Short Communications

Pakistan J. Zool., vol. 46(3), pp. 863-866, 2014.

Screening of Mungbean (*Vigna radiata* (L.) Wilczek) Genotypes against Sucking Insect Pests under Natural Field Conditions

Sajid Nadeem*, Muhammad Hamed, Muhammad Jawad Asghar, Ghulam Abbas and Noor Abid Saeed
Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad.

Abstract.- This study was conducted to examine the resistance in eight advance mungbean genotypes in comparison with two check varieties against sucking insect pests under natural field conditions at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. Findings of the trial showed that none of the tested genotypes have complete resistance against sucking pests *i.e*., whiteflies, thrips and jassids. Comparison of resistance among the tested genotypes against whitefly showed that the lowest number of whiteflies per leaf (3.7±1.20) was observed in MH 3153, lower than those of both checks, whereas, the highest (11±1.53) was observed in MH 34143. Number of thrips per leaf was observed the lowest (4±1.00) and the highest (12.3±0.67) in cultivar MH 3153 and MH 34143, respectively. Similar population trend of jassid was observed with per leaf population of 1.2 and 3.3, the highest and the lowest in MH 3153 and AZRI 2006, respectively. Among all the tested cultivars, MH 3153 gave the highest yield (438.7 g/plot) with 129 and 161% increase over check 1 and check 2, respectively. Therefore, genotypes which showed the highest resistance against the sucking pests and tied with high grain yield could be used for direct release as variety or may be used in cross breeding programme to get improved resistant germplasm against sucking insects.

Key words: Mung bean, cultivars, sucking insect pests.

Mungbean (*Vigna radiata* (L.) Wilczek) is an important pulse crop and a protein (22-24%) rich source (Nazir, 1994). It is a native to Indian subcontinent and mainly cultivated in China, India, Philippines, Burma, Bangladesh, and Pakistan. It is a short duration crop and is widely cultivated for seed, edible purpose and fits well in any cropping system. Mungbean is an important legume crop, fix the atmospheric nitrogen which becomes the source of fertilizer in the soil (Hafeez *et al*., 1988). After chickpea, mungbean is called as poor people diet owing to its protein nature and is meeting the major protein demand of the people (Shafique *et al*., 2009). Biomass of mungbean is a good source of fodder for animals and also used as green manuring to produce good quality organic matter in soil. It is grown on all types of soils in both rain fed and irrigated conditions of the country twice a year *i.e*., both in rabi and kharif seasons. During the year 2012, mungbean was cultivated on an area of 13.6 thousand ha, with total production of 89.3 thousand tonnes (Anonymous, 2012) and its cultivated area and production has decreased to 4% compared to the previous years.

Mungbean crop is vulnerable to different species of insect pests. Attacks of insect pests on mungbean crop occurred at any stage from seedling to harvest with budding is the most preferred attractive stage to insects. There are 64 species of insects attacking on mungbean crop and among them sucking pests are the most notorious one (Lal, 1985), these sucking insect pests includes whiteflies, jassids, and thrips (Khattak *et al*., 2004). In mungbean crop, whiteflies play a key role in the spread of mungbean yellow mosaic virus which is known as a serious disease of this crop (Akhtar *et al*., 2011, 2012). Heavy attack of whitefly cause the severe loss of cell sap of plants, make plants weakened and sickly black appearance to plants due to injection of body toxins of whitefly. Heavy infestation of jassid in mungbean causes leaves to turn brown, curling from the edges and ultimately dried the plants. In flowers, both nymph and adults of thrips nourish on pollen and scratch flower parts by sucking the plant sap causing ooze out of cell contents from the injured parts and consequently flower drop resulted in less pod formation. Different control strategies are in practice in the field for the control of insect pests of mungbean which mainly includes chemical insecticides and biocontrol agents. Among the insect control strategies, host plant resistance by the use of resistant varieties is an

* Corresponding Author: sajidniab@hotmail.com
0030-9923/2014/0003-0593 $ 8.00/0

effective and safe strategy in pest management with no additional cost to the growers by the plantation of resistant cultivars.

Previous workers like Chhabara and Kooner (1991), Sahoo and Hota (1991); Chhabra and Kooner (1993); Chhabara and Kooner (1994) have evaluated mungbean cultivars against their resistance to insect pests and screened a large numbers of mungbean genotypes for resistance/susceptibility against sucking pests. Naqvi *et al*. (1995) has tested 10 genotypes of mungbean against insects and found only two cultivars, M-8-20 and M-1030 resistant against insects compared to others. Khattak *et al*. (2004) has screened five mungbean varieties *viz*., NM 92, NM-98, NM-121-125, M-1 and NCM-2009 against sucking pests, whiteflies, jassid and thrips. It was observed that whitefly, jassid and thrips population was comparatively lower on NM-92 and NM-98 which enables to get higher yield compared to other tested varieties. Present study was therefore, carried out to screen eight advance genotypes of mungbean for their resistance against sucking insect pests under field conditions.

Materials and methods

The present studies were conducted in experimental field area of Plant Breeding and Genetics Division at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. Eight advance mungbean genotypes/cultivars developed at NIAB *viz*., MH 3153, MH 5251, MH 5254, MH 5255, MH 34143, MH 34144, MH 34164, MH 34241 and two check varieties *i.e*., NM 2006 (Check 1), AZRI 2006 (Check 2) were sown under natural field conditions. Experiment was planned in Randomized Complete Block Design with three replicates of each treatment. A plot size of 4.8 sq meters was maintained in each replicate of treatment with each row of 4 m length. Distance of 10 and 30 cm between the plants and rows were maintained, respectively. No plant protection measures were adopted throughout the crop growing period. Standard agronomic practices including hoeing, irrigations and fertilizers were carried out according to the crop requirements. Population of whiteflies, jassids and thrips were counted from per leaf basis of three mungbean plants by random selection from each replicate of the treatment. Plot yield (grams) of mungbean grains were measured from each plot of replicate. All the data were subjected to analyze statistically by MSTAC-C programme following Steel *et al*. (1997) and significance was applied to the genotypes by using Duncan's multiple range test. Standard error was calculated by Microsoft Excel.

Results and discussion

Results showed significant variations in the population levels of whiteflies, thrips and jassids observed per leaf basis in different mungbean cultivars in response to yield of grains.

Population of whitefly (number per leaf) demonstrates significant variations (Table I) among the tested cultivars ($F = 3.67$: $df = 9$; $P = 0.0090$). Population of whitefly (3.7 ± 1.20) was observed the lowest on MH 3153, whereas, the highest (11) on MH 34143. Population of whitefly on other cultivars were observed 6, 8, 8.7, 9.7, 9.3, 6.7, 5.7 and 6 in MH 5251, MH 5254, MH 5255, MH 34144, MH 34164, MH 34241, NM 2006 (Check 1) and AZRI 2006 (Check 2), respectively. Among the tested cultivars, none showed complete resistance against whiteflies however, MH 3153 showed comparatively better resistance against sucking insects.

Population of thrips (numbers per leaf) showed significant variations (Table 1) among the tested cultivars ($F = 12.57$: $df = 9$; $P = 0.0000$). Population trend of thrips (4.0) observed the lowest on the MH 3153 whereas, the highest (12.3) on MH 34143. Population of thrips on other lines were observed as 8.7, 5.3, 9.3, 7.7, 7.3, 9, 5.7 and 7.3 in MH 5251, MH 5254, MH 5255, MH 34144, MH 34164, MH 34241, NM 2006 (Check 1) and AZRI 2006 (Check 2), respectively. Complete resistance against thrips was not observed in any of the tested cultivar, except MH 3153 which showed comparatively better resistance among the tested genotypes.

Trend of jassid population (numbers per leaf) has got significant variations (Table I) among the tested cultivars ($F = 2.65$: $df = 9$; $P = 0.0000$). The lowest population of jassid (1.2) observed on MH 3153, whereas, the highest (3.3) on AZRI 2006 (Check 2). On other genotypes, population of jassid

Table I.- Average ten weeks population of insects, grain yield and yield difference over checks of mungbean cultivars.

Genotypes	Insect population (No. per leaf)			Grain yield per plot (g)	Yield difference over check 1 (%)	Yield difference over check 2 (%)
	Whiteflies	Thrips	Jassids			
MH 3153	3.7±1.20 d	4.0±1.00 e	1.2±0.44 ab	438.7±24.70 a	+129	+161
MH 5251	6.0±0.58 bcd	8.7±1.33 b	1.7±0.73 ab	171.7±9.85 bc	−10	+2
MH 5254	8.0±1.00 abc	5.3±0.67 de	1.5±0.76 ab	253.3±18.57 b	+32	+51
MH 5255	8.7±1.77 abc	9.3±1.20 b	2.5±0.29 ab	176.7±12.03 bc	−8	+5
MH 34143	11.0±1.53 a	12.3±0.67 a	2.6±0.98 ab	148.0±10.55 c	−23	−12
MH 34144	9.7±1.20 ab	7.7±1.45 bc	2.5±1.04 ab	179.3±7.54 bc	−7	+7
MH 34164	9.3±0.67 abc	7.3±1.20 bcd	1.9±1.07 ab	191.0±10.16 bc	−0.5	+14
MH 34241	6.7±1.77 bcd	9.0±1.53 b	1.8±1.09 ab	181.7±4.34 bc	−5	+8
NM 2006 (Check 1)	5.7±0.67 cd	5.7±1.20 cde	1.4±0.45 ab	192.0±17.92 bc	-	-
AZRI 2006 (Check 2)	6.0±1.16 bcd	7.3±1.20 bcd	3.3±0.33 a	168.0±14.06 bc	-	-

Means (±SE= Standard error) sharing same letters in a column are statistically at par at 5% level.

was recorded as 1.7, 1.5, 2.5, 2.6, 2.5, 1.9, 1.8, and 1.4 in MH 5251, MH 5254, MH 5255, MH 34143, MH 34144, MH 34164, MH 34241 and NM 2006 (Check 1), respectively. None of the tested genotype showed complete resistance against jassid, while MH 3153 observed as comparatively better resistant cultivar among the tested ones.

Response of mungbean grains yield (g/plot) showed significant variations (Table I) among the tested genotypes ($F = 19.26$; $df = 9$; $P = 0.000$). The highest grain yield (438.7 g) was observed in MH 3153, and it was 129 and 161.3 times increased yield as compared to NM 2006 (Check 1) and AZRI 2006 (Check 2), respectively. While, the lowest (148.0) in MH 34143 which were 23 and 12 times lower when compared with two checks. Yield performance of other genotypes was observed as intermediate when compared to that of two checks. Cultivar MH 5254 yielded 253.3 g which were 32 and 51 times more as compared to check 1 and check 2. Among the tested genotypes MH 3153 and MH 5254 are better genotypes with low insect population and high grain yield as compared to other tested genotypes. So these lines can be used in further breeding programmes towards evaluations of new varieties with higher resistance against insect pests.

Our results in comparison to work of the previous researchers (Sahoo and Hota, 1991; Chhabra and Kooner, 1991; Fargali *et al*., 1996) showed that the findings regarding screening of mungbean cultivars against sucking pests are in the line of the results that we have attained in our study. Our present findings are in accordance to the results reported by Naqvi *et al*. (1995) who have screened ten cultivar of mungbean and found none of them resistant against sucking pests as we have in our study. Consistent results to our findings has been reported by Khattak *et al*. (2004) who has screened five cultivars of mungbean *viz*., NM 92, NM 98, NM 121-125, M-1 and NCM-209 for resistance against whiteflies, jassid and thrips and found none has complete resistance. Whereas, mungbean varieties, NM-92 and NM-98 showed comparatively better resistant cultivars regarding low mean population of whiteflies as compared to other tested varieties. Results of the present findings lead towards a conclusion that among the tested cultivars, MH 3153 was found least affected by sucking insects and gave the higher yield with an increase of 129 and 161% over check 1 and check 2, respectively. So, cultivar MH 3153 and others which showed different level of resistance against the sucking pests associated with high grain yield could be used for direct release as a variety or may be used in cross breeding programmes to get improved germplasm.

References

Akhtar, K.P., Sarwar, G., Abbas, G., Asghar, M.J. and Hamed, M., 2012. *Intl. J. Pest Manag.,* **58**: 139-145.

Akhtar, K.P., Sarwar, G., Abbas, G., Asghar, M.J., Sarwar, N. and Shah, T.M., 2011. *Crop Protection*, **30**: 1202-1209.

Anonymous, 2012. Agricultural Statistics of Pakistan. Govt.

Pakistan, Economic trade and investment wing, Islamabad, pp. 23.

Chhabra, K.S. and Kooner, B.S., 1991. *Lugume Res*., **14**: 175-184.

Chhabra, K.S. and Kooner, B.S., 1993. *Pest Manag. Econ. Zool*., **6**: 215-218.

Chhabra, K.S. and Kooner, B.S., 1994. *Pest Manag. Econ. Zool*., **2**; 11-14.

Fargali, M.A., Ali, A.G. and Hussein, H.A., 1996. *Assiut J. agric. Sci*., **27**: 125-134.

Hafeez, F.Y., Aslam, Z. and Malik, K.A., 1988. *Plant and Soil*, **106**: 3-8.

