

Description of new nematode species *Rhabdochona (Rhabdochona) sindhicus* of genus *Rhabdochona* (Railliet, 1916) from Indus River Pakistan

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Abstract

New nematode species of genus *Rhabdochona* collected from host catfishes *Rita rita* of Indus River, Jamshoro, Sindh, Pakistan. Collected nematodes were processed with standard method for feature research. New species *Rhabdochona (Rhabdochona) sindhicus* differs from other species of genus with body shape and size, buccal capsule shape, prostomal teeth arrangement, nerve ring position, 18 pairs of caudal papillae, spicules shape curved and broad anteriorly and pointed posteriorly, female genital structures, shape of posterior end in male and female, eggs shape and boundary. Due to morphometric differences between present and previously described species of *Rhabdochona* the *Rhabdochona sindhicus* n. sp. proposed.

Keywords: Nematodes, *Rhabdochona sindhicus* n. sp., Freshwater fish, *Rita rita*, Sindh.

Fish is superb source of food. Its flesh is rich in minerals and vitamins and stumpy in saturated fats. Its flesh nutritionally equivalent to mutton in protein contents. Fish should be restricted from all types of infections to obtain healthy fish. Therefore, the world policy maker are attempting to make the fish as supplement of food source in view of increased food demand, food security and earning of income for poor people (World Fish Centre, 2011). Throughout the world fishes infected from varieties of parasitic infections which result in mortality of fish (Lerssutthichawal, 1999). Especially the helminth parasites of fish which live in the alimentary canal damage the lining wall of host and some other organs. The parasitic activities cause injuries to fish tissues (Khanum *et al.*, 2008). Human also effected from few helminth parasites transfer by fish as host (Wisniewski, 1958). Reports on helminth parasites of freshwater catfishes from Pakistan are (Ahmad *et al.*, 2014; Ayaz *et al.*, 2013; Khanum *et al.*, 2008; Kakar

and Bilqees, 2008; Soofi *et al.*, 2015, 2016a, 2016b, 2016c, 2016d, 2016e, 2017).

The genus *Rhabdochona* was created by Railliet (1916). Authors like Gustafson (1949), Choquet (1951), Jainszeuska (1955), Roytman & Trofimenko (1964), Rasheed (1965), Holloway and Kiewar (1969), Moravec (1972, 1975), Margous *et al.* (1975) study the taxonomy and morphology of the genus *Rhabdochona*, and the characters of egg has been generally selected as a key feature for the genus. Moravec (1972) on the basis of egg types had split the genus *Rhabdochona* into three subgenera, *Rhabdochona*, *Filochona* and *Globochona*. These parasites were found in the intestinal tract of their fresh water fishes and their host, but *R. praecox* Pionar & Kannangara (1972) was found from crab; *R. puylaerti* Moravec (1983) from snake; *R. parastromatei* Bilqees (1979), *R. marina* Lakshmi & Sudha (1999) and *R. indiana* Lakshmi (2001) from marine fishes.

Species has been reported from world viz., *R. milesi* Kakar *et al.*, (2008), *R. uvaginus* Kakar & Bilqees (2007), *R. annai* Kakar *et al.*, (2012) *R. kharani* Kakar *et al.*, (2006), *R. hellichi* Skryabin (1917) and Moravec *et al.*, (2010), *R. hospeti* Thapar (1950) and Moravec *et al.*, (2010), *R. papuanensis* Moravec *et al.*, (2008), *R. mujibi* Kakar & Bilqees (2009), *R. hingoli* Kakar & Bilqees (2007), *R. bifidum* Kakar & Bilqees (2007), *R. pakistanica* Kakar *et al.*, (2012), *R. megasacculata* Ghazi & Rahim (1999), *R. magnavesicula* Kakar & Bilqees (2008), *R. cavasius* Rehana & Bilqees (1973), *R. Pseudomysti* Moravec & Yookan (2011), *R. acuminata* Molin (1860) and Cremona *et al.* (2002), *R. centroafricana* Moravec & Jirku (2014), *R. marcusenii* Moravec & Jirku (2014), *R. tigridis* Moravec *et al.*, (2009), *R. ahuehuellensis* Mdril & Leon (2003), *R. Mexicana* Caspeta-Mandujano *et al.*, (2000), *R. ictaluri* Aguilar-Aguilar *et al.*, (2010).

