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Strongylosis (Red Worms Infestation); a Potential Threat to Donkey's Health and Performance

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Abstract: The primary objective of this review article is to raise awareness among the donkey owners about the socio-economic importance of the donkeys, their esteemed role in the uplift of the lives of poor people, their health complications and other parasitic diseases with particular reference to strongylosis and the least cost effective treatment of the disease. Strongylosis is one of the major health issues of donkeys throughout the world. The disease is caused by strongyle nematodes which are ubiquitous in nature. Infection rate of the disease shows enormous variation because of ecological variations in different parts of the world. The disease is responsible for causing substantial losses and even may prove fatal if no treatment rendered. The clinical manifestation associated with strongylosis justifies an emergent awareness and the use of patent pharmacological agents efficient in the treatment of strongylosis. Several methods are available to treat strongylosis such as several standard anthelmintics and various medicinal plants with varying efficacies. The article may help the readers to better understand the disease, its pathogenicity and a least cost effective chemotherapy.

Key words: Anthelmintics · Donkeys · Infection Rate · Strongylosis

INTRODUCTION

Donkeys are used for variety of purposes in different countries and parts of the world. In the face of increased expansion in mechanization, donkeys are still considered as the "beasts of burden". In Pakistan, donkeys are used for ploughing, transport of goods and a cut-rate source of labour. In most of the unfledged countries, donkey's potential is used in agricultural land cultivation and transportation [1] and have a foremost socio-economic significance in numerous fields [2]. Donkey's potential can be best utilized in areas with uneven topography and underdeveloped infrastructures and for this reason donkeys are considered as the most valuable, appropriate and cost-effective animals [3]. In some countries like Italy, equines meat consumption is the highest compared to other European countries even to the extent that the national production is insufficient to meet market requirements [4- 6]. Donkeys are utilized in circuses and riding schools and also retained as a pet animal in zoo [7]. In some arid and semi-arid areas, donkeys are the sole draught animals used as a source of transport [8]. They are used for carriage purpose and a saddle animal in hill stations [9]. Donkey's population is much more in developing countries being 90% out of the total 44 million estimated donkey's population throughout the world [10]. Donkeys have a good experience of working in tough conditions accompanied with prolonged working hours and when get free; they are offered garbage and left for browsing [11].

Parasitism in Donkeys: Equines serve as a host to a number of parasites. It is barely possible for any grazing equine to be parasite free at any specific time [12]. Surprisingly, research work about the parasitic species of donkeys, their prevalence and effect on donkey's health is shockingly negligible [13]. Moreover, there is also unavailability of an effective parasitic control program

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particularly in rural areas where donkeys are kept for so many purposes [14]. There is also an increased ignorance about the donkey's health complications and other management requisites (8) and the pathogenicity and epidemiology of helminthes parasites of donkeys is usually predicted from what is recognized in horses [15]. Donkey is an exceptionally hardy and robust creature but is attacked by so many diseases as well [3]. The animal must be in excellent health status for high performance [8]. Parasitic infections limit the improvement in animal's health [16], causes pain in affected animals [17] and results in substantial clinico-pathological vagaries in donkeys [8]. Young animals may experience heavy parasitism with severe clinical symptoms and mortality if untreated [18]. Parasitic diseases have an adverse financial impact on donkey owners thereby bringing about losses through lowered fertility, reduced work potential and high treatment cost [19]. Heavy internal parasitism accompanied with hard work, stress and malnutrition severely affect donkey's health [20] and the condition may prove deadly in situation of neglected control measures [21].

Strongylosis: Strongylosis is an important disease of donkeys. Strongyle (S) nematodes are distributed worldwide. These are robust dark red worms commonly found in the gastro-intestinal tract of donkeys [22] and their predilection site is the ceacum and colon [23]. The disease is caused by two subfamilies of strongyle nematodes namely strongylinae and Cyathostominae [24]. The taxonomic classification of strongyle nematodes is an under [23].

