Journal of Coastal Life Medicine

journal homepage: www.jclmm.com

Original article doi: 10.12980/jclm.4.2016J6-181

Parasitic nematodes of amphibians from Lombok Island, Indonesia with description of *Camallanus senaruensis* sp. nov. and *Meteterakis lombokensis* sp. nov.

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ARTICLE INFO

Article history:
Received 6 Sep 2016
Accepted 12 Sep 2016
Available online 14 Sep 2016

Keywords:
Nematode
Camallanus senaruensis sp. nov.
Meteterakis lombokensis sp. nov.
Amphibian
Lombok Island

ABSTRACT

Objective: To determine and describe the nematode species of amphibians collected from Lombok Island, West Nusa Tenggara, Indonesia.
Methods: The materials examined were found in the intestines of twenty-four *Fejervarya cancrivora* (*F. cancrivora*), sixteen *Fejervarya verruculosa*, six *Duttaphyrnus melanostictus* (*D. melanostictus*) from Senaru and Gangga District, Lombok Island on April 2015. The amphibian hosts were collected by hand. Before observing the nematodes, the hosts were anesthesized to death with chloroform. The ventral of the host was opened by longitudinal incision and the internal organs were removed, placed separately in the Petri-dish and then examined under a dissecting microscope. The nematodes found were fixed with warm 70% alcohol. The specimens for light microscope observation were cleared in glycerol and mounted in the same solution, and for the SEM Jeol scanning electron microscope 5310 low vacuum were re-fixed in caccodylate buffer and glutaraldehyde, dehydrated through a graded series of alcohol and vacuum-dried using TAITEC Vacuum-96Nitrogen, prior to attaching to stubs with double sided cello-tape, coated with gold 400 Å thickness in an Eico I-B2 ion coater. Drawings were made with the aid of a drawing tube attached to a Nikon compound microscope. Measurements were given in micrometers (μm) as the average, followed by the range in parentheses, unless otherwise stated.
Results: Two new species of nematodes were found and described herein: *Camallanus senaruensis* sp. nov., and *Meteterakis lombokensis* sp. nov., parasitic in the intestine of *F. cancrivora* and *D. melanostictus*, respectively. *C. senaruensis* differs from other congeners in having a bluntly rounded tip of tail in the male and female, the structure of trident and having teeth in the buccal capsule. *Meteterakis lombokensis* differs from other previously described species in having no vulval flap, has a strongly widened proximal end of spicules, forming a cup shaped, and the number of caudal papillae. Others species found are *Meteterakis singaporensis* from *D. melanostictus*, and *Chabaudus rauschi* (*Ch. rauschi*) from sixteen *F. cancrivora* and eight *Fejervarya verruculosa*.
Conclusions: The species of parasitic nematodes from Lombok Island are common in amphibians, but *Camallanus*, *Meteterakis singaporensis*, *Ch. rauschi* are the new record in Indonesia. The dominant species found in Lombok Island is *Ch. rauschi*.

1. Introduction

Acaudated amphibians could be a final host for a great number of parasite nematode species. Some of them may also have potential zoonotic and may affect animal and human health[1]. However, helminths are the most common invertebrate parasites of amphibians. In spite of this fact, the helminths of amphibian parasites in Indonesia have so far been rarely studied[2]. Some species of *Meteterakis* from amphibians have been reported from Indonesia: *Meteterakis wonosoboensis* (*M. wonosoboensis*), *Meteterakis japonica* (*M. japonica*) in Central and West Java, and *Meteterakis longispiculata* from Gecko gecko[2,3].

