal and the system of management. The interest of rabbit diseases returns to (1062-1161) when Ibn Zohr in Arabia, was the first to mention that the cause of skin itch was a minute animalcule known as scab (Hegazi 1978).

The losses from death around weaning in industrial rabbit are very high compared with other animals. There are many diseases facing young age of rabbits (pre and post weaning age). Enteritis is one of the major problems facing rabbitaries in Egypt, causing high mortalities.

Enteritis in rabbits may caused by parasitic and bacterial organism and they are the commonly recorded in Egypt. Clostridium species, *Escherichia coli, Staphylococcus aureus*, and Salmonella species usually were isolated from young rabbits (Eid and Ibraheem 2006). The bacterial isolates were more common at the

early weaning period rather than suckling period, altough may be found in adults. This may be attributed to stress at weaning and change of diet leading to increase ceacal pH (Bekheet 1983; Shahin et al. 2011). While, there is no or little investigation about the viral diseases causing enteritis in rabbits (such as corona and rotaviruses) in Egypt.

It is important to consider that Egyptian scientist's goal is the establishment of potential impact in improving rabbit industry. Many efforts are done over the years relevant to epidemiological studies of rabbit diseases as well as vaccine production and medication trials (Abd El Motelib et al. 1998; Khodeir and Daoud 2002; Hamed and Youssef 2013).

This paper will review the diseases that threaten rabbit industry in Egypt (1952-2013) in the light of available national literature.

PARASITIC INFECTION

Coccidiosis

Ahmed (1952) recorded five species of Emeria in rabbits to cause coccidiosis.The *Emeria stiedae* was the cause of hepatic coccidiosis and *Emeria magna, Emeria media, Emeria perforans, Emeria irresidua, Emeria exigua* were the cause of intestinal coccidiosis. The incidence of intestinal coccidiosis was higher than hepatic coccidiosis. He observed that the hepatic coccidiosis was more prevalent in 6-8 weeks of age than in adult rabbits.

In 1981, six species of *Emeria* sp were detected in fecal smears of rabbits in Dakahlia state, consisted of one hepatic, *E. stiedae* and five intestinal, *E. perforams, E. media, E. magna, E. irresidua* and *E. exigus* (El Masry 1983). The hepatic coccidiosis was manifested by rough hair, mild diarrhea, emaciation, constipation, hepatomegaly and enlarged abdomen, while postmortem lesions are enlarged liver, multiple abscesses, enlarged gall bladder and ascitis. However, intestinal coccidiosis induced profuse watery diarrhea, feces mixed with mucus and/or blood, dehydration and death, while postmortem lesions are enteritis; multiple greyish areas in the intestinal wall and white milky like material contents.

The endogenous cycle of the *E. magna* was investigated in germ free rabbits using light and electron microscopy. Visible pathological lesions were observed at 7 days in ileum which was amply pale and thick segmented mucosa. The first oocystic shedding in feces were seen at 152 hours (Ahmed 1983). (Taha 1952) reported that sporulation of *E. stiedae* sporocysts took place outside the host independent of the host. However, it depended on environmental temperature and relative humidity.

Haiba et al. (1955) studied the incidence of parasites in farm animals. Their results revealed coccidiosis occurred in 75.8% of the examined animals.

The first comprehensive clinical report of the faculty of Veterinary Medicine Cairo University (1960-1963) demonstrated that coccidiosis was one of the both diseases (mange and coccidia) that only found in rabbits during that period. Coccidiosis was also the common disease in 1964 and 1965 as mentioned in the annual reports (Hegazi 1978). Coccidiosis with a special reference to hepatic type still in the debate since 1985 until now.

The poor hygienic condition increased the incidence of coccidiosis and was found higher in young ages rather than in adults. This may due to the immunity to previous infestation lack of in young rabbits up to 8 weeks of age (Saad 1970). Seasonal incidence studies revealed that the hepatic coccidiosis reached its maximum rate during June and July with its peak in August after which it declined till it reached to its minimum in November and December (Hamed 1988).

Treatment of hepatic coccidiosis with toltrazoril during early stages of infection prevents the appearance of most clinical signs on rabbits (Mohamed 1997). Abd El Rahman (1979) studied the effect of three anticoccidial drugs in naturally infected rabbits with hepatic coccidiosis, the result concluded that darvisul (diaverdine and sulpha quinoxaline) in 0.25 ml/kg body weight dose for 8 days as well as whityns (pyrimethamine and sulpha quinoxaline) on 0.07ml/kg body weight for 9 days are effective to treat of hepatic coccidiosis.

