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Prevalence and Intensity of Ectoparasitic Infestations in Commercial Layer Chickens reared under Elevated Cage System

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ABSTRACT

A cross-sectional study was carried out for a period of one year to identify the species spectrum and determine the prevalence of ectoparasites in Thalaivasal region, Tamil Nadu, India among 16 commercial layer farms comprising multi-age flocks which were divided into four age groups of 20 to 35, 36 to 50, 51 to 65 and 66 to 80 weeks. The result of the study showed that 93% flocks were infested in 20 to 35 week group whereas 100% in all other age groups during winter (December 2020 to March 2021). During summer (April 2021 to July 2021), the 100% chickens in all groups except 51 to 65 week group which showed 98% infestation. In rainy season (August 2021 to November 2021), 100% flocks of all ages were infested. The present study, two lice species namely shaft louse (*Menopon gallinae*) and wing louse (*Lipeurus tropicalis*) and one species of feather mites (*Megninia ginglymura*) were recorded throughout the year. In the entire study period, the birds were infested with either single or mixed type of ectoparasites. The prevalence of louse infestation was significantly higher ($P<0.05$) in older birds ranging from 36 to 80 weeks of age and lower in younger birds of less than 36 weeks of age. The prevalence of feather mite infestation was significantly higher ($P<0.05$) in younger age ranging from 20 to 50 weeks of age and lower in older birds of more than 50 weeks of age. The mean intensity revealed heavy ectoparasite infestation in the rainy season irrespective of age.

HIGHLIGHTS

- Prevalence of louse was higher in older than in young birds.
- Prevalence of feather mite was higher in younger than in older birds.
- Heavy ectoparasite infestation was noted in rainy season.

Keywords: Ectoparasites, Seasonal prevalence, Shaft louse, Wing louse, Feather mite

Poultry is an economic and effective source for the production of animal protein within the shortest possible time, playing a vital role in narrowing down the gap of animal protein supply worldwide especially in the developing countries (Khattak, 2012). Chickens are easily infected with several types of bacterial, viral, fungal and parasitic infections. Ectoparasitic problems are a major impediment to commercial layer production in many parts of the world. Parasites are a threat not only to the health

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of poultry, but also to workers in the poultry industry (Windhorst, 2017). Ectoparasites of poultry play on important role in the transmission of certain pathogens which cause heavy economic losses to the poultry industry (Moller *et al*., 2009). The occurrence and frequency of external parasite infestation has increased in the laying hens which are confined in cage rearing system that facilitates their easy spreading and rapid multiplication. Ectoparasites like lice, mites, bugs, fleas and ticks parasitize the commercial layers causing suboptimal egg production, ill health and suboptimal liveability. Severe ectoparasite infestation may lead to huge economic losses to the farming community (Maina, 2005). The problem of external parasites is common in tropical countries because of the favourable climatic conditions for their development and the poor standards of husbandry practices (Mungube *et al*., 2006).

The ectoparasite causes weight loss at the rate of 2 to 3 per cent per bird and decrease the egg yield at the rate of 66 eggs per bird in a year (Pavlovic, 1991), besides lameness in heavy lice infestation (Okaeme, 1989). This apart, the activities of the ectoparasites like blood sucking, crawling and nibbling induce major stress to the birds. The present study was undertaken with the objective of prevalence of ectoparasites and magnitude of ectoparasitic infestations in layer chickens.

MATERIALS AND METHODS

Study area

A study was conducted in and around Thalaivasal region of Salem District, Tamil Nadu. Thaliavasal is one of the Taluks of the Salem District and lies between latitude of 11° 35′ 7.74″ N and longitude 78° 45′ 36.46″ E. The mean maximum temperature is 25°C - 42°C and the mean minimum temperature is 19°C - 25°C. The mean annual rainfall is 939 mm of which 47.6 per cent (447 mm) is commonly received during the North East Monsoon, 33.7 per cent (316 mm) during the South West Monsoon, 17.4 per cent (164 mm) during summer and 1.3 per cent (12 mm) during winter.

