



# Further description of the poorly known zooparasitic nematode *Abbreviata baltazardi* Chabaud, 1953 (Spirurida: Physalopteridae)

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**Abstract** *Abbreviata baltazardi* Chabaud, 1953 (Nematoda: Physalopteridae) is a hitherto poorly known parasitic nematode species reported from *Phrynocephalus helioscopus* Pallas (Squamata: Agamidae) in Iran. The current knowledge on the morphology of *A. baltazardi* is still very limited. In the present study, the detailed morphology of *A. baltazardi* was studied using light microscopy and, for the first time, scanning electron microscopy, based on newly collected specimens from the yarkand toad-headed agama *P. axillaris* Blanford Pallas (Squamata: Agamidae) in China. Some erroneous or previously unreported morphological features of *A. baltazardi* were observed using SEM, which include the presence of one large semicircular protrusion and 20–30 denticles on each pseudolabium, the absence of

precloacal medioventral papilla in some individuals and the presence of 4–5 postcloacal medioventral papillae in males. SEM observations also clearly showed the detailed morphology of deirids, cloacal ornamentation, caudal papillae, vulva and egg. *Abbreviata baltazardi* represents the first species of *Abbreviata* Travassos, 1920 reported in China.

## Introduction

The genus *Abbreviata* (Nematoda: Spirurida: Physalopteridae), erected by Travassos (1920), currently includes about 47 nominal species, which mainly parasitize the reptiles and mammals worldwide (Morgan, 1945; Skrjabin & Sobolev, 1964; Yeh, 1957; Jones, 1978, 1983, 1988, 2013; Bursey & Brooks, 2011; Johkool et al., 2021). However, most of the *Abbreviata* species have been described based only on morphological characters using light microscopy, which may prevent a clear observation of some morphological features with taxonomic significance, especially in relation to the details of the cephalic structures. With the success of scanning electron microscopy in the redescription of some physalopterid nematodes (Chen et al., 2017, 2023; Harras & Elmahy, 2019; Tang et al., 2022), many erroneous or previously unreported morphological features were revealed, improving the specific identification.

In the present study, several nematode specimens collected in the yarkand toad-headed agama

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*Phrynocephalus axillaris* Blanford Pallas (Squamata: Agamidae) from China, were identified as the poorly known physalopterid species *Abbreviata baltazardi* Chabaud, 1953. The detailed morphology of *A. baltazardi* was studied using light microscopy and, for the first time, scanning electron microscopy.

## Materials and methods

A total of 90 individuals of the species *P. axillaris* (Sauria: Agamidae) (mean snout - vent length  $44.37 \pm 4.38$  mm, mean body weight  $4.43 \pm 1.09$  g) were collected from the Tokson County ( $88.76051979^{\circ}\text{E}$ ,  $42.82725354^{\circ}\text{N}$ ) and Shanshan ( $89.87067977^{\circ}\text{E}$ ,  $42.76818498^{\circ}\text{N}$ ) County in Xinjiang, China. A total of 141 nematodes found from the stomach and small intestine of the lizards, were washed in saline, and then fixed and stored in 70% ethanol. For light microscopy, nematode specimens were cleared in glycerin, and then examined using a Nikon® optical microscope (Nikon ECLIPSE Ni-U, Nikon Corporation, Tokyo, Japan). For scanning electron microscopy (SEM), the anterior and posterior ends of the specimens were transferred to 4% formaldehyde solution, post-fixed in 1%  $\text{OsO}_4$ , dehydrated via an ethanol series and acetone and critical point dried in  $\text{CO}_2$ . The specimens were coated with gold and examined using a Hitachi S-4800 scanning electron microscope (Hitachi Ltd., Tokyo, Japan) at an accelerating voltage of 20 kV. Voucher specimens were deposited in the College of Life Sciences, Hebei Normal University, Hebei Province, China. Measurements (the range, followed by the mean in parentheses) are given in micrometres unless otherwise stated.