Kindom	Anemalia
Phylum	Nematohelminthes
Class	Nematoda
Order	Strongylida
Suborder	Strongylina
Superfamily	Strongyloidea
Family	Strongylidae
Subfamilies	1. Strongylinae
	2. Cyathostominae

Members present in the subfamiliy Strongylinae are commonly called as large strongyles. These include *Strongylus spp (S.vulgaris, S. edentatus* and *S. equinus)*, *Triodontophorus spp (T. serrratus, T. tenuicollis, T. brevicauda, T. minor)* [23] and *Oesophagodontus robustus*. *Strongylus spp* are migratory while *Triodontophorus spp* and *Oesophagodontus robustus* are non-migratory. Members of the second subfamily Cyathostominae are generally called small strongyles, trichnemes or cyathostomins. These are non-migratory worms containing more than 40 species belonging to *Cylicostephanus, Cyathostomum, Cylicocyclus, Cylicodontophorus, Poteriostomum, Gyalocephalus* and *Cylindropharynx* genera [24].

Infection Rate: Infection rate of strongylosis varies widely and is different from area to area. Variations in the infection rate may be due to ecological factors and access to the deworming program. In Morocco, the infection rate of *S. vulgaris* in donkeys is 90.5% in a whole year with a monthly percentage infection being 61.5% to 100% [25]. In Burkino Faso, the prevalence of *S. vulgaris* is 100% along with two *Triodontophorus,* four *Strongylus* and six *Cyathostominae* species in adult donkeys [2]. In Queensland Australia, the infection rate of intestinal strongyles in equines is (89%, 41/57). The most common large strongyles encountered include *S. vulgaris, S. edentatus, S. equinus* and *T. serratus* being 28%, 22%, 22% and 30% [26]. The mean prevalence of strongylosis is 31.7% in equine population of district Faisalabad, Pakistan [27]. In South Africa, among the 27 species of nematodes in *Ascarididae, Atractidae, Habronematidae, Onchocercidae, Oxyuridae* and *Strongylidae,* cyathostomes (small strongyles) and *Strongylus vulgaris* are the most numerous species in donkeys [10]. The prevalence of strongylosis in horses is 56.66% in District Lahore Pakistan [28]. The prevalence of *Strongylus spp* and Cyathostomes in donkeys is 35.8% and 36.7% in Sudan [1]. The overall prevalence of endo-parasites is 53.33% in horses of District Lahore, Pakistan [29]. In Dugda Bora district (Ethiopia), out of 339 faecal samples collected from donkeys, strongyles infection rate was 100% [30]. The prevalence of *Strongylidae* is 100% in donkeys after conducting a study to find out the endoparasites of horses and donkeys [9]. The prevalence of *Strongylus spp* is 50% in equines population of District Faisalabad, Pakistan [16]. The infection rate of strongylosis is 57.47% in horses of district Layyah, Pakistan [31]. The infection rate of *Strongylus* is 54.87% along with *Strongyloides* (24.39%), *Trichonema* (15.85%) and *Triodontophorus* (2.43%) after conducting coprological examination of 82 feacal samples collected from donkeys [32]. The percentage of *Strongylidae* species encountered in donkeys is (96.77%) in the Central Black Sea Region, Turkey [22]. A study reveals that 133 out 200 (65.51%) equine's faecal samples were infected with helminths and the infection rate of *strongyles* was 58.5% (117/200) [33]. The prevalence of

strongyles in working donkeys is 92.5%, 87% and 95% in Bereh, Boset and Adaa districts of Central Shoa, Ethiopia. On the basis of cultural identification, *S. vulgaris, S. edentates, S. equinus, Trichostrongylus axei, Cyathostomes, S. westeri* and *Triodontophorus* were 67.5%, 46%, 8%, 58.5%, 35.8%, 35.8% and 15.8% [34]. The infection rate of strongyles in donkeys is 82.75% (168/203) in and around Bahir Dar town, west Gojjam administrative zone, northwest Ethiopia [11]. The prevalence of gastrointestinal parasites in donkey's population of district Lahore, Pakistan is 56.66% and the prevalence of *Strongylus* being 28.33% [35].