Lombok is a small island in Indonesia in the southwest of the Wallacea line as a transition zone between the Asian and Australian faunal biodiversity. This island is an integral part of the chain of the Lesser Sunda Islands. In Lombok Island and Nusa Tenggara harbor, there are at least eleven species of amphibian[4]. However, to our knowledge, there have been no previous papers dealing with nematodes from anuran amphibians from Lombok. During research on Lombok Island, two new species and two new records of nematodes were found from amphibians, *i.e.*, *Meteterakis*

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Foundation Project: Supported by the project "DIPA of Research Centre for Biology 011/2015: Keanekaragaman dan Potensi Biota Nusa Tenggara", sponsored by Indonesian Institute of Sciences.
The journal implements double-blind peer review practiced by specially invited international editorial board members.

lombokensis sp. nov (*M. lombokensis*) and *Camallanus senaruensis* sp. nov. (*C. senaruensis*), *Meteterakis singaporensis* Sandosham 1954 (*M. singaporensis*), *Chabaudus rauschi* Le Van Hoa & Pham Ngoc Khue, 1971 (*Ch. rauschi*). The descriptions of all of those nematodes were presented in this paper.

2. Materials and methods

The materials examined were collected from the intestine of the *Fejervarya cancrivora* (*F. cancrivora*) (24), *Fejervarya verruculosa* (*F. verruculosa*) (14) and from *Duttaphyrnus melanostictus* (*D. melanostictus*) with four from Senaru and two from Gangga District, Lombok Island on April 2015. The amphibian hosts were collected by hand. Before observing the nematode, the hosts were anesthesized to death with chloroform. The ventral of the host was opened by longitudinal incision and the internal organs were removed, placed separately in the Petri-dish and then examined under a dissecting microscope. The nematodes found were fixed with warm 70% alcohol. The specimens for light microscope observation were cleared in glycerine-alcohol and mounted in the same solution. Drawings were made with the aid of a drawing tube attached to a Nikon compound microscope. Measurements were given in micrometers (μm) as the average, followed by the range in parentheses, unless otherwise stated. Specimens for SEM were re-fixed in caccodylate buffer and glutaraldehyde, dehydrated through a graded series of alcohol and vacuum-dried using TAITEC Vacuum-96Nitrogen, prior to attaching to stubs with double sided cello-tape, coated with gold 400 Å thickness in an Eico I-B2 ion coater and observed with a Jeol scanning electron microscope 5310 low vacuum scanning electron microscope.

3. Result

The nematode found in this research were two new species: *C. senaruensis* sp. nov. from one *D. melanostictus* and *M. lombokensis* sp. nov. from three *D. melanostictus*; *M. singaporensis* from one *D. melanostictus*; *Ch. rauschi* from 16 *F. cancrivora* and from eight *F. verruculosa.*

3.1. C. senaruensis sp. nov

3.1.1. General descriptions

The body of *C. senaruensis* sp. nov (Figures 1A–1F and Figures 2N–2P) is thin and small, it has a cuticle surface with thin striae, and the buccal capsule is laterally compressed, formed by two lateral valves, each of them bears 14–15 longitudinal ribs (Figures 1A, 1C, 2N and 2P). Tridents are present, beginning from the buccal capsule, hanging posteriorly, median branch longer than two laterals (Figures 1A and 1C). Some small chitinized toothlike processes were seen between the longitudinal ribs, projecting to the buccal cavity (Figure 1B, and Figure 2P). The chitinious ring is present at the junction of the posterior end of the buccal capsule and anterior part of the oesophagus (Figures 1A and 1C). The anterior end has four large lateral papillae, four sub-dorsal and four sub-median (Figure 1B). The nerve ring lies at the anterior extremity, excretory pore posterior to that, the oesophagus consist of anterior muscular part, club shaped and longer posterior part club shaped (Figure 1A).

