EGYPTIAN ACADEMIC JOURNAL OF

BIOLOGICAL SCIENCES

E

MEDICAL ENTOMOLOGY & PARASITOLOGY

ISSN
2090-0783

WWW.EAJBS.EG.NET

Vol. 14 No. 2 (2022)

Citation: *Egypt. Acad. J. Biolog. Sci. (E-Medical Entom. & Parasitology Vol.14(2) pp **171-18**0(2022)*
DOI: 10.21608/EAJBSE.2022.272457

Egypt. Acad. J. Biology. Sci., 14 (2):171–180 (2022)

Egyptian Academic Journal of Biological Sciences
E. Medical Entomology & Parasitology

ISSN: 2090–0783
www.eajbse.journals.ekb.eg

Prevalence and Larval Burden of Myiasis in Sheep and Goats in Jazan Region, Saudi Arabia

Alahmed, A. M. [1]; Kheir, S.M. [1]; Sallam, M. F. [1]; Dawah, H.[2]; Nasser, M. G. [1]; Mohammad M.E. Aljameeli[3] and Al Kuriji, M.A.[4]

1-Department of Plant Protection, College of Food and Agricultural Sciences, King Saud University, Riyadh 11451, Saudi Arabia.
2- Center of Environmental Research Studies, University of Jazan, Jazan, Saudi Arabia.
3- Department of Biology, Faculty of Science and Arts, Northern Border University, Rafha, Saudi Arabia
4-. King Abdul-Aziz City for Science and Technology, Riyadh, Saudi Arabia.
E-mail: mkuriji@kacst.edu.sa

ARTICLE INFO
Article History
Received:19/9/2022
Accepted:27/11/2022
Available:2/12/2022

Keywords:
Larval myiasis, Prevalence rate, Larval burden, *Oestrus ovis*, *Chrysomiya bezziana*, Jazan Region, Saudi Arabia.

ABSTRACT

Oestrosis, caused by the infestation of the sheep nasal bot *Oestrus ovis* larvae into the nasal cavities of sheep and goats, is a myiasis of worldwide distribution. The aim of this work is to study the prevalence and intensity of infection of *O. ovis*, as well as larval myiasis in mixed grazing sheep and goats, particularly due to *Chrysomya bezziana*, in Jazan Region, Saudi Arabia. A survey for larval myiasis due to *O. ovis* **(**Diptera: Oestridae) Linnaeus, 1761, in sheep and goats was conducted in Jazan municipal slaughterhouse, Jazan, Saudi Arabia. Out of 720 heads of slaughtered sheep and goats examined, 122 (16.94%) were found infected with *O. ovis* larvae**,** with a mean larval burden of 3.79 larvae per infected head. The mean infection rate of *O. ovis* in sheep was 30.84%, which is significantly higher than that in goats (3.78%) (P< 0. 05). Similarly, the mean infection rate of *O. ovis* in old sheep (62%) is significantly higher than in young sheep (7.5%) (P < 0.01). The results have shown that the infection rates of *O. ovis* among old and young goats were 6.47% and 1.5% respectively, which are not significantly different from one another (P>0.05). During this study, *O. ovis* larvae were collected throughout the year with varying infestation levels, indicating the existence of long favorable periods for larval development. Statistical analysis showed that there is no correlation between the intensity of infection with *O. ovis* (infection rates and larval burdens) and the prevailing climatic conditions (temperature and humidity). Larval myiasis due to other dipterous larvae in mixed grazing sheep and goats was investigated in 40 farms located in different ecological zones in Jazan Region. The larvae collected from infected sheep and goats were *C. bezziana* Villeneuve, 1914; *Chrysomya albiceps* (Wiedemann, 1819)*; Wohlfahrtia nuba* (Wiedemann, 1830) and *Sarcophaga africa* (Wiedemann, 1824). The results showed that 20 farms (50%) were infected with larval myiasis. Similarly, it was found that 27.5%, 22.5%, 10% and 10% of the mixed grazing sheep and goats farms were infected with *C. bezziana*, *C. albiceps*, *W. nuba* and *S. africa* larvae, with the larval burden of 2.8, 2.6, 3.6 and 4.6 larvae per animal respectively.

