

Full Length Research Paper

Two avian cestodes parasitic to *Corvus* species of Kashmir, India

Javid Ahmad Dar* and Syed Tanveer

Department of Zoology, University of Kashmir, Srinagar-190 006, India.

Accepted 18 March, 2013

Three species of birds belonging to the genus *Corvus* (*Corvus monedula*, *Corvus splendens* and *Corvus macrorhynchos*) were collected from nine different localities of Kashmir valley and investigated for the presence of helminthes. *Dilepis undula* (Schrank, 1788) was recovered from all the three host species. While, *Mayhewia kavini* Chishti and Khan, 1982 was recovered only from *C. monedula* and no specimen of this cestode was obtained from *C. splendens* and *C. macrorhynchos* during the present study. The specimens were identified and redescribed on the basis of various morphological and morphometric characters when compared to the known species of genera as *Dilepis* and *Mayhewia*, respectively. However, some intraspecific variations were observed when the present measurements were compared with those of previous authors. The prevalence, mean intensity and abundance of the parasites were determined.

Key words: Cestode, crows, *Corvus*, *Dilepis*, *Mayhewia*, prevalence, Kashmir.

INTRODUCTION

The present study was a part of helminthological investigation carried out on three *Corvus* species (*Corvus monedula*, *Corvus splendens* and *Corvus macrorhynchos*) of Kashmir from November, 2007 to May, 2009. *C. monedula* Linnaeus, 1758 (Jackdaw) is a black-plumaged passerine bird with distinctive white irises; sexes and ages are alike (Goodwin, 1983). It is omnivorous and feeds on plant material and invertebrates (Lockie, 1956). *C. splendens* Vieillot, 1817 (House crow) is about 40 cm in length with lighter grey-brown neck and breast. The wings, tail and legs are black. It appears to be associated with humans and no populations are known to exist independently of humans (Nyari et al., 2006). *C. macrorhynchos* Wagler, 1827 (Jungle crow) is a Large-billed crow with black glossy wings, tail, face and cause diseases include viruses, bacteria, protozoans and throat. The groups of parasites which infect birds and helminthes besides some arthropod ectoparasites. Sexually mature tapeworms live in the intestine or the

diverticula of all classes of vertebrates (Roberts and Janovy, 2005). These parasites are found more frequently in warmer seasons, when intermediate hosts are abundant. Birds become infected by eating an intermediate host (infested with larval stage of a cestode), which may be an insect, crustacean, earthworm, slug, snail or leech depending upon the species of tapeworm (Calnek, 1997). Over 4,000 species of cestodes have been described from animals (Schmidt, 1986). Recently many workers have contributed to the knowledge of avian cestodes such as evaluation of genetic basis of host specificity of cestodes (Benesh, 2010; Henrich et al., 2013), description of ultrastructural characters of the spermiogenesis and mature spermatozoon of *Notopentorchis* sp. by means of transmission electron microscopy (Yoneva et al., 2012), description of some new cestode species like *Spiniglans sharpiloi* from *Pica pica* (Kornyushin et al. 2009), *Cotugnia orientalis* from *Gallus gallus domesticus* (Nanware et al., 2011).

*Corresponding author. E-mail: javid60@gmail.com. Tel: +918803314150.

Table 1. Prevalence, mean intensity and abundance of *Dilepis undula* in *Corvus* species of Kashmir.

Host spp.	NE	NI	NP	P%	MI	AB
<i>C. monedula</i>	30	6	18	20	3	0.6
<i>C. splendens</i>	23	3	11	13.0 4	3.6 6	0.47
<i>C. macrorhynchos</i>	12	3	11	25	3.6 6	0.92
Total	65	12	40	18.4 6	3.3 3	0.61

NE = number examined; NI = number infected; NP = number of parasites; P = prevalence; MI = mean intensity; Ab = Abundance.

Table 2. Prevalence, mean intensity and abundance of *Mayhewia kavini* in *Corvus* species of Kashmir.

Host spp.	NE	NI	NP	P%	MI	AB
<i>C. monedula</i>	30	4	10	13.3	2.5	0.33
<i>C. splendens</i>	23	0	0	0	0	0
<i>C. macrorhynchos</i>	12	0	0	0	0	0
Total	65	4	10	6.15	2.5	0.15

NE = number examined; NI = number infected; NP = number of parasites; P = prevalence; MI = mean intensity; Ab = abundance.