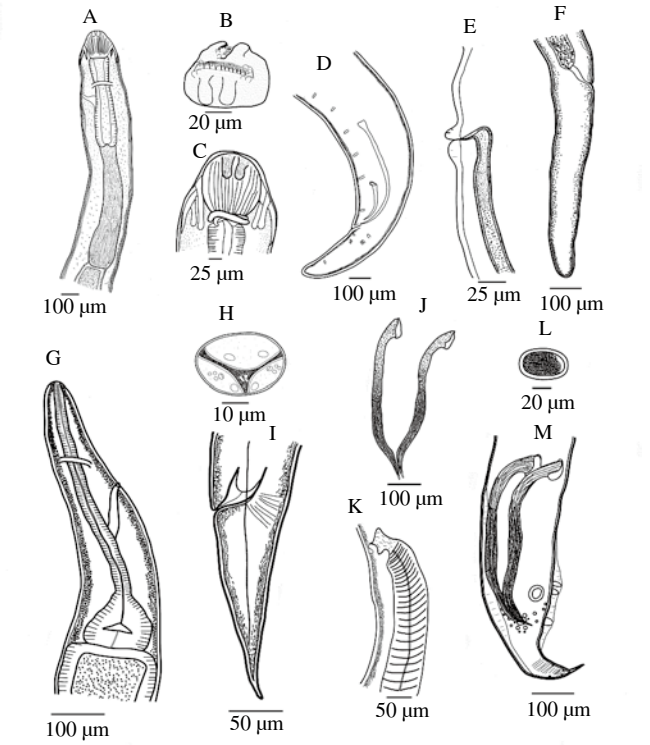
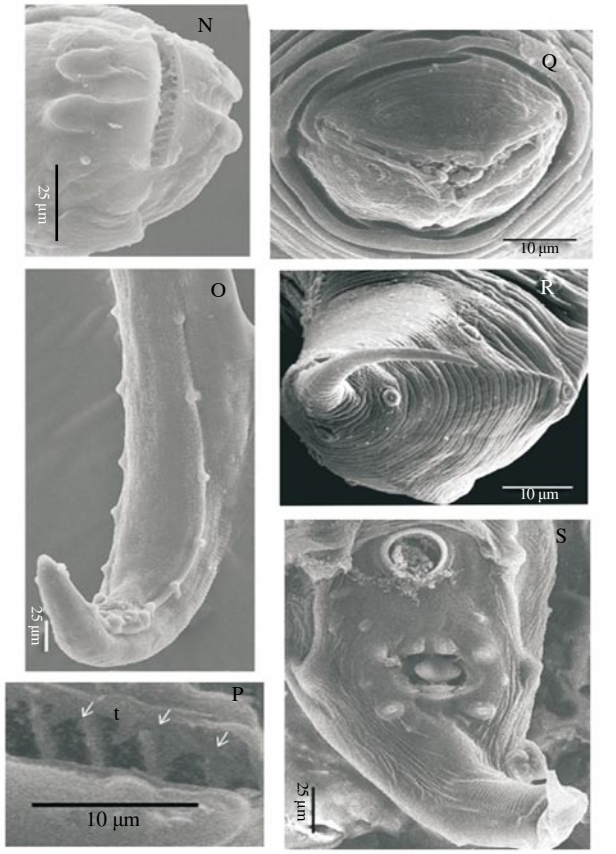


Figure 1. A: Anterior part of male, lateral view; B: Anterior tip, enface view; C: Buccal capsule, lateral view; D: Posterior end of male, lateral view; E: Vagina vera, lateral view; F: Posterior part of female, lateral view; G: Anterior part of male, lateral view; H: Anterior tip, en face view; I: Posterior part of female, lateral view; J: Spicules; K: Vagina vera, lateral view; L: Egg; M: Posterior part of male, ventral view, showing the sucker and caudal papillae.



Figures 2. N: Anterior tip of male, enface view; O: Posterior part of male ventro-lateral view; P: Longitudinal rib of buccal capsule (arrow) and tooth-like processus (t), en face view; Q: Anterior tip, enface view; R: Tail tip of male, showing lateral and subdorsal papillae and spike; S: Posterior part of male, lateral view.

3.1.2. Male (1 specimen)

The body is 5 045 μm long and 237 μm wide at the maximum level. The valves of buccal capsule is 163 μm long and 153 μm wide, median branch of tridents is 147 μm long and lateral branch 108 μm, chitinous ring is 6.4 (8.0–9.5) μm wide and 76 (65–87) μm long. Distance from anterior end to nerve ring and excretory pore are 260 μm and 221 μm, respectively, anterior part of oesophagus is 566 μm long, posterior part is 736 μm. Tail, bluntly rounded end without any processes, is 233 μm long. Spicules are unequal and dissimilar, left spicule is tubular and simple (Figure 1D), is 533 μm long, right spicule is shorter, 192 μm long. Caudal papillae consist of 6 pairs precloacal, 1 ad-cloacal, 1 pair just cloacal, 2 pairs lateral and 1 pair submedian behind that, 2 pairs and 1 pair after mid of tail, caudal alae is narrow, commencing from the first caudal papilla to mid of tail (Figure 1D).

