JNU, NEW DELHI uploaded the journal in UGC CARE PORTAL.
Page 71, http://www.epitomejournals.com Vol. 7, Issue 12, December 2021, ISSN: 2395-6968

Epitome : International Journal of Multidisciplinary Research
ISSN : 2395-6968

On a New Species of *Avitellina shantae* n.sp.from *Ovis–Bharal* From Buldhana district (M.S.) India

Dr. Raosaheb K. Barote
Assistant Professor & Head,
Vice-Principal,
Sant Dnyaneshwar Mahavidyalaya, Soegaon 431120.
Email. drrkbarote@gmail.com

ABSTRACT

The present investigation deals with the new species of Avitellina shantae n.sp. obtained from the host ovis bharal from buldhana district (M.S.) India. The present cestode parasites Avitellina shantae differs from the characters the scolex is large in size, almost oval in shape, distinctly marked off from the strobilla, broader anteriorly, tapering posteriorly, with a blunt anterior surface. The four Suckers are large in size, oval in shape, arranged in two pairs, one in each half of it overlapping with each pair, with high musculature. The neck is long wide, slightly longer than broad, with high musculature, broader anteriorly, narrow posteriorly. The mature segment broader than long, cirrus pouch is small in size, oval in shape, the cestode parasites is identified and confirmed to be representing Avitellina shantae n.sp. in mammalian host i.e Ovis bharal.

KEY WORDS

Avitellina, Buldhana, Ovis bharal, India.

RESEARCH PAPER

INTRODUCTION:

The genus *Avitellina* was established by Gough 1911, and its type species *A. centripunctata* (Rivolta, 1874) in *Ovis aries* in Europe. Helminths are one of the more destructive internal parasites of the vertebrate including man (Strickland, G.T., 2000). The genus *Avitellina* is an important parasitic tapeworm that has many final hosts such as cattle, sheep, goats and other domestic and wild ruminants. It is common parasite of domestic ruminants in Europe, Asia and Africa (Gary R. M., 2002). The presence of *Avitellina* species in ruminant can negatively affect their productivity. Lambs are more susceptible to infection with *Avitellina* causes diarrhea and reduced weight gain. Also it causes gastrointestinal disorders and even death in sheep and goats.
So it constitutes a big problem in sheep raising countries.

Avitellina tapeworms are the intestinal cestodes of wild and domestic ruminants. Members of the genus have an indirect life cycle with ruminants as final hosts, with oribatid mites or collembolans as intermediate hosts (Narsapur, 1988; Denegri et al., 1998). After ingestion of the intermediate hosts, cysticercoid larvae actively move to small intestine of the definitive host and mature (Soulsby, 1986; Denegri et al., 1998; Ndom et al., 2016).
Avitellina tapeworms have a worldwide distribution, and a great veterinary importance (Woodland, 1935; Schmidt, 1986; Belem et al., 2001; Achi et al., 2003a,b). The prevalence of *Avitellina* tapeworms varies among regions and hosts. Among sheep, prevalence was documented to be around 35% and 8% in Ivory Coast (Achi et al., 2003b) and in Burkina Faso, respectively (Ouattara and Dorchies, 2001). In Senegal, 15 to 38.7% infection was reported (Ba et al., 1994; Ndom et al., 2016). Infections in goats were reported to be 30%, 2.5% and 8% in Burkina Faso (Belem et al., 2005), Mongolia (Sharkhuu, 2001) and Senegal (Ba et al., 1994), respectively. Prevalence of *Avitellina* in cattle was estimated around 4% in Ivory Coast (Achi et al., 2003a) and 7% in Senegal (Ba et al., 1994).

