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Prevalence and Diversity of Gastrointestinal Parasites in small Ruminants under Two Different Rearing Systems in Jenin District of Palestine

دراسة انتشار وتنوع طفيليات الجهاز الهضمي عند المجترات الصغيره باستخدام نظامين من التربية في محافظة جنين في فلسطين

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Abstract

This study was undertaken to investigate the prevalence of gastrointestinal parasites (GIP) in goats and sheep kept under extensive and intensive management systems in the district of Jenin, Palestine, during the period from January to December 2010. Factors affecting diversity, distribution and intensity of infection by GIP were investigated. Data about farm history and breeding management were collected by means of a questionnaire. A total of 810 faecal samples from small ruminants composed of 285 and 525 samples from intensive and extensive rearing systems, respectively, were collected from eight villages (Yamoun, Bet qad, Merkah, Talfeet, Kfaret, Tarem, Jab`a and Aneen). A total of thirteen genera of the GIPs, included (eleven nematodes, one cestode (*Moniezia*) and one protozoan (*Eimeria*) were recovered. The results showed fewer diversity of GIP in intensive rearing system. The prevalence of GIPs in animals reared under extensive system (26.5%) was significantly higher (P<0.01) than those reared under intensive system (7.9%). The prevalence values of GIPs differed significantly (P<0.01) between some villages. The highest prevalence of infection (30.8%) was in Tarem with a proportion of (21.1 %) and the lowest (7.7%) in Betqad with a proportion of (5.3%). The dominant parasite was *Eimeria spp* (81.1% prevalence and 34.2% proportion) of total parasites in the area. This was followed by *Dictyocaulus spp* (49.1% prevalence, 20.7% proportion) and *Haemonchus spp* (23.1% prevalence and 9.7% proportion). Results showed that, animals kept under intensive grazing system had lower prevalence of GIP with low diversity (*Eimeria spp*, *Dictyocaulus spp*, *Trichostrongylus spp*, *Neoscaris spp*, and *Ascaris spp* than animals kept under extensive grazing system (*Eimeria spp*, *Dictyocaulus spp*, *Haemonchus spp*, *Moniezia spp*, *Trichostrongylus spp*, *Strongylus spp*, *Neoscaris spp*, *Nematodirus spp*, *Strongyloides spp*, *Ascaris spp*, *Cooperia spp*, *Chabertia spp* and *Trichuris spp*). The occurrence of parasites with zoonotic significance (*Eimeria spp*, *Dictyocaulus spp* and *Haemonchus spp*) is discussed.

Key words: Gastrointestinal parasite, Prevalence, Extensive rearing system, Intensive rearing system, Species diversity, Small ruminant.

ملخص

هدفت هذه الدراسة الى عزل الطفيليات التي تصيب الجهاز الهضمي في المجترات الصغيرة حسب نوع التربية في المزرعة وهي نوعان (تربية مكثفة، تربية غير مكثفة) في منطقة جنين وذلك خلال الفترة الواقعة بين شهر يناير واكتوبر من العام ٢٠١٠. تم جمع المعلومات عن طرق التربية المتبعة لكل مزارع واستخدامه للعقاقير المضادة للطفيليات وعدد الحيوانات في المزرعة من خلال استبيان واسئلة مباشرة وغير مباشرة للمزارعين. تم جمع ٨١٠ عينة من الروث اخذت من فتحه الشرج من الحيوانات، منها ٢٨٥ عينة من الحيوانات المرباه باستخدام نظام التربية المكثفه و٥٢٥ من الحيوانات المرباه باستخدام نظام التربية غير المكثفه في ثمانيـة قرى من محافظه جنين وهي: اليامون، بيت قاد، مركة، تلفيت، كفيرت، الطرم، جبع وعانين. خلال الدراسة تم عزل ثلاثة عشر جنس من الطفيليات التي تصيب المجترات الصغيرة وهي احد عشرجنس ينتمي للديدان الاسطوانيه وجنس واحد ينتمي للديدان الشريطيه *Moniezia* وجنس واحد ينتمي للاوليات *Emieria*. بينت الدراسة ان نسبه معدلات الاصابه بالاجناس المختلفه هي ٢٦.٥% في الحيوانات الموجوده في النظام التربية الغير مكثف والاجناس هي (*Eimeria*, *Dictyocaulus*, *Haemonchus*, *Moniezia*, *Trichostrongylus* *Strongylus*, *Neoscaris*, *Nematodirus*, *Strongyloides*, *Ascaris*, *Cooperia*, *Chabertia* and *Trichuris*) بينما كانت نسبه معدلات الاصابه ٧.٩% عند المجترات الصغيره باستخدام نظام التربيه المكثف وهذه الاجناس هي (*Eimeria*, *Dictyocaulus*, *Trichostrongylus*, *Neoscaris* and *Ascaris*). ومن