INTRODUCTION

Oestrosis, caused by the infestation of the sheep nasal bot *O. ovis* larvae into the nasal cavities of sheep and goats, is a myiasis of worldwide distribution.

Oestrus ovis is a cosmopolitan obligatory parasite commonly found in sheep, and occasionally in goats (Zumpt, 1965). The larvae of *O. ovis* inhabit the nasal sinuses of ruminants (especially sheep), where it causes nasal sinus myiasis with varying clinical respiratory signs. The *O. ovis* infestation affects livestock production causing abortion, reduced milk production, loss in body weight, low fertility, poor hide quality and impairment of the host immune system (Spradbery, 1994 and Otrano *et al.*, 2004). In Saudi Arabia, Bosly (2013), who found that 53.54% of the total slaughtered sheep heads examined showed positive infestations, studied the prevalence rate of O. ovis in sheep. The distribution, epidemiology and economic importance of *O. ovis* and *C. bezziana* have been studied by many researchers (Dorchies *et al.*, 2000; Alahmed, 2000, 2004; Papadopoulos *et.al*., 2006; Jarret *et al.*, 2010; Smaragda Jafari *et al.*, 2011; Hall, 2012; Ali Asghar, 2013 and Haris and Hathal, 2014)

In spite of the. the popularity of sheep and goats in Saudi Arabia, the prevalence and economic importance of ovine and caprine larval myiasis due to *O. ovis* and *C. bezziana* has not been well documented, and more studies are required, particularly in the Southern Region of Saudi Arabia, which is heavily populated with sheep and goats and remarkable for its agricultural production. Worldwide many surveys have been conducted to study the infection rate of *O. ovis* and *C. bezziana* in sheep or goats, which are living in separate areas, but few studies have compared rates of infection in mixed sheep and goats grazing in the same area. The aim of this work is to study the prevalence and intensity of infection of *O. ovis*, as well as larval myiasis in mixed grazing sheep and goats, particularly due to *C. bezziana*, in Jazan Region, Saudi Arabia.

MATERIALS AND METHODS

The Study Area:

The Kingdom of Saudi Arabia is a vast country with an area of about 2.25 million km². It lies between lat. 15º 44' - 32º 9' N, and long. 34º 24' - 55º 39' E (Fig.1). The Kingdom is an extremely arid country, except for the southwestern region and some coastal zones. The topology and climate of Jazan Region can be categorized into three distinct sectors: the eastern Sarawat Mountains range 2,000-2,500 meters above sea level, with an annual precipitation rate > 300 mm; hilly middle areas north to south with an elevation range of 400-600 meters above sea level, and < 300 mm rain/year; and the coastal western plains with elevation <400 meters above sea level, and little, if any, annual precipitation (Khattab and El Haddidy, 1971; Mohammedein 2001). The vegetative cover of the study area varies from bare desert with short grass and shrubs in the north to poor savannah with scattered tall grasses and trees in the south.

Collection of *Oestrus ovis* from Jazan Slaughterhouse:

Jazan municipal slaughterhouse was selected for the collection of sheep nasal bot, *O. ovis* larvae. The slaughterhouse was visited bimonthly during the period from April 2013 to March 2014. The slaughterhouse is under the rigorous and consistent supervision of governmental veterinarians, and all examination processes are carried out under their guidance and assistance. In each month, 60 heads of slaughtered sheep or goat heads (30 heads in each visit) were randomly selected and examined for the presence of *O. ovis* larvae. The selected heads were opened at the region of the sinuses, and all recovered larvae from infected heads of old (one year or more) or young (less than one year) sheep or goats were collected by forceps and put directly into hot water (65°-70 °C) for 15-30

seconds, then preserved in 70% analytical grade ethanol, labeled and kept for identification. The date of examination, age, species and number of recovered larvae per infected head were recorded.

