Vet.Med.J.,Giza. Vol.51, No.2. (2003):177-187.

# CONCURRENT GASTROINTESTINAL NEMATODES AND PSOROPTIC MANGE INFESTATION IN SHEEP: CLINICAL INVESTIGATION, SOME BIOCHEMICAL ALTERATION AND TREATMENT

**M.I. EISA and M. ESMAIL***

Dept. of Animal Medicine, Faculty of Veterinary Medicine, Zagazig University

* Dept. of Biochemistry, Faculty of Veterinary Medicine, Zagazig University

Received: 22. 10. 2002

Accepted: 8. 2. 2003

## SUMMARY

Four hundred and eighteen native breed of sheep aged 6-18 months were reared in a private farm belongs to Wady El-Moallak, Ismaillia governorate, Egypt, were examined for the presence of internal parasites and mange. Faecal samples and skin scrapings were collected from diseased animals for parasitological examination and serum for biochemical analysis. Faecal examination revealed that, 121 out of 418 sheep were naturally infested with gastrointestinal nematodes, indicating that the prevalence rate in the examined flock was 28.9%. The most prevalent nematodes recovered by larval cultural were *Trichostrongylus* spp. (33.9%), *Haemonchus* spp. (30.6%), *Oestertagia* spp. (18.2%) and *Nematodiurus* spp. (17.4%).

While, skin scraping examination revealed that, 95 out of 418 sheep (22.7%) were naturally infested with psoroptic mange. Mixed infestation of gastrointestinal nematodes and psoroptic mange were recorded in 86 cases. A high rate (71.1%) of psoroptes ovis was found in gastrointestinal nematodes infested sheep, while it was low (3%) in gastrointestinal nematodes free animals.

On the other side, serum biochemical analysis of minerals, total proteins and some vitamins in sera of infested animals revealed significant decrease in the levels of calcium, inorganic phosphorus, copper, zine, total proteins and vitamins A and E, while significant increase in serum creatinine level was noticed. Treatment of the infested animals with doramectin 1% (Dectomax) was found to be effective against gastrointestinal nematodes and psoroptic mange. In addition, supplementation of the diet with minerals and vitamins, beside spraying of the stables with diazinon assisted in recovery of the infested ainmals.

The present observation declare the problem of naturally occuring of gastrointestinal nematodes-psoroptic mange interaction in sheep and it could be concluded that, GIN infestation can enhance the establishment, survival and pathogenicity of concomitant psoroptic mange infestation.

## INTRODUCTION

Parasitic gastroenteritis is an important disease in animals specially sheep which causes many losses in body weight, milk & wool and death in many young animals (Umur and Arslan, 2000). Economic losses due to gastrointestinal nematode (GIN) parasites in sheep throughout the world and Egypt are considerable. (Spell et al 2001). Parasitic infection ranges from acute disease, frequently with high rates of mortality, chronic disease, resulting in various degrees of morbidity and premature culling, to subclinical infection (Martin and Aitken, 1999).

The incidence of the parasitic diseases varies greatly between areas depending on many factors such as nutrition; pasture, management, climate and immunity (Miller et. al 1998). The prevalence and trials of treatment of parasitic gastroenteritis in Egypt among sheep were investigated by many authors as Shawkat et. al (1991), Fawzia et. al (1994), Abdel-Rahman et. al (1996) and El-Sawalhy and Hassan (1996).

Mange is also of considerable economic significance because of poor animal growth, loss of condition and the downgrading of wool & leather (0íBrien 1999, Marchand 1984 and Khan et. al. 1999). Loss of body weight attributable to parasitoses was put at 25-30% for mange (Naidu and Rao 2000).

In this study, a concurrent gastrointestinal nematodes and mange infestations in sheep have been investigated, beside some serum biochemical analysis and trials of treatment.

## MATERIAL AND METHODS

- **Investigated animals:-** 418 sheep of native breed aged 6-18 months, belonging to a private farm in Wady El-Moallak, Ismaillia governorate, Egypt were used. The clinical examination of diseased sheep was carried out.

- **Samples:- a. Faecal samples** were collected from 418 sheep individually and directly from rectum in clean plastic containers and examined as soon as possible for the presence of parasitic gastroenteritis nematodes.

**Parasitological examination** was done microscopically by using the concentration flotation method for nematode eggs according to Kelly (1984). Gastrointestinal nematodes infestation was evaluated by faecal egg count (FEC) per gram by using McMaster technique according to Solusby (1982). The faccal culture and larval dif-

ferentiation were carried out according to Georgi (1980).

