

DISTRIBUTION AND TROPHIC ASSOCIATIONS OF ANT GENUS *MONOMORIUM* MAYR, 1855 (HYMENOPTERA: FORMICIDAE: MYRMICINAE) WITH APHIDS IN POTHWAR REGION OF PAKISTAN

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ABSTRACT

Two species of genus *Monomorium* Mayr, 1855 namely *Monomorium indicum* Forel, 1902 and *Monomorium sagei* Forel, 1902 have been recorded for the first time from Pothwar region of Pakistan. Currently a total of five species of this genus have been documented from Pakistan. Conservation status of two newly recorded species has also been discussed. Both species have been described here using Bingham (1903). Morphological characters of prosoma, mesosoma and metasoma were used for the identification of the species. Description has been supported with micrographs of identification characters, morphometric, world distribution and GPS coordinates of Pakistan. Trophic associations of both species with aphid partners are also reported for the first time from Pakistan. *M. indicum* was found to be associated with 2 aphid species namely, *Aphis gossypii* Glover, 1877 and *Aphis fabae* Scopoli, 1763 while *M. sagei* lived in associations with *Greenidea (Trichosiphum) psidii* van der Goot, 1917, *Aphis gossypii*, *A. fabae* and *A. fabae solanella* Theobald, 1914.

Key words: *Monomorium*, Myrmicinae, Aphid associations, Pothwar, Pakistan.

INTRODUCTION

Genus *Monomorium* was first described by Mayr in 1855. *Monomorium* is considered as diverse and taxonomically the most difficult ant genus in the subfamily Myrmicinae, having 384 reported species and subspecies throughout the world (Antweb, 2019). *Monomorium* ants mostly occur in Old world, tropics, and temperate zones (Brown, 2000). This genus contains world's most widely distributed and successfully established tramp-species, sharing terrestrial habitats and microhabitats. Species of this genus are generalistic in feeding behaviour, more rarely granivorous and several species have been reported as lepto-biotic or parasitic (Ettershank, 1966; Bolton, 1987). These ants prefer nesting in leaf litter, in the soil, under stone and in rotten wood (Collingwood, 1985; Collingwood and Agosti, 1996; Aldawood and Sharaf, 2011).

Members of this genus can be classified on the basis of following characters: workers monomorphic to polymorphic; 3-5 teeth at mandibles which decrease in size from anterior to posterior margin; distinct median clypeal seta; clypeus raised medially; antennae 10-12 segmented (mostly 12) with 3 segmented club; propodeal

dorsum not spinose; petiole pedunculated anteriorly (Bolton, 1987; Bingham, 1903).

Various scientists have done a lot of work on this genus regarding revision and exploration of these ants like; Afrotropical region (Bolton, 1987), Australian and Malagasy region (Heterick, 2001, 2006), North America (DuBois, 1986), Neotropical region (Fernández, 2007) and for Saudi Arabia (Collingwood, 1985; Collingwood and Agosti, 1996). According to Bolton (2018) this genus is native to Afrotropical, Australasia, Indomalaya, Malagasy, Nearctic, Neotropical, Oceania and Palearctic bioregions. Forty three species belonging to genus *Monomorium* have been reported from Australia (Heterick, 2001; Heterick, 2003), forty species described from Saudi Arabia (Collingwood and Agosti, 1996; Sharaf *et al.*, 2018), four species from Sri Lanka (Antweb, 2019), eight species from Afghanistan (Pisarski, 1970), nineteen species from Iran (Paknia *et al.*, 2010) and twenty species have been reported from India (Bharti *et al.*, 2016; Bolton, 2018). However in Pakistan, ants have been poorly studied. A limited work on ants in Pakistan includes new distributional records, new country records of ants, their associations with sucking insects etc. (Umair *et al.*, 2012; Bodlah *et al.*, 2016; Bodlah *et*

al., 2017a, b; Rasheed *et al.*, 2018; Bodlah *et al.*, 2019 and Rasheed *et al.*, 2019). As a result of our surveys during 2015-17, two species of this genus along with their association with aphids are reported for the first time from Pothwar region of Pakistan.