Materials and Methods

Host catfishes *Rita rita* of Indus River, Jamshoro, Sindh, Pakistan gathered from aquatic habitats during December 2014 to May 2016. Live fishes were carried to the Department of Zoology, University of Sindh, Jamshoro. Host was dissected longitudinally. The entire alimentary canal along with other organs, separated in petri plates in saline solution and examined thoroughly under stereodissecting microscope. Processing of recovered nematodes was done by killing specimens in hot 70% ethanol and preserved in alcohol-glycerol solution in glass vials. Temporary mounts made for the detailed study. Diagrams were made with the help of Camera Lucida. Measurements were taken in millimeters (mm) whereas those of eggs in micrometer (μm). Storing of all labeled specimens were deposited in the Department of Zoology, University of Sindh, Jamshoro, Sindh, Pakistan.

Results and Discussion

Systematic position:

Family: Rhabdochoniidae Wigdor, 1916

Genus: *Rhabdochona* Railliet, 1916

Species: *Rhabdochona sindhicus* n. sp.

Host: *Rita rita*

Site of infection: Intestine

Locality: River Indus Jamshoro, Sindh, Pakistan

Number of specimen: 58 (48 ♀ & 10 ♂) from 56 hosts

Etymology: New species refer to name of Province Sindh from where host were collected.

Description:

General: Body of worm elongate, anterior end broad with highly curved posterior end in male and straight in female. Body covered with thick, irregular striated cuticle. Male worm widest at pre-equatorial region and female at post-equatorial region. Buccal capsule funnel shape broad anteriorly and narrow posteriorly. Prostome triangular in shape bear 8 conical teeth (2 at each lateral side, 2 dorsal and 2 ventral). Nerve ring encircle at posterior end of buccal capsule. Muscular esophagus straight in male and curved in female. Glandular esophagus elongate curved at some points. Posterior end of male highly curved with rounded tip, 18 sets of caudal papillae including 5 postanal and 13 preanal. Two spicules curved, rounded, broad anteriorly and pointed posteriorly. Posterior end of female straight with pointed tail. Anus just above the tail region. Vulva postequatorial in region with pointed vulvar lips, vagina elongate and muscular, uterus filled with eggs. Eggs oval in shape, double walled, embryonated, without filaments.

Male: Body of the worm measures 9.3-10.16 X 0.1-0.8. Prostome measures 0.01-0.03. Mesostome measures 0.045-0.049. Muscular esophagus measures 0.4-0.7 × 0.04-0.06. Glandular esophagus measures 1.21-1.43 × 0.06. Larger spicule measures 0.06-0.09 × 0.008-0.009. Smaller spicule measures 0.04-0.07 × 0.005-0.006. Tail measures 0.11-0.13.

Female: Body of the female measures 11.38-13.23 X 0.12-0.13. Prostome measures 0.04-0.07. Mesostome measures 0.064-0.069. Muscular esophagus measures 0.6-0.11 × 0.06-0.07. Glandular esophagus measures 1.46-1.76 × 0.068-0.071. Genital pore from posterior extremity measures 1.52-1.53. Vulva measures 0.012-0.013. Vagina measures 0.27-0.31. Tail measures 0.15-0.17. Eggs measures 0.032-0.043 × 0.024-0.026.