**b. Skin scraping:-** samples were collected from the edges of recent observed lesions upon the bodies of the diseased sheep. Each sample was prepared for microscopical examination using 10% KOH (Mackie and McCartney, 1975) and identification of mites was performed according to Solusby (1982).

*** Serum analysis:-** Serum of diseased animals was subjected to biochemical analysis were done. Estimation of serum total proteins according to the method described by Doumas et. al (1981) was carried out, calcium, inorganic phosphorus, copper and zinc were estimated according to Gindler (1972), Fernandez and Kahn (1971) and Versieck et. al (1974) respectively; creatinine was estimated by kits according to Husdan and Rapapost (1968), and vitamin A level was determined by using trifluoroacetic acid according to Neeld and Pearson (1963), while serum vitamin E level was determined according to Hidiroglou and Karpinski (1987).

**Treatment:-** Treatment were carried out by using doramectin 1% (Dectomax, pfizer, France, batch No. 178400) tried by subcutaneous injection in a dose of 1ml/50kg. B.W. for the diseased sheep either infested with GIN or mange. Also, the diseased animals were supplemented with minerals and vitamins in diet, mineral mixture (1kg/1 ton of feed, UCCMA, Egypt, batch No. 6600) and vitamin AD3E (1kg/1 ton of feed, Arab Co Vet, Egypt, batch No. 010905).

- Diazinon (Diazinon-60, ADWIA, Egypt, batch No. 021063) 1/1000 conc. spray for the stables was used as a control measure to the mange.

Faecal samples and skin scraping were taken from treated sheep after 7 and 14 days post treatment and examined.

**Statistical Analysis:-** The obtained data were computed and analysed for significance using ìTî test according to Selvin (1996). Moreover variability between the groups of sheep was done by analysis of variance (ANOVA) on a computer program (SAS, 1996).

## RESULTS

The diseased sheep were suffering from diarrhea, rough coat, reduced of growth rate, loss of weight, emaciation and unthriftness. Submandibular oedema was observed in 6 cases. Skin affection appeared on some cases in addition to the previous signs. The skin lesions were observed on the wether, flanks, back and thighs. There were itching manifested by bitting and rubbing of the

infested skin; the skin of the affected areas was thickened with some fissures as well as denuded crusts; the wool was broken and extirpated.

Results of the parasitological examination of faecal samples revealed gastrointestinal nematode eggs in 121 sheep out of 418 animals (28.9%) and the mean number of eggs per gram (EPG) by Mc Master technique was 2200 egg/gram. While, the results of faecal culture for larval differentiation revealed the infestation of these animals with *Trichostrongylus* spp., *Haemonchus* spp., *Oesertagia* spp. and *Nematodiurus* spp. (Table 1).

Skin scraping examination recorded 95 sheep were infested with mange (22.7%); table (2). The

Table (1): Result of larval differentiation of faecal culture:

| No. of infested sheep | *Trichostrongylus* | | *Haemonchus* spp. | | *Oesterlagia* spp. | | *Nematodiurus* spp. | |
|---|---|---|---|---|---|---|---|---|
| | No. | +ve% | No. | +ve% | No. | +ve% | No. | +ve% |
| 121 | 41 | 33.9 | 37 | 30.6 | 22 | 18.2 | 21 | 17.4 |

Table (2): Results of parasitological examination of faecal samples and skin scraping:

| Total No. of examined sheep | No. of infested with GIN | Percentage | No. of infested with mite | Percentage | No. of mixed infestation |
|---|---|---|---|---|---|
| 418 | 121 | 28.9% | 95 | 22.7% | 86 |

Table (3): Results of psoroptic mite recovered from GIN infested and GIN free animals

| Total No. of examined sheep | No. of GIN infested sheep | No. of M.I.A. recovered from GIN infested sheep | Positive percentage | No. of GIN free sheep | No. of M.I.A. recovered from GIN free sheep | Positive percentage |
|---|---|---|---|---|---|---|
| 418 | 121 | 86 | 71.1% | 297 | 9 | 3% |

GIN = Gastro intestinal nematodes
M.I.A. = Mite infested animals

mites were identified as *psoroptes ovis*.

Mixed infestation of gastrointestinal nematodes and psoroptic mange was observed in 86 cases. The percentage of infestation with psoroptic mange in GIN infested sheep was high (71.1%) in which 86 animals out of 121 GIN infested one, while it was low (3%) in GIN free sheep (9 animals out of 297 one) Table ( 2,3)

Results of serum analysis revealed significant biochemical alteration in minerals, total proteins, creatinine and vitamins A and E. (Table 4).

