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The presence of the genus *Palpita* hübner, 1808 (Lepidoptera, Crambidae, Spilomelinae) on the Arabian Peninsula–A review with description of a new species

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Abstract
The genus *Palpita* Hübner, 1808 has been known from the Arabian Peninsula only from historical records till date. In the present study, recent records are reported on the basis of a sample of four specimens collected in Dhofar, the south-western province of the Sultanate of Oman. Two specimens of the sample are attributed to *Palpita vitrealis* (Rossi, 1794), which is reported as new to the entomofauna of Oman. The adults, the male and the female genitalia of the records of *P. vitrealis* are figured. The other two specimens of the sample exhibit significant differences in external and internal characters (male and female genitalia) with regard to externally similar Oriental and Afrotropical species. These differences result in the description of the new species *Palpita subflavalis* sp.nov. The adults, the male and female genitalia and the tympanal organs of the new species are described and figured. The differential character states with regard to the closest congeners are listed.

Keywords: pyraloidea, taxonomy, morphology, fauna, Oman

Introduction
The genus *Palpita* Hübner, 1808 is among the three most diverse genera of the subfamily Spilomelinae – besides *Glyphodes* Guenée, 1854 and *Udea* Guenée, 1845 - comprising 163 known species world-wide up to date (Nuss *et al*. 2021 [1]). The genus is widely distributed in the Palearctic, Oriental, Afrotropical and Neotropical zones. From the Palearctic zone one species – *Palpita vitraelis* (Rossi, 1794) – has been reported till date. 60% of the total species of the genus are distributed in the Oriental zone (Inoue 1996 [2], 1997 [3], 1999 [4]), A total of 21 species is distributed in the Afrotropical zone (De Prins and De Prins 2021 [5]).
A comprehensive revision of the Oriental species was done in Inoue (1996 [2], 1997 [3], 1999 [4]). In this revision, the genus was divided into two species groups, group A and group B. These two species groups are externally differentiated by the shape of the subterminal fasciae – strongly angled in group A, bare from angulation and running parallel to the termen, sometimes evanescent or absent in group B. Within each of these groups several species complexes were recognized, the members of which are externally indistinguishable, yet strongly differ in genital morphological characters. Diagnostic characters include the number and shape of the saccular processes in the valva, the number and shape of the cornuti in the phallus apodeme and the shape of the signa in the corpus bursae wall. Most recent partial faunistic and taxonomic revisions of the Oriental species include Zhang and Li (2005) [6], Ko, Lee, Bayarsaikan, Kim, Park and Bae (2021) [7], Ko, Lee, Bayarsaikan, Cha, Park and Bae (2021) [8], Ko, Lee, Bayarsaikan & Cha (2021) [9]. For the Afrotropical species no comprehensive revision has been done till date. 40% of the Afrotropical species have been known till date by their types exclusively. Recent faunistic updates on the distribution of Afrotropical species have been given in Shaffer and Munroe (2007) [10], De Prins & Mazzei (2016) [11], Poltavski *et al*. (2018) [12], Poltavski *et al*. (2019) [13] and Bippus (2019) [14]. Maes (2004) [15] described a new species from Namibia.
From the Arabian Peninsula the genus has been known till date by historical records (De Prins and De Prins 2021 [5], Butler 1884 [16]), which have been attributed to one species, namely *P. vitrealis*.
In this paper, recent records collected in Dhofar, the south-western province of the Sultanate of Oman are reported. The records are attributed to the species group B sensu Inoue (1997[l]) [3]. Two of these records are attributed to *P. vitrealis*, which is reported as new to the entomofauna of Oman. The two other specimens of the sample show significant differences in external and genital-morphological character states with regard to externally similar Afrotropical and Oriental species. These differential character states result in the description of the new species *Palpita subflavalis* sp.nov.

Materials and Methods
Sampling
The specimens were collected in three research expeditions of the author to Dhofar in the years 2018 and 2019. The specimens were captured at night by means of a light-trap equipped with a 20W tube of infra-blue light.