Selection of farms

Thalaivasal is one of the major egg producing layer belts next to the Namakkal district of Tamil Nadu. As many as 36 commercial layer poultry farms with a total population of 35- 40 lakhs exist in and around Thalaivasal region. Out of 36 commercial layer farms, 16 farms were selected to study the prevalence of ectoparasitic infestation.

Study design and sample size determination

A cross sectional study was carried out from December 2020 to November 2021 by sampling of ectoparasites to identify species and determine the ectoparasites prevalence of layer chickens in the study area. The farms selected were visited on monthly basis to study the prevalence and intensity of ectoparasite population.

All the farms selected for the study had totally 8,92,000 layer chickens with different age. Hence the age of the flock was considered for grouping the flocks so as to calculate statistically correct number of samples for assessing the prevalence of ectoparasites. Therefore, the bird population in the selected farms was divided into four age groups *viz*., 20 to 35, 36 to 50, 51 to 65 and 66 to 80 weeks and each group was considered as one stratum.

As per Thursfield (1995) it was arrived that 384 number of samples for the stratified random sampling. The sample size was determined using 95 per cent level of confidence. Since there was no previous work in the study area, 50 per cent expected prevalence and 0.05 per cent desired absolute precision were considered. Hence, the number of samples to be collected for the prevalence study was fixed as 384 per selected farm. Generally, at least four flocks were maintained at a given time in any of the farm. To be on the higher side, 100 samples per flock at a time were taken for the survey.

Physical examination and sample collection

The poultry pens and farm houses, crevices, cages, feeders, waterers and fogger pipe line were screened for the presence of ectoparasites. Physical examination for ectoparasites was carried out by gently flubbing the feathers of birds towards the opposite direction of its alignment. The whole body of the each chicken was thoroughly examined to assess the presence of ectoparasites by close visual inspection and using magnifying hand lens. Individual bird was carefully screened by parting the feathers and spreading wings for lice. The lice were collected with the

help of the blunt plastic forceps and placed into aerated zip lock covers. The mites on chicken were collected from fluffy down-feathers and vent directly during daylight hours. The materials suspected of ectoparasite presence were collected in zip lock covers and sample collection vials. The collected samples were brought to the laboratory for morphological characterization and species identification.

Species identification

The ectoparasites like lice and mites were processed by boiling in 10 per cent NAOH for 15 minutes, washed in water gently, and then dehydrated in ascending grades of alcohol *viz.* 50 , 70 and 90 per cent alcohol for 15 minutes each and in absolute alcohol for 2 minutes. After that, the specimens were cleared in Xylol and mounted on a slide with DPX mountant. The morphological characters of mounted specimens were studied under light microscope and specific identity of specimens was determined based on the description (Soulsby, 1982).

Prevalence rate and mean intensity of infestation

The prevalence rate and mean intensity of the ectoparasites were calculated as per the method described by Anderson (1993). The mean intensity of infestation was calculated for the total host population including the uninfected birds.

Mean intensity of infection =

$$\frac{\text{Total number of parasites}}{\text{Number of host parasitized}}$$

Percentage prevalence =

$$\frac{\text{Number of host parasitized by specific parasite}}{\text{Number of hosts examined}} \times 100$$

Determination of intensity score of ectoparasites

Lice score

The intensity score was arrived based on the physical examination of birds. During this examination, the number of lice that were present in a site was counted by parting the body feathers gently. The lice score was arrived at with a slight modification of method adopted by Mansur *et al.* (2019), as given below:

Nil = No infestation (0)

+ = Weak infestation (0-5)

++ = Medium infestation (6-10)

+++ = Strong infestation (11-15)

++++ = Highly infested (>15)

Mite score average index

The feathers in the vent-area of each bird were visually examined and mite intensity was scored as given below as per method described by Murillo *et al*. (2020):

1 = 1–10,

2 = 11–50,

3 = 51–100,

4 = 101–500,

5 = 501–1000,

6 = 1001–10,000

and 7 > 10,000

STATISTICAL ANALYSIS

Comparative analysis for type of prevalence, species of ectoparasites and mean intensity of infestations in layer chickens of different age groups and season-wise was performed by using the chi-square test (Word Excel, Microsoft office, version 2013). A p-value less than or equal to 0.05 were used as a limit of statistical significance.