Khattak, M.K., Ali, S. and Chishti, J.I., 2004. *Pak. Ent.,* **26**: 9-12.

Lal, S.S., 1985. *Trop. Pest Manag*., **31**: 105-114.

Naqvi, S.H., Talpur, M.A., Rustamani, M.A., Khan, M.M. and Hussain, T., 1995. *Proc. Pakistan Congr. Zool*., **15**: 247-251.

Nazir, M.S., 1994. *Crop Production*. NBF, Islarnabad, pp. 51.

Sahoo, B.K. and Hota, A.K., 1991. *Madras agric. J*., **78**: 84-86.

Shafique, M., Nadeem, S., Hamed, M., Atta, B.M. and Shah, T.M., 2009. *Pakistan J. Zool*., **41**: 277-280.

Steel, R.G.D., Torrie, J.H. and Dickey, D.A., 1997. *Principles and procedures of statistics. A biometrical approach.* 3rd ed. McGraw Hill Inc., New York.

(Received 20 February 2014, revised 20 March 2014)

Pakistan J. Zool., vol. 46(3), pp. 866-870, 2014.

Plant Parasitic and Virus Vector Nematodes Associated with Vineyards in the Central Anatolia Region of Turkey#

İlker Kepenekci,[1] * Halil Toktay[2] and Emre Evlice[3]

[1]Department of Plant Protection, Faculty of Agriculture, Gaziosmanpaşa University, 60250 Tokat, Turkey

[2]Department of Plant Production and Technologies, Niğde University, Faculty of Agricultural Sciences and Technologies, 51240 Niğde, Turkey

[3]Department of Entomology, Plant Protection Central Research Institute, 06172 Ankara, Turkey

Abstract.- Grapevines is host for many plant parasitic nematode species and virus transmission species. Surveys were undertaken in 15 vineyards in Turkey. Samples were taken from each vineyard older than 10 years, from depth of 0-30 cm and 30-60 cm. Totally 300 subsamples were examined. In this study, 22 species were identified belonging to 16 genus within Tylenchida, Aphelenchida, Dorylaimida and Triplonchida orders from soil and root samples of vine (*Vitis vinifera* L.) in the Central Anatolia Region (Nevşehir, Karaman, Konya, Isparta and Burdur provinces). *Malenchus fusiformis*, *Aphelenchoides clarus*, *A. confusus*, *Rotylenchus* (*R.*) *colbrani*, *Xiphinema diversicaudatum* and *Trichodorus similis* were found for the first time in Turkey. The species most frequently encountered were *X. pachtaicum* and *Helicotylenchus crenacauda*.

Key words: Plant parasitic nematodes, virus vector nematodes, vineyards.

Grapevine (*Vitis vinifera*) is one of the most extensive fruit crop grown worldwide. Approximately 7,086,022 hectares of grapevine are grown in the worldwide and Turkey where takes the

This study was presented in the *28th International Symposium of the European Society of Nematologists*.

* Corresponding author: kepenekci@gmail.com

5th order for grapevine growing areas in the world covers 472,545 hectares mainly in Aegean, Southeast Anatolia and Central Anatolia region (Anonymous, 2013)

Crop losses caused by plant parasitic nematodes are increasing in Turkey, but the economic significance of the damage caused by these parasites is not well-understood or recognised by growers. Basic information about plant parasitic nematodes, their host associations, and occurrence in different localities in Turkey was recently reviewed by Kepenekci (2012), who listed 240 nematode species associated from different localities in the country.

Grapevines are hosts for many nematode species. The most serious direct damage is caused by *Meloidogyne*, *Xiphinema* and *Pratylenchus* spp (Brown *et al.,* 1993). Less important species are *Criconemoides*, *Paratylenchus*, *Helicotylenchus*, *Rotylenchus*, *Longidorus*, *Paralongidorus* and *Trichodorus* in the world grapevine areas (Boubals and Dalmasso, 1964; Raski and Krusberg, 1984; Tacconi and Mancini, 1987; Raski, 1988). One of the most serious problem is grapevine fanleaf nepovirus, transmitted by *Xiphinema index*. This problem is covered in the section on nematode transmitted viruses. However, little information is available on the plant parasitic nematodes associated with grapevine in Turkey and no information is available for Central Anotolia.

Studies associated with *Xiphinema* species were carried out in Turkey (Ertürk and Özkut, 1974; Arınç, 1982; Elekçioğlu, 1992) while studies related to other virus vector nematodes i.e. *Longidorus, Paratrichodorus* and *Trichodorus* species were very few (Öztürk and Enneli, 1994). The *Longidorus, Paratrichodorus* and *Trichodorus* species are the substantial virus vector nematodes as they carry viral diseases.

The first detection of virus vector nematodes in Turkey was initiated with detection of *X. index* and *Longidorus* sp. of vine short virus (Kaşkaloğlu and Türkmenoğlu, 1965; Kaşkaloğlu, 1965). In another study, *X. index* and *X. americanum* were detected to be dominant in Izmir vineyard (Yüksel, 1966). In our country, *X. mediterraneum* was firstly detected in the grapevine sites by Arınç (1982). According to the statement of the analyst, Tarjan (1969), in another study on different populations of *X. americanum,* the analyses were performed in the populations available in Adapazarı, Söke, Amasya and Gaziantep, some cities of Turkey. Some researchers stressed out the fact that the species defined as *X. americanum* and detected in some Mediterranean countries should be a separate species (Dalmasso and Younes, 1970; Coomans and Loof, 1969). Lamberti and Martelli (1971) claimed that this species should be *X. mediterraneum.* It is claimed that this species was the same as the one previously detected in the surveys on Aegean and Marmara and defined as *X. americanum* and great possibly this species was *X. mediterraneum* (Arınç, 1982). It is apparent that different and similar nematode was confused by another nematode belonging to *X. americanum* of which presence is still not known in Turkey and Europe. The presence of this species is not known in our country (Kepenekci, 2012).

The first study held on nematode-virus relations in Turkey carried out by Arınç (1982) was associated with “Aegean Region vineyard sites in *Xiphinema* species (Nematoda: Longidoridae), as well as their separation, hosts and damages". In this research, the studies were performed between 1971-1974 in order for detecting the *Xiphinema* species associated with nematodes in Aegean Region including İzmir, Manisa, Balıkesir, Çanakkale, Aydın, Denizli, Muğla and Uşak cities. According to the results of the study, *X. turcicum, X. mediterraneum, X. index, X. italiae, X. brevicolle, X. ingens* and *X. pyrenaicum* were detected. In addition to morphological and morphometric properties, synonyms, variations detected, the separation in research area, and in literature as well as habitats are demonstrated. Of this *X. index* and *X. italiae* species are virus vector nematodes. These two viruses are available in the vineyards of our country where *Grapevine fanleaf nepovirus* are also available.

Grapevines are hosts for many plant parasitic nematode species and some of the species can transmit viruses. In this study, virus vector nematode species of Dorylaimida in grapevines growing areas of The Central Anatolia of Turkey were examined considering their two main aspects, namely faunistic and taxonomic.

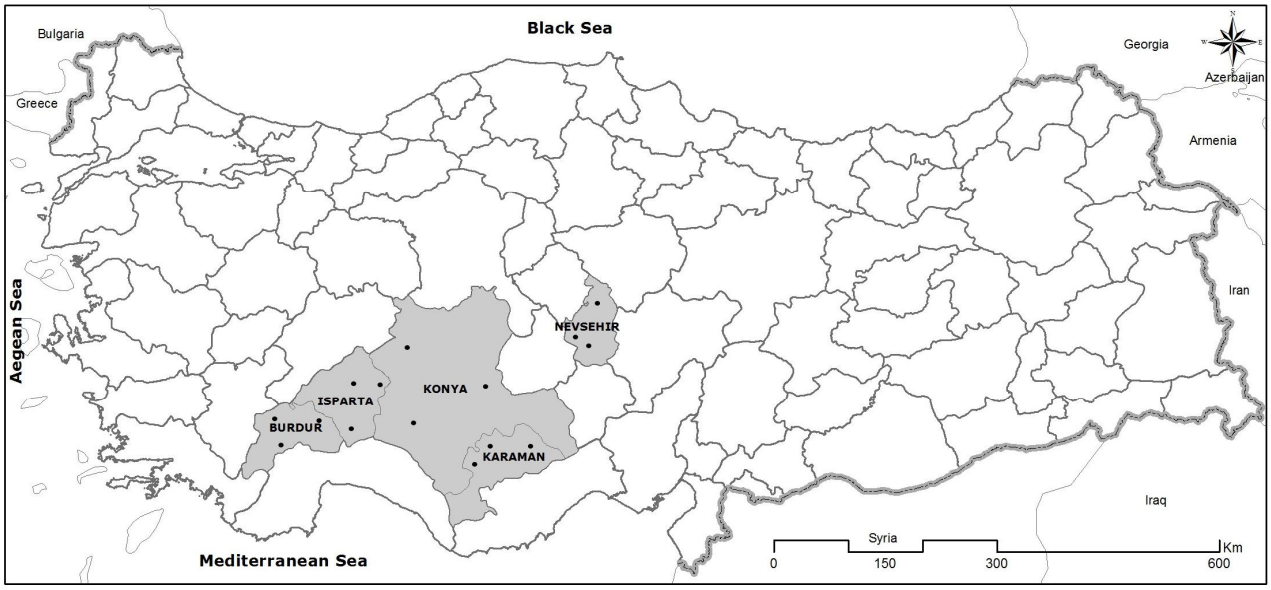

Fig. 1. Map of Turkey showing sampling sites in the Central Anatolia Region.

Material and methods

Soil samples and grapevine roots were collected from vineyards of five provinces in the Central Anatolia Region during July and August 2004-2005. Fifteen vineyards, older than ten years, from Nevşehir, Karaman, Konya, Burdur and Isparta provinces were sampled (Fig. 1). Soil samples were collected with a spade or a 70 mm auger (800-1500 cm^3) from depths of 0-30 cm and 30-60 cm. Ten subsamples were taken from each vineyard and each depth. Totally 300 subsamples were collected. Root samples were collected from ten vine plants in each vineyard (approximately 50 gram of roots for each sample).

In laboratory studies, sieve and funnel methods were used to obtaining active nematodes from soil (Hooper, 1986a). Incubation method was used to extract the nematodes from plant roots (Young, 1954). For identification, nematodes were fixed according to De Grisse (1969). The slides were prepared by the paraffin ring method (Hooper, 1986b). Taxonomic status was given according to Hunt (1993) and Siddiqi (2000).

Results and discussion

Twenty two species were identified belonging to 16 genera within the orders Tylenchida, Aphelenchida, Dorylaimida and Triplonchida. Most of them are new records for vineyards in Turkey. *Malenchus fusiformis* (Thorne and Malek); *Aphelenchoides clarus* Thorne and Malek, *A. confusus* Thorne and Malek, *Rotylenchus* (*R.*) *colbrani* Brzeski and Choi; *Xiphinema diversicaudatum* (Micoletzky) and *Trichodorus similis* Seinhorst were found for the first time in the nematofauna of Turkey. The species most frequently encountered were *X. diversicaudatum* and *Helicotylenchus crenacauda* (Table I).

Root-knot nematodes occurring in vineyards in some provinces of Turkey (Ertürk and Özkut, 1974; Lamberti *et al.,* 1994) were not found in the present survey. *X. index,* the most important nematode species in vineyards was not also found in the present survey.

A preliminary experiment was undertaken to evaluate the changes in nematode levels by soil depth. Soil samples from 15 vineyards of five different provinces were taken at depths 0-30 cm and 30-60 cm. *Paratylenchus* (*P.*) *variabilis*, *Filenchus filiformis*, *Safianema lutonense*, *Rotylenchus* (*R.*) *colbrani*, *Ditylenchus destructor*, *Helicotylenchus canadensis*, *H. pseudorobustus*, *Boleodorus thylactus*, *Merlinius brevidens*, *A. confusus*, *Scutylenchus stegus*, *S. tartuensis* were

Table I.- Plant parasitic and virus vector nematodes associated with grapevine in the Central Anatolia Region of Turkey.