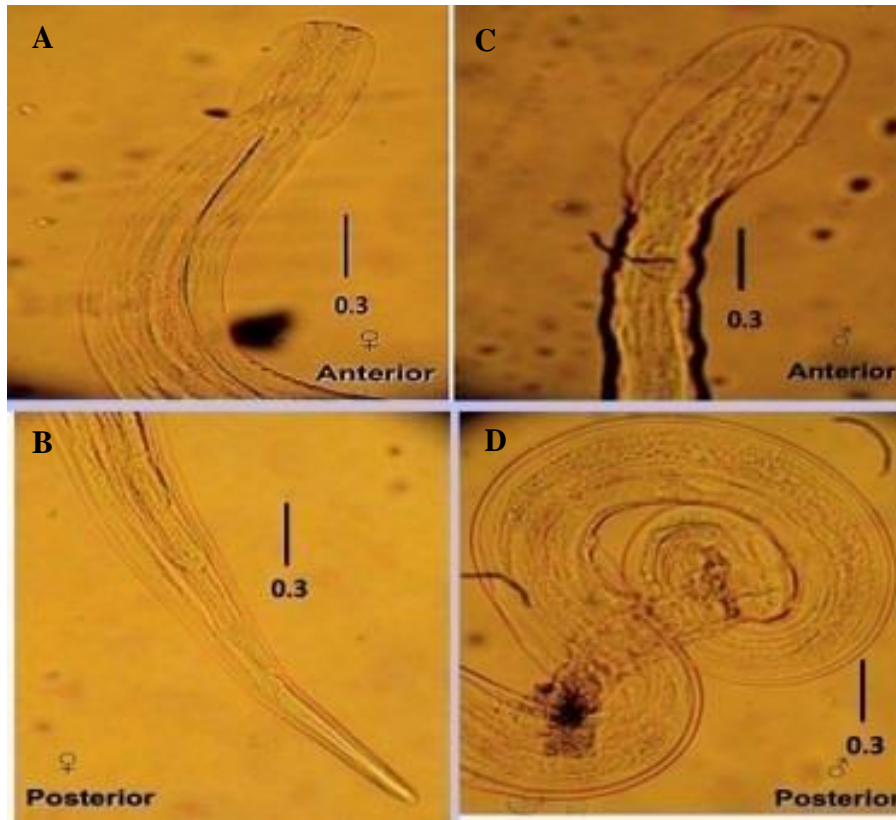


Fig. 1. *Rhabdochona sindhicus* n. sp. (A-D) A: Anterior region of female; B. Posterior region of female; C. Anterior region of male; D. Posterior region of male. Scale (10 X 3.5X).

Remarks: The comparison (Tables 1 and 2) of new species with earlier described species of genus including:

R. (R). milesi Kakar *et al.* (2008) from *Cyprinion milesi* of Balochistan, Pakistan differs from new species in having smaller length; cephalic end bear 2 cephalic papillae; 10 prostomal teeth; derides present; large spicule anteriorly straight tip with rounded chitinous knob, posteriorly pointed; small spicule spherical anteriorly and flat posteriorly separated in two portions; 13 pairs of caudal papillae; vulval lips beak like; eggs rounded to oval. *R. (R). uvaginus* Kakar & Bilqees (2007) from fish *Tor putitora* of Balochistan, Pakistan varies in new species from

having smaller in length; a set of cephalic papillae; vulva contain two elongate lips bent ventrally; vagina U-shaped; eggs rounded to oval; large spicule curved posteriorly and congested at tip; small spicule rounded at proximal end and bent ventrally; 13 pairs of caudal papillae.

R. (R). annai Kakar *et al.* (2012) from fish *Tor putitora* of Balochistan, Pakistan differs to new species in having reduced length; buccal capsule cup-shaped in female and trilateral in male; a set of cephalic papillae, derides exist; large spicule bent anteriorly and bilobed tip posteriorly; small spicule bent anteriorly and triangular at posteriorly; 15 pairs of caudal papillae; vulva beak shaped; excretory vesicle in male.

