



Evaluation of The Prevalence and Oxidative Status in Sheep infected with *Sarcoptes scabiei* in Ismailia Governorate, Egypt.

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Abstract:

Oxidative stress is a general mechanism whereby free radicals induces oxidative damages and reduces the antioxidant defenses of the biological systems. The highly reactive oxygen agents represent a powerful effector mechanism against parasites. The present study was aimed to examine the oxidative status in blood of naturally infected sheep with *Sarcoptes scabiei* in relation to its prevalence effects of age, gender and season in Ismailia governorate, Egypt. In the present study a number of 760 sheep, 1-3 years old, suffering from pruritis, crusted skin lesion and alopecia were investigated during October 2017 to March 2019. Microscopically examination of skin scraping revealed that 80 out of 760 sheep were infested with *Sarcoptes scabiei* with an overall percentage of infestation 10.5 %. The prevalence of infestation was highest in winter time (14%), followed by autumn (11.5%), spring (10.7%) and summer (4.4 %). Higher prevalence of infection (15%) was recorded in animals aging less than one year old than those of 1-3 years old (6.60%). Significant ($p < 0.05$) higher prevalence rate (12%) was recorded in femal than in male sheep (6.3%). There is a significant increase in MDA, NO and Albumin in blood of infected sheep infected in comparison with the control non-infected group. Moreover there is a significant decrease on the activities of the antioxidant SOD, CAT, GSH, GPx, ZN and Cu in comparison with control group, Inflammatory markers (IL1 β and CRP) showed significant increase in infected sheep than healthy one. Scanning electron microscopy (SEM) revealed the tortoise-like *Sarcoptes scabiei* with four long bristles, suckers on legs 1 and 2, dorsal spines and a terminal anus. For conclusion Sarcoptic mites infestation causing increases in the oxidative stress and decreases the antioxidant status in infected sheep

Key words: *Sarcoptes scabiei*, Oxidative stress, Antioxidant, Sheep.

Introduction

Mites consider as one of the old cosmopolitan groups, with various terrestrial and aquatic habitats and environmental variations. The skin burrowing *Sarcoptes scabiei* causes sarcoptic mange among a variety of mammalian species, including human. In a non-adequate host, these mites lead to pseudo-scabies which are often self-curable. Sarcoptic mites (scabies) is a major global health problem in human and animal populations (Kraabøl et al., 2015). Members of family Sarcoptidae are obligatory parasites which causes tunneling through animal skin. *Sarcoptes scabiei* is the causative agent of scabies as well as itching mange among domestic and wild animals, mainly affecting barely haired areas of body (Dinka et al., 2010). The disease is revealed as severe skin lesions which may affect the body surface in form of intense pruritus, alopecia, thickened skin, dry, exudative crusts, emaciation, hemorrhagic and non-hemorrhagic fissures on the upper neck, skin of the face, upper eyelids and ear (Pérez et al., 2011). Sarcoptic mange in sheep caused by *Sarcoptes scabiei* is one of the most economically important zoonotic and epizootic diseases spread among animals via direct physical contact with infested sources and indirectly through fomites (e.g., ropes, blankets) especially in tropical and subtropical areas (Parsani et al., 2008).

Economically, mite infection decreased bodyweight, deterioration of skin due to perforation, the expense of therapy and intense pruritus as skin lesions may cover almost the entire body and occasional

mortalities in untreated and young animals (Wilson, 2008).

Moreover, mange severely decrease the welfare of milking animals decreasing its vitality and increasing their susceptibility to infection by other secondary bacterial diseases (Megersa et al., 2012). Parasitism is known to exacerbate oxidative stress in the animals; the parasites can produce oxidative stress to host cells. Oxidative stress gives to parasite persistence in host and damage caused by it contributes to the development of the pathological conditions. Many factors help in improvement of oxidative stress, certain endogenous enzymes (Kataria et al., 2010). Oxidative status is an important physiological index to consider when investigating associations between infection and host health status (Dowling et al., 2008).