## Results

### Family Physalopteridae Railliet, 1893

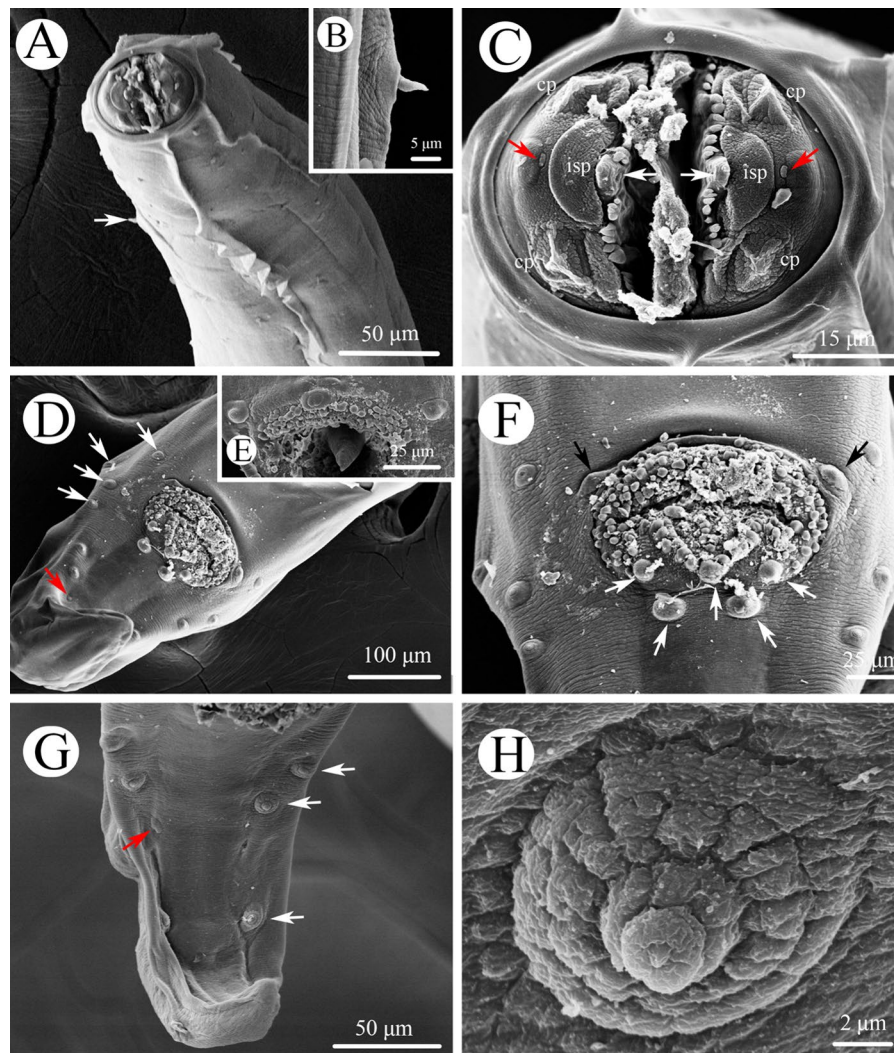
#### Genus *Abbreviata* Travassos, 1920

##### *Abbreviata baltazardi* Chabaud, 1953 (Figs. 1–3)

Small-sized, whitish nematodes. Cuticle with fine transverse striations. Body cylindrical, tapering at both ends; maximum width at about mid-body. Cephalic cuticular collar absent in most of specimens

(only few individuals with slightly cephalic cuticular inflation). Cephalic end dome-shaped, oral aperture dorsoventrally elongate, surrounded by two lateral pseudolabia (Figs. 1A, C, 2A, B). Inner margin of each pseudolabium with row of small pointed denticles (about 20–30 on each row, some apically bifurcated) and single large median tooth, surrounded by one large semicircular protrusion (Figs. 1A, C, 2A, B, D). Each pseudolabium bearing two large cephalic papillae and one median amphid (amphidial papilla-like pore located at proximal edge of semicircular protrusion) (Figs. 1C, 2A, B). Oesophagus divided into anterior short muscular portion and posterior long glandular portion (Figs. 3A–C). Nerve ring encircling posterior part of muscular oesophagus (Figs. 3A–C). Excretory pore situated slightly posterior to junction of muscular and glandular oesophagus in both sexes (Figs. 3A, C). Deirids well developed, finger-like, slightly posterior to nerve ring (Figs. 1B, 3B). Posterior end of body sexually dimorphic.