هنا نلاحظ أن نسبة الاصابة في الحيوانات في نظام التربية غير المكثف أعلى وعدد اجناس الطفيليات التي تم عزلها اكثر من الحيوانات المرباه في نظام التربية المكثف وكانت الفروق معنوية (P<0.01)، وقد لوحظ أن هناك فروق معنوية (P< 0.01) في نسبة الاصابة بين القرى المختلفة حيث أن قرية الطرم سجلت اعلى نسبة اصابه حيث بلغت ٣٠.٨% وهي تشكل حوالي ٢١.١% من نسبة انتشار الطفيليات في مواقع الدراسة، واقل هذه النسب سجلت في بيت قاد وتشكل ٧.٧% ما نسبته ٥.٣% من نسبة انتشار الطفيليات في مواقع الدراسة. وبينت الدراسة ايضا ان هناك فروق معنوية (P <0.01) بين الاجناس التي تم عزلها حيث ان *Eimeria* كانت اكثر الاجناس انتشارا ٨١.١% من العينات المصابة وتشكل ما نسبته ٣٤.٢% من الاجناس التي تم عزلها، ثم تليها *Dictyocaulus* ٤٩.١% أي ما نسبته ٢٠.٧% من الاجناس التي تم عزلها، ثم *Heamonochus* ٢٣.١% من العينات المصابة وهي تشكل ما نسبته ٩.٧% من الاجناس التي تم عزلها.

Introduction

Despite the large livestock population in Palestine, the productivity per unit of animal and the economic benefits remain marginal (Palestinian Ministry of Agriculture 2009). This may be due to different factors such as poor nutrition, prevalence of diseases, lack of appropriate breeding strategies, reproductive inefficiency, management constraints and general lack of veterinary care (Za'za' 2008, Isaac and Hassassian 2001). However, production of livestock under natural conditions has led to a reversion to primarily outdoor production systems and less intensive indoor housing, more forage-based diets, and reduced reliance on external inputs like parasiticides causing an emergence of parasitic infections (Thamsborg and Roepstorff 2003).

Helminth parasitism, especially gastrointestinal GI parasitism, has been considered as a major constraint to livestock production worldwide, particularly in developing countries or in resource-poor regions (Tariq et al. 2010, Perry et al. 2002). Economic losses, lowered productivity, reduced animal performance and weight gain, retarded growth, cost of treatment, and mortality are caused by parasites affecting the income of small holder farming communities (Perry et al. 2002). Most of the losses are caused by the gastro-intestinal nematodes (roundworms). However, trematode (fluke) and cestode (tapeworm) parasites may also contribute to detrimental worm burdens in animals (Rahmann and Seip 2006).

Various risk factors, including those of the host and the environment, play an important role in the onset of GI infections. The diverse agro-climatic conditions, animal husbandry practices and pasture management, largely determine the type, incidence and severity of various parasitic diseases (Mohanta et al. 2007, Tariq et al. 2010). No epidemiological information is available on GI parasites of goats and sheep in Palestine. Information on the epidemiological patterns of the parasitic diseases in Jenin district, provides a significant understanding of the prevalence of GI parasites within given environment and associated risk factors that influence their transmission which can in turn give us the basis for developing an efficient and effective strategic and tactical control of these diseases. So far, very little attention has been paid to determine the population dynamics, prevalence and pathological conditions produced by intestinal helminths in goats and sheep in Palestine. The objectives of the present study are to evaluate association of the grassland with parasitic diseases in two different rearing systems of small ruminants (goats and sheep) in Jenin district. This study was designed to investigate the epidemiological aspects and prevalence of infection by GI parasites in randomly selected goat and sheep populations.