Nematode species (Family)	Distribution[x]
Filenchus filiformis (Bütschli) Meyl (Tylenchidae)	k(1)
Boleodorus thylactus Thorne (Tylenchidae)	k(1)
Malenchus (*M.*) *fusiformis* (Thorne & Malek) Siddiqi (Tylenchidae)[y]	n(2)
Ditylenchus destructor Thorne (Anguinidae)	k(1)
Safianema lutonense Siddiqi (Anguinidae)	n(1)
Helicotylenchus canadensis Wassem (Hoplolaimidae)	n(1)
H. crenacauda Sher (Hoplolaimidae)	b(2), k(2), i(1)
H. pseudorobustus (Steiner) Golden (Hoplolaimidae)	n(1)
Rotylenchus (*R.*) *colbrani* Brzeski & Choi (Hoplolaimidae)[y]	n(1)
Pratylenchus scribneri Steiner in Sherbakoff & Stanley (Pratylenchidae)	n(2)
Merlinius brevidens (Allen) Siddiqi (Telotylenchidae)	n(1)
Scutylenchus stegus (Thorne & Malek) Siddiqi (Telotylenchidae)	n(1)
S. tartuensis (Krall) Siddiqi (Telotylenchidae)	o(1)
Paratylenchus (*P.*) *variabilis* Raski (Paratylenchidae)	k(1)
Aphelenchus avenae Bastian (Aphelenchidae)	n(1), k(2)
Aphelenchoides clarus Thorne & Malek (Aphelenchoididae)[y]	n(1), k(1)
A. confusus Thorne & Malek (Aphelenchoididae)[y]	k(1)
Xiphinema diversicaudatum (Micoletzky) Thorne (Longidoridae)[y]	n(2), o(1), i(1)
X. pachtaicum (Tulaganov) Kirjanova (Longidoridae)	n(1), k(1)
Longidorus elongatus (de Man) Micoletzky (Longidoridae)	n(1)
L. attenuatus Hooper (Longidoridae)	n(1)
Trichodorus similis Seinhorst (Trichodoridae)[y]	n(1), i(1)

[x] Province: n, Nevşehir; k, Karaman; o, Konya; b, Burdur; I, Isparta

[y] Species reported for the first time in Turkey.

found in one vineyard and same soil depth 0-30 cm. *Aphelenchoides clarus* a vineyard in two different provinces and same soil depth 0-30 cm. On the other hand *Malenchus* (*M.*) *fusiformis* and *Paratylenchus scribneri* in two same vineyards at depths 0-30 and 30-60 cm. *Aphelenchus avenae* was at soil depth of 0-30 cm. *H. crenacauda* was at soil depth of 30-60 cm unlike other species of *Helicotylenchus*. *Xiphinema diversicaudatum*, *X. pachtaicum*, *Trichodorus similis* were found in more than two province and vineyard and the same soil depth of 30-60 cm. Unlike other virus transmission species, *Longidorus elongatus, L. attenuatus* were at soil depth of 0-30 cm and in one vineyard.

A majority of the genera were found in higher densities at depth of 0-30 cm from other depth. The highest density of the virus transmission species, *Xiphinema* and *Trichodorus* were at soil depth of 30-60 cm. Plant parasitic nematode species populations were also higher at the shallower layer than at 30-60 cm; however, this did not apply to all nematodes, for example, root lesion nematode (*Pratylenchus scribneri*).

The present study indicates that several nematodes are associated with vineyards in Turkey. However, more investigations are required to fully elucidate the role of plant parasitic nematodes in grapevine production in Turkey.

Acknowledgments

This study is part of a research project "The vineyards of Central Anatolia Region Integrated Pest Management Research, Practice and Training Project" TAGEM/BS/96/06/09/502, supported by the General Directorate of Agricultural Research and Policies (GDAR), Food, Agriculture and Livestock Ministry.

References

Anonymous, 2013. www.fao.org. FAOSTAT- Crop Production, reached in February, 21, 2013.

Arinç, Y., 1982. *T.C. Tarım ve Orman Bakanlığı Zirai Mücadele ve Zirai Karantina Genel Müdürlüğü İzmir Bölge Zirai Mücadele Araştırma Enstitüsü Müdürlüğü, Araştırma Eserleri Serisi*, **41**: 83.

Boubals, D. and Dalmasso, A., 1964. *Prores Agricole et Viticole*, **168**: 1-16.

Coomans, A. and Loof, P.A.A., 1969. *Nematologica*, **15**: 293-294.

Dalmasso, A. and Younes, T., 1970. *Nematologica*, **16**: 51-54.

De Grisse, A., 1969. *Meded. Ritksfac. Landwet. Gent*., **34**: 351-359

Elekçioğlu, I.H., 1992. *Plits,* **10**: 120 pp.

Ertürk, H. and Özkut, S., 1974. *IV. Bilim Kongresi*, 1-7.

Hooper, D.J., 1986a. In: *Laboratory methods for work with plant and soil nematodes* (ed. J.F. Southey). Her Majesty's Stationery Office, London, pp. 5-30.

Hooper, D.J., 1986b. In: *Laboratory methods for work with plant and soil nematodes* (ed. J.F. Southey). Her Majesty's Stationery Office, London, pp. 59-80.

Hunt, D.J., 1993. *Aphelenchida, Longidoridae and Trichodoridae: Their Systematics and Bionomics.* CAB International, pp. 352.

Kaşkaloğlu, N., 1965. *Zirai Mücadele Haberler Bülteni,* Yıl 4,

Sayı 81.

Kaşkaloğlu, N. and Türkmenoğlu, H., 1965. *Tarım Bakanlığı, İzmir, Bornova Zirai Mücadele Enstitüsü Yayını*.

Kepenekci, I., 2012. *Nematoloji*. Eğitim, Yayım ve Yayımlar Dairesi Başkanlığı, Tarım Bilim Serisi Yayın No: **3** (2012/3), 1155 pp.

Lamberti, F. and Martelli, G., 1971. *Nematologica*, **17**: 75-81.

Lamberti, F., Özaslan, M., Catalano, L., Elia, F. and Kaskavalcı, G., 1994. *Proceedings of the 9th Congress of the Mediterranean Phytopathological Union*, pp. 411-412.

Öztürk, G. and Enneli, S., 1994. *Proceedings of the 9th Congress of the Mediterranean Phytopathological Union*, pp. 537, 538.

Raski, D.J. and Krusberg, L.R., 1984. In: *Plant and insect nematodes* (ed. W.R. Nickle). New York, Marcel Dekker, pp. 457-506.

Raski, D.J., 1988. In: *Compendium of grape diseases* (eds. R.C. Pearson and A.C. Goheen). Minesota, USA, American Phytopathological Society, pp. 55-59.

Siddiqi, M.R., 2000. *Tylenchida parasites of plants and insects*. CABI Publishing, UK, 833 pp.

Tacconi, R. and Mancini, G., 1987. *Informatore Agraria*, **43**: 69-75.

Tarjan, A.C., 1969. *Nematologica*, **15**: 241-252.

Young, T.W., 1954. *Pl. Dis. Rep.*, **38**:794-795.

Yüksel, H.S. 1966. *Plant Protection Bulletin*, **6**: 31-34.

(Received 28 September 2013, revised 2 March 2014)

Pakistan J. Zool., vol. 46(3), pp. 870-873, 2014.

Prevalence and Chemotherapy of Theileriosis in Clinical Affected Equines of Lahore District, Pakistan - A Review of 300 Cases

Muhammad Azhar,[1] Muhammad Ijaz[1] and Muhammad Muddassir Ali[2]

[1]Department of Clinical Medicine and Surgery, University of Veterinary and Animal Sciences Lahore, 54000

[2]Institute of Biochemistry and Biotechnology, University of Veterinary and Animal Sciences Lahore, 54000

Abstract.- The prevalence of theileriosis in clinical affected equines of Lahore district was examined and the efficacy of three treatments measured. A total of 300 blood samples (horses, 100; donkeys, 100; mules, 100) were collected from equines and examined microscopically; Overall, 174 (58%) were positive for *Theileria equi* whereas prevalence in horses, mules and donkeys was 54%, 64% and 56%, respectively. The final efficacy of treatment with Imidocarb dipropionate, Buparvaquone and Aak (*Calotropis procera*) was 91.70%, 66.70% and 58.30%, respectively, making Imidocarb dipropionate the most effective treatment. This is the first report of *Theileria equi* infection in equines of Pakistan.

Key words: *Calotropis procera*, donkeys, *Theileria equi,* Imidocarb dipropionate

Theileriosis is economically significant disease in numerous countries of Asia and Africa. Losses in terms of vaccination and treatment cost, decrease in live weight of sub-clinical cases, increase in inter calving interval, mortality and delay in the age of maturity of affected female animals have been reported (Gharbi *et al.,* 2006). Theileriosis effected animals show petechial and echymotic hemorrhages on serosal surfaces of internal organs and serous fluid is found in body cavities. Edematous and hemorrhagic enlarged lymph nodes are seen in case of acute infection. But in chronic case shrunken lymph nodes are found.

* Correspondence author: muddassir.ali@uvas.edu.pk

The enlargement of spleen and liver is also found. The gastro intestinal tract shows signs of hemorrhagic enteritis especially in small intestine and abomasums region. Severe pulmonary edema is often found during postmortem (De-Waal and Heerden, 2004). Donkeys usually remain asymptomatic carriers with positive antibody titer throughout life (Kumar *et al.,* 2009). The animals that recover from infection act as carriers of the parasite for several years, becoming reservoirs for vector ticks (Cacciò *et al.,* 2000). Incidence of theileriosis can be controlled by acaricides and tick control methods. Diagnosis of theileriosis can be made by direct microscopy of stained thick and thin blood smears slides (De Waal and Heerden, 2004). In view the importance and utilization of equines in Pakistan and the significant losses rendered by theileriosis due to improper diagnosis and expensive treatment of theileriosis, the present study was designed to find prevalence of theileriosis and evaluate the efficacy parameters of allopathic and herbal drugs under field conditions in equines.

Materials and methods

A total of 300 equines (horses, 100; donkeys, 100; mules, 100) suspected for theileriosis were included. Intermittent fever, loss of appetite, anemia, loss of weight, dyspnea, pale mucous membrane, jaundice and recumbency were the main clinical signs showed by *Theileria* infected equines. In severe cases petechial hemorrhages and haemoglobinuria were also observed in some clinically positive animals. Data on species, age, sex, clinical history and treatment protocols were recorded. Blood samples were collected from ear tip puncture and Jugular venipuncture and thin blood smear slides were prepared by using Giemsa's stain. *T. equi* was identified microscopically by their morphological characteristics as described by standard key. Thirty six equines (horses, 12; donkeys, 12; mules, 12) positive for theileriosis were divided into three groups (A-C), each group comprised 4 horses, 4 donkeys and 4 mules. The equines of group A were treated with imidocarb dipropionate (Imizol®, ICI, Pakistan) at the dose of 2 mg/kg BW, i/m. The equines of group B were treated with buparvaquone (Butalex®, ICI, Pakistan) at dose rate of 2 mg/kg BW, i/m, while the group C was treated with *Calotropis procera* (Aak) stem, flowers and buds orally in dried powder form at the dose rate of 0.3 mg/kg BW, divided into eight equal doses on alternative days (Durrani *et al.,* 2009). Efficacy of drugs was measured on the basis of disappearance of clinical signs and blood smear examination on day 2, 4, 6 and 10 post-medication.

Data on prevalence of theileriosis was estimated by Pearson's chi-square test for significance using statistical software package STATA 9.1 (College Station T×77845, USA).

Results and discussion

Of 300 animals 58% were positive for theileriosis when comma or pear shaped *T. equi* were observed inside the RBCs. These morphological observations coincide with the studies of Rashid *et al.* (2009). Out of 300 animals 54% horses, 64% mules, and 56% donkeys were found positive for theileriosis ($p<0.05$, Table I). Most of the equines under study belonged to the poor farmers who were rearing these on poor management and prophylactic measures. Moreover, higher temperature that characterizes the current study area might be another reason of higher prevalence. Garba *et al.* (2011) reported overall 20.1% equines prevalence of piroplasmosis in Niger state, amongst which infection rate was 80.4% due to *T. equi* and 19.6% due to *Babesia caballi*. Similarly Nagore *et al.* (2004) observed 9 out of 24 horses positive (37.5%) for *T. equi* through microscopy. Contrary to this, Ibrahim *et al.* (2011) reported 18%, Moretti *et al.* (2010) reported 3.1%, Baldani *et al.* (2010) 3.52%, Sevinc *et al.* (2008) 0.62% and Ruegg *et al.* (2006) 6.7% prevalence in equines. These low values of prevalence were probably due to the carrier stage of infection or good management practices or season of low tick infestation. The sex wise data showed higher prevalence in males equines compared to female (Table I, $P<0.05$), whereas more prevalence (66.66%) was observed in equines having age <5 years compared to age ≥5 having 61.88% prevalence except in donkeys who showed more prevalence (59.42%) in ≥5 years adult donkeys ($p<0.05$, Table I). These results correspond closely to the findings of Al-saad (2009) who found 85.7% prevalence of *T. equi* in foals aged 1 to 8 months.

Table I.- Sex and age wise prevalence in equines.

Age groups	Horses (n=100)			Mules (n=100)			Donkeys (n=100)		
	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)
<5 years	04/06 (66.60)	06/10 (60.00)	10/16 (62.50)	05/05 (100.0)	04/04 (100.0)	09/09 (100.0)	09/17 (52.94)	06/14 (42.86)	15/31 (48.39)
≥5 years	18/38 (47.37)	26/46 (56.52)	44/84 (52.38)	51/68 (75.00)	04/23 (17.39)	55/91 (60.44)	39/62 (62.90)	02/07 (28.57)	41/69 (59.42)
Total	22/44 (50.00)	32/56 (57.14)	54/100 (54.00)	55/73 (75.34)	09/27 (33.33)	64/100 (64.00)	48/79 (60.76)	08/21 (38.10)	56/100 (56.00)

Table II.- Efficacy of various drugs against *Theileria equi* in equines.