Antioxidants play a role in preventing cell damage by reducing free radicals (Kleczkowski et al., 2003). There is a balance between free oxygen radicals and the defensive antioxidant system in healthy animals. The change in the balance between free radicals and antioxidant system is known as oxidative stress. Oxidative stress is a part of cellular and molecular tissue damage in various diseases (Ercan and Fıdancı, 2012). Free radicals induce adverse effects on the skin, including inflammation, edema, wrinkling, erythema, autoimmune reaction, keratinization abnormalities and hypersensitivity (Camkerten et al., 2009). Circulating oxidants were found to be increased in dogs with sarcoptic mange (Valko et al., 2007). These free radicals play a key role in host defense against the invading parasite, but when generated at high levels they can

result in metabolic dysfunction and biomolecular oxidative damage, which contribute to pathological changes in the tissues (Dimri et al., 2008). Changes in oxidative stress indices have been reported in mite-infested buffaloes (Bickers and Athar., 2006), dogs (Beigh et al., 2016), sheep (Dimri et al., 2010), goats (De and Dey., 2010), dromedary camels (Saleh et al., 2011) and pigs (Dimri et al., 2014). Recent findings suggest that the tissue damage attributed by oxidative stress play a key role in the pathogenesis of many ectoparasitic and skin diseases (Camkerten et al., 2009).

Serum nitric oxide (NO), MDA increased in infected camels with *Sarcoptes scabiei* than healthy camels, the activities of oxidative stress markers SOD, CAT, GSH and albumin decreased in blood of infected animals than healthy camels (Espinosa et al., 2017). Infection of Iberian ibex with *S. scabiei* showed a decrease in SOD, GSH, CAT and Albumin activities in the blood of infected animals than the healthy ones. Total oxidant status (TOS), MDA level increased in the blood of infected Iberian ibex than healthy animal (Mervat et al., 2017). Buffaloes infested with Psoroptic mange showed a high level of MDA than the healthy group. The oxidative stress biomarkers CAT, GST and SOD activities were dropped in infected buffalos than the healthy animal control group. The inflammatory biomarkers as CRP, IL6, TNF were significantly raised in infected group with mange than healthy group. Tikaram et al., (1986) mentioned that Blood zinc and copper concentration in healthy sheep were higher than infected sheep with Psoroptic mange. Activities of CAT and SOD in the skin of infected sheep

with mange mite were lower than the healthy sheep

The present study was aimed to examine the oxidative status in blood of naturally infected sheep with *Sarcoptes scabiei* in relation to its prevalence effects of age, gender and season in Ismailia governorate, Egypt

Material and Methods

Animal selection criteria:

This study was organized and carried out at different farms located in Ismailia governorate. A total of 760 sheep, aged up to 3 years were screened during the period from October 2017 to March 2019 for the occurrence of mange mites. The suspected animals (110/760) were examined following the standard procedures of skin scrapings,. Diagnosis of sarcoptic mites was based on the following six clinical criteria: (1) intense pruritus, (2) papular eruption, (3) self-trauma, (4) excoriations, (5) alopecia and (6) crusting of the elbow, ear margins and hocks.

Parasitological examination and skin scraping:

The suspected sheep were selected for parasitological investigation. Profound skin scrapings from the peripheral or the edges of the clinical lesions which were obtained from different areas of the body such as head, face, neck, ears, tail and trunk (scraping varied from 1 to 2.5 cm²) area of affected lesions, until the skin was bled. The scraped samples were treated with 5 ml of 10% of potassium hydroxide (KOH) to dissolve tissue material and heated for 5-10 min. After that, samples were centrifuged at 1500 rpm for 4-5 min, and then the sediment was spread on a glass slide and examined by microscope (Soulsby, 1986).

Blood collection:

Ten ml of blood was collected from the jugular vein of every suspected sheep to non-heparinized tubes. The blood samples were left to clot at room temperature. The clotted blood was centrifuged at 3,000 rpm for 10 min for serum separation. All the sera were stored at -20°C till analysis (Tuck et al., 2009).

Estimation of serum biochemical parameters:

Determination of MDA level:

Lipid Peroxide was determined by the colorimetric method by using readymade kits provided by Biodiagnostic CAT.NO. MD 25 29 (Ohkawa et al., 1979).

Determination Superoxide Dismutase (SOD):

Superoxide Dismutase was determined by the colorimetric method by using readymade kits provided by Biodiagnostic CAT.NO. SD 25 21 (Nishikimi et al., 1972).

Reduced Glutathione (GSH):

Glutathione Reduced was determined by the colorimetric method by using readymade kits provided by Biodiagnostic CAT.NO. GR25 11 (Beutler, 1963).

Determination of Catalase (CAT):

Catalase was determined by the colorimetric method by using readymade kits provided by Biodiagnostic CAT.NO. CA 25 17 (Aebi, 1984).

Determination of GPx activity:

Glutathione peroxidase was determined by the colorimetric method by using readymade kits provided by Biodiagnostic CAT.NO. CA 25 16 (Pascual et al., 1992).