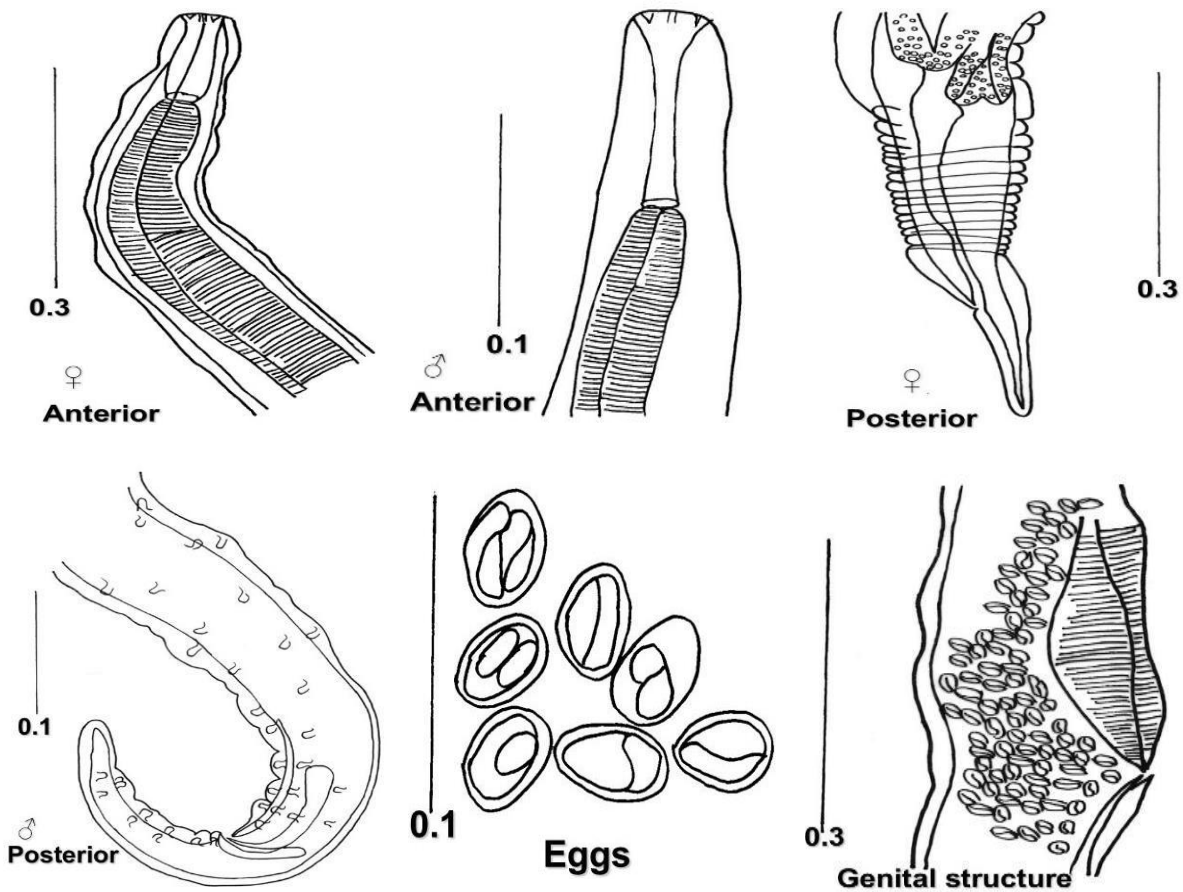


Fig. 2. *Rhabdochona sindhicus* n. sp. Anterior and Posterior Diagrams of Male and Female Worm with genital structure.

R. (R.) kharani Kakar *et al.* (2006) from fish *Lebeo gedrosicus* of Balochistan, Pakistan varies from present species in having reduced in length; a pair of cephalic papillae spicules shape; vulvar lips triangular; vagina enclosed in bulbous structure.

R. (R.) hellichi Sramek, 1917 and Moravec *et al.* (2010) from *Schizothorax* species of Bangladesh and India varies from present species in having mouth hexagonal with 4 submedian sublabia; 14 prostomal teeth; two pairs of cephalic papillae; a set of amphid; derides present; tail sharply pointed in both; excretory pore preequatorial; large spicule bifurcated tip; small spicule with posterior barb at distal tip; 16 sets of caudal papillae.

R. (R.) hospiti Thapar, 1950 and Moravec *et al.* (2010) from fish *Tor* species of India varies from present species in having mouth hexagonal with 4 submedian sublabia; 14 prostomal teeth; two pairs of cephalic papillae; a set of amphid; derides present; large spicule narrowed at distal tip; small spicule with barb at distal tip; 15-16 sets of caudal papillae.

R. (R.) papuanensis Moravec *et al.* (2008) from *Melanotaenia affinis* of New Guinea differs in new species in having smaller in length; mouth hexagonal; 14 prostomal teeth; 4 sets of cephalic papillae; a pair of amphids; derides present; large spicule distal tip expanded; small spicule with dorsal barb at distal tip; 16 sets of caudal papillae.