*Male* (based on 6 mature specimens): Body 7.73–9.41 (8.54) mm long; maximum width 340–380 (355). Entire oesophagus 1.47–1.91 (1.68) mm long, representing 17.3–21.2 (19.6) % of body length; muscular portion 179–256 (208) long, 48–63 (56) wide; glandular portion 1.27–1.71 (1.47) mm long, 120–150 (130) wide; length ratio of two oesophageal portions 1: 6.20–8.40 (1: 7.10). Nerve-ring, deirids and excretory pore 208–227 (217), 328–410 (361) and 319–396 (348) from cephalic extremity, respectively. Posterior end of body spirally coiled ventrally. Spicules dissimilar in length and shape; left spicule slender, relatively long, basal of left spicule distinctly inflated to bulb, 280–360 (300) long, representing 3.17–3.97 (3.50) % of body length; right spicule robust, relatively short, 180–210 (190) long, representing 1.90–2.56 (2.29) % of body length; spicule (right: left) ratio 1/1.33–2.00 (1/1.54) (Figs. 3J). Posterior expansion of cuticle forming caudal bursa, supported by four pairs of ventro-lateral pedunculate papillae (1 pair precloacal, 2 paracloacal, 1 pair postcloacal) (Figs. 1D, E, F, 3E, F). Cloacal labia ornamented with numerous cuticular tubercles (Figs. 1D, E, F, 3E). Anterior margin of cloaca with two small subventral pedunculate papillae, single medio-ventral sessile papilla may be present or absent; posterior margin of cloaca with 4–5 subventral sessile papillae (Figs. 1D, E, F, 3E). Three additional pairs of



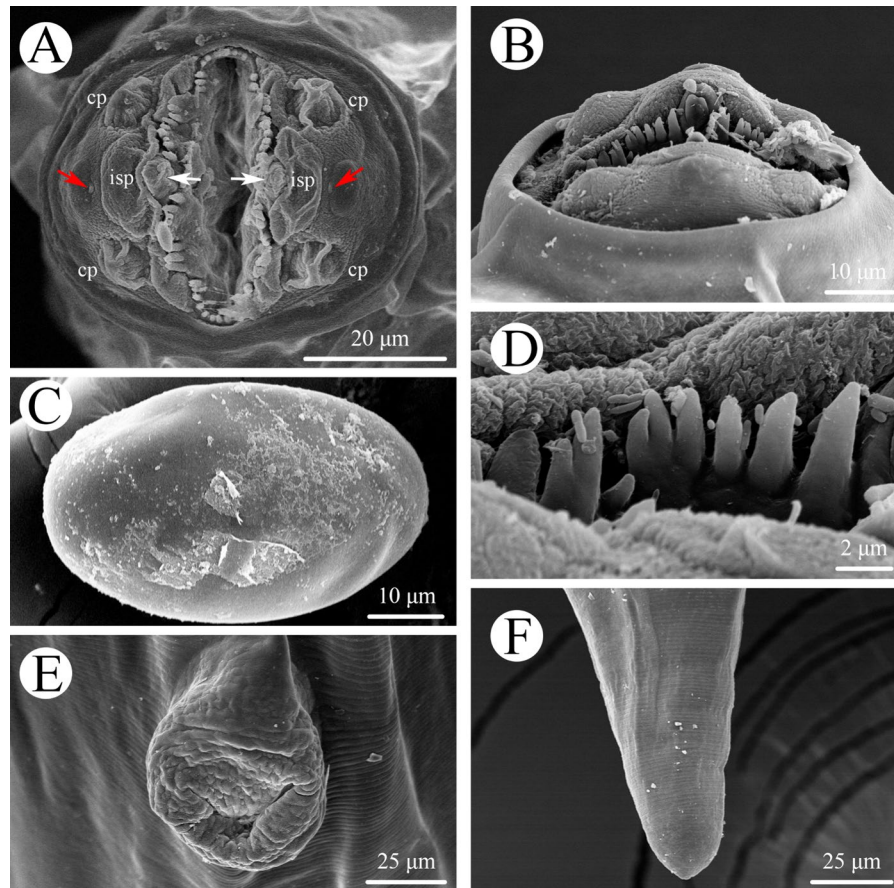
**Fig. 1** Scanning electron micrographs of *Abbreviata bal-tazardi* collected from *Phrynocephalus axillaris* in China. A, anterior end of male (deirid arrowed), subapical view; B, magnified image of deirid, lateral view; C, cephalic extremity of male (median tooth indicated using white arrows and amphids indicated using red arrows), apical view; D, posterior end of male (ventro-lateral pedunculate papillae indicated using white arrows and suspected phasmid indicated using red arrow), ventral view; E, magnified image of two subventral precloacal