Table (4): Results of biochemical analysis:- (Mean ± S.E.)

| Parameters | Apparently normal sheep (Non infested) | Sheep infested with GIN | Sheep infested with mange | Mixed GIN and Mange infestation |
|---|---|---|---|---|
| Calcium | 9.15 | 7.22* | 8.12• | 6.95* |
| (mg%) | ±0.16 | ±0.40 | ±0.14 | ±0.016 |
| Phosphorus | 6.16 | 4.50* | 5.17• | 4.13* |
| (mg%) | ±0.18 | ±0.72 | ±0.56 | ±0.69 |
| Copper | 118.40 | 92.15• | 98.46• | 89.88* |
| (p.p.m.) | ±2.4 | ±0.22 | ±0.26 | ±0.35 |
| Zinc | 102.06 | 83.12• | 89.29• | 78.64* |
| (p.p.m.) | ±1.16 | ±1.10 | ±1.20 | ±1.14 |
| Total proteins | 6.96 | 6.25• | 6.55• | 6.05* |
| (g/dL) | ±0.12 | ±0.18 | ±0.14 | ±0.16 |
| Creatinine | 0.97 | 1.6• | 1.32• | 1.94• |
| mg/dL) | ±0.02 | ±0.04 | ±0.06 | ±0.03 |
| Vitamin A | 1.75 | 1.25• | 1.35• | 1.10* |
| (mg/100ml) | ±0.90 | ±0.30 | ±0.60 | ±0.30 |
| Vitamin E | 2.80 | 2.10• | 2.30• | 2.0• |
| (mg/100ml) | ±1.10 | ±75 | ±0.90 | ±0.35 |

S. E.= Stander error.
• Significant at P<0.05.
* Highly significant at P < 0.01.

Table (5): Result of examined samples taken from treated sheep (7 and 14 days post treatment)

| Samples | No. of examined samples | 7 days post treatment | | 14 days post treatment | |
|---|---|---|---|---|---|
| | | No. of + ve | Efficacy % | No. of +ve | Efficacy % |
| Faecal sample for GIN egg | 121 | 12 | 90% | 0 | 100% |
| Skin scraping for mite | 95 | 14 | 85.3% | 0 | 100% |

**Treatment:-**

Doramectin 1% (Dectomax) at a dose of 1ml/ 50kg. B. W. S/C. injection was proved to be effective against gasttrointestinal nematodes and posroptic mange. Clinical improvement was observed after treatment of infested sheep as indicated by disappearance of previously recorded signs. Spraying the stables with diazinon controlled the mange disease.

Faecal examination and skin scraping which were taken from treated sheep after 14 days post treatment revealed negative results.

## DISCUSSION

Gastrointestinal helminths are major contributors to reduced productivity and can lower the production of meat, milk and wool (Maiti et. al. 1999). In intensive farming systems, control is achieved through regular treatment with anthelmintics. The prevalence rate of infestation; severity of signs of parasitism and damage to the gastrointestinal tract will be influenced by host age, breed, immunological experience, management, pasture, climate and nutritional status (Miller et. al 1998; Martin & Aitken, 1999 and Valderrabano et. al 2002).

This investigation revealed the parasite spectrum and the prevalence of gastrointestinal nematodes infestation in naturally infested sheep in Wady El-Moallak, Ismaillia governorate, Egypt. Of the 418 investigated sheep, 121 animals (28.9%) were infested with GIN. The nematodes recovered from sheep by larval cultural were *trichostrongylus spp.* (33.9%), Haemonchus spp. (30.6%), *Oestertagia spp.* (18.2%) and Nematodiurus spp. (17.4%). The previously mentioned clinical signs of diseased sheep and the results of faecal exaimination and faecal culture were nearly similar to these previously reported in Egypt by Degheidy (1981), Shawkat et. al (1991), Fawzia et. al (1994) and El-

Sawalhy and Hassan (1996).

Results of skin scraping examination revealed that 95 out of 418 (22.7%) sheep were naturally infested with psoroptic mange. The mites have been identified as *psoroptes ovis*. This result agree with Mage (1998), Corke and Broom (1999), Ochs et. al (1999) and Taylor (1999). At farm level relevant factors must be considered in approaching the mange outbreak such as source of infestation, helminth parasite status and general health status of the flock (O'Brien 1999). On the other hand, mixed infestation of gastrointestinal nematodes and psoroptic mange were recorded in 86 animals out of 121 GIN infested one (71.1%), while it was low (3%) in GIN free animals (9 animals out of 297 one).