Serum albumin (ALB):

It was measured using the kits reagent of Diamond-Diagnostic, Egypt (Dumas et al., 1981).

Determination of nitric oxide (NO):

Nitric oxide (NO) was determined by colorimetric assay (Montgomery and Dymock, 1961).

Analysis of zinc (Zn):

Two milliliters of plasma sample was analyzed for zinc using Polarized Zeeman Atomic Absorption Spectrophotometer, (Kolmer, 1981).

Copper Analysis (Cu):

Serum Cu levels were determined using a Pye Unicam 2900 Atomic Absorption Spectrophotometer (Fick et al., 1976).

Serum C - reactive protein (CRP):

Serum CRP concentrations were determined by turbidimetric immunoassay (TIA) (Vojtic and Krajnc, 2000).

The serum concentration of interleukin-1 beta (IL-1 β):

Was measured by a quantitative enzyme immunoassay (sandwich ELISA) kit (Genorise Scientific Inc., Paoli, USA) (Kutu et al., 2018).

Preparation for (SEM) Scanning electron microscopy:

Each sample has been fixed in equal volumes of glutaraldehyde 4% + Cacodylate 0.2 % for 2 hours. Then it washed in equal volumes of sucrose 0.4 % and cacodylate 0.2 % for 2 hours. Post fixed in equal volumes of osmic acid 2% and cacodylate 0.3 % for 1 hour, then washed with distilled water. Finally dehydrated in ascending grades of ethyl alcohol for 5 min each (30%, 50%, 70% and 90%) then absolute

alcohol 100% for 10 min for 3 times and examined on Formvar coating grid by Environmental Scanning Electron Microscope (Inspect S; FEI, Holland) at Electron Microscopy Unite of Theodor Bilharz Research Institute (TBRI) (Glauert, 1974).

Statistical analysis:

The packaged SPSS program (Statistical Package for Social science) was used for statistical analysis. The data of oxidative stress obtained are expressed as mean \pm SD. The data were analyzed by the use of standard statistical analyses, t-independent test to determine significance between different samples. The percent of significance ($P < 0.05$). Differences in the prevalence of mites between seasons, age groups and sexes were tested for significance by the chi-square test.

RESULTS

The collected *Sarcoptes scabiei* were identified by its size, shape and morphology following up the identification key of Mellanby, (1985). Adult scabies mites are roughly round, ventrally flattened and dorsally convex tortoise-like bodies. Adult female scabies mites have four pairs of short legs (two pairs in front and two pairs behind), and its first and second pairs of legs well separated from the third and fourth pairs of legs Fig. (1A&B).

In the end of the body the anus was located that surrounded with spines Fig. (1C).

Clinical observation:

The initial lesions were localized accompanied by alopecia and were found on the body parts which had thin skin and less wool. Scabby lesions appeared as

erythematous skin with irregular alopecic areas and scab formation.

Observations on the prevalence of mange:

During the period from October 2017 to March 2019, 760 sheep belong to different farms of Ismailia governorate were examined. Out of that total 10.5 % of sheep were found to be infested with *Sarcoptes scabiei* which is the only type of mite was found to be infesting the sheep in the study area.

Significant association ($p < 0.05$) was found between the prevalence rate and season and the highest prevalence rate was found in the winter season (14%), followed by autumn (11.5%), spring (10.7%) and summer (4.4 %) Table (1). Higher prevalence of infection by mites(15%) was recorded in younger animals less than one year old than that recorded in 1-3 years old sheep (6.60%) Table (2). There were significant differences in the rate of infection according to the sex of animals. Females had a significant ($p < 0.05$) higher prevalence rate (12%) than male sheep (6.3%) Table (3).

Biochemical finding:

Sarcoptes scabiei caused a significant decrease in activities of antioxidant capacity SOD, CAT, GSH, GPx compared with healthy sheep, showed a significant increase in the concentration of lipid peroxidation MDA, NO, Albumin in the blood of infected sheep compared with the control group. Zn, Cu a significantly decreases in blood of sheep infected with *S. scabiei* compared with the control group.

Inflammatory markers (IL1 β and CRP) showed a significant increase in the infected sheep than the healthy control group Table (4).

The characteristic features of the collected mite species using scanning electron microscopy (SEM):

SEM revealed that, they are round with ventral surface somewhat flattened, the cuticle finely striated Fig. (2C), There were finger prints on the body surface Fig. (2C, 3D). There is small spine on the dorsal surface with various rows directed backward Fig.(2A, 3A).in addition to large spine with various direction located

posteriorly (2D, 3A), beside the presence of smooth setae on the body surface and long setae along their legs Fig. (2C, 2D, 3D). These spines help the mite attachment with their different shapes, sizes and directions. The un-segmented pedicels of first and second legs of females had pulvillus suckers Fig. (2C), and third and fourth legs ended with long hair bristles shown in Fig. (2D).