However, systematic knowledge of cestodes from birds of Kashmir including *Corvus*, is still represented through a few references as is obvious by tracing the historical review of cestodes from aves of Kashmir (Gupta, 1967; Fotedar et al., 1970; Chishti, 1973, 1980a, b, c; 1981; Fotedar and Chishti, 1973, 1974, 1976a, b; 1977; Chishti and Khan, 1978; 1979; 1982; Chishti et al., 1986). *Choanotaenia infundibulum*, *Choanotaenia micracantha*, *Anomotaenia galbulae* and *Mayhewia kavini* are the only cestodes reported from *Corvus* species in Kashmir so far (Fotedar and Chishti, 1974; 1976; Chishti and Khan, 1982; Chishti et al., 1986). Thus a thorough investigation of helminth parasitism of *Corvus* species of Kashmir was imperative. The present paper gives redescription of two cestodes (*Dilepis undula* and *M. kavini*) collected from the intestines of three species of crows (*C. monedula*, *C. splendens* and *C. macrorhynchos*) caught from different localities in Kashmir.

MATERIALS AND METHODS

Study area

Kashmir valley is a temperate, North-west Himalayan region of Jammu and Kashmir states in India. It lies between 33° 20' and 34° 54' N latitudes and 73° 55' and 75° 35' E longitudes, covering an area of about 15,948 km². It is a deep bowl shaped valley bounded by lofty mountains of the Pir Panjal and the great Himalayan ranges. The floristic and faunal diversity of the valley is considerably rich owing to its unique topography, temperate climate and geographical isolation from the surrounding plains (Dar et al.,

2002). The birds were collected from different localities of Kashmir valley like Barzulla, Bugam, Chadoora, Khansahib, Naseembagh, Rajbagh, Rambagh, Wathora, and Yousmarg. These collection sites lie within the radius of five to fifty Kilometers (km) from the center of Srinagar city, the summer capital of Jammu and Kashmir States in India and are easily accessible by road transport.

Collection and processing of cestodes

During the present study, 65 birds belonging to three species of *Corvus* (*C. monedula* Linnaeus, 1758; *C. splendens* Vieillot, 1817 and *C. macrorhynchos* Wagler, 1827) were caught alive with the help of nylon net traps, locally known as "Walwash" using suitable baits. The hosts were slaughtered and dissected for parasitological investigation, and the cestode parasites thus collected were fixed in Carnoy's fixative, stained in acetoalum carmine and transferred to xylene for clearing before mounting them in dextrine plasticised xylene (DPX) (Meyer and Olsen, 1975). The drawings of the specimens were made with the help of prism type camera Lucida. Measurements were taken with objective and stage micrometers and expressed in mm (unless otherwise stated). The specimens were identified on the basis of various taxonomic characters using Yamaguti (1961), Schmidt (1986) and Chishti and Khan (1982). Photomicrography was conducted with the help of Digital Olympus Camera.

RESULTS

Two cestode species (*D. undula* and *Mayhewia kavini*) recovered from the intestines of three species of crows (*C. monedula*, *C. splendens* and *C. macrorhynchos*) are

Table 3. Comparative measurements of *Dilepis undula* (Schrank, 1788) with present form (measurements in microns = μ).

Characteristic	Davies (1935)	Matricker (1958)	Chishti (1974)	Present author
No. of rostellar hooks	45-60	48-62	64-70	46-58
Size of outer rostellar hooks (μ)	84	91-116	72-80	74-85
Size of inner rostellar hooks (μ)	72	70-88	60-64	67-78
No. of testes	28-35	28-36	24-26	24-32

redescribed based on their detailed morphological and morphometric studies, revealing some minor intraspecific variations. The prevalence, mean intensity and abundance of each parasite were recorded (Tables 1 and 2).

***Dilepis undula* (Schrank, 1788)**

Hosts: *C. monedula*, *C. splendens* and *C. macrorhynchos*;

Locality: Naseembagh, Rajbagh, Wathora and Yousmarg;

Location: Intestine.

The following redescription is based on twelve cestode specimens, taking four specimens from each *Corvus* species. The cestodes measure 38 to 43 mm in length and 1.36 mm in maximum breadth. All the proglottids are broader and longer, and the posterior margin is broader than anterior margin. The mature proglottids measure 0.18 to 0.27 mm in length and 1.16 to 1.28 mm in breadth. The gravid proglottids measure 0.16 to 0.23 \times 0.8 to 1.25 mm in length and 1.12 to 1.25 mm in breadth (Table 3 and Figure 1: A to E).

