
Re-interpretation of *Cocconia palmae*, with description of the genus *Dianesea* (Ascomycota: *Dothideomycetidae*)

Carlos A. Inácio* and Paul F. Cannon

CABI Bioscience, Bakeham Lane, Egham, Surrey TW20 9TY, UK; *e-mail c.inacio@cabi.org

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The original circumscription of *Cocconia palmae* F. Stevens was found to consist of elements of two unrelated species, belonging to *Hysterostomella* Speg. (*Parmulariaceae*) and an undescribed genus of *Dothideomycetidae* probably referable to the *Coccoideaceae* respectively. The name *Cocconia palmae* is typified to represent the latter fungus, for which the new genus *Dianesea* is introduced.

Key words: palm fungi, Ascomycota, *Coccoideaceae*, *Dothideomycetidae*, morphology.**Introduction**

The circumscription and content of the ascomycete family *Parmulariaceae* are currently confused. A project to monograph the family with special reference to generic limits has led to examination of type material of a wide range of species which have not been subject to modern interpretation and description. One of these is *Cocconia palmae* F. Stevens (Stevens, 1927). Sectioning fruit-bodies of type specimens revealed two different fungi, and it is clear that the original description is a composite of both species. One of these fungi is clearly identifiable as a member of the *Parmulariaceae* and can be referred to *Hysterostomina palmae* Stev. (Stevens, 1923). The other is considered to belong to a new genus of the *Dothideomycetidae* (Kirk *et al.*, 2001) with an uncertain familial placement. *Cocconia palmae* is lectotypified to represent the latter species, which is described as the only member of the new genus *Dianesea*, *D. palmae* (Stev.) Inácio & P.F. Cannon.

Materials and Methods

Type material of *Cocconia palmae* was obtained from K and IMI. Dried material was observed directly and after rehydration, using a dissecting microscope. Samples were examined with a compound microscope after sectioning using a cryomicrotome, or fruit bodies were dissected out using a needle, and transferred to slides as squash mounts. Stains and mounting media employed were lactofuchsin, erythrosin in ammonia, lactic acid/cotton-blue, KOH-glycerol/phloxine and Meltzer's reagent.

Results

Hysterostomina palmae F. Stevens, *Illinois Biological Monographs* 8: 176 (1923, publ. 1924).

Stromata crustose, black, often aggregated, containing single or multiple ascomata. *Ascomatal locules* 55-130 × 22-60 μm, often difficult to distinguish from the outside, opening with an irregular split. *Upper wall* dark, 17-24 μm thick, appearing in horizontal view as brown to dark brown with prismatic cells 7-12 × 3-5 μm. *Asci* 60-90 × 17-27 μm, saccate to broadly clavate, containing up to 8 ascospores. *Ascospores* 19-36 × 7-10 μm, ellipsoidal to ellipsoidal-clavate, brown, 1-3-septate, constricted at the middle septum, apparently smooth.

Dianesea Inácio & P.F. Cannon, **gen. nov.**

Etymology: named in honour of José Carmine Dianese, Universidade de Brasília, a prolific and well-respected modern contributor to knowledge of Latin American fungal diversity.

Macula in foliis vivis, ad 4.5 × 2 mm in dimensio. *Stromata* 65-113 × 138-288 μm, atra, irregulariter crustosa, erumpentes. *Conidomata* loculata. *Cellulae conidiogenae* 6-12 × 2-4 μm, ampulliformae vel ampulliformae-cylindricae, percurrentes. *Conidia* 11-17 × 2-4 μm, variabilis, aseptatae, laeves, hyalinae. *Ascomata* perithecioidea, 83-238 × 100-218 μm, ± globosa, ostiolo periphysatis. *Hamathecium* pseudoparaphysibus cellulares composito. *Asci* 54-72 × 12-16 μm, cylindraceo-clavati vel clavati, crassitunicati, non caerulescentes in iodo, 6- ad 8-sporis, rostratis. *Ascosporae* 12-20 × 3-5 μm, pallide brunneae, gelatinosae, verrucosae, uniseptatae, constrictae, cylindrico-ellipsoideae.

