References

Abbot, E.M., Parkins, J.J. and Holmes, P.H., 1985. Influence of dietary protein on parasite establishment and pathogenesis in Finn Dorset and Scottish Black face lambs given a single moderate infection of *Haemonchus contortus*. *Research in Veterinary Science*, 38, 13-16.

Abule E., Geremew E. and Aliye, H., 1998. Adamitulu Agricultural Research Center Bulletin No 1, Oromia Agricultural Bureau, Ethiopia, 120 pp.

Alemayehu, M., 2004. Pasture and forage resource profiles of Ethiopia. Addis Ababa: Alemayehu Mengistu and Associates, 51 pp.

Ali, D.N. and Hennessy, D.R., 1993. The effect of feed intake of the rate of flow of digesta and the disposition and activity of oxfendazole in sheep. *International Journal for Parasitology*, 23, 477-484.

Allonby, E.W. and Urquhart, G.M., 1975. The epidemiology and pathogenic significance of haemonchosis in a merino flock in East Africa. *Veterinary Parasitology*, 1, 129-143.

Anderson, N., 1985. The controlled release of anthelmintics for helminth control in ruminants. In: Anderson, N. and Waller, P.J. (Eds.). *Resistance in nematode to anthelmintic drugs*, CSIRO, Division of Animal Health, p 127-136.

Anonymous, 1990. Faecal egg count or worm count reduction test analysis program, version 2.0, CSIRO, 1990, Australia.

Anonymous, 1991. FAO expert consultation on helminth infections of livestock in developing countries. Rome, Italy.

Anonymous, 1993. FAO, Agrostat data. Statistics Division, Rome, Italy.

Anonymous, 1995. Livestock sector development project, Ministry of Agriculture, Addis Ababa, Ethiopia.

Anonymous, 1999. Summary of livestock research strategy. Part-1. Ethiopian Agricultural Research Organization, Addis Ababa, Ethiopia, p 1-11.

Anonymous, 2003. Sustainable development and poverty reduction program, Government of Ethiopia, Addis Ababa.

Anonymous, 2004. Resistance management and integrated parasite control in ruminants. Guidelines, Cd-FAO Animal Production and Health Division.

Armour, J. and Gettinby, G., 1983. A critical review of the evaluation production effects of helminth disease and mismanagement of livestock production. *Third International Symposium on Veterinary Epidemiology and Economics, 6-10 September 1982, pp. 164-172.*

Asharaf, M. and Nepote, K.H., 1990. Prevalence of gastro-intestinal nematodes, coccidia and lungworms in Maryland dairy goats. *Small Ruminant Research*, 3, 291-298.

Atanasio, A., 2000. Helminths, protozoa, heartwater and the effect of gastro-intestinal nematodes on productivity of goats of the family sector in Mozambique. PhD thesis, Medical University of Southern Africa.

Atanasio, A., Boomker, J. and Sitoe, C., 2002. A survey on the occurrence of resistance to anthelmintics of gastro-intestinal nematodes of goats in Mozambique. *Onderstepoort Journal of Veterinary Research*, 69, 215-220.

Barger, I.A., 1982. Helminth parasites and animal production. In: L.E. Symons, A.D. Donald and J.K. Dineen (Eds.). *Biology and control of endoparasites*, Sydney: Academic Press, 133-155.

Bathaei, S.S. and Leroy, T., 1996. Growth and mature weight of Mehraban Iranian fat tailed sheep. *Small Ruminant Research*, 22, 155-162.

Bath, G.F., Malan, F.S. and Van Wyk, J.A., 1996. The "FAMACHA©" ovine anaemia guide to assist with the control of haemonchosis. In: *Proceedings of the 7th Annual Congress of the Livestock Health and Production Group of the South African Veterinary Association, Port Elizabeth, 5-7 June 1996, 5 pp.*

Bath, G.F., Malan, F.S. and Van Wyk, J.A., 1997. The use of clinical anaemia as an aid in the control of haemonchosis in sheep. In: *Proceedings of the 4th International Congress for Sheep Veterinarians. Armidale, NSW, Australia.*

Bekele, T., Kasali, O.B. and Woldeab Woldemariam, 1992a. Endoparasite prevalence of the highland sheep in Ethiopia. *Preventive Veterinary Medicine*, 13, 93-102.

Besier, B.R., 1997. Ecological selection for anthelmintic resistance: re-evaluation of sheep worm control programs. Managing anthelmintic resistance in endoparasites. *Workshop held at the 16th International Conference of the World Association for the Advancement of Veterinary Parasitology. Van Wyk. J.A. and Van Schalkwyk, P.C. (Eds.). Sun City, South Africa, p 30-38.*

Besier, R.B. and Love, S.C.J., 2003. Anthelmintic resistance in sheep nematodes in Australia: the need for new approaches. *Australian Journal of Experimental Agriculture*, 43, 1383-1391.

Blood, D.C. and Radostits, O.M, 1989. Veterinary medicine, 7th ed. London: Bailliere Tindall.

Boag, B. and Thomas, R.J., 1971. Epidemiological studies on gastro-intestinal nematode parasites of sheep: Infection patterns on clean and autumn-contaminated pasture. *Research in Veterinary Science*, 12, 132-139.

Boden, E., 1991. Sheep and goat practice. In: E. Boden (Ed.). *Practice Handbook Series*, London: Bailliere Tindall, 272 pp.

Boersema, J.H. , 1992. Anthelmintic pharmacology and anthelmintic resistance. In: *Anthelmintic Resistance in Nematodes of Farm Animals*. G.C. Coles, F.H.M. Borgesteede, and S. Geerts (Eds.). Brussels: European Commission, p 153-161.

Boersema, J.H. and Pandey, V.S., 1997. Anthelmintic resistance of trichostrongylids in sheep in the highveld of Zimbabwe. *Veterinary Parasitology*, 68, 383-388.

Bogan, J. and Armour, J., 1987. Anthelmintics for ruminants. *International Journal for Parasitology*, 17, 483-491.

Boomker, J., Horak, I.G. and De Vos, V., 1989. Parasites of South African wildlife. IV. Helminths of kudu, *Tragelaphus strepsiceros*, in the Kruger National Park. *Onderstepoort Journal of Veterinary Research*, 56, 111-121.

Boomker, J., Horak, I.G. and Ramsay, K.A., 1994. Helminth and arthropod parasites of indigenous goats in the northern Transvaal. *Onderstepoort Journal of Veterinary Research*, 61, 13-20.