In heavy infestation, *Avitellina* tapeworms may cause serious disorders (Euzeby, 1966a,b), particularly in lambs, kids and calves under 1 year old (Soulsby, 1986). Thus, *Avitellina* tapeworms represent an economic point in animal industry (Narsapur, 1988).
In spite of the importance of these parasites, little is known about their ecology, evolutionary biology or population genetics (Ndom, 2018). Among the members of the genus, 25 species have been described from wild and domestic ruminants in different regions of the world, but only 15 are currently considered valid (http://www. tapewormdb.uconn.edu). In domestic ruminants, three species *A. centripunctata* (Rivolta, 1874) Gough, 1911, A. chalmersi Woodland, 1927, and *A. tatia* Bhalerao, 1936 are considered valid (Spasskii, 1951). This species have been described based on their relatively narrow set of morphological features (Ndom, 2018). Thus A. chalmersi is morphologically distinct for *A. centripunctata* by his annular thickening on the proglottids margin (Woodland, 1927), while *A. tatia* is characterized by a very long cirrus pouch (3–4 times larger than the copulative portion of vagina) (Spasskii, 1951).

In Senegal, *A. centripunctata* has been reported as the only species among domestic ruminants (Vassiliades, 1981; Ba, 1989; Tamssar Missam, 2006). However, a multilocus isoenzyme electrophoresis study reported the existence of cryptic species in *Avitellina centripunctata* in Senegal (Ba et al., 1994). Which are often convergent, causing controversy about the taxonomy of this genus, further questing the value of only using morphological characters in identifying and differentiating *Avitellina* cestode species. In addition, recent studies in *Anoplocephalids* tapeworms showed the necessity of molecular analysis and re-evaluation of taxonomy and species identification (Diop et al., 2015, Guo, 2015, 2016, 2017, Ndom et al., 2018).

The present investigation deals with the morphological characters of the Cestode parasites *Avitellina* from O*vis bharal* from Buldhana District (M.S.) India.

MATERIAL AND METHODS:

Cestode parasites were collected from the intestine of *Ovis- bharal* at Buldhana district (M.S.) India. These Cestodes preserved in hot 4% formalin and stained with Aceto-caramine or Harris haematoxylin, passed through various alcoholic grades, cleared in xyline, mounted in D.P.X. and drawings are made with the aid of camera lucida. All measurements are given in millimeters, otherwise mentioned. The identification is made with the help of Systema Helminthum.

DESCRIPTION :

Sixteen specimens of the Cestode parasites were collected from the intestine of the *Ovis-Bharal* in the month of January at Malkapur District. Buldhana M.S. India.