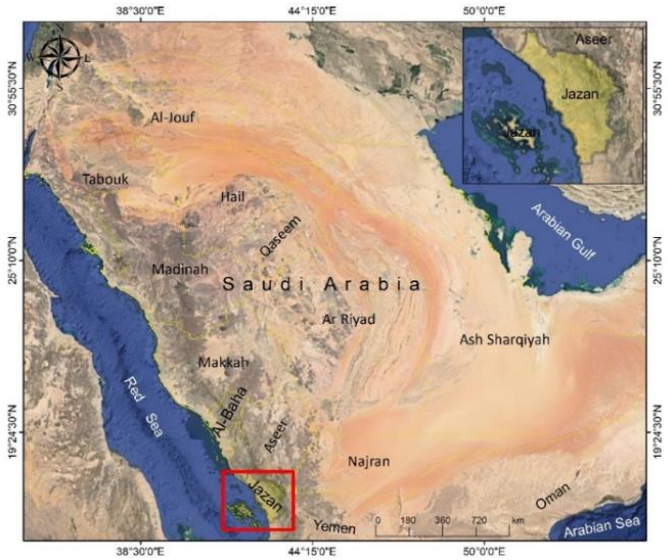

Fig. 1: Map of Saudi Arabia showing Jazan Region

Collection of Myiasis Causing Larvae from Mixed Grazing Sheep and Goat Farms:

During the study period, the mobile team visited forty mixed-grazing sheep and goat farms, in different ecological zones in Jazan Region. On each farm, wounded animals were examined for the presence of larval myiasis. Recovered larvae from each wounded animal were put into hot water (65°-70° C) for 15-30 seconds, and then preserved in 70% analytical grade ethanol, labeled and kept for identification. All information about the date of collection, coordinates of the collection site, herd size, age, species of infected animals and the number of recovered larvae from each infected animal were recorded.

Meteorological Data:

The mean monthly temperature, rainfall and relative humidity (R.H.) of the study area during the study period were kindly supplied by Meteorological Department, Jazan (Table 1).

Table 1: Mean monthly temperature, relative humidity and rainfall in Jazan Region during the study period (2013-2014)

Month	Mean monthly temperature˚ C	Mean monthly % relative humidity	Mean monthly rainfall (mm)
April, 2013	31.7	63	0
May	33.7	60	0
June	34.0	61	0
July	34.2	59	14
August	33.0	65	34
September	33.6	65	1
October	32.3	64	10
November	30.1	69	19
December	27.5	70	27
January, 2014	26.8	72	0
Feb	27.4	70	1
March	29.1	69	0

(Source: Meteorological Department, Jazan).

Identification of Recovered Larvae:

The larvae collected from Jazan municipal slaughterhouse and from mixed grazing sheep and goat farms were identified according to Zumpt (1965) and Haris and Hathal (2014). Representative specimens of collected larvae were sent to Prof. J. C. Deeming, National Museum of Wales, Cardiff, United Kingdom for identification and confirmation.

Statistical Analysis:

Two samples of t-test were used to compare the mean infection rates of *O. ovis* in old and young sheep and goats (SAS, 2001). All values of $P \leq 0.05$ were considered significant at the 0.05 level. Pearson correlation coefficient was used to measure the association between the intensity of infection (larval infection rates and larval burdens) and climatic conditions (mean temperature and rainfall)**.**

RESULTS

Infection Rate of *O. ovis* in Sheep and Goats:

Out of the total 720 slaughtered sheep and goats heads examined (150 old sheep, 200 young sheep, 170 old goats and 200 young goats), 122 heads were found infected with *O. ovis* larvae, with an overall infection rate of 16.94% (Table 2). The mean infection rate of *O. ovis* in old and young sheep was 62% and 7.5% respectively, while the mean infection rate of *O. ovis* in old and young goats was 6.47% and 1.5% respectively (Table 2). Statistical analysis showed that the mean infection rate of *O. ovis* in old sheep is significantly higher than in young sheep ($P<0.05$); while the mean infection rate of *O. ovis* in old and young goats is not significantly different from one another ($P> 0.05$). Similarly, the overall infection rate of *O. ovis* in all sheep (30.86%) is significantly higher than that in all goats (3.78%) ($P< 0.05$).