From the obtained results it could be concluded that gastrointestinal nematodes may enhance susceptibility of sheep to psoroptic mange and predispose to infestation and provides data on naturally occurring concurrent GIN-mange infestation in reared sheep and declares the problem of their infestation in sheep. Naturally occurring of parasitic diseases in farm animals are frequently caused by concurrent infections with two or more immunobiologically unrelated or remotely related species of parasites (Fakae and Chiejina, 1993), while, Christensen et. al. (1987) reported that heterologous parasite - parasite interaction in domestic animals may give rise to the prolonged survival and enhanced pathogenicity of one of the concomitant infections. Also, Zeybek (1985), Wosu (1988), Bruere and West (1993) and Fritsche et. al (1993) reported that gastrointestinal nematodes naturally infested with mange. However, these infestations were always reported as separate health problems in their own right and no consideration was given to the implication of concurrent infestation.

Regarding serum biochemical analysis to of minerals, total proteins, creatinine and vitamins A & E, the obtained results in our study demonstrated a significant decrease in the levels of calcium, inorganic phosphorus, copper, zinc, total proteins and vitamins A and E. A significant decrease ($P<0.5$) was showed either with gastrointestinal nematodes or psoroptic mange infested animals, while high significantly decrease ($P<0.01$) was shown in mixed infestation. Similar results were reported by many authors as El-Gharieb et. al. (1995), Paranagama et. al (1997) and Butter et. al (2000). They attributed these results to the nematodes infestation which induces desquamation & sloughing of the epithelium, villous atrophy and consequently decreases absorption of minerals & other food nutrients and inappetance. Moreover, the results recorded significant increase ($P<0.5$) in serum creatinine. The result recorded normal value of serum creatinine in non infested sheep, while the value was increased in infested sheep

with GIN and mixed GIN with mange. This results were nearly similar to these previously recorded by Metwalli (1987) and Omer et. al (1995). They attributed these changes to kidney impairments and dysfunction caused by toxins produced by parasites.Vitamins A and E deficiency may increase the susceptibility of sheep to infection with parasites (Omar et. al. 1995). It seems very essential for increasing the disease resistance that a daily allowance of both vitamins A and E should be given. Sheep on poor nutrition have significantly higher mite population, more scurf and greater fleece derangement (Radostits et. al. 2000). Inadequate nutrition of some minerals (copper and zinc) alter immunocompetence in animals and minerals deficient status leads to increased susceptibility to infectious illnesses (Sherman 1992).

The control of the nematodes depend on grazing management and/or anthelmintic treatment, the anthelmintic treatment has been the primary control method (Waller 1994 Hertzberg et. al. 2001 and Maingi et. al 2002). Treatment of the infested animals with doramectin 1% (Dectomax) in dose of 1ml/50Kg. B.W.S/C. injection was found to be effective. The result have been shown it to be have full therapeutic efficacy against gastrointestinal nematodes and psoroptic mange. The drug gave an efficacy reached to 90% and 85.3% on GIN and mange respectively after 7 days post treatment; while; parasitological examination of faecal samples and skin scraping which taken from treated animals after 14 days revealed negative result (efficacy 100%). Of course when used correctly endectocides have many advantages. Endectocides have both anthelemintic and acaricidal properties and it is easy to use. In addition to supplementation of the diet with minerals and vitamins beside spraying the stables with diazinon controlled these cases.

Finally, gastrointestinal nematodes infestation can enhance the establishment, survival and pathogenicity of concomitant psoroptic mange infestation. The apparent association between two classes of parasites was due to an interaction between them and the minerals and vitamins deficiency due to gastrointestinal nematodes infestation may increase the susceptibility of sheep to psoroptic mange. There is a clear need for greater recognition and study of concurrent helminthes-skin affection in general and gastrointestinal nematodes-mange infestation in particular.

## REFERENCES

Abdel-Rahman M.S., El-Bahy M.M., El-Bahy N.M. and Ramadan E.I. (1996). Testing a new formulation of ivermectin (Ivomec pour-on & Bolus) as broad spectrum parasiticide. Vet. Med. J. Giza. 44 (4) 637-656.