papillae and single medio-ventral precloacal papilla, ventral view; F, cloacal area (two ventral precloacal papillae indicated using black arrows and five ventral sessile papillae indicated using white arrows), ventral view; G, tail tip of male (ventro-lateral postcloacal papillae indicated using white arrows and suspected phasmid indicated using red arrow), ventral view; H, magnified image of postcloacal pedunculate papilla; *Abbreviations*: cp, cephalic papillae; isp, large semicircular protrusion

ventro-lateral postcloacal papillae present (2 pairs close to each other located at anterior 2/5 of tail, 1 pair located at posterior 1/3 of tail) (Figs. 1D, G, 3E, E). Tail 440–507 (479) long, representing 4.99–5.95 (5.62) % of body length (Figs. 1D, G, 3E, F).

*Female* (based on 13 mature specimens): Body 6.20–12.8 (10.4) mm long; maximum width

340–640 (514). Entire oesophagus 1.42–2.78 (2.08) mm long, representing 16.6–25.4 (20.4) % of body length; muscular portion 154–260 (208) long, 53–80 (70) wide; glandular portion 1.27–2.56 (1.87) mm long, 120–300 (184) wide; length ratio of two oesophageal portions 1: 7.40–11.6 (1: 9.00). Nerve-ring, deirids and excretory pore 188–246



**Fig. 2** Scanning electron micrographs of *Abbreviata baltazardi* collected from *Phrynocephalus axillaris* in China. A, cephalic extremity of female, apical view (median tooth indicated using white arrows and amphids indicated using red arrows); B, cephalic extremity of female, lateral view; C, egg; D, magnified image of denticles; E, vulva, ventral view; F, tail tip of female. *Abbreviations:* cp, cephalic papillae; isp, large semicircular protrusion

(223), 348–450 (384) and 275–450 (384) from cephalic extremity, respectively. Vulva with conspicuous protruded labia, situated 1.20–2.31 (1.94) mm from cephalic extremity, at 15.2–24.3 (19.0) % of body length (Figs. 2E, 3A). Vagina long, muscular; uteri with four uterine branches (Fig. 3A, D). Eggs oval, thick-shelled, unembryonated or embryonated, with smooth surface, 33–70 (60.4) × 25–40 (32.9) (n=64) (Figs. 2C, 3H, I). Tail 200–430 (344) long, representing 2.98–4.13 (3.35) % of body length (Figs. 2F, 3G).

**Host and locality:** Yarkand toad-headed agama *Phrynocephalus axillaris* Blanford Pallas (Squamata: Agamidae), Tokson County (88.76051979E, 42.82725354N) and Shanshan

County (89.87067977E, 42.76818498N) in Xinjiang, China.