The scolex is globular and measures 0.44 to 0.54 mm in length and 0.60 to 0.64 mm in breadth across the suckers. The four suckers are rounded, muscular and measure 0.16 to 0.20 mm in diameter. The rostellum with its sac extends below the posterior margin of suckers and measures 0.44 to 0.58 mm in length and 0.14 to 0.20 mm in maximum breadth; it bears 46 to 58 hooks arranged in a double crown; each crown alternating with the other. The blade of hooks is smaller than handle, with guard as knob-like structure. The hooks of anterior and posterior crown measure 74 to 85 μ and 67 to 78 μ in length, respectively. The scolex is followed by a short neck that measures 0.24 to 0.33 mm in length and 0.50 to 0.55 mm in breadth. The dorsal longitudinal excretory duct is 14 μ in diameter and the ventral duct is 17 μ in diameter. The testes lie posterior to female reproductive organs, numbering 24 to 32 in each proglottid. They are rounded and measure 48 to 53 μ in diameter. The vas-deferens forms many coils in the anterior region of the proglottid. The vesicula seminalis are absent and the ductus ejaculatorius is straight. The cirrus pouch is cortical, extending up to the longitudinal excretory ducts of poral side; measuring 0.12 to 0.15 mm in length and 0.04 to 0.07 mm in width. The cirrus is slender and small 82 to 88 μ in length, armed with small spines. The genital pores

are unilateral and present just near the anterior margin of proglottids, laterally.

The ovary is bilobed, with the poral lobe being smaller than the aporal one; the two lobes show further lobulations. The two lobes are connected in the middle by a narrow U-shaped isthmus. The ovary extends 0.65 to 0.72 mm across. The vitelline gland is compact, horse-shoe shaped and lies posterior to the ovary. It measures 0.12 to 0.17 \times 0.04 to 0.06 mm. An oval receptaculum seminis, 0.08 to 0.10 \times 0.03 to 0.05 mm in size, lies dorsal and anterior to the ovary. The uterus occupies the whole of the gravid proglottid filled with eggs, which measure 23 to 26 \times 14 to 17 μ .

***Mayhewia kavini* (Chishti and Khan, 1982)**

Hosts: *Corvus monedula*;

Locality: Barzulla, Naseembagh, Rambagh and Wathora;

Location: Intestine.

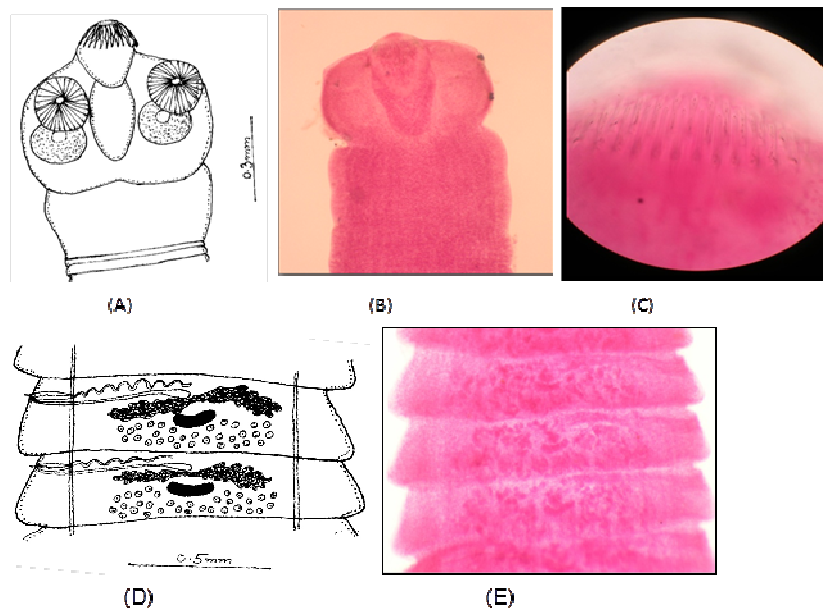
The following redescription is based on ten cestode specimens, collected from the intestines of four, out of thirty jackdaws, *C. monedula*. The cestodes measure 55 to 84 mm in length and 0.77 to 1.0 mm in their maximum breadth. The strobila consists of many proglottids which are broader than being long. The mature proglottids measure 0.20 to 0.26 mm in length and 0.8 to 0.92 mm in breadth. The gravid proglottids are 0.30 to 0.36 mm in length and 0.77 to 1.0 mm in breadth (Table 4 and Figure 2: A to D).