Drugs names	Efficacy (%)			
	Horses (n=4)	Mules (n=4)	Donkeys (n=4)	Overall (n=12)
Imidocarb dipropionate	3(75%)	4(100%)	4(100%)	11(91.7%)
Buparvaquone	2(50%)	3(75%)	3(75%)	08(66.7%)
Aak (*Calotropis procera*)	3(75%)	2(50%)	2(50%)	07(58.3%)

Table II shows the comparative therapeutic efficacy of imidocarb dipropionate, buparvaquone and *C. procera* (Aak). The imidocarb dipropionate showed higher efficacy (91.70%) followed by buparvaquone (66.70%) and *C. procera* (58.30%) in equines. Results regarding the efficacy of imidocarb dipropionate correlate with the findings of Correa *et al.* (2005), Butler *et al.* (2008), Rashid *et al.* (2009), Adaszek *et al.* (2011) who reported greater efficacy of this drug against equine theleriosis. Bruning (1996) also found buparvaquone as an effective drug against *T. equi* infection along with imidocarb dipropionate. Kumar *et al.* (2003) reported no efficacy of buparvaquone against *T. equi* infection. This contradiction in efficacy of buparvaquone in equines might be due to the drug resistance of organism, difference in strains of parasite or environmental conditions. It is concluded that the equine theileriosis is highly prevalent in the area under study and imidocarb dipropionate is the most effective drug against this malady.

References

Adaszek, L., Gorna, M.J., Krzysiak, M., Adaszek, M., Garbal, M. and Winiarczyk, S., 2011. *Wiadom. Parazytol.,* **57**: 21–26.

Al-Saad, K.M., 2009. *J. Anim. Vet. Adv.,* **8**: 2585-9.

Baldani, C.D., Nakaghi, A.C.H. and Machado, R.Z., 2010. *Parasitol. Vet. Jaboticabal.,* **19**: 228-232.

Bruning, A., 1996. *Br. Vet. J.,* **152**: 139-151.

Butler, C.M., Nijhof, A.M., Van Der Kolk, J.H., De Haseth, O.B., Taoufik, A., Jongejan, F. and Houwers, D.J., 2008. *Vet. Parasitol.,* **151**: 320-322.

Caccio, S., Camma, C., Onuma, M. and Severini, C., 2000. *Int. J. Parasitol.,* **30**: 1181-1185.

Correa, R.R., Roncati, N.V. and Bonagura, G., 2005. *A. Hora. Vet.*, **24**: 53-58.

De-Waal, D.T. and Heerden, J.V., 2004. In: *Infectious diseases of livestock*, 2nd edn. (eds. J.A.W. Coetzer and R.C. Tustin) Oxford University Press, New York, pp. 425-433.

Durrani, A.Z., Maqbool, A., Mahmood, N., Kamal, N. and Shakoori, A.R., 2009. *Pakistan J. Zool.,* **41**: 389-397.

Garba, U.M., Sackey, A.K.B., Tekdek, L.B., Agbede, R.I.S. and Bisalla, M., 2011. *J. Vet. Adv.,* **1**: 11-15.

Gharbi, M., Sassi, L., Dorchies, P. and Darghouth, M.A., 2006. *Vet. Parasitol.,* **137**: 231-241.

Ibrahim, A.K., Gamil, I.S., Ad-Elbaky, A.A., Hussein, M.M. and Tohamy, A.A., 2011. *Glob. Vet.,* **7**: 201-210.

Kumar, S., Gupta, A.K., Pal, Y. and Dwivedi, S.K., 2003. *J. Vet. med. Sci.,* **65**, 1171-1177.

Kumar, S., Kumar, R. and Sugimoto, C., 2009. *Jpn. J. Vet. Res.,* **56**: 71-80.

Moretti, A., Mangili, V., Salvatori, R., Maresca, V., Scoccia, E., Torina, M.1., Gabrielli, S., Maria, P. and Tampieri, P.M., 2010. *Vet. J.,* **184**: 346–350.

Nagore, D., Garcia-Sanmartin, J., Garcia-Perez, A.L., Juste, R.A. and Hurtado, A., 2004. *Vet. Parasitol.*, **123**: 41–

54.

Rashid, A., Mubarak, A. and Hussain, A., 2009. *Vet. Ital.,* **45**: 391-395.

Ruegg, S.R., Torgerson, P.R., Doherr, M.G., Deplazes, P., Bose, R., Robert, N. and Walzer, C., 2006. *J. Wildl. Dis.,* **42**: 518-526.

Sevinc, F., Maden, M., Kumas, C., Sevinc, M. and Derinbay, E.O., 2008. *Vet. Parasitol.*, **156**: 173–177.

(Received 27 December 2013, revised 16 March 2014)

Pakistan J. Zool., vol. 46(3), pp. 873-876, 2014.

A Comparative Study of Wool Quality of Sheep Breeds in Gilgit-Baltistan, Pakistan

Akbar Khan[1,*] and A. N. Naqvi[2]

[1]Department of Biological Sciences, Karakoram International University, Gilgit-Baltistan, Pakistan

[2] Faculty of Life Sciences, Karakoram International University, Gilgit-Baltistan, Pakistan

Abstract.- Livestock in Gilgit Baltistan contributes significantly to the nutritional requirements and economy of the people of the area. Sheep is a sacrificial animal and very important to many communities as it fits better to environmental and socioeconomic circumstances of the area. The locally made woolen products from sheep such as shuqa, socks, blankets, shawls, gloves, jerseys and woolen caps are major source of income generation. In order to compare the wool quality of sheep, samples were collected from various breeds of sheep from all over Gilgit Baltistan. Average fibre diameter (µm) was found to be 30.22±13.68, 29.56±15.09, 35.42±15.30, 30.39±13.90, 36.72±21.95, 28.43±15.16, 30.61±15.27 and medulation (%) 28.83, 26.19, 32.49, 23.14, 39.90, 20.62 and 22.94 for Koh-e-Ghezir, Batherathi, Gojali, Baltistani, Diameri, Gilgiti and Astori breeds, respectively. Information has been provided about the indigenous woolen products, raw materials and their market prices based on a survey of the three markets of Gilgit.

Key words: Sheep, wool quality, medulation, wool fibre diameter.

* Corresponding author: akbar@kiu.edu.pk

Sheep are the major source of revenue for over a million livestock farmers in Pakistan as it fits better than other livestock to environmental and socioeconomic circumstances (Khan *et al*., 2007). Goat and sheep are multipurpose animals which provide hair, wool, meat and milk, goat and sheep meat is the major source of animal protein for the people of our country (Nasrullah *et al,*.2013). The population of sheep in Pakistan is about 27.8 million (Economic Survey of Pakistan 2009-10) and the annual contribution of wool in livestock products is 42 thousand tons. However, an estimated increase of 41% in sheep population in the last 20 years has not proportionally corresponded with increased productivity. The major factors being lack of selective breeding for improvement, and poor management, nutrition and disease control (Qureshi and Ghaffar, 2002).

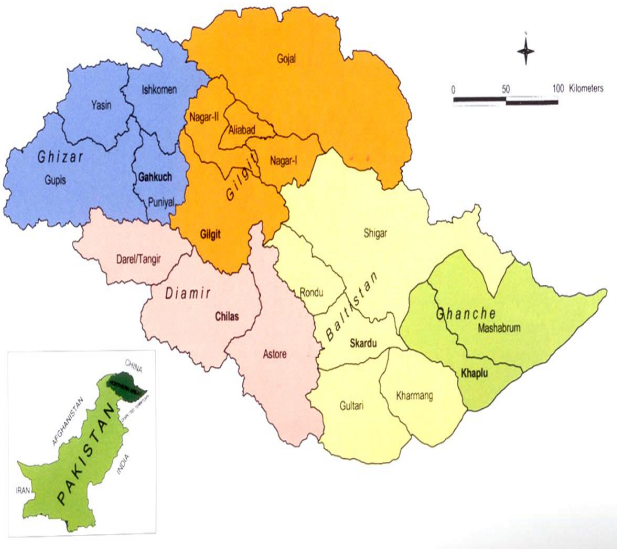

Fig.1. Map of Gilgit-Baltistan

There are 31 breeds of sheep in Pakistan; the most important are 'Baltistani', 'Bibrik', 'Cholistani', 'Kajli' and 'Lohi', or salt range (Isani and Baloch, 1996). Sheep are generally raised in mixed flocks with goats, though separate sheep flocks are also raised. Besides meat (mutton), almost all sheep breeds produce coarse type wool. The difference in fleece type/yields results from variation within and between breeds under the influence of climate, nutrition, wool grease and

foreign matter (Abbas *et al.,* 2012). Wool from breeds such as Kaghani and Kari is known to be finer than the others but still not fine enough to meet the domestic needs of fine wool and long fibre, hence wool export from Pakistan is limited (Khan *et al*., 2007).

The Gilgit-Baltistan spans an area of some 72,496 square kilometers, bordering China, Afghanistan, Azad Jammu and Kashmir (AJK) and India (Fig. 1). The area is important globally due to its strategic position. The woolen products such as shuqa, socks, blankets, shawls, gloves, jerseys and woolen caps are major sources of income in the region and most of the people are directly or indirectly connected with woolen product business. Seven main sheep breeds are present in Gilgit-Baltistan, namely Diameri, Astori, Gilgiti, Baltistani, Gojali, Koh-i-Ghezir and kali breed. The last breed being found mainly in upper areas of Chilas Tehsil close to Babuser pass next to Kaghan Naran valley of KPK. Since no report is available on the quality of the wool in the region, this study aims to provide baseline data on two quality parameters (fiber diameter and average medulation) of wool in local breeds and on current monetary value of raw wool and wool products originating from different wool production areas in Gilgit-Baltistan.

Materials and methods

Wool samples were collected from 300 adult animals from 60 flocks in seven districts of Gilgit-Baltistan and were analyzed for their quality attributes. Wool samples were taken from 5x5 cm^2 on the mid side of each animal and were kept in envelopes labeled with the registration ID of the animal. Five samples were randomly selected from each herd and subsequently at least 40 fibres were taken incidentally from each randomly selected sample. The wool testing was done in the wool testing lab of National Agriculture Research Centre, Islamabad. The wool fibers were virtually observed and counted with the help of a projection microscope at 500 power magnification. The fiber diameter was measured in accordance with the standard protocol suggested by Von Bergen (1963). The visual subjectively and benzol test were used to separate the true wool and medullated fiber. In parallel, to determine the impact of local woolen product business, information on material, market prices of raw wool and woolen products was collected by interview in the three markets of Gilgit city.

Results and discussion

The quality parameters of wool of sheep from Gilgit-Baltistan are presented in Table I. The average wool diameter ranges from median 28.43±15.16 µm (Gilgiti), 29.56±15.09 µm (Batherathi), 30.22±13.68 µm (Koh-e-Ghizar), 30.39±13.90 µm (Baltistani) to coarse wool 35.42±15.30 µm (Gojali) and 36.72±21.95 µm (Diameri breed). The quality of the wool is determined by fibre diameter, yield and staple length. Mean fiber diameter is the single most important quality character of wool and is the driver of its monetary value (Bray, 1955; Von Bergen, 1963; Lang, 1964; Wan, 1970; Hunter and Gee, 1980). The wool ranging from 12-24.5 µm is deemed fine, 24.5-31.5 µm is medium and 35.5 µm < is coarse (Anonymous, 2013). Wool thinner than 25 µm is used for garments while coarse grades are used for out wears or rugs.

Table I.- Wool diameter (µm) and modulation (%) in seven sheep breeds found in the Gilgit-Baltistan region of Pakistan.

Breed	Location	Type of wool	Average diameter (µ)	Average Medulation %
Koh-e-Ghezir	Ghezir, Gupis	Medium	30.22±13.68	28.83
Batherathi	Ghezir	Medium	29.56±15.09	26.19
Gojali	Hunza Nagir, Gojal	Coarse	35.42±15.30	32.49
Baltistani	Baltistan	Medium	30.39±13.90	23.14
Diameri	Diamer	Coarse	36.72±21.95	39.90
Gilgiti	Gilgit	Medium	28.43±15.16	20.62
Astori	Astore	Medium	30.61±15.27	22.94

Bhasin and Desai (1965) studied the wool quality of the Chokla breed, which shows diameter of 28.22±0.20µm and medulation 24.01±0.62%. The present study showed similarity in fibre diameter and, on average, higher medulation as compared to the Chokla breed, which is perhaps a fine carpet wool breed. Food and Agriculture Organization (1982) reported that the Nali breed,

which is good carpet-quality wool breed, has diameter and medulation of 34.92±0.69µm and 30.74±0.40%, respectively. Similar wool diameter and medulation values were found in sheep Hunza-Nagir and Diamer breeds (Table I). According to Kushwaha *et al*. (1999) the average fibre diameter and medulation in six monthly growths reported in Munjal sheep were 51.18±0.97µm and 64.37±41% respectively, while fibre diameter and medulation reported by FAO (1982) on sheep breeds of India (Marwari, Magra, Jaisal Meri, Pugal and Malpura) were 36.93±0.16 µm, 65.18±1.66%, 32.45±0.35 µm, 48.29±0.39%, 39.1±2.76 µm, 64.1±3.1%, 35.15±1.00 µm, 61.86%, 41.95±0.37 µm, 71.84%, respectively. The present study suggests that sheep breeds found in Gilgit-Baltistan have medium fine wool which is the best for carpet production. The medulation seen in the present study (Table I) showed greater deviation from values reported by FAO (1982).