3.1.3. Female (4 specimens)

The body is 5 184 (5 038–5 077) μm long and 153 (146–168) μm wide. The valves of buccal capsule is 163 (125–200) μm long and 164 (130–198) μm wide, median branch of tridents is 135 (130–139) μm long, and lateral branch 114 (111–117) μm long, chitinous ring is 10 (10–11) μm wide and 96 (95–100) μm long. Nerve ring and excretory pore are 175 (141–200) μm and 239 (206–271) μm from the anterior end, respectively, anterior part of oesophagus is 476 (457–530) μm, posterior part is 615 (594–700) μm long. Tail, bluntly rounded end without any processes (Figure 1F), is 864 μm long. Swollen cuticle is seen at anterior and posterior vulva (Figure 1E), vulva, located behind midbody, is 2 855 (2 807–2 903) μm from posterior end. Egg are not found.

This type host is *F. cancrivora* Gravenhorst (Amphibia: Anura). The locality of this type is Senaru, Bayan, South Lombok, Nusa Tenggara Barat Povince, Indonesia. The site of infection is intestine with specimens deposited in Museum Zoologicum Bogoriense, Research Center for Biology–Indonesian Institute of Sciences (LIPI) [Nos. MZBNa 713 (1 holotype male and 1 allotype female), MZBNa 714 (1 male paratype, 2 females paratype)]. The species name was given by the name of village locality where the specimens were found.

3.2. M. lombokensis sp. nov.

3.2.1. General descriptions

The body of *M. lombokensis* (Figures 1G–1M and Figures 2Q–2S) is small, the cuticle surface has transversal striae, thin lateral alae is present, commencing from the nerve ring to the mid of the tail in male and to almost the posterior end in female. Three triangular lips are present surrounding the anterior end, it's separated by groove, the dorsal lip is larger than two lateral lips, two large cephalic papillae are present at dorsal lip, each of two lateral lips with one large cephalic papilla, and an amphid, and three smaller papillae behind the amphid, three pharyngeal teeth are seen projecting from the buccal capsule, where the dorsal is the largest (Figures 1H and Figure 2Q). The nerve ring is located at the anterior extremity, excretory pore lies at the mid–level of the oesophagus. The oesophagus is slender, with a short pharynx, ending in a pear shaped bulb with valve (Figure 1G).

3.2.2. Male (7 specimens)

The body is 4 304 (3 900–5 120) μm long and 268 (213–380) μm wide. Pharynx is 71 (60–85) μm long, and oesophagus is 809 (750–880 long) μm, oesophageal bulb is 153 (148–163) μm long, and 122 (115–133) μm wide. The nerve ring and excretory pore are 292 (250–390) μm and 383 (320–410) μm from anterior end, respectively. Tail which is short with long spike, bent ventrally, is 213 (190–230) μm long (Figure 1M). Spicules which are areequal, similar, alate and tessellated, except at the tip, strongly widened at proximal end, are 478 (300–670) μm long (Figures 1J and 1M). Precloacal sucker is prominent with chitinious rim, ellipsoidal (Figure 1M), is 42 (40–43) μm long, and the distance from cloaca is 72 (70–73) μm. Large caudal papillae are 3 pairs, 2 at level of sucker, 1 pair at level of cloaca, small papillae are: 3 pairs anterior to cloaca, 1 pair at anterior rim of cloaca, 2 pairs ad–cloaca, 2 pairs behind cloaca, 2 pairs small near the tip of tail (Figure 1M and Figure 2S), some small lateral and sub–dorsal papillae present near tip of tail (Figure 2R), gubernaculum mass is present.