The scolex is small and globular, measuring 0.15 to 0.18 mm, with everted rostellum up to the base of suckers, and 0.12 to 0.14 mm without rostellum. It measures 0.22 to 0.23 mm across suckers. The rostellum with its sac measures 0.17 to 0.21 mm in length and extends below the posterior margin of suckers. The rostellum bears a single crown of 10 wrench-shaped hooks which measure 26 to 28 μ in length. The handle of hook is larger than the blade and is parallel to the equally long blade. The suckers are rounded and muscular, measuring 0.06 to 0.08 mm in diameter. The scolex is followed by a short neck that measures 0.17 to 0.22 mm in length and 0.10 to 0.15 mm in breadth. The dorsal longitudinal excretory duct is 10 to 13 μ and ventral excretory duct is 16 to 20 μ in diameter.

Testes are three in number, disposed in a triangle, two being aporal and one poral. They measure 92 to 100 μ in diameter. Cirrus pouch extends into the medullary

Table 4. Comparative measurements of *Mayhewia kavini* Chishti and Khan, 1982 with present form. (measurements in mm unless stated otherwise).

Particulars	Chishti and Khan, 1982	Present author
	<i>Mayhewia kavini</i>	
Max. length	60-90	55-84
Max. breadth	0.72-0.785	0.77-1.0
Mature proglottids	0.22-0.25 × 0.65-0.72	0.20-0.26 × 0.8-0.92
Gravid proglottids	0.26-0.35 × 0.72-0.785	0.3-0.36 × 0.77-1.0
Scolex length upto rostellum	0.19-0.198	0.15-0.18
Scolex length without rostellum	0.138-0.146	0.12-0.14
Width across suckers	0.242-0.249	0.22-0.23
Rosetellum length	0.222-0.228	0.17-0.21
Number of rostellar hooks	10	10
Hook size	25-30 μ	26-28 μ
Sucker size	0.09-0.1 × 0.075-0.082	0.06-0.08 (Dia.)
Dorsal excretory duct	10-12 μ	10-13 μ
Ventral excretory duct	18-22 μ	16-20 μ
Testis diameter	72-84 μ	93-100 μ
Cirrus pouch extent	Medullary	Medullary
Cirrus pouch size	0.14-0.155 × 0.052-0.057	0.16-0.19 × 0.050-0.053
External vesicula seminalis	0.16-0.18 × 0.06-0.072	0.18-0.25 × 0.07-0.072
Internal vesicula seminalis	0.06-0.072 × 0.048-0.052	0.05-0.065 × 0.42-0.50
Genital pore position	Anterior 1/3 rd.	Anterior 1/3 rd.
Ovary extend across	0.172-0.23 × 0.052-0.09	0.25-0.3 × 0.06-0.08
Vitelline gland	50-60 μ × 40-50 μ	65-72 μ × 48-53 μ
Receptaculum seminis	0.121-0.15 × 0.088-0.11	0.14-0.16 × 0.07-0.08
Egg size	42-54 μ × 30-41 μ	38-44 μ × 28-33 μ
Embryo size	28-32 μ × 18-22 μ	22-26 μ × 16-20 μ
Embryonic hook size	12-15 μ	9-12 μ

**Figure 1.** *Dilepis undula* Schrank, 1788. (A, B) Scolex showing suckers and rostellum with hooks; (C) rostellum showing hooks; (D, E) mature proglottids showing reproductive organs.