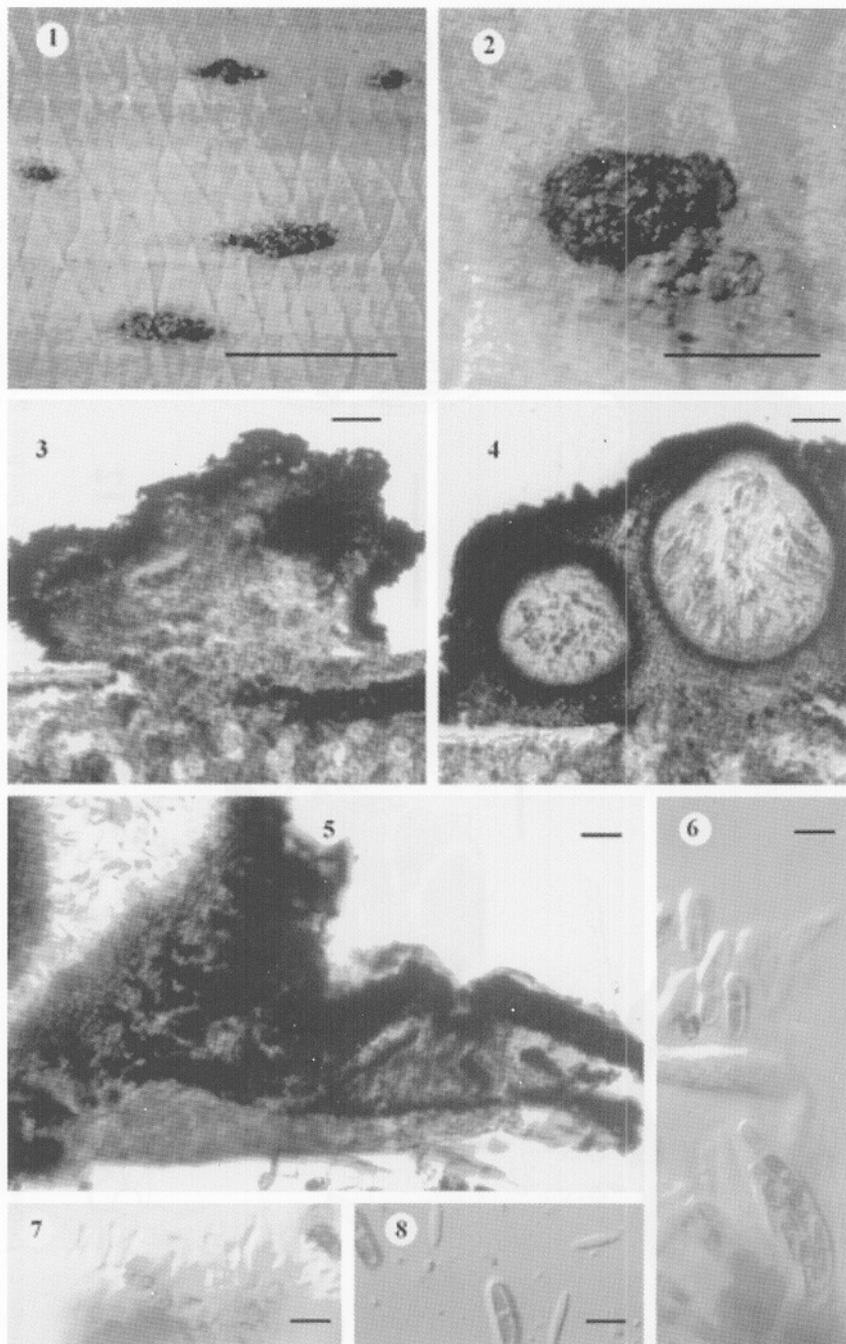
Dianesea palmae (F. Stevens) Inácio & P.F. Cannon, **comb. nov.** (Figs. 1-13)

≡ *Cocconia palmae* F. Stevens, *Illinois Biological Monographs* 11: 175 (1927).