MATERIALS AND METHODS

Members of Genus *Monomorium* were collected from Pothwar during 2015-17. Specimens were collected with the help of mouth aspirator. Collected specimens were killed using potassium cyanide. A few killed individuals were preserved in 75% ethanol in glass vials; others were mounted on small triangular cards. Ant specimens were also collected from different aphid infested plants. Aphids were also collected and preserved in 75% ethanol. Taxonomic treatment was performed with the help of Labomed CZM6 microscope with the help of Bingham (1903) and Sharaf *et al.* (2017). Morphometric analysis was conducted by stage microscope. Micrographs were prepared using Labomed CZM6 microscope attached with digital camera (Amscope 18 megapixels, model number MU1803). Images were cleaned using Adobe Photoshop CS6 software. Ant specimens were identified up to species level using keys by Bingham (1903) while aphids were identified using keys by Blackman and Eastop (1984). Identified species were tagged with name, date of collection, habitat and coordinates of collection sites. After identification, species were deposited in the Department of Entomology, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, Pakistan. Description method, morphometric treatment and indices follow Bolton (1987), Sharaf *et al.* (2017). They are as given below.

TL: Total length; maximum length of body from mandibular apex to gaster dorsally

HW: Head width; Head width including eyes in full face view

HL: Head length; Head length (Excluding mandible)

SL: Scape length; entire scape length

EL: Eye length; maximum length of eyes

EW: Eye width; eye width in oblique view

WB: Weber's length; Thorax length in lateral view

PRW: Prothorax width; maximum broader part of pronotum

PL: Petiole length; length of petiole laterally

PH: Petiole height; in lateral view maximum node height

PW: Petiole width; in dorsal view maximum petiolar width

CI: Cephalic index = $HW/HL \times 100$

OI: Ocular index = $EL/HW \times 100$

SI: Scape index = $SL/HW \times 100$

LPI: Lateral petiole index = $PH/PL \times 100$

RESULTS AND DISCUSSION

Monomorium indicum Forel, 1902 (Figs. 1-7)

Description (worker): Head in full-face view distinctly longer than broad with nearly parallel sides and little broader anterior margin; median clypeal portion smooth and shining without carina, anterior clypeal margin feebly emarginated; antennae 12- segmented, terminal funicular segment large, twice longer than two preceding segments, scape short hardly crossing beyond the top of head (Fig. 4); eyes oval, small, more in length than width, placed at middle of head in oblique view. Mandibles shining and longitudinally striated. Mesosoma in profile view with a feebly convex pro-mesonotal dorsum, well developed metanotal groove (Fig. 6), propodeal spiracle small in lateral view. Petiole more in length than width, rounded posteriorly at dorsum. Postpetiole circular, attached with gaster posteriorly. **Sculpture.** Head, mesosoma, petiole and post petiole strongly rugose in profile view (Fig. 1, 5). Gaster smooth and shining having erect and suberect hairs (Fig. 7). **Pilosity.** Cephalic surface with minute pilosity, anterior clypeal margin with short and long yellowish hairs, scape and pedicel having short pilosity. **Colour.** Head, antennae, mesosoma, legs, petiole and post petiole dark brownish while gaster dark brown-blackish.

Morphometric (Worker): n=5

Body Parts	Measurements(mm)	Indices
HL	0.81- 0.82	CI= 80.24-80.48
HW	0.65- 0.66	OI= 30.76-33.33
EL	0.2- 0.22	SI=103.03-103.07
EW	0.14- 0.15	LPI= 78.78-80.64
SL	0.67-0.68	
PRW	0.35- 0.36	
WB	0.93- 0.95	
PH	0.25-0.26	
PL	0.31- 0.33	
PW	0.1-0.2	

Distribution: India, Hawaii, Afghanistan, United Arab Emirates (Bolton, 2018)

Material Examined: 05 ♀, Forest area, Plant stem, Trail 6 (Islamabad) (N36°14.359'E074°30.037'), 638.55 m. elev., coll. Muhammad Tariq Rasheed, 17.x.2015; 15 ♀, Forest area, plant stem, Kachnar Park (Islamabad) (N33°40.602' E073°04.574'), 602.89 m. elev., coll. Imran Bodlah, 20.xi.2015; 25 ♀, Forest area, under stone, Kotli sattian (Rawalpindi) (N33°41.902'E073°30.612'), 1260.65 m. elev., coll. Muhammad Tariq Rasheed, 12.iv.2016; 07 ♀, Forest area, plant stem, Daman-e-Koh (Islamabad) (N33°73.95'E073°10.69'), 638.55 m. elev., coll. Imran Bodlah, 02.iv.2017.