Borgsteede, F.H.M. and Dercksen, D.P., 1996. Coccidial and helminth infections in goats kept indoors in The Netherlands. *Veterinary Parasitology*, 61, 321-326. Abstract/Journal Format-PDF.

Brunsdon, R.V., 1964. The effect of nutrition on the establishment and persistence of trichstrongyle infection. *New Zealand Veterinary Journal*, 12, 108-111.

Brunsdon, R.V., 1980. Principles of helminth control. *Veterinary Parasitology*, 6, 185-215.

Brunsdon, R.V., Kissling, R. and Hosking, B.C., 1983. A survey of anthelmintic usage for sheep: A time for change? *New Zealand Veterinary Journal*, 63, 139-143.

Chandrawathani, P., 2004. Problems in the control of nematode parasites of small ruminants in Malaysia: Resistance to anthelmintics and the biological control alternative. PhD thesis, Uppsala University.

Charles, T.P., Pompen, J. and Miranda, D.B., 1989. Efficacy of the three broad spectrum anthelmintics against gastro-intestinal nematode infections of goats. *Veterinary Parasitology*, 34, 71-75.

Chhabra, R.C. and Pandey, V.S., 1992. Prevalence of coccidia in sheep in Zimbabwe. *Small Ruminant Research*, 8, 257-264.

Chiejina, S.N., 1994. Epidemiology of some helminth infections of domesticated animals in the tropics with emphasis on fasciolosis and parasitic gastroenteritis. In: Chowdhury, N. and Tada, I. (Eds.). *Helminthology*. Delhi: Springer Verlag, 373 pp.

Coles, E.H., 1986. Veterinary clinical pathology. Manhattan: Kansas State University.

Coles, G.C. and Roush, R.T., 1992. Solving the spread of anthelmintic resistant nematodes of sheep and goats in the UK. *Veterinary Record*, 130, 505-510.

Coles, G.C., Bauer, C., Borgsteede, F.H.M., Geerts, S., Klei, T.R., Taylor, M.A. and Waller, P.J., 1992. World Association for the Advancement of Veterinary Parasitology (W.A.A.V.P) methods for the detection of anthelmintic resistance in nematodes of veterinary importance. *Veterinary Parasitology*, 44, 35-44.

Dash, K.M. and Waller, P., 1987. Drench plan: research-based worm control. *Rural Research*, 135, 4-9.

Donald, A.D. and Waller, P.J., 1982. In: *Biology and control of endoparasites*. Symons, L.E.A., Donald, L.E.A., Donald, A.D and Dineen, J.K. (Eds.). Sydney: Academic Press, 157 pp.

Dorny, P., Claerebout, E., Vercruysse, J., Sani, R. and Jalila, A., 1994. Anthelmintic resistance in goats in peninsular Malaysia. *Veterinary Parasitology*, 55, 327-342.

Dunn, A.M., 1978. *Veterinary Helminthology*, 2nd ed. London: William Heinemann Medical Books, 323 pp.

Drudge, J.H., Leland, S.E., Wyant, Z.N., 1957. Strain variation in the response of sheep nematodes to the action of phenothiazine. I. Studies of mixed infections in experimental animals. *American Journal of Veterinary Research*, 18, 133-141.

Edwards, J.R., Worth, L., De Chaneet, G.C., Brasie, R.B., Karlson, J., Mercombes, P.W., Parton Morgan, G. and Roberts, D., 1986. Survey for anthelmintic resistance in Australian sheep flocks. 2. Relationship with sheep management and parasite control practices. *Australian Veterinary Journal*, 63, 139-143.

Eysker, M. and Ogunsusi, R.A., 1980. Observations on epidemiological and clinical aspects of gastro-intestinal helminthiasis of sheep in northern Nigeria during the rainy season. *Research in Veterinary Science*, 28, 58-62.

Fairweather, I. and Boray, J.C., 1999. Fasciolicides: efficacy, actions, resistance and its management. *The Veterinary Journal*, 158, 81-112.

Faizal, A.C.M. and Rajapakse, R.P.V.J., 2001. Prevalence of coccidian and gastro-intestinal nematode infections in cross bred goats in the dry areas of Sri Lanka. *Small Ruminant Research*, 40, 233-238.

Fakae, B.B. and Chiejina, S.N., 1988. Further studies on the development and availability of infective larvae of bovine gastro-intestinal trichostronglylids on pasture in eastern Nigeria. *Veterinary Parasitology*, 28, 143-152.

Fakae, B.B., 1990. The epidemiology of helminthosis in small ruminants under the traditional husbandry system in eastern Nigeria. *Veterinary Research Communication*, 14, 381-391.

Fritsche, T., Kaufmann, J. and Pfister, K., 1993. Parasite spectrum and seasonal epidemiology of gastro-intestinal nematodes of small ruminants in The Gambia. *Veterinary Parasitology*, 49, 271-283.

Gall, P.H. and Scott, J.M., 1978. The interrelationship of *Lymnaea truncatula* and ovine fascioliasis in Ethiopian central highlands. *British Veterinary Journal*, 134, 551-555.

Gatenby, R.M., 1986. *Sheep production in the tropics and sub-tropics*. Tropical Agricultural Series. Essex: Longman, pp 351.

Gatongi, P.M., 1995. Seasonal variation of egg count to total worm count index in small ruminants. *Proceedings of the Scientific Conference held at the National Veterinary Research Center, Muguga, Kenya, 6-8 December, 1995.*

Gettinby, E., Armour, J., Bairden, K. and Penderleith, R.W.J., 1987. A survey by questionnaire of parasitic worm control in and sheep at Glasgow University Lanark practice. *Veterinary Record*, 121, 487-490.

Gezahegn, L., 1992. Report to the Ministry of Agriculture, Addis Ababa, Ethiopia, 28 pp.

Gibbons, L.M. and Khalil, L.F., 1982. A key for the identification of genera of the nematode family Trichostrongylidae Leiper, 1912. *Journal of Helminthology*, 56, 185-233.

Githigia, S.M., Thamsborg, S.M. Munyua, W.K. and Maingi, N., 2001. Impact of gastro-intestinal helminths on production in goats in Kenya. *Small Ruminant Research*, 42, 21-29.

Gordon, H.McL., 1953. The epidemiology of helminthosis in sheep in winter rainfall regions of Australia. I. Preliminary observations. *Australian Veterinary Journal*, 29, 337-348.

Gordon, H.McL., 1973. Epidemiology and control of gastro-intestinal nematodes of ruminants. *Advances in Veterinary Science*, 17, 395-437.