Table 2: Infection rate of *O.ovis* in sheep and goats in Jazan slaughterhouse

Age Group	Sheep			Goats		
	Examined	**Infected**	**Infection rate***	**Examined**	**Infected**	**Infection rate***
young	200	15	7.50% (a)	200	3	1.5 (d)
old	150	93	62.00% (b)	170	11	6.47 (d)
total young and old	350	108	30.86%(b)	370	14	3.78%(d)
total sheep and goats	total examined 720		total infected 122		total prevalence 16.94%	

old sheep or goat: one year or more
young sheep or goat: less than one year

The monthly infection rates of *O. ovis* in Jazan slaughterhouse are shown in Table 3. The presence of *O. ovis* larvae was recorded throughout the year, with high infection rates in July (33.3%) and January (21.7%), and low infection rates in September (8.3%) and May (10%). Statistical analysis showed that there is no correlation between monthly infection rates with *O. ovis* and the season of the year (temperature or humidity).

Table 3: monthly infection rate of *O. ovis* in sheep and goats in Jazan Region slaughterhouse

Month	Total Examined	Total Infected	Sheep		Goats		%Total Infected
			Infected	%Infected	Infected	% Infected	
April, 2013	60	9	7	11.7	2	3.3	15
May	60	6	5	8.3	1	1.7	10
June	60	9	7	11.7	2	3.3	15
July	60	20	18	30	2	3.3	33.3
Aug	60	12	12	20	0	0	20
Sept	60	5	5	8.3	0	0	8.3
Oct	60	9	8	13.3	1	1.7	15
Nov	60	8	7	11.7	1	1.7	13.4
Dec	60	9	8	13.3	1	1.7	15%
Jan, 2014	60	13	12	20	1	1.7	21.7
Feb	60	12	11	18.3	1	1.7	20
Mar	60	10	8	13.3	2	3.3	16.6
Total	720	122	108	30.86	14	3.78	16.94

The mean monthly larval burdens of *O. ovis* larvae per infected head in sheep and goats at Jazan slaughterhouse are shown in Table (4). Higher larval burdens were recorded in June (6.55 larvae / infected head) and July (7.25 larvae / infected head); and lower larval burdens were recorded in October (1.89 larvae / infected head) and December (2.11 larvae / infected head). Statistical analysis did not show any correlation between the mean monthly burdens with *O. ovis* and the prevailing temperature and relative humidity in the study area.

Table 4: monthly larval burden of *O. ovis* in sheep and goats at Jazan slaughterhouse

Month	Total heads Examined	Infected heads	Total larvae Recovered	Mean larval burden per infected head
Apr 2013	60	9	25	2.77
May	60	6	16	2.67
June	60	9	59	6.55
July	60	20	145	7.25
August	60	12	50	4.16
Sept	60	5	18	3.6
Oct	60	9	17	1.89
Nov	60	8	20	2.5
Dec	60	9	19	2.11
Jan, 2014	60	13	36	2.77
Feb	60	12	30	2.5
March	60	10	27	2.7
Total	720	122	462	3.79

Prevalence Rate and Larval Burden of Larval Myiasis in Mixed Grazing Sheep and Goats Farms:

Out of the forty mixed grazing sheep and goat farms visited, 20 farms (50%) were found infected with larval myiasis due to different dipterous larvae (Table 5). The results showed that 11 farms (27.5%), 9 farms (22.5%), 4 farms (10%) and 4 farms (10%) were infected with *C. bezziana, C. albiceps, W. nuba* and *S. Africa.*; with larval burdens of 2.8, 2.6, 3.6 and 4.6 larvae

/animal respectively. Most of the larvae were collected from infected wounds under the tail, around the anal and umbilicus regions, inner sides of the thigh, the base of the horn and interdigital spaces.