Clinical Signs: Natural infestations usually signify the combined effects of a mixed infestation. There is poor hair coat, impaired performance, weight loss, anemia, persistent low grade fever, verminous arteritis and colic related with *S. vulgaris* [24], ill-thrift to sudden death [22], diarrhea and anorexia [36]. Strongyle parasites with high infection rate results in a stumpy performance and life probability of working equines [11]. Changes in haemotological values include reduction in total erythrocyte count (TEC) and packed cell volume (PCV) [28], reduced haemoglobin concentration and eosinophilia [35, 37], monocytopaenia, normocytic and normochromic anaemia and reduced cell survival because of blood sucking capability of the strongyles [27].

Diagnosis: Diagnosis is primarily based on clinical history, clinical signs of the disease and detection of strongyle eggs in the faeces of affected animal mainly through direct smear method [35]. Specific amplification of ribosomal DNA in faeces may be used for the strongyle detection and identification [24].

Treatment: Now-a-days, different anthelmintic preparations are available for the treatment of parasitic diseases, but because of the increased chances of development of resistance against them, they may not be as effective as to completely eliminate the disease. Broad spectrum activity, wide therapeutic index and shortest residual time are the idyllic properties of an anthelmintic [38]. It is vital to have an in-depth knowledge about the pre-patent and patent phases of parasites which serves as the base for parasite control program [39]. Research publications shows that so many anthelmintics have been successfully used to treat strongylosis in equines such as Avermectins, benzimidazoles, pyrantel and several medicinal plants.

Avermectins

Ivermectin: Though the use of Ivermectin is not registered in donkeys, still many donkey owners use the injection with no side effects and with higher efficacy. According to some initial studies, Ivermectin at the dose of 0.02 mg/kg and 0.1 mg/kg was effective against large and small strongyles of equines [40], but because of the presence of many other parasitic species and to achieve a broad spectrum anthelmintic efficacy, a dosage of 0.2 mg/kg is excellent and available for commercial usage. Ivermectin is administered in the form of an oral paste as well as a subcutaneous injection. Adverse reactions of Ivermectin in the shape of local abscessation and swelling at the injection site in the equine species have been wholly related to the intramuscular route of administration [35, 41].

Ivermectin as an oral paste containing 1.87% of the active ingredient shows an efficacy of more than 98% in the equines with particular reference to the strongyle species [41]. Ivermectin (1.87% oral paste) at the dose rate of 0.2 mg/kg is 100% and 99.7% effective against the large and small strongyles and 67.8% effective against the *S. vulgaris* larvae [42]. Ivermectin administered orally at the dose rate of 0.2 mg/kg has 100% efficacy against equine strongylosis [43]. Ivermectin oral paste at the dose rate of 200 mcg/kg b.wt is highly effective for treatment and control of small and large strongyles [44]. As a single subcutaneous injection, Ivermectin at the dose rate of 0.2 mg/kg body weight (1 ml/50 kg) in equines has shown the efficacy of 96.42% on 14^{th} day post medication [35], 98 % and 96 % on day 14 and 28 post medication [45], 96% [46] and 95.17% [29]. The efficacy of ivermectin at the same dose rate has also been reported to be 100% against strongyle nematodes in equines [27, 47, 48].

Abamectin: A single subcutaneous injection of Abamectin at the dose rate of @ 0.2 mg/kg body weight reported being 98% effective against gastrointestinal parasites of horses [16].

