The role of Chorioptic mange infestation in aggravating the infection rates of Staphylococcal dermatitis and Edematous skin disease in Egyptian buffaloes

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Abstract: Chorioptes mange is a skin disease affects both domestic and wild ruminants. A total of 341 Egyptian buffaloes, aged from 2 to 10 years old were examined clinically to determine incidence rate, clinical finding, age susceptibility of Chorioptic mange besides measuring cell mediated immune response of Chorioptic mite infested buffaloes. Incidence of Chorioptic mange was recorded in 252 out of 341 (73.9 %) Egyptian buffaloes raised in Alexandria city, Egypt. With higher incidence at age group 6-9 years old. Microscopic examinations of skin scraping revealed chorioptic mite at all stages. Chorioptic mange infestation reduced the milk yield. Infested buffaloes with Chorioptic mange had lower lymphocyte transformation index which were 22.52±6.77 as compared with non-infested buffaloes 32.45 ± 4 .49. Chorioptes pruritus and injury in lower leg region found to be in concurrent with staphylococcal dermatitis and edematous skin disease infection. 252 infested buffaloes with Chorioptes, 92 and 71 of them suffered from Staphylococcal dermatitis and edematous skin diseases, respectively, 53 buffaloes showed both infections. 89 non-infested buffaloes with Chorioptes, 8 of them showed edematous skin disease and no staphylococcal dermatitis infection. This confirms our hypothesis that Chorioptic mite plays an important role in initiating staphylococcal dermatitis and edematous skin disease infection.
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1. Introduction

Mange is a contagious skin disease, characterized by crusty, pruritic dermatitis and hair loss and caused by a variety of parasitic mites burrowing in or living on the skin **(1).** Chorioptes species comprises five putative species of obligate ectoparasitic mites that cause Chorioptic mange in domestic and wild mammals. Three of the species, collected rarely from wild animals, are poorly known and may not be valid entities, but *Chorioptes bovis* and *Chorioptes texanus*, primarily from domestic animals, have withstood modern biogenetic scrutiny and are accepted species (**2 and 3).** Chorioptic mange, also called 'barn itch,' may be the most common form of mange in cattle and horses. It can cause irritation, localized dermatitis, and self-trauma due to pruritus, and is currently considered to be the most common form of cattle mange in many countries in the Northern Hemisphere. Chorioptic mites are able to feed and survive on host-produced epidermal debris at the skin surface, without necessarily attacking the living parts of the host's skin. Infestations tend to concentrate on the lower portions of the host, especially the feet and legs, but may include the udder/scrotum, tailhead, and perineum. In some cases, *C. texanus* infests the host's ears **(4, 5 and 6).** *C. bovis* causes lesions characterized by an exudative dermatitis on the lower legs and scrota of rams and has been stated that scrotal mange affects ram fertility (**7).** Both *C. bovis* and *C. texanus* have been reported to infest dairy and beef cattle in Japan (**8)** and *C. bovis* in a wild Japanese serow (**9).** *C. texanus* was also observed in goats from Malaysia (**10).**

Edematous skin diseases affect mainly buffaloes caused by *Corynebacterium ovis* transmitted through skin injuries characterized by painful nodules and ulcer along the course of lymphatic vessels associated with oedema and enlargement of lymph node (**11, 12 and 13).**

Staphylococcal scalded-skin syndrome refers to a spectrum of blistering skin diseases caused by *Staphylococcus aureus[S. aureus*] exfoliative toxins (ETs) (**14 and 15).** These toxins cause intraepidermal splitting through the granular layer by specific cleavage of desmoglein 1, a desmosomal cadherin protein that mediates cell-cell adhesion of keratinocytes in the granular layer **(16)**. *S. aureus* infections are known as triggers for skin inflammation and can modulate immune responses. These effects can be due to either direct invasion by the bacteria or by bacterial products (**17 and 18).**

2. Materials and Methods

A. Animals:

A total of 341 Egyptian buffaloes, aged from 2 to 10 years old were examined clinically to determine incidence rate, clinical finding, age susceptibility of Chorioptic mange and cell mediated immune response of Chorioptic mange infested buffaloes. The animals belong to breeding buffalo's farm at Alexandria Governorate, Egypt.

