Review Article

Parasite Fauna of Ostriches, Emus and Rheas

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Abstract

In most parts of the world ratite farming (i.e. farming of ostriches, emus and rheas) is a new field of livestock production. These birds are livestock with broad utilisation of their products. Both wild and captive ostriches, emus and rheas may be infested with their own specific parasites as well as with external and internal parasites of other birds and animals. *Eimeria* spp. (protozoa), *Houttuynia struthionis* (cestoda) and *Libyostrongylus douglassii* (nematoda) belong to parasites causing the most serious economic losses in ratites in the world. As farming of these big birds is still in the beginning, many years of research and development are necessary to reach levels of medical and technological progress that is nowadays practised in poultry industry.

Keywords: ratite farming; endoparasites; ectoparasites; coprology; treatment; *Struthio camelus*; *Dromaius novaehollandiae*; *Rhea americana*; *Pterocnemia pennata*.

INTRODUCTION

Ostriches (*Struthio camelus*), emus (*Dromaius novaehollandiae*), greater (*Rhea americana*) and lesser rheas (*Pterocnemia pennata*), are big flightless birds, very good runners, scientifically called ratites because of the absence of the keel of the breastbone (Deeming, 1999; Dingle and Shanawany, 1999).

Wild ostriches are confined to the drier parts of Africa, generally from south of the Sahara to Cape Province, extending also to southern Morocco, the northern Sudan and southern Egypt (Dingle and Shanawany, 1999). Emus can be found in most parts of Australia, ranging from coastal regions to high in the Snowy Mountains, and they live in a wide variety of habitats (Del Hoyo et al., 1992). The different subspecies of greater rheas are distributed through Argentina, Bolivia, Brazil, Paraguay and Uruguay (Sales, 2006). They live exclusively on the open plains.

In most parts of the world ratites are quite a new field of livestock production (Nemejc, 2007) and it has not yet achieved sufficient volume to provide meaningful data for many studies. Ratite farming is still in its infancy compared to the poultry industry, and many years of research and development are needed in order to reach levels of medical and technological development similar to those found in poultry farming today. Preventive medicine, public health and welfare are the most necessary issues in the future development of ratite production.

RATITE PARASITES

Both internal and external parasites affect ostriches (Jefferey, 1996). Usually careless management, high bird

density as well as poor hygiene contribute to parasitic infection (Chang Reissig et al., 2001). The prevalence of internal parasites in hand-raised ostriches is low in comparison with pasture-raised or free roaming birds. In commercial ostrich operations, the eggs are incubated artificially and the chicks are raised in segregated flocks. This separates the chicks from potentially infested adult birds, thus interrupting the life cycle of most internal parasites (Dingle and Shanawany, 1999).

Ostriches may be infested with their own specific parasites as well as with external and internal parasites of other birds, some parasites of ruminants and raccoons (Eslami et al., 2007).

In emus, parasites are not a common problem although some farms found it necessary to treat for these (O'Malley, 1998).

Lesser rheas have only been raised on farms in recent years; therefore information about parasitic diseases of farmed lesser rhea is scant (Chang Reissig et al., 2001).

The economic impact of most of ratite parasites is still undetermined. Further detailed analyses are needed to determine not only the host-specific status of ratite parasites, but also the risk of infection for other animals and humans (Ponce Gordo et al., 2002).

INTERNAL PARASITES

Parasites of the digestive system (proventriculus, gizzard, small intestine and large intestine), as well as those of respiratory and circulatory systems infest ratites. No parasites of the nervous system of veterinary importance were reported in them (Taylor et al., 2007).

Most of the parasites are of minor economic importance; however, some of them have been recognized as causing serious losses (Dingle and Shanawany, 1999).

Protozoa

A number of intestinal protozoans, including *Hexamita*, *Giardia*, *Trichomonas*, *Cryptosporidium* (Deeming, 1999; Chang Reissig et al., 2001; Cooper, 2005), and *Toxoplasma*, have been isolated from ostrich chicks. Often, they cause serious diarrhoea in ratites. Metronidazole at 10 mg/kg, orally, should be administered as a treatment (Jurajda, 2002; Cooper, 2005).