Table 5: Prevalence rate and larval burden of larval myiasis in mixed grazing sheep and goat farms in Jazan Region

Larval species	Farms surveyed	Infected farms (% infected)	Collected larvae	Animals infected	Mean larval burden /animal
C.bezziana	40	11 (27.5%)	54	19	2.8
C.albiceps		9 (22.5%)	42	16	2.6
W.nuba		4 (10%)	29	8	3.6
S.africa		4 (10%)	23	5	4.6
Total	40	20 (50%)	148	35	4.2

DISCUSSION

In this study, *O. ovis* larvae were recovered from heads of slaughtered sheep and goats throughout the year, indicating long favorable climatic conditions during the year for larval development. High infection rates and larval burdens were observed during the summer season (June, July and August). These high infection rates and larval burdens during the summer season might be due to the prevailing favorable climatic conditions, which are hot and relatively dry conditions favored by most of the myiasis-causing flies (Farkas *et al*., 1997). In fact, the maximum and minimum mean monthly temperatures during the study period were 34.2˚C and 26.8˚C respectively, and the maximum and minimum monthly percent relative humidity were 72% and 59% respectively (Table 1), which falls within the normal range of fly activity. In a similar study, Bosly (2013) studied the seasonal prevalence of *O. ovis* larvae in sheep in Jazan slaughterhouse, and she found that 53.54% of the total examined sheep heads showed positive infestations, and she recorded four peaks for *O. ovis* seasonal activity in January, May, July and October. The long favorable climatic conditions indicate that there may be several generations of adults produced continually in Jazan Region, and the seasonal temperature and humidity might have effects on larval development. In fact, the epidemiology of myiasis is affected by many factors, which affect the fly prevalence and host susceptibility, e.g., changes in husbandry practices and insecticide resistance. Global warming could also become a significant factor if it results in an increasingly hot and dry summer favoured by myiasis-causing flies.

This study has shown that sheep are more susceptible to infection with *O. ovis* larvae than goats, and the infection rate with *O. ovis* in old sheep is significantly higher than in young sheep; unlike in goats, where there is no significant difference in the infection rates of old and young goats. Despite the fact that both sheep and goats can act as hosts for *O. ovis*, the infection rates and larval burdens are always higher in sheep than in goats after either natural or artificial infestation (French *et al.*, 1995; Duranton *et al.*, 1996; Dorchies *et al.*, 2000; Papadopoulos *et al.*, 2001; and Smaragda and Hall, 2012). However, in most of these studies, there is no information available regarding the geographical origin of the animal species compared. In fact, not all sheep in a flock are equally susceptible to infection with *O. ovis* larvae. The infestation of sheep is strongly associated with a range of predisposing conditions, such as soiling of the fleece by urine and feces (and associated bacterial contamination of these sites), endoparasitic worm burden, fleece length and humidity which promote oviposition and larval

survival (French *et al.*, 1995, Smaragda and Hall, 2012). The differences in the infection rates with *O. ovis* in sheep and goats might be due to several factors. Goats appear to be more sensitive to the irritations of larvipositing flies than sheep, and might effectively avoid larval laying by adult flies. Another factor might be that *O. ovis* larvae from sheep are poorly adapted to goats. Dorchies *et al.* (1998) found that more *O. ovis* larvae of goat origin (10.7%) survived in experimentally infected goats than those of sheep origin (1.7%), suggesting that there might be an "ovine strain" and a "caprine strain". Alternatively, the female fly might actively select sheep as hosts if there are abundant hosts available (such as a mixed-species flock). Odours from various sources on sheep may stimulate host location, landing and larviposition of females. Hall *et al.* (1995) have reviewed these odours.

In fact, there is some evidence that a caprine strain of *O. ovis* might exist with a much smaller distribution and lower prevalence compared to those of ovine strains. This is supported by the findings of Grisez-Duranton *et al.* (2000) that genetic differences between larvae from sheep and goats do not represent different species, but as revealed by the amplified DNA polymorphism, a strain classification could be suggested. Further support for this assumption might come from the molecular analysis of larvae collected from sheep and goats mixed flocks. On the other hand, oestrosis seems to be related at least in part to host behavioral responses. Goats might possibly have generally lower levels of infestation than sheep as a result of their browsing habits (Hoste *et al.*, 2001).