Trophic associations with aphids: 20 ♀, Rawalpindi (Neela Sandh): (N33°39'41.90"E73°23'3.37") 691.59 m. elev. Ammara Gull-E-Fareen, 09-iv-2016 *Parthenium hysterophorus* (Parthenium weed); 15 ♀, Rawalpindi (Charapani): (N33°50'52.3"E73°19'1.1") 1204.26 m. elev. Imran Bodlah, 11-xi-2016 *Parthenium hysterophorus* (Parthenium weed); 23 ♀, Attock (Kamrial): (N33°54.762"E72°28.237") 562.66 m. elev. Ammara Gull-E-Fareen, 21-xi-2016 *Setaria viridis* (Green Foxtail).

Comments: *M. indicum* most resembles *M. glyciophilum* but can easily be differentiated on the basis of comparison of head width. Head in front distinctly broader than posteriorly in *M. indicum*. Whereas head as broad posteriorly as in front in *M. glyciophilum* (Bingham, 1903).

Remarks on Ecology and on trophic associations with aphids: During surveys, specimens were observed on plant stems near water sources. Their nests were found in trees and in the soil near water sources in the forest of mountainous areas of district Rawalpindi and Islamabad. Individuals of *M. indicum* were also observed in association with sap-sucking insect viz. aphids and mealybugs for taking honey dew as food source. This ant was found in association with *Aphis gossypii* on *Parthenium hysterophorus* (Parthenium weed) and *Setaria viridis* (Green Foxtail) from Kamrial and on Ak plant from Charra Pani and with *Aphis fabae* from district Rawalpindi. Ants and aphids were present on the shoots of host plant. Aphids were sucking sap while ants were getting honey dew. *M. indicum* is reported for the first time in association with any aphid species from Pakistan.

Monomorium sagei Forel, 1902 (Figs. 8-14)

Description (worker):

Head. In full-face view distinctly longer than broad, feebly round at posterior margin; median clypeal portion without carinate, anterior clypeal margin smooth and feebly convex at inner margin; antennae 12- segmented with 3- segmented club (Fig. 8), scape little longer beyond the top of head; eyes smaller than *M. indicum*, placed at middle of the head. **Mesosoma.** In profile promesonotum forming a single convexity, metanotal groove well defined, propodeal dorsum sloping to short declivity (Fig. 11). **Petiole.** Longer in length than width, rounded dorsally. **Postpetiole.** Node massive and more rounded dorsally than petiole (Fig. 12), attached to gaster dorsally. **Sculpture.** In profile rugai at meso-metanotum (Fig. 13), weakly striated at metanotum dorsally, head, mandible, pro-mesonotum, petiole, Postpetiole and gaster smooth and shining. **Pilosity.** Cephalic surface having 3-4 erect hairs; pronotum with single seta; scattered, erect and sub erect hairs at gaster; tibiae smooth (Fig. 10 arrows), without pilosity, minute pilosity at funicular segments of antennae (Fig. 8). **Colour.** Head, mesosoma, legs, petiole

and post petiole are pale yellowish in colour (Fig. 8, 13, 14) while gaster having blackish tint (Fig. 12).

Morphometric (Worker): n=5

Body Parts	Measurements (mm)	Indices
HL	0.46-0.48	CI= 83.33-84.78
HW	0.39-0.40	OI= 12.82-17
EL	0.05-0.07	SI= 102.56-105
EW	0.06-0.07	LPI= 13-70
SL	0.4-0.42	
PRW	0.20-0.21	
WB	0.5-0.6	
PH	0.013-0.14	
PL	0.1-0.2	
PW	0.10-0.11	

Distribution: India, Nepal, Afghanistan, China (Bolton, 2018)