Moxidectin: Moxidectin oral gel at the dose rate of 300, 400 and 500 µg kg^{-1} body weight is 100% efficacious against adult *S. vulgaris, S. edentatus, Triodontophorus* spp and 22 species of small strongyles and more than 90% efficacious against the larvae of *S. vulgaris and S. edentatus* [49]. Moxidectin 2% gel at the dosage of 0.4 mg/kg b.wt is 100% and 99.7% effective against the large and small strongyles. Moxidectin is 84.9% effective

against the *S. vulgaris* larvae [42]. Moxidectin 2% oral gel in term of reduction in FECs of strongyle nematodes is 100% against *Triodontophorus* spp, > 99.9% against Cyathostomes adults and L_5 and 92% against *S. edentatus* L_5 [50].

Doramectin: Doramectin @ 200µg kg^{-1} (0.2 mg/kg) as a single S/C injection has been found to be 100% effective against strongyle worms with a faster faecal egg count reduction [43, 51].

Benzimidazoles: Fenbendazole at the dose rate of 7.5 mg/kg b. wt daily for 5 days is 80% and 100% effective in the removal of migrating *S. vulgaris* larvae and *S. edentatus* larvae and 95% of the mucosal stages of *Trichonema spp*, with a virtually 100% removal of adult stages of large and small strongyles [52]. Fenbendazole at the dose rate of 10 mg/kg orally is 100% and 80.8% effective against equine strongylosis [43]. Oxibendazole (10 mg/kg b.wt) has the efficacy of 97-100% against equine strongylosis [53]. Oxfendazole (Oxafax suspension, Glaxo Welcome, Pakistan) at the dose rate of 1 ml /2.2 kg body weight is 94.7% and 100% effective on day l4 and 28th post medication against strongylosis in equines [45]. Oxfendazole (Systamex) at the dose rate of 10mg/kg body weight orally has shown the efficacy of 98.14% against strongylosis in equines after day 14 post medication [31]. Albendazole (Farbenda 10%, Farvet) at the dose rate of 1 ml/13 kg body weight orally is 81-86% effective on day l4 and 28th post medication against strongylosis in equines [45]. Mebendazole (Vermox) at the dose rate of 10mg/kg body weight orally has shown the efficacy of 95.16% against strongylosis in equines after day 14 post medication [31].

Tetrahydropyrimidines/Imidazothiazoles: Pyrantel pamoate oral administration at the dose rate of 19 mg/kg b.wt is 97-100% effective against equine strongylosis at two weeks post-treatment [53], 96.1% and 94.1% [43] and 99% effective against helminthes parasites of equines [54].

Medicinal Plants: Many studies have been conducted on the medicinal plants to evaluate their anthelmintic efficacies but *azadirachta indica* has been documented by many researchers being effective in the treatment of equine strongylosis. Dried leaves of *azadirachta indica* at the dose rate of 375 mg/kg body weight were 8.62% effective against strongyles infection in horses [31] and 33.33% effective in donkeys [35]. Researchers are encouraged to conduct more studies to evaluate and authenticate the anthelmintic properties of medicinal plants in order to use the medicinal plants as alternate therapies for equine strongylosis.

CONCLUSION

Strongylosis is an important disease of donkeys as well as other members of the equidae family. The clinical manifestations associated with the disease are enormous, suggesting the need to further explore the pathogenicity of the disease as well as the newest treatment options.

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REFERENCES

1. Seri, H.I., T. Hassan, M.M. Salih and A.D. Abakar, 2004. A Survey of Gastrointestinal Nematodes of Donkeys (Equus asinus) in Khartoum State Sudan. J. Anim Vet Advance, 3(11): 736-739.
2. Vercruysse, J., E.A. Harris, Y.Y. Kaboret, L.J. Pangui and D.I. Gibson, 1986. Gastro-intestinal helminthes of donkeys in Burkina Faso. Z. Parasiten, 72: 821-825.
3. Hosseini, S.H., B. Meshgi, A. Eslami, S. Bokai, M. Sobhani and R.A. Ebrahimi, 2009. Prevalence and biodiversity of helminth parasites in donkeys (Equus asinus) in Iran. Int. J. Vet Res, 3(2): 95-99.
4. Martuzzi, F., A.L. Catalano and C. Sussi, 2001. Characteristics of horse meat consumption and production in Italy. Ann Fac Med Vet Parma, 21: 213-223.
5. Catelli, J.L., 2004. El caballo en Europa para producción de carne. Vet. Argent., 21: 364-368.
6. Dobrani'c, V., A. Veckovec, M. Kadivc and B. Njari, 2008. Horse meat and hip-pophagia. Meso, 10: 314-318.