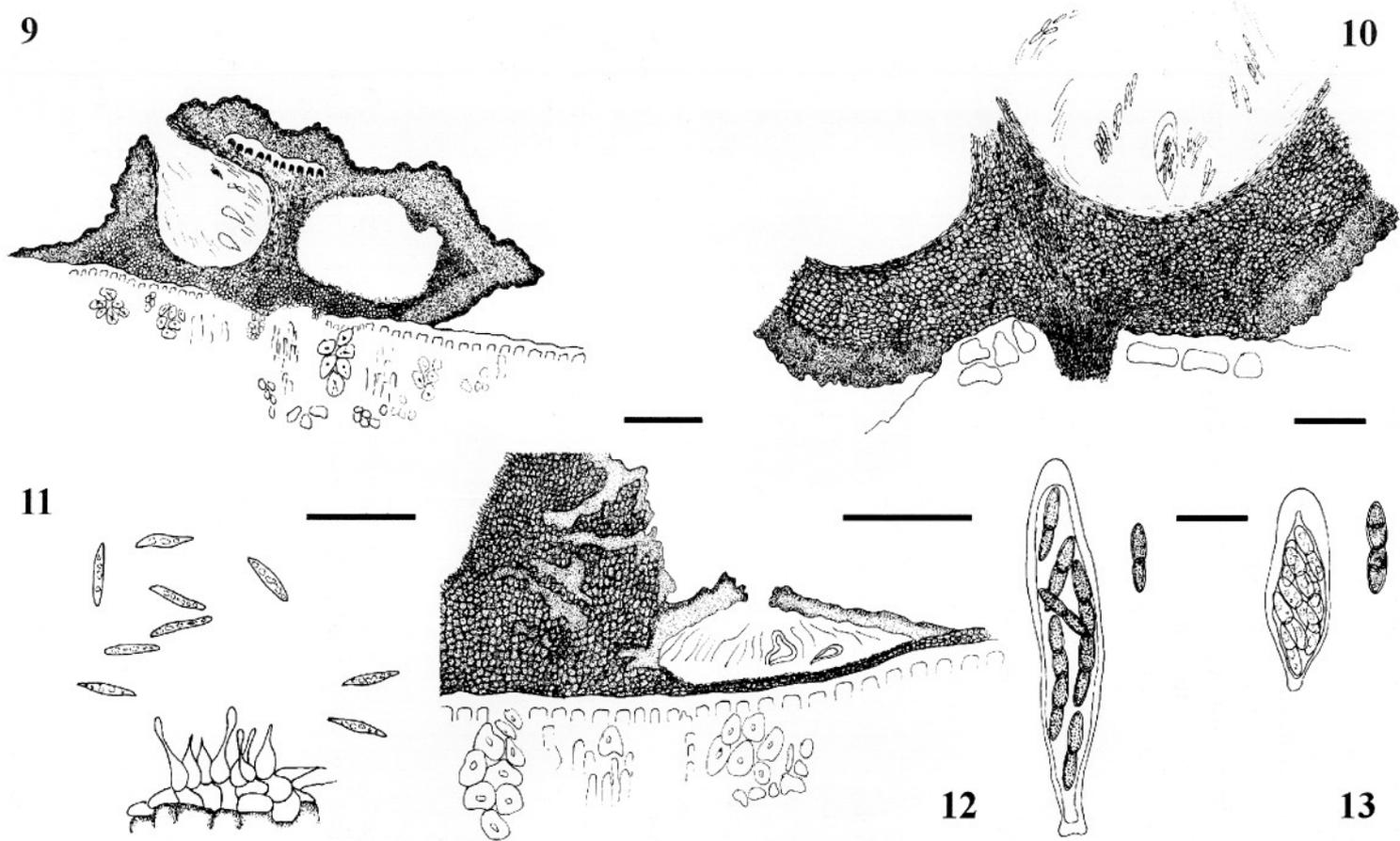
Typification: COSTA RICA, Peralta, on unidentified palm, 13 July 1923, F.L. Stevens 432 (K, **isotype, here designated lectotype** of *Cocconia palmae*; IMI 164045! **isotype**).

Symptoms: present as small leaf spots to 4.5 mm long × 2 mm wide, scattered, rarely confluent, amphigenous, different in appearance between leaf upper and lower surfaces; on the lower leaf surface as small ± flat black stromatic structures, variable in shape, mostly elliptical, but sometimes circular or irregular, within dark-brown to greyish leaf spots. On the upper leaf surface stromata prominent, black, crustose, within reddish-brown spots, intimately associated with flat black stromata belonging to *Hysterostomina palmae*.

