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Journal of Agricultural Sciences
Journal homepage:
www.agri.ankara.edu.tr/journal

A Comparison of Natural *Eimeria spp.* and Gastrointestinal Nematode Infections of Goat Breeds

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ARTICLE INFO
Research Article
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Received: 03 December 2014, Received in Revised Form: 06 July 2015, Accepted: 19 July 2015

ABSTRACT

The number of *Eimeria* oocysts per gram faeces (OPG) and number of gastrointestinal nematod (GIN) eggs per gram faeces (EPG) depend on some factors such as gender, season and production systems. In order to determine the *Eimeria* infection and some gastrointestinal nematode burdens in Maltese, Gökçeada and Turkish Saanen goats, OPG, EPG and packed cell volume (PCV) were investigated. Maltese breed tended to have lower parasite burden than other goat breeds ($P \leq 0.05$). In the first observation, the prevalence of *Eimeria* and nematodes was 100% in Gökçeada breed, while the prevalence of *Eimeria* and the prevalence of GIN infection were 98% and 78%, respectively, in Maltese. It was determined that OPG and EPG burdens were significantly affected by the age of goats and the sampling date ($P \leq 0.0193$). It was seen that OPG burden decreased as the goats get older ($P = 0.0157$), while EPG value varied by the age of a goat in an unsteady manner ($P < 0.0001$). The PCV values determined in the breeds ranged from 0.23 to 0.31. Statistically significant and positive correlation coefficients were determined between OPG and EPG $r = 0.20$ ($P = 0.0036$), and between the PCV value and OPG $r = 0.41$ and PCV and EPG $r = 0.37$ ($P < 0.0001$).

Keywords: Gökçeada; Maltese; Turkish Saanen; Packed cell volume; Age

Keçi Genotiplerinin *Eimeria* Türleri ve Mide-Bağırsak Nematodları ile Doğal Enfestasyonlarının Karşılaştırılması

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Geliş Tarihi: 03 Aralık 2014, Düzeltmelerin Gelişi: 06 Temmuz 2015, Kabul: 19 Temmuz 2015

ÖZET

Keçilerde koksidiyal ookist (OPG) ve parazit yumurtası (EPG) yükü ırk, cinsiyet, mevsim, yetiştirme sistemi gibi etmenlere göre değişebilmektedir. Bu çalışmada Gökçeada, Malta ve Türk Saanen keçi genotiplerinde üç yıl süreyle OPG, EPG ve kan hematokrit değeri (PCV) takip edilmiştir. Malta genotipi iç parazit yumurtası bakımından diğer keçi genotiplerinden önemli derecede düşük düzeyde yüke sahip olmuştur ($P \leq 0.05$). Gökçeada keçilerinin ilk gözlemde *Eimeria* ve mide bağırsak kıl kurtları bakımından prevalansı % 100 olurken, Malta genotipinde *Eimeria*'da % 98, mide

bağırsak kıl kurtları içinse % 78'lik bir prevalans tespit edilmiştir. OPG ve EPG yükü keçilerin yaşı ve örnekleme tarihine göre istatistiksel olarak önemli düzeyde farklılık göstermiştir (P≤0.0193). Keçi yaşı ilerledikçe OPG yükü azalırken (P= 0.0157) EPG değerinin keçi yaşlarında sistemli olmasa da farklılaştığı görülmüştür (P<0.0001). Keçilerde, PCV değeri 0.25-0.31 arasında değişmiştir. Çalışmada, OPG ile EPG arasındaki korelasyon katsayısı r= 0.20 (P= 0.0036) olarak gerçekleşmiş, PCV ile OPG (r= 0.41) ve PCV ile EPG arasında da (r= 0.37) önemli derecede pozitif ilişki tespit edilmiştir (P<0.0001).

Anahtar Kelimeler: Gökçeada; Maltız; Türk Saanen; Hematokrit; Yaş

1. Introduction

Parasite diseases are the leading cause of the losses in sheep husbandry. It was reported that 60% of the losses in sheep husbandry in USA are due to parasite diseases (Charon 2004). Thus, research on the parasites has been steadily increasing lately. The most common method of controlling parasites is the use of drugs. However, factors such as parasite resistance and risk of residues make these control methods questionable. Therefore, in the recent years, different approaches have been adopted to determine resistance or tolerance to parasites among breeds or individuals. There are reports of genetic variation of resistance on gastrointestinal parasites between and within goat breeds (Chhabra & Pandey 1991; Pralomkarn et al 1997; Baker et al 1998; Baker et al 2001). The studies in the last twenty years have shown that, by selection, it may be possible to get resistant or tolerant animals to parasite diseases (Bishop & Stear 1997; Gauly & Erhardt 2002; Cardellino et al 2002).