Materials and methods

Study area

The study was conducted in Jenin district, Palestine (32° 27′ 42.51″ North and 35° 18′ 4.88″ East). The area is considered one of the most agricultural districts in Palestine with some grassland used for grazing. The climate of the area is temperate with the mean maximum temperature range 17.4 - 34.2°C, Mean Relative Humidity 65-80% and mean annual rainfall 468.2mm (Palestine Met. Office 2010). The study sites and farms were purposively selected on the basis of having a higher number of livestock as well as on earth-based environmental variables in the area of study such as: geographical locations (north, south, east and west), morphological characteristics of the site, climate and vegetation. Samples were collected from eight villages (Yamoun, Bet qad, Merkah, Talfeet, Kfaret, Tarem, Jab`a and Aneen) and examined during the period from January to December 2010.

Study design and description of animals

The flocks used in this study consisted of 1787 heads of goats and sheep. A well-structured questionnaire was prepared, including farm and owner details (location and owner`s name); details about animals including numbers and other information for further studies such as age, sex, local (indigenous breed) or hybrid (cross-bred); farm management and husbandry practices (animals kept under extensive system were grazed in communal grasslands whereas animals kept under intensive system were zero grazed); and actions taken against parasitic infection when necessary, and general grazing management. Subjects were randomly selected from the population without knowledge of the disease status. In order to prevent any bias in sampling, randomization was done to prevent differential selection of goats and sheep, so that variation in data is evenly distributed among the subjects. From each farmer, three to five animals were sampled to achieve equal representation. A total of 810 faecal samples were composed of 285 and 525 samples from intensive and extensive rearing systems, respectively, were obtained from the rectum of the animals (Table 1). Samples were kept cool in faecal pots and transferred to the laboratory of the Palestinian National Agriculture Research Center (NARC) for further evaluation of nematode, cestode and Protozoan eggs.

Parasitological examination

Faecal samples were collected every second week directly from the rectum of each animal were subjected to qualitative examinations for GI parasites. Faecal GI parasites eggs were determined using a modified technique with saturated sodium chloride solution (NaCl; SG 1.20) as the floating medium (Urquhart et al. 1996 and Pereckiene et al. 2007). For each sample, 3 g of faeces were mixed in 40 ml of saturated salt solution in a test tube. The tubes were spun in a centrifuge for a short time and allowed to settle for 10 – 15 min. Then, the upper phase containing parasite eggs collected and examined under the microscope. Faecal direct smears were used to detect motile trophozoites, cysts and larvae of parasites.

Table 1: Number of animals sampled (810) from different sites of Jenin district area, included the positive samples (761) that contain at least one or more genus type of parasite. Animals were managed either in an extensive or in an intensive rearing system.

Rearing System	Jenin District Area (Sample/Animals/Positive sample)								
	Yamoun	Bet qad	Merkah	Talfeet	Kfaret	Tarem	Jab`a	Aneen	Total
Extensive	137/400/137	50/182/50	30/78/30	95/400/95	42/272/38	10/25/10	93/260/93	68/170/68	525/1787/521
Intensive	45/400/40	68/182/68	14/78/10	40/400/35	32/272/22	5/25/5	76/260/55	5/170/5	285/1787/240
Sample tested	182/400/177	118/182/118	44/78/40	135/400/130	74/272/60	15/25/15	169/260/148	73/170/73	810/1787/761

Data analysis

The factors included were rearing system (extensive and intensive rearing systems) and region (which was confounded by sequential sampling at different sites). Data analysis was carried out using Ms Excel® 2007 (Microsoft corporation, USA) and XL-STAT®. Descriptive statistics were calculated and presented the prevalence (%) of each parasite. The association between independent factors (rearing system and region) and continuous dependent variables (prevalence of GIP) was tested using one way analysis of variance (ANOVA). Data on the percent of GIP-prevalence were *arcsin*-transformed and analysed by ANOVA. For analysis of significant differences in parasite prevalence, Tukey´s HSD tests at $P = 0.01$ was used.

Results and discussion

There are no widely available recent estimates on prevalence of gastrointestinal parasite (GIP) in goats and sheep in Jenin district area, and none that assess how observed changes in livestock numbers. A total of 810 faecal samples from small ruminants composed of 285 and 525 samples from intensive and extensive rearing systems, respectively, were collected from eight villages, 761were positive samples that contain at least one or more genus type of parasite (Table 1).