B. Crust collection and examination:

Crusts were collected and fixed in 70% methanol. Mites in scrapings were collected from the edges of active lesions were counted as described before **(19).** Scrapings were done using a sharp spoon from an area approximately 3 × 3 cm, scraped on each animal. Mites were extracted from these samples and mounted on slides. Diagnosis of the mites to the genus Chorioptes was made according to the key of Fain **(20).**

C. Bacterial diagnosis:

Isolation and identification of *S. aureus and C. ovis* was done as described before **(21, 22).**

D. Cell mediated immunity

Lymphocyte transformation procedure and conditions as published **(23).**

F. Treatment:

Treatment of mange was done by spray dipping or vat dipping; topical application of non-systemic acaricides; and oral, topical, or injectable formulations of systemic drugs. Spray dipping is time consuming but useful for small herds, whereas vat dipping is efficient but fairly expensive and difficult to manage. Dipping solutions as 0.1% phoxim, 0.075% diazinon, and 0.025-0.050% amitraz can be used. Only hot lime-sulfur is registered for use on lactating dairy cows. Injectable formulations of avermectins (ivermectin and doramectin) and milbemycins (moxidectin) are approved for control of mange at dilution 200 µg/kg (not in lactating dairy cattle). Although one treatment is effective, cattle should be isolated for 2 wk after treatment (**12 and 13).**

3. Results

3.1. Incidence of Chorioptic mite among Egyptian buffaloes:

Table (1) and figure (1) showed that, Chorioptic mite infestation reported in 252 animals from 341 Egyptian dairy buffaloes raised in some Egyptian buffalo farms by incidence rate 73.90%.

3.2. Age susceptibility of Chorioptic mite to Egyptian buffaloes:

Table (2) and figure (2) showed the difference in age susceptibility of Chorioptic mite in Egyptian buffaloes. Numbers of infested buffaloes were 52, 69 and 131 in age groups 2-3 years, 4-6 years and 7-10 years respectively.

3.3. Clinical infestation of Egyptian buffaloes by Chorioptic mite with parasitological examination:

Lower legs lesions, characterized by dermatitis, alopecia, accumulation of crust and fissuring with corrugated skin. Irritation and self-trauma due to pruritus and lameness were observed in different cases. Back, tail base, sacral and perineal regions characterized by accumulation of crust with irritation and trauma due to itching as shown in plate (1).

3.4. Effect of Chorioptic mite infestation on daily milk yield:

Table (3) and figure (3) reported that, average daily milk yield of infested buffaloes was 6.45± 0.46 liters as compared with non-infested buffaloes 7.75±0.78 liters.

3.5. Cell mediated immune response:

Table (4) and figure (4) show that infested buffaloes with Chorioptic mite had lower lymphocyte transformation index which was 22.52±6.77 while non infested buffaloes was 32.45 ± 4 .49.

3.6. The role of Chorioptic mite in lower leg regions in the initiation of staphylococcal dermatitis and edematous skin disease infection.

Table (5) and figure (5) explains the role of Chorioptic mite pruritus and injury in lower leg region in initiation of staphylococcal dermatitis and edematous skin disease infection. 252 infested buffaloes with Chorioptic mange, 92 and 71 of them showed signs of staphylococcal dermatitis and edematous skin disease, respectively, 53 buffaloes showed both infections. 89 non infested buffaloes with Chorioptic mange, 8 of them showed edematous skin disease and no infection with staphylococcal dermatitis.

Staphylococcal dermatitis in lower leg region found to be characterized clinically by lameness, dermatitis of the skin in the form of redness, corrugation and thickening of the skin as shown in plate (3). On the other hand, Edematous skin disease characterized clinically by fever, enlarged mainly hind limb and opened nodule as shown in plate (4).