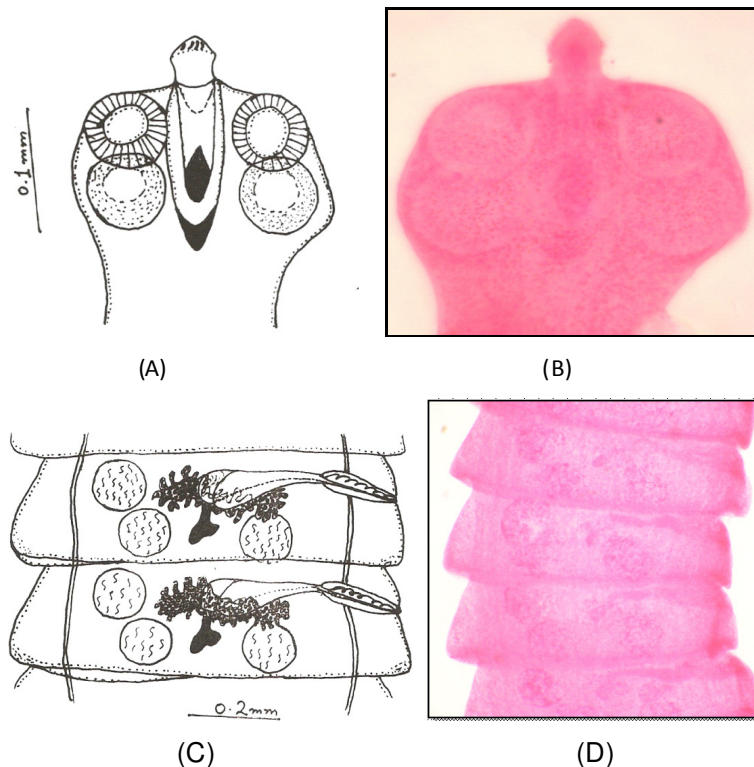


Figure 2. *Mayhewia Kavini* Chishti and Khan, 1982. (A, B) Scolex showing suckers and rostellum with hooks; (C, D) mature proglottids showing reproductive organs.

region and measures 0.16 to 0.19 mm in length and 0.05 to 0.053 mm in width. The external vesicula seminalis is large, extending to the middle of progottids and measures 0.18 to 0.25 mm in length and 0.07 to 0.072 mm in width. The small and oval internal vesicula seminalis measures 0.05 to 0.065 mm \times 0.042 to 0.05 mm. The genital pores are unilateral, opening in the anterior third margin of proglottid laterally. The follicular ovary lies in the middle of proglottid and is bilobed. It measures 0.25 to 0.3 mm across and 0.06 to 0.08 mm in thickness. Vitelline gland is slightly lobed and lies posterior to the ovary. It measures 65 to 72 \times 48 to 53 μ . The receptaculum-seminis is flask-shaped, situated anterior to ovary and measures 0.14 to 0.16 \times 0.07 to 0.08 mm. Receptaculum seminis narrows into a slender vaginal tube which opens into the genital atrium just posterior to the opening of cirrus pouch. The gravid proglottids are compactly filled with eggs which are oval in shape and measure 38 to 44 \times 28 to 33 μ . The embryo measures 22 to 26 \times 16 to 20 μ , and embryonic hooks measure 9 to 12 μ in length. In addition to *D. undula* and *M. kavini* redescribed in this paper, concurrent infestation with other helminth parasites such as *Echinostoma revolutum*, *Capillaria anatis*, *Anomotaenia galbulae* and *Choanotaenia micracantha* was also observed in some of the bird hosts during the present investigation.

DISCUSSION

The distinguishing characteristics of the present *Dilepis* specimens are: 46 to 58 rostellar hooks arranged in double crown; that of the anterior and posterior crown measure 74 to 85 and 67 to 78 μ , respectively; testes 24 to 32 in number, postovarian; cortical position of cirrus pouch; large bilobed ovary and unilateral genital pores.

When compared with the known species of genus *Dilepis* Weinland, 1858 described from different avian hosts, the present specimens shows a large similarity of characters with *D. undula* (Schrank, 1788). This species has also been redescribed several times, giving variation in the number and size of rostellar hooks, number of testes and length of strobila (Table 1). However, the present measurements come in the range of those described by various authors. In view of these measurements and other similarities as described above, the present cestode specimens are assigned to *D. undula* (Schrank, 1788). It is recorded for the first time in *Corvus* species from Kashmir. The earliest record of this species in Kashmir is from *Sturnus vulgaris humii* and *Turdus unicolor* (Chishti, 1974). The present cestode specimens of genus *Mayhewia* collected from *C. monedula* possess characteristics like rostellum with single crown of 10 small hooks; strobila comprising of numerous transversely

elongated progottids; two pair of excretory stems; three testes arranged in a triangle; cirrus pouch extending into medullary region; external and internal seminal vesicles present; ovary bilobed and uterus succular. All these characters are in conformity with the description of genus *Mayhewia* Yamuguti, 1956.