Macro-Preparation and Dissection
The adults were photographed with a SONY HX400V after relaxation and subsequent preparation. For examining the genitalia and tympanal organs, dissection, preparation and slide-mounting techniques were applied on the specimens on the basis of the protocol described in Robinson (1976) [17]. The preparation of the tympanal organs and of the genitalia was done under a Motic stereomicroscope (SMZ-171). The slides were photographed with a ToupCam c-

mount camera (ToupTek Inc., Zhejiang, China) under a resolution of 18 megapixels. The images were optimized by means of the imaging software Adobe Photoshop PS, Version 21.0.2.

Morphological Analyses

Analyses of wing pattern characters and morphological structures were done on the images. Structural ratios in external characters, genitalia and tympanal organs were calculated on the images by means of the imaging software ToupView, Version 1.0 (ToupTek Inc., Zhejiang, China).

Terminology and Abbreviations

The descriptions of wing pattern characters follow the terminology in Inoue (1997) [3]. The denotations of the veins follow Shaffer and Munroe (2007) [10]. The descriptions of the genitalia and tympanal organs follow the terminology in Maes (1995) [18]. Descriptions of characters and character states in the male and female genitalia were furthermore adopted from Mally *et al*. (2019) [18]. Abbreviations: ZSM = Zoological State Collection Munich, Germany.

Results and Discussion

***Palpita vitrealis* (Rossi, 1794)**

Material: Oman, Dhofar, Jebel al Qamar, Road 47, 20 km E Sarfait, 03-II-2019, 1♂, slide no. 21GP001, 10-I-2018, 1♀, slide no. 21GP002, leg., prep. et coll. M. Seizmair

Diagnosis (Fig 1 – 3): Wingspan 35.6 mm – 41.6 mm. Forewing costal stripe darkish yellow to brown, terminating at the apex. Discal and basicellular marks, posterior discal spot present, very small. Subterminal fasciae evanescent to completely absent. Terminal line black, uninterrupted. Fringe greyish-white. Hindwing posterior discal spot present, termen and fasciae as for forewing. Uncus elongate, slender and rod-shaped, apex slightly curved, undifferentiated in width from the rest of the uncus, with ventro-lateral sclerotization, setose. Apical area of the valva slightly projected, rounded, setose, post-basal costal border strongly convex, ventral border straight. Sacculus with two spatially separated dorso-distal processes, strongly differing in length, directed costad, running parallel, forming a right angle with the post-basal sacculus, acuminate, posterior ends strongly sclerotized, with the anterior most process three times as long as the posterior most one. Juxta elongate, lobe-shaped, constant in width. Saccus v-shaped with an extensive ventro-apical sclerotization. Coremata sub-rectangular-shaped with several rod-shaped sclerites. Vesical surface of the phallus apodeme with three elongate, straight cornuti, two of which are equal in length, the third one 0.77 times as long as the other ones. Ductus ejaculatorius inserted at the anterior end of the phallus. Bulba ejaculatoria slightly sclerotized. Corpus bursae wall elongate, 2.3 times as long as short, with a pair of short, straight, thorn-shaped signa. Transition from the ductus bursae to the corpus bursae distinct, from a narrowed anterior ductus bursae to a widened posterior corpus bursae, ductus bursae medially widened. Lamella antevaginalis oviform, with lateral sclerotization. Ratio length of the apophyses posteriores / length of the apophyses anteriores 2.7.

Distribution: Mediterranean Basin – Southern Europe, North Africa (Slamka 2013 [20]). Widely distributed in Subsaharan Africa, in the Malagasy region (De Prins and De Prins 2021) [5] and in the Oriental zone – India, Nepal, Afghanistan, Pakistan (Inoue 1997 [3]). For the Arabian Peninsula historical records have been known from Yemen (De Prins and De Prins 2021[5], Butler 1884) [16], without recent records till date. The species is reported as new to the entomofauna of Oman.