Material Examined: 20 ♀, Forest area, Tree stem, Shakarparian (Islamabad) (N33°41'13.026"E73°43'43.398"), 491.94 m. elev. coll. Muhammad Tariq Rasheed, 15.iv.2016; 05 ♀, Forest area, plant stem, Trail 6 (Islamabad) (N36°14.359'E74°30.037"), 638.55 m. elev., coll. Muhammad Tariq Rasheed, 17.x.2015; 05 ♀, Forest area, plant stem, Kachnar Park (Islamabad) (N33°40.602'E73°04.574"), 602.89 m. elev. coll. Imran Bodlah, 20.xi.2015; 15 ♀, Forest area, plant stem, Trail 5 (Islamabad) (N33°45.247'E73°05.146"), 638.55 m. elev. coll. Imran Bodlah, 12.iv.2016; 25 ♀, Forest area, under stone, Kotli Sattian (Rawalpindi) (N33°41.902'E073°30.612"), 1260.65 m. elev. coll. Ammara Gull E Fareen, 12.iv.2016.

Trophic associations with aphids: 5 ♀, Rawalpindi: (N33°38.929'E73°04.943") 501 m. elev. coll. Ammara Gull -E- Fareen, 12.ii.2016. *Psidium guajava* (Guava); 3 ♀, Islamabad: (N33°40.527'E73°08.376") 537 m. elev. coll. Ammara Gull E Fareen, 03.iv.2016. *P. guajava* (Guava); 2 ♀, (N32°38.928'E74°04.943") 499 m. elev. coll. Imran Bodlah, 27.iii.2015. *Cestrum nocturnum* (Night-blooming jasmine); 4 ♀, Islamabad: (N33°40.527'E72°08.375") 536 m. elev. coll. Muhammad Tariq Rasheed, 10.iv.2016. *C. nocturnum* (Night-blooming jasmine); 2 ♀, Islamabad: (N33°40.527'E73°08.376") 537 m. elev. coll. Ammara Gull E Fareen, 03.ix.2016. *Solanum nigrum* (Black nightshade), *Spinacia oleracea* (Spinach). Same plant on different coordinates.

Comments: Workers of *M. sagei* resemble more to *M. minutum* but can easily be separated in having twelve jointed antennae, scape extending beyond the top of head, mesosoma convex dorsally, cephalic surface having 3-4 erect hairs; pronotum with single seta; scattered, erect

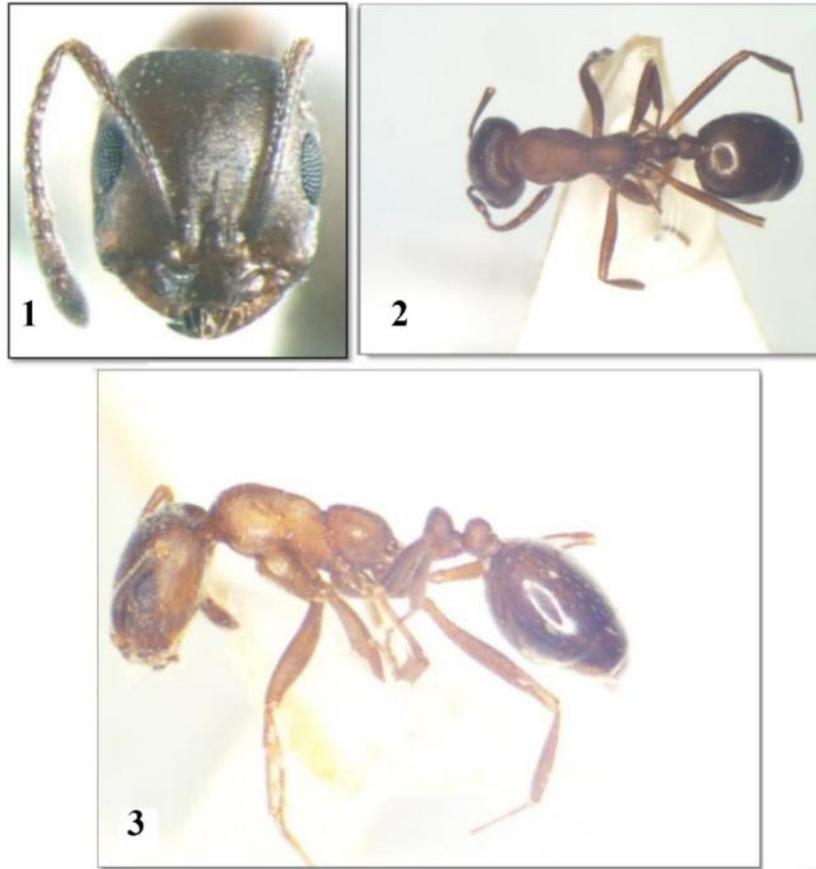
and sub erect hairs at gaster; tibiae smooth, without pilosity, minute pilosity at funicular segments of antennae (Bingham, 1903).