There are at least two *Cryptosporidium* species infecting ostriches. *Cryptosporidia* complete their biological cycle on the surface of epithelial cells of the digestive and respiratory system of birds, mammals and reptiles (Ponce Gordo et al., 2002; Santos et al., 2007). In ostriches, unidentified species of *Cryptosporidium* spp., have been shown to infect the bursa, the rectum and the pancreas of ostrich chicks and they are considered to cause prolapse of the penis in young ostrich males. They have been diagnosed in ostriches in South Africa as well as in ostriches imported to Canada. The infection is diagnosed histopathologically on section of the affected organs or by identification of oocysts in faecal samples (Deeming, 1999; Jurajda, 2002). Functional intestinal microflora is considered the best defence against cryptosporidia (Jurajda, 2002).

Coccidiosis is common in emu chicks (Jurajda, 2002). No cases of coccidiosis in farmed ostriches have ever been confirmed. According to Deeming (1999) no outbreaks of coccidiosis in farmed ostriches have been documented although an *Isoospora struthionis* has been described from an ostrich in a Russian zoo. Chang Reissig et al. (2001) observed *Eimeria* spp. oocysts in faecal samples of lesser rheas.

Infected birds generally exhibit loss of appetite, weakness, ruffled feathers, their droppings may contain blood. Symptoms are usually minimal in ostriches and infection can only be properly diagnosed by post-mortem examination (Dingle and Shanawany, 1999).

Regular use of anti-coccidial drugs is the best treatment. Increased dietary levels of vitamin K as well as sulphonamides and vitamin A supplements make the recovery faster if outbreaks occur. Ammonia fumigation of buildings appears to be an effective control of coccidiosis (Dingle and Shanawany, 1999).

The flagellate *Histomonas meleagridis* (blackhead) is a parasite of turkeys and other gallinaceous birds causing inflammation of caeca and liver. It may infect ostriches in close contact with such birds and cause a similar disease (Deeming, 1999; Jurajda, 2002). Histomoniasis infection can be controlled with furazolidone and treated with

metronidazole and by the periodic examination of the faeces (Jefferey, 1996).

A *Trichomonas* (a flagellate) infection can be acquired by ostriches via contact with pigeons and doves. It causes pseudomembraneous lesions in the upper digestive tract (Deeming, 1999; Jurajda, 2002).

Flagellate infections are treated by individual dosing with dimetridazole (50 mg/kg body mass) (Deeming, 1999; Jurajda, 2002) and prevented by strict separation of ostriches from poultry, pigeons and wild birds (Deeming, 1999).

Balantidium struthionis is a ciliate and a common inhabitant of ostrich intestines, probably capable of becoming somewhat pathogenic under favourable conditions. Its cysts could also be mistaken for coccidial oocysts (Deeming, 1999; Jurajda, 2002). The same is pronounced in case of *Blastocystis* sp. (Jurajda, 2002).

Under favourable circumstances, ostriches are susceptible to infections with avian species of *Plasmodium* spp., a parasite of the circulatory system, transmitted by mosquitoes (Deeming, 1999; Jurajda, 2002; Cooper, 2005).

Leucocytozoon struthionis, a parasite of the circulatory system, is transmitted by arthropods (blackflies) and commonly infects ostrich chicks in South Africa - mostly without causing clinical disease (Deeming, 1999; Cooper, 2005; Taylor et al., 2007). Treatment and control has not been reported yet (Taylor et al., 2007).

Cestoda

The tapeworm (*Houttuynia struthionis*) belongs to a genus of tapeworms in the family *Davaineidae*. It is a parasite of the small intestine, and the exclusive and major endoparasite of the ostrich and rhea. *Houttuynia* causes unthriftiness and diarrhoea mainly in chicks (Blood et al., 2007; Jurajda, 2002). Frequent occurrence of this tapeworm is in chicks and pasture-raised ostriches in South Africa (Dingle and Shanawany, 1999; Jurajda, 2002).

The tapeworm has also been spread to Europe with ostriches imported from Africa and it was diagnosed sporadically in the USA, too (Jurajda, 2002; Cooper, 2005).

They are long, large, flat, segmented, white worms of about 50 to 100 cm in length and deprive the bird of food (Deeming, 1999; Dingle and Shanawany, 1999).

The life cycle and intermediate host of this tapeworm is unknown (Deeming, 1999; Jurajda, 2002; Taylor et al., 2007).

Ostrich chicks are the most susceptible and show signs of infestation very slowly: gradual loss of condition, lethargy and anaemia, loss of appetite, sometimes accompanied by mild diarrhoea (Dingle and Shanawany, 1999; Taylor et al., 2007).