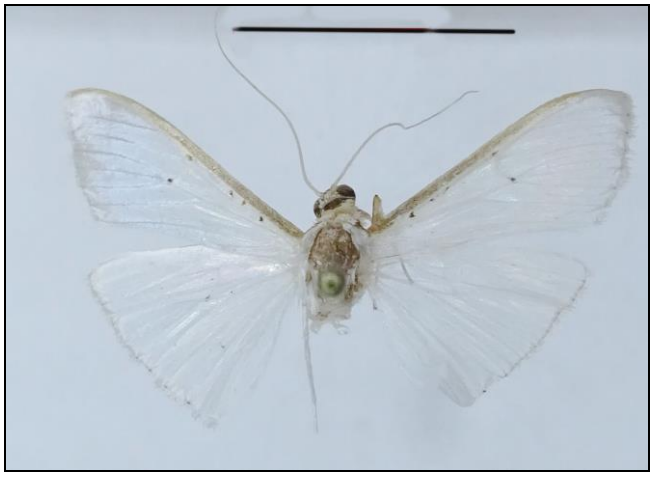

Fig 1: *P. vitrealis* – male adult, dorsal view, Oman, Dhofar, Jebel al Qamar, Road 47, 20 km E Sarfait, 03-II-2019, leg. et coll. M. Seizmair. Scale bar = 10 mm.

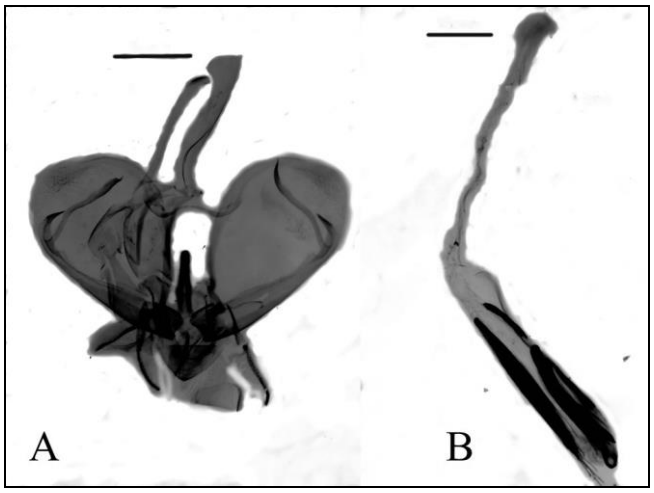

Fig 2: *P. vitrealis* – male genitalia, slide no. 21GP001. A: male genitalia capsule, B: phallus apodeme. Scale bar = 1 mm.

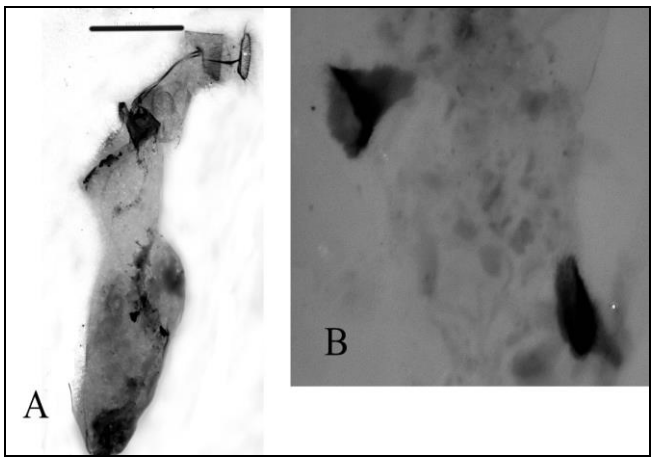

Fig 3: *P. vitrealis* – female genitalia, slide no. 21GP002. A: female genitalia capsule, B: close-up, signa. Scale bar = 1 mm.

***Palpita subflavalis* sp.nov.**

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Material: Holotype: ♂, Oman, Dhofar, Jebel al Qamar, Road 47, 20 km E Sarfait, 20-I-2018, leg. M. Seizmair, coll. ZSM, slide no. 21GP047. Paratypes: same location as holotype, 06-XI-2018, 1♀, slide no. 21GP013, leg. et coll. M. Seizmair.