While comparing with the known species of genus *Mayhewia* Yamaguti, 1956, the present form shows a similarity of characters with those of *Mayhewia kavini* Chishti and Khan, 1982 as regards the number (10) and size of rostellar hooks, number of testes, extent of cirrus pouch, presence of seminal vesicles etc. However, some intraspecific variations were recorded in different structures as indicated in Table 2, the reason for which could be the age of parasite, host species, intensity of infection (higher intensity, smaller parasites), methodology (fixation), environmental factors of the study area, body conditions of the host, etc. (Ternopolskaya, 1984; Kuchai et al., 2012). Since these variations are of minor significance, therefore the present specimens in view of above similarities, are assigned to *Mayhewia kavini* Chishti and Khan, 1982.

Conclusion

The present paper redescribes only two species of cestode parasites (*D. undula* and *M. kavini*) recovered from three species of the genus *Corvus*. This work adds to the parasite species diversity infecting these avian hosts and may prove helpful for the future research on helminthes of birds. In addition, the present study showed that *M. kavini* was recovered only from *C. monedula*, hence the parasite may be host specific in nature.

ACKNOWLEDGEMENTS

The authors would like to thank all the members of the Department of Zoology, University of Kashmir who helped during the study. The authors express their deep sense of gratitude and sincere thanks to Prof. M. Z. Chishti, Professor Emeritus, Centre of Research for Development (CORD), University of Kashmir for helping in the identification of the cestode parasites.