Results of this research indicated that the animals were affected by a wide variety of parasites. Thirteen different genera of parasites were recorded in this study, eleven were included gastrointestinal nematodes, one was cestode (*Moniezia*) and one was protozoa (*Eimeria*).

The most prevalent GI nematodes in this survey were the *Dictyocaulus spp,* and *Haemonchus spp*, while the most abundant and ubiquitous parasite was *Eimeria*. It was evident that prevalence of GIP in the samples collected from Tarem (30.8% ± 1.6) was significantly higher compared to samples collected from Merkah (9.8% ± 2.5) and Bet qad (7.7% ± 0.0). Results did not show any significant differences among the other sites, Aneen (22.1% ± 1.4), Yamoun (21.7% ± 1.2), Kfaret (19.2% ± 4.4), Talfeet (17.9% ± 5.6), and Jaba`a (16.7% ± 7.0) (Figure 1). Data in Figure 3a show the proportion of total GIP prevalence in different villages in Jenin. Tarem comprises the largest proportion of GIP (21.1%) followed by Aneen (15.2%), Yamoun (14.8%), kfaret (13.2%), Talfeet (12.3%), and Jaba`a (11.4%).

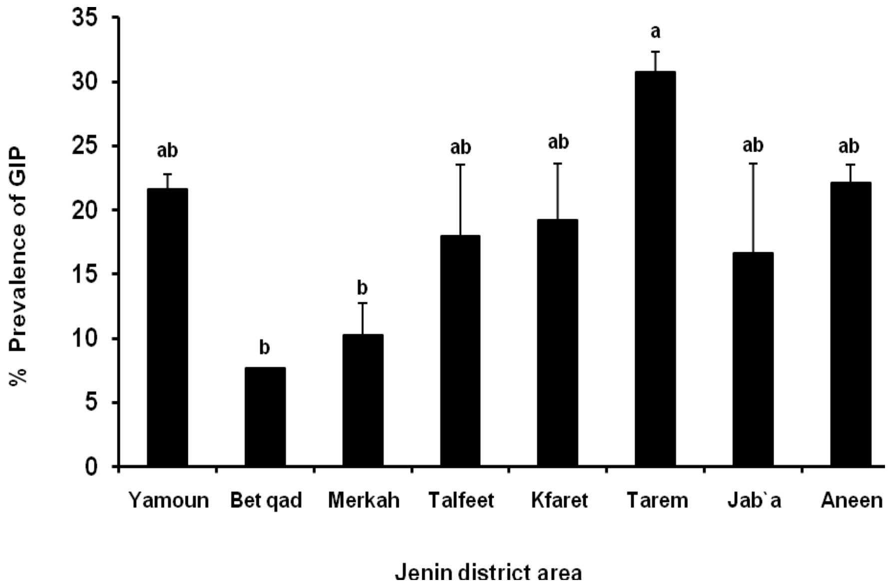


Figure (1): Average percent prevalence (%) of gastrointestinal (GIP) in positive faecal samples (761) obtained from goats and sheep in different villages of Jenin district area. Mean values followed by different letters are significantly different according to Tukeys HSD test at $P \leq 0.01$ (F = 3.1, df = 7, 415, p = 0.003). Error bars indicate standard deviation.

The results for assessment of the mean prevalence (Figure 2) and the proportion (Figure 3b) of GIP species in positive faecal samples from goats and sheep indicate that *Eimeria spp* comprises the largest percentage of disease prevalence (81.1% ± 3.3) and (34.2%), followed by *Dictyocaulus spp* (49.1% ± 5.4) and (20.7%) and *Haemonchus spp* (23.1% ± 3.3) and (9.7%). No significant differences were detected in the prevalence and proportion of the other parasites, the prevalence was relatively low with neglected importance; *Moniezia spp* (16.0% ± 2.6; 6.7%), *Trichostrongylus spp* (15.5% ± 2.8; 6.5%), *Strongylus spp* (12.5% ± 3.1; 5.3%), *Neoscaris spp* (11.6% ± 2.4; 4.9%), *Nematodirus spp* (10.6% ± 1.5; 4.5%), *Strongyloides spp* (9.9% ± 1.4; 4.2%), *Ascaris spp* (4.1% ± 0.9; 1.7%), *Cooperia spp* (1.4% ± 0.5; 0.6%), *Chabertia spp* (1.4% ± 0.1; 0.6%) and *Trichuris spp* (0.8% ± 0.5; 0.3%).