Table 1. Comparison of present species with closely related species of genus *Rhabdochona*.

| Species | Present species | | <i>R. mujibi</i> Kakar and Bilquees, 2009 | | <i>R. pseudomysti</i> Moravec and Yookan, 2011 | | <i>R. annai</i> (Kakar <i>et al.</i> , 2012 | | <i>R. centroafricana</i> Moravec and Jirku, 2014 | |
|----------------------------|-----------------------------|---------------------------|--|-----------------------------|---|-------------------|--|-----------------------------|---|-----------|
| | Female | Male | Female | Male | Female | Male | Female | Male | Female | Male |
| Host | <i>Rita rita</i> | | <i>Tor putitora</i> | | <i>Pseudomystus siamensis</i> | | <i>Tor putitora</i> | | <i>Barbus miolepis</i> | |
| Locality | Pakistan | | Pakistan | | Thailand | | Pakistan | | Africa | |
| Teeth | 8 | 8 | 8 | 8 | 14 | 14 | 8 | 8 | 14 | 14 |
| Body length | 11.38-13.23 | 9.3-10.16 | 3.3-3.6 | 4.4-4.6 | 15.22-21.75 | 10.68-12.76 | 4.43-6.56 | 3.68-4.55 | 15.82 | 6.72 |
| Greatest width | 0.12-0.13 | 0.1-0.8 | 0.1-0.12 | 0.13-0.13 | 150-163 | 95-122 | 0.13-0.15 | 0.09-0.12 | 163 | 109 |
| Prostome | 0.04-0.07 | 0.01-0.03 | 0.004-0.005 ×0.006-0.008 | 0.003-0.004 ×0.005-0.006 | 24 × 21 | 18-21 × 15- 18 | 0.006-0.009 ×0.004-0.007 | 0.003-0.005 ×0.005-0.007 | 21 × 15 | 27 × 15 |
| Mesostome | 0.064-0.069 | 0.045-0.049 | 0.006-0.007 ×0.007-0.009 | 0.012-0.014 ×0.009-0.01 | | | 0.007-0.01 ×0.008-0.011 | 0.008-0.11 ×0.007-0.01 | | |
| Muscular esophagus | 0.6-0.11 × 0.06- 0.07 | 0.4-0.7 × 0.04-0.06 | 0.05-0.07×0.005- 0.006 | 0.081-0.086 | 276-303 | 186-249 | 0.05-0.08 ×0.005- 0.008 | 0.042-0.067× 0.003-0.005 | 246 × 27 | 270 × 30 |
| Glandular esophagus | 1.46-1.76 × 0.068-0.071 | 1.21-1.43× 0.06-0.06 | 0.169-0.173 ×0.023-0.025 | 0.198-0.227 | 585-705 | 450-600 | 0.12-0.28 ×0.011- 0.025 | 0.14-0.25 ×0.008-0.016 | 1.71 × 81 | 2.12 × 81 |
| Large spicule | | 0.06-0.09× 0.008-0.009 | | 0.37- 0.39×0.01-0.02 | | 1.10-1.22 | | 0.38-0.53 ×0.008-0.014 | | 120 |
| Small spicule | | 0.04-0.07× 0.005-0.006 | | 0.084-0.087 ×0.017-0.019 | | 81-99 | | 0.07-0.12 ×0.02-0.034 | | 111 |
| Caudal papillae | | 18 pairs | | 15 pairs | | 18-19 pairs | | 15 pairs | | 14 pairs |
| Vulva | 0.012-0.013 | | 0.037-0.045 ×0.02- 0.03 | | | | 0.022-0.035 ×0.010.014 | | | |
| Vagina | 0.27-0.31 | | 0.021-0.23 ×0.043- 0.045 | | | | 0.19-0.27 ×0.020.031 | | | |
| Eggs | 0.032-0.043× 0.024-0.026 | | 0.034-0.042 ×0.024-0.033 | | | | 0.009-0.21 ×0.005- 0.012 | | 33 × 21 | |

Table 2. Comparison of present species with all new species of genus *Rhabdochona* recovered during current study.