Graber, M.M., 1975. Helminths and helminthiasis of different domestic and wild animals of Ethiopia. *Bulletin of Animal Health and Production in Africa*, 23, 57-86.

Graber, M.M., 1978a. Helminth and helminthiases of domestic and wild animals in Ethiopia. *Institut Médicine Vétérinaire des pays Tropicaux*, 1, 200 pp.

Graber, M.M., 1978b. Muscle cysticerciasis of Ethiopian wild and domestic ruminants, *Revue d'Elevage et de Médicine Vétérinaire des pays Tropicaux*, 33-37.

Graber, M.M., Delavenay, R. and Tesfa-Mariam., 1978c. *Pseudomarshalagia elongata* Roetti, 1941 (Nematoda: Trichostrongylidae), from the abomasums of small ruminants in Ethiopia. *Revue d'Elevage et de Medicine Veterinaire des pays Tropicaux*, 31, 171-177.

Hansen, J. and Perry, B., 1994. The epidemiology and control of helminth parasites of ruminants. A handbook. International Laboratory for Research on Animal Diseases (ILRAD), Nairobi, Kenya, 171 pp.

Harper, C.K. and Penzhorn, B.L., 1999. Occurrence and diversity of coccidia in indigenous goats, Saanen and crossbreed goats in South Africa. *Veterinary Parasitology*, 82, 1-9.

Holmes, P.H., 1987. Pathophysiology of nematode infection. *International Journal for Parasitology*, 17, 443-451.

Horak, I.G., 1981. Host specificity and the distribution of the helminth parasites of sheep, cattle, impala and blesbok according to climate. *Journal of the South African Veterinary Association*, 52, 201-206.

Horak, I.G., Knight, M.M. and Williams, E.J., 1991. Parasites of domesticated and wild animals in South Africa. XXVIII. Helminths and arthropod parasites of Angora goats and kids in Valley Bushveld. *Onderstepoort Journal of Veterinary Research,* 58, 253-260.

Jalila, A., Dorny, P., Sani, R., Salini, N.B. and Vercruysse, J., 1998. Coccidial infections of goats in Selangor, Peninsular Malaysia. *Veterinary Parasitology*, 74, 165-172.

Kaplan, R.M., 2004. Drug resistance in nematodes of veterinary importance: a status report. *Trends in Parasitology*, 20, 477-481.

Kaplan, R.M., Burke, J.M., Terrill, T.H., Miller, J.E., Getz, W.R., Mobini, S., Valencia, E., Williams, M.J., Williamson, L.H., Larsen, M. and Vatta, A.F., 2004. Validation of the FAMACHA© eye color chart for detecting clinical anaemia in sheep and goats on farms in southern United States. *Veterinary Parasitology*, 123, 105-120.

Kanyari, P.W.N., 1993. The relationship between coccidial and helminth infections in sheep and goats in Kenya. *Veterinary Parasitology*, 51, 137-141.

Kaya, G., 2004. Prevalence of *Eimeria* species in lambs in Antakya Province. *Turkish Journal of Veterinary and Animal Science*, 28, 2004.

Kettle, P.R., Vlassoff, A., Judith, M., Jennifer Lukies, Ayling, M. and McMurty, L.W., 1981. A survey of nematode control measures used by sheep farmers and of anthelmintic resistance on their farms. *New Zealand Veterinary Journal*, 29, 81-83.

Kettle, P.R., Vlassoff, A., Ayling, J.M., McMurty, L.W., Smith, S.J. and Watson, A.J., 1982. A survey of nematode control measures used by sheep farmers and anthelmintic resistance on these farms. Part 2. South Island excluding the Nelson region. *New Zealand Veterinary Journal*, 30, 79-81.

Kettle, P.R., Vlassoff, A., Reid, T.C. and Horton, C.J., 1983. A survey of nematode control measures used by milking goat farmers and of anthelmintic resistance on their farms. *New Zealand veterinary Journal*, 31, 139-143.

Krecek, R.C., Groeneveld, H.T. and Van Wyk, J.A., 1991. Effect of time of day, season and stratum on *Haemonchus contortus* and *Haemonchus placei* third stage larvae on irrigated pasture. *Veterinary Parasitology*, 40, 87-98.

Kusiluka, L.J.M., Kambarage, D.M., Matthewman, R.W., Harrison, L.J.S. and Daborn, C.J., 1996. Coccidiosis of small ruminants in Tanzania. *Small Ruminants Research*, 21, 127-131. Abstract/Journal Format-PDF.

Kusiluka, L.J.M., Kambarage, D.M., Harrison, L.J.S., Daborn, C.J. and Matthewman, R.W., 1998. Causes of morbidity and mortality in goats in Morogoro district, Tanzania: The influence of management. *Small Ruminants Research*, 29, 167-172. Article/Journal Format-PDF.

Le Jambre, L.F., Royal, W.M. and Martin, P.J., 1979. The inheritance of thiabendazole resistance in *H. contortus. Parasitology*, 78, 107-119.

Le Jambre, L.F., Prichard, R.K., Hennessy, D.R. and Laby, R.H., 1981. *Research in Veterinary Science* 31, 289.

Lemma, B., Gebre-ab, F. and Tedla, S., 1985. Studies on fascioliasis in four selected sites in Ethiopia. *Veterinary Parasitology*, 18, 29-37.

Levine, N.D., 1978. *Nematode parasites of domestic animals and of man*. 2nd edition. Minneapolis: Burgess Publishing Company.

Levine, N.D., 1985. *Veterinary protozology*. Ames: Iowa State University Press.

Lloyd, S., Smith, J., Connan, R.M., Hatcher, M.A., Hedges, T.R., Humphrey, D.J. and Jones, A.C., 2000. Parasite control methods used by horse owners: factors predisposing to the development of anthelmintic resistance in nematodes. *The Veterinary Record*, 146, 487-492.

MacKenzie, P.K.I., Boyt, W.P., Emslie, V.W., Lauder, K.P. and Swanepoel, R., 1975. Immunosupression in ovine trypanosomiasis. *The Veterinary Record*, 97, 452-453.

MAFF, 1986. Manual of veterinary parasitological techniques. Technical Bulletin No. 18, London, pp 131.

Maingi, N., 1991. Resistance to thiabendazole, fenbendazole and levamisole in *Haemonchus* and *Trichostrongylus* species in sheep on a Kenyan farm. *Veterinary Parasitology*, 39, 285-291.