The images show two pairs of first and second legs aligned beside the capitulum and another two pairs third and fourth legs on the ventral side Fig, (3B) on the dorsal surface there are three pairs of lateral spines Fig (3A).

Figures

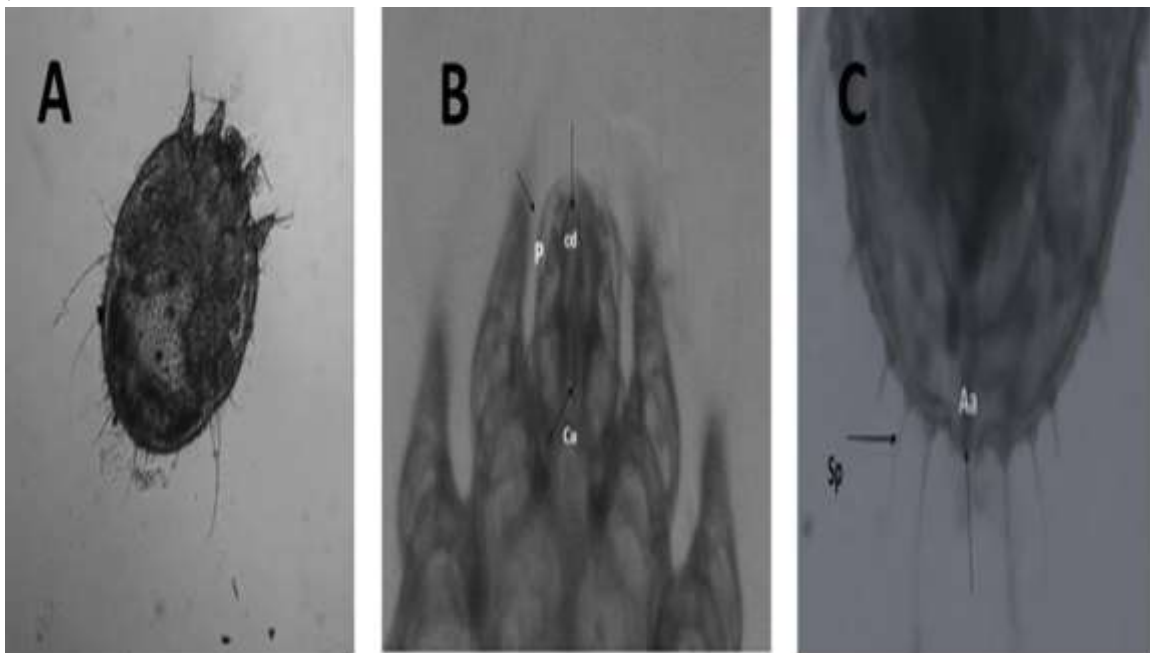


Figure 1: (A) LM of *Sarcoptes scapiei* adult dorsal view (X10) ; (B) dorsal view showing the basis capituli (X40); (C) dorsal view showing the posterior part(X40).