Remarks on Ecology and on trophic associations with aphids: During present studies individuals of this species were collected from nests in rotten wood, dead wood, tree bark and from the soil. They were also collected in association with mostly sucking insect like psyllids, aphids and mealy bugs etc. *M. sagei* was found associated with 4 aphid species namely *Greenidea (Trichosiphum) psidii*, *Aphis gossypii*, *Aphis fabae solanella* and *Aphis fabae* on *Psidium guajava* (Guava), *Cestrum nocturnum* (Night-blooming jasmine), *Solanum nigrum* (Black nightshade) and *Spinacia oleracea* (Spinach) plants from different areas of Rawalpindi and Islamabad. *M. sagei* is reported for the first time in association with any aphid species from Pakistan.

General Discussion: Both species were recorded from a range of habitats like in soil, near water sources, rotten wood, tree bark etc. Members of this genus have been already mentioned to be found in such microhabitats in many studies like Collingwood, 1985; Collingwood and Agosti, 1996; Aldawood and Sharaf, 2011 and Eguchi *et al.*, 2011. Both were also found to be associated with various aphid species. Already different species of this genus have been mentioned as to be associated with various species of aphids in different parts of the world

like Nielsson *et al.* (1971); Addicott (1979); Idechiil *et al.* (2007); Özdemir *et al.* (2008); Kataria and Kumar (2013); Shiran *et al.* (2013); Mortazavi *et al.* (2015) and Ahmad (2015).

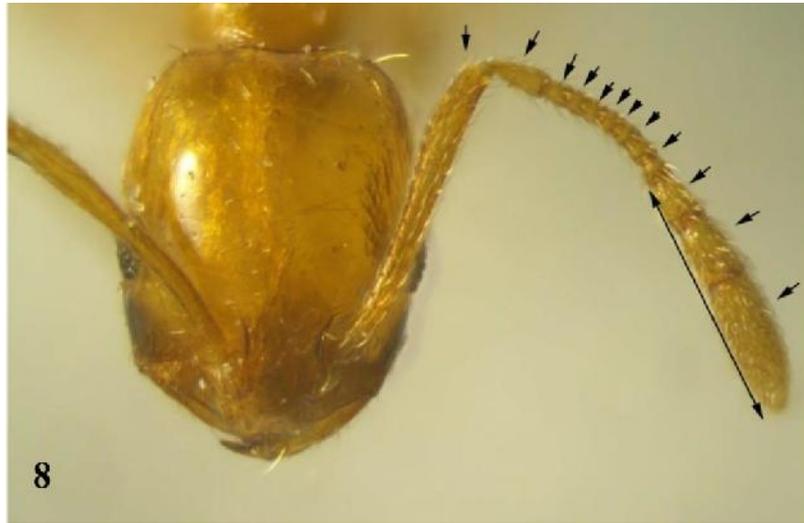
Conservation Status of *M. indicum* and *M. sagei*: During present study *M. indicum* was found in association with *Aphis gossypii* on *Parthenium hysterophorus* (Parthenium weed) and *Setaria viridis* (Green Foxtail) from Kamrial and on Ak plant from Charra Pani and with *Aphis fabae* from district Rawalpindi. Similarly *M. sagei* was also observed while workers were foraging on different host plant such as *Psidium guajava* (Guava), *Cestrum nocturnum* (Night-blooming jasmine), *Solanum nigrum* (Black nightshade) and *Spinacia oleracea* (Spinach) in various localities of Rawalpindi and Islamabad. However these host plants of above mentioned insects are highly in threat of extinction due to rapid road development in village areas of district Rawalpindi and Islamabad. Similarly development of housing societies in these areas also playing a key role in the destruction of these weeds and plants by turning agriculture land into housing structure. Due to these activities population of various plants species decreasing day by day. In order to conserve these plant and its associated communities of insect, strong efforts must be made at government level. These conservation activities will ultimately conserve *M. indicum* and *M. sagei* too