This study has shown that the infestation rate of nasal myiasis in old sheep (62%) is significantly higher than in young sheep (7.5%) ($P<0.01$), suggesting that the infestation rate increases with an increase in age. This may indicate that the old animals do not develop any protective host resistance or immune response as a result of repeated exposure due to the immunosuppressive effect of *O. ovis* infestation (Otranto *et al.*, 2004). Alternatively, older sheep may be more attractive to female flies than younger animals. In fact, host stimuli (visual and olfactory stimuli) are very important in the host location (Hall, 1995). Similar results were reported by Tavasolli *et al.* (2012) who showed that the infestation rate of *O. ovis* in different age groups including 6-24 months, 2 to 4 years, and older than 4 years were 17.39%, 28.33% and 35.68% respectively, and they attributed this to the low host resistance. Similarly, Mahmoud *et al.* (2012) found that in Jordon, the number of *O. ovis* larvae increased with the age of sheep. It is a well-known fact that infestation of *O. ovis* in sheep can cause impairment of the host's immune system (Otranto *et al.*, 2004), and this may explain the higher infestation rate in older sheep. On the contrary, in another study conducted by Alem *et al.* (2010) in Ethiopia, in which they found that the prevalence of *O. ovis* in small ruminants of less than 1 year of age was significantly higher than those with greater than 1 year of age ($chi^2 = 8$, $df = 1$, $P < 0.05$), and they attributed this effect to the development of host resistance with increase in age due to continuous exposure to *O. ovis* infection.

In this study, statistical analysis did not show any significant differences between the infection rate with *O. ovis* among old or young goats, however, Jafari *et al*. (2011) reported that an increased infestation rate with *O. ovis* in goats was observed in older animals, and he attributed this to the fact that many goat breeders do not perform routine treatment of their animals against parasitic diseases in the regular time. In another study, Gebremedhin (2011) studied the prevalence of ovine and caprine oestrosis in Ambo, Ethiopia, and concluded that oestrosis is a common problem in the study area and more prevalent in sheep than goats, in adults than young, and in animals with poor body condition. In another similar study, Papadopoulos *et al.* (2006), demonstrated in a serological survey of sheep and goats in

Greece that seroprevalence of *O. ovis* is significantly higher in sheep than goats (P= 0.001), and he added that perhaps sheep is either a more immunologically compatible host, or the avoidance behavior of the goats gives it a protective advantage. Dorchies *et al.* (2000) who reported that the prevalence and parasitic burden with O. ovis is less in goats than in sheep reported similar results, and they mentioned that according to the breeders, goats are not infected, and oestrosis is only a sheep disease. Development of more aggressive fly strains could be also a possible factor, as was observed in connection with *L. cuprina* in Africa (Norris, 1990).

This study has shown that larval myiasis is widespread in mixed-grazing sheep and goats farms in Jazan Region (50% of the visited farms were infected). This high prevalence rate might be due to the prevailing favorable climatic conditions and methods of animal husbandry in Jazan Region. In a similar study for the prevalence of larval myiasis in mixed grazing sheep and goats farms in Riyadh Region, Alahmed (2004) found low infestation rate (2%) with different dipterous larvae; and 87% of the recovered larvae were *C. bezziana*, while 8.7% were *C. albiceps* and 4.3% were *W. nuba*. Also, he reported that the prevalence rate of larval myiasis among adult and young sheep was 40% and 60% respectively. He found that the prevalence of larval myiasis was highest during March-May and Sept-Nov, where temperature and relative humidity are optimum for larval development; while in the dry hot season (June-August) and cold season (Dec-Feb) the prevalence rates were low. The differences between Alahmed's study (2004) and our study might be due to the differences in the climatic conditions between Riyadh and Jazan Regions, or differences in breed susceptibility of sheep in Riyadh and Jazan Regions. In fact, most of the animals examined in the mixed grazing farms were found treated previously for larval myiasis, which may indicate that the actual larval myiasis prevalence rates and larval burdens due to *C. bezziana*, *C. albiceps*, *W. nuba* and *S. africa* in sheep and goats are actually higher than what was recorded in this study.