Diagnosis is made by observing mature tapeworm segments looking like white grains of rice in the faeces,

by observing eggs in faeces and by flotation laboratory techniques (Dingle and Shanawany, 1999; Cooper, 2005).

Treatment is fenbendazole (i.e. Panacur 2.5%), the dosage 15 mg/kg, orally, for 5 days (Jurajda, 2002), fenbendazole (Panacur 2.5%) at the dose of 25 mg/kg after Dingle and Shanawany (1999) or with resorantel (130 mg/kg), niclosamide (100 mg/kg per orally), praziquantel (7.5 mg/kg) orally (Deeming, 1999; Dingle and Shanawany, 1999; Cooper, 2005; Taylor et al., 2007) or oxfendazole 5 mg/kg orally (Jurajda, 2002; Cooper, 2005).

In Argentina, the anoplocephalid cestode *Monoecocestus rheiphilus* was identified in *Rhea americana* (Uhart et al., 2006).

Nematoda

The wireworm (stomach worm) - *Libyostrongylus douglassii*, a parasite of the digestive system causing libyostrongylosis (gastric verminosis, "rotten stomach"), is the economically most significant gastrointestinal parasite of ostriches, causing serious losses. It belongs to a genus of nematodes in the family *Trichostrongylidae* (Yaman and Durgut, 2005; Blood et al., 2007; Taylor et al., 2007).

Wireworms are very small, round, wire-like, yellowish red worms of about 3 mm long, males being 4-6 mm and females 5-6 mm long (Taylor et al., 2007).

Mature worms and late larval stages live in the crypts of the glandular portion of the proventriculus and gizzard wall (Deeming, 1999).

The life cycle of this parasite is typically strongyle (Taylor et al., 2007). The parasite may be spread with infective larvae on the pasture, by the spread of dung containing parasite eggs, on footwear or on vehicle tires (Thompson and Mason, 2006).

Young ostrich chicks are particularly susceptible to this parasite (Dingle and Shanawany, 1999). They grow poorly, are anaemic and death losses may be heavy (Blood et al., 2007). Heavy infestation can produce impaction of the proventriculus and may lead to a high mortality rate (Dingle and Shanawany, 1999).

Diagnosis is based on finding wireworms in the proventriculus or finding trichostrongyloid-type eggs in the faeces of the host (Deeming, 1999; Dingle and Shanawany, 1999; Jurajda, 2002). There can be up to 3 million parasite eggs passed per bird per day (Thompson and Mason, 2006).

Treatment is by ivermectin at 0.2 mg/kg orally (0.3 mg/kg subcutaneously), fenbendazole (Panacur 2.5%) at 15 mg/kg orally, or levamisole 30 mg/kg per orally (Deeming, 1999; Dingle and Shanawany, 1999; Jurajda, 2002; Taylor et al., 2007).

As prevention, levamisole is administered monthly to chicks, four times a year to adult birds (Jurajda, 2002).

Wireworms are distributed in Africa, North America and

Europe (Taylor et al., 2007).

Appropriate hygiene and husbandry measures, including removal of faeces aimed at limiting pasture contamination help limit exposure to dangerous levels of infective larvae (Taylor et al., 2007).

Two additional species of *Libyostrongylus* have been described, namely *L. magnus* in Ukraine found in ostriches originating from Ethiopia, and *L. dentatus* in the USA, found in ostriches originating from Tanzania (Huchzermeyer, 2002). Their pathogenicity needs further investigation (Eslami et al., 2007).

Trichostrongylus tenuis has been detected in caeca of the emu, causing mucous haemorrhagic diarrhoea (Jurajda, 2002). This trichostrongylid nematode is widespread in North America, Asia and Europe. Game birds, chickens, ducks, geese, turkeys and emus are hosts of this parasite (Taylor et al., 2007).

Codiostomum is a genus of parasitic nematodes of the family *Strongylidae*. *Codiostomum struthionis* is a slightly larger roundworm (Deeming, 1999). It is found in the large intestine and caeca of the ostrich and it interferes with water absorption (Dingle and Shanawany, 1999; Jurajda, 2002; Blood et al., 2007; Ederli et al., 2008). It is distributed in Africa (Taylor et al., 2007).