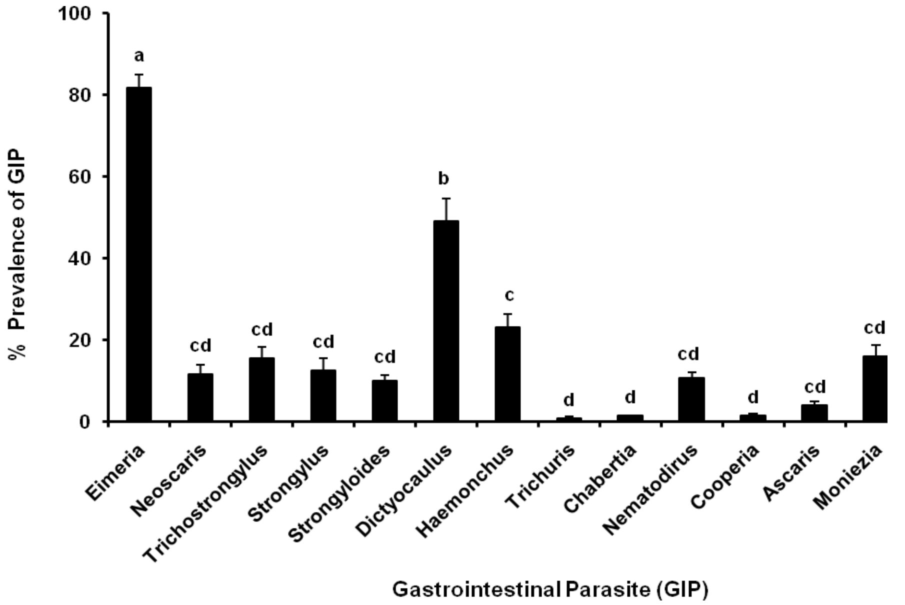
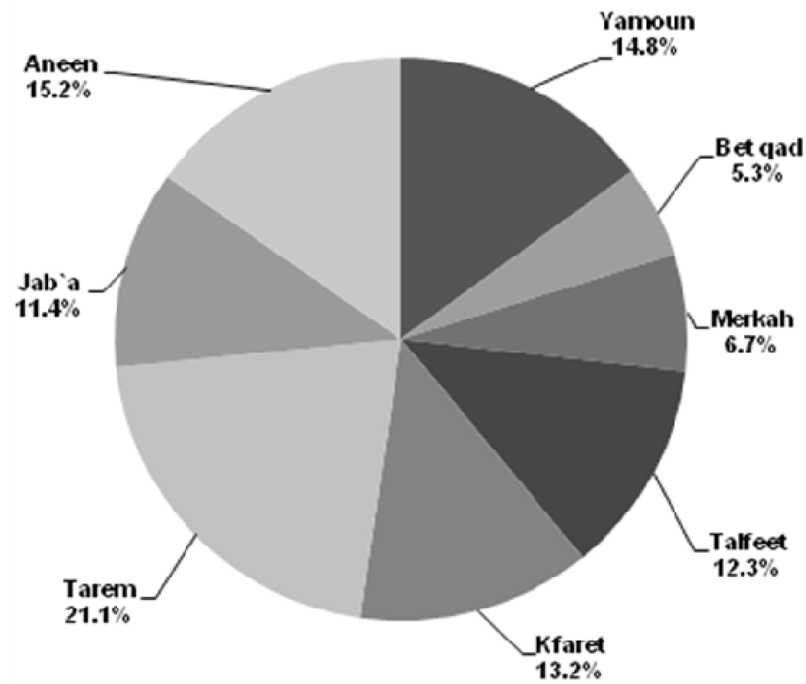