RESULTS AND DISCUSSION

The prevalence study was carried out on seasonal wise from December 2020 to November 2021 in 16 commercial layer poultry farms with multi-age flocks. The result of the study showed that 93% (52/56) in 20-35 weeks and 100% (50/50, 45/45 and 58/58) in 36-50, 51-65 and 66-80 weeks age groups were found infested during winter season (December 2020 to March 2021). During summer season (April 2021 to July 2021), all the flocks examined

(52/52, 48/48, and 37/37) in 20-35, 36-50 and 66-80 weeks were found infested and 98% (48/49) in 51-65 weeks age group was infested. In rainy season from August 2021 to November 2021, 100% (34/34, 52/52, 45/45 and 45/45) of all the above said age group flocks were found infested (Table 1). Season-wise prevalence of louse infestation in birds with higher intensity and prevalence during the rainy season was congruous to the observation made by Lawal *et al.* (2017). However, the previous reports (Saxena *et al*., 1995; Islam *et al*., 1999) revealed higher intensity and prevalence of ectoparasite infestation in the summer season.

Single species of ectoparasite was observed in 67% (n=35), 42% (n=21), 53% (n=24) and 43% (n=25) during winter season. In the summer season, 56% (n=29), 21% (n=10), 50% (n=24) and 57% (n=21). During the rainy season, 68% (n=23), 46% (n=24), 47% (n=21) and 53% (n=24) in the age groups of 20 to 35, 36 to 50, 51 to 65 and 66 to 80 weeks respectively. The mixed species of ectoparasites presence in 33% (n=17), 58% (n=29), 47% (n=21) and 57% (n=33) during winter season. In the summer season, 44% (n=23), 79% (n=38), 50% (n=24) and 43% (n=16). In the season of rainy, 32% (n=11), 54% (n=28), 53% (n=24) and 47% (n=21) were recorded in the above mentioned age groups wise (Table 1 & Fig. 1). The layer chickens examined throughout the study period showed ectoparasite infestation either with single or multiple species. Significant difference (*P<0.05*) between the different age groups and prevalence of single and mixed species of infestation in different seasons was noted commensurate to the age and prevailing climatic conditions. Similarly, the type of prevalence was also recorded by Lawal *et al.* (2017).

In the study period, the birds were infested with two species of lice *Menopon gallinae* 40, 66, 71 and 72%, *Lipeurus tropicalis* 13, 12, 20 and 24% and one species

Table 1: Season-wise type of ectoparasitic prevalence in commercial layer chicken of Thalaivasal region, Salem district, Tamil nadu (December 2020 to November 2021)

Age groups (weeks)	Winter						Summer						Rainy					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
20 - 35	56	52	35	17	67	33	52	52	29	23	56	44	34	34	23	11	68	32
36 - 50	50	50	21	29	42	58	48	48	10	38	21	79	52	52	24	28	46	54
51 - 65	45	45	24	21	53	47	49	48	24	24	50	50	45	45	21	24	47	53
66 - 80	58	58	25	33	43	57	37	37	21	16	57	43	45	45	24	21	53	47
	χ^2 = 16.2766, p-value = 0.033596, significant at $p < 0.05$.						χ^2 = 16.2766, p-value = 0.000995, significant at p < 0.05.						χ^2 = 4.5888, *p*-value = 0.204502, *not* significant at $p < .05$.					

A - Number of flocks examined; B - Number of flocks infested; C - Number of flocks single in infestation; D - Number of flocks; E - Percentage of prevalence for single infestation; F - Percentage of prevalence for mixed infestation.

