动物营养学报
CHINESE JOURNAL OF ANIMAL NUTRITION

动物营养学报 » 2013, Vol. 25 » Issue (9) :1921-1928 DOI: 10.3969/j.issn.1006-267x.2013.09.003

羊捻转血矛线虫的免疫机理及控制其感染的营养调控措施

钟荣珍, 周道玮

中国科学院东北地理与农业生态研究所, 长春 130012

Immune Mechanisms of *Haemonchus contortus* Infection in Sheep and Goats and the Control Strategies by Nutritional Manipulation

ZHONG Rongzhen, ZHOU Daowei

Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun 130012, China

摘要 捻转血矛线虫是感染羊的主要胃肠道吸血线虫之一,主要引起羊贫血和生产性能下降,给养羊业造成极大经济损失。防控胃肠道线虫感染的普遍措施是采用化学驱虫药,然而,胃肠道线虫的抗药性和畜产品中药物残留问题迫使人们研究新的抗虫措施。明确捻转血矛线虫的免疫机理并通过营养调控措施改善宿主抗性和恢复力是理想的防控途径。营养调控原理是基于胃肠道线虫感染后宿主的生理和病理反应,通过调控宿主营养水平来提高自身抗虫性和感染后的恢复力。本文综述了羊捻转血矛线虫的生活史、免疫机理及控制羊捻转血矛线虫感染的营养调控措施,包括调控羊饲粮蛋白质水平、矿物元素水平和抗虫营养活性物质。

关键词: 捻转血矛线虫 免疫机理 营养调控

Abstract: *Haemonchus contortus* is one of main blood-sucking gastrointestinal nematodes that infects in sheep and goats, which induces anemia and decreases production performance of hosts and results in economic lose to producers. Chemical anthelmintic drugs were used to control infections of gastrointestinal nematodes in animals. However, the problems of drug resistance and the safety of animal products urge us to choose alternative strategies. To probe mechanisms of immune responses of *H. contortus* and improve immunity and resilience of hosts through nutritional regulations have been reported to be effective. Theories of nutritional manipulation are based on the physiological and pathological responses of hosts to *H. contortus* infection and strategies of improving host resistance and resilience to *H. contortus*. This review focused on the life cycle of *H. contortus*, immune mechanisms, and nutritional manipulation strategies of controlling *H. contortus* infection, such as manipulate dietary protein level, mineral level, and bioactive compounds.

Keywords: *Haemonchus contortus*, immune mechanisms, nutritional manipulation

收稿日期: 2013-04-11;

基金资助:

中国科学院东北地理与农业生态研究所"优秀青年人才"基金(DLSYQ12008);国家自然基金项目(31201820)

通讯作者 周道玮,研究员,博士生导师,E-mail:zhoudaowei@neigae.ac.cn

引用本文:

钟荣珍, 周道玮 . 羊捻转血矛线虫的免疫机理及控制其感染的营养调控措施[J]. 动物营养学报, 2013,V25(9): 1921-1928

ZHONG Rongzhen, ZHOU Daowei . Immune Mechanisms of *Haemonchus contortus* Infection in Sheep and Goats and the Control Strategies by Nutritional Manipulation[J]. Chinese Journal of Animal Nutrition, 2013,V25(9): 1921-1928.

链接本文:

http://118.145.16.228/Jweb_dwyy/CN/10.3969/j.issn.1006-267x.2013.09.003 或 http://118.145.16.228/Jweb_dwyy/CN/Y2013/V25/I9/1921

[1] LIGHTBODY J H,STEVENSON L M,JACKSON F,et al.Comparative aspects of plasma antioxidant status in sheep and goats,and the influence of

experimental abomasal nematode infection[J].Journal of Comparative Pathology,2001,124(2/3):192-199.

[2] GONZÁLEZ J F,HERNÁNDEZ A,MOLINA J M,et al.Comparative experimental *Haemonchus contortus* infection of two sheep breeds native to the Canary islands[J].Veterinary Parasitology,2008,153(3/4):374-378.

[3] OLSEN O W.Animal parasites—their life cycles and ecology[M].Mineola,N.Y.:Dover Publication Inc.,1986.

[4] DAS K M,WHITLOCK J H.Subspeciation in *Haemonchus contortus* (Rudolphi,1803) Nemata,Trichostrongyloidea[J].Cornell Veterinarian,1960,50:182-197.

[5] DIJK J V,DAVID G P,BAIRD G,et al.Back to the future:developing hypotheses on the effects of climate change on ovine parasitic gastroenteritis from historical data[J].Veterinary Parasitology,2008,158(1/2):73-84.