Stroma: apparently mostly superficial (the relative location of the leaf cuticle is hard to determine), 65-113 × 138-288 μm, brown to black, composed of *textura angularis* with cells 3-10 μm diam which gradually become paler and eventually colourless in the lower part of the epidermis and the upper part of the mesophyll.



Figs. 1-8. *Dianesea palmae*, lectotype (K). 1. Stromata on upper surface of leaf. 2. Close-up of stromatal complex. 3. Vertical section of developing stroma. 4. Vertical section through ascoma. 5. Vertical section through conidiomal locule (left) and accompanying ascoma of *Hysterostomina palmae* (right). 6. Asci and ascospores. 7. Conidiogenous cells. 8. Ascospore and conidia. Bars: 1 = 5 mm; 2 = 1 mm; 3-4 = 50 μ m; 5-8 = 10 μ m.



Figs. 9-13. *Dianesea palmae*, lectotype (K) and *Hysterostomina palmae*. 9-11. *Dianesea palmae*. 9. Vertical section through ascoma. 10. Detail of stromata and ascomatal wall. 11. Conidiogenous cells and conidia. 12. Vertical section through stroma (left) and accompanying ascoma of *Hysterostomina palmae* (right). 13. Asci and ascospores of *Dianesea palmae* (left) and *Hysterostomina palmae* (right). Bars: 9, 12 = 100 μm ; 10 = 50 μm ; 11, 13 = 20 μm .

Teleomorph: Habit appearing at the same time as, or possibly after the conidiomata, often occupying the same stromatic crusts. *External appearance* brown to dark-brown, perithecial, immersed in the stromatic crust, forming irregular warts. *In horizontal section* with an upper wall composed of *textura angularis* with cells 3-7 μm diam with dark brown walls. *In vertical section* 213-325 μm deep, composed of a brown to dark-brown outer wall enclosing a central fertile locule, usually with a small portion of displaced cuticle and epidermis above the stroma, and with a basal stromatic layer mixed with plant cells. *Stromatal wall* dense, thick, making observation of individual layers difficult, composed of brown-walled cells 3-8 μm diam, \pm globose around the edge and angular and somewhat larger in the central part. *Ascomatal wall* composed of several layers of compressed cells, sometimes intergrading with but easily distinguishable from the stroma due to their darker colour. *Locule* 83-238 \times 100-218 μm , composed of a thin basal subhymenial cushion 18-30 μm deep, with asci and paraphyses above. *Interascal tissue* composed of cellular pseudoparaphyses, mostly colourless, septate, thin-walled, filiform but rounded and slightly swollen at the tips, 1-2 μm thick, sometimes dichotomously branched, the branches arising at an acute angle from the middle or near the top of individual cells. *Asci* maturing sequentially, with young and old asci in the same locule. *Young asci* variable in shape before spores can be distinguished, normally cylindrical or cylindric-clavate to clavate, at first thin-walled, becoming thick-walled particularly in the upper part, with a subapical chamber formed before spores are visible. *Full-sized asci* containing spores, 54-72 \times 12-16 μm , cylindric-clavate to clavate, thick-walled particularly in the upper part, not changing colour in iodine, with 6 or 8 spores arranged in one, two rows or in a cluster. *Asci after spore release* collapsed, with a large apical crack in the outer wall, and with the inner wall extending like a tongue through the crack. *Ascospores* 12-20 \times 3-5 μm , initially colourless, guttulate, becoming light brown to brown, covered by a gelatinous layer, verrucose, 1-septate, slightly narrowed at the septum, cylindric-ellipsoidal, the lower cell slightly attenuated and rounded towards the base, the upper cell with a rounded apex.