| Species | <i>R. indusi</i> n. sp. | | Present species | |
|----------------------------|---|---|--|---|
| Host | <i>Rita rita</i> | | <i>Rita rita</i> | |
| Locality | Pakistan | | Pakistan | |
| Gender | Female | Male | Female | Male |
| Teeth | 8 | 8 | 8 | 8 |
| Body | Elongated 38.081–43.020 | Elongated 9.121–10.167 | Elongate 11.38-13.23 | Elongate, anteriorly broad and highly curved posteriorly 9.3-10.16 |
| Greatest width | In front of the female 0.312–0.428 | In posterior part of male 0.126–0.248 | At postequatorial region 0.12-0.13 | At preequatorial region 0.1-0.8 |
| Prostome | 0.064–0.069 X 0.04–0.06 | 0.01–0.04 X 0.006–0.008 | Triangular in shape 0.04-0.07 | Triangular in shape 0.01-0.03 |
| Mesostome | 0.052–0.060 X 0.032–0.040 | 0.014–0.017 X 0.005–0.008 | 0.064-0.069 | 0.045-0.049 |
| Muscular esophagus | Double lined uncovered pattern 0.288–0.380 X 0.024–0.030 | Double lined uncovered pattern 0.06–0.09 X 0.006–0.007 | Curved in female. 0.6-0.11 × 0.06-0.07 | Straight in male 0.4-0.7 × 0.04-0.06 |
| Glandular esophagus | Smaller, broader 5.04-5.35 × 0.275-0.483. | Smaller and broader 4.151–5.791 X 0.077–0.092 | Elongate curved at some points 1.46-1.76 × 0.068-0.071 | Elongate curved at some points 1.21-1.43 × 0.06-0.06 |
| Large spicule | | Rounded in front, with small groove at lateral side, piercing posteriorly with bent ventrally 0.03–0.06 X 0.004–0.008 | | Curved, rounded, broad anteriorly and pointed posteriorly 0.06-0.09 × 0.008-0.009 |
| Small spicule | | Rounded anteriorly and piercing posteriorly 0.022–0.040 X 0.016–0.020 | | Curved, rounded, broad anteriorly and pointed posteriorly 0.04-0.07 × 0.005-0.006 |
| Caudal papillae | | 19 pairs | | 18 pairs |
| Vulva | Marginal 0.012–0.015 X 0.028–0.030 | | Postequatorial in region with pointed vulvar lips 0.012-0.013 | |
| Vagina | vagina muscular directed posteriorly 0.16–0.019 X 0.06–0.07 | | vagina elongate and muscular 0.27-0.31 | |
| Egg | Double walled, almost round to ovoid in shape 0.04–0.07 X 0.088–0.090 | | Oval in shape, double walled, embrocated, without filaments. 0.032-0.043 × 0.024-0.026 | |

R. (R). mujibi Kakar & Bilqees (2009) from *Tor putitora* of Balochistan Pakistan varies from present species in having smaller in length; a pair of cephalic papillae; deirids present; large spicule curved ventrally, narrow ending into a flat base, pointed both side; 15 sets of caudal papillae; vulva with C-shaped structure.

R. (R). hingoli Kakar & Bilqees (2007) from fish *Cyprinion milesi* of Balochistan, Pakistan varies from present species in having smaller in length; buccal capsule cup shaped; 6 prostomal teeth; two cephalic papillae; large spicule bent at both end; small spicule ventrally curved anteriorly and narrow posteriorly; 15 pairs of caudal papillae.

R. (R). bifidum Kakar & Bilqees (2007) from fish *Tor putitora* of Balochistan, Pakistan varies from present species in having buccal capsule cup shaped; 6 prostomal teeth; two cephalic papillae; deirids present; large spicule broad anteriorly and narrow with bifid at posteriorly; small spicule curved anteriorly, narrow and curved with bifid tip posteriorly; 15 sets of caudal papillae.

R. (R). pakistanica Kakar *et al.* (2012) from fish *Cyprinion watsoni* of Baluchistan, Pakistan varies from present species in having buccal capsule pentagonal; 8 prostomal teeth; a pair of cephalic papillae; deirids present; large spicule with bifid; small spicule rounded at proximal end and trophy shaped at anteriorly; 12 pairs of caudal papillae; vulval lip beak shaped.

R. (R). megasacculata Ghazi & Rahim (1999) from fresh water fish *Birliius vagra* of Islamabad, Pakistan varies from present species in having cuticle smooth; 10 teeth; genital opening open through broader opening with globular, sac like feature follow vagina.

R. (R). magnavesicula Kakar & Bilqees (2008) from fish *Schizocyprus brucei* of Balochistan, Pakistan varies from present species in having smooth cuticle; 3 rectal glands at posterior end; 10 prostomal teeth; buccal capsule oval; a pair

of cephalic papillae; deirids present; female contain circular sucker like excretory vesicle with tube extending from them; large spicule bent ventrally into bilobed at terminal portion; small spicule spindle shaped; 9 pairs of caudal papillae.