Figure (2): Average percent prevalence (%) of gastrointestinal (GIP) in positive faecal samples (761) obtained from goats and sheep in different sites of Jenin district area. Mean values followed by different letters are significantly different according to Tukeys HSD test at $P \leq 0.01$ (F = 40.0, df = 12, 415, $p < 0.0001$). Error bars indicate standard deviation.

a


Yamoun
14.8%
Bet qad
5.3%
Merkah
6.7%
Talfeet
12.3%
Kfaret
13.2%
Tarem
21.1%
Jab`a
11.4%
Aneen
15.2%

b

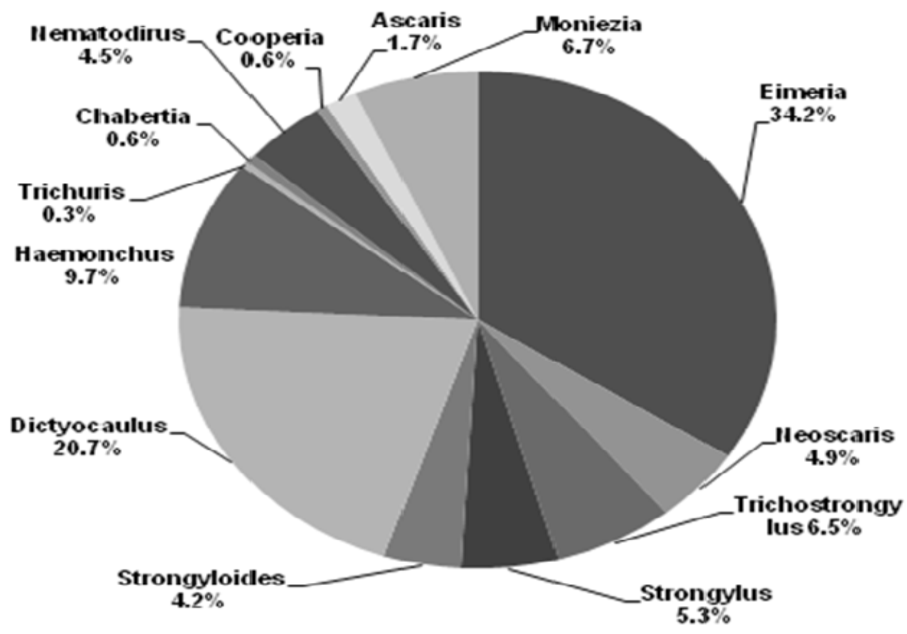


Figure (3): Total proportions (%) of different gastrointestinal GIP species in positive faecal samples (761) obtained from goats and sheep of Jenin district area considering GIP species (a) and the distribution of all GIP in different villages of Jenin (b).

The GIP genera recorded during this investigation (Table 2), have also been reported previously (Khan et al. 2009; Raza et al. 2007; Odoi et al. 2007; Sissay et al. 2007; Ng'ang'a et al. 2004; Regasa et al. 2006). The higher prevalence rate of GIP (26.5% ± 6.2) in animals reared under extensive system was significantly different from that animals reared under intensive system (7.9% ± 1.0), (Figure 4). Although no significant differences were detected in the distribution of some GIP between extensive and intensive rearing systems in this survey, *Dictyocaulus spp* and *Haemonchus spp* have significantly higher prevalence value under extensive rearing system. *Dictyocaulus spp*; (70.5% ± 19.9 and 11.1% ± 2.7) for extensive and intensive rearing system, respectively, while *Haemonchus spp* (40.8% ± 14.2 and 0.0% ± 0.0) for extensive and intensive rearing system, respectively, (Figure 5).