3.2.3. Female (12 specimens)

The body is 5 190 (3 910–5 990) μm long and 357 (213–415) μm wide. Pharynx is 72 (60–82) μm long and oesophagus 1 059 (830–1 180) μm long, oesophageal bulb is 176 (173–180) μm long and 153 (150–158) μm wide at maximum level. The nerve ring and excretory pore are 296 (145–360) μm and 438 (360–480) μm from anterior end, respectively. Tail is short, tapering, pointed tip, is 278 (190–355) μm long (Figure 1I). Vulva without vulval flap (Figure 1K), the distance 2 211 (1 760–2 630) μm from anterior end, vagina is running posteriorly (Figure 1K). Eggs are oval, and thick shelled (Figure 1L), its measure 67 (63–70) μm by 44 (42–48) μm.

This type host is *D. melanostictus* (Schneider, 1799) (Amphibia: Anura). The locality of this type is Lempenge, Rampek, Gangga, North Lombok, Nusa Tenggara Barat Province, Indonesia. The specimens were deposited in Museum Zoologicum Bogoriense, Research Center for Biology–LIPI with Nos. 1 holotype male and 1 allotype female (MZBNa 711), 2 males and 4 females paratype (MZBNa 712), 3 males and 3 females (MZBNa 719), 1 male and 4 females (MZBNa 720). The species name WASgiven by the name of island where the specimens were found.

3.3. M. singaporensis (Sandosham, 1954)

General descriptions are same with *M. lombokensis*.

3.3.1. Male (5 specimens)

The body is 5 501 (4 350–6 324) μm long and 410 (390–440) μm wide. Pharynx is 65 (60–70) μm long, and oesophagus 534 (420–640) μm long, oesophageal bulb is 171 (150–183) μm long and 123 (98–151) μm wide. The nerve ring and excretory pore are 347 (290–380) μm and 498 (420–640) μm from anterior end, respectively. Tail is short, strongly curved ventrally, is 246 (205–270) μm long. Spicules which are equal and similar, alate, and tessellated except at the tip, slightly widened at proximal end, are 771 (715–900) μm long. Precloacal sucker is ellipsoidal, less prominence, is 38 (35–40) μm long and 62 (60–63) μm from cloaca. Large caudal papillae are 3 pairs: 2 at level of sucker, 1 pair at level of cloaca, small papillae are: 3 pairs behind the sucker, 1 pair in the anterior rim of cloaca, 1 pair just posterior to cloaca, 1 pairs just posterior to cloaca, 5 small pairs postcloacal, gubernaculum mass is present.

3.3.2. Female (7 specimens)

The body is 6 230 (5 040–6 960) μm long and 437 (375–520 μm) wide. Pharynx is 60 (70–80) long and oesophagus is 1 009 (840–1 300), oesophageal bulb is 197 (180–210) μm long and 160 (150–170) μm wide. Nerve ring and excretory pore are 315 (301–320) μm and 534 (420–640) μm from anterior end, respectively. Tail is short tapering, pointed tip, is 366 (330–410) μm long. Vulva without vulval flap, 2 309 (1 860–2 820) μm from anterior end. Vagina is running posteriorly. Eggs are oval and thick shelled, its measure 67 (63–73) μmby 47 (45–48) μm.

The host of *M. singaporensis* is *D. melanostictus* (Schneider, 1799) (Amphibia: Anura). The locality is Senaru, Bayan, South Lombok, Nusa Tenggara Barat Povince, Indonesia. The specimens were deposited in Museum Zoologicum Bogoriense, Research Center for Biology–LIPI with Nos. MZBNa 715 (5 males, 7 females)

3.4. Ch. rauschi Le–Van– Hoa & Pham– Ngoc–Khue, 1971

3.4.1. General descriptions

The body is small, delicate and long. The mouth opening is hexagonal in shape, surrounded by six internal circle papillae, four external circle papillae, two amphids and four submedian papillae. Cephalic vesicle present, lateral alae commencing from the anterior end to the level of deirid. The buccal capsule has three teeth, one dorsal larger than two sub–ventral. The oesophagus is short, attenuated anteriorly, followed by tubular and end in an elongated bulb. The deirid vary in position, at level of mid bulb or just at the posterior end of the oesophagus. The nerve ring lies at the anterior of the oesophagus, excretory pore behind the oesophagus.