External characters (Fig 4): Wingspan of the holotype: 20.9 mm. Wingspan of the paratype: 24.0 mm. Head: Antenna filiform with slight ciliae, flagellum black, ciliae greyish-white. Labial palpus porrect, anterior end acuminate, dorsally with darkish-brown to blackish scales in segment 1, darkish-grey in segments 2 and 3, ventrally yellowish-brown in all segments, 2.3 times as long as the diameter of the eye, 5.4 times as long as the maxillary palpus. Maxillary palpus darkish-brown to black in all segments, broadened in segments 1 and 2, tapered and acuminate in segments 3 and 4. Frons flattened, darkish-grey medially, darkish-brown to black laterally. Vertex greyish-white. Thorax: Dorsal scaling of the pro- and mesothorax darkish-ochreous, metathorax dorsally interspersed with greyish scales, lateral scaling of the thorax constantly darkish-ochreous, ventral scaling greyish-white interspersed with ochreous scales. Fore- and hindlegs whitish-grey interspersed with darkish-ochreous scales at the base. Tegula darkish-yellow. Abdomen: Dorsally greyish-white, ventrally greyish interspersed with ochreous scales.

Forewing: Sub-triangular shaped, twice as long as wide. Costal border concave near the apex. Apex strongly narrowed, acute. Tornus rounded. Anal border straight. Ground white, irrorated with yellowish scales at the sub-costa, at the apex and in the subterminal area and with darkish-brown to blackish scales along the veins. Posterior discal dot present, very small. Cellular marks and discal mark absent. Subterminal fasciae absent. Costal stripe darkish-yellowish to brown, evanescent from the medial area onwards. Termen darkish-grey interspersed with black interneural spots. Fringe darkish-grey. Underside like upper side. Hindwing: Ground concolorous with the ground of the forewing. Posterior discal dot absent. Subterminal fasciae absent. Termen and fringe like forewing. Underside with yellowish scales between the costal border and the Sc+R1.

Male genitalia (Fig 5): Uncus rod-shaped, of constant width from the basis to the apex, with strong lateral sclerotization, apex strongly dilated, triangular-shaped, ratio maximum width of the apex / maximum width of the medial uncus 2.6, apex spatulate and setose dorso-laterally. Basal uncus with a pair of down-curved, anteriad-pointed acuminate processes. Tegumen arms strongly sclerotized, lobe-shaped, strongly broadened and rounded anteriorly. Transtillum arms very slender, of constant width, lobe-shaped, spatially separated. Valva elongate, ratio length / maximum width 2.7, apical area acuminate, slightly chaetose, costal border straight, post-basal ventral border with a concave curvature. Fibula present, developing from the posterior end of the tegumen arm, bilobed, with the lobes differing in length and directedness, the shorter lobe straight, sub-triangular shaped, acuminate, directed apicad, the longer lobe directed ventrad, orthogonal to the shorter lobe, with a distinct concave curvature medially. Basal and post-basal sacculi strongly narrowed, each with a short, thorn-shaped, antero-basad directed projection, with these two projections equal in length. Distal sacculus with an elongate, unilobed, acuminate apicad-directed process running parallel to the ventral border. Juxta short, lobe-shaped. Saccus broadened, v-shaped. Vesical surface of the phallus apodeme with a pair of straight, elongate cornuti, differing in length by a factor of 1.2, posterior ends acuminate, anterior halves tapered, the longer cornutus with a sub-triangular-shaped dilatation. Ventral phallus with a sclerotized stripe ranging over the entire length of the coecum.