7. Kuzmina, T.A. and Yu.I Kuzmin, 2008. The community of Strongylids (Nematoda, Strongylida) of working donkeys (Equus asinus) in Ukraine. Vestnik zoologii, 42(2): 18-23.
8. Lewa, A.K., T.A. Ngatia, W.K. Munyua and N.E. Maingi, 1999. Comparison of haematological changes and strongyle faecal egg counts in donkeys in Kiambu district of Kenya. Proceedings of an ATNESA Workshop, September, South Africa.
9. Uslu, U. and F. Guclu, 2007. Prevalence of endoparasites in horses and donkeys in Turkey. Bull Vet. Inst Pulawy, 51: 237-240.
10. Matthee, S., R.C. Krecek and S.A. Milne, 2000. Prevalence and biodiversity of helminth parasites in donkeys from South Africa. J. Parasito, 86(4): 756-762.
11. Bogale, B., Z. Sisay and M. Chanie, 2012. Strongyle Nematode Infections of Donkeys and Mules in and Around Bahirdar, Northwest Ethiopia. Global Veterinaria, 9(4): 497-501.
12. Duncan, J., 1983. Anthelmintics for Use in Equine Practice. In: Pharmacological Basis of Large Animal Medicine. Blackwell Scientific Publications; USA.
13. Kheir, S.M. and H.S.M. Kheir, 1981. Gastrointestinal nematodes of equines in the Southern Darfur region of the Sudan. Sud J. Vet Res., 3: 53-57.
14. Javed, K., M. Ijaz, M.M. Ali, I. Khan, K. Mehmood and S. Ali, 2014. Prevalence and Hematology of Tick Borne Hemoparasitic Diseases in Equines in and Around Lahore. Pak J. Zool., 46(2): 401-408.
15. Wells, D., R.C. Krecek, M. Wells, A.J. Guthrie and J.C. Lourens, 1998. Helminth levels of working donkeys kept under different management systems in the Moretele district of the North-West Province, South Africa. Vet Parasitol., 77: 163-177.
16. Mahfooz, A., M.Z. Masood, A. Yousaf, N. Akhtar and M.A. Zafar, 2008. Prevalence and anthelmintic efficacy of abamectin against gastrointestinal parasites in horses. Pak Vet J., 28(2): 76-78.
17. Fikru, R., D. Reta and M. Bizunesh, 2005. Prevalence of equine gastrointestinal parasites in western high lands of Oromia, Ethiopia. Bulletin of Animal Health and Production in Africa, pp: 161-166.
18. Herd, R.P., 1990. The changing world of the worms: the rise of the cyathostomes and the decline of *Strongylus vulgaris*. Comp Cont Edu Pract Vet, 2: 732-736.
19. Krecek, R.C., S. Mathee, R.A. Pearson, D. Fieldings and D. Tabba, 2002. Forth international colloquium on working equines 20-26th April. Hama, Syria, pp: 249.