The present study reveals that sheep found in Diamer and Gojal (Hunza Nagar) produce coarse wool with higher diameter and medulation than the rest of the districts under study. Overall, investigated beeds showed close resemblance in their fibre diameter and greater diversity in the medulation property of the fibre, with lower modulation in Gilgit, Astore, Baltistan and Ghezir districts. Fleece weight is around 1.5 kg per shearing with two shearing a year in March/April and September/ October for all the breeds. The wool products play a key role in economic development of the people of Gilgit-Baltistan. Table II shows the prices of different products (thread, pattu, coat, caps and shuga) which are usually available in the market.

Table II.- Average cost of woolen products at markets of Gilgit-Baltistan.

Potential areas of wool production	Thread		Pattu		Coat		Caps			Shuga	
	White cost/ kg	Brown cost kg	White cost yard	Brown cost yard	White cost	Brown cost	White	Brown	Black	White	Brown
Gojal	1000-1200	1100-1500	600-700	700-800	6000	7000	200-450	200-800	150-180	2500	5000
Nagar (Chalt)	1200-1500	1300-1600	800-1000	1000-1200	8000	9000	300-500	250-1000	200-250	4000	7000
Chilas	900-1000	1000-1200	600	800	8000	9000-10000	300-400	200-800	150-200	3000-3500	6000
Ghezir	1000-1100	1200-1300	700-800	900-1000	7000-8000	10000-12000	300-400	300-900	-	4000-5000	7000
Bagroot	1000	1200-1300	700-800	1000	7000-8000	10000-12000	300-400	300-500	150-250	3000-4000	5000-6000
Haramosh	1000-1100	1100-1200	600-800	900-1200	7000-8000	10000-12500	300-400	300-500	200-250	3000-5000	4000-6000
Astore	800-1000	1200-1300	700-800	800-1200	6000-8000	10000-13000	300-400	400-500	200-300	4000	5000-7000
Naltar	1000	1200	700	1000	7000-8000	10000-11000	300-400	400-500	200	4000-5000	6000-6500

Conclusion

This study has provided baseline information on wool quality of different breeds of the area.

Acknowledgements

We appreciate the cooperation of Dr. Fateullah Khan and his team for his cooperation in testing the wool samples at wool testing lab of National Agriculture Research Centre, Islamabad.

References

Abbas, R.Z., Iqbal, Z. and Saleemi, K., 2012. Grading and marketing of wool**,** *http://www.pakissan.com/english/allabout/crop/cotton/grading.and.marketing.of.wool.html*

Bray, R.J., 1955. *Wool characteristics in relation to manufacturers' requirements*. International Wool Secretariat, London.

Bhasin, N.R. and Desai, R.N., 1965. Studies on factors affecting the characters concerning 1965 quality of wool fibre in a Chokla flock of sheep. *Indian Vet. J.,* **42**: 782–788.

Economic Survey of Pakistan, 2010-09. Ministry of Food and Agriculture Federal Bureau of Statistics

Food and Agriculture Organization. 1982. FAO Production Yearbook. Rome.

Hunter, L. and Gee, E., 1980. The effects of staple crimp, resistance to compression and fiber diameter and length characteristics on the physical properties of wool worsted yarns. *Proc. 6th Quin. Int. Wool Text. Res. Conf., Pretoria, South Africa*, IIL327.

Isani, G.B. and Baloch, M. N., 1996. *Sheep and goat breed of Pakistan*, Karachi Press Corporation

Kushwaha, B.P., Riyazuddin, Singh, R.N. and Parthasarathy, S., 1999. *Anim. Genet. Resour. Inform.,* **25**: 27-31

Lang, W.R., 1964. The technical relevance of wool quality. *Wool Technol. Sheep Breed*, **11**:8

Nasrullah, Abdullah. M. and Baber, M.E., 2013. *Pakistan J. Zool.*, **45**:107-111

Qureshi, M.A. and Ghaffar, A., 2002. Performance of Kajli sheep in Pakistan, *Proc. 7th World Congress on Genetics Applied to Livestock Improvement,* held at Montpellier. France on August, 19-23

Khan, S.M., Muqarrab, A. K., Sohail, A. and Sultan, M., 2007. *Int. J. Agric. Biol.,* **9**: 941-944

Von Bergen, W., 1963. *Wool Technol. Sheep Breed,* **101**:43.

Wan, R.B., 1970. *Wool Technol. Sheep Breed,* **17**:9

Young, S.S.Y., Turner, H. N. and Dolling, C.H.S. 1960. *Aust. J. Agric. Res.,* **11**:604

(Received 4 April 2013, revised 4 March 2014)

Pakistan J. Zool., vol. 46(3), pp. 876-880, 2014.

Prevalence and Chemotherapy of Anaplasmosis in Clinically Affected Small Ruminants in the River Ravi Region, Lahore

Akhtar Ali,[1] Muhammad Ijaz,[1] Aneela Zameer Durrani,[1] Muhammad Mudassir Ali,[2] Khalid Mehmood[3*] and Ahmad Jawad Sabir[4]

[1]Department of Clinical Medicine and Surgery, University of Veterinary and Animal Sciences Lahore, 54000

[2]Institute of Biochemistry and Biotechnology; University of Veterinary and Animal Sciences Lahore, 54000

[3]Department of Clinical Medicine and Surgery, University College of Veterinary and Animal Sciences; Islamia University of Bahawalpur, 63100

[4]ICE&E, University of Veterinary and Animal Sciences, Lahore, 54000

Abstract.- Anaplasmosis is deadly infectious malady of small ruminants throughout the world. The prevalence of anaplasmosis in clinically affected small ruminants from the River Ravi region of Lahore was estimated along with hematological and therapeutic studies on infected animals. A total of 300 (n=150 sheep; n=150 goats) blood samples were collected from clinically affected small ruminants and examined microscopically; 129 (43%) were positive for *Anaplasma ovis*. A higher prevalence of anaplasmosis was recorded in sheep (55.33%) as compared to goats (30.67%). Hb and WBCs were significantly increased ($P<0.05$), while the concentration of RBCs and PCV non-significantly decreased ($P>0.05$) in infected small ruminants. The final efficacy of oxytetracycline, imidocarb dipropionat and diaminazin aceturate was 100, 87.5 and 62.5%, respectively in small ruminants making oxytetracycline the most effective drug.

Key words: Anaplasmosis, oxytetracycline, *Anaplasmosis ovis*.

Ticks are the most important ectoparasites of ruminants and are responsible for substantial

* Corresponding author: khalid.mehmood@iub.edu.pk

economic losses in terms of high morbidity and mortality resulting in decrease production of meat, milk and other livestock by-products (Makala *et al.,* 2003). Ticks not only cause direct damage but also can transmit several protozoans, rickettsial and viral diseases (Noaman, 2012). Tick borne diseases (TBDs) are widely distributed throughout the world especially in tropical and subtropical regions including Pakistan (Khan *et al.,* 2004). The prevalence varies from region to region and various factors determine the occurrence of the TBDs (Magona *et al.,* 2011).

Anaplasmosis is also a tick-borne infectious disease of cattle, sheep, goats and other domestic ruminants (Inokuma, 2007). In the poor countries of tropical and subtropical regions where livestock consists mainly of sheep and goats, anaplasmosis causes large losses in livestock productivity (Rymaszewska and Grenda, 2008). *Anaplasma ovis* (*A. ovis*) is an obligate intraerythrocytic rickettsial pathogen which infects sheep, goats and wild ruminants (Fuente *et al.,* 2006). It is characterized by depression, debility, marked decline in body weight, fever and progressive anemia whose consequence is reduction in milk production (Rymaszewska and Grenda, 2008).

The hematological profile can be considered a useful tool for diagnosis, prognosis, and evaluation of the treatment for *A. ovis* (Ahmadi-Hamedani *et al.,* 2013). The most effective and confirmed method of control is through the strategic use of drugs which kill the pathogen without harming the host. Many of the standard chemotherapies are used today, however expensive, with toxic side effects and in some cases have marginal efficacy because of the emergence of drug resistant pathogen (Cheesman, 2000). Tetracyclines (Chlortetracycline, Tetracycline and Oxytetracycline) are used for the treatment of anaplasmosis. Other compounds such as imidocarb eliminate parasites from carrier animals (Akhter *et al.,* 2010).

Keeping in view the importance of small ruminants in our country and the significant losses rendered by anaplasmosis, the present project has been designed to study the prevalence, hematology and chemotherapy against anaplasmosis in small ruminants under field conditions.

Materials and methods

Three hundred blood samples (n=150 sheep; n=150 goats) of small ruminants were collected from the field, various private and public hospitals located in the River Ravi region of Lahore, Pakistan. Data on sex, age and breed of small ruminants were recorded. The samples were collected from clinically affected small ruminants with anaplasmosis and examined in Medicine Laboratory, University of Veterinary and Animal Sciences, Lahore. Thin blood smears were prepared and blood parasites were identified as described by various OIE publications (OIE, 2004, 2008).

Ten small ruminants out of 129 (n=83 sheep; n=46 goats), affected with anaplasmosis were selected for hematological examination. Blood sample (5 ml) was collected directly from the jugular vein of affected small ruminants into sterilized plastic bottles with anticoagulant coated with EDTA at 1 mg/ml of blood. Hemoglobin (Hb), white blood cell count (WBCs), red blood cell count (RBCs) and packed cell volume (PCV) were estimated using a hematological analyzer.

Of 129 small ruminants (n=83 sheep; n=46 goats) of mixed age, sex and breed that tested positive for *Anaplasma*, 24 were randomly selected and placed in three groups (A–C). Each group comprised of 8 animals (n=4 sheep; n=4 goats). Groups A, B and C were treated with oxytetracycline (Oxy-fen, Selmore, Pvt. Ltd., Pakistan) @ 20mg/kg BW, imidocarb dipropionate (Imizol, ICI, Pvt. Ltd., Pakistan) @ 3mg/kg BW and diminazene aceturate (Fatrybanil, Fatro, Pvt. Ltd., Pakistan) @ 3.5-7mg/kg BW, respectively. Efficacy of drugs was measured on the basis of disappearance of clinical signs and blood smear examination at days 2, 4, 6 and 10 of post-medication.

Data on prevalence of anaplasmosis in clinical affected cases was estimated by Pearson's chi-square (χ^2) test for significance where as data on hematology was analyzed by Student's *t*-test, while data on chemotherapy was analyzed by repeated measures analysis of variance (rANOVA), using SPSS (statistical package for social science), $P<0.05$ was considered significant.

Table I.- Overall prevalence of anaplasmosis in small ruminants.

Animal	Male		Female		Total No. examined	Total No. positive (%)
	No. examined	No. positive (%)	No. examined	No. positive (%)		
Sheep	77	36 (46.75)	73	47 (64.38)	150	83 (55.33)
Goats	68	25 (36.76)	82	21 (25.61)	150	46 (30.67)
Total	145	61 (42.07)	155	68 (43.87)	300	129 (43.0)

Chi-square analysis showed significant difference (χ^2=18.618, df=1, *P*-Value=0.000), Figures in parenthesis indicate percentage.

Results and discussion

Data on overall prevalence and breed wise prevalence of anaplasmosis in small ruminants is given in Tables I and II, whereas the data regarding hematology is shown in Table III. Of 300 (n=150 sheep; n=150 goats) small ruminants, 129 (43%) tested positive for *Anaplasma*. These observations coincide with the findings of Ameh *et al.* (2004) who reported prevalence of hemoparasite 52.3% in Jos and south east Bouchi while Opera and Wokedi (2011) also recorded 32% prevalence of *Anaplasma ovis* in the small ruminants. Jatau *et al.* (2011) also reported similar results of the prevalence of *A. ovis* in small ruminants. In this research work it was found that the prevalence of *A. ovis* is 55.33% in sheep. Alessandra and Santo (2012) studied the prevalence of *A. ovis* in small ruminants and found that *A. ovis* is 82.9% prevalent in sheep. *A. ovis* is predominant hemoparasite in sheep (Adejinmi *et al.,* 2004). Opara and Wokedi (2011) in Nigeria found that the prevalence of *A. ovis* is 29.3% in Sheep. Sparagano *et al.* (2004) observed seven groups of the sheep and found that the *A. ovis* is 29%. The low prevalence of anaplasmosis in sheep in the above two study might be because of the season, good prophylactic measures and low disease load. In present study prevalence of *A. ovis* was 30.67% in goats. These results correlate with the findings of Useh *et al.* (2006). He found that hemoparasites are 27% prevalent in goats of Nigeria, while Ahmadi-Hamedani *et al.* (2009) showed that 22.3% (43/193) goats were positive for *Anaplasma* by thin blood smear examination. In present study the prevalence of anaplasmosis in goat was more than findings of Ajanusi and Chiezey (2006) who reported *A. ovis* 9.2% in goats. The low prevalence might be due to season, less number of vectors, low disease load and good managemental practices. These results showed that *Anaplasma* is more prevalent in sheep than goats. These observations correlate with the readings of Jatau *et al.* (2011) who also reported more prevalent in sheep than goats. In case of sex wise prevalence it was recorded that prevalence was more in female sheep (64.38%) than male sheep (46.75%). These observation overlaps with the results of the Opera and Wokedi (2011) that *A. ovis* prevalence is more in female (81.3%) than male (18.8%) in small ruminants. In present study anaplasmosis was 36.76 and 25.61% prevalent in male and female goats, respectively. Ahmadi-Hamedani *et al.* (2009) reported 43.5 and 66.5% anaplasmosis in male and female goats, respectively. In this study the samples were collected from the animals whose owner was usually poor men, so the reason for high overall prevalence may be poor management and poor prophylactic measures to be adopted.