3.4.2. Male (5 specimens)

The body is 13 000 (9 971–18 200) μm long and 158 (128–200) μm wide at maximum level. Nerve ring, deirid and excretory pore are 175 (170–180) μm, 368 (290–464) μm and 440 (360–520) μm from anterior end, respectively. Oesophagus is short, club shaped, is 488 (470–510) μm long. Tail is short, tapering bent ventrally, is 179 (163–200) μm long. Spicules are subequal, similar, alate, except at the tip, right spicule is 265 (233–306) μm long and left spicule is 307 (268–354) μm. Precloacal sucker is ellipsoidal, is 100 μm long and 35 μm wide, located at 470 μm from cloaca. Caudal papillae are 10 pairs, 6 precloacal, 4 postcloacal. Gubernaculum small, V shaped with thick cuticle frame, is 55–56l μm long and 20–23 μm wide.

3.4.3. Female (9 specimens)

The body is 16 460 (10 910–27 180) μm long and 192 (135–260) μm wide. Nerve ring, deirid and excretory pore are 210 (200–220) μm, 460 (420–500) μm, and 510 (520–550) μm from anterior end, respectively. Oesophagus is 497 (450–560) μm long. Vulva is 880 μm from anterior end, vagina is running posteriorly. Tail is short, tapering, pointed tip, is 243 (210–290) μm long. Eggs are thick shelled, its measure 65–68 by 60–62 μm.

The host of *Ch. rauschi* is *F. cancrivora* Gravenhorst, *F. verruculosa* (Roux) (Amphibia: Anura). The locality is Senaru, Bayan, South Lombok, Nusa Tenggara Barat Povince, Indonesia. The specimens were deposited in Museum Zoologicum Bogoriense, Research Center for Biology-LIPI with Nos. MZBNa 717 (5 males, 9 females).

4. Discussion

The first species of *Camallanus* described was *Camallanus lacustris* (Zoega, 1776) from fish in Europe. To date, more than 90 species have been described from Asia mainly India, Africa, Europe and South and North America[5,6]. The *Camallanus* from amphibians are *Camallanus baylisi* Karve, 1930 (syn. of *Camallanus nigrescens* Linstow, 1906); *Camallanus bufonis* Agrawal, 1967; *Camallanus inglisi* Agrawal, 1967 (syn. *Camallanus thapari* Gupta, 1959, all from *Rana tigrina*, and *Camallanus nodulosus* Gupta, 1959 from *Rana cyanophylectis*); *Camallanus cyanophylectis* Sahay, 1966 from *Rana cyanophylectis* Rigby and Rigby, 2014[7]. *Camallanus* in this study differs from *Camallanus baylisi* in the bifid male tail and same length of the trident's branch. This new species differs from *Camallanus bufonis* in the bifid female tail and undeveloped middle branch of tridents and from the *Camallanus cyanophylectis* in the bifid female tail and it only has a right spicule. It also differs from *Camallanus inglisi* in the bifid tip in male tail. It differs from the *Camallanus pipientis* Walton, 1935 from *Rana pipiens*, USA in no teeth in buccal capsule, right spicule with hook–like process at the tip. This new species also differs from some species of *Camallanus* from African amphibians *i.e.*, *Camallanus multiruga* Walton, 1932 (*C. multiruga*) in no teeth in buccal capsule, branches of trident are the same and shorter length, *Camallanus mazabukae* Kung, 1948 in tetragonal thickening of anterior corner of valves, distinct right spicule, tip of female tail with five cuticular spines; *Camallanus*

kaapstaadi Southwell and Kirschner, 1937 in tail of male with two spines, female with three spines; *C. johni* Yeh, 1960 in posterior part of the buccal capsule ending in six processes, tail male with bifid, female with four spines.