Table (1): Incidence of Chorioptic mite among Egyptian buffaloes:

No. of examined buffaloes	Infested buffaloes		Non infested buffaloes	
341	No.	%	No.	%
	252	73.90	89	26.09

$Chi^2 = 4.55$ * *Significant at (P= 0.05)

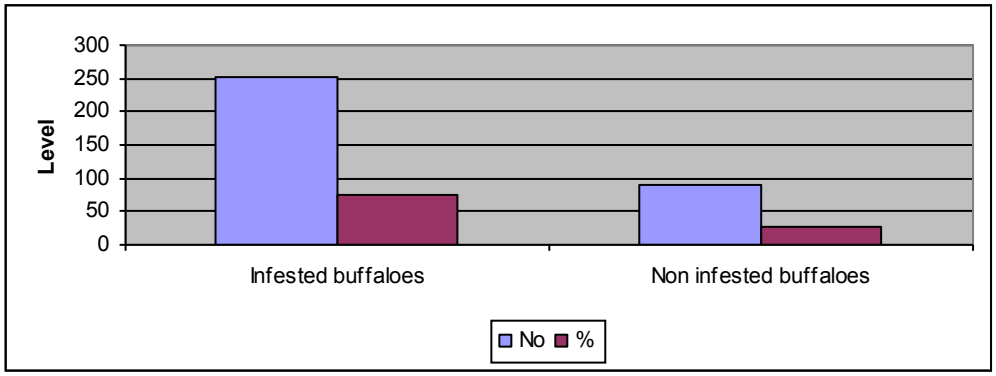


Figure (1): Incidence rate of Chorioptic mite among Egyptian buffaloes

Table (2): Age susceptibility of Chorioptic mite to Egyptian buffaloes:

Age (year)	No of infested buffaloes	% of infestation from total number (341)
2-3	52	15.24
4-6	69	20.23
7-10	131	38.41
Total	252	73.90

$Chi^2 = 6.55$ * *Significant at (P= 0.05)

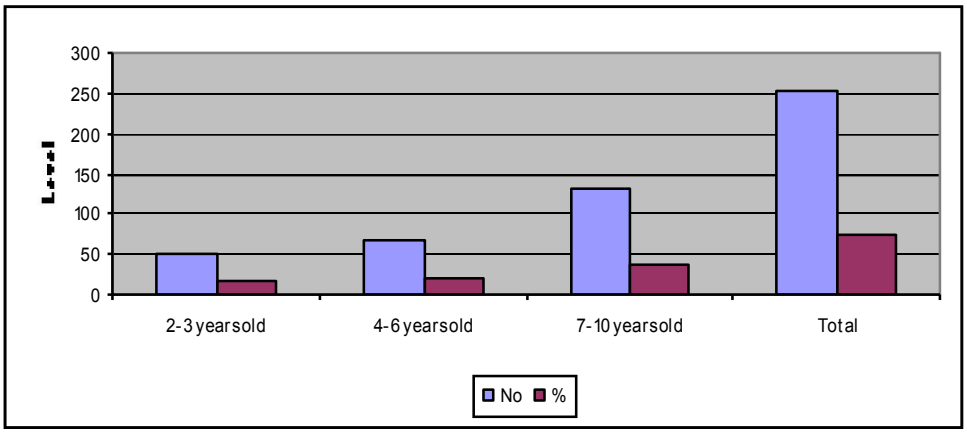


Figure (2): Age susceptibility of Chorioptic mite to Egyptian buffaloes

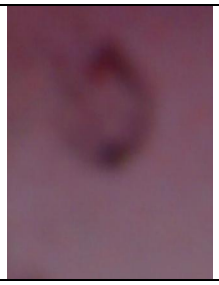
Plate (1)

Alopecia, crust on back region

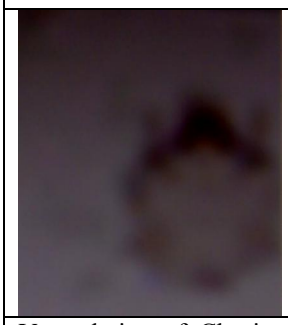
Crust on lower leg region

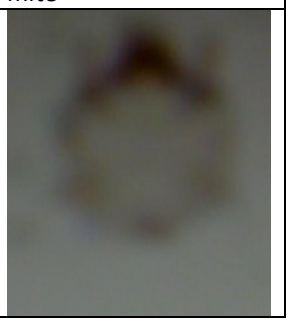
Plate (2) Microscopic examinations of skin scraping samples from affected areas revealed numerous Chorioptic mite of all developmental stages.