Coccidiosis, caused by the protozoa of *Eimeridae* family, is a contagious disease that may lead to mortalities particularly among young animals (Gül & Değer 2002). The disease occurs more and progresses more gravely in young animals. This disease, encountered frequently in the kid growing period, hinders the progress of performance in kids and, in some cases, it may result in death (Daş et al 2012). It is guessed that, apart from the known clinical effects of the disease, its subclinical effects are also high (Dinçer 2001). The number of coccidial oocysts per gram faeces (OPG) is a good parameter to observe its subclinical stage. The OPG burden is higher in young animals (Balicka-Ramisz 1999). It has been determined that high values might also be reached in old animals in some regions (Harper & Penzhorn 1999). There are also reports of breed differences of *Eimeria* resistance. Chhabra & Pandey (1991) express that Zimbabwean native goats are more resistant to coccidiosis than Boer goats. EPG (the number of parasite eggs per gram of faeces) is a good parameter when determining the presence and burden of gastrointestinal nematodes (GIN) infection in a host. Besides, the packed cell volume value, an indication of anemia, is regarded as an essential means particularly when revealing the effects of some endoparasites which feed by sucking blood on the animal (Gauly & Erhardt 2002). Pralomkarn et al (1997) reported that goats were more sensitive to gastrointestinal nematodes than sheep.

In order to determine the *Eimeria* infection and some gastrointestinal nematode burdens in three goat breeds, OPG and EPG were examined in this study. We also investigated the relationship between OPG and EPG, and packed cell volume (PCV).

2. Material and Methods

The study was conducted on each thirty Gökçeada, thirty Maltese and thirty Turkish Saanen goats in the small ruminant husbandry unit at the Center of Technological and Agricultural Research at Çanakkale Onsekiz Mart University for 30 months. The center had a fenced area of about 0.30 ha. Gökçeada goat is an autochthonous breed from the Island of Gökçeada, located in the North Aegean Sea. The breed is maintained under near feral conditions. Maltese goats were imported into Anatolia during

the Ottoman era. It is grown under extensive husbandry conditions and is now widespread in the Coastal Region of Aegean. The Turkish Saanen goat breed is a backcross between Saanen bucks and local does. The breed has been developed in the last 30 years and is a relatively high yielding genotype under intensive husbandry conditions. All goats used in the study were adult animals with ages between 1 and 6 years. The average live weights (± standard deviation) were 35.9±3.1 kg for Gökçeada goats, 41.7±7.3 kg for Maltese goats and 47.8±6.4 kg for Turkish Saanen goats. The average daily milk yield values of the breeds were found 1.25±0.27 kg in 240 days, 1.52±0.31 kg in 250 days and 2.18 kg±0.42 in 274 days for the Gökçeada, Maltese and Turkish Saanen, respectively. The goats were milked twice a day, at 7 am and 7 pm. They were fed with a concentrate in pellet form (890 g DM kg^{-1}, 210 g CP kg^{-1} DM, 2.8 Mcal ME kg^{-1} DM; 1.0 kg $goat^{-1}$ per day) and oat hay (890 g DM kg^{-1}, 82 g CP kg^{-1} DM, 2.1 Mcal ME kg^{-1} DM; 0.3 kg $goat^{-1}$ per day) throughout the study. Concentrate feed was given in two equal portions during each milking, while the oat hay was given only before daily grazing period in group conditions. The does stayed in the pasture between 9 am and 5 pm hours and were housed in the barn for the rest of the day. The goats treated for endoparasites in October 2006, June 2007, January 2008 and May 2008 (Tölü 2009). In the current study, the number of coccidial oocysts (OPG) and the number of gastrointestinal nematode eggs (EPG) per gram of faeces and the packed cell volume (PCV) have been determined immediately before treatment for endoparasites in all examined goats. For this purpose, the related parameters were observed after the first introduction of Gökçeada and Maltese breeds to the establishment (September 2006) and all of the three breeds in May 2007 and May 2008. Since endoparasite treatment was performed in Turkish Saanen, no faecal samples were taken from these animals during the measurements in 2006. The faecal sample was taken from the rectum, brought to the laboratory and subjected to analysis. The samples were preserved at +4 ºC and, OPG and EPG were determined with the modified McMaster method without any distinction between species (MAFF 1986; Cork & Halliwell 2002). A saturated salt solution was used and the flotation technique was utilized in faecal analyses.