The parasitic nematode from amphibians collected from Lombok were also found in Java[2] except *Camallanus*, that species is the new record in Indonesia. *Camallanus* from amphibians reported before commonly have two or more spines in the tip of tail, both on the male and the female. *Camallanus* in amphibians with bluntly rounded tip tail besides *C. senaruensis* is male of *C. multiruga*. Longitudinal ribs of lateral valves of buccal capsule vary in number, between the ribs the teeth are present, except in *Camallanus pipientis* and *C. multiruga*.

The type species of *Meteterakis* were *Meteterakis govindi* from *Bufo melanostictus* (= *D. melanostictus*) in Burma (Myanmar)[6]. Currently, twenty–four species have been known from amphibians and reptiles[2,8,9]. The species hitherto reported from Indonesia are *Meteterakis longispiculata*[10] (Inglis, 1958) found from Gecko gecko (Linnaeus), *M. japonica* (Wilkie, 1930) and *M. wonosoboensis* from *F. cancrivora* both from and Central Java[2,3]. *M. lombokensis* sp. nov. is closest to *Meteterakis ishikawanae* Hasegawa (*M. ishikawanae*), 1987 in having the vulva without vulval flap and the same body length. However, the spicules of *Meteterakis* in the present study have a strongly widened proximal end, forming a cup shape, while *M. ishikawanae* has slightly widened spicules at the proximal portion. Although the body length is almost same, but the pharynx, distance of precloacal sucker to cloaca, spicules and egg of *Meteterakis* in the present study are longer *i.e.*, 72 μm *vs.* 33 μm,71 μm *vs.* 58 μm, 771 μm *vs.* 590 μm and 67 μm × 44 μm *vs.* 78 μm × 44 μm, respectively. This new species differs from *Meteterakis lyricocephali* Crusz and Ching, 1975, *Meteterakis bufonis* (Biswas and Charkavaty, 1963) and *Meteterakis amamiensis* Hasegawa, 1990 in having equal spicules. It differs from *M. wonosoboensis* by having slender, longer and not widened proximal end of spicules. This new species also differs from *Meteterakis triaculeata* (Kreis, 1933), *Meteterakis mabuyi* Chakarvaty, 1944, *Meteterakis ghambiri* Zhang & Zhang, 2011, *Meteterakis guptai* Gupta & Naiyer, 1993, *Meteterakis sinharajensis* Crusz & Ching, 1975, *Meteterakis govindi* Karve, 1930 and *M. singaporensis* Sandhosam, 1954 by having shorter spicules. Furthermore, it differs from *Meteterakis vaucheri* Adamson, 1986 and *Meteterakis lousi* Inglis, 1958 in having longer spicules. It also differs from *Meteterakis aurangabadensis* Desmukh & Choudori, 1980, *Meteterakis karvei* Naidu & Thahare, 1981, *Meteterakis striatus* Oshmarin & Demshin, 1972 and *M. japonica* in having non-alate spicules and gubernaculum. *M. lombokensis* sp. nov. differs from *Meteterakis crombiei* Bursey, Goldberg & Kraus, 2005 in eggs with tuberculated shells, and *Meteterakis baylisi* Inglis, 1958, in cup like distal end of spicules. It differs from *Meteterakis wangi* in normally proximal end, non-alate and tessellated distal of spicules. It differs from *Meteterakis paucipapillosa* Wang, 1980, *Meteterakis andamensis* Soota & Chaturvedy, 1970 in having less number of caudal papillae. Finally, it differs from *Meteterakis saotomensis* in the spicule without a widened proximal end, shorter pharynx [(65–68) μm], anterior lip of the vulva with small flap and smaller eggs [(57–63) μm × (60–39) μm][8]. Those differences justify the conclusion that *Meteterakis* from Lempenge is a new species.