Different eggs



Larvae of Chorioptic mite





Ventral view of Chorioptic mite

All developmental stages of mites, from the egg to adult stages, were observed from samples collected from affected Egyptian buffaloes (plate 2). Morphologically, pedicels of the mites were short and unjointed. Tarsal suckers occurred on the pedicels of all legs in the adult male and on the first, second, and fourth pair of legs in the adult female.

A single long seta at the tarsus of legs III and the length of legs II being about twice as long as legs IV in adult male mites were observed. Based on these observations, the mites were identified as the genus Chorioptes.

Dorsal view of adult Chorioptic mite

Table (3): Average daily milk yield of infested and non infested Egyptian buffaloes.

Animals	Average daily milk yield for 20 days
Infested buffaloes	6.45 liters
Non infested buffaloes	7.75 liters

Means within the same column of different litters are significantly different at (P < 0.01).

Figure (3): Average daily milk yield of infested and non infested Egyptian buffaloes.

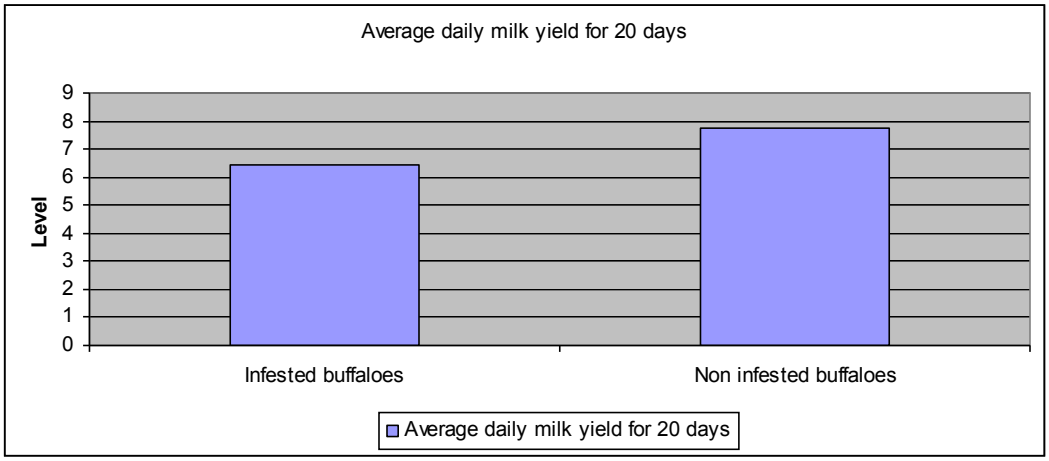


Table (4): Cell mediated immune response of Chorioptic mite infested buffaloes as compared with non infested buffaloes as measured by lymphocyte transformation test.

Groups	Lymphocyte transformation index
	$\bar{X} \pm$ S.D
Infested buffaloes	A 22.52±6.77
Non infested buffaloes	B 32.45 ± 4 .49

Means within the same column of different litters are significantly different at (P < 0.01).

Figure (4): Cell mediated immune response of Chorioptic mite infested buffaloes as compared with non infested buffaloes as measured by lymphocyte transformation test.

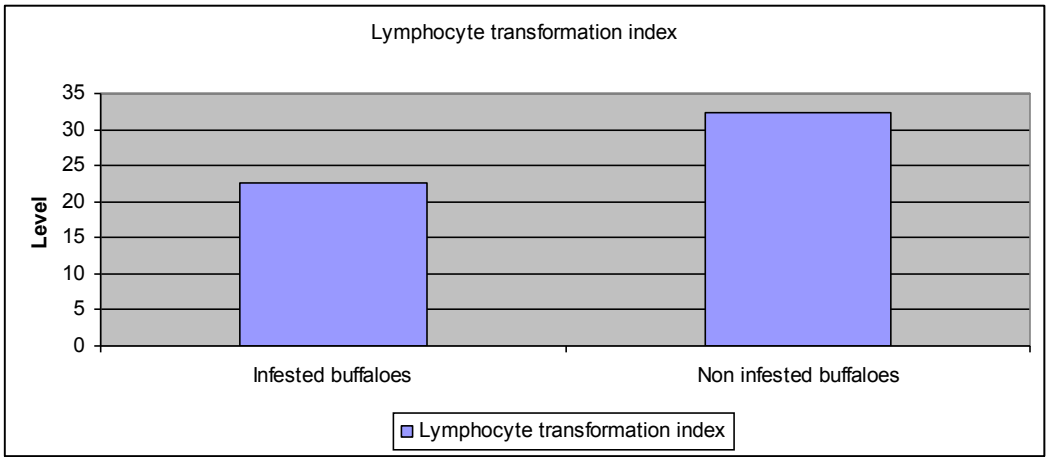


Plate (3)