The faecal consistency was also checked when taking faeces for parasite observations. In addition, the PCV was detected with the blood samples taken simultaneously from *vena jugularis*. The PCV was determined by means of capillary tubes and hematocrit centrifuge (5 min. at 5,000 rpm turns) (Cork & Halliwell 2002).

In order to fulfill the preconditions for the analysis of variance, the OPG and EPG values were subjected to logarithmic (Log (OPG+100); Log (EPG+100)) transformation. A linear model including breed (Gökçeada, Maltese, Turkish Saanen), age (1,...,6) and sampling day (1, 2, 3) was utilized in the repeated measurement variance analyses for all traits. TUKEY test was utilized in the *post-hoc* analyses. The Pearson correlation coefficient (r) was used to determine the relationship among the parameters concerned. SAS (1999) package program was used for the statistical analyses.

3. Results and Discussion

It was determined that the number of OPG tended to decrease in goats over the experiment years, while fluctuations were seen in the gastrointestinal parasite EPG (Table 1). The highest OPG value in the study was in the Maltese in 2006, whereas the highest EPG value was in the Turkish Saanen in 2007. In the first observation, the prevalence of *Eimeria* and gastrointestinal nematodes (GIN) was 100% in the Gökçeada breed, while the prevalence of *Eimeria* was detected as 98% and the prevalence of GIN was 78% in the Maltese breed. The prevalence of GIN for the years 2007 and 2008, was 45-36%, 47-70% and 70-62% for Gökçeada, Maltese and Turkish Saanen breeds, respectively. In the other studies conducted in Turkey, 9 to 10 *Eimeria* species were determined in farm animals, while the prevalence was around 80% (Arslan & Tüzer 1998; Değer et al 2003; Gül 2007). It might be stated that subclinical coccidiosis is quite common in goats. Değer et al

Table 1- The least square mean (LSM) and standard error (SE) values for the OPG, EPG and PCV values determined in different periods according to goat breeds

Çizelge 1- Irklara göre farklı dönemlerde belirlenen OPG, EPG ve PCV değerlerine ait en küçük kareler ortalama (LSM) ve standart hata (SE) değerleri

Traits	*Breed*	*Gökçeada*		*Maltese*		*Turkish Saanen*	
	Year	*LSM*	*SE*	*LSM*	*SE*	*LSM*	*SE*
OPG	2006	3.46^{a}	0.08	3.11^{b}	0.08	-	-
	2007	3.22^{a}	0.09	3.06^{a}	0.09	2.79^{b}	0.09
	2008	3.11^{a}	0.08	2.68^{b}	0.10	2.71^{b}	0.09
EPG	2006	2.89^{a}	0.06	2.47^{b}	0.06	-	-
	2007	2.18^{a}	0.06	2.22^{ab}	0.07	2.36^{b}	0.07
	2008	2.57	0.12	2.52	0.08	2.59	0.08
PCV	2006	0.31^{a}	0.006	0.25^{b}	0.007	0.25^{b}	0.007
	2007	0.25^{a}	0.001	0.23^{b}	0.006	0.24^{ab}	0.006
	2008	0.24	0.007	0.25	0.007	0.24	0.006

OPG, number of oocysts per gram of faces; EPG, number of parasite eggs per gram of faces; PCV, packed cell volume; $^{a-b}$, values in the same row without a common superscript letter are significantly different (P≤0.05)

(2003) reported that the prevalence of *Eimeria* oocysts ranged from 53.3% to 94.8% for goat herds in Turkey. Arslan & Tüzer (1998) determined the rate of cattle's free from *Eimeria* species as 32% and reported that the correlation coefficient between bloody diarrhea and soft faeces and the OPG value was 0.96.