In conclusion, more studies on the effects of age and breed of sheep and goats on the prevalence of *O. ovis* and *C. bezziana* larvae, and the effects of visual and olfactory stimuli in host locations are required. More information on the epidemiology, economic importance and distribution of larval myiasis due to *O. ovis* and *C. bezziana* in Saudi Arabia is required.

Acknowledgement

We would like to thank King Abdul-Aziz City for Science and Technology (KACST), Riyadh, for financial support. Special thanks are extended to the Center of Environmental Research Studies, University of Jazan, Jazan for providing space and technical assistance. The help of the Agriculture and Animal Resources Directorate, Jazan, for the selection of sheep and goats farms is highly appreciated. We would like to express our thanks and appreciation to Dr. J. C. Deeming, National Museum of Wales, Cardiff, U. K. for the identification of insect specimens.

REFERENCES

Alahmed, A. M. (2000). Seasonal infestation of *Oestrus ovis* larvae (Diptera: Oestridae) in sheep heads in Central Region of Saudi Arabia. *Journal of the Egyptian Society of Parasitology,* 30 (3): 895-901.

Alahmed, A. M. (2004). Myiasis in sheep farms in Riyadh Region, Saudi Arabia. *Journal of Egyptian Society of Parasitology,* 34 (1):153-60.

Alem F, Kumsa B.; Degefu H. (2010). *Oestrus ovis* larval myiasis among sheep and goats in Central Oromia, Ethiopia. *Tropical Animal Health and Production,* 42 (4): 697-703.

Ali Asghar Mozaaffari, Saeedeh Shojaeepour and Shahin Ghareh Cheshmeh. (2013). High mortality rate due to false gid in a sheep herd. ISRN Veterinary Science,

Article ID 650358. 3pp. Hindawi Publishing Corp. Vol 2013. http: //dx.doi.org/10.1155/2013/650358

Bosly, A. Hanan. (2013). Seasonal prevalence of *Oestrusovis* L. (Diptera: Oestridae) larvae in infested sheep in Jazan Region, Saudi Arabia. *Journal of Parasitology and Vector Biology*, Vol 5 (5): 66-71.

Dorchies, Ph.; Bergeaud, J. P; Tabouret, G.; Duranton, C.; Prevot, F. Jacqiet, Ph. (2000). Prevalence and larval burden of *Oestrus ovis* (Linne, 1761) in sheep and goats in northern Mediterranean region of France. *Veterinary Parasitology*, 88: 269-273.

Dorchies, P.H.; Duranton, C.; Jacquiet, P. (1998). Pathophysiology of *O. ovis* infection in sheep and goats: a review. *Veterinary Record*, 142(18):487-9.

Dorchies, P.; Yilma, J. P.; Savey, J. (1993). Prevalence of lung abscesses and interstitial pneumonia in ovine oestrosis. *Veterinary Record (United Kingdom).* 133(13):325.

Duranton, C.; Bergeaud, J. P.; Dorchies, P. (1996). Experimental infestation of goats with instars larvae of *Oestrusovis*. *Veterinary Research*, 27(4-5), 473-477.

Farkas, Robert; Hall, M.J.R.; Kelemen, Ference (1997). Wound myiasis of sheep in Hungary. *Veterinary Parasitology*,69,133-144.

French NP.; Wall R.; Morgan, K.L. (1995). The seasonal pattern of the sheep blow fly strike in England and Wales. *Medical and Veterinary Entomology*,9 (1): 1-8.

Gebremedhin, E. Z. (2011). Prevalence of ovine and caprineoestrosis in Ambo, Ethiopia. *Tropical Animal Health and Production*, Vol. 43, no. 1, pp. 265–270, 2011.