Redness and dermatitis on leg region

Chorioptic mite and staphylococcal dermatitis causing crust, corrugations and thickening

Plate (4)

Double size limbs of edematous skin disease

Nodules along lymphatic of lower limbs

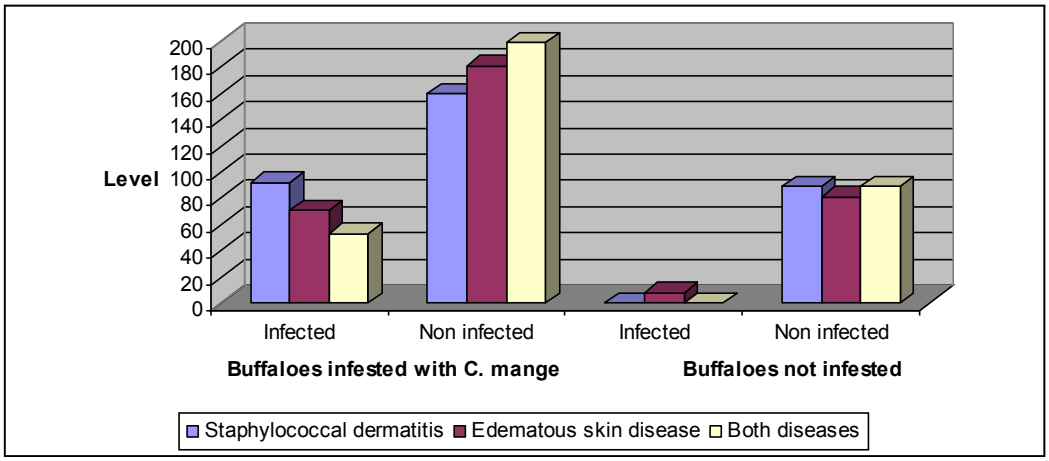
Nodules gives pus

Table (5): The role of Chorioptic mite in lower leg regions in the initiation of Staphylococcal dermatitis and edematous skin disease infection

Infectious diseases	Buffaloes infested with Chorioptic mange No = 252		Buffaloes non infested with Chorioptic mange No = 89	
	Infected	Non infected	Infected	Non infected
Staphylococcal dermatitis	92	160	–	89
Edematous skin disease	71	181	8	81
Both diseases	53	199	–	89

$Chi^2 = 6.55$* *Significant at (P= 0.05)

Figure (5): The role of Chorioptic mite in lower leg region in the initiation of Staphylococcal dermatitis and edematous skin disease infection.



4. Discussion

Chorioptes mites cause a mild form of skin disease in both domestic and wild ruminants. In July 2006, dermatitis characterized by alopecia, marked lichenification, accumulation of crust, and fissuring was recognized in 14 out of 200 Holstein dairy cattle raised in the cattle farm of the National Institute of Animal Science in Cheonan, Republic of Korea (**24).** *C. texanus* has so far been isolated from both domestic and wildlife animals including goats in Texas, reindeer in Canada, cattle in Brazil, Israel, Germany, and USA and elks in Poland (**3**). In the Southeast Asian countries, *C. texanus* has been reported to infest cattle and goats from Japan (**8)** and Malaysia (**10**). *C. bovis* has been reported to infest the feet of horses, sheep, and goats in the Netherlands (**25)** and in a wild Japanese serow (**9).** *C. texanus* has been found on the body of domestic goats in Texas (**26).**

Incidence of Chorioptic mite was reported in 252 out of 341 Egyptian dairy buffaloes raised in some Egyptian buffalo farms by rate 73.90% as shown in table (1) and figure (1). These result explained significant difference between infested and non infested buffaloes at (P=0.05). Table (2) and figure (2) showed significant difference in age susceptibility of Chorioptic mite to Egyptian buffaloes at (P=0.05). Numbers of infested buffaloes were 52, 69 and 131 in age groups 2-3 years, 4-6 years and 7-10 years respectively. These results explain that, old ages buffaloes higher susceptible than young ages.