It was determined that the OPG and EPG burdens were significantly affected by the age of goats and the sampling date (P≤0.0193). It was seen that the OPG burden decreased as the goat got older (P= 0.0157), while the EPG value varied by the age of a goat, although not in a systematic way (P<0.0001). Harper & Penzhorn (1999) determined the prevalence of *Eimeria* species as 88-100% in their study performed in three different regions in Africa. The authors reported that the highest OPG value was detected in the goats older than 1 year old in a region, and the highest value was in the goats younger than 1 year old in another region. Balicka-Ramisz (1999) determined that the goats had a lower OPG value than kids and the values ranged from 50 to 2500. Sharkhuu (2001) reported that the highest average number of parasites per gram of faeces as 2634 for the Mongolian goat.

The Maltese breed, which had a lower average than the Gökçeada breed in terms of EPG and OPG in the first observation, had also low values in the other observations (Table 1). In the first observation, the median values were determined as 2784 and 923 for OPG and as 70 and 300 for EPG in Gökçeada and Maltese breeds, respectively (P≤0.05). The Gökçeada breed had a significantly lower mean EPG value than the other breeds in the measurements performed in 2007 after the parasite treatment in 2006 (P≤0.05). The OPG values of the Turkish Saanen were slightly lower than those of the other breeds, whereas the EPG value was at slightly higher levels (P≤0.05). In a study on goats aged more than one year old, conducted in three different regions of South Africa, the researcher found similar OPG values in native goats and Saanen breeds, while they found significantly higher values in the crossbreeds (Harper & Penzhorn 1999). The authors could not see any significant difference among the breeds, aged less than one year. It is seen that there is a similar case in our study. Usually intensive husbandry conditions are more contaminated with *Eimeria spp.* than extensive husbandry conditions. Therefore, Turkish Saanen goats are more confronted with *Eimeria spp.* oocysts than the other genotypes and

for this reason Turkish Saanen goats could develop a higher resistance to *Eimeria spp*. On the contrary, the GIN eggs are more common in pastures than in barns. This resulted with a higher infection pressure in pasture based livestock systems. Moreover, the Gökçeada goats are kept outdoors year around. The lower value of the EPG's of the Gökçeada breed maybe an adaptation to this condition.

The PCV values determined by the breeds ranged from 0.23 to 0.31 (Table 1). A significant and positive relationship was determined between the PCV and OPG (r= 0.41), and PCV and EPG (r= 0.37) (P<0.0001). The mean PCV value in goats ranged from 0.24 to 0.28. It has been shown that the PCV value decreases in the groups infected with various endoparasite species (Baker 1998; Mandonn et al 2005; Eguale et al 2009). Goossens et al (1998) stated that PCV value ranged from 0.22 to 0.24 in the goats infected with *Trypanosoma congolense,* and that it was 0.30 in the control group. Baker et al (1998) reported significant differences among breeds for endoparasite burden and PCV value. It seems that an endoparasite infection to an organism causes a decline in the PCV value. However, the positive relationship of PCV with OPG and EPG in this study contradicts with this argument. That might be because the infection was not at clinical level, and therefore, anemia had not been formed yet. In addition, the humoral immunity mechanism was probably activated, so that the number of eosinophils in infected goats increased (Mandonnet et al 2005). Furthermore, the anemia was probably formed in the presence of bloodsucking parasites and as no distinction between species was made in this study, it is not known by which gastrointestinal nematodes the goats were infected. On the other hand, especially the Gökçeada goats came in a far better environment than on the island, where the animals may face insufficient nutrition. This could mislead the expected relationship between OPG and PCV, or EPG and PCV. In this regard, another problem may be the relatively small variation of the measured variables in the study. Therefore, the relationships of EPG with OPG and PCV should be repeated with larger data records.

4. Conclusions

In this study it was seen that the OPG and EPG values which were used to observe the *Eimerian* and nematode burden varied significantly by year, age and breed. It can be speculated that animals from Maltese breed would have lower OPG and EPG values than the other breeds. The low values in Maltese suggest that this breed, reared in Western Anatolia for long years, is well adapted to the environment in terms of endoparasites.

Acknowledgements

The authors thank TÜBİTAK, which provided support for the supply of animals within the scope of Project No. 106O411, and Gökçe GAMLI, Halil TUNCA, Tamer GARAGON, Elif DALAR (AKYÜZ), Ercan DIBEK and Raziye IŞIK for their assistance in the collection and analysis of the samples. The last but not the least, we thank Dr. Cem Ömer EGESEL for his valuable contribution.

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