Table II.- Breed wise prevalence of anaplasmosis in small ruminants.

Animal	Breeds	No. of animals examined	No. of animals positive (%)
Sheep	Salt range	55	34 (61.82)
	Thali	42	22 (52.38)
	Kajli	29	14 (48.27)
	Mix breed	24	13 (54.17)
Goats	Teddy	82	27 (32.93)
	Beetal	47	11 (23.40)
	Mix breed	21	08 (38.09)

Non-Significant difference (P>0.05) was observed among various breeds of sheep and goats.

The result of hematological study in small ruminants is shown in Table III. Anaplasmosis have

Table III.- Average values of different blood parameters of *Anaplasma ovis* affected small ruminants (Mean ± S.E).

Hematological parameters	Sheep		Goat	
	Healthy	Affected	Healthy	Affected
Hemoglobin (g/dl)	11.84±1.54	07.44±1.43*	11.53±1.10	8.59±0.53*
WBC ($x10^9$/l)	9.56±1.41	10.84±0.66	8.27±1.40	10.18±1.08*
RBC ($x\ 10^{12}$/l)	12.30±1.26	11.03±0.95	12.30±1.26	11.92±1.35
PCV (%)	35.81±2.92	28.82±2.62*	32.21±2.09	29.9±2.07

*Significant difference (P>0.05)

significant effect on few parameters of the blood. Hemoglobin level of the infected small ruminants was decreased from the normal value. Ahmadi-Hamedani *et al.* (2013) also observed that hemoglobin level was decreased in infected small ruminants. A significant decrease of Hb was found in the animals suffering from anaplasmosis as compared to healthy animals (Adejinmi *et al.,* 2004; Alsaad *et al.,* 2009; Younis *et al.,* 2009). A decreased hemoglobin level was recorded in small ruminants which were experimentally infected with *A. ovis* (Yasini *et al.,* 2012). It was also observed that there was no significant increase in the numbers of the WBC. These results correlate with the findings of Yasini *et al.* (2012). Ahmadi-Hamedani *et al.* (2013) found that WBC numbers in the infected group were lower than in the uninfected group. Biobaku *et al.* (2010) observed that the number of the WBC increase during protozoan infection. In present study it was found that there is no significant decrease in RBC number and PCV. These observations correlate with the findings of the Ahmadi-Hamedani *et al.* (2013). The hematological study showed that the number of RBC and PCV value decreased in animals suffering with *A. ovis* infection (Alsaad *et al.,* 2009; Younis *et al.,* 2009; Yasini *et al.,* 2012). Biobaku *et al.* (2010) studied the prevalence and clinico-hematological parameters of small ruminants and concluded that RBC and PCV value decreased in *A. ovis* infected animals.

The result of treatment trials is given in Table IV. It was found that oxytetracycline drug was more effective against *Anaplasma* infection in small ruminants at dose rate of 20mg/kg body weight I/M as animals showed complete recovery after 10^{th} day of treatment. Imidocarb dipropionat at dose rate of 3mg/ kg BW I/M was found less effective as 75% of the animals recovered the 10^{th} day of treatment. Diaminazin aceturate was least effective at dose rate of 3.5-7mg body weight I/M as 50% of the animals recovered at 10^{th} of the treatment. These results show a relation with the findings of Coetzee *et al.* (2005). He found that the animals treated with oxytetracycline were recovered completely while the animals treated with imidocarb diapropionat were diagnosed positive after treatment. Oxytetracycline is the most effective drug against anaplasmosis than imidocarb dipropionate and enrofloxacine (Atif *et al.,* 2012). As compared to diaminazene aceturate, imidocarb dipropionate is less effective drug against the blood protozoan infection in animals (Akhtar *et al.,* 2010).

Table IV.- Comparative efficacy in terms of recovery of small ruminants suffering from anaplasmosis after 10 days of treatment with different drugs.

Drug name	Efficacy (%)		Overall efficacy n=8
	Sheep (n=4)	Goats (n=4)	
Oxytetracycline (20 mg/kg body wt./day)	4(100%)	4(100%)	8(100%)
Imidocarb dipropionate (3 mg/kg body wt./day)	4(100%)	3(75%)	7(87.5%)
Diaminazin aceturate (3.5 mg/kg body wt./day)	2(50%)	3(75%)	5(62.5%)

Conclusion

From this study it was concluded that anaplasmosis is significantly prevalent in small ruminants in and around Lahore, while oxytetracycline is the most effective drug against anaplasmosis in both sheep and goats. The outcome of this study will help the veterinarians and farmers in the field.

References

Adejinmi, J.O., Sadiq, N.A., Fashanu, S.O., Lasisi, O.T. and Ekundayo S., 2004. *Afr. J. Biol. Res.,* **7**: 41-43.

Ahmadi-Hamedani, M., Khaki, Z., Rahbari, S. and Ahmadi-Hamedani, M.A., 2013. *Comp. Clin. Pathol*., **22**: 545.

Ahmadi-Hamedani, M., Khaki, Z., Rahbari, S., Kazemi, B. and Bandehpour, M., 2009. *Iran. J. Vet. Res.,* Shiraz University, **10:** 367-372.

Ajanusi, O.J. and Chiezey, N.P., 2006. *Nigerian J. Parasitol.,* **26:** 13-17.

Akhter, N., Lal, C., Gadahi, A.J., Mirbahar, B.K. and Memon, I.M., 2010. *Vet. World,* **3:** 272-274.

Alessandra, T. and Santo, C., 2012. Tick born diseases in sheep and goats: clinical and diagnosis aspects. *Small Ruminant Res.,* **106S**: S6-S11.

Alsaad, M.K., Al-Obaidi, T.Q. and Esmaeel, A.S., 2009. *Iraqi J. Vet. Sci*., **23:** 101-106.

Ameh, L.G., James-Rugu, N.A.T. and Izang, S.D., 2004. *Nigerian J. Parasitol*., **25**: 21-24.

Atif, F.A., Khan, M.S., Khan, M.A., Ashraf, M. and Avais, M., 2012. *Pakistan J. Zool.,* **44:** 449-456.

Biobaku, K.T., Takeet, M.I., Olurode, S.A., Ono, O.O. and Oloye, A.A., 2010. *Nigerian J. Parasitol*., **31**: 1-6.

Cheesman, S.J., 2000. The Topoisomerases of protozoan parasites. *Parasitol. Today,* **16:** 277.

Coetzee, J.F., Apley, M.D., Kocan, K.M., Rurangirwa, F.R. and Van Donkersgoed, J., 2005. *Vet. Parasitol*., **127:** 61-73.

Fuente, D.L., Atkinson, M.W., Hogg, J.T., Miller, D.S., Naranjo, V., Almazan, C., Anderson, N. and Kocan, K.M., 2006. *J. Wildl Dis.,* **42**: 381–385.

Inokuma,. H., 2007. Vectors and reservoir hosts of Anaplasmataceae. In: *Rickettsial diseases* (eds. D. Raoult and P. Parola),. Taylor & Grancis Group LLC, New York, pp. 199–212.

Jatau, I.D., Abdulganiyu, A., Lawal, A., Okubanjo, O.O. and Yusuf, K.H., 2011. *Sokoto J. Vet. Sci.,* **9:** 7-11.

Khan, M.Q., Zahoor, A., Jahangir, M. and Mirza, M.A., 2004. *Pak. Vet. J.,* **24:** 193-195.

Magona, J.W., Walubengo, J., Olaho, W.M., Jonsson, N.N., Welburn, W.S. and Eisler, C.M., 2011. *Exp. appl. Acarol.,* **55**: 203-213.

Makala, L.H., Mangani, P., Fujisaki, K. and Nagasawa, H., 2003. *Vet. Res.,* **34**: 27–45.

Noaman, N., 2012. *Comp. Clin. Pathol.,* **21:** 367–369.

OIE, 2004. *Manual of diagnostic tests and vaccines for terrestrial animals*. Paris, France.

OIE, 2008. *Terrestrial Manual, Bovine anaplasmosis*. Paris, France.

Opara, M.N. and Nwokedi, C.C., 2011. *Bull. Anim. Hlth. Prod. Africa*, **59:** 393-398.

Rymaszewska, A. and Grenda, S., 2008. *Vet. Med*., **53:** 573–584.

Sparagano, O., Spitalskal, E., Namavari, M.M., Hosseini, H.M., Shad-Del F., Seghatoleslam, A. and Amabadi, R.O., 2004. *Epid. santé Anim.,* **45:** 73-75.

Useh, N.M., Ajanusi, O.J., Lawal, I.A., Adamu, S., Agbeder, R.I.S. and Esievo, K., 2006. *Nigerian J. Parasitol.,* **27**: 54-57.

Yasini, S.P., Khaki, Z., Rahbari, S., Kazemi, B., Amoli, S.J., Gharabaghi, A. and Jalali, S.M., 2012. *Iran. J. Parasitol*., **7:** 91-98.

Younis, E.E., Hegazy, N.A.M., El-Deeb, W. and El-Khatib, 2009. *Bull. Anim. Hlth. Prod. Africa,* **57**: 297-309.

(Received 25 February 2014, revised 15 April 2014)

Pakistan J. Zool., vol. 46(3), pp. 880-884, 2014.

Biometric Assessment of the Testis in Pakistani Adult Male Goats (*Capra hircus*)

Hamayun Khan,[1] Muhammad Misri Rind[2], Muhammad Usman Mehmood[3], Qaisar Shahzad, Ali Gohar, [4] Mehboob Alam,[4] Qaisar Ali[4] and Hamza Khan Kumbar[5]

[1]Department of Animal Health, The University of Agriculture, Peshawar
[2]Departement of Anatomy and Histology, Sindh Agriculture University, TandoJam
[3]Department of Theriogenology, Faculty of Veterinary Sciences, University of Veterinary and Animal Sciences, Lahore
[4]Reproduction Division, Buffalo Research Institute, Pattoki, District Kasur
[5]Department of Livestock and Dairy Development (Ext), Peshawar, Khyber Pakhtoonkhawa
[6]Department of Animal Reproduction, Sindh Agriculture University, TandoJam

Abstract.- The biometric analysis of the testes of adult male of the local breeds of goat is reported. The mean length, breadth, thickness and circumference of right testicle with epididymis recorded was 8.42±0.91 cm, 4.58±0.56 cm, 4.19±0.53 cm and 12.53±1.23 cm and those of left testicle with epididymis were 8.44±1.06 cm, 4.62±0.57 cm, 4.24±0.51 cm and 12.66±1.32 cm, respectively. The measurement of circumference of left testicle with epididymis were significantly ($P < 0.05$)

* Corresponding author: hamayunkhan@aup.edu.pk

higher than those of right testicle with the epididymis. The mean length, breadth, and circumference of right testicle without epididymis were 6.62±0.83 cm, 4.38±0.55 cm, and 12.36±1.16 cm, whereas those of the left testicle without epididymis were 6.65±0.84cm, 4.41±0.56 cm and 12.47±1.18 cm, respectively. The mean weight of right and left testicle without epididymis was 59.36±16.86 g and 60.35±17.16 g, respectively. The breadth, circumference and weight of left testicle without epididymis were significantly ($P<0.05$) higher than those of right testicle without epididymis.

Key words: Biometry, *Capra hircus*, testicle measurements.

Pakistan is the main goat producing countries in the world. Indigenous goats are primarily valued for meat, milk, skin, fiber, and other associated products. The by-products are blood, dung (a good fertilizer), bones and horns. The male goat is capable of propagating at one year age and the female at seven months; but the fruits of a generation so premature are generally weak and defective; their best time is at the age of two years or eighteen months at least. The goat is a short lived animal, full of ardour, but soon enervated. His appetite for the female is excessive, so that one buck is sufficient for one hundred and fifty female (Mackenzie, 1980).

The testis, epididymis and accessory organs are principal organs of mammalian male reproductive system. Functionally the testis is both exocrine and endocrine in nature producing the spermatozoa and the male sex hormone-testosterone. Available literature indicated that the testes vary somewhat from species to species as far as shape, size and location are concerned but the essential structure is the same (Frandson, 1981).

The biometric assessment of the male genital tract is vital to determine the actual cause of reproductive failures of the animals leading to greater economic losses. Such information could help to design programs for the treatment of animals having various reproductive disorders and suggest the preventive remedies if possible to enhance reproductive ability of the male animals. Chronic infection of Johne's Disease appears to interfere with the normal development of reproductive organs and functions of related endocrine glands (Singh *et al.,* 1986).