Table 2: Species-wise prevalence of ectoparasites in commercial layer chicken of Thalaivasal region, Salem district, Tamil nadu (December 2020 to November 2021)

Age groups (weeks)	Winter								Summer								Rainy							
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
20 - 35	56	52	48	7	21	92	13	40	52	52	52	1	8	100	2	15	34	34	34	2	11	100	6	32
36 - 50	50	50	42	6	33	84	12	66	48	48	45	5	38	94	10	79	52	52	51	4	27	98	8	52
51 - 65	45	45	27	9	32	60	20	71	49	48	15	10	47	31	21	98	45	45	21	5	40	47	11	89
66 - 80	58	58	37	14	42	64	24	72	37	37	18	8	27	49	22	73	45	45	13	9	43	29	20	96
	χ^2 = 13.2152, *p*-value = 0.039743, significant at $p < 0.05$.								χ^2 = 61.7984, *p*-value = < 0.00001, significant at $p < 0.05$.								χ^2 = 45.9386, *p*-value = < 0.00001, significant at $p < 0.05$.							

A - Number of flocks examined; B - Number of flocks infested; C - Number of flocks in feather mite; D - Number of flocks in wing louse; E - Number of flocks in shaft louse; F - Percentage of feather mite; G - Percentage of wing louse; H - Percentage of shaft louse.

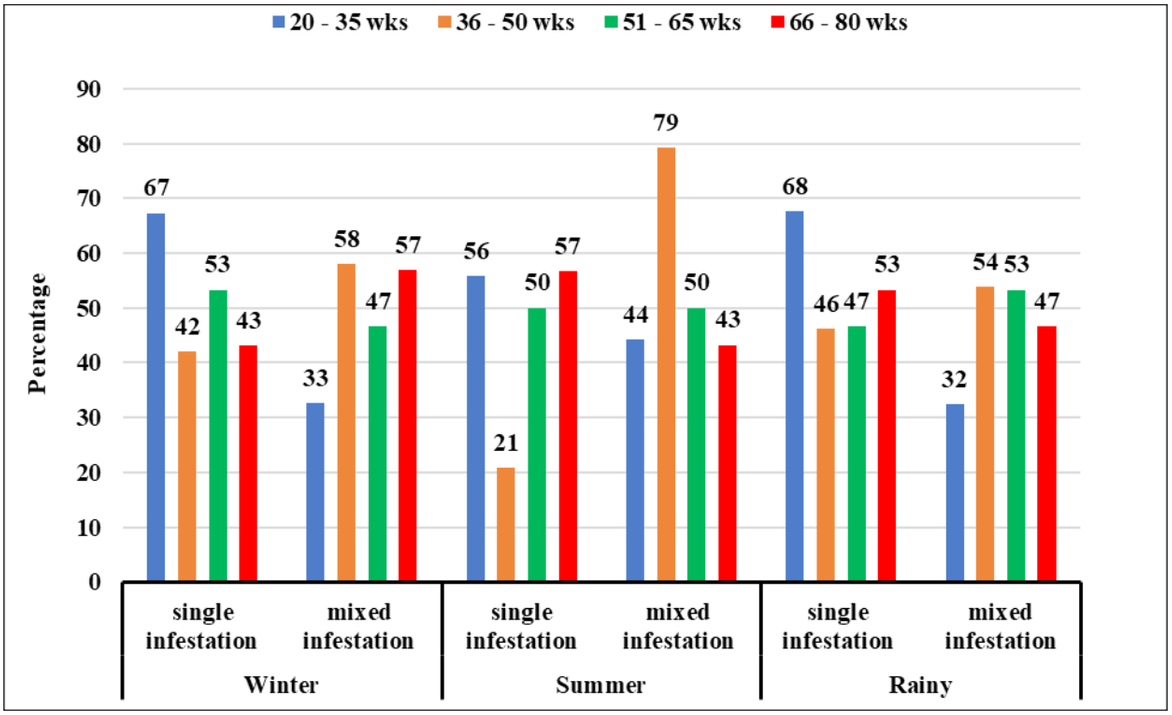


Fig. 1: Season-wise type of ectoparasitic infestation in commercial layer chicken of Thalaivasal region, Salem district, Tamil nadu (December 2020 to November 2021)