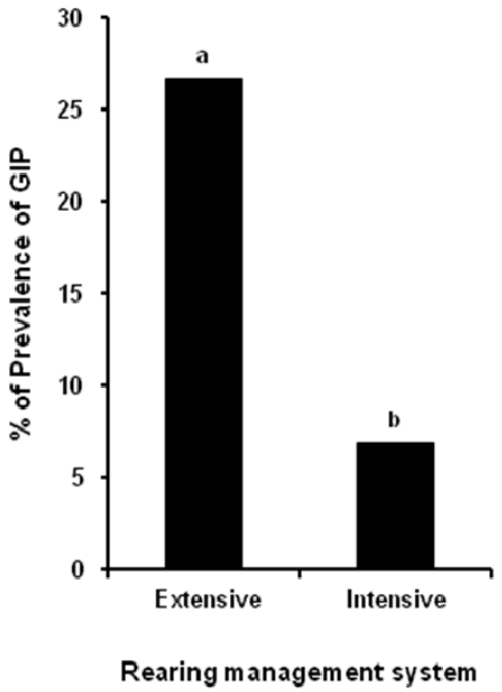


Figure (4): Average percent prevalence (%) of all gastrointestinal (GIP) in positive faecal samples (761) obtained from goats and sheep in different sites of Jenin district area. Animals were managed either in an extensive or in an intensive rearing system. Mean values followed by different letters are significantly different according to Tukeys HSD test at $P \leq 0.01$ ($F = 17.9$, df = 1, 155, $p < 0.0001$). Error bars indicate standard deviation.

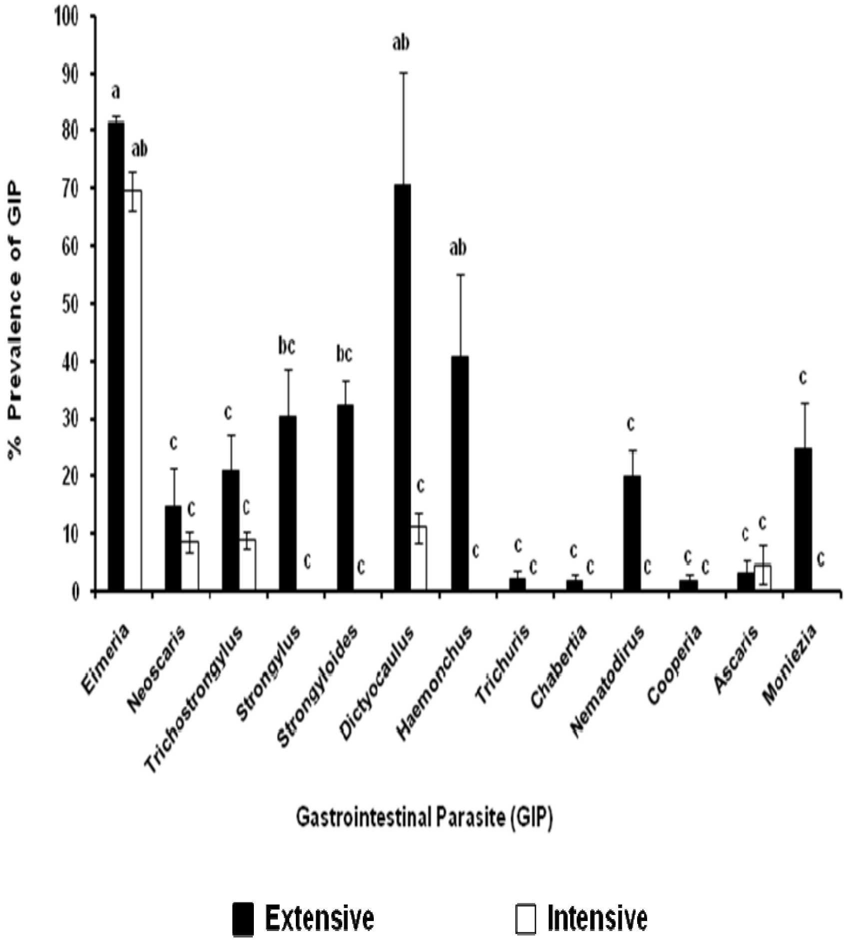


Figure (5): Percent prevalence (%) of different gastrointestinal (GIP) in positive faecal samples (761) obtained from goats and sheep in different sites of Jenin district area. Animals were managed either in an extensive or in an intensive rearing system. Mean values followed by different letters are significantly different according to Tukeys HSD test at $P \leq 0.01$ ($F = 10.4$, df = 25, 155, $p < 0.0001$). Error bars indicate standard deviation.