Extensive researches has been concentrated towards the enhancements of productivity and understanding of the domesticated animals of Europe and America (Bokonyi, 1983;Wing, 1983) whereas little or no attention has been given to the intellect of the animal's functional morphology of the indigenous stock. Currently many research workers investigated biometry of testis of male goats under different environmental condition (Kabiraj *et al.,* 2011; Ibrahim *et al*., 2012; Oyeymi *et al*., 2012) in different region of world. Available literature regarding the biometry of testis in indigenous livestock is very limited. Khan *et al*. (2003) investigated the testicular size and dimension in male buffalo, Nisar *et al*. (1992) carried out research on the biometry of testis in bull, Siddiqui *et al.* (2005) evaluated the biometry of the ram testis. Currently there is dearth of reliable information on the reproductive parameters of testis of goats owned by farmers in different area of Pakistan. Recent review of literature indicated that the size of the testis and functional testicular charteristics are indicators of sexual activity and semen production from the daily sperm production potential of the animals (Hassan *et al.*, 2009; Leal *et al.*, 2004). Therefore the aim of this study was to describe in detail the biometric characteristic values of the testis of the local breed of the goat.

Materials and methods

One hundred reproductive organs of male goats of various ages slaughtered at different slaughter houses of Hyderabad district were collected for this study. The genital tract having no gross abnormalities or pathological lesions was removed from the carcasses, packed in polyethylene bags and brought to the Departmental laboratory within 2 hours of collection. The organs were cleaned and freed from adhering tissues and were placed on the surgical table in their normal position. The measurements of the length, breadth and thickness of the right and left testicles with and without epididymis were taken with the help of vernier-caliper. The circumference of testicles with

and without epididymis were measured with measuring tape or with the help of modified thick thread graduated with a measuring tape and the readings were noted against a centimeter scale.

The weight of right and left testicles was estimated with a triple beam balance and the readings were recorded in grams. According to the technique used by Khan *et al.* (2003) and Oyeyemi *et al.* (2012) following methodology was adopted;

Testicle with epididymis: The length was measured from the caputal extremity to the caudal extremity, *breadth* from the free border to the epididymal border, thickness from the medial surface to the lateral surface; circumference was measured by encircling the thickest portion of the testicle along with the body of the epididymis by a graduated nylon tape.

Testicle without epididymis: The length was measured from the dorsal extremity to the ventral extremity (pole to pole); *breadth* from the free border to the attached border excluding epididymis, circumference was measured by encircling the thickest part of the testicle excluding epididymis by a graduated nylon tape.

The data collected regarding the biometry of the testis of male goat was subjected to statistical analysis as per method (Bhattacharyya and Richard, 1977). The following measures were computed for analyzing the data such as: mean standard deviation and range. Student's paired t-test was utilized to determine differences between means.

Results and discussion

Testicles with the epididymis

The biometric data on the testicles with epididymis are presented in Table I. The mean± S.D. Range of length, breadth, thickness and circumference of right testicle with epididymis were 8.42±0.91 cm (5.9-11.4 cm), 4.58±0.56 cm (3.5-6.4 cm), 4.19±0.53 cm (2.9-5.9 cm) and 12.53±1.23 cm (8.2-15.2 cm) respectively, and the left testicle with epididymis was 8.44±1.06 cm (4.5-11.6 cm) in length, 4.62±0.57 cm (3.5-6.5 cm) in breadth, 4.24±0.51 cm (2.9-5.8 cm) in thickness and 12.66±1.32 cm (6.75-15.5 cm) in circumference. The mean breadth, thickness and circumference of left testicle with epididymis were significantly ($P<0.05$) higher than those of the right testicle with epididymis. On the other hand, no significance difference was observed for the length of the right and left testicles with the epididymis.

Testicles without epididymis

The biometric data on testicle without epididymis are presented in Table I. From these data it appeared that the mean±S.D. (range) of length, breadth and circumference of right testicle without epididymis were 6.62±0.83 cm (4.35-8.9 cm), 4.38±0.55 cm (3.2-6.1 cm) and 12.36±1.16 cm (9.3-15.1 cm) respectively, and the left testicle without epididymis was measured as 6.65±0.84 cm (4.8-8.7 cm) in length, 4.41±0.56 cm (3.1-6.15 cm) in breadth and 12.47±1.18 cm (9.2-15.2 cm) in circumference. The Mean±S.D. (Range) of weight of right testicle without epididymis was 59.36±16.86 g (24.8-118.3 g) and that of left testicle without epididymis was 60.35±17.16 g (23.9-120 g). The mean breadth, circumference and weight of left testicle without epididymis in the present study were significantly ($P<0.05$) higher than the right testicle without epididymis whereas no significant difference between the lengths of right and left testicle without epididymis was observed.

The testicular dimension is the important indicator of the present and future sperm production in animal. Also the basic biometric assessment of reproductive organs is vital in breeding soundness evaluation and potential fertility in breeding males (Togun and Egbunike, 2006). Additionally, morphometric evaluation of the testes is essential in estimating Spermatogenic function of any species or breed. Correspondingly, the mammalian testis has been demonstrated as reliable interpreters of spermatozoa production (Gage and Freckleton, 2003). In scientific literature the varying figures for length, breadth, circumference and weight of right and left testicle without epididymis have been reported by various workers in male goat and other domestic species. The findings regarding length and breadth of the right and left testicle without epididymis of male goat obtained in the current study were in close agreement with those reported for bucks by Mahmood *et al.* (1988) and Yaseen *et al.* (2010). According to them, the right testicle without epididymis of adult buck averaged 6.59±0.10 cm in length and 4.10±0.08 cm in breadth

Table I.- Biometric values of the right and left testicles of male goat and other animals.

Variable	Side	Adult male[a]	Steer[b] (1-3 year)	Marwari goat[c]	Pashmina buck[d]
Length of testis with epididymis (cm)	Left	8.435±1.06		10.59±0.26	
	Right	8.422±0.911		10.16±0.24	
Length of testis without epididymis (cm)	Left	6.652±0.840	7.59±0.13		6.70±0.11
	Right	6.618±0.832	7.52±0.13		6.59±0.10
Breadth of testis with epididymis (cm)	Left	4.619±0.571*		5.72±0.17	
	Right	4.583±0.565		5.30±0.17	
Breadth of testis without epididymis (cm)	Left	4.407±0.557*	3.71±0.08		4.17±0.09
	Right	4.384±0.832	3.76±0.08		4.10±0.08
Thickness of testis with epididymis (cm)	Left	4.237±0.509**			
	Right	4.190±0.528			
Circumference of testis with epididymis (cm)	Left	12.657±1.330**			
	Right	12.531±1.233			
Circumference of testis without epididymis (cm)	Left	12.476±1.186**	11.46±0.20		
	Right	12.361±1.166	11.52±0.21		
Weight (g) of testis without epididymis	Left	60.346±17.246**	61.56±2.89	97.94±1.59	
	Right	59.360±16.942	60.86±2.16	96.94±1.61	

*and ** represent the significant level at 0.05% and 0.01% respectively
a, Present study; b, Nisar *et al.,* 1992; c, Yaseen *et al.,* 2010; d, Mahmood *et al.,* 1988.

and the left testicle without epididymis averaged 6.70±0.11 cm in length and 4.17±0.09 cm in breadth. Likewise in Marwari goat, Yaseen *et al.* (2010) reported average length, width and weight of left testes were 10.59±0.26 cm, 5.72±0.17 cm and 97.94±1.59 g, whereas the same parameters for right testes were 10.16±0.24 cm, 5.30±0.17 cm and 96.94±1.61g, respectively. On the other hand, Roberts (1971) and Nickel *et al.* (1973) reported much higher length, breadth and weight of the testicles of ram and buck than present findings. The higher values might be due to change of specie of the ram and different breeds of bucks having different genetic make reared under better management and nutritional conditions.

The present observations were in close vicinity with those reported for steers aged 1-3 years by Nisar *et al.* (1992). They reported the average length, of right testicle without epididymis as 7.52±0.13 cm, breadth 3.76±0.08 cm, circumference 11.52±0.21 cm and weighed 60.86±2.16 g and the left testicle without epididymis averaged 7.59±0.13 cm in length, 3.71±0.08 cm in breadth 11.46±0.20 cm in circumference and weighed 61.56=2.89 g. The findings of the present study in male goat were also in partial agreement with those reported for Indian buffalo males by Joshi *et al.* (1967). According to them, the right testicle without epididymis of Indian buffalo male averaged 7.60 cm (6.00-8.90 cm) in length, 4.30 cm (3.30-5.30 cm) in breadth, 12.20 cm (9.50-15.00 cm) in circumference, and 74.86 g (38.20-116.45 g) in weight, and the left testicle without epididymis averaged 7.87 cm (5.70-9.80 cm) in length, 4.33 cm (3.30-5.50 cm) in breadth, 12.29 cm (9.00-15.90 cm) in circumference and 79.06 g (36.00-120.40 g) in weight. In the present study it was found that the weight of the left testicle without epididymis was significantly higher than the right one. The results of this study that the left testicular weight was more than the right one in adult buck, confirmed the findings of Siddiqui *et al*. (2005) and Ott *et al.* (1982) in the Ram.

It is well established that testicular size is considered as measure of the reproductive growth status, spermatogenesis yield and the semen producing ability of the animal (Daudu, 1984; Hassan *et al.*, 2009; Leal *et al.*, 2004). In addition, it has been demonstrated that heavier testes produce more spermatozoa than the smaller ones (Brito *et al*., 2004). It seems reasonable from these reports including our current finding that the significant ($p<0.05$) higher testes size and weight of adult male goat could contain more seminiferous tubule where

sperm production occur and Interstitial endocrine cells where testosterone is produced. In order to establish the functional significance of the seminiferous tubules and the interstitial endocrine cells with spermatozoa production, further study would be needed to elucidate the correlation of these biometric measurements with histological assessment of testis of local goat population.

In conclusion, this study demonstrated the distinctive biometric assessment of both caprine testicles. The breadth, thickness and circumference of left testicle with epididymis and breadth, circumference and weight of left testicle without epididymis were significantly higher than those of right testicle with and without epididymis respectively.

Acknowledgements

Authors are grateful to staffs and butchers at slaughterhouse Hyderabad, who extended the cooperation in collection of the specimen.

Conflict of interest

All authors have no conflict of interest with any one about this manuscript.

References

Bhattacharyya, G.K. and Richard, J.A., 1977. *Statistical concepts and methods*. 1st edition. John Wiley and sons. Inc. U.S.A.

Bokonyi, S., 1983. Domestication, dispersal and use of animals in Europe. In: *Domestication, conservation and use of animal resources* (eds. L. Peel and D.E. Tribe). Elsevier, Amsterdam, pp. 1-20.

Brito, L.F., Silva, A.E., Unanian, M.M., Dode, M.A., Barbosa, R.T. and Kastelic, J.P., 2004. *Theriogenology*, **62**: 1198-1217.

Daudu, C.S., 1984. *Theriogenology*, **21**: 317-324.

Frandson, R.D., 1981. Anatomy of the male reproductive system. In: *Anatomy and physiology of farm animals*. Lea and Febiger, Great Britain, pp. 430-444.

Gage, M. J. and Freckleton, R.P., 2003. *Proc. biol. Sci.,* **270**: 625-32.

Hassan, M. R., Pervage, S., Ershaduzzaman, M. and Talukder, M. A. I., 2009. *J. Bangladesh Agric. Univ.,* **7**:301-304.

Ibrahim, A. A., Aliyu, J., Ashiru, M. and Jamilu, M., 2012. *Int. J. Morphol.,* **30**:1597-1603.

Joshi, N.H., Luktuke, S.N. and Chatterjee, S.N., 1967. *Ind. Vet. J*., **44**: 137-145.

Kabiraj, S. K., Masusul Hoque, S. A., Yahia Khandoker, M.A.M. and Husain, S. S., 2011. *J. Cell Anim. Biol.,* **5**: 27-32.

Khan, H., Ahmed, N., Khan, S., Ahmed, R. and Rind, M.M., 2003. *J. Anim. Vet. Adv*., **2**: 639-643.

Leal, M.C., Becker-Silva, S.C., Chiarini-Garcia, H. and Franca, L.R., 2004. *Anim. Reprod.,* **1:**122-128

Mackenzie, D., 1980. *Goat husbandry*. 4th Ed. Faber and Faber, London, pp. 24.

Mahmood, S., Biswas, J.C. and Koul, C.L., 1988. *Ind. Vet. J*., **65**: 952-954.

Nickel, R., Schumer, A. and Seiferl, E.E., 1973. *The viscera of the domestic mammals*. Parey, Berlin, pp.75.

Nisar, I., Khan, M.Z., Ahmed, A., Khan, A. and khan, H.A., 1992. *Pak. Vet. J*., **12**: 167-169.

Ott, R.S., Health, E.H. and Bane, A., 1982. *Am. J. Vet. Res*., **43**: 241–245.