of mite like *Megninia ginglymura* 92, 84, 60 and 64 % in the age group of 20-35, 36-50, 51-65 and 66-80 weeks respectively in winter. During summer *Menopon gallinae* 15, 79, 98 and 73%, *Lipeurus tropicalis* 2, 10, 21 and 22% and one species of mite like *Megninia ginglymura* 100, 94, 31 and 49% in the age group of 20-35, 36-50, 51-65 and 66-80 weeks respectively. In rainy season, *Menopon gallinae* 32, 52, 89 and 96%, *Lipeurus tropicalis* 6, 8, 11 and 20% and one species of mite like *Megninia ginglymura* 100, 98, 47 and 29% in the age group of 20-35, 36-50, 51-65 and 66-80 weeks respectively (Table 2 & Fig. 2). Perennial presence of ectoparasites like lice and mites observed in current study (Fig. 4) endorses the finding by Chaddha *et al.* (2005) who reported that the lice infestation was recorded throughout the year while the mites were mainly prevalent during rainy season in non-descript village birds.

The prevalence of louse infestation irrespective of the species was significantly higher ($P<0.05$) in older birds ranging from 36 to 80 weeks of and lower in younger birds of less than 36 weeks of age. The results of age-wise prevalence of lice infestation of the current study are akin to the previous report (Nadeem *et al.,* 2007). This trend of lice infestation in older birds might be due to the poor quality of litter, improper sanitary management practices and irregular use of insecticides for control of lice infestation. Among the two lice species, presence of *Menopon gallinae* was significantly higher ($P<0.05$) than the presence of *Lipeurus tropicalis* in all seasons. This finding is in similar line with the report of Mansur *et al.* (2019) in Libya which is also a tropical country.

The prevalence of feather mite infestation was significantly higher ($P<0.05$) in younger age groups ranging from 20 to 50 weeks than in older age groups. The feathers seem to provide a suitable niche exclusively to *M. ginglymura*. Further investigation as to why the high prevalence of feather mite in young layers may shed the light on the factors such as feather fibre arrangements etc., which can contribute in providing suitable platform for multiplication of the mite. Intensive confinement of poultry might elicit stress (Tucci *et al.*, 2005) leading to ectoparasite proliferation (Sparagano, 2009) which was