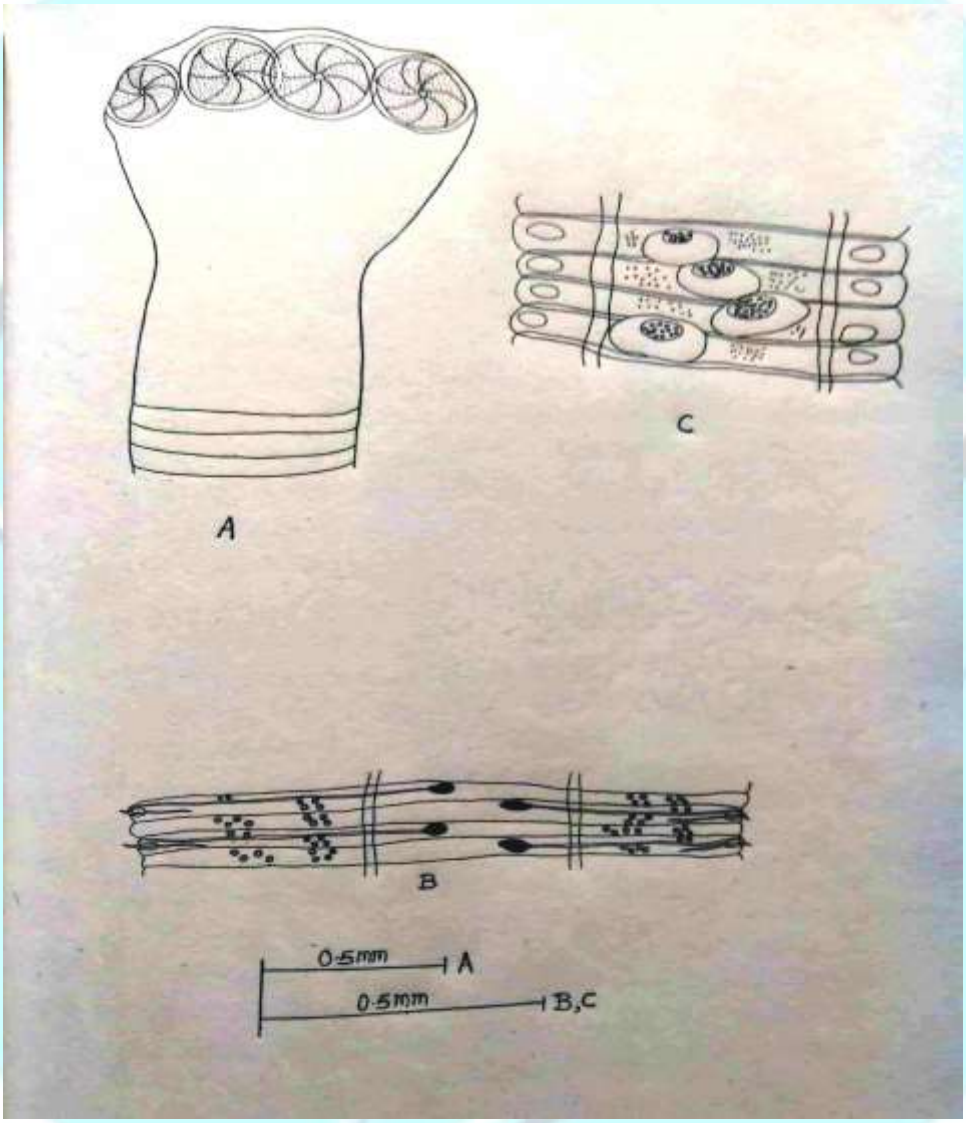
The scolex is large in size, almost oval in shape, distinctly marked off from the strobila, broder anterioly, tapering posterioly, with a blunt anterior surface and measures 1.924 (10893-1.954) in length and 2.564 (2.439-2.689) in width. The four suckers are large in size, oval in shape, arranged in two pair, one pair in each half of it overlapping with each pair, with high musculature and measures 0.693 (0.674-0.712) in length and 0.723 (0.704-0.742) in width. The neck is long wide, slightly longer than broad, with high musculature, broder anteriorly, narrow posterioly and measures 1.424 (1.401-1.446) in length and 1.518 (1.1.446-1.590) in width.
The mature segments are broader than long, almost 14 to 15 times broader than long, proglottides indistinct, very thin, narrow, with irregular lateral margins, with convex lateral margins, with slight projections at the posterior corners of the segments and measures 0.111 (0.101-0.121) in length and 2.808 (2.781-2.834) in width. The testes are small in size, rounded in shape, 6 to 8 in numbers, divided in two on each side of the excretory canal and measures 0.2912 in dimeater.

The cirrus pouch is small in size, oval in shape situated obliquely, at the anterior margin or at the segment and measures 0.075 (0.067-0.082) in length and 0.038 (0.033-0.043) in width.
The cirrus is short, thin slightly curved, contained within the cirrus pouch and measures 0.135 (0.131-0.140) in length and 0.0291 (0.048-0.009) in width. The ovary is small in size, dumb-bell shaped, transversely elongated and measures 0.087 (0.082-0.092) in length and 0.050 (0.043-

0.058) in width. The lobes are with irregular margin, unequal size, situated outside the longitudinal excretory canals and with numerous acini.

The vas deference is thin, almost straight, runs parallel to the anterior margin of the segments and measures 0.225 (0.223-0.228) in length and 0.016 (0.014-0.019) in width.

The vitellaria are absent in the segments. The longitudinal excretory canals are narrow and measures 0.546 (0.543-0.548) in length and 0.832 (0.820-0.844) in width.



DISCUSSION:

The genus *Avitellian* was established by Gough, 1911 and as its type species *A. centripunctata* erected by Rivolta, 1874 in ovies aries. Later on four species were added to this genu (Woodland, 1927) i.e. *A. chalmeri* from *Ovis aries*, *A. goughi* from *Ovis aries*, *Bos taurus* and *Capra hircus*, *A. lahorea* from *Bubalus bubalis* and *A. sudanea* from *Ovis aries* and *Capra hircus*. Then *A. sandgroundi* (Woodland, 1928) from *Hippotragus equines*, Later on *A. tatia*

added from *Capra hircus* and *A. woodlandi* from *Ovis aries* (Bhalerao, 1936). Then *A.nagbhushanmi* from *Bos indicus* (G. B. Shinde, 1983). Recently *A. hircusae* from *Capra hircus* (Kale, 2005) *A. singhii* from *Capra hircus* (Shinde S.M., 2013) and *A. ali* From *Capra hircus* (Suryawanshi, 2015). The present form collected from the intestine of the *Ovis-Bharal* in the month of January at Malkapur. District. Buldhana M.S. India.