Codiostomum is about 1-1.5 cm long and white (Dingle and Shanawany, 1999; Taylor et al., 2007). These nematodes feed on the caecal mucus (Ederli et al., 2008). They are exclusive to ostriches (Dingle and Shanawany, 1999). The nematode life cycle has not yet been determined but it is believed to be simple and direct (Taylor et al., 2007; Ederli et al., 2008).

Heavy infestations are likely to be dangerous (Jurajda, 2002; Blood et al., 2007).

Treatment and control are the same as for *Libyostrongylus* spp. (Taylor et al., 2007).

There were identified ova of gastrointestinal nematodes of the genus *Capillaria* in greater rheas' faeces (Uhart et al., 2006). Eggs of *Capillaria* sp. were found also in lesser rheas (Chang Reissig et al., 2001).

Other nematodes related to ostriches are *Struthiofilaria megaloccephala* that affect body cavity of an ostrich, and *Paronchocerca struthionis*, a filariad nematode, a parasite of the respiratory system recovered from the lungs of an ostrich in West Africa. *Dicheilonema spicularum* is a filariad nematode parasiting in the subperitoneal connective tissue. It is up to 2.1 m long, having 2.5 cm in diameter (Jurajda, 2002).

Heterakis dispar, a nematode common in poultry, was recorded in the alimentary canals of ostriches on a farm in Iran (Eslami et al., 2007). It was the first report on *H. dispar* in ostriches. Another nematode with clinical significance is *Baylisascaris*, which is transmitted to ostriches in the USA by skunks or raccoons through faecal material in which the

eggs remain viable in the soil for years. It is a neurotropic parasite that causes CNS lesions and signs. Restricting exposure to raccoon and skunk faeces is the best prevention (Cooper, 2005).

Deletrocephalus dimidiatus is a strongylid nematode parasite of the small intestine of greater and lesser rheas. The life cycle is thought to be direct, with birds ingesting infective larvae whilst foraging. There is little information on the pathogenesis and treatment of this parasitosis in rheas. The parasite is widespread in South America, North America and Europe (Taylor et al., 2007).

Haemorrhagic tracheitis is caused by *Syngamus trachea* in trachea of emus. *Syngamus trachea* is transmitted by ingestion of its intermediate host with infectious larvae or eggs from the ground. The definitive hosts are gallinaceous and singing birds. Affected birds shake their heads and symptoms of dyspnoea are present (Jurajda, 2002). This parasite of chickens, turkeys, game birds, and various wild birds is worldwide distributed (Taylor et al., 2007).

Treatment is by ivermectin (0.2 mg/kg of body mass), fenbendazole or mebendazole. Preventive measures are the same as in poultry (Jurajda, 2002).

Cyathostoma variegatum affects trachea and bronchi of ducks and emus. It is a strongylid nematode 0.4-3 cm long. Females are larger than males. It has been reported to cause severe respiratory diseases in young emus in Australia. A number of hosts may be involved in transmission. Ivermectin is likely to be effective as for treatment and control (Taylor et al., 2007).

The following species have been diagnosed in rheas in South America: *Sicarius uncinipenis* (*Spiruria uncinipenis*) is a parasite of the digestive system of rheas. Proventriculus of the birds is infested by these nematodes that measure 15-20 mm (males) and 16-26 mm (females). *Spiruria zschokkei* (*Vaznema zschokkei*) is another nematode found in rheas. Proventriculus and gizzard of rheas can be infected by *Odontospiruria cetiopenis*. *Paradeletrocephalus minor* is a strongylid parasite infecting small intestine of greater and lesser rheas (Taylor et al., 2007).

Trematoda

Philophthalmus gralli (eye fluke) can infest ostrich as well as several other birds. It requires specific freshwater snails as intermediate hosts. It affects the eye and inhabits the conjunctival sac, leading to conjunctivitis and lacrimation. It is extremely small, no longer than 2-3 mm (Dingle and Shanawany, 1999; Cooper, 2005). It is reported to cause severe eye irritation and discharge in captive ostriches in Florida (Kocan and Crawford, 2007).

Fascioliasis caused by *Fasciola hepatica* (liver fluke) is a zoonotic parasitic disease that occurs worldwide causing important economic losses to sheep and cattle in commercial herds. The infection also occurs in horses, pigs, deer, alpacas,

rabbits, kangaroos, wombats, possums, emus and humans. It was also recorded in farmed and wild greater rheas in Brazil. The intermediate hosts of *F. hepatica* are freshwater snails of the genus *Lymnaea* (Soares et al., 2007).