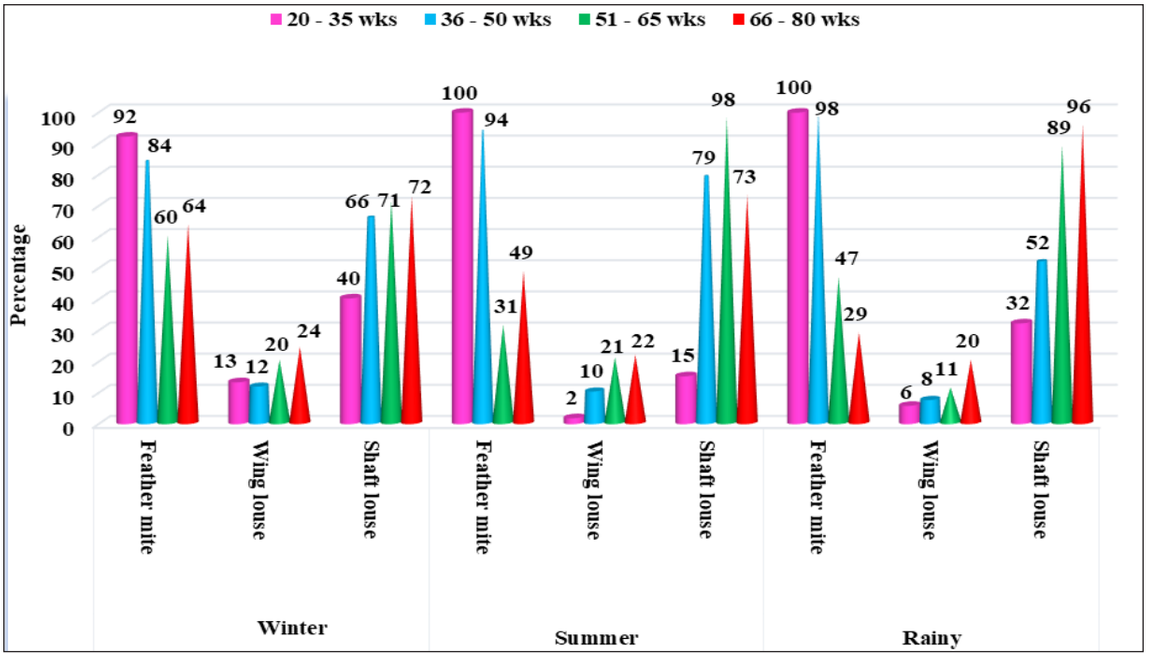


Fig. 2: Species-wise prevalence of ectoparasites in commercial layer chicken of Thalaivasal region, Salem district, Tamil Nadu (December 2020 to November 2021)

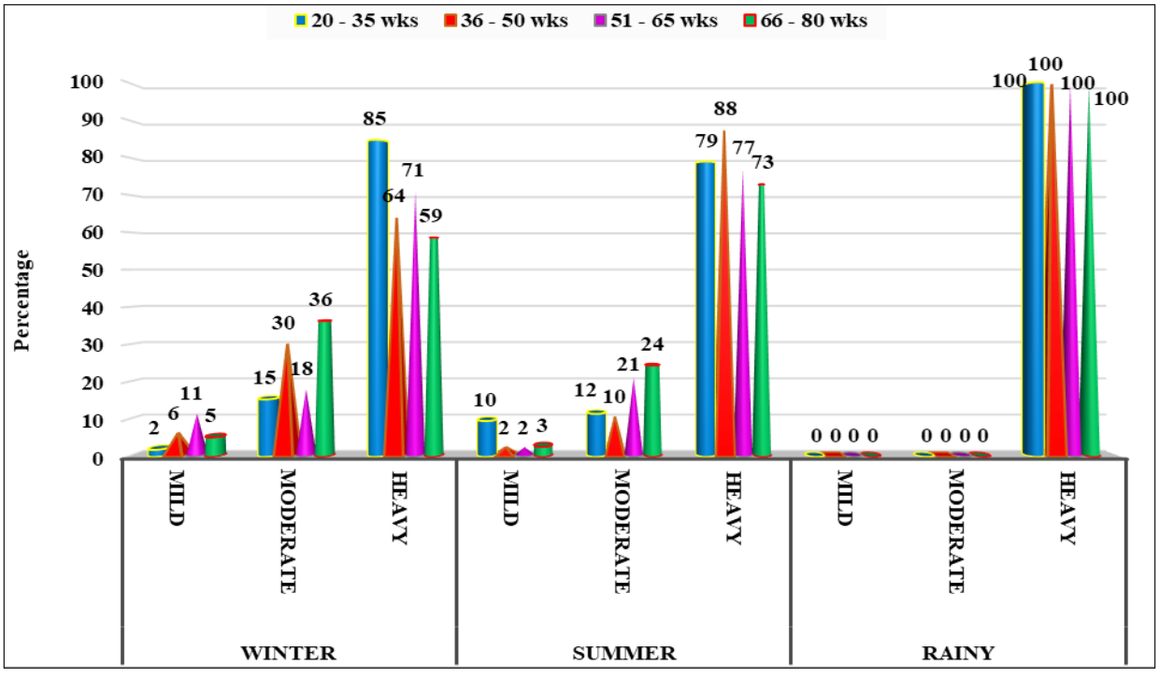


Fig. 3: Intensity of infestation in commercial layer chicken of Thalaivasal region, Salem district, Tamil nadu (December 2020 to November 2021)

Table 3: Season-wise intensity of infestation in commercial layer chicken of Thalaivasal region, Salem district, Tamil nadu (December 2020 to November 2021)