Kutkat et al. (1998) immunized rabbits against liver coccidiosis by subcutaneous inoculation with 1 ml of sporulated *E stiedae* antigen extract which partially protected rabbits against hepatic coccidiosis as estimated by the percent of protection as well as reduction of oocyst number output post-challenge.

In naturally affected rabbits, Fahmy et al. (1985) and Ibraheem (1999) recorded that emaciation and bloody diarrhea soiled the perianal region and hind quarters. On necropsy, enlarged liver with grayish white spots of irregular size and shape and congestion of intestinal mucosa with presence of a mount of yellowish bloody exudates were observed. Moreover, ascites was seen in experimentally infected rabbits with *E. stiedae*. The gall bladder was enlarged and distended with biliary secretion and the kidneys were enlarged and congested as well (Mekawy 1997).

Helmy (2002), evaluated the counter immune electrophoresis CIEP and ELISA for serodiagnosis of *E. stiedae* in experimentally infected rabbits. He succeeded to detect antibodies against *E. stiedae* as early as 9th day of infection which peaked at day 10

using ELISA with gradual decrease up to 30 days. While CIEP was positive from 5 days up to 30 days post infection. He concluded that CIEP is easier, more rapid and sensitive for diagnosis of hepatic coccidiosis in rabbits.

Rabbit mange

The economic importance of mange among rabbits in Egypt came next to coccidiosis, where the body mange was more propagated and less serious than the ear mange which seemed to be more serious (Ezzat 1955).

The first comprehensive clinical report of the faculty of veterinary medicine Cairo University in 1957 indicated that rabbit mange in its two forms was common and was found in relatively variable incidence. Subsequent reports (1960-1963) demonstrated that mange was one of the both diseases (mange and coccidia) that only found in rabbits during that period, and the body mange was rare as compared with ear mange. In 1964 report mange became the most common among rabbit diseases (Hegazi 1978).

In a previous study, Saad (1970) observed both forms of mange in rabbits, and mentioned that body mange is more frequent while ear mange was less frequent.

Seasonal incidence of mange in rabbits was investigated by Hegazi (1978), concluded that the body mange (*Sarcoptic acarines*) reach its maximum incidence from May to July with its peak in August after. Then it declined to its minimum in October to December and with almost absence in January. Similarly, the ear mange (psoroptic) cases fluctuated in the same above seasonal body picture.

The authors observed that the young rabbit are more susceptible than the adult ones and baladi species were the most affected breed to *S. acarines* followed by Boskat, chinchilla. Rashed (1993) reported comparable findings about body and ear mange.

Toxoplasmosis

Seroprevalence of *T. gondii* antibodies among rabbits reared under both extensive and intensive management system was studied using indirect HA test and modified agglutination tests. Antibodies were detected at a titer of 1:80 up to 1:2560. Indirect HA in infected animals. While modified agglutination gave titers 1:500-1:1000 appeared more sensitive (Al Araby 2008). Females infected 8-20 days before mating showed failure of pregnancy. On the other hand infected males showed depression or no sexual desire and refuse females.

Experimental infection of rabbit male and female with *Toxoplasma gondii* revealed that infection of female at first third of pregnancy showed early embryonic death and resorbtion while in the second and third semesters of pregnancy, abortion occurred.

Helminthiasis

Abu El khair (1994) investigated the presence of helminth in rabbits. He recorded that *P. ambiguous* was 13.37% and *C. pisiformis* 2.88% with a peak of 20.91% in spring.

BACTERIAL INFECTION

Colibacillosis

E. coli was the most prevalent species among bacterial organisms that causing enteritis and mortalities of rabbits. Colibacillosis has several syndromes and it is associated with biotypes *E. coli*.

Neonatal diarrhea with high mortality due to severe yellowish diarrhea and dehydration is caused by highly virulent *E. coli* (O109:H2). However, the disease is characterized by moderate to high losses among weaned rabbits (O103:H2 and O15:H), mild diarrhea, loss of weight, lower mortality caused by low virulent *E. coli* (O123, O128 and O132). Sadek and El Agroudi (1963) isolated *E. coli* O128 from affected rabbits with diarrhea.