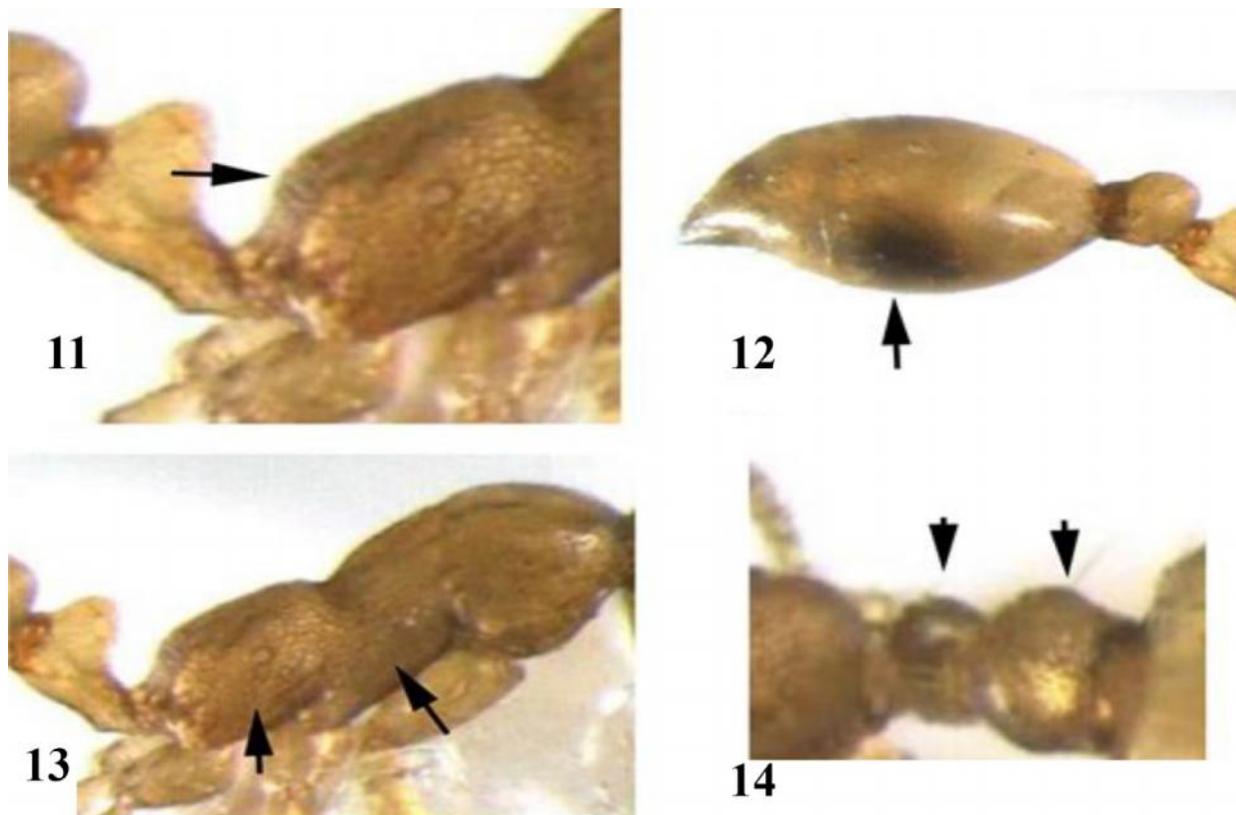
Figs. (1-3) *Monomrium indicum* Forel, 1902 (1) Head; full face-view (2) Body; dorsal view (3) Body, in profile



Figs. (4-7) *Monomrium indicum* Forel, 1902 (4) Scape short hardly crossing beyond the top of head (5) Mesosoma strongly rugose in profile view (6) Well developed metanotal groove (7) Gaster smooth and shining having erect and suberect hairs.



Figs. (8-10) *Monomrium sagei* Forel, 1902 (4) Head; full face-view (5) Body; dorsal-view (6) Body, profile-view



Figs. (11-14) *Monomrium sagei* Forel, 1902 (11) Propodeal dorsum sloping to short declivity (12)Gaster having blackish tint (13) Rugai at meso-metanotum in profile view (14) Postpetiole massive and more rounded dorsally than petiole.

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