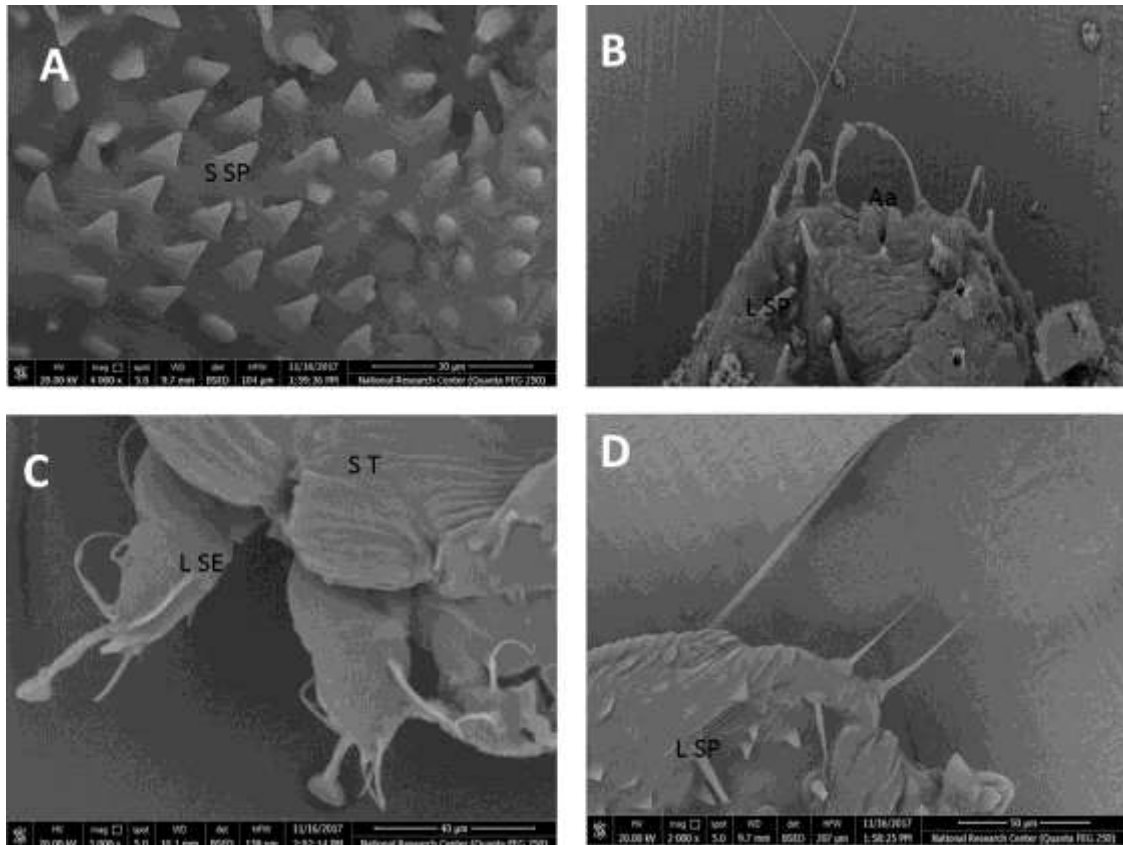


Figure 2: SEM of *Sarcoptes scapiei* adult; (A) Thorn like spines present on the central part of the dorsum of sarcoptic; (B): The anus was located at the posterior end of the body and was surrounded by several short stout setae; (C): The un-segmented pedicels of legs 1 and 2 of female are terminate by a disk-like structure; (D): long trailing bristles on legs 3 and legs 4.
 L sp: long spines, S sp: small spines, SE: setae, St: striation.