Anamorph: coelomycetous. Habit intimately mixed with ascomata, often occupying the same stromatic crusts. *External appearance* difficult to distinguish from the teleomorph, brown to black, shiny, crustose, embedded within a common stroma. *Conidiomatal locule* 118-238 \times 80-188 μm , containing conidia and with conidiogenous cells lining all of the internal wall surface. *Conidiogenous cells* 6-12 \times 2-4 μm , ampulliform to ampulliform-cylindrical, colourless, smooth. *Conidia*: 11-17 \times 2-4 μm , colourless, aseptate, smooth, variable in shape, cylindric-ellipsoidal, ovoid or cylindric-clavate,

guttulate. *Conidial development* by a replacement wall-building apex system with enteroblastic percurrent non-progressive proliferation (replacement wall-building apex phialides).

Discussion

Hysterostomina palmae

The discoid fruit bodies in the specimen originally described as *Cocconia palmae* are poorly preserved, but appear very similar to the fungus described as *Hysterostomina palmae* (Stevens, 1923). *Hysterostomina* was originally described as a counterpart of *Hysterostomella* which lacked interascal tissue, but is now regarded as a synonym of that genus. *Hysterostomella* itself is poorly defined and possibly polymorphic, and will be the subject of further monographic treatment. At least two other species of *Hysterostomella* are known from palms, *H. sparsa* (Peck & Clinton) Barr (syn. *H. sabalicola* Tracy & Earle; Barr *et al.*, 1986) and *H. elaeicola* Maubl. Both are quite distinct in ascospore measurements.

Dianesea palmae

Stevens (1927) in his description of *Cocconia palmae* mentioned: "The loculiferous stroma occurs either as the superficial stroma or on the erumpent stroma. The circular arrangement of the perithecia is so irregular that the suggestion of this as character is questionable. This fungus is of special interest as a form showing the characters of the *Microthyriaceae* in the radiation of the superficial stroma, and of the *Dothideales* in possessing globose locules in a stroma". The difficulty Stevens had in assessing the relationships of his species can clearly be attributed to his failing to appreciate that two fungi were present and that his description was therefore a composite. The International Code of Botanical Nomenclature allows the name to be typified subsequently by one of the original elements. We have therefore chosen the perithecial fungus to represent the name *Cocconia palmae* as it is the most prominent of the two. Stevens also described and illustrated the asci and ascospores of this species rather than those of the *Hysterostomina* (Stevens, 1927).

Cocconia palmae as newly circumscribed is now well characterised, but its relationships remain unclear. It clearly cannot be maintained as a species of *Cocconia*, a member of the *Parmulariaceae* (*Dothideomyetidae*) with ascomata which release their spores through irregular splits rather than the distinct ostioles found in *C. palmae*. An alternative placement is problematic, and an appropriate, previously existing genus could not be found. The familial affinities of the new genus are also not clear, but it seems most closely allied to

Table 1. Morphological characters of *Coccoidea*, *Coccoidella* and *Dianesea*.

	<i>Coccoidea</i>	<i>Coccoidella</i>	<i>Dianesea</i>
Stromata	Black, peltate to pulvinate	Black, peltate to botryose	Black, botryose
Anamorph	Unknown	Acervular	Locular, irregular in form
Ascomata	Locular, lacking a distinct wall	Locular, lacking a distinct wall	Perithecial, with a well-defined wall
Ostiole	Lacking periphyses	Lacking periphyses	Periphyses present
Interascal tissue	Cellular	Cellular	Cellular
Asci	pseudoparaphyses	pseudoparaphyses	pseudoparaphyses
Ascospores	Clavate, fissitunicate	Cylindric-clavate, fissitunicate	Cylindric-clavate, fissitunicate
	Brown, ellipsoidal, septate near the base, smooth	Hyaline to pale brown, cylindric-ellipsoidal, septate near the middle, smooth	Hyaline to pale brown, cylindric-ellipsoidal, septate near the middle, verrucose

the *Coccoideaceae*. An appropriate genus could not be found in the extensive list of ascomycetes known from palms (Hyde *et al.*, 2000).