Grisez-Duranton, C.; Dorchies, Ph.; Jourdane J.; Durand, P.(2000). Genetic structure of *Oestrusovis* populations in sheep and goats. *Veterinary Parasitology*,104, 167-173.

Hall, M.J. R. (1995). Trapping the flies that cause myiasis: their host response to host stimuli. *Annals of Tropical Medicine & Parasitology*, 89(4): 333- 357.

Haris Setyaningrum and Hathal (2014). The Calliphoridae, the blow flies (Diptera: Oestroidea) of Kingdom of Saudi Arabia. *Egyptian Academic Journal of Biological Sciences and Entomology E-Medical Entom. & Parasitology*, 7 (1):49-139.

Hoste, H.; Leveque, H.; Dorchies, Ph. (2001). Comparison of nematode infections of gastro-intestinal tract in Angora and dairy goats in a rangeland environment: relations with the feeding behavior. *Veterinary Parasitology*,101:127-135.

Jafari, S. Shoorijeh; Tamadon, A.; Negahban, Sh; Behazadi,, M.(2011). Prevalence of *Oestrusovis* in goats of Shiraz, Southern Iran. *Veterinarski arhiv*, 81 (1): 43-49.

Jarret, S.; Morgan, J. A. T.; Wlodek, B.M.; Brown, G. W.; Urech, R.; Green. P.E.; Lew- Tabor, A. E. (2010). Specific detection of *Chrysomya bezziana* in bulk fly trap catches using real- time PCR. *Medical and Veterinary Entomology*, 24 (3): 227-235.

Khattab, A. and El Haddidy, M. (1971). Results of botanical expedition to Arabia. Univ. Cairo Herbarium Publications, 4: 1-95.

Mahmoud N. Abo-Shehada, Baker Arab, Rami Mekbel, D. Williams, P.R. Torgerson. (2000). Age and seasonal variations in the prevalence of *Oestrusovis* larvae among sheep in northern Jordan. *Preventive Veterinary Medicine*, 47 (3): 205-212.

Mohammedein, M. M. (2001). In: "Kingdom of Saudi Arabia: A geographical Study". (In Arabic), Al Khereji Printing Press, Riyadh, Saudi Arabia.

Norris,K. R. (1990). Evidence for the multiple exotic origin of Australian populations of sheep blowfly *Lucilia cuprina* (Wiedemann) (Diptera: Calliphoridae). *Australian Journal of Zoology*, 38 (6): 635-648.

Otrano, D; Traversa , D. and Giangaaspero, A. (2004). Myiasis caused by Oestridae: Serological and molecular diagnosis. *Parasitologica*, 46 (1-2): 169-72.

Papadopoulos, E.; Prevot, F.; Diakou, A.; Dorchies, Ph. (2006). Comparison of infection rates of *Oestrus ovis* between sheep and goats kept in mixed flocks. *Veterinary Parasitology*,138: 382-385.

Papadopoulos, E.; Prevot, F.; Jacquiet, Ph.; Duranton, C.; Bergggeaud, J.P.; Kalaitzakis, E.; Dorchies, Ph. (2001). Seasonal variation of *Oestrus ovis*-specific antibodies in sheep and goats mixed flocks in Greece. *Veterinary Parasitology*, 95:73-77.

SAS (2001). SAS system for windows, 2001. SAS Institute, Inc., Cary, NC., USA.

Smaragda Sotiraki and Martin J. R. Hall (2012). A review of Comparative aspects of myiasis in goats and sheep in Europe. *Small Ruminants Research,*103:75-83.

Spradbery, J. P. (1994). Screwworm fly: a tale of two species. *Agricultural Zoology Reviews;* 6: 1-62.

Tavassoli, M.; Tajik, H.; Malekifard, F. Soleiman, A. and Mardani, K. (2012). Seasonal infestation of *Oestrusovis* larvae in slaughtered sheep in Urmia, Iran. *Iranian Veterinary Journal*, 7(4):73-78.

Zumpt, F. (1965). Myiasis in human and animals in the old world. London Butterworths, London, United Kingdom Publ. 267 pp.

````
````