Clinical infestation of Egyptian buffaloes by Chorioptic mite characterized by dermatitis, alopecia, accumulation of crust and fissuring with corrugated skin in lower legs regions, irritation and self-trauma due to pruritus and lamness in many cases. Back, tail base, sacral and perineal regions characterized by accumulation of crust with irritation and trauma due to itching as shown in plate (1). These findings are nearly similar to those found in Korean area **(24)**. Skin lesions were distributed mainly over the tail base, and sacral and perineal regions. The observed clinical signs of Chorioptic mites were; crusty lesions in the root of the tail and the grooves on either side, and tend to be localized with moderate pruritus. Initially starting with a varnished surface, later the affected area is covered with fine, dry scales which can spread towards the perineum, escutcheon, inner sides of the thighs, and fetlocks (**19).**

It has been reported that irritation and itching caused by Chorioptic mite become intense when

lesions extend in size and coalesce to form crusts and heavy scabs that can spread even to the sacral region and the udder **(27)**.

Plate (2) shown that microscopic examinations of skin scraping samples from affected areas revealed Chorioptic mites of all developmental stages. Morphologically, pedicels of the mites were short and unjointed. Tarsal suckers occurred on the pedicels of all legs in the adult male and on the first, second, and fourth pair of legs in the adult female. A single long seta at the tarsus of legs III and the length of legs II being about twice as long as legs IV in adult male mites were observed. Based on these observations, the mites were identified as the genus Chorioptes.

Chorioptic mite infestation reduce milk yield as shown in table (3) and figure (3) where average daily milk yield of infested buffaloes was 6.45± 0.46 liters as compared with non infested buffaloes 7.75±0.78 liters. These results revealed significant difference in daily milk yield between infested and non infested buffaloes at **(P < 0.01).** This reduction confirmed the indirect effect of mange on milk production **(24)** and **(27).**

In regard to the immune status of infested buffaloes, Table (4) and figure (4) showed that infested buffaloes with Chorioptic mite had lower lymphocyte transformation index which were 22.52±6.77 as compared with non infested buffaloes 32.45 ± 4 .49. These results explain the higher susceptibility of infested buffaloes to other infections.

This study considered the first record about the correlation between Chorioptic mite infestation and infection by staphylococcal dermatitis and edematous skin disease. Skin injuries from Chorioptic mite are considered the main route of entry of *C. ovis* and *S. aureus*. Among 252 infested buffaloes with Chorioptic mite, 92 and 71 of them suffered from S. dermatitis and edematous skin disease, respectively, 53 buffaloes showed both infections. 89 non-infested buffaloes with Chorioptic mite, 8 of them showed edematous skin disease and no staphylococcal dermatitis infection as shown in table (5) and figure (5). So Chorioptic mite plays an important role in enhancement staphylococcal dermatitis and edematous skin disease infection.

Staphylococcal dermatitis in lower leg region characterized clinically by lameness, dermatitis of the skin in the form of redness, corrugations and thickening of the skin as shown in plate (3). Staphylococcal scalded-skin syndrome refers to a spectrum of blistering skin diseases caused by *S. aureus* exfoliative toxins (ETs) **(14 and 15).** These toxins cause intraepidermal splitting through the granular layer by specific cleavage of desmoglein 1, a desmosomal cadherin protein that mediates cell-cell adhesion of keratinocytes in the granular layer **(16)**. *S. aureus* infections are known triggers for skin inflammation and can modulate immune responses. These effects can be due to either direct invasion by the bacteria or by bacterial products (**17 and 18).**

Edematous skin disease characterized clinically by fever, enlarged mainly hind limb and opened nodule as shown in plate (4). Edematous skin disease transmitted through skin injuries characterized clinically by painful nodules and ulcer along the course of lymphatic, the nodules soften then ulcerate, development of edematous swelling in dewlap, sides of abdomen, prescapular and poplotial regions and limbs are oedematous and reach double size (**11, 12 and 13).**

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