Maingi, N., Bjørn, H., Thamsborg, S.M., Bogh, H.O. and Nansen, P., 1996a. A survey of anthelmintic resistance in nematode parasites of goats in Denmark. *Veterinary Parasitology*, 66, 53-66.

Maingi, N., Bjørn, H., Thamsborg, S.M., Dangolla, A. and Kyvsgaard, N.C., 1996b. A questionnaire survey for nematode parasite control practices on goat farms in Denmark. *Veterinary Parasitology*, 66, 25-37.

Maingi, N., Bjørn, H., Gichihi, V.M., Munyua, W.K. and Gathuma, J.M., 1998. Resistance to benzimidazoles and levamisole in nematode parasites of sheep in Nyandarua district of Kenya. *Acta Tropica*, 69, 31-40.

Malan, F.S. and Van Wyk, J.A., 1992. The packed cell volume and colour of the conjunctiva as aids for monitoring *Haemonchus contortus* infection in sheep. In: *Proceedings of the South African Veterinary Association, Biennial National Veterinary Congress. Grahamstown, South Africa.*

Malan, F.S., Van Wyk, J.A. and Wessels, C.D., 2001. Clinical evaluation of anaemia in sheep: early trials. *Onderstepoort Journal of Veterinary Research*, 68, 165-174.

Mamo, B., Gebre-ab, F. and Tedla, S., 1981. Observations on *Dictyocaulus filaria* (Rudolphi, 1809) in Wolo and Arsi administrative regions of Ethiopia. *Ethiopian Journal of Agricultural Science*, 3, 75-80.

Martin, P.J., 1985. Nematode control schemes and anthelmintic resistance. In: Anderson, N. and Waller, P.J. (Eds.). *Resistance in nematodes to anthelmintic drugs*, CSIRO, Division of Animal Health, p 29-45.

Martin, P.J., 1987. Development and control of resistance to anthelmintics. *International Journal for Parasitology*, 17, 493-501.

McKenna, P.B., 1972. The identity and prevalence of coccidia species in sheep and cattle in New Zealand. *New Zealand Veterinary Journal*, 20, 225-228.

McKenna, P.B., 1997. Use of arithmetic and geometric means in calculation of anthelmintic efficacy. *The Veterinary Record*, 141, 472-473.

Michel, J.F., 1969. The epidemiology and control of some nematode infections in grazing animals. In: Dawes, B. (Ed.). *Advances in Parasitology*, 7, 211-282.

Michel, J.F., 1976. The epidemiology and control of some nematode infections in grazing animals. In: Dawes, B. (Ed.). *Advances in Parasitology*, 14, 355-397.

Michel, J.F., Lotham, J.O. and Leech, P.K., 1981. Use of anthelmintics for cattle in England and Wales during 1978. *The Veterinary Record*, 108, 252-258.

Michel, J.F., 1985. Strategies for the use of anthelmintics in livestock and their implications for the development of drug resistance. *Parasitology*, 90, 621-628.

Mulugeta, H.S., Tafesse, M., Getachew, W., Kinfe, G., Getachew, T. and Teshome, Y., 1989. The significance of helminth parasites in livestock production improvement. *Proceedings of the 3rd National Livestock Conference, 24-26 May 1989. Addis Ababa, Ethiopia, 49-53.*

Mwamachi, D.M., Audho, J.O., Thorpe, W. and Baker, R.L., 1995. Evidence for multiple anthelmintic resistances in sheep and goats reared under the same management in coastal Kenya. *Veterinary Parasitology*, 60, 303-313.

Ndamukong, K.J.N. and Sewell, M.M.H., 1992. Resistance to benzimidazole anthelmintics by trichostrongyles in sheep and goats in North-West Cameroon. *Veterinary Parasitology*, 41, 335-339.

Ndarathi, C.M., Wagbela, S. and Semenye, P. P., 1989. Helmenthiasis in Massai ranches in Kenya. *Bulletin of Animal Health and Production in Africa*, 37, 205-208.

Ngomuo, A.J., Kassuka, A.A., Ruheta, M.R., 1990. Critical controlled test to evaluate resistance of field strains of *Haemonchus contortus* to thiophanate. *Veterinary Parasitology*, 36, 21-26.

Norton, C.C., 1986. Coccidia of the domestic goat *Capra hircus*, with notes on *Eimeria ovinoidalis* and *E. bakuensis* (Syn. *E. ovina*) from the sheep *Ovis aries. Parasitology*, 92, 279-289.

O' Callaghan, M.G., O' Donoghue, P.J. and Moore, E., 1987. Coccidia in sheep in South Australia. *Veterinary Parasitology*, 24, 175-183.

Ogunsui, R.A. and Eysker, M., 1979. Inhibited development of trichostrongylids of sheep in Northern Nigeria. *Research in Veterinary Science*, 26, 111-116.

Orr, R.M., 1982. Animal production. Animal physiology. In: Haaley, R.T. (Ed.). *The agricultural note book*, 17th edition. London: Butterworth, pp 305-318.

Pandey, V.S. and Sivarj, S., 1994. Anthelmintic resistance in *Haemonchus contortus* from sheep in Malaysia. *Veterinary Parasitology*, 53, 67-74.

Pearson, A.B. and McKenzie, R., 1986. Parasite control in fibre goats-results of a postal questionnaire. *New Zealand Veterinary Journal*, 34, 198-199.

Penzhorn, B.L., Rognlie, M.C., Hall, L.L. and Knapp, S.E., 1994. Enteric coccidia of Cashmere goats in Southwestern Montana, USA. *Veterinary Parasitology*, 55, 137-142. Abstract-Elsevier-BIOBA SE.

Perry, B.D., Randolph, T.F., McDermott, J.J., Sones, K.R. and Thornton, P.K., 2002. Investing in animal health research to alleviate poverty. International Livestock Research Institute, Nairobi, Kenya. pp 148.

Pout, D.D. 1976. Coccidiosis of sheep. A review, *Veterinary Record*, 98, 340-341.

Presidente, P.J.A., 1985. Methods of detection of resistance to anthelmintics. In: Anderson, N. and Waller, P.J. (Eds.). *Resistance in nematode to anthelmintic drugs*, CSIRO, Division of Animal Health, 13-27.

Prichard, R.K., Hall, C.A., Kelly, J.D., Martin, I.C.A. and Donald, A.D., 1980. The problem of anthelmintic resistance in nematodes. *Australian Veterinary Journal*, 56, 239-251.

Prichard, R.K., 1990. Anthelmintic resistance in nematodes: extent, recent understanding and future directions for control and research. *International Journal for Parasitology,* 20, 515-523.