Female genitalia (Fig 6): Corpus bursae elongate, 2.8 times as long as wide. Corpus bursae wall with an elongate, slender, acuminate signum. Transition from the ductus bursae to the corpus bursae smooth, from a strongly narrowed anterior ductus bursae to an equally narrow posterior corpus bursae. Anterior ductus bursae slightly sclerotized. Posterior ductus bursae strongly dilated, ratio maximum width of the posterior ductus bursae / width of the anterior ductus bursae 4.2. Antrum with an extensive quadrangular shaped sclerotization and lateral, quasi-symmetrical, strongly sclerotized projections, which are rounded at their posterior ends. Ostium membranous. Apophyses posteriores dilated at their bases. Apophyses anteriores of constant width, equal in length with the apophyses anteriores. Papillae anales oviform, 1.8 times as long as wide, dorsal end 1.2 times as wide as the ventral end.

Tympanal organs (Fig 7): Fornix tympani strongly sclerotized, medially widened, tapering and acuminate towards the tergo-sternal sclerite. Tergo sternal sclerite short, very slender, anterior end stout. Ala tympani dorso-basally with sub-triangular shaped, strongly sclerotized postero-lateral dilatations, which are with short, thorn-shaped asymmetrical lateral projections differing in length. Conjunctivum strongly narrowed. Tympanum laterally strongly sclerotized. Pons tympani strongly invaginated, the lobes strongly sclerotized medially, with elongate and acuminate posteriad-directed projections forming an obtuse angle, the opening of which is pointed posteriad. Bulla tympani strongly invaginated. Rama tympani present, of concave shape, asymmetrical. Venula prima strongly sclerotized, straight, slightly slanted. Venula secunda weakly sclerotized, with a smooth transition from the venula prima.

Differential diagnosis: The new species is externally closest to the Afrotropical species *P. tsisabiensis* Maes, 2004 and *P. irroratalis* (Hampson, 1912) and to the Oriental species *P. javanica* Inoue, 1997, *P. margaritacea* Inoue, 1997, *P. candicantis* Inoue, 1997 and *P. argoleuca* (Meyrick, 1938). With these species the new species shares the absence of subterminal fasciae on the fore- and hindwings, the absence of cellular forewing markings and the costal stripe fading from the medial area onwards. The differential external character states with regard to the comparative species are given as follows: Presence of forewing and hindwing terminal black interneural spots: present in the new species, *P. irroratalis*, *P. margaritacea*, absent in *P. tsisabiensis*, *P. javanica*, *P. candicantis* and in

P. argoleuca. Presence of a forewing posterior discal dot: present in the new species, in *P. javanica*, *P. margaritacea*, absent in *P. irroratalis*, *P. tsisabiensis*, *P. candicantis* and in *P. argoleuca*. Presence of a hindwing posterior discal dot: Present in *P. javanica*, *P. margaritacea*, absent in the new species, *P. irroratalis*, *P. tsisabiensis*, *P. candicantis*, *P. argoleuca*. Presence of irroration by darkish-brown to blackish scales (forewing and hindwing), in particular along the veins: Present in the new species, *P. irroratalis* and *P. tsisabiensis*, absent in *P. javanica*, *P. margaritacea*, *P. candicantis*, *P. argoleuca*. Presence of irroration by yellowish scales (forewing and hindwing): Present in the new species (forwing apical, subcostal andsubterminal areas, hindwing subcostal area) and in *P. candicantis* (forewing anal border, hindwing costal border and along vein 3A), absent in each of the other comparative species. The new species furthermore significantly differs from the comparative species in the male genitalia. The male genitalia of *P. irroratalis* and *P. tsisabiensis* are described and figured in Maes (2004) [10], those of *P. javanica*, *P. margaritacea*, *P. candicantis* and *P. argoleuca* are figured in Inoue (1997) [3]. The differential character states are given as follows: Shape of the distal uncus: Apex strongly expanded, ratio maximum width of the apex / width of the medial uncus > 1.5 in the new species, apex slightly expanded, ratio maximum width of the apex / width of the medial uncus < 1.5 in *P. irroratalis*, *P. tsisabiensis*, *P. javanica*, apical dilatation absent in *P. margaritacea*, *P. candicantis* and *P. argoleuca*. Presence of a distinct, postero-medially constricted apex in the valva: Present in the new species, in *P. irroratalis*, *P. tsisabiensis*, *P. margaritacea*, *P. candicantis*, absent in *P. javanica* and in *P. argoleuca*. The apex is acuminate in the new species, rounded in *P. irroratalis*, *P. tsisabiensis*, *P. margaritacea*, *P. candicantis*. Shape of the costal border of the valva: Straight in the new species, convex post-basally in each of the comparative species. Presence of a projection at the basal costa of the valva: Present in *P. irroratalis* and in *P. tsisabiensis*, absent in the new species, in *P. javanica*, *P. margaritacea*, *P. candicantis* and *P. argoleuca*. Structure, number and directedness of the saccular processes: One elongate apicad-directed, unilobed and acuminate dorso-distal process and two thorn-shaped basal and post-basal processes in the new species, one unifid, costad-directed, posteriorly rounded dorso-distal process in *P. irroratalis* and *P. tsisabiensis*, two spatially separated costad-directed dorso-distal-processes in *P. javanica*, *P. margaritacea*, *P. candicantis* strongly differing in length, one short, acuminate, costad-directed process in *P. argoleuca*. Number and shape of the cornuti: two anteriorly tapered, posteriorly broadened and acuminate cornuti in the new species, two anteriorly broadened, posteriorly tapered and acuminate cornuti in *P. irroratalis* and *P. tsisabiensis*, two cornuti of constant width and strongly differing in length in *P. argoleuca*, one cornutus in *P. javanica*, *P. candicantis* and *P. margaritacea*.