Age groups (weeks)	Winter								Summer								Rainy							
	A	B	C	D	D	F	G	H	A	B	C	D	D	F	G	H	A	B	C	D	D	F	G	H
20 - 35	56	52	1	7	44	2	13	85	52	52	5	6	41	10	12	79	34	34	0	0	34	0	0	100
36 - 50	50	50	3	15	32	6	30	64	48	48	1	5	42	2	10	88	52	52	0	0	52	0	0	100
51 - 65	45	45	5	8	32	11	18	71	49	48	1	10	37	2	21	77	45	45	0	0	45	0	0	100
66 - 80	58	58	3	21	34	5	36	59	37	37	1	9	27	3	24	73	45	45	0	0	45	0	0	100
	$\chi^2 = 13.6406$, p-value = 0.033919, significant at $p < 0.05$.								$\chi^2 = 9.1576$, p-value = 0.164906 *not* significant at $p < 0.05$.															

A - Number of flocks examined; B - Number of flocks infested; C - Number of flocks in mild infestation; D - Number of flocks in moderate infestation; E - Number of flocks in heavy infestation; F - Percentage of mild infestation; G - Percentage of moderate infestation; H - Percentage of heavy infestation.

Wing louse - *Lipeurus tropicalis*

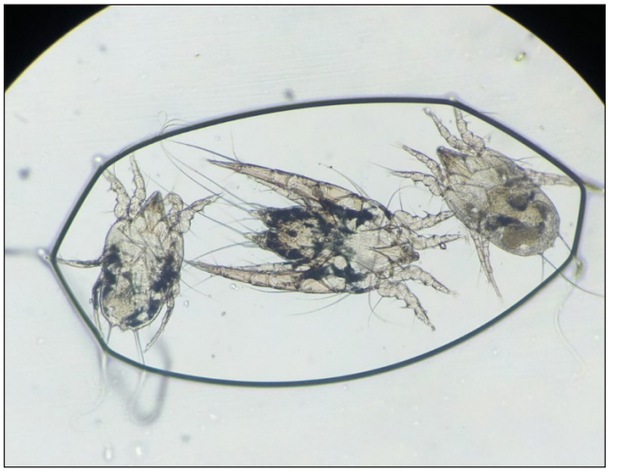
Shaft louse - *Menopon gallinae*

Mixed infestation - Wing louse and feather mite

Menopon gallinae (10x)

Lipeurus tropicalis (10x)

Feather mite - *Megninia ginglymura*



Megninia ginglymura (10x)

Fig. 4: Species of ectoparasites identified

observed all along the study period. Higher prevalence and intensity of ectoparasite infestation in intensive in-house management system of layer chickens during the rainy and summer than winter season could be attributed to the seasonal temperature. Similarly, Hernández *et al.* (2007) also found influence of climatic conditions on the occurrence of mites with an increase of the population in the rainy season. On the contrary, Quintero *et al.* 2006 observed higher prevalence in free range chickens during warmer months whereas higher prevalence in battery caged birds during colder months in Mexico where the climatic conditions are different from the study area. *Megninia ginglymura* was the most abundant mite in the feathers and more so in the battery cage system of rearing as battery cages have closed environment facilitating *M. ginglymura* development (Quintero *et al.* 2006).

The mean intensity of infested flocks were recorded. Mild infestation of 2, 6, 11 and 5% (winter), 10, 2, 2 and 3% (summer), moderate infestation of 13, 30, 18 and 36% (winter), 12, 10, 21 and 24% (summer) and heavy infestation of 85, 64, 71 and 59% (winter), 79, 88, 77 and 73% (summer) in 20-35, 36-50, 51-65 and 66-80 weeks respectively (Table 3 & Fig. 3). During rainy season all the age groups examined were heavily infested. Prevailing tropical condition with average temperature of 30.58°, relative humidity of 79.58% and heavy rainfall (1468.2 mm) during the rainy season might have favoured the multiplication of ectoparasites. Consequently, maximum number of birds were found infested with high intensity of lice and mites in this season followed by summer and winter. Earlier, it was pointed that the optimum temperature for the development of *Menacanthus stramineus* is 37.7 - 41.5ºC (Brown, 1970).

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