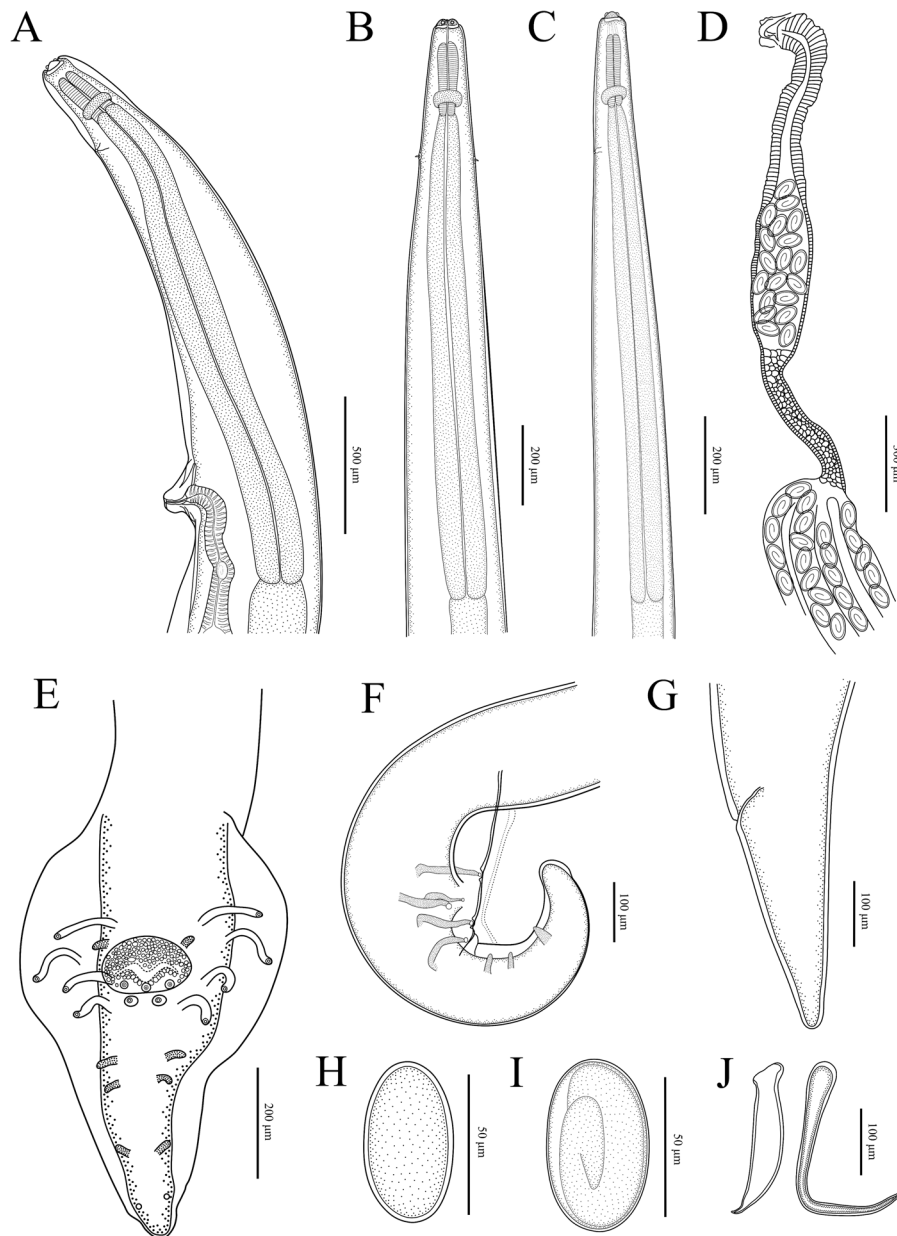
**Site of infection:** Stomach and intestine.

**Prevalence and intensity:** 20.0% (18 out of 90 individuals of *P. axillaris*) and  $7.45 \pm 7.42$  (1–20) nematodes.

**Voucher specimens:** 6 male, 13 females (HBNU-N-R20240422GL), deposited in the College of Life Sciences, Hebei Normal University, Hebei Province, China.

## Discussion

Chabaud (1953) described *A. baltazardi* infecting *P. helioscopus* Pallas (Squamata: Agamidae) in Iran. Since then, this species has never been reported.