The caudal papillae of *Meteterakis* in the male is specific with three or four large papillae and some small papillae[9,11]. Previous descriptions of *Meteterakis* did not mention the papillae in the anterior rim of cloaca[8,10,12]. It seems that character is specific in *Meteterakis*, as reported by Purwaningsih *et al*.[2], by using an electron microscope that character was seen clearly in *M. wonosoboensis* and *M. japonica*. That character also seen in *M. lombokensis*, maybe that are overlooked in the *Meteterakis* reported before. Compared with *Meteterakis* from Indonesia, morphologically, *M. lombokensis* is closer to *M. japonica* and *M. singaporensis* in having no vulval flap, is curved and has strongly widened proximal end of spicules, and both are found in the same species of host, *D. melanostictus*. Such characters are also found in *M. ishikawanae* although found in other species of host, *Rana ishikawae* in Japan. *Meteterakis* was more often found in *D. melanostictus*, than other host species[10]. Commonly, the species of *Meteterakis* have a vulfal flap in the female. The absence of a vulval flap was found in *M. ishikawanae* from Rana ishikawanae in Japan, *M. singaporensis* and *M. lombokensis*. It may be that the vulval flap is retracted into the body, although there is no vulval flap, the channel S shaped is present between the vulva and the muscular part of the vagina[13]. Furthermore, a strongly widened at proximal end spicules of male is found in *Meteterakis amamiensis*, *Meteterakis baylisi*, *Meteterakis cophotis*, *M. japonica*, *M. longispicularis*[10,12]. Besides *M. lombokensis* sp. nov., the present study also obtained *M. singaporensis* from the same host *i.e.*, *D. melanostictus* from Senaru. This species is characterized by having equal, longer than 700 μm and alate spicules, caudal alae supported by 3 pairs of large papillae, besides some small papillae. *M. singaporensis* is new record for Indonesia. This species was described for the first time from *D. melanostictus* (= *Bufo melanostictus*) in Singapore[8] and from the other host, *Cnemaspis* (Gekkonidae), in Southeast Asia[14].

Chabaudus Inglis and Ogden, 1965 is the genus described from fish, *Heterobranchus bidorsalis* (Geoffroy) of Siera Leone (West Africa) with *Chabaudus chabaudi* as a type species[6]. Five species of *Chabaudus* had hitherto been reported from amphibian, *i.e.*, *Chabaudus leberrei* (*Ch. leberrei*) (*Bufo regularis* of Africa), *Chabaudus wiliamsi* (*Peterpedetes natator*, Vietnam), *Ch. rauschi*, from Indian bullfrog, Vietnam, *Chabaudus alaini* (*Ch. alaini*) (unidentified frog – East Timor), and *Chabaudus dehradunensis* from *Euplyctis cyanophlyctis* in India[5,15-19], *Ch. leberrei* and *Ch. rauschi* were described as *Gendria leberrei* and *Gendria rauschi*, respectively. They were transferred to *Chabaudus* because the cephalic structure was typical of *Chabaudus*[20].

The mouth opening of the *Gendria* is rounded without lip, while the *Chabaudus* has a triangular mouth opening with bilobed three lips[11]. *Chabaudus williamsi* and *Ch. leberrei* have equal spicules[17,21], while *Ch. rauschi* have subequal spicules. The author of *Ch. alaini* did not mention whether the spicules of *Ch. alaini* were equal or unequal, but the figures show that the spicules were sub-equal[18] *Ch. alaini* differs from *Ch. rauschi* in the present study in the length of spicules (2.4% *vs.* 1.6% of body length), deirid located behind posterior of the oesophagus, and the arrangement of caudal papillae. The specimens in this study differ from *Chabaudus dehradunensis* in having equal spicules, a shorter body, but longer spicules compared with body length[19]. The morphological description of *Chabaudus* mentioned above, concluded that *Chabaudus* in the present study is *Ch. rauschi*. *Ch. rauschi* (Lombok Island) and *Ch. alaini* (Timor Island) found from frog have unequal spicules, however, the *Chabaudus* sp. from *F. cancricora* in Java have equal spicules. *Chabaudus* sp. of amphibians have been described from Vietnam, India, Africa, Timor and Indonesia.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgments

We want to thank Y. Apriyanti for her assistance to prepare the material for the SEM observation. This study was financially supported by the project "DIPA of Research Centre for Biology 011/2015: Keanekaragaman dan Potensi Biota Nusa Tenggara", sponsored by Indonesian Institute of Sciences.

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