Under the extensive system, animals are grazed and herded together in the same area during dry and wet seasons. This increases the possibility of pasture contamination and consequently higher prevalence rate of parasitic infections (Magona and Musisi 2002). In addition to that, in extensive system, the grazing areas are located lowland and mid altitude areas, which are thought to be suitable for survival of the larval stage of the parasite. Moreover, the low levels of infection were detected in animals reared in an intensive system and were kept in wooden barn with raised floor that were cleaned regularly while those in extensive rearing system were kept in places which were not regularly cleaned. The access to the extensive and the change in housing conditions result in breaking existing biosecurity barriers both between and within farms. Furthermore, the extensive rearing environment is considered more conducive of parasitic infections than the intensive rearing environment. In both cases, the closer contact between faeces, parasites and hosts may increase the incidence of existing infections, and potentially result in emergence (or re-emergence) of new parasitic diseases (Waller 2004; Ng'ang'a et al. 2004). Results of this research are consistent with the findings of other researchers (Raza et al. 2007; Keyyu et al. 2006) who found a direct influence of grazing characteristics on the prevalence of most of GIP and who reported that under traditional free-range grazing systems (extensive) there is continuous infection and re-infection from heavily contaminated pastures compared to their intensive-grazed counter parts.

Evaluation of genera diversity in the two rearing systems revealed that poor diversity is found in the intensive rearing system (Table 2). Thirteen GIP genera were detected in samples collected from goats and sheep reared in extensive rearing system, while only five GIP genera were detected in intensive rearing system (*Eimeria*, *Dictyocaulus*, *Trichostrongylus*, *Neoscaris*, and *Ascaris*). The most common parasites encountered in both extensive and intensive rearing system were *Eimeria spp* (81.4 % ± 1.2) and (69.4 % ± 3.3), respectively. The various species of GIP detected during this investigation had already been reported by various researchers in different parts of the world (Alemu et al. 2006 and

Sissay et al. 2007). The grazing management factor that affects the initial diversity might be the area of permanent pastures. It was hypothesized that larger areas would include greater range of diverse environments and would possibly allow the maintenance of larger number of species, as seen with goat nematodes in Touraine (Cabaret and Gasnier 1994).

Table (2): Prevalence of various gastrointestinal parasites (GIP) in positive faecal samples (761) obtained from goats and sheep in different sites of Jenin district area. Animals were managed either in an extensive or in an intensive rearing system. Data were presented as value of total percent of prevalence (%) ± SD. Mean values of total percent of prevalence (%) for one management system in the same column followed by different letters are significantly different according to Tukeys HSD test at $P \leq 0.01$.

Gastrointestinal Parasite (GIP)	Management Practices Total PER (%)	
	Extensive	Intensive
Eimeria	81.4 ± 1.2^{a}	69.4 ± 3.3^{a}
Neoscaris	14.4 ± 7.1^{c}	8.5 ± 1.8^{b}
Trichostrongylus	21.0 ± 6.0^{bc}	9.0 ± 1.5^{b}
Strongylus	30.3 ± 8.2^{abc}	0.0 ± 0.0^{b}
Strongyloides	32.2 ± 4.5^{abc}	0.0 ± 0.0^{b}
Dictyocaulus	70.5 ± 19.9^{ab}	11.1 ± 2.7^{b}
Haemonchus	40.8 ± 14.2^{abc}	0.0 ± 0.0^{b}
Trichuris	2.2 ± 1.5^{c}	0.0 ± 0.0^{b}
Chabertia	1.9 ± 1.3^{c}	0.0 ± 0.0^{b}
Nematodirus	19.9 ± 4.7^{bc}	0.0 ± 0.0^{b}
Cooperia	1.9 ± 1.3^{c}	0.0 ± 0.0^{b}
Ascaris	3.1 ± 2.2^{c}	4.6 ± 3.3^{b}
Moniezia	24.7 ± 8.2^{bc}	0.0 ± 0.0^{b}
Average mean	26.5 ± 6.2^{A}	7.9 ± 1.0^{B}

The present study showed that major nematodes belonging to the genera, *Dictyocaulus*, *Haemonchus*, *Trichostrongylus*, *Strongylus*, *Nematodirus*, *Strongyloides*, cestode; *Moniezia*, and intestinal protozoan parasite *Eimeria spp* were prevalent in different villages of Jenin district. Management practices and different locations influence the prevalence of GIP infection in goats and sheep. Our findings should be considered when designing control strategies of GIP infections in ruminants reared under the traditional husbandry system in agro-climatic conditions of Jenin area, as well as in similar climatic zones of other parts in Palestine.

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