The cestode under discussion comes closer to *Avitellina centripunctata* (Rivolta, 1874) in having all the essential morphological characters i.e the scolex is large in size, almost oval in shape, distinctly marked off from the strobila, broder anterioly, tapering posterioly, with a blunt anterior surface. The four suckers are large in size, oval in shape, arranged in two pair, one pair in each half of it overlapping with each pair, with high musculature. The neck is long wide, slightly longer than broad, with high musculature, broder anteriorly, narrow posterioly.
The mature segments are broader than long, almost 14 to 15 times broader than long, proglottides indistinct, very thin, narrow, with irregular lateral margins, with convex lateral margins, with slight projections at the posterior corners of the segments, The testes are small in size, rounded in shape, 6 to 8 in numbers, divided in two on each side of the excretory canal and measures 0.2912 in dimeater. The cirrus pouch is small in size, oval in shape situated obliquely, at the anterior margin or at the segment.

The cirrus is short, thin slightly curved, contained within the cirrus pouch, The ovary is small in size, dumb-bell shaped, transversly elongated, The lobes are with irregular margin, unequal size, situated outside the longitudinal excretory canals and with numerous acini.
The vas deference is thin, almost straight, runs parallel to the anterior margin of the segments. The vitellaria are absent in the segments, The longitudinal excretory canals are narrow.

The present cestode parasite differs from the *Avitellina centripuncta* Rivolta, 1874, *A. centripunctata* (Rivolta, 1874) Gough, 1911, *A. aegyptica*, Nagaty, 1929, *A. artica*, Kolmakov, 1938, *A. chalmesi*, Woodland, 1927, *A. edifontaineus*, Woodland, 1928, *A. monardi*, Fuhrmann, 1933, *A. pygargi*, Kholodkovsky, 1902, *A. ricardi*, Woodland, 1928, *A.sandgroundi*, Woodland, 1935, *A. tatia*, Bhalerao, 1936.

Table 1 A comparison of morphometric characters of *Avitellina* spp.

Avitellina spp.	**Hosts**	**Localities**	**length of cestode**	**Width of immature proglottids(µm)**
***Avitellina centripuncta* Rivolta, 1874**	*Bos taurus, Bubalus bufellus, Capra hircus, Ovis aries, Camelus sp., Aepicros melappus, Cephalophus grimmia, Hippotragus equknus*	Europe, Africa, Asia	1 m	1800
***Avitellina centripuncta* (Rivolta, 1874) Gough, 1911**	*Bos taurus, Bubalus bufellus, Capra hircus, Ovis aries, Camelus sp., and wild ruminants*	Europe, Africa, Asia	1 – 2.5 m	1000
***Avitellina aegyptica,* Nagaty,1929**	*Cephalophus* sp. *Camelus dromedarius*	Northeast Rhodesia, Africa	fragments 20–100 mm	-
***Avitellina artica,*kolmakov,1938**	*Rangifer tarandus, Capreolus pygargus*	*USSR (west Siberia)*	-	275
***Avitellina chalmesi,* Woodland, 1927**	*Ovis aries*	North Africa, India	4.572 mm	1720
***Avitellina edifontaineus,* Woodland, 1928**	*Taurotragus oryx*	Tanganyika, East Africa	-	680
***Avitellina monardi,* Fuhrmann, 1933**	*Taurotragus oryx*	Angola (West Africa)	-	-
***Avitellina pygargi,* Kholodkovsky, 1902**	*Capreolus pygargus*	Altai (USSR)	1.5 m	
***Avitellina ricardi,*Woodland, 1928**	*Kobus* sp.	Zeeland (East Africa)	-	590–710
***Avitellina sandgroundi,* Woodland, 1935**	*Hippotragus equinus*	North Katanga, Africa	fragment (40 cm)	-
***Avitellina tatia,* Bhalerao,1936**	*Capra hircus*	United provinces, India	-	-
Avitellina Centripunctata (n=32 1	*Ovis aries*	Senegal	1.2–3.75 m	1478.56 (774–2257)
Avitellina sp. 2(n=14)	*Ovis aries*	Senegal	0.75–1.10 m	560 (273–833)
Avitellina sp.3(n=6)	*Ovis aries*	Senegal	-	782 (655–1200)
Avitellina shantae nov.sp	*Ovis bharal*	Buldhana dist. (M.S.) India	8-9 cm	-