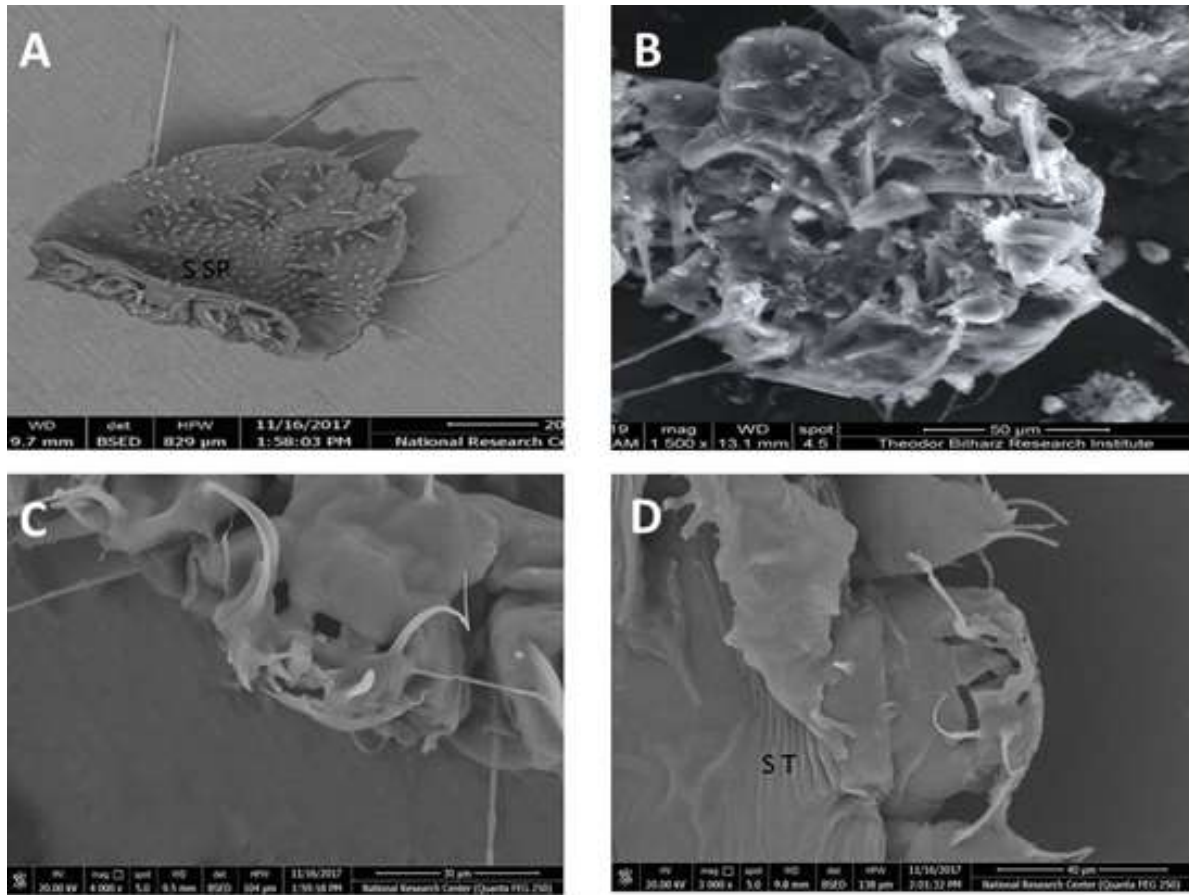


Figure 3: SEM of *Sarcoptes scabiei*; (A) Adult, dorsal view; (B): Adult, ventral view; (C): The capitulum , dorsal view (D): The capitulum, ventral view.
 L sp: long spines, S sp: small spines, SE: setae, St: striation.

TABLES

Table (1): The rate of infection with *Sarcoptic scabiei* according to seasons from October 2017 to March 2019:

Season	No of examined sheep	No of infected sheep	Percentage	Person Chi-Square X ²	P-value
Autumn	200	23	11.5%	10.482	0.015
Winter	250	35	14%		
Spring	130	14	10.7%		
Summer	180	8	4.4%		
Total	760	80	10.5%		

Probability value (P.v) = 0.015, P ≤ 0.05

Table (2): The rate of the mite infection according to age of sheep, in Ismailia governorate.

Age of sheep	Examined sheep	Infected sheep	Percent	Person Chi-Square X ²	P-value
Up to 1 year	340	52	15%	14.849	0.000
Above 1 year	420	28	6.6%		
Total	760	80	10.5%		

Probability value (P.v) = 0.000, P ≤ 0.05

Table (3): The rate of *Sarcoptic scabiei* infection according to gender of sheep.

Gender of sheep	Examined sheep	Infected sheep	Percentage	Person Chi-Square X ²	P-value
Male	190	12	6.3%	4.769	0.029
Female	570	68	12%		
Total	760	80	10.5%		

Probability value (P.v) = 0.029, P ≤ 0.05

Table (4): Comparison of oxidative stress markers (mean ± SE) measured in blood of sheep infected with *Sarcoptic scabiei* and control group.

Samples	MDA μmol/g	SOD U/mg	CAT U/g	GSH mg/dl	GPx mg/ dl	NO nmol/m g protein	ZN μmol/L	Cu μmol/L	ALB g/dl
Infected With mites (group 2)	46.93 ^a ± .45	15.7 ^b ± 1.36	0.28 ^b ± .04	0.57 ^b ± .03	66.12 ^b ± 6.81	17.34 ^a ± .90	1.18 ^b ± .09	0.25 ^b ± .04	3.22 ^a ± .28
Control (group 1)	37.35 ^b ± 1.21	29 ^a ± 0.86	0.76 ^a ± .03	0.74 ^a ± .05	164.07 ^a ± 16.17	11.95 ^b ± 1.41	1.73 ^a ± .19	0.58 ^a ± .10	2.18 ^b ± .45

MDA= malondialdehyde, SOD= superoxide dismutase, CAT=catalyse, GSH=reduced glutathione, GPx= glutathione peroxidase, NO= nitric oxide, ZN= zinc, Cu= copper, ALB= albumin, Values with different superscript letters (a, b) between columns differ significantly (P < 0.05).

Table (5): Inflammatory markers (mean ± SE) measured in blood of sheep infected with *Sarcoptic scabiei* and control group.