REFERENCES

- Benesh DP (2010). Developmental inflexibility of larval tapeworms in response to resource variation. *Int J. Parasitol.* 40(4):487-497.
- Calnek BW (1997). *Diseases of Poultry*. 10th Ed. Iowa State University Press, Ames, Iowa 50014. pp. 850-851.
- Chishti MZ (1973). On a new species of the cestode genus *Choanotaenia* Railliet, 1896 from *Acridotheres tristis* in Kashmir. *J. Sci. Univ. Kashmir* 1(1-2):51-54.
- Chishti MZ (1980a). A new record of *Choanotaenia gondwana* Inamdar, 1934 (Choanotaeniidae: Cestoda) from *Passer domestica* in Kashmir. Proceedings of the 5th All India Congress on Zoology, Bhopal, India.
- Chishti MZ (1980b). *Dilepsis fotedari* n. sp. (Dilepididae Fuhrmann 1907: Cestoda) from *Anas platyrhynchos* in Kashmir. *Indian J. Helminthol.* 32(1):1-3.
- Chishti MZ (1980c). On the infection of Cestode genus *Sobolevicanthus* Spassky et Spaskeja, 1954 from Aves in Kashmir. Proceedings of the 3rd National Congress on Parasites, Hissar. pp. 13-14.
- Chishti MZ (1981). On a new species of the genus *Choanotaenia* Railliet, 1826 from *Corvus monedula* in Kashmir. Proceedings of the 68th Session of the Indian Science Congress.
- Chishti MZ, Khan AR (1978). Epidemiology of Cestode infection in Snipe, *Tringa hypoleuca* from Kashmir, with description of a new species of the genus *Amoebotaenia*. Proceedings of the 65th Session of the Indian Science Congress. p 316.
- Chishti MZ, Khan AR (1979). A new record of *Dilepsis undula* (Schrank, 1788) from some avian hosts in Kashmir. Proceedings of the 66th Session Indian Science Congress. p 107.
- Chishti MZ, Khan AR (1982). *Mayhewia kavini* sp. nov. (Hymenolepididae Railliet et Henry, 1909: Cestoda) from *Corvus monedula* in Kashmir. *Indian J. Helminthol.* 34(2):139-142.
- Chishti MZ, Mir AA, Rasool A (1986). *Choanotaenia micracantha* sp. nov. (Dilepoidea: Cestoda) from *Corvus monedula* in Kashmir. *Indian J. Helminthol.* 38(2):107-111.
- Dar GH, Bhagat RC, Khan MA (2002). Biodiversity of the Kashmir Himalaya, 1st Ed. Valley Book House, Kashmir University Road, Srinagar-190006, India.
- Davies TI (1935). The anatomy of *Dilepis undula* (Schrank, 1788). *Proc. Zool. Soc. London.* pp. 717-722.
- Fotedar DN, Chishti MZ (1973). On a new species, *Anomotaenia kashmirensis* (Choanotaeniidae, Methevossian 1953) from *Sturnus vulgaris* in Kashmir. *J. Sci. Univ. Kashmir* 1(1-2):48-50.
- Fotedar DN, Chishti MZ (1976). *Anomotaenia acrocephali* n. sp. and first record of *A. galbulae* (Gmelin, 1709) Fuhr; 1932 from some birds of Kashmir. *Riv. Parassitol.* 37(2):247-252.
- Fotedar DN, Chishti MZ (1976). *Pseudoschistotaenia* n. gen. (Amabillidae, Fuhrman, 1908: Cestoda) from *Podiceps ruficollis capensis* in Kashmir. Proceedings of 63rd Session Indian Science Congress, Part III (Abt). p 21
- Fotedar DN, Chishti MZ (1977). On a new species of the genus *Pseudoschistotaenia* Fotedar and Chishti, 1976. Proceedings, All Indian Symposium of Helminthology held at Srinagar (Abt). p 37.
- Fotedar DN, Mahajan, R, Dhar RL, Chishti MZ (1970). New variety of *Raillietina* from common Blue Rock Pigeon in Kashmir. *Kashmir Sci.* 7(1-2):103-106.
- Fotedar DN, Chishti MZ (1974). Redescription of *Choanotaenia oriole* Joyeux et Baer 1955 and *C. infundibulum* (Bloch, 1979) with a note on the synonymy of *C. dutii* Mukherjii 1964. *J. Sci. Univ. Kashmir* 2(1-2):73-78.
- Goodwin D (1983). *Crows of the World*. Queensland University Press, St Lucia, Qld.
- Gupta SP (1967). Helminthic-fauna of Kashmir. *Kashmir Sci.* 4(12):56-61.
- Henrich T, Daniel PB, Martin K (2013). Hybridization between two cestode species and its consequences for intermediate host range. *Parasit. Vectors* 6:33.
- Khan AR, Chishti MZ (1982). On *Echinostoma revolutum* (Froelich) Looss, 1899 and synonymy of *Neoechinostoma spinosa* Agarwal, 1963. *Kashmir Univ. Res. J.* 2:22-24.
- Kuchai JA, Fayaz A, Chishti MZ, Tak H, Javid AD, Dar SA, Muzaffar R (2012). A study on morphology and morphometry of *Haemonchus contortus*. *Pak. J. Zool.* 44(6):1737-1741.
- Kornyushin VV, Salamatin RV, Greben OB, Georgiev BB (2009). *Spiniglang sharpiloi* sp. n. (Cestoda, Dilepididae), a parasite of the common magpie, *Pica Pica*, in the palaeartic. *Vestn. zool.* 23:85-93.
- Lockie JD (1956). The Food and Feeding Behavior of the Jackdaw, Rook and Carrion Crow. *J. Anim. Ecol.* 25(2):421-428.
- Meyer CM, Olsen WO (1975). *Essentials of Parasitology*. WM. C. Brown Company Publishers, Dubuque, Iowa (USA).
- Mettrick DF (1958). Helminth parasites of Hertfordshire Birds-II Cestoda. *J. Helminthol.* 32:157-194.
- Nanware SS, Dhondge RM, Bhure DB (2011). Biosystematic studies on *Cotugnia orientalis* sp. nov. (Cestoda: Davaineidae, Fuhrmann 1907) from *Gallus gallus domesticus*. *Bioscan (Ranchi)* 6(1):71-75.
- Nyari A, Ryall C, Peterson AT (2006). Global invasive potential of the house crow *Corvus splendens* based on ecological niche modeling. *J. Avian Biol.* 37:306-311.

- Roberts LS, Janovy JJ (2005). Gerald D. Schmidt and Larry S. Roberts' Foundation of Parasitology. 7th Ed., Mc Graw-Hill Companies. p 311.
- Schmidt GD (1986). Handbook of Tapeworm Identification. CRC Press, Boca Raton, FL.
- Ternopolskaya LD (1984). Variability of *Fasciola hepatica* L., 1785 in different hosts. Bulletin Vsesoyuznogo Instituta Gel. Mintologii Im. K. I. Skrybin. 38: 47-51.
- Yamaguti S (1961). Systema Helminthum. Vol. 2. The Cestodes of Vertebrates. Interscience Publisher, John Wiley Sons, New York.
- Yoneva A, Céline L, Pavel NN, Yana M, Jean M, Boyko BG (2012). Spermiogenesis and spermatozoon ultrastructure of the paruterinid cestode *Notopentorchis* sp. (Cyclophyllidea). Parasitol. Res. 111(1):135-142.