Avitellina spp.	**width of matures proglottids (µm)**	**Scolex diameter (µm)**	**Sucker diameter (µm)**	**Number of testicular column**
***Avitellina centripuncta* Rivolta, 1874**	2500	1500–2200	500–1000	4
***Avitellina centripuncta* (Rivolta, 1874) Gough, 1911**	4000	1500–3000	400–500 × 300–400	4
***Avitellina aegyptica*, Nagaty,1929**	-	-	-	4
***Avitellina artica*,kolmakov,1938**	1209	-	-	4
***Avitellina chalmesi*, Woodland, 1927**	3000	2080–2420	950–1020	4
***Avitellina edifontaineus*,Woodland, 1928**	2200	-	-	4
***Avitellina monardi*, Fuhrmann, 1933**	2300	-	-	2
***Avitellina pygargi*, Kholodkovsky, 1902**	4000	500	160	2
***Avitellina ricardi*,Woodland, 1928**	1140-1620	-	-	2
***Avitellina sandgroundi*, Woodland, 1935**	3420	2060	880	4
***Avitellina tatia*, Bhalerao,1936**	2470	-	-	4
Avitellina Centripunctata (n=32) 1	2719.41 (1116–3995)	1841.13 (1160–2661)	370 (334–406)	4
Avitellina sp. 2(n=14)	1968.43 (769–2945)	671 (540–840)	135 (107–171)	4
Avitellina sp. 3(n=6)	1886.5 (889–2932)	898 (850–1150)	105 (78–139)	4
Avitellina shantae nov.sp	0.111 (0.101-0.121) length 2.808 (2.781-2.834) width	1.924 (1.893-1.954) length 2.564 (2.439-2.689) width	0.693 (0.674-0.712) length 0.723 (0.704-0.742) width	3-4

Avitellina spp.	**Excretory vessels**	**Testes diameter (µm)**	**Length X width of cirrus pouch (µm)**	**Length X width of paruterin organe (µm)**
***Avitellina centripuncta* Rivolta, 1874**	2 pairs	40–70	210–250 × 38–45	560–1000
***Avitellina centripuncta* (Rivolta, 1874) Gough, 1911**	2 pairs	80	60–100 × 30–40	-
***Avitellina aegyptica*, Nagaty,1929**	2 pairs	90 × 54	83 × 24	245 × 100
***Avitellina artica*,kolmakov,1938**	2 pairs	-	122 × 76	-
***Avitellina chalmesi*, Woodland, 1927**	2 pairs	-	63–72 × 14–22	425 × 200
***Avitellina edifontaineus*,Woodland, 1928**	1 pair	80	25–27 × 18	340 × 660
***Avitellina monardi*, Fuhrmann, 1933**	1 pair	-	36 × 06	170–200
***Avitellina pygargi*, Kholodkovsky, 1902**	-	-	-	-
***Avitellina ricardi*,Woodland, 1928**	1 pair	44–50 × 18–33	18 × 32	210–240 × 430–490
***Avitellina sandgroundi*, Woodland, 1935**	-	87	117 × 73	-
***Avitellina tatia*, Bhalerao,1936**	2 pairs	-	300–393 × 42–50	600 × 340
Avitellina Centripunctata (n=32) 1	2 pairs	51 (34–85)	196 (140–344) X 52 (27-85)	324.6–635 × 106–136
Avitellina sp. 2(n=14)	2 pairs	75 (54–93)	277 (190–258) X 73 (58-97)	365–1000 × 169–214
Avitellina sp. 3(n=6)	2 pairs	41 (33–56)	170 (89–233) X 40 (28-42)	306–463 × 198–311
Avitellina shantae nov.sp	1 pair	0.291	0.075 (0.067-0.082) 0.038 (0.033-	-

			0.043)	

REFERENCE

Abassa, K., 1975. le Teniasis des petits ruminants au Togo. These de Medecine Veterinaire. E.I.S.M.V de Dakar.