Probert, A.J., 1994. Chemotherapy of helminthes of livestock and man. In: Chowdhury, N. and Tada, I. (Eds.). *Helminthology*. Delhi: Springer Verlag, p 315-334.

Reinecke, R.K., 1983. *Veterinary Helminthology*. Durban: Butterworths, 392 pp.

Riffkin, G.G., Callinan, A.P.C., Freemantle, A.M., Wescott, J.M., Napthine, D.V. and O'Connor, A.J., 1984. Anthelmintic resistance and sheep management practices in South Western Victoria. *Australian Veterinary Journal*, 61, 248-251.

Rolfe, P.F., Boray, J.C., Fitzgibbon, C., Parsons, G., Kemsley, P. and Sangster, N., 1990. Closantel resistance in *Haemonchus contortus* from sheep. *Australian Veterinary Journal*, 67, 29-31.

Russel, A.J.F., Doney, J.M. and Gunn, R.G., 1969. Subjective asseement of body fat in live sheep. *Journal of Agricultural Science*, 72, 451-454

Scherrer, A.M., Pomeroy, W.E. and Charleston, W.A.G., 1990. Anthelmintic usage on goat farms in New Zealand. Results of a postal survey. *New Zealand Veterinary Journal*, 38, 133-135.

Smith, M.C., 1992. Coccidiosis. Goat Handbook. Ithaca, NY: Cornell University,

Smith, M.C. and Sherman, D.M., 1994. Goat medicine, Philadelphia: Lea and Febiger.

Smith, R.D., 1995. *Veterinary Clinical Epidemiology: A problem-oriented approach*. 2nd ed. Boca Raton: CRC Press, 279 pp.

Solomons, Noel W. and Scott, Marilyn E., 1994. Nutritional status of host populations influences parasitic infections. In*: Parasitic and Infectious Diseases*. Marilyn E. Scott and Gary Smith (Eds.). San Diego: Academic Press.

Sotomaior, C., Milczewski, V., Moraes, F.R. and Schwartz, M.G., 2003. Evaluation of FAMACHA system: accuracy of anaemia estimation and use of the method on commercial sheep flocks. V. *International seminar in animal parasitology, Merida, Yucatan, Mexico, p 61-64.*

Soulsby, E.J.L., 1982. *Helminths, Arthropods and Protozoa of Domestic Animals*. 7th ed. London: Bailliere Tindall.

Sutherst, R.W., 1987. Epidemiological concepts and strategies for parasite control: what changes are likely to occur. *International Journal for Parasitology*, 17, 721-728.

Sykes, A.R. and Coop, R.L., 1976. Intake and utilization of food. *Journal of Agricultural Sciences*, 86, 507-515.

Sykes, A.R., 1978. The effect of subclinical parasitism in sheep. *The Veterinary Record*, 102, 32-34.

Taylor, E.L., 1939. Technique for estimation of pasture infestation by strongyloid larvae. *Parasitology*, 31, 473-478.

Taylor, M.A., Hunt, K.R., Wilson, C.A. and Quick, J.M., 1991. Effectiveness of strategic anthelmintic dosing in controlling *Haemonchus contortus* infections in sheep in the United Kingdom. *The Veterinary Record*, 129, 189-192.

Taylor, M.S., Mallon, T.R., Blanchflower, W.J., Kennedy, D.G. and Green, W.P., 1992. Effects of dietary variations of oral fluckicides in sheep. *Journal of Veterinary Pharmacology*, 16, 48-54.

Tembely, S., Lahlou-Kassi, A., Rege, J.E.O., Sovani, S., Diedhiou, M.L. and Baker, R.L., 1997. The epidemiology of nematode infections in sheep in a cool tropical environment. *Veterinary Parasitology*, 70, 129-141.

Tembely, S., Lahlou-Kassi, A., Rege, J.E.O., Mukasa-Mugerwa, E., Anindo, D., Sovani, S. and Baker, R.L., 1998. Breed and season effects on the peri-parturient rise in

nematode egg output in indigenous ewes in a cool tropical environment. *Veterinary Parasitology*, 77, 123-132.

Thamsborg, S.M., Roepstorff, A. and Larsen, M., 1999. Integrated and biological control of parasites in organic and conventional production systems. *Veterinary Parasitology*, 84, 169-186.

Thomson, J.G. and Hall, G.N., 1933. Observation on intestinal coccidiosis of sheep in northern Nigeria. *Journal of Comparative Pathology*, 46, 218-220.

Tilahun, G., 1988. *Dictyocaulus filaria* in Ethiopian sheep: studies on pathogenesis and vaccination. In: *Nuclear Techniques in the Study and Control of Parasitic Diseases of Livestock. PANEL Proceedings Series, 1988, IAEA, Vienna, p 43-60.*

Tritschler, J.P., Giordano, d.J. and Coles, C.G., 1986. Use of anthelmintics by New-England sheep producers. *Journal of American Veterinary Medical Association*, 189, 1309-1313.

Troncy, P.M., 1989. Helminths of livestock and poultry in tropical Africa. In: *Manual of Tropical Veterinary Parasitology,* English Ed. Wallingford: CAB International, pp 3-175.

Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, A.M. and Jennings, F.W., 1987. The epidemiology of parasitic diseases. In: *Veterinary Parasitology*. Essex: Longman Scientific and Technical, pp 249-279.

Van Geldorp, P.J.A. and Schillhorn van Veen, T.W., 1976. Periparturient rise in faecal helminth egg counts of Udah sheep in the Zaria area of Nigeria. *Veterinary Parasitology*, 1, 265-269.

Van Wyk, J.A., Malan, F.S. and Bath, G.F., 1997a. Rampant anthelmintic resistance in sheep in South Africa-what are the options? In: *Managing Anthelmintic Resistance in Endoparasites.* Van Wyk, J.A. and Van Schalkwyk, P.C. (Eds.). *Workshop held at the 16th International Conference of the World Association for the Advancement of Veterinary Parasitology, Sun City, South Africa, August 1997.*

Van Wyk, J.A., Alves, R.M.R. and Michael, L.M., 1997b. A novel key for identifying nematode infective larvae (L_3) from domesticated ruminants. In: *Proceedings of the 16th International Conference of the World Association for the Advancement of Veterinary Parasitology, Sun City, South Africa, August 1997.*

Van Wyk, J.A., Stenson, M.O., Van der Merwe, J.S., Vorster, R.J. and Viljoen, P.G., 1999. Anthelmintic resistance in South Africa: Surveys indicates an extremely serious situation in sheep and goat farming. *Onderstepoort Journal of Veterinary Research,* 66, 273-284.