There are many serotypes of *E. coli* were isolated and identified by several workers in Egypt from rabbits suffering from enteritis or mucoid enteropathy as serotypes O55, O119, O126 and O128 were recorded in case of enteritis in rabbits, serotypes O55 and O126 were highly pathogenic, while serotypes O119 and O128 were non or less pathogenic Saad (1970) and Bekheet (1983), who isolated *E. coli* serotypes O126, O128, O125 and O119 from diseased rabbits and also concluded that O128 was less virulent strain. As well, the *E. coli* serotypes O109, O103 and O15 were firstly isolated from rabbit in Egypt (Fetaih 1985).

Moreover *E. coli* serotypes O78, O111, O44, with other bacterial agents; *S. dublin* and *S. newport, Pr. mirabilis, Enetrobacter cloacae, Klebsiella pneumoniae* and *Citrobacter freundii* which were recorded for the first time from rabbits in Egypt. The O26 of *E. coli* was highly pathogenic caused 80% mortality among affected animals (Abd El Gwad 1988). Later on, Saif-Edin et al. (1994) isolated *E. coli* serotypes O85, O119, O101 and O78 from rabbits at 4-8 weeks old suffering from diarrhea with high mortality rate up to 70-78%. *Proteus mirabilis*, klebsiela and citrobacter were also isolated.

Frequent isolation of different *E. coli* serotypes from affected rabbits including O55, O128, O126, O119, O78, O44, O111, O114, O26, O75, O103, O145 and O158 was reported by many authors (Abd El Azeem 1995; Abbas 2002; El Bakrey 2009; Hassan & Abd Al Azeem 2009; Shahin et al. 2011)Thickened wall with paint brush hemorrhages in small intestine and mesenteric, lymph nodes are the common gross lesions of the disease.

Clostridial infections

Clostridia species are incriminated in the induction of enteritis problem in rabbits with high occurrence percentages. There are different types of Clostridial species circulating in weaned rabbit, farms at different Egyptian governorates.

Clostridial enterotoxaemia refers to enteropathy (enteritis) caused by toxigenic microorganism of the genus clostridium which characterized by diarrhea and sometimes sudden death. The main etiological agents are *C. perfringens, C. spiroforme* and *C. difficile.*

Ali et al. (1994) isolated *C. perfringens* types A, type D and type E, from diseased rabbits of 1-3 months of age and the type A was most common finding and highly fatal especially when associated with coccidia. Also Saad (1994) reported that *C. perfringens* causes high mortality rate among kids at weaning age (3-4 weeks), causing severe economic losses in commercial rabbit farms in Egypt.

Different clostridia including *C. perfringens, C. spiroforme* and *C. difficile* were isolated from diarrheatic post-weaned rabbits at 4-6 weeks old, and *C. perfringens* (Ibraheem 1999).

Weaned rabbits were seriously affected by clostridia species infection (2003-2012). Mucoid enteropathy outbreaks were observed in different rabbit farms in Egypt in 2010. *C. perfringens* type A was isolated from caecum of affected rabbits which died suddenly after short illness with severe diarrhea (Diab et al. 2003). *C. perfringens* type A, C, D and B were detected using multiplex PCR and the most predominant strain was *C. perfringens* type A (El Bakrey 2009). The high incidence of clostridia infection at 2-3 months old rabbits was (78.4%) (Lebdah and Shahin 2011). Beside *C. perfringens* which constituted the highest incidence, other clostridia species; C. *tertium, C. sporogenes, C. bifermentans, C. septicum, C. difficile* were also detected in affected rabbits (Khelfa et al. 2012).

The most commonly recorded clinical signs in naturally infected early weaned rabbits with clostridial organisms at different Egyptian governorates were severe bloat associated with offensive odour, doughy brownish and/or yellowish diarrhea that soil the regions around anuses and hind quarters, swollen belly, impacted caecum and off food, inability to walk, depression and ruffled fur. In late stages of the disease, dehydration, emaciation and deaths among all ages especially young animals are common (El Bakrey 2009; Lebdah and Shahin 2011; Khelfa et al. 2012).

Post-mortem lesions of *Clostridial enteritis* in the freshly dead rabbits were severe enteritis, typhlitis, ballooning with offensive odour doughy brownish or bloody stained contents mixed with gases, different degrees of necrosis and hemorrhages of the mucosa. The liver showed congestion, enlargement with sub-capsular hemorrhages, necrosis especially at its margins and friability as well as distended gall bladder. The kidneys were congested and enlarged and the urinary bladder was distended with urine (Khelfa et al. 2012).