Achi, Y.L., Zinsstag, J., Yeo, N., Dea, V., Dorchies, P.H., 2003a. Les nematodes gastrointestinaux des bovins de la region des savanes de la Cote-d ' Ivoire: enquete d 'abattoir. Rev. Medecine Vetairinaire 154, 105–112.

Achi, Y.L., Zinsstag, J., Yeo, N., Dea, V., Dorchies, P.H., 2003b. Epidemiologie des helminthosesdes moutons et des chevres dans la region des savanes du Nord de la Cote d' Ivoire. Rev. Med. Vet 154, 179–188.

Arun gaware, Sunita borde and Amol thosar -2017. Rediscription of a species from *Capra hircus*, *Avitellina centripunctata* Rivolto, (1874) From Jalna distinct (M.S.), India. ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

Ba, C.T., 1989. Contribution a la connaissance des Anoplocephalidae Cholodkowsky,1902 (Cestoda, Cyclophyllidea) parasites de l'intestin grele des ruminants domestiques au Senegal. In: These 3ieme cycle. Departement Biol. Anim. UCAD Universite (100p).

Ba, C., Wang, X.Q., Renaud, F., Euzet, Marchand, Meeus, D.E., 1993. Diversity and specificity in cestodes of the genus Moniezia: genetic evidence. Int. J. Parasitol. 23,853–857.

Ba, C., Wang, X., Renaud, F., Euzet, L., Marchand, B., De Meeus, T., 1994. Diversity in the Genera Avitellina and Thysaniezia (Cestoda: Cyclophyllidea): genetic evidence. J. Helminthol. Soc. Wash. 61, 57–60.

Belem, A., Ouedraogo, O., Bessin, R., 2001. Gastro-intestinal nematodes and cestodes of cattle in Burkina Faso. Biotechnol. Agron. Soc. Environ. 5, 17–21.

Belem, A., Kabore, A., Bessin, R., 2005. Gastrointestinal helminthes of sheep in the central, eastern and northern parts of Burkina Faso. Bull Anim. Hlth. Prod. Afr 53, 13–23.

Bhalerao, G.D, 1936. On some representatives of the Cestode Genus Avitellina from India. J. Helminthol. XIV (3). 141-162.

Denegri, G.,Bernadina, W.,Perez-Serrano, J.,Rodriguez-Caabeiro, F., 1998. Anoplocephalid cestodes of veterinary and medical significance: a review. Folia Parasitol. 45, 1–8.

Diop, G., Yanagida, T., Hailemariam, Z., Sissay, M., Nakao, M., Sako, Y., Ba, C., Ito, A., 2015. Genetic characterization of Moniezia species in Senegal and Ethiopia. Parasitol. Int. 64, 256–260. https://doi.org/10.1016/j.parint.2015.02.008.

Euzeby, J., 1966a. Maladies dues aux Platyhelminthes.Tome II, fasc.1: Cestodoses. Cestodes. (Vigot freres. Ed) Paris. (1-136p).

Euzeby, J., 1966b. Maladies dues aux Platyhelminthes. (Vigot freres. Ed) Paris. Tome II. (F, 1–136p).

Fuhrmann, O., 1933. Deux nouveaux Cestodes de mammiferes d'Angola. Bulletin Societe Neuchateloise des Sciences Naturelles. 58, 97–106.

Felsenstein J. (1985). Confidence limits on phylogenies: An approach using the bootstrap. Evolution39:783-791

Gough, L.H., 1911. A monograph of the tape-worms of the sub- family Avitellininse, being a revision of the genus Stilesia, and an account of the his- tology of Avitellina centripunctata (Riv). Quart Four Microsc. Sci. 56, 317–385.