Van Wyk, J.A., 2001. Refugia-overlooked as perhaps the most potent factor concerning the development of anthelmintic resistance, *Onderstepoort Journal of Veterinary Research,* 68, 55-67.

Van Wyk, J.A., Bath, G.F., Groeneveld, H.T., Stenson, M.O. and Malan, F.S., 2001. Wide testing of the FAMACHA© system for accuracy of clinical evaluation of anaemia caused by Haemonchus spp. Infection in sheep in South Africa. In: *Proceedings of the 5th International Sheep Veterinary Congress, Stellenbosch, South Africa, January 2001.*

Van Wyk, J.A., Cabaret, J. and Michael, L.M., 2004. Morphological identification of nematode larvae of small ruminants and cattle simplified. *Veterinary Parasitology*, 119, 277-306.

Varady, M., Praslicka, J., Corba, J. and Vesely, L., 1993. Multiple anthelmintic resistance of nematodes in imported goats. *The Veterinary Record*, 132, 387-388.

Vatta, A.F., Letty, B.A., Van der Linde, M.J., Van Wijk, E.F., Hansen, J.W., and Krecek, R.C., 2001. Testing for clinical anaemia caused by *Haemonchus* spp. in goats farmed under resource-poor conditions in South Africa using an eye colour chart developed for sheep. *Veterinary Parasitology*, 99, 1-14.

Vatta, A.F., Krecek, R.C., Letty, B.A., van der Linde, M.J., Grimbeck, R.J., De Villiers, J.F. Motswatswe, P.W., Molebiemang, G.S., Boshoff, H.M. and Hansen, J.W., 2002. Incidence of *Haemonchus* spp. and effect on haematocrit and eye colour in goats farmed under resource-poor conditions in South Africa. *Veterinary Parasitology*, 103, 119-131.

Vercruysse, J., 1982. The coccidia of sheep and goats in Senegal. *Veterinary Parasitology*, 10, 297-306.

Vercruysse, J., 1985. The seasonal prevalence of inhibited development of *Haemonchus contortus* in sheep in Senegal. *Veterinary Parasitology*, 17, 159-163.

Vlassoff, A. and Bisset, S.A., 1991. Basic principles of parasite epidemiology. In: *Proceedings of the 21st Seminar, sheep and beef cattle society, New Zealand Veterinary Association, July, 1991,*

Waller, P.J., 1985. Resistance to anthelmintics and the implication for animal production. In: Anderson, N. and Waller, P.J. (Eds.). *Resistance in Nematodes to Anthelmintic Drugs*, CSIRO, Division of Animal Health, p 1-11.

Waller, P.J., 1987. Anthelmintic resistance and the future for roundworm control. *Veterinary Parasitology*, 25, 177-191.

Waller, P.J., Dash, K.M., Barger, I.A., Le Jambre, L.F., and Plant, J., 1995. Anthelmintic resistance in nematode parasites of sheep: learning from the Australian experience. *The Veterinary Record*, 136, 411-413.

Waller, P.J., 1997. Anthelmintic resistance. *Veterinary Parasitology*, 72, 391-412.

Waller, P.J. and Thamsborg, S.M., 2004. Nematode control in 'green' ruminant production systems. *Trends in Parasitology*, 20, 493-497.

Waruiru, R.M., Githigia, A.M. and Nginyi, J.M., 1991. The prevalence of coccidia of goats in Ol'Magogo farm in Kenya. *Bulletin of Animal Health and Production in Africa*, 39, 247-249.

Annexure 1

QUESTIONNAIRE SURVEY ON WORM CONTROL IN SMALL RUMINANTS

Section I. To be answered by the Animal Health Workers (AHW)

Name ……..

Zone……

Address……

To answer questions, please tick or choose number and write in the space provided.

	Yes	No
Q I. Do you treat sheep and goats to control worms?		

Q II. During which seasons do sheep and goats in your area need anthelmintics treatment most?

1. Between June and September		
2. Between October and December		
3. Between January and May		

Q III. Please specify if you drench at the following occasions

	Yes	No
1. Drench when farmers request ?		
2. Drench in connection to mortality sheep & goats?		
3 Drench after faecal examination for worms?		
4. Drench as seasons change		

Q.. IV. How do you get your anthelmintic supply?

	Yes	No
1 From Zonal bureau of agriculture		
2. Regional state bureau of agriculture		
3. Any local drug store/pharmacy		

Q V Rank from 1 to 5 the criteria most commonly used (1) to the least commonly used (5) by farmers when selecting anthelmintic.?

1. Price of drugs	
2. The drug is of bolus & easy to take	
3. Known by colour & trusted efficacy	
4. Experience of good effect	
5. Recommendation from veterinarians	

	Yes	No
Q VI Do farmers in your area buy anthelmintics so that they can treat sheep and goats on their own?		

Q VII Do you think farmers knowingly or unknowingly under-drench the recommended dosage?

1. Yes, they could without knowing 2. No they do not 3. Do not know	

	Yes	No
Q VIII. Do you change the class of anthelmintics you use each year?		
Q IX. Do you change the class more than once per year?		
Q X. Have you had flocks tested for anthelmintic resistant nematode in your area?		
Q XI Have you had any problems with any anthelmintic?		

Q XII. Please tick the anthelmintics you used during the last four years (tick for every year).

	1999	2000	2001	2002
ALBENDAZOLE				
1 Fenbendazole				
2 Wormita				
3. Wormex				
4 Oxibendazole				
5 Albendazole				
6 Vetalbel				
7 Thiabenzole				
8 Triclobendazole				
9 Albenol				
LEVAMISOLE				
10 Febantel				
11 Deaxamine				
12 Pamizole sheep				
13 Tetramisole				
14 Bolumisol				
15 Fenbendazole				
AVERMECTINS				
16 Ivermectin				
17 Doramectin				
18 Avimec				
19 Ivectin				
SALICYLANILIDES				
20 Closantel				
21 Rafoxanide				
If others write & tick				

Q XIII Do you know of any farmer in your area who uses herbal preparation for the control of worms in animals?

Yes	No

Q XIV. Animals may be treated according to their live-weight. How do you estimate the weight of sheep or goat?

Sheep 1. Visual estimate
2. After weighing

Goats 1 Visual estimate
2 After weighing

Q XV. Which body weight of sheep or goats do you use for estimating dose for drenching (please tick once at sheep and sheep) ?