[6] JOHNSTONE C.Parasites and parasitic diseases of domestic animals.(2000-01-24) http://cal.vet.upenn.edu/projects/merial/Nematodes/nems_9.htm.

[7] MICHEL J F.Arrested development of nematodes and some related phenomena[J].Advances in Parasitology,1974,12:279-366.

[8] 沈杰,叶明忠,陈永军,等.绵羊寄生线虫在体内及牧场上各发育阶段的季节动态研究[J].中国兽医寄生虫病,1994,2(1):10-15.

[9] 王春仁,马桂芬,赵金萍,等.黑龙江西部羊寄生虫的调查及控制技术的建立[J].黑龙江八一农垦学报,2005,17(4):53-57.

[10] MILLER J E,BAHIRATHAN M,LEMARIE S L,et al.Epidemiology of gastrointetinal nematode parasitism in Suffolk and Gulf Coast Native sheep with special emphasis on relative susceptibility to *Haemonchus contortus* infection[J].Veterinary Parasitology,1998,74(1):55-74.

[11] HOSTE H,CHARTIER C.Response to challenge infection with *Haemonchus contortus* and *Trichostrongylus colubriformis* in dairy goats.Consequences on milk production [J].Veterinary Parasitology,1998,74(1):43-54.

[12] GEORGI J R,GEORGI M E.Parasitology for veterinarians[M].Philadelphia,P.A.:W.B.Saunders Company,1990.

[13] BURKE J M,KAPLAN R M,MILLER J E,et al.Accuracy of the FAMACHA system for on-farm use by sheep and goat producers in the southeastern United States[J].Veterinary Parasitology,2007,147(1/2):89-95.

[14] SUCHITRA S,ANBU K A,RATHORE D K,et al.*Haemonchus contortus* calreticulin binds to C-reactive protein of its host,a novel survival strategy of the parasite[J].Parasite Immunology,2008,30(6/7):371-473.

[15] GILL H S.Cell-mediated immunity in Merino lambs with genetic resistance to *Haemonchus contortus*[J].International Journal of Parasitology,1994,24(5):749-756.

[16] GILL H S,WATSON D L,BRANDON M R.Monoclonal antibody to $CD4^+$ T cells abrogates genetic resistance to *Haemonchus contortus* in sheep [J].Immunology,1993,78(1):43-49.

[17] GASBARRE L C.Effects of gastrointestinal nematode infection on the ruminant immune system[J].Veterinary Parasitology,1997,72(3/4):327-343.

[18] MILLER H R,JACKSON F,NEWLANDS G,et al.Immune exclusion,a mechanism of protection against the ovine nematode *Haemonchus contortus* [J].Research in Veterinary Science,1983,35(3):357-363.

[19] GILL H S,ALTMANN K,CROSS M L,et al.Induction of T helper 1- and T helper 2-type immune responses during *Haemonchus contortus* infection in sheep[J].Immonology,2000,99(3):458-463.

[20] ELSE K J.Have gastrointestinal nematodes outwitted the immune system?[J].Parasite Immunology,2005,27(10/11):407-415.

[21] BELLABY T,ROBINSON K,WAKELIN D.Induction of differential T-helper-cell responses in mice infected with variants of the parasitic nematode *Trichuris muris*[J].Infection and Immunity,1996,64(3):791-795.

[22] JACKSON F,COOP R L.The development of anthelmintic resistance in sheep nematodes[J].Parasitology,2000,120(Suppl.):95-107.

[23] VALDERRÁBANO J,GOMEZ-RINCÓN C,URIARTE J.Effect of nutritional status and fat reserves on the periparturient immune response to *Haemonchus contortus* infection in sheep[J].Veterinary Parasitology,2006,141(1/2):122-131.

[24] POPPI D P,SYKES A R.The effect of endoparasitism on host nutrition—the implication for nutrient manipulation[J].Proceedings of the New Zealand Society of Animal Production,1990,50:237-243.

[25] BRICARELLO P A,AMARANTE A F T,ROCHA R A,et al.Influence of dietary protein supply on resistance to experimental infections with *Haemonchus contortus* in Ile de France and Santa Ines lambs[J].Veterinary Parasitology,2005,134(1/2):99-109.

[26] NNADI P A,KAMALU T N,ONAH D N.The effect of dietary protein on the productivity of West African Dwarf (WAD) goats infected with *Haemonchus contortus*[J].Veterinary Parasitology,2009,161(3/4):232-238.