Furthermore, the new species differs significantly in the female genitalia from *P. margaritacea*, *P. candicantis* and *P. argoleuca*. The female genitalia of *P. margaritacea*, *P. candicantis* and *P. argoleuca* are figured in Inoue (1997) [3], the female genitalia of *P. irroratalis*, *P. tsisabiensis* and *P. javanica* are unknown. The differential character states are given as follows: Shape of the signum: straight, acuminate with the ends differing in width in the new species, straight, of constant width in *P. margaritacea* and in *P. candicantis*, curved with the ends differing in width in *P. argoleuca*. Shape of the ductus bursae: strongly dilated towards the antrum in the new species, narrowed towards the antrum in *P. margaritacea*, *P. candicantis*, of constant width in *P. argoleuca.* Presence of lateral quasi-symmetrical projections in the antrum: present in the new species, absent in *P. margaritacea*, *P. candicantis* and *P. argoleuca*.

Remarks: The male genitalia of the new species exhibit peculiarities in the modified tegumen, the bilobed fibula, the shape of the apical area of the valva and the narrowed basal sacculus. The new species is attributed to the genus *Palpita* Hübner, 1808 due to character states in the male and female genitalia characteristic of the genus, namely the presence of saccular processes, the presence of deciduous cornuti in the phallus apodeme, the strongly sclerotized antrum, the shape of the ductus bursae and the thorn-shaped signa in the corpus bursae wall. The strongly dilated apical uncus in the male genitalia is shared with the oriental species *P. nigricollis* (Snellen, 1895) and *P. picticostalis* (Hampson, 1896). The new species and its closest relatives strongly differ from these species in the shape and inner structure of the valva and in the wing maculation. The male genitalia of *P. nigricolli*s and *P. pcicticostalis* are described and figured for the first time in Ko, Lee, Bayarsaikan, Cha, Park and Bae (2021) [8].

Distribution: Known only from the type locality in Dhofar, the south-western province of the Sultanate of Oman.

Bionomics: The type material was collected in an escarpment interspersed with flowery banks on the southern slopes of the Jebal Al Qamar.

Etymology: The epitheton refers to one of the external differential character states, the yellowish irroration in the fore- and hindwing (lat: sub - = - ish, flavus = yellow).