It is believed that clostridia vaccine could be suitable to minimize or prevent severe losses due to enterotoxaemia in the rabbits. The rabbit clostridial enterotoxaemia bloat vaccine has been produced from a locally isolated toxigenic strain of *C. perfringens* type A and prepared for the first time in Egypt in the Anaerobic Department at Veterinary Serum and Vaccine Research Institute. The vaccine induced a good protection against the disease for 5 months (Diab et al. 2003).

Salmonellosis

Salmonella is unusual cause of enteritis in rabbits, salmonellosis in rabbits is characterized by acute enteritis, rapid death, while pregnant does commonly abort. The *S. enteritidis, S. mbadaka, S. sheidelburg S. typhimurium* and *S. pullorum* were isolated from rabbits at weaning (Saad 1970). Moreover *Salmonella dublin* and *Salmonella newport* were recorded for the first time from rabbits in Egypt (Abd El Gwad 1988). Salmonella caused high mortality may reached 80% in rabbits at 4-8 weeks old (Saif-Edin et al. 1994).

(Abd El Azeem 1995) reported that *S. typhimurium* represented a high percentage of bacteriological diseases infecting young rabbits (1-4 weeks) with a significant bad impact on production of rabbit's farms. Salmonella species*; S. arizona, S. typhimurium* and *S. dublin* were also isolated from rabbits suffering from enteritis (Ibraheem 1999). Abortion, infertility, and even sudden death may threaten rabbit breeder farms.

Pasteurellosis

Pasteuerelosis induce variable clinical pictures depending on age, stress factors as well as concurrent infections. depression, inappetence, decrease water intake and occunasal discharge, sneezing, coughing

(snuffles), conjunctivitis, rhinitis, subcutaneous abscess with severe emaciation and variable mortalities, mastitis, infertility with discharges from urogenital opening were the commonly observed clinical signs (Eid and Ibraheem 2006; Suelam and Abdel 2011; Awad 2013)

Septicemia and congestion and ulceration of nasal mucosa, hemorrhages in lungs beside frothy exudates in trachea, multiple abscesses in lungs, s/c tissue, pymetria, presence of inspirited pus in the deeper structure of ear and congested brain were recorded. Other pathological changes like hemorrhagic exudates in the thoracic cavity, pneumonia with partial adhesions of pleura to lung surface, congestion of liver and subcutaneous abscesses were also observed in pasteuerella infected rabbits.

Abd El Motelib (1982) isolated *Pasteurella. lepiseptica* (12 isolates), 11 were type A and one was type D from rabbits of variable ages (1-24) months. The isolates were highly pathogenic to rabbits on experimental infection. Further more, Fahmy et al. (1985) recorded Pasteurella species incidence (14-100%) among the affected rabbits of different ages.

Gergis et al. (1992) reported that *Pasteurella multocida* is one the most important pathogens inducing respiratory problems in rabbit farm in Egypt which essentially strike the breeding adults. Pneumonia regularly is a clinical disease accompanied by deaths with incidence ranging from 51-59%. The causative bacterial agents of pneumonia. *P. multocida* was the most frequently isolated bacteria in single bacterial infection while *Bordetella bronchiseptica* was more common in mixed infection. The serotyping of the isolated *P. multocida* strains from rabbits suffered from respiratory disease or pneumonia revealed that capsular type A was present with high incidence. However, capsular type D was lower incidence. Somatic typing revealed the presence of seven O groups 1, 3, 4, 7, 9, 11 and 16.

A comprehensive study to investigate the pasteurellosis and its initiating factors among rabbits was carried out in Upper Egypt (Abd El Motelib 1993). Eid and Ibraheem (2006) investigated sudden death among rabbits in Sharkia province. They found that deaths were mostly observed in spring and sometimes in winter. Bacterial isolation incidence was 95.5%. *Pastereurella mulocida* was isolated from 36.4% with other microorganism; *E. coli, Bordetella bronchiseptica, Staphylococcus aureus, Erysipelas rhusiopathiae, Streptococcus faecalis*, colistridium species, salmonella species and *Pseudomonas pseudomalie.* The highly virulent strain of *P. multocida* infection was increased with advancing age reaching nearly 100% in adults more than 5 months of age.