Sheep 1. Weight of lightest animal
2. Average body weight
3. Weight of heaviest animal
4. Weight of individual animal

Goat 1. Weight of lightest animal
2. Average body weight
3. Weight of heaviest animal
4. Weight of individual animal

Q XVI. Do you agree to participate in similar study in the future?

Yes	No

Thank you for your cooperation

Annexure 2

QUESTIONNAIRE SURVEY ON WORM CONTROL IN SMALL RUMINANTS

Section II. To be answered by farmers (or his/her representative).

Farmer's name ……..……
Zone …….
District ……..…….
Peasant farmers' association (PA) ……..…….

A. Questions on farm data

Q I. Is the respondent the farm owner or employee?	Yes	No
1. Farm owner	Yes	No
2. Employee	Yes	No
3. Relative	Yes	No

Q II. Gender

1. Female
2. Male

Q III. What is the level of your education?

1. Primary
2. Secondary
3. Read & write
4. Illiterate

Q IV. How many sheep do you have?

1. Lambs	
2. Adult	
3. None	

Q V. How many goats do you have?

1. Kids	
2. Adult	
3. None	

Q VI. Where do your sheep and goats graze?

		Always (1)	Sometimes (2)	Never (3)
1	Back yard			
2	Communal grazing			
3	Aywhere the animals get grass			

Q VII. Do your sheep graze together with?

	Yes	No
1. Cattle		
2. Horse and donkeys		
3. Goats		

Q VIII. What is the condition of the communal grazing area?

1. Poor
2. Average
3. Very good

Q IX. How far is the communal grazing area from your house?

1. About Km
2. Between and 2 Km
3. About 3 Km
4. About 5 Km or more

Q X. Do you supply feed to your sheep and goats?

Yes	No

Q XI. What type of supplement ?

1. Hay
2. Forage leaves
3. Concentrates

Q XII. Which health problems have encounter with your sheep and goats?

1. Infectious diseases
2. Parasitic diseases (worms)
3. If other specify

Q XIII. When do you think the animals' health deteriorates?

1.During wet season
2. During dry season
3. All year round

Always (1)	Sometimes (2)	Never (3)

Q XIV. Did you have sick animals last season?

Yes	No

Q XV. Did your sheep and goats die?

Yes	No

Q XVI. Which worms cause problems?

1. Flukes
2. Round worms
3. All worms

B. Questions on worm contro

Q XVII. Do you treat sheep and goats for worm control?

Yes	No

Q XVIII. Who takes care of your animal health?

1. Self
2. Veterinarians from the Ministry of Agriculture
3. Private veterinary practitioners
4. Traditional healers

Q XIII. When do you think the animals' health deteriorates?

1.During wet season
2. During dry season
3. All year round

Always (1)	Sometimes (2)	Never (3)

Q XIX. How many times do you treat you sheep and goats with anthelmintics?

1. Once in a year
2. Once every six months
3. Only when illness occur
4. More than three times in a year

Commonly (1)	Sometimes (2)	Never (3)

Q XX. Do you know how to dose animals with anthelmintics?

Yes	No

Q XXI. How do you recognize worm problems in your sheep and goats?

1.Diarrhoea and/or coughing
2. Emaciation
3. General weakness/illness sign
4. Bottle jaw

Always (1)	Sometimes (2)	Rarely (3)

Q XIV. Do you observe diarrhoea, loss of body condition or other signs in ewes or dams around the time of parturition?

Yes	No

Q XXIII. If you deworm your animals yourself, from where do you obtain the drugs?

1.Open market
2. From drug vendors
3. From other farmers

Always (1)	Sometimes (2)	Rarely (3)

Q XXIV. How important are the following criteria to select the anthelmintics ?

1. Colour of the drug
2. History of the drug efficacy
3. Recommendation by other farmers
4. Recommendation by veterinarians

Very important (1)	Important (2)	Not important (3)

Q XXV Have you had any problems with any anthelmintics?

Yes	No

Q XXVI.Have you noticed any drug which was not effective?

Yes	No

Q XXVII. Do you know people in your area who use herbs to control worms in animals?

Yes	No

Q XXVIII. How important are the following sources for you to gain knowledge about worms and their management?

1. Farmers' Associations
2. Radio,TV and News papers
3. Extension program of the MOA
4. Government vet. Clinics
5. Private vet. Clinics
6. Rural vet. drug vendors
7. Traditional healers

Very important (1)	Important (2)	Not important (3)

Q XXIX. Was there any governmental or non-governmental program design for worm control strategy in your locality?

Yes	No

Q XXX. Do you agree to participate in a project to study the management of worm control in sheep and goats in your area?

Yes	No

Thank you for your cooperation

Annexure 3

Table A1. Manova Test criteria and exact F statistics for the hypothesis of no weight effect in sheep in the FAMAQCHA© trial.

Statistics	Value	F value	DF	Den DF	Pr>F
Wilks' Lambda	0.0531	25.43	14	20	0.0001
Roy's Greater Root	17.801	25.43	14	20	0.0001

The dependent variables are the levels of monthly weight gain or loss (w1-w15)
Reject the "H_0" hypothesis that there is no weight effect (P<0.0001).

Table A2. Manova Test criteria and exact F statistics for the hypothesis of no weight effect and group interaction in sheep in the FAMAQCHA© trial

Statistics	Value	F value	DF	Den DF	Pr>F
Wilks' Lambda	0.028	3.37	42	60.095	<0.0001
Roy's Greater Root	5.082	7.99	14	22	< 0.0001

The dependent variables are the levels of monthly weight gain or loss (w1-w15)
Reject the "H_0" hypothesis that there is no weight*group effect (P<0.0001).

Table A3. Manova Test criteria and exact F statistics for the hypothesis of no weight effect in goats in the FAMAQCHA© trial.

Statistics	Value	F value	DF	Den DF	Pr>F
Wilks' Lambda	0.094	17.89	14	26	<0.0001
Roy's Greater Root	9.634	17.89	14	26	< 0.0001

The dependent variables are the levels of monthly weight gain or loss (w1-w15)
Reject the "H_0" hypothesis that there is no weight effect (P<0.05).

Table A4. Manova Test criteria and exact F statistics for the hypothesis of no weight effect and group interaction in goats in the FAMAQCHA© trial.

Statistics	Value	F value	DF	Den DF	Pr>F
Wilks' Lambda	0. 161	1.58	42	77.894	<0.004
Roy's Greater Root	9.634	3.75	14	26	< 0.001

The dependent variables are the levels of monthly weight gain or loss (w1-w15)
Reject the "H_0" hypothesis that there is no weight*group effect (P<0.05).