**Fig. 3** *Abbreviata baltazardi* collected from *Phrynocephalus axillaris* in China. A, anterior end of female, lateral view; B, anterior end of male, dorsal view; C, anterior end of male, lateral view; D, vagina and uteri; E, posterior end of male, ventral view; F, posterior end of male, lateral view; G, tail of female, lateral view; H, I, eggs; J, spicules

Therefore, as far as we know, the present study is only the second record of *A. baltazardi*. The morphology and measurements of the present specimens collected in *P. axillaris* are more or less identical to the original description of this species of *A. baltazardi* in many features, such as the body and oesophageal length, the shape and length of spicules, the number

and arrangement of caudal papillae, the morphology and position of vulva, the number of uterine branches, the size of eggs and the length and morphology of tail from the males and females. It should be noted that the present specimens were collected from *P. axillaris*, which is a congener to the type-host. Therefore,

we have no hesitation in considering the present material as *A. baltazardi*.

Chabaud (1953) reported approximately 24 denticles along the inner margin of each pseudolabium. The present SEM observations showed the presence of 20–30 denticles on each pseudolabium, some of which are apically dichotomous. Additionally, SEM observations revealed the presence of one large semicircular protrusion surrounding the median tooth on each pseudolabium for the first time. Chabaud (1953) illustrated the single medio-ventral, precloacal papilla in the male, which is very common in *Abbreviata* spp. (Yeh, 1957; Skrjabin & Sobolev, 1964; Jones, 1978, 1983, 1988, 2013; Bursley & Brooks, 2011). However, this feature seems to be inconsistent, because we observed the presence of single medio-ventral precloacal papilla only in some individuals of the present material. Moreover, the detailed morphology of deirids, cloacal ornamentation, caudal papillae, vulva and egg was showed by SEM for the first time.

In the genus *Abbreviata*, *A. baltazardi* is similar to *A. amaniensis* (Sandground, 1928) and *A. golvani* Le-Van-Hoa, 1961 by having each pseudolabium possessing single large median tooth without bifid submedian tooth, spicules smaller than 0.50 mm and left spicule less than 2 times longer than the right one (Sandground, 1928; Skrjabin & Sobolev, 1964). However, *A. baltazardi* can be easily distinguished from *A. amaniensis* based on the pseudolabium with large semicircular protrusion (*vs* absence in *A. amaniensis*), different morphology of the left spicule (proximal end of left spicule distinctly bulbous in *A. baltazardi* *vs* with conspicuous beak-like protrusion in *A. amaniensis*) and the presence of 4–5 medio-ventral, postcloacal papillae (*vs* only two medio-ventral, postcloacal papillae in *A. amaniensis*). *Abbreviata baltazardi* is also different from *A. golvani* by the distinctly smaller body (male 7.73–9.41 mm and female 6.20–12.8 mm long in *A. baltazardi* *vs* male 12.0–18.0 mm and female 26.0 mm long in the latter) and different morphology of left spicule (proximal end of left spicule distinctly bulbous in *A. baltazardi* *vs* not bulbous in *A. golvani*). *Abbreviata baltazardi* represents the first species of *Abbreviata* reported from China.

**Authors contributions** X.H.G. and L.L. identified the nematode specimens. X.F.Y. collected nematode specimens.

X.H.G. and H.X.C. prepared figures 1–3. All authors wrote and reviewed the manuscript.

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**Data availability** All data generated or analyzed during this study are included in this published article. For the raw data, please contact the corresponding author.

#### Declarations

**Competing interests** The authors declare no competing interests.

**Ethical approval** All applicable institutional, national and international guidelines for the care and use of animals were followed.