Bruere A.N. and West D.M. (1993): The sheep health disease and production. Vet. Assoc., Palmerston North, New Zealand pp. 397.

Butter N.L., Dawson J.M., Wakelin D. and Buttery P.

(2000): Effect of dietary tannin and protein concentration on nematode infection in lambs. J. Agricul. Science, 134 (1) 89-99.

Christensen N.O., Nansen P., Fagbemi B., and Monrod J. (1987): Heterologous antagonistic and synergistic interaction between helminths and between helminths and protozoan in concurrent experimental infection of mammalin hosts. Parasitol. Res., 73: 387-410.

Corke M.J. and Broom D.M. (1999): The behaviour of sheep with sheep scab, psoroptic ovis infestation. Vet. Parasitol. 83 (3-4) 291-300.

Degheidy, N.S. (1981): Studies on thread worms affecting sheep in Egypt. Ph. D. Thesis Dept. parasitology, Fac. Vet. Med., Cairo University.

Doumas B.T., Carter R.J., Peters T. and Schaffer R.A. (1981): Method for determination of total protein in serum: Development and Validation Clin. Chem., 27: 1642.

El-Gharieb S.A., Abou El-Enean G.E., Metwalli A.A. and Zaghawa A.A. (1995): Clinical and laboratory studies of parasitic gastroenteritis in sheep with a field trial of santonin treatment. Alex. J. Vet. Sci., 11 (3): 121-130.

El-Sawalhy A.A. and Hassan H.Y. (1996). Anthelmintic efficacy and immuno-biochemical studies of Levamisole, Ivermectin and Thiabendazole against GIN in sheep. 7th. Sci. Cong. 17-19 Nov., Fac. Vet. Med. Assiut. Univ.

Fakae B.B. and Chiejina S.N. (1993): The prevalence of concurrent typanosome and GIN infection in West African Dwarl sheep and goat in Nigeria. Vet. Parasitol. 49, 313-318.

Fawzia F.A., Abdella M.S. and Wafaa A.R. (1994). Nematodiasis in sheep at Sharkia governorate: prevalence, some biochemical studies and efficacy of treatment. Alex. J. Vet. Sci. 10 (1) 45-50.

Fernandez F.J. and Kahn H.L. (1971): Clinical methods for atomic absorption spectroscopy. Clin. Chem. News 3: 24.

Fritsche T., Kaufmann J. and Pfister K. (1993): Parasite spectrum and seasonal epidemiology of GIN of small ruminants in the Gambia. Vet. Parasitol. 49: 271-283.

Georgi J.R. (1980): Parasitology for Veterinarian 3rd. Ed., W.B. Saunders, Philadelphia.

Gindler E.M. (1972): Determination of serum calcium level Amer. J. Clin. Pathol. 58: 376.

Hertzberg H., Meyer A, Kohler L., Falconi F and Ochs H (2001): Effect of a single treatment with doramectin on GIN infections of sheep grazing on alpine pastures. Vet. Bull. Vol. 71, No. 12, p. 1483.

Hidiroglou M. and Karpinski K. (1987): Vitamin E kinetics in the sheep. Br. J. Nutr., 58: 113-125.

Husdan H. and Rapapost, A. (1968): Estimation of creatinine by the jaffe reaction. Clini. Chemo. 14 (3) 222-238.

Kelly W.R. (1984): Veterinary Clinical Diagnosis. 3rd. Ed. Bailliere, Tindall, New York.

Khan F.A., Swarnkary C.P. Singh D. and Bhagwan P.S (1999): Efficacy of closantel against sarcoptic mange in sheep. Indian Vet. J. 76 (9) 788-790.

Mackie J.J. and McCartney J.E. (1975): Handbook of practical bacteriology. 10Ed., Edinburgy and Living Stone.

Mage C. (1998): Parasites of sheep: prevention, diagnosis, treatment. Editions France Agricole, Paris, France, P. 124.

Maingi N., Otieno R.O., Gichohi V.M. & Weda F.H. (2002): Strategic control of GIN of sheep in the high-

lands of central Kenya. Ondenstepoort J. Vet. Res. 69 (3) 229-235.

Maiti S.K., Rao V.N., Pal S. and Alis, S.L. (1999). Clinico-haematological and therapeutic studies in parasitic gastroenteritis in sheep. Indian Vet. J. 76 (5) 435-437.

Marchand A. (1984): Economic effects of the main parasitoses of cattle. Revue-de-med. Vet. 135: 5, 299-302.