In vitro sensitivity test indicated that oxytetra cyclin and chloramphenicol were highly effective on isolates, while streptomycin, ampicillin, erythromycin and penicillin and nitrofurans were moderate efficiency. Neomycin and sulpha methoxazole were the least effective drugs (Abd El Motelib 1982).

In Egypt, polyvalent vaccines were from the most commonly isolated pasteurella serotypes from infected rabbits. The vaccines have a great value in the protection of rabbits against pasteurellosis. Two forms of rabbit pasteurellosis inactivated vaccines in Egypt, formalized and oil adjuvant one used as a primary and boostering purposes, respectively.

The bacterine containing serovars A: 3, A: 12 and D: 11 of *P. multocida* protected rabbits against pasteurella infection (Gergis 1994). Ten years later a newly aluminium hydroxide gel adjuvant rabbit pasteurella vaccine (ALV) was prepared. Its protective effect in comparison to aqueous formalized AV and oil adjuvant vaccines in routine use against pasteurellosis in commercial rabbit farm was studied. After evaluation the vaccines in rabbits under field conditions in private rabbit farm, they recorded that two doses of the new vaccine is at least equal to the usage of formalized AV boostered with oil vaccines (Zyan et al. 2004).

Recently, Awad (2013) prepared an oil adjuvant autogenously bacterium from three *P. multocida* local strains (PS/R/BB/3,1/009; PS/R/2G/26,1/010 and PS/R/HH/28,2/011). The vaccine induced higher protection (80-100%) than the commercial one (60-80%)

Staphylococcosis

There is limited data on rabbit Staphylococcosis in Egypt. In spite of its importance as a common isolated micro organism from rabbit farms the disease is usually sporadic and has little interest from investigators and veterinarians. Staphylococcus infection was reported accompanying variable clinical features in rabbit farms in Egypt. El Ghawas (1972) investigated the bacterial flora of the respiratory tract of rabbits in health and disease, the results revealed *S. aureus* (23.08%) and *S. epidermidis* (6.16%) were detected. However, infected animals revealed *S. aureus* (13.33%) and *S. epidermidis* (8%).

S. aureus was also isolated from intra-abdominal abscess in rabbit after surgical removal (Nassef and Shahata 1988). Intra-abdominal abscess might be attributed to microorganism from viscera to the surroundings or through perforation of the abdomen with sharp foreign body.

In 1991, *Staphylococcus mastitis* in domestic rabbits was recorded in Assiut province. The animals showed swelling and redness of skin and mammary gland together with reduction of food intake, ruffled fur and 100% losses in suckling rabbits. Animals abscess

were observed in subcutaneous and mammary gland with loss of suckling 30-50%. Six strains of B-hemolytic coagulase-positive. *S. aureus* was isolated from infected lactating does and their suckling rabbits. The pathogenicity of the isolated *S. aureus* was evidenced by experimental infection (Abd El Motelib and Salem 1991).

S. aureus is one of common pathogens found in breeders which causes mastitis in the teats, inflammation in uterus and abscess or dermatitis in broiler rabbits and this resulted mortality of young rabbits and newly born. It is very important to improve hygiene and nutrition as well as early recognition of this severe form of Staphylococcosis by practitioners are of great value for avoidance further spreading of rabbit pathogenic (Abd El Gwad et al. 2004).

S. aureus was isolated from rabbits suffering from respiratory stress, from infecting lactating does and their suckling rabbits, also from an intra-uterine site of adult female pregnant rabbits with metritis and fatal death and rabbits with intra-abdominal abscess (Abd El Motelib and Salem 1991; Ali 1991)

Staphylococcus septicemia was recorded in young rabbits. Congestion with petechial hemorrhages in internal organs as liver, lung, spleen, kidneys, heart and intestine in young rabbits were in seen in freshly dead animals, while abscessation of lungs, liver, and subcutaneous are the common in adult rabbits. In few cases endometritis with mucopurulant inflammation of uterus in female pregnant does also were observed (Girgis et al. 2003; Abd El Gwad et al. 2004). However, the death rate during the fattening period is not usually higher than normal (Hamed and Youssef 2013).