Oyeyemi, M.O., Fayomi, A.P., Adeniji, D.A. and Ojo, K. M., 2012. *Int. J. Morphol.,* **30**:489-492

Roberts, S.J., 1971. *Veterinary obstetrics and general diseases*. 2nd edition. CBS Publishers and Distributors (India), pp. 604-607.

Siddiqui, H.U.R., Ahmad, A. and Khan, M.Z., 2005. *J. Agric. Soc. Sci.,* **1**: 1813–2235.

Singh, N., Singh, S.V. and Vihan, V.S., 1986. *Reproductive inefficiency in Johne's disease affected goats*. Annual Report. Central Institute for Research on Goats. Makhdoom, P.O. Farah-281122, Mathura (U.P.) India, pp.70.

Togun, V.A. and Egbunike, G. N., 2006. *Middle-East J. Sci. Res.,* **1**: 87-95

Wing, E.S., 1983. Domestication and use of animal in the America. In: *Domestication conservation and use of animal resources* (eds. L. Peel and D.E. Tribe) Amsterdam: Elsevier, pp. 21-39.

Yaseen, S.M., Joshi, S., Mathur, R. and Gajbe, U.R., 2010. *Haryana Vet.,* **49:** 72.

(Received 27 February 2014, revised 18 March 2014)

Pakistan J. Zool., vol. 46(3), pp. 885-887, 2014.

The Study of Anemia in Relation to the Socio-Demographic Factors in Pregnant Females of Quetta, Balochistan

Ambreen Ijaz,[1] Mohammad Masood Tariq,[2]* GulMakai,[1] Najamunnisa,[1] Rukhsana,[1] Aqalmina,[1] Shahid Ameen,[3] Majid Rafeeq,[2] Saadullah Jan[2] and Zafar Ahmad[2]

[1]Sardar Bahadur Khan Womens University, Quetta

[2]*Centre of Advanced Studies in Vaccinology and Biotechnology, University of Balochistan, Brewery Road, Quetta*

[3]*Livestock and Dairy Development Department, Balochistan*

Abstract.- The present study was conducted in the general out-patient Department of Mission Hospital Quetta. A total of 90 pregnant women were included in the study. The data regarding ethnic group, age, trimester, education, monthly income, type of tea taking and their hemoglobin (Hb) and weight were collected through a questionnaire. Out of the 90 women, 54 were anemic, 52 (96%) had mild and 2 (4%) had moderate anemia. Females of the age less than 20 and weight more than 25 kg showed higher prevalence of anemia. There was less prevalence of anemia in educated pregnant females. The prevalence of anemia is more in the first and third trimester. The study recommends that emphasis should be laid on education of females, early marriages be discouraged and the importance of balanced diet should be emphasized.

Key words: Anemia, pregnancy, hemoglobin content.

Anemia during pregnancy according to the WHO is defined as having hemoglobin (Hb) level less than 11.0g/dL (WHO, 2001) but extreme anemia is the one in which Hb level is less than 7.0g/dL (Hinderaker *et al.,* 2001). Anemia is common in developing countries. Out of 700-800 million people that are effected by anemia, 60-70 million are from the developed countries (Sabah *et al.,* 2010).

* Corresponding address: tariqkianiraja@hotmail.com

Pregnant women are more susceptible to have anemia with an estimation of above 65% in South Asia. According to WHO report (2001), about 35-75% of pregnant women are anemic in developing countries and 18% in industrialized countries. Iron deficiency anemia is an important health issue in Pakistan; about 22,000 maternal deaths during the last 10 years due to iron deficiency (Sabah *et al.,* 2010). In pregnant women, iron deficiency during early days leads to limited supply of oxygen to cells, tiredness, poor work performance, decreased immunity, risk of premature delivery and low birth weight (Kvale, 2001; Raza *et al.,* 2011).

General population from developing countries does not have resources to cope up with their iron requirements using animal protein as well as different kinds of fruits and vegetables that are rich in vitamins and iron. In a survey in Isparta province of Turkey the population was anemic since their food was restricted to legumes (beans and peas) and cereals (corn, oat, grains) (Kisioglu *et al*., 2005). In Malaysia 35% of the population was anemic and higher prevalence was seen in young girls (Haniff *et al.,* 2007). One fifth of Pakistani women suffer from anemia. One study, however, showed that there was a gradual increase in anemia in pregnant and lactating women (Saeed *et al.,* 2008). In the global scenario the prevalence of anemia is found to be highest in India which includes pregnant women and preschool children. Among population which is highly educated and are highly paid, 50% of the pregnant women, children and young girls are anemic (Kalaivani, 2009). Lack of essential nutrients like iron, folate and vitaminB_{12} are also one of causes of anemia, which is responsible for symptoms like fatigue, weakness, cognitive deficits and serious heart complications (Bhatti and Shaikh, 2009).

In pregnancy the iron requirement are very high which is very difficult to be met only through diet so the maternal iron stores are the only source to keep the iron stability (VanderJagt *et al.,* 2007). There is a greater need of iron in pregnant adult females (27mg/day) as compared to non pregnant females (18mg/day) (Raza *et al.*, 2011). However social norms also hinder and people who can easily get iron rich food not allow pregnant women to take them, which again makes them deficient in getting

important nutrients. In later pregnancy the quantity of iron which is absorbed from an average normal diet is less than the quantity which should be provided to her in this condition. If she has to fulfill her iron needs then a healthy female should have iron storage greater than 300mg to have pregnancy. In developing countries this amount of iron has to be possessed by most of the women for a healthy pregnancy (Kalaivani, 2009). The present study was conducted in Christian Missionary Hospital Quetta, to determine prevalence of anemia in pregnant females and to find out relationship of socio-demographic factors with anemia among pregnant women.

Materials and methods

The present study is a cross sectional community based study conducted from September, 2012 to March, 2013 in Christian Missionary Hospital Quetta (CMHQ) where patients of different districts also come to Quetta for treatment. The population of Quetta city consists of Pathans, Baloch, Punjabi and other (Hazara, Uzbak) communities. All the pregnant women attending the Hospital were included in the study and 90 pregnant women were personally interviewed. The information recorded in a designed proforma was bout age, weight, duration of marriage, number of children already had, interval between the pregnancies, worm infestation, gestational age, trimester, socioeconomic status, dietary habits, intake of iron preparation, use of egg, meat, poultry, intake of tea, Hb level, performance of daily routine work, blood pressure and other diseases if any. Haemoglobin (Hb) level less than 11g/dl was considered to be anemia in pregnancy. The degrees of anemia studied were: mild anemia (9.0-10.9 g/dL), moderate anemia (7.0-9.0 g/dL) and severe anemia (<7g/dL). The collected data were tabulated in the statistical format using SPSS version 9.5 (SPSS cary, NC, USA) statistical analysis program. *Chi* square test was used for data analysis of demographic characters in relation to anemia.

Results and discussion

Out of 90 females studied 54 were anemic. The overall prevalence of anemia observed the pregnant females in the age group 14-40 was 60%. The prevalence of mild (10.2±0.6 g/dl), moderate (Hb 8.1±0.5 g/dl), and severe anemia (<7 g/dl) was 96%, 4% and 0%, respectively. Most of the anemic females had mild anemia with mean Hb level of 10.2.

The maximum number of pregnant women was in the age group 20-30 (55%). The analysis of data suggested that there was a significant association between prevalence of anemia and age group ($P<0.05$). Out of 8 females in the age group less than 20 years, 6 (11%) were anemic, while 2 (6%) were normal. Out of total of 55 (61%) females in the age group 20-30, 35 (64%) were anemic, and 20 (56%) were normal. From amongst 25 (27%) pregnant women in the age group 30-40 years, 12 (22%) were anemic, while 13 (36%) were normal, whereas there was only 1 anemic female (2%) from the age group >40.

The association of anemia with socio-demographic aspects is shown in Table I. Analysis of data shows that there is no significant association ($P>0.05$) between education, ethnicity, trimester, tea intake and weight categories. However, significant association ($P<0.05$) was observed in weight category. Majority of pregnant women weighed 46-65 kg; 22 (61%) amongst them were anemic, while 26 (48%) were normal. Fourteen females weighed in range of the 25-45kg and all were anemic. Anemia is also more prevalent in females during first trimester and 3rd trimester of pregnancy. The educated females showed less percentage of anemia as compared to illiterate and having low level of education. There is also high prevalence of anemia in females taking tea either milk tea or green tea.

This study did not show any statistically significant association between anemia and tea intake although tea intake is known to inhibit absorption of non-heame iron. The prevalence of anemia was found higher in pregnant females taking milk tea compared to black or green tea. While there were high proportion of normal females who did not take any kind of tea during pregnancy. This observation is similar to the data presented by Nelson *et al.* (2004) that the healthy people having no possibility of iron deficiency have no limitation on tea intake, while those having danger of iron deficiency should limit to taking tea between meals and or one hour after meal.

Table I.- Relationship of anemia with different age, blood pressure, weight, ethnicity, eating habits and socio-economic factors.

Demographic characters	n	Anemia[a] (%)	Normal[b] (%)	P value
Ethnic group				
Pathan	34	21(39%)	3(36%)	>0. 05
Baloch	20	11(20%)	9(25%)	
Punjabi	30	18(33%)	12(33%)	
Others[c]	6	4(7%)	2(6%)	
Education				
Illiterate	33	19(35%)	14(39%)	>0. 05
High school	23	14(26%)	9(25%)	
Intermediate	16	9(17%)	7(19%)	
Graduate	9	6(11%)	3(8%)	
Postgraduate	9	6(11%)	3(8%)	
Trimester of pregnancy				
1st	8	7(13%)	1(3%)	>0. 05
2nd	26	13(24%)	I3(36%)	
3rd	56	34(63%)	22(61%)	
Type of tea intake				
Milk tea	42	25(46%)	17(47%)	>0.05
Black tea	26	15(28%)	11(30%)	
Green tea	9	6(11%)	3(8%)	
No tea intake	13	8(15%)	5(13%)	
Age group (year)				
< 20		6(11%)	2(6%)	<0.05
21-30		35(64%)	20(56%)	
31-40		12(22%)	13(36%)	
>41		1(2%)	0(0%)	
Weight (Kg)				
25-45	14	0(%)	14(26%)	<0.05
46-65	48	22(61%)	26(48%)	
66-85	28	14(38%)	14(26%)	

[a]Anemia :moderate anemia level is 7-.9 g/dL, severe anemia level is <7g/dL.
[b]Normal: Hb level is 11-14 g/dL.
[c]Others: (Hazara, Uzbak, Tajic)

The relationship between anemia and trimester was observed significant and the prevalence of anemia is more in first and third trimester.

Low socioeconomic status, lack of education and less awareness of important factors relating to anemia are risk factors for anemia in Pakistan. Another threat contributing for iron deficiency during pregnancy is multiparity which might lead to insufficiency of iron stores in females (Sharma *et al.,* 2008; Hinderaker *et al.,* 2011).

The anemia was more prevalent in the females with age less than 20 and more prevalent in higher age more than 40 years that is coherent with study of Haniff *et al.* (2007) conducted from February to March to assess the prevalence of anemia. The overall prevalence of anemia was 35% and the majority was of mild type the prevalence was higher in teenage group, Indians followed by Malays and Chinese females.

References

Haniff, J., Das, A., Onn, T.L., Sun, C.W., Nordin, N.M., ampal, S, Bahrin, S. and Ganeslingam, M., 2007. *Asia Pacif. J. clin. Nutr.,* **16**: 527-536.

Hinderaker, S.G., Olsen, B.E., Bergsjo, P., Lie, R.T., Gasheka, P. and Jabeen, N., Mahmood, M. and Farooq, R., 1211. *J. Islamabad med. Dental Coll*., **37**: 9655

Kalaivani, K., 2009. *Indian J. med. Res*., **130**: 627-633.

Kisioglu, A.N., Ozturk, M., Cakmak, Z.A. and Ozguner, F., 2005. *Biomed. Res.,* **16**: 11-14.

Kvale, G., 2001. *Acta Obstet. Gynecol. Scand.,* **80**: 18-26.

Nelson, M. and Poulter, J., 2004. *J. Hum. Nutr. Dietet*., **17**: 43-54.

Raza, N., Sarwar, I., Munazza, B., Ayub, M. and Suleman, M., 2011. *J. Ayub Med. Coll. Abbottabad.* **23**: 36-40.

Bhatti, R. and Shaikh, D.M., 2009. *Pakistan J. Zool., **41***:158-160.

Sabah, S., Fatima, I. and Ramzan, M., 2010. *Profess. Med. J.,* **17**: 686-690.

Saeed, M. S. and Khalid, M.S., 2008. *Pakistan Armed Forces med. J.*, **56**: 150-56.

Sharma, J.B., Soni, D., Murthy, N.S. and Malhotra, M., 2008. *J. Obst. Gyn. Res.,* **29**: 73-78. DOI:10.1046/j.1341-8076.2003.00079.

Vanderjagt, D.J., Brock, H.S., Melah, G S., Elnafaty, A.U., Crossy, M.J. and Robert, H.G., 2007. *J. H. Popul. Nutr.*, **25**: 75-81.

WHO/UNICEF/UNU, 2001. *Iron deficiency anemia, assessment, prevention and control: a guide for program managers*.

(Received 27 February 2014, revised 24 April 2014)