Martin W.B. and Aitken I.D. (1999): Diseases of sheep 3rd. ed. Blackwell science, p. 159.

Metwalli A.M. (1987): Clinical laboratory investigation on a common disease manifestation among some farm animals. M.V. Sci. Theis, Fac. Vet. Med. Alex. Univ.

Miller J.E., Bahirathan M., Lemarie S.L., Hembry F.G., Kearney M.T. and Barras S.R. (1998). Epidemology of GIN parasitism in Suffolk and Gulf Coast native sheep with special emphasis on relative susceptibility to Haemonchus contortus infection. Vet. Parasit. 74, 55-74.

Naidu M.M. and Rao D.V. (2000): Clinical and haematological observations in goats with sarcoptic mange. Vet. Bull. Vol. 70 No. 5 P. 542.

Neeld J.B and Pearson M.N. (1963): Macro and micromethods for the determination of serum vitamin A using trifluroacetic acid. J. Nutr., 79: 454-462.

O'Brien (1999): Treatment of psoroptic mange with reference to epidemiology and history. Vet. Parasito 83: 177-185.

Ochs, H. Mathis, A. and Deplazes P. (1999): Single nucleotide variation in r DNA ITS-2 differentiates psoptic isolates from sheep and rabbits from the same geographical area. Parasitology, 119 (4) 419-424.

Omar M.A., Samia A. Ahmed, Radwan Y.A., El-Nimer I.Z. and El-Sherief Y.G. (1995): Changes in blood serum vitamins A and E as well as testosterone hormone in Borki sheep infested with Eimeria species. Alex. Vet. Science. 11 (2) 53-57.

Paranagama W.D., Rajapakse R.P., Horadagoda N.U. and Faizal A.C. (1997): Correlation between naturally occurring caprine haemonchus contortus infection and the packed cell volume, haemoglobin concentration, total protein and albumin. Tropical Agrica. Res., 9: 229-235.

Radostits, O.M, Gay C.C., Blood D.C. and Hinchcliff, K.W. (2000): Veterinary Medicine. A textbook of the diseases of cattle, sheep, pigs, goats and horses 9th Ed., W.B. Saunders Company Ltd, London, New York, Philadelphia, Sydney.

SAS (1996): SAS user's Guide: Statistics, 6th. Ed., Institute Inc. Cary, North Carolina, USA.

Selvin S. (1996): Statistical Analysis of Epidemiologic Data. 2nd Ed. pp 44-78. Oxford Univ. Press, New York, London.

Shawkat E.M., Abdel Halim A.A., Kubesy G.M., Rakha G.M. and El-Fauomy M.M. (1991). Clinical and therapeutic studies on parasitic gastroenteritis in sheep. Vet. Med. J. Giza, 39 (2) 237-254.

Sherman A.R. (1992): Zinic, copper and iron nutriture and immunity J. Nutr., 122, 604-609.

Solusby F.J. (1982): Helminthes, Arthropods and protozoa of domesticated animals. 7th Ed., the English language book society and Baillere, Tindall, London.

Spell A., Khan M. and Khan F (2001): Prevalence of GIN parasite in sheep and goats maintainel at NARC, Islamabad. Vet. Bull. Vol. 71, No. 11, p. 1339.

Taylor S.M. (1999): Sheep scab enviromental considerations of treatment with doramectin Vet. Parasitol., 83 (3-

4) 309-317.

Umur S. and Arslan M.O. (2000). Effect of doramectin on gastrointestinal nematodes and weight gains of naturally infected lambs. Acta parasitologica Turcica, 24 (1) 67-72.

Valderrabano J. Delfa R.V. and Uriate J. (2002): Effect of level of feed intake on the development of GIN parasitism in growing lambs. Vet. Parasito., Apr 2, 104 (4) 327-338.

Versieck J., Barbier F.S., Peecke A. and Hostest J. (1974): Manganese, copper and zinc concentration in serum. Clinical Chem. 20: 1141-1145.

Waller P.J. (1994): The development of anthelmintic resistance in ruminant livestock Acta. Tropica 56: 233-243.

Wosu L.O. (1988): Prevalence of disease conditions and pregnarncy in sheep and goats seen over 3 year period in Nigeria Arch. Roum. De Pathol. Exper. Micro. 47: 1. 57-64.

Zeybek H. (1985): Activity of ivermectin against Hypoderma larvae and other endo and ectoparasites in Angora goats. Etlik Vet. Mikro.-Enst. Derg., 5: (8-9) 51-60.