The *Coccoideaceae* contains a single biotrophic genus *Coccoidea* Henn. with a possible further member *Coccoidella* Höhn. (Kirk *et al.*, 2001). The circumscription of the family is largely similar to that of *Dianesea*, but ascomata are formed as multiple distinct locules in peltate stromata, and the anamorph is acervular rather than locular (stromatic). *Coccoidea* also has ascospores which are septate close to the ends in contrast to those of *Dianesea* where they have a \pm median septum (Eriksson, 1981; Barr, 1987; Sivanesan, 1987; Kirk *et al.*, 2001). *Coccoidella* forms irregular or botryose stromata (Sivanesan, 1987); it is currently considered to be of uncertain familial placement, but shares many characters with the *Coccoideaceae* (Kirk *et al.*, 2001). The three genera are compared in Table 1. Potentially the most fundamental distinction between *Dianesea* and the genera of the *Coccoideaceae* is the apparently ascohymenial type of ascomata with distinct walls, rather than the ascolocular type which is typical of the *Dothideomycetidae*. This might invite placement of *Dianesea* in the *Sordariomycetidae*, but fissitunicate asci with rostrate dehiscence are unknown in that group.

No other potential family placement within the *Dothideomycetidae* appears appropriate. The *Venturiaceae* are mostly necrotrophs, but a small proportion exhibit biotrophic nutrition. The family is currently poorly defined, but most genera have small setose ascomata and hyphomycetous anamorphs, in contrast to *Dianesea* (von Arx and Müller, 1975; Sivanesan, 1984; Barr, 1987;

Kirk *et al.*, 2001). The genus *Rosenscheldiella* has some resemblance to *Dianesea* with its external stromatal shape, but these contain multiple ascomatal locules producing colourless ascospores but without a distinct periphysate ostiole (Barr, 1987). The *Botryosphaeriaceae* contain a few biotrophic species, but typically lack interascal tissue and have aseptate ascospores. The *Mycosphaerellaceae* are primarily necrotrophs and saprobes and rarely have any significant level of stromatic development, but some species of *Microcyclus* are biotrophic and appear superficially similar to *Dianesea*. However, they lack interascal tissue (Cannon *et al.*, 1995). The *Dacampiaceae* show some similarities with *Dianesea*, but stromatic tissue is poorly developed, ascomatal walls are much thicker and multilayered, and many are lichenicolous or lichenised (Barr, 1987). The *Parodiellaceae* contains biotrophic fungi, but have well-developed verrucose unilocular ascostromata. The *Phaeosphaeriaceae* have thin-walled ascomata which are occasionally aggregated into multilocular stromata, but are saprobes or necrotrophs and have quite distinct anamorphs.

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References

- Arx, J.A. von and Müller, E. (1975). A re-evaluation of the bitunicate Ascomycetes with keys to families and genera. *Studies in Mycology* 9: 1-159.
- Barr, M.E. (1987). *Prodromus to the class Loculoascomycetes*. Published by the author, USA.
- Barr, M.E., Rogerson, C.T., Smith, S.J. and Haines, J.H. (1986). An annotated catalog of the pyrenomycetes described by Charles H. Peck. *Bulletin of the New York State Museum* 459: 1-74.
- Cannon, P.F., Carmarán, C.C. and Romero, A.I. (1995). Studies on biotrophic fungi from Argentina: *Microcyclus porlieriae*, with a key to South American species of *Microcyclus*. *Mycological Research* 99: 353-356.
- Eriksson, O.E. (1981). The families of bitunicate ascomycetes. *Opera Botanica* 60: 1-210.
- Hyde, K.D., Taylor, J.E. and Fröhlich, J. (2000). *Genera of Ascomycetes from Palms*. [Fungal Diversity Research Series 1], Fungal Diversity Press, Hong Kong.
- Kirk, P.M., Cannon, P.F., David, J.C. and Stalpers, J.A. (2001). *Ainsworth & Bisby's Dictionary of the Fungi*. (9th ed.). CABI Publishing Wallingford, Oxon, UK.
- Sivanesan, A. (1984). The Bitunicate Ascomycetes and their Anamorphs. Vaduz, J. Cramer.
- Sivanesan, A. (1987). *Coccoidella perseae* sp. nov. and its anamorph *Colletogloeum perseae* sp. nov. *Transactions of the British Mycological Society* 89: 265-270.

Stevens, F.L. (1923, publ. 1924). Parasitic fungi from British Guiana and Trinidad. Illinois Biological Monographs 8: 173-242.

Stevens, F.L. (1927). Fungi from Costa Rica and Panama. Illinois Biological Monographs 11: 159-254.

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