EXTERNAL PARASITES

Several species of ectoparasites affect ratites of all ages, both ratite specific and non-specific parasite species (Jurajda, 2002).

Birds infested with ectoparasites generally exhibit irritation and react by scratching. Lice and mites can be found by examining the skin and feathers, especially around the vent, legs, wings and neck. Night-time examination of birds may detect parasites that feed at night, but specific identification of the parasite requires microscopic examination (Dingle and Shanawany, 1999).

Biting lice (feather lice, ostrich lice), *Struthiolipeurus struthionis* cause skin and feather damage in ostriches. The lice and eggs can be seen in feathers close to the skin (Jefferey, 1996; Jurajda, 2002; Cooper, 2005; Yaman and Durgut, 2005; Taylor et al., 2007). They are narrow-bodied lice with large heads (Taylor et al., 2007), not sucking blood but feeding on feathers. It is difficult to spot them as they can easily vanish under feathers. *Struthiolipeurus* eggs are deposited on feather barbs on both sides along the shaft (Deeming, 1999).

Treatment is 5% carbaryl dust at 14-day intervals (Jefferey, 1996).

A variety of other lice may also be found on ostrich including *Struthiolipeurus nandu* and *Struthiolipeurus stresemanni* (Yaman and Durgut, 2005; Taylor et al., 2007).

Meinertzhageniella lata and *Meinertzhageniella schubarti* are lice that have been reported in rheas, *Dahlehornia asymmetrica* is an emu louse (Taylor et al., 2007).

The feather (quill, shaft) mites *Gabucinia bicaudata* (*Pterolichus bicaudatus*) of ostriches live in the vein in the ventral groove of the feather shaft and feed on blood and gelatinous contents of feather sheath. They can be visualized as small, reddish, dust-like, elongated particles in the feather vein (Jefferey, 1996; Deeming, 1999; Jurajda, 2002; Cooper, 2005; Cooper and El Doumani, 2006; Taylor et al., 2007). They are about 0.5 µm long (Taylor et al., 2007).

As ostriches moult continuously, there are always immature feathers for them to feed on, although when their population grows out of control they also attack the skin causing scabies-like damage (Deeming, 1999).

Treatment for quill mites is ivermectin at 0.2 mg/kg at 30-day intervals (Jefferey, 1996; Cooper, 2005; Cooper and El Doumani, 2006). Also *G. sculpturata* is common in the ostrich (Taylor et al., 2007).

Struthiobosca struthionis flies from one animal to another and irritates its host by sucking blood (Jurajda, 2002).

A number of ticks of various species (e.g. *Hyalomma* and *Amblyomma* spp.) affect ostriches, their main significance being disease vectors (Jefferey, 1996; Deeming, 1999). In addition, the long mouth parts of the tick cause extensive damage to the skin when they tunnel through the skin.

High infestation is associated with areas of high rainfall and dense vegetation (Dingle and Shanawany, 1999; Cooper, 2005). A preferred site of attachment is under the chin (Deeming, 1999).

Species of the family of *Culicoides* may act as a risk factor in ratite industry as well. Biting insects are notorious for irritating ostriches causing stress when they attack in large numbers. They may also be vectors of *Plasmodium struthionis* and *Leucocytozoon struthionis* and mechanical transmitters of fowl pox virus or filariosis (Deeming, 1999; Mushi et al., 1999).

In general, infestations by lice, mites, flies and ticks are treated by regular and thorough spraying with synthetic pyrethroids or by dosing or injecting with ivermectin. Preparations containing lindane should not be used as this is highly toxic to ostriches (Deeming, 1999).

The significance of ticks, lice and mites should not be as serious as in the south of Africa (Jurajda, 2002).

CONCLUSIONS

There is still very little known and written about both internal and external parasites and veterinary care in ostriches, emus and rheas. As ratite farming is quite a new field of animal production on a world-wide scale and only few studies have been focused on these - for a prosperous farm - important questions, more attention should be paid to veterinary problems and health management of these exotic birds. Due to the lack of information in ratite industry, current and future breeders as well as veterinarians should familiarize with basic aspects of ratite production.

Up to now the most endoparasite species are known in ostriches, the same is in case of external parasite species of ratites. The vast majority of informative materials on ratites comes from other than European countries. Most scientific publications and articles all over the world are devoted to ostriches. Very few materials are focused on aspects of emu, greater rhea and lesser rhea health care and related problems.

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