20. Herd, R.P., 1990. Equine parasite control-solutions to anthelmintic associated problems. Equine Vet Edu., 2: 86-91.
21. Hayat, B., M.Q. Khan, C.S. Hayat and Z. Iqbal, 1987. Studies on the incidence of gastro-intestinal nematodes of horses in Faisalabad city. Pak Vet J., 1: 145-147.
22. Umur, S. and M. Acici, 2009. A survey on helminth infections of equines in the Central Black Sea region, Turkey. Turk J. Vet Anim Sci., 33(5): 373-378.
23. Urquhart, G.M., J. Duncan, J. Armour, A.M. Dun and F.W. Jennings, 1996. Veterinary Parasitology 2nd ed. Blackwell Science Ltd, pp: 42-47, 276-277.
24. Radostits, O.M., C.C. Gay, K.W. Hinchcliff and P.D. Constable, 2006. Veterinary Medicine, A textbook of the diseases of cattle, horses, sheep, pigs and goats. 10th ed. Saunders Elsevier, pp: 1558-1562.
25. Pandey, V.S., 1980. Seasonal prevalence of *Strongylus vulgaris* in the anterior mesenteric artery of the donkey in Morocco. Vet Parasitol., 7(4): 357-362.
26. Mfitilodze, M.W. and G.W. Hutchinson, 1990. Prevalence and Abundance of Equine Strongyles (Nematoda: Strongyloidea) in Tropical Australia. J. Parasito, 76(4): 487-494.
27. Sipra, A.S., A.H. Anwar and M.N. Khan, 1999. Studies on Strongylosis in Equines with special emphasis on Hematology and Chemotherapy. Pak J. Bio Sci., 2(4): 1634-1636.
28. Saleem, A., K. Pervez, M.S. Khan and H.A. Hashmi, 2000. Prevalence and Chemotherapy of Strongylosis and its Effect on various blood Parameters in Horse. Pak J. Sci., 52(3-4): 41-43.
29. Aftab, J., M.S. Khan, K. Pervez, M. Avais and J.A. Khan, 2005. Prevalence and chemotherapy of ecto-and endoparasites in rangers horses at lahore-pakistan. Int J Agri Biol, 7(5): 853-854.
30. Ayele, G., G. Feseha, E. Bojia and A. Joe, 2006. Prevalence of gastro-intestinal parasites of donkeys in Dugda Bora District, Ethiopia. Livestock Research for Rural Development, 18(10).
31. Mahboob, K., J.A. Khan and M.S. Khan, 2008. Prevalence, Chemotherapy and haematology of Strongylosis in horses of district Layyah. J. Anim Plant Sci., 18(4): 117-119.
32. Shrikhande, G.B., S.G. Rewatkar, S.S. Deshmukh, D.K. Maske and Y.M. Raghorte, 2009. The Incidence of Helminth Parasites in Donkeys. Vet World, 2(6): 224.