**Consent to participate** All authors consent to participate in this publication.

**Consent for publication** All authors consent to publish the manuscript.

#### References

- Bursley, C. R., & Brooks, D. R. (2011). Nematode parasites of Costa Rican snakes (Serpentes) with description of a new species of *Abbreviata* (Physalopteridae). *Comparative Parasitology*, 78(2), 333–358.
- Chabaud, A. G. (1953). Un nouveau physaloptère parasite d'agame. *Annales de Parasitologie Humaine et Comparée*, 28(4), 305–311.
- Chen, H.-X., Ju, H.-D., Li, Y., & Li, L. (2017). Further study on *Physaloptera clausa* Rudolphi, 1819 (Spirurida: Physalopteridae) from the amur hedgehog *Erinaceus amurensis* Schrenk (Eulipotyphla: Erinaceidae). *Acta Parasitologica*, 62, 846–852.
- Chen, H.-X., Zeng, J.-L., Gao, Y.-Y., Zhang, D., Li, Y., & Li, L. (2023). Morphology and genetic characterization of *Physaloptera sibirica* Petrow & Gorbunov, 1931 (Spirurida: Physalopteridae), from the hog-badger *Arctonyx collaris* Cuvier (Carnivora: Mustelidae), with molecular phylogeny of Physalopteridae. *Parasites & Vectors*, 16(1), e227.
- Harras, S. F., & Elmahy, R. A. (2019). New record of *Abbreviata leptosoma* Gervais, 1848 (Spirurida: Physalopteridae) infection in two species of lizards in North and South Sinai, Egypt. *Egyptian Journal of Zoology*, 72, 1–10.
- Johkool, M. G., Eslahi, A. V., Badri, M., Hooshmand, E., Pirestani, M., Jablonski, D., Jafari, R., & Dalimi, A. (2021). Molecular and morphological data confirmed first

- record of *Abbreviata kazakhstanica* Markov and Paraskiv, 1956 (Spirurida: Physalopteroidea) in Iran. *Iranian Journal of Parasitology*, 16(4), 686–691.
- Jones, H. I. (1978). *Abbreviata* (Nematoda: Physalopteroidea) from Western Australian snakes. *Australian Journal of Zoology*, 26, 789–807.
- Jones, H. I. (1983). *Abbreviata* (Nematoda: Physalopteridae) in lizards of the *Varanus gouldii* complex (Varanidae) in Western Australia. *Australian Journal of Zoology*, 31, 285–298.
- Jones, H. I. (1988). Nematodes from nine species of *Varanus* (Reptilia) from tropical Northern Australia, with particular reference to the genus *Abbreviata* (Physalopteridae). *Australian Journal of Zoology*, 36, 691–708.
- Jones, H. I. (2013). Gastrointestinal nematodes of the Australian leaf-tailed gecko, *Phyllurus platurus* (Reptilia: Gekkonidae), with a redescription of *Abbreviata bancroftii* (Irwin-Smith, 1922) and observations on physalopterid larvae. *Comparative Parasitology*, 80(2), 217–224.
- Morgan, B. B. (1945). The Nematode genus *Abbreviata* (Travassos, 1920), Schulz, 1927. *The American Midland Naturalist*, 34(2), 485–490.
- Sandground, J. H. (1928). Some new cestode and nematode parasites from Tanganyika Territory. *Proceedings of the Boston Society of Natural History*, 39, 131–150.
- Skrjabin, K. I., & Sobolev, A. A. (1964). Principles of nematology. Vol. XII. Spirurates of animal and man and the diseases caused by them. Part II. Physalopteroidea. Izdat. AN SSSR, Moscow, Russia, 334 pp.
- Tang, L.-S., Gu, X.-H., Wang, J.-H., Ni, X.-F., Zhou, K.-F., & Li, L. (2022). Morphological and molecular characterization of *Paraleptus chiloscyllyi* Yin & Zhang, 1983 (Nematoda: Physalopteridae) from the brownbanded bambooshark *Chiloscyllium punctatum* Müller & Henle (Elasmobranchii: Orectolobiformes). *Parasitology International*, 87, e102511.
- Travassos, L. (1920). Contribuições para o conhecimento da fauna helmintologica brasileira. *Memórias do Instituto Oswaldo Cruz*, 12, 73–77.
- Yeh, L.-S. (1957). On *Physaloptera lutnsdeni* n. sp. from a bush-baby in Tanganyika, with a note on *Abbreviata caucasica*. *Journal of Helminthology*, 31 (1–2), 29–32.

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