In a recent study Hamed and Youssef (2013) found that all *S. aureus* isolated from rabbits were multi-drug resistant (MRSA) strains; methicillin and cloxacillin resistant. Vancomycin and oxytetracycline also were resistant in 91.66% of strains, followed by sulbactin and ampicillin, erythromycin, trimethoprim and sulphamethoxazole, gentamicin, clindamycin and ampicillin showed a marked resistant to the *S. aureus* isolates by percentage 66.66% or more. Marked sensitivity was shown to colistin, amoxicillin-claveulinic, Penicillin, cefotaxime and ciprofloxacin. So, antibiotic resistance could be a factor of failure of curing the herd by different antibiotic administered.

Clinical diseases, particularly, high mortalities and infertility of rabbits caused by of methicillin-resistant *S. aureus* (MRSA) with dissemination to environment and contamination of rabbit meat shed the light on its impacts on rabbit production and public health in Egypt. Thus, large-scale epidemiological investigations of HV-SA in rabbit farm in Egypt are needed.

Listeriosis

Abd El Motelib et al. (1990) also isolated the microorganism in Assiut province from affected rabbits suffering from nervous manifestation, eye lesions, infertility with petechial hemorrhages in uterine horns and nodules formation in lungs. Poor appetite, depression, ruffled fur, diarrhea, respiratory signs, eye affection, emaciation and death. in addition to abortion and bloody stained vaginal discharge as well as delayed parturition and/or delivery of week foetoes that died within 24 hours post-partum are the commonly clinical signs observed in affected animals. Conjunctivitis and complete blindness also can occur.

Galli (1970) isolated 15 strains *Listeria monocytogenes* from 7 outbreaks of listeriosis in rabbits. A little interest was given to listeriosis until the 1980s, when (Abd El Waneas 1985) isolated 14 strains of *L. monocytogenes* out of the 70 rabbits in 14 flocks. The highest rate of bacterial re-isolation of experimentally infected rabbits with *L. monocytogenes* was from uterus followed by liver, fetuses, kidney, heart, urinary bladder and zero percent from brain and spleen. Only 4 strains were belonged to polyvalent 1-4 O and H antisera.

On necropsy, severe congestion was seen in liver, spleen, lungs, kidneys, uterus and brain with engorged mesenteric blood vessels, urine retention as well as abscess formation are observed in some affected animals is microorganism was sensitive to oflaxacin, erythromycin, gentamicin, norfloxacin and ciprofloxacin. The treatment with gentamicin and oflaxacin showed improvement in health condition after experimental infection with listeria monocytogenes (Awad 2009).

VIRAL INFECTION

Rabbit Hemorrhagic Disease (RHD)

The year of 1991 marks as a historic event in Egypt, the introduction of a new disease severely threaten rabbit industry due to Rabbit Hemorrhagic Disease (RHD). RHDV is a destructive agent for industry through economic losses in rabbit production in Egypt due to high morbidity and mortality (Mohamed 2009; Fahmy et al. 2010). The disease outbreak was first reported during spring of 1991 in Sharkia province with heavy losses 90% (Ghanem and Ismail 1992). Subsequent disease occurred in Kaluobia province (Sharawi 1992). The disease was also reported Assuit Province during winter of 1992 (Salem and El Ballal 1992). In 1993, the disease

was recorded in Minia and Sohag provinces with mortality rate of 26.7 up to 100% of the affected rabbits (El Zanaty 1994).

Abd El Ghafar et al. (2000) reported that RHDV particles have characters resembling that of calicivirus in its morphology and cytopathology and also recorded incoordination, convulsion and epistaxis with vaginal bloody discharge of impact rabbits.

The clinical signs of disease were characterised by depression, anorexia, pyrexia, rapid respiration and epistaxis. Hemorrhagic foamy discharge from the nostrils and vagina were observed in some cases. The mortality rate ranged from 75-100%. It was common that infected RVD, rabbit died suddenly without any clinical manifestations.

The postmortem findings in naturally infected rabbits included hemorrhagic rhinitis with muffle of bloody stained and frothy exudates in trachea, bronchi and bronchioles. The lungs showed characteristic punctuate hemorrhages and blood tinged fluids were seen in thoracic cavity. Liver was congested friable with reticular pattern of necrosis. Minute hemorrhages were seen in visceral organs and lymph nodes. The brain and intestinal tract were seen congested and hemorrhagic.