Guo, A., 2015. The complete mitochondrial genome of Anoplocephala perfoliata, the first

representative for the family Anoplocephalidae. Parasit. Vectors 1–9.

Guo, A., 2016. Complete Mitochondrial Genome of Anoplocephala magna Solidifying the Species. Korean J. Parasitol. 54, 369–373.

Guo, A., 2017. Moniezia benedeni and Moniezia expansa are distinct cestode species based on complete mitochondrial genomes. Acta Trop 166, 287–292.

Irene S. G. (2012). Morphological and molecular studies of Ophiotaenia Sp. (Cestoda: Proteocephalidea) a parasite of the Sandfish Lizard Scincus scincus Linnaeus, 1758 (Family: Scincidae). World Journal of Zoology, 7(1): 65-74.

Kale, M.K., Barote, R.K. and Pawar, S.B. (2005). A new species Avitellina hircusae n.sp.
(Eucestoda:Thysanosomidae) from Capra hircus at Beed, M.S. India. Rivista di Parasitologia. XXII(LXVI) N-2:109-113.

Katoh, K., Standley, D., 2013. MAFFT multiple sequence alignment software version 7:251 improvements in performance and usability. Mol. Biol. Evol. 30, 772–780.

Kerry A. Padgett. 2005. Systematics of Mesocestoides (Cestoda: Mesocestoididae): Evaluation of molecular and morphological variation among isolates. J. Parasitol. 91(6):1435-1443.

Khalil, L., Jones, A., Bray, R., 1994. Keys to the Cestode Parasites of Vertebrates. CAB Int,
Wallingford (366pp).

Kholodkovsky, N., 1902. Contribution a la connaissance des tenias des ruminants. Archives de Parasitologies VI (1).

Kumar, S., Stecher, G., Tamura, K., 2016. MEGA7: Molecular Evolutionary Genetics Analysis Version 7.0 for Bigger Datasets. Molecul. Biol. and Evol. 33, 1870–1874.

Librado, P., Rozas, J., 2009. DnaSP v5: a software for comprehensive analusis of DNA polymorphism data. Bioinformatics 25, 1451–1452.

Nagaty, H.F., 1929. An account of the anatomy of certain cestodes belonging to the genera Stilesia and Avitellina. Annals of Trop. Med et Parasitol XXIII.

Narsapur, V.S., 1988. Pathogenesis and biology of Anoplocephaline cestodes of domestic animals. Ann. Rech. Veterinaires 19, 1–17.

National Centre for Biotechnology Information (NCBI) website.

Nei, M., Kumar, S., 2000. Molecular Evolution and Phylogenetics. Oxford University Press, New York.

Ndom, M., 2018. Etudes morphoanatomique, epidemiologique et phylogenetique des Anoplocephalidae (Cestodes, Cyclophyllidea) parasites intestinaux des bovins, ovins du Senegal. Universite Cheikh Anta IOP de Dakar.

Ndom, M., Diop, G., Quilichini, Y., Yanagida, T., Ba, C.T., Marchand, B., 2016. Prevalence
and scanning electron microscopic identification of anoplocephalid cestodes among small ruminants in senegal. J. Parasitol. Res. https://doi.org/10.1155/2016/ 3937292. ID3937292, 9p.

Ndom, M., Yanagida, T., Diop, G., Quilichini, Y., Ba, A., Sako, Y., Nakao, M., Marchand, B., Dieye, A., Ba, C.T., Ito, A., 2018. Genetic and morphological characterization of Thysaniezia tapeworms from cattle and sheep in Senegal. Vet. Parasitol. Reg. Stud. Rep. 11, 27–31. https://doi.org/10.1016/j.vprsr.2017.11.008.

Ouattara, L., Dorchies, P.H., 2001. Helminthes gastro-intestinaux des moutons et chevres en zones sub-humide et sahelienne du Burkina Faso. Rev. Med. Vet 152, 165–170.