R. (R). cavasius Rehana & Bilqees (1973) from *Mystus cavasius* of Pakistan differs by new species in having 3 prostomal teeth; buccal capsule cup-shaped; 14 pairs of caudal papilla.

R. (R). Pseudomysti Moravec and Yooken (2011) from *Pseudomystus siamensis* of Thailand differs by new species in having hexagonal mouth with 4 sublabia; 4 cephalic papillae, a pair of amphid; large spicule with expanded distal tip; small spicule narrow; tail pointed.

R. (R). acuminata Molin, 1860 and Cremonte *et al.* (2002) from *Diplomystus mesembrinus* of Argentina varies from present species in having rectangular mouth with 8 cephalic papillae, a pair of amphid; deirids present; 14 prostomal teeth; 10 pairs of caudal papillae; tail with phasmids; large spicule hook shape tip; small spicule with distal tip.

R. (R). ictaluri Aguilar-Aguilar *et al.* (2010) from *Ictalurus pricei* of Mexico varies from present species in having smooth cuticle; oval in shape mouth with 4 cephalic papillae, a set of amphid; 6 prostomal teeth; tail of both sexes with spike; 10 pairs of caudal papillae; large spicule with bifurcated tip; small spicule with dorsal barb at distal tip; vulva pre-equatorial.

R. (R). mexicana Caspeta-Mandujano *et al.* (2002) from *Astyanax mexicanus* of Mexico varies from present species in having smooth cuticle; mouth oval shape; 14-15 pairs of caudal papillae; large spicule expanded at tip.

R. (R). ahuehuellensis Mejia-Madrid and Leon (2003) differs from present species in having oval shape mouth with 8 cephalic papillae, a pair of amphid; 10 prostomal teeth; tail of both sexes with spike; 11-15 pairs of caudal papillae; large

spicule expanded at tip; small spicule with dorsal barb at distal tip.

R. (R). centroafricana Moravec & Jirku (2014) gathered from intestine of *Barbus miolepis* of Africa differs by new species in having smaller in length; tetragonal mouth with 4 sublabia; 4 cephalic papillae, a pair of amphid; 14 prostomal teeth; 14 sets of caudal papillae; large spicule with bifurcated tip; small spicule boat shape.

R. (R). marcusenii Moravec & Jirku (2014) gathered from intestine of *Marcusenius greshoffi* of Africa differs by new species in having smaller in length; hexagonal mouth with 4 sublabia; 4 cephalic papillae, a pair of amphid; 14 prostomal teeth; 11 sets of caudal papillae; large spicule expanded at tip; small spicule with dorsal barb at distal tip.

R. (R). tigridis Moravec *et al.* (2009) gathered from intestine of *Copoeta trutta* and *Cyprinion macrostomum* of Iraq varies from present species in having oval shape mouth with 8 cephalic papillae, a pair of amphid; 14 prostomal teeth; tail of both sexes with spike; 14 pairs of caudal papillae; large spicule expanded at tip; small spicule with posterior barb at distal tip; vulva equatorial.

R. (R). indusi Soofi *et al.* (2017) gathered from intestine of *Rita rita* of Pakistan differs by species in having 8 prostomal teeth; excretory pore in posterior extremity of body; larger spicule rounded anteriorly, with small groove at lateral side, pointed posteriorly with curved ventrally, without uniform thickness; smaller spicule rounded anteriorly and pointed posteriorly; caudal papillae are 19 pairs; genital opening post-equatorial in position; vulva marginal; anterior vulvar lip hook shape and posterior vulvar lip pointed, vagina muscular directed posteriorly; eggs are double walled, almost round to oval in shape; tail of the worms is strongly curved in male and slightly curved in female.

New species *Rhabdochona sindhicus* on the basis of differential diagnostic characteristics from other species of genus including body form and size, buccal capsule shape, prostomal teeth arrangement, nerve ring position, quantity and organization of caudal papillae 18 sets, spicules shape curved, broad anteriorly and pointed posteriorly, female genital structures, shape of posterior end in male and female, eggs shape and proposed as such.

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