[27] DONALDSON J,VAN HOUTERT M F J,SYKES A R.The effect of dietary fish meal supplementation on parasite burdens of periparturient sheep [J].Animal Science,2001,72(1):149-158.

[28] WALLER P J,BERNES G,RUDBY-MARTIN L,et al.Evaluation of copper supplementation of control *Haemonchus contortus* infections of sheep in Sweden[J].Acta Veterinaria Scandinavica,2004,45:149-160.

[29] SIDDIQUI H U R,CAMERON R D.Effect of *Haemonchus contortus* infection and nutrition on glucose and trace element[J].International Journal of Agriculture and Biology,2005,7(2):281-284.

[30] AFRC.Technical committee on responses to nutrients.Report 10.The nutrition of goats[J].Nutrition Abstracts and Reviews Z:Series B,1997,67:806-815.

[31] BURKE J M,MILLER J E.Evaluation of multiple low doses of copper oxide wire particles compared with levamisole for control of *Haemonchus*

contortus in lambs[J].Veterinary Parasitology,2006,139(1/2/3):145-149.

[32] SYMONS L E.Plasma zinc and inappetence in sheep infected with *Trichostrongylus columbriformis*[J].Journal of Comparative Pathology,1983,93(4):547-550.

[33] SHAIK S A,TERRILL T H,MILLER J E,et al.Effects of feeding sericea lespedeza hay to goats infected with *Haemonchus contortus*[J].South African Journal of Animal Science,2004,34:234-237.

[34] 钟荣珍,孙海霞,刘华伟,等.植物单宁调控反刍动物胃肠道线虫抗性及作用机理研究进展[J].华北农学报,2011,26:252-257.

[35] CALLAHAN H L,CROUCH R K,JAMES E R.Helminth anti-oxidant enzymes:a protective mechanism against host oxidants?[J].Parasitology Today,1988,4(8):218-225.

[36] BROPHY P M,PRITCHARD D I.Immunity to helminths:ready to tip the biochemical balance?[J].Parasitology Today,1992,8(12):419-422.

[37] DO RÊGO LEAL M L,NICOLODI P R S J,SOARES J F,et al.Hematological parameters of lambs infected experimentally with *Haemonchus contortus* and supplemented with selenium and vitamin E[J].Comparative Clinical Pathology,2011,20:369-374.

[38] DE WOLF B M.The effect of vitamin E supplementation on an experimental *Haemonchus contortus* infection in Dorset lambs.Ph.D.Thesis.University of Rhode Island,2012:1-15.

[1] 王洪荣, 季昀.氨基酸的生物活性及其营养调控功能的研究进展[J]. 动物营养学报, 2013,25(3): 447-457

[2] 王笑笑, 高腾云, 秦雯霄.2010年至2011年奶牛养殖中碳减排的研究概况[J]. 动物营养学报, 2012,24(8): 1404-1413

[3] 陈伟, 林映才, 张罕星, 马现永, 阮栋, 王爽.家禽脂肪酸代谢及其在禽蛋中的沉积和营养调控[J]. 动物营养学报, 2012,24(2): 204-211

[4] 王永伟, 吗于明, 彭运智, 蔡虹.肉鸡腹水征的发病机理及其调控措施[J]. 动物营养学报, 2012,24(12): 2295-2302

[5] 黄志清,陈小玲,余冰,毛湘冰,陈代文.microRNA在骨骼肌发育中的功能及其表达的营养调控[J]. 动物营养学报, 2011,23(10): 1647-1650

[6] 赵一广，刁其玉，邓凯东，刘洁，姜成钢，屠焰.反刍动物甲烷排放的测定及调控技术研究进展[J]. 动物营养学报, 2011,23(05): 726-734

[7] 马现永，林映才*，张罕星，阮栋.蛋鸭的产蛋机制及其营养调控[J]. 动物营养学报, 2010,22(05): 1147-1153

[8] 武晶1,2,3，赵克斌2*，王立贤2，袁世态1，颜华2，赵恒寿.育肥猪日粮中通过营养调控和添加益生素或牛至油替代抗生素的研究[J]. 动物营养学报, 2009,21(05): 645-651

[9] 桂丹　刘文斌*.不同营养添加剂对热应激异育银鲫血液生化指标的影响[J]. 动物营养学报, 2008,20(02): 228-233

[10] 冯仰廉 李胜利 张晓明.奶牛和肉牛日粮淀粉和葡萄糖的营养调控及其评定的建议[J]. 动物营养学报, 2008,20(01): 115-122