Rivolta, S. 1874. Sopra alcuni specie del Taenia della pecora. Studi fatti nel gabnetto di Anatomia Patologica della R. Scuola Veterinaria di Pisa. (This is the reference given by **B.Galli- Valerio, in his 'Notices Biographiques. V.-Sebastiano Rivolta', Arcb.Parasit., T.X,1899,** p.377. Stiles and Hassall's reference (dated 1879 and quoted as published in the studi fatti n. gab. Di anal. Patol. Di

Pisa, p.79,3 figs.) in the index Catalogue of Med. And Vet. Zoology, 1909, is apparently a mistake, through these authors give the correct date in their paper published in 1893).

Saitou N. and Nei M. (1987). The neighbor-joining method: A new method for reconstructing phylogenetic trees. Molecular Biology and Evolution4:406-425.

Schmidt, G., 1986. Handbook of Tapeworm Identification. CRC Press, Boca Raton, Florida (Part II, 675p).

Sharkhuu, T., 2001. Helminths of goats in Mongolia. Vet. Parasitol. 101, 161–169. https://doi.org/10.1016/S0304-4017(01)00508-8.

Shinde, G.B., Aghav, B.B. and Jadhav, B.V. (1983) Avitellina nagbhushanmi n.sp.
(Cestoda: Thysanosomidae) at Aurangabad. II Nat. Conv. Ind. Helm. Bodh Gaya. 39: 31-32.

Shinde, S.M., Nanware S.S. and Bhure, D.B. (2013) Taxonomic observation of new mammalian tapeworm Avitellina from Capra hircus L. Flora and Fauna. 19: 138-144.

Soulsby, E., 1986. Text Book of: Helminths, Arthropods, and Protozoa of Domesticated Animals, 7th edn. English Lang. B. Soc. Bailliere Tindall, Loncon.

Spasskii, A.A., 1951. Essentials of cestodology. In: Skrjabin, K.I. (Ed.), Anoplocephalate Tapeworms of Domestic and Wild Animals. Essentials of Cestodology, vol 1 Akademia NAUK, Moskva (SSR Vol. 1 730 pp).

Strickland, G. T. (2002). Helminth infections- General principles: Hunter's Tropical Medicine and Emerging Infection Diseases philadelphia: W. B. Saunders, pp: 713-716.

Tamura K., Nei M., And Kumar S. (2004). Prospects for inferring very large phylogeniesby using the neighbor-joining method. Proceedings of the National Academy of Sciences (USA) 101:11030-11035.

Tamura K., Peterson D., Peterson N., Stecher G., Nei M., and Kumar S. (2011). MEGA5:
Molecular Evolutionary Genetics Analysis using Maximum Likelihood, Evolutionary Distance, and Maximum Parsimony Methods. Molecular Biology and Evolution(In Press).

Tamssar Missam, N., 2006. Parasitisme heminthique gastro-intestinal des moutons abattus aux abattoirs de Dakar. (These de Medecine Veterinaire. E.I.S.M.V de Dakar).

Vassiliades, G., 1981. Parasitisme gastro-intestinal chez le mouton du Senegal. Rev. Elev. Med.vet.Pays trop. 34, 169–177.

Wardle, R. A. 1974. Advances in the Zoology of tapeworms, 1950-1970, Univ. of Minnesota Press Minneapolis, 1-274.

Woodland W.N.F. (1927) A new species of Avitelinae tapeworm Avitellina sandroundi from Hippotragus equines. 185-189.

Woodland, W., 1927. On three new species of Avitellina (Cestoda) from India and the Anglo-Egyptian Sudan, with a re-description of the type-species A. centripunctata (Rivolta), 1874. Ann. Trop. Med. Parasitol. 21, 385–414.

Woodland, W.N.F., 1928. On a new genus of Avitellinine tapeworms from ruminants in east Africa. Parasitology XX (1).

Woodland, W., 1935. A new species of Avitellinine tapeworm,Avitellina sandgroundi, from Hippotragus equinus. Ann. Trop. Med. Parasitol. 29, 185–189.

Yamaguti, S. 1959. Systema Helminthum, Vol. II, The Cestodes of vertebrates, Interscience Pub. INC, New York London, 1-860.

Zhao WJ et. al. 2009. Generation and analysis of expressed sequence tags from Cdna library of Moniezia expansa. Mol.Biochem Parasitol, 164:80.