Sample	IL1β	CRP
Infected With mites (group 2)	.74 ^a ± .05	10.14 ^a ± 1.10
Control (group 1)	.30 ^b ± .02	4.89 ^b ± .17

IL1= Interleukin 1-beta, CRP= C - reactive protein

Discussion

Mange is a highly infectious skin disease of sheep, which badly affects the health and productive capacity of the infected animals (Ashraf et al., 2014). The skin condition of sheep could be used as a mirror for the general health status of the animal. The result of main clinical signs of sheep infested by sarcoptes mite agreement with other authors reported that the itching and loss of wool can be explained by the mites dig tunnels beneath the skin, their saliva has potent digestive enzymes that dissolve the skin tissues (Al-Shebani et al., 2012). The present study showed that there is a positive significant correlation ($P < 0.05$) between the prevalence of sarcoptic mite infestation and season. The severity of infestation was observed during the winter season (14%), while the lowest infestation was recorded in the summer season (4.4 %) followed by autumn and spring season (11.5% and 10.7%, respectively). This result was agreed with Vishe et al., (2012) who found that sarcoptic mites survive better at 20-27°C than at 31-39°C, higher incidence during the cold period was attributed to low ambient temperature (aT), which favored the propagation of mites, cold climate has been reported to favor the propagations of mites. However, our results were not supported by Ashraf et al., (2014). who found that the disease most prevalent in the hot humid rainy season.

The effect of sex on sheep, we found that the prevalence rate of sarcoptic mite was 6.3 %

in males and 12% in females .Statistical analysis of data showed that there was a significant correlation between sarcoptic mange infestation and gender. A higher infestation rate in females than males suggests that differences in susceptibility between sexes may exist. Our result coincided with Awol et al., (2014) who found that the statistical analysis of variable between the prevalence of male and female, the females were higher than males. A higher prevalence of sarcoptic mites was observed in younger animals aging less than one year (15 %) and lowest in sheep with age (1-3) years old (6.60%). The young animals showed a higher infestation rate of *S. scabiei* than the adults. This could be attributed to soft and tender skin, dense hair coat, huddling tendency and relatively low level of immunity in young animals (Patel et al., 2003).

The obtained data was agreed with Ashraf et al., (2014).who stated that the age of sheep might be important factors in mange infestation, in which very young are particularly susceptible.

Oxidative stress is defined as a situation where the production of free radicals exceeds the anti-oxidative processes necessary to detoxify these toxic molecules, resulting in molecular disturbance and tissue damage (Niki, 2009).

Lipids are the most susceptible substrates to free radical damage. MDA is the last product of lipid peroxidation and is a key marker of oxidative stress. LPO can be harmful to skin due to change in the permeability and structure, increased levels of lipid peroxides may be implicated in the pathology of skin

lesions induced by sarcoptes mites (Celi, 2010).

The MDA increased in peripheral blood showed the exhaustion of these enzymes and supervened oxidative damage to the tissues of sheep with clinical sarcoptic mange. Similar observations in mange cases have also been reported in other animal species, including dog (Beigh et al., 2016), goat (De and Dey, 2010), water buffaloes, pigs (Dimri et al., 2014) and camel (Espinosa et al., 2017).

The observed decrease in antioxidant activity SOD, CAT, and GSH-Px, activities with the progression of the disease could be attributed to their overconsumption to counter the free radicals generated during the sarcoptic infestation This was in agreement with Beigh et al., (2016).

In the author,s opinion and on agreement with Majewska et al., (2016), inflammatory markers (IL1 β and CRP) showed the significant increase in infected sheep than healthy, maybe accredited to the severe allergic inflammatory condition induced by sarcoptes mites which stimulated the release of already secreted and newly synthesized cytokines and contributed to the parasites pathology ..

The obtained results in the present study was agreed with (Tikaram et al., 1986). who found the significant increase in ALB levels and CRP, IL-6 levels among infested buffaloes were considered good markers of inflammation induced by mites.

CRP is considered a positive acute phase protein which serves different physiological functions for the immune system as a part of innate immunity (Herpers et al., 2009). However, as Sarcoptic mange progresses, the

overproduction of these substances can have systemic consequences. Variations in OS parameters can therefore, be reliable indicators to evaluate the degree of damage and physiological changes in the host (Okayama, 2005).

Data described in this study provide a reliable biochemical evidence for the generation of circulating oxidative stress as detected by increased free radical generation (NO \bullet). Increased NO \bullet production was reported also in humans with cutaneous leishmaniasis and other inflammatory skin diseases as previously mentioned by Bickers and Athar, (2006). Lower serum zinc (Zn) and copper (Cu) concentrations were observed in sheep suffering from Sarcoptic mange. Both zinc and copper are essential components of the antioxidant enzyme Cu–Zn superoxide dismutase. Therefore, the overall utilization of zinc and copper to neutralize the overproduction of ROS might be responsible for their lower blood concentrations in diseased animals this was in agreement with Singh et al., (2011).