As soon as in 1992, trials of RHDV vaccine preparation were adopted by Salem and El Ballal (1992) who prepared inactivated formalized tissue vaccine from liver and lung suspensions of rabbits which were previously infected with RVHD virus, rabbits were protected by seven days after vaccination and immunity lasted for more than two months and Salem and El Zanaty (1992) also succeeded to use the in activated tissue derived RHDV vaccine in prevention of the disease. An inactivated RHDV vaccine from the local isolate of RHDV (Egypt 96) by 0.4% formalin at 37^{o}C/48 hours adjuvant with aluminum hydroxide and rabbit pasteurellosis and RHDV combined vaccines were also used. (Daoud et al. 1998a; 1998b and Abd El Motelib et al. 1998)

In 1993, administration of hyper immune sera by intra muscular route in 4 months of age rabbits either simultaneously with the RHDV or before its injection with the virus gave 100% protection against RHDV (Abd El Motelib 1993). In spite of the availability of RHDV vaccine, several outbreaks of the disease were recorded along subsequent years until now. Relax in vaccination or even its absence especially in small scale and backyard rabbit farms were the main cause of the disease persistence.

The RHDV cytopathogenicity, on the Vero cell culture took about 7 days at the first passage and decreased to 3 days at the 4th passage (Mostafa 2001). These studies initiated Khodeir and Daoud (2002) who prepared an inactivated a cell culture vaccine of RHDV on Vero cell which was more potent than local liver suspension vaccine (tissue derived RHDV), then in 2005 they prepared bivalent vaccine from RHDV and *P. multocida* lipopolysaccarides (Khodeir and Daoud 2002). A new turn in history of the disease is the record of RHDV breaks in vaccinated rabbits. Some authors attributed the event to emergence of new or modified viruses, however, others suggested that vaccine failure is the question.

Metwally and Madbouly (2005); Abd El Lateff (2006); Ewees (2007); El Sissi and Gafer (2008) recorded RHDV outbreaks in vaccinated flocks. Although the causative virus was HA positive but it may be of different strain. Eid and Ibraheem (2006) reported that both commercially used vaccines against RHDV (IZOVAC-MEVAX and SVRS-Vac) equally provided 100% protection of vaccinated rabbits at the age of 1.5 month against RHDV infection.They concluded that the endemic status of the disease in Egypt along two decades resulted in earlier age susceptibility (40-60 days of age) and so the vaccination regimen (2 months and older) became late. They solved the problem by a new vaccination regimen suitable for endemic areas that start as early as (1-1.5) months of age with booster dose 15 days later and every 4-6 months vaccine was repeated. As well they reported that the rabbit infected with RHD, showed epistaxis, anorexia, dullness, nervous and respiratory signs, the mortality rate reached about 67%.

However, reports about different or variant RHD viruses were issued since 2007. (Ewees 2007) detected more than Egyptian rabbit hemorrhagic disease virus strains and El Sissi and Gafer (2008) recorded that some rabbit hemorrhagic disease (RHD) outbreaks in different governorates in Egypt caused by variant strain of RHDV (RHDVa) which caused high morbidity and mortality with similar clinical symptoms, PM and pathogenicity to that of the other RHD outbreaks, but the isolated virus lacked hemagglutinating (HA) activity while they confirmed to be rabbit hemorrhagic disease by other techniques. So, they provide that HA-negative RHD strains are circulating in Egypt and the non-HA strain is probably an antigenic variant of RHDVa.

No variation in susceptibility of affected breeds and seasons, rabbits less than two months are resistant to the infections while females particularly those pregnant or lactating were more susceptible to infection (El Sissi and Gafer 2008).

El Mongy (1998) recorded 25 outbreaks of RHDV in rabbit farm during the period of 1992-1994 in six governorates of Egypt (Giza, Cairo, Marsa-Matroh, Kalubia, Kafr-El-Sheikh, Dakahlia and Gharbia). The presence of the virus was evidenced by HA, HI, Electron microscope on liver homogenates, RK-13 cell line culture, indirect IF test, analysis of the structural protein by SDS-PAGE, western immunoblot concluded

that the RHDV adversely affects the liver, kidneys, spleen and lungs, leading to high mortalities (62.5%) which were reduced to 0-13.3% with vaccination.

CONCLUSION

Rabbit industry in Egypt is promising to be developed and can play a positive impact on national economy in Egypt. Considerable efforts have done in epidemiological studies to highlight the nature of rabbit diseases and control measures and immediate planning for national survey to review the current rabbit problems. Based on findings of such study, a new effective strategy for rabbit industry development will be implemented. Hence, a national committee consisting of representatives of agencies with legislative responsibility for assessing and improving rabbit industry should be established.

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