33. Saeed, K., Z. Qadir, K. Ashraf and N. Ahmad, 2010. Role of intrinsic and extrinsic epidemiological factors on strongylosis in horses. J. Anim Pl Sci., 20(4): 277-280.
34. Ayele, G. and A. Dinka, 2010. Study on strongyles and parascaris parasites population in working donkeys of central Shoa, Ethiopia. Livestock Research for Rural Development, 22(12).
35. Waqas, M., M.S. Khan, A.Z. Durrani, M.A. Khan, M. Avais, S.A. Khan, S.U. Rehman, A. Hussain, A. Nasir, A. Hussain and F.C. dos Santos, 2014. Prevalence of Gastrointestinal parasites, chemotherapy and haematology of Strongylosis in Donkeys of District Lahore, Pakistan. Int. J. Curr. Microbiol App Sci., 3(7): 198-207.
36. Soulsby, E.J.L., 1982. Helminths, Arthropods and Protozoa of domesticated animals. 7th ed. The English language book society, Bailliare Tindall; London, pp: 172-179.
37. Dennis, V.A., R.K. Thomas, A.M. Margaret, R.C. Melanie and J.R. McClure, 1992. Immune responses of pony foals during repeated infections of *S. vulgaris* and regular ivermectin treatments. Vet Parasitol, 42(1-2): 83.
38. Robert, R.K. and M. Edwound, 1986. Effect of anthelmintics on helminth metabolism. Br Vet J., 129: 87.
39. Irfan, M., 1984. Key note address on effects of parasitism in lowering livestock Production. Pak Vet J., 3(1): 25.
40. Egerton, J.R., E.S. Brokken, D. Su-Hayda, C.H. Eary, J.W. Wooden and R.L. Kilgore, 1981. The antiparasitic activity of ivermectin in horses. Vet Parasiotol., 8: 83-88.
41. Barragry, T.B., 1987. A Review of the Pharmacology and Clinical Uses of Ivermectin. Can Vet J., 28: 512-517.
42. Costaa, A.J., O.F. Barbosaa, F.R. Moraesa, A.H. Acunab, U.F. Rochaa, V.E. Soaresa, A.C. Paulliloa and A. Sanchesc, 1998. Comparative efficacy evaluation of moxidectin gel and ivermectin paste against internal parasites of equines in Brazil. Vet Parasitol., 80(1): 29-36.
43. Davies, J.A. and L.M. Schwalbach, 2000. A study to evaluate the field efficacy of ivermectin, fenbendazole and pyrantel pamoate, with preliminary observations on the efficacy of doramectin, as anthelmintics in horses. J. S Afr Vet Assoc., 71(3): 144-7.
44. Klei, T.R., S. Rehbein, M. Visser, W.K. Langholff, M.R. Chapman, D.D. French and P. Hanson, 2001. Re-evaluation of ivermectin efficacy against equine gastrointestinal parasites. Vet Parasitol, 98(4): 315-320.
45. Saeed, K., Z. Qadir, S.A. Khan, K. Ashraf and S. Nazir, 2008. Evaluation of some broad spectrum antiparasitic drugs against natural strongyie infections in horses. J. Anim Pl Sci., 18(2-3): 64-66.
46. Binev, R., Z. Kirkova, J. Nikolo, A. Russenov, K. Stojanchev, L. Lazarov and T. Hristov, 2005. Efficacy of parentral administration of ivermectin in the control of strongylidosis in donkeys. J. S. Afr Vet Assoc, 76(4): 214-6.
47. Seri, H.I., A.D. Abakar, A.A. Ismail and T.A. Tigani, 2005. Efficacy of Ivermectin in an injectable formulation against gastrointestinal nematodes of donkeys (Equus asinus). Vet Arhive, 75: 369-374.
48. Hassan, R., M.A. Khan, T. Akhtar, I. Khan, T. Abbas and M. Younus, 2005. Epidemiology of parasitic load and therapeutic control against ecto and endoparasites with ivermectin in horses. Punjab Univ J. Zool., 20(2): 143-150.
49. Monahan, C.M., M.R. Chapman, D.D. French, H.W. Taylor and T.R. Klei, 1995. Dose titration of moxidectin oral gel against gastrointestinal parasites of ponies. Vet Parasitol., 59(3-4): 241-248.
50. Dorchies, P., J.D. de Lahittea, A. Flochlayb and F. Blond-Rioub, 1998. Efficacy of moxidectin 2% equine gel against natural nematode infections in ponies. Vet Parasitol, 74(1): 85-89.
51. Shahardar, R.A., B.A. Pandit, M.A. Ahmad and L. Jeyabal, 2006. Efficacy of ivermectin and doramectin in ponies naturally infected with strongyle worms. J. Vet Parasitol., 20(2): 179-181.
52. Duncan, J.L., D.G. McBeath and N.K. Preston, 1980. Studies on the efficacy of fenbendazole used in a divided dosage regime against strongyle infections in ponies. Equine Vet J., 12(2): 78-80.
53. Bauer, C., J.C. Merkt, G. Janke-Grimm and H.J. Burger, 1986. Prevalence and control of benzimidazole-resistant small strongyles on German thoroughbred studs. Vet Parasitol, 21: 189-203.
54. Mathee, S., 2003. Anthelmintic treatment in horses: the extra-label use of products and the danger of under-dosing. J. S Afr Vet Assoc, 74(2): 53-6.