The mite Species diagnosed in this study were identified as *Sarcoptes scabiei* in sheep, based on characteristic morphology described by light and electron microscopy the identification depending mainly on the key of Mellanby, (1985).

The obtained results in this study were in concordance with Walter et al., (1983, and Ninomiya and Ogata, (2005). As they revealed that the adult sarcoptic mie, female was the stage most commonly seen. It measures about 320–534 μ m long and 229–378 μ m wide. The un-segmented pedicels of legs 1 and 2 of females had suckers, and legs 3 and 4 ended in long trailing bristles. Large spines were present on the central part of the

dorsum and body striations were prominent. The anus was located at the posterior end of the body and was surrounded by several short stout setae.

Conclusion:

The present study concluded that mite infection considered being a notable problem in Ismailia governorate. Infestation with *Sarcoptes scabiei* affected by gender, age and season. Small age (under one year) is more susceptible to infestation. *Sarcoptic* infestation increases the oxidative stress and decrease the antioxidant status in sheep which affect the health status of animals and damaged their skin.

From a veterinary medicine perspective, the administration of antioxidant substances could be considered, in addition to anti-parasitic treatment in the animals suffered from sarcoptes mites. Moreover, Scanning electron microscopy can be used as an alternative and additional tool for the accurate identification of mite species, as it revealed more topical details which not clear by light microscopy.

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المخلص العربي

دراسات وبائية وتقييم التغيرات البيوكيميائية الحالة التاكسدية في الاغنام المصابة بحلم الجرب بمحافظة الاسماعيلية

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الجرب من اهم الامراض الطفيلية التي تصيب الاغنام في مصر حيث يؤثر على صحة الحيوان و العائد المادي ومشاريع الثروة الحيوانية في هذه الدراسة تم فحص عدد ٧٦٠ من الاغنام بمحافظة الاسماعيلية في الفترة ما بين اكتوبر ٢٠١٧ الى مارس ٢٠١٩ وتم تسجيل معلومات عن الاغنام المصابة مثل السن والنوع(ذكر - انثى) والحالة الصحية للحيوان وقد وجد ان نسبة الاصابة الكلية بطفيل حلم الجرب في الاغنام ١٠.٥% ومن الفحص تبين وجود نوع واحد هو سركوبتس سكيبياي خلال هذه الدراسة وايضا وجد علاقة بين نسبة الاصابة والموسم حيث سجلت اعلى اصابة في فصل الشتاء ثم يليه الخريف وقلها في فصل الصيف ووجد ايضا علاقة بين نسبة الاصابة و سن الحيوان حيث سجلت اعلى نسبة اصابة في الاغنام الصغيرة.

الاجهاد التاكسدي هو الية يحدث فيه انتاج الشقوق الحرة التي بدورها تحث على قله في دفاع الانزيمات داخل الخلايا و تعتبر جزيئات الاكسجين النشط المتفاعل الية قوية ومؤثرة ضد الاصابة بالطفيليات والحالة التاكسدية للحيوان تعتبر عامل مهم لتحديد صحة و انتاجية الحيوان. وجد ان هناك علاقة عكسية وبين الاصابة بالطفيليات والحالة التاكسدية للحيوان والاجهاد عامة يؤثر على ظهور الامراض.

عند الاصابة بالامراض الجلدية يمتلك الجسم مجموعة من الحماية الفعالة من مضادات الاكسدة و من خلال الدراسة وجد ان هناك انخفاض احصائي واضح في الانزيمات الدفاعية في دم الاغنام المصابة مقارنة باقرانها السليمة (الغير مصابة) مثل (SOD, CAT, GPX, GSH)

MDA في دم الحيوانات المصابة يعتبر مؤشر لأكسدة الدهون و وجد ارتفاع ملحوظ لهذا المؤشر دليل على الاجهاد التاكسدي

كما سجل انخفاض ملحوظ في نسبة الزنك والنحاس في دم الحيوان المصاب عن نظائرها السليمة وارتفاع كلال من نسبة الاليومين و اكسيد النيتريك اما بالنسبة لعوامل ظهور الالتهابات شهدت ارتفاع ملحوظ في دم الحيوانات المصابة مقارنة بالسليمة.

ويعتبر الميكروسكوب الألكتروني الماسح وسيلة بديلة وأضافة للميكروسكوب الضوئي في الفحص والاستعراف علي طفيل حلم الجرب و ذلك لوجود بعض الخصائص التي اوضحها الميكروسكوب الاللكتروني عن الضوئي.