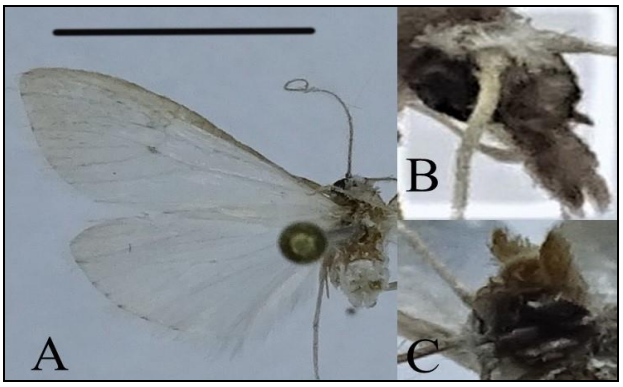

Fig 4: *Palpita subflavalis* sp.nov. – holotype, male adult, Oman, Dhofar, Jebel al Qamar, Road 47, 20 km E Sarfait, 20-I-2018, leg. M. Seizmair, coll. ZSM. A: adult, dorsal view, B: head profile, dorso-lateral view, C: head profile, frontal view. Scale bar = 10 mm.

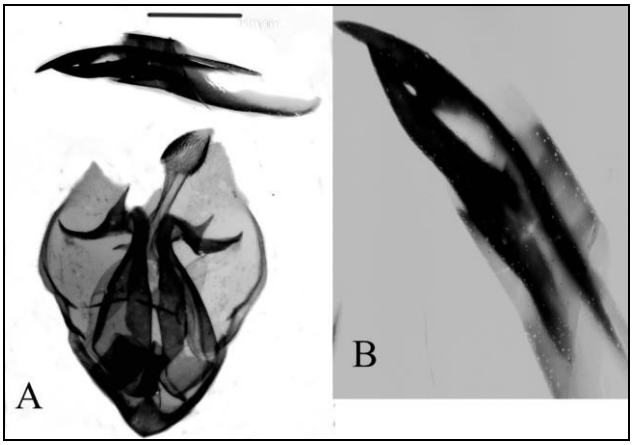

Fig 5: *Palpita subflavalis sp.nov*. – holotype, male genitalia, slide no. 21GP047. A: global view, B: close-up, phallus apodeme, posterior part, cornuti. Scale bar = 1 mm

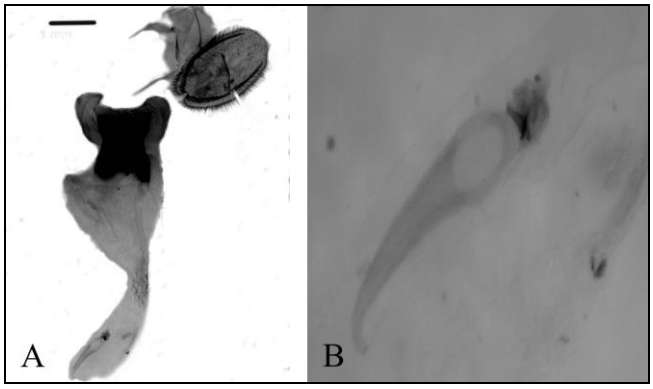

Fig 6: *Palpita subflavalis sp.nov*. – paratype, female genitalia, slide no. 21GP013. A: global view, B: close-up, signum. Scale bar = 1 mm

Fig 7: *Palpita subflavalis sp.nov*. – paratype, tympanal organs, slide no. 21GP013. Scale bar = 1 mm

Conclusion

A faunistic review on the presence of the genus *Palpita* Hübner, 1808 on the Arabian Peninsula was given. Recent records of *P. vitrealis* were reported from the Southern Arabian Peninsula on the basis of specimens collected in Dhofar in the south-west of Oman. *P. vitrealis* was reported as new to the entomofauna of Oman. *P. subflavalis* sp.nov. was described as new for science. The new species is unique with regard to its closest congeners in the modified tegumen arms, the modified apical area in the valva, the presence of basal and post-basal saccular processes, in the shape of the cornuti and in the structure of the ductus bursae.

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