Annexure 4

Sensitivity, specificity and predictive values for positive and negative tests of sheep using FAMACHA© scores and haematocrit cut-off for positive test results and anaemia

FAMACHA© categories	Ht<19% n	Ht>19% n	Sensitivity	Specificity	PV* (-ve)	PV# (+ve)
3,4,5	30	74				
1,2	3	476	90.9	86.6	99.3	28.9
Total	33	550				
4,5	24	44				
1,2,3	9	522	72.7	92.2	98.3	35.3
Total	33	550				

n=number of observations, Ht<19% anaemia present,
Ht>19% anaemia absent, *Predictive value positive,#Predictive value negative.

When FAMACHA© values equal 4 and 5, the Chi-square = 136.1037, P <0. 0001
Fishers Exact Test: 2-sided P <3.579E-26, Thus, P <0.001

When FAMACHA© values equal 3, 4 and 5, the Chi-square = 197.6721 P <0. 000
Fishers Exact Test: 2-sided P <5.o78E-7, Thus, P <0.0001.

Sensitivity, specificity and predictive values for positive and negative tests of goats using FAMACHA© scores and haematocrit cut-off for positive test results and anaemia

FAMACHA© categories	Ht<19% n	Ht>19% n	Sensitivity	Specificity	PV * (-ve)	PV # (+ve)
3,4,5	43	114				
1,2	3	514	93.5	81.9	94.4	27.4
Total	46	628				
4,5	35	44				
1,2,3	11	584	76.1	92.9	98.2	44.3
Total	46	628				

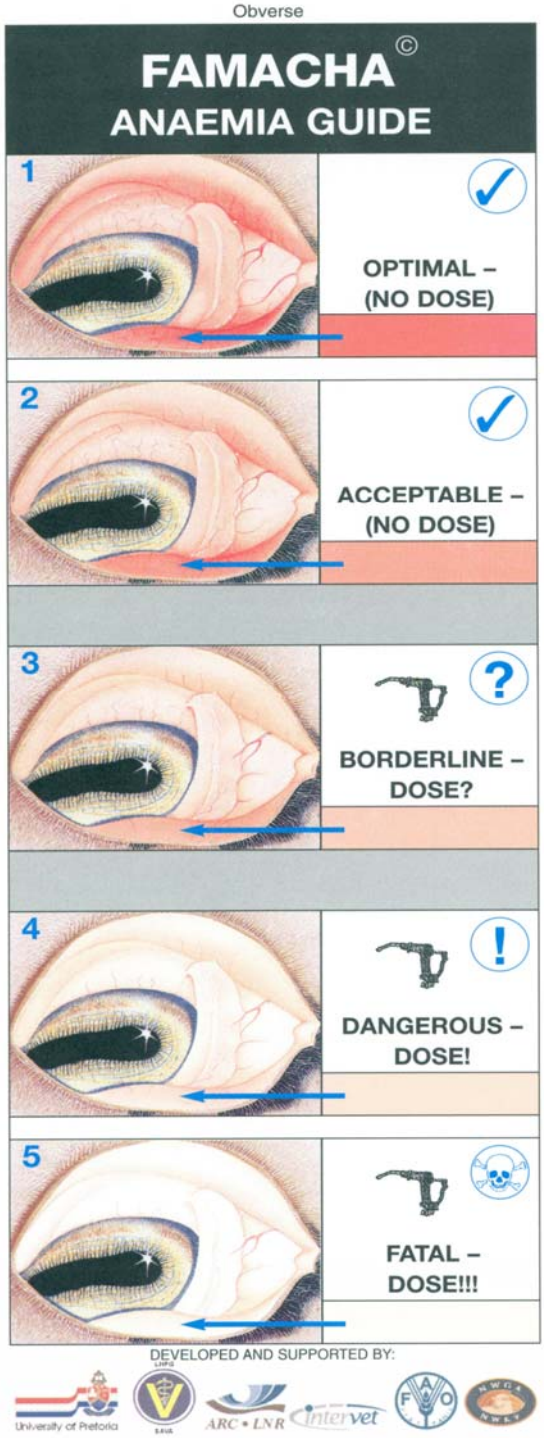
n=number of observations, Ht<19% anaemia present,
Ht>19% anaemia absent, *Predictive value positive, #Predictive value negative.

When FAMACHA© values equal 4 and 5, the Chi-square = 175.31105, P <0.001,
Fishers Exact Test: 2-sided P <3.579E-26, Thus, P <0.001

When the FAMACHA© values equal 3, 4 and 5 the Chi-square = 127, 4296, P <0. 0001
Fishers Exact Test: 2-sided P <3.579E-26, Thus, P <0.001.

Annexure 5

Obverse

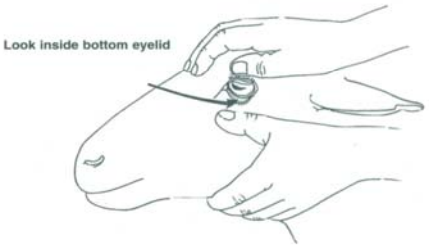


Reverse

INSTRUCTIONS FOR USE

Examination

- Examine sheep in good, natural light
- Open the eyelid as shown in the sketch
- Push the upper eyelid down with the upper thumb, while the lower thumb gently pulls the lower lid downward
- Look especially at the colour inside the lower eyelid
- Open the eyelid for a short time only, or else the mucous membrane may become redder
- Compare the colours seen to those on the reverse side of this card
- Score the sheep 1 to 5 and proceed as explained in the pamphlet
- If in doubt, score the sheep at the lower (paler) category
- Examine weekly and no less than every 2 to 3 weeks
- Contact your veterinarian if you have any questions



Precautions

- Only properly trained persons should use this card
- Read the full information pamphlet before using the guide and follow instructions carefully
- This guide is intended for sheep only
- If used for goats, all those in category 3 should also be treated
- This card is an aid in the control of wireworm only
- Paleness or reddening of the eyes may have other causes
- Maintain standard worm control measures
- The colours of this card will fade with time, especially if exposed to the sun
- Replace the card after 12 months use
- As the system is used in conditions outside their control, no organisation involved in its development or distribution accepts liabilty for losses or problems associated with its use

Enquiries:

Prof. G F Bath

phone: + 27 12 529-8038

fax: + 27 12 529-8396

email: gfbath@op.up.ac.za