Phytocordyceps, a new genus of the Clavicipitaceae

Ching-Hua Su¹ and Hsi-Hua Wang²

¹Institute of Chinese Medicine Research
Taipei Medical College, Wu-Hsing Street, Taipei, Taiwan, ROC

²Department of Agricultural Chemistry
National Taiwan University, Taipei, Taiwan, ROC

Phytocordyceps C.-H. Su & H.-H. Wang is described for a single species recently found in Taiwan. The typical ascospore is characterized as ninchuka-form, consisting of two viable, multisepulate, fusiform units linked end-to-end by a long, persistent, non-nucleate, filiform connective. The host of the type species P. ninchukispora Su & Wang, sp. nov., is seed of Beilschmiedia erythrophloia Hay. (Lauraceae), a deciduous dicotyledonous tree. The anamorph is a species of Acremonium. Stromata with mature perithecia have been induced to develop from mated ascospore isolates.

Rogerson (1970) segregated a group of perithecial fungi with filiform, thick-capped asci in the Clavicipitaceae, the single family of the Clavicipitales, in which 23 genera were included. Müller and von Arx (1973), using similar concepts, keyed 18 important genera of the family, which they retained in the Sphaeriales. Criteria used in delimiting genera have been the characters of stromata, perithecia, asci, and ascospores as well as the nature of host materials; ascospore and host differences usually have been the bases for distinguishing species from each other. In line with this approach to classification of the group, the combination of a newly observed, unique ascospore form and a distinctly different host merits description of a new genus.

In 1984 and 1985, during a 5-yr survey of Cordyceps in Taiwan, two collections of an unusual stromatic, perithecial fungus on seeds in forest litter were made by the authors. The specimens originally were considered to represent a new species of Cordyceps on the basis of stroma, perithecium, and ascus characters. However, after examining mature discharged ascospores and establishing the identity of the
host, we consider it feasible and appropriate to propose a new genus for the single new species.

**PHYTOCORDYCEPS** C.-H. Su & H.-H. Wang, gen. nov.

Stromata mycelio in seminibus dicotyledonibus exorientia, lutea vel aurantiaca, stipite simplici cylindrico, apice fertile clavato. Perithecia superficiaria vel basi vix immersa, pyriformis, aggregata. Asci cylindrici, apice hemisphaerico incrassato, uniperforato, haud amyloideo, octospori, sine paraphysibus. Ascosporeae ninchukiformes, i. e., ex duabus monadibus elongatis, septatis, fusiformibus connectivo filiformi concatenatis constantes, in sporas secundarias non secedentes. Typus: *P. ninchukispora.*

**Phytocordyceps ninchukispora** C.-H. Su & H.-H. Wang sp. nov. (Etym.: nin-chuka (Chinese dial.), an elongate, hinged handweapon similar to a flail)

Stromata 1-6 ex quoque semine orientia, 13.8-22.4 x 0.3-0.9 mm; stipite 6.8-8.4 x 0.2-0.5 mm, armeniaco, postea aurantiaco; apice fertile 5.7-14.2 x 0.8-0.9 mm, ununquidque peritheciis usque ad 800, flavo, postea bubalino, sulco longitudinali 3.2-10.1 x 0.1-0.2 mm sine peritheciis. Perithecia 95-145 x 50-60 μm, pariete 5-10 μm crasso, fere superficiaria, unumquidque ascis usque ad 200. Asci unitunicati, longicylindrici, 75-105 x 2.1-3.1 μm. Ascosporeae hyalinae, 90-110 x 1.2 μm, ninchukiformes, partibus terminalibus fusiformibus expansis, unaqueque 3-4-septata, 20-30 x 1.2 μm, binatim connectivo filiformi persistenti 60-70 x 0.1 μm junctis. Anamorphosis (Acremonium): mycelium hyalimum, cellulis angustatis monophialidicis 30-50 x 2.0-3.0 μm hyphis conidiogenis simplicibus vel ramosissimis exorientibus; conidia hyalina, ellipsoideocylindrica, levia, 0-1-septata, 2.5-10 x 1.5-3 μm.


**Phytocordyceps Su & Wang:** Stromata arising from masses of mycelium in dicotyledonous seeds clavate, yellow to orange; stalk simple (simple or branched in culture), cylindric; apical fertile portion clavate. Perithecia superficial or with base scarcely immersed, pyriform, crowded in a stellate-radial arrangement. Asci cylindric, with an enlarged, nonamyloid, hemispheric apical cap penetrated by a fine pore; 8-spored; without paraphyses. Ascospores con-
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-H. Su & H.-H. Wang sp. nov., an elongate, hinged lail) Fig. 1-1

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Fig. 1. *Phytocordyceps ninchukispora* (NTU 850106)
A. Stromata in natural position. B. Host fruit under leaf litter. C and D. Fertile portion of fruiting stromata. The bar in each figure = 50 mm.
sisting of two elongate, septate, fusoid units linked by a filiform connective; not separating into secondary spores.

Phytocordyceps ninchukispora Su & Wang: Stromata 1-6 arising from different areas of the host seed, clavate, 13.8-22.4 x 0.3-0.9 mm; stalk portion cylindric, 6.8-8.4 x 0.2-0.5 mm, apricot orange when young, becoming zinc orange to ochraceous orange; fertile portion clavate, 5.7-14.2 x 0.8-0.9 mm, maize yellow when young, becoming antimony yellow to warm buff, with a narrow longitudinal furrow 3.2-10.1 x 0.1-0.2 mm that is free of perithecia. Perithecia pyriform, 95-145 x 50-60 μm, with wall 5-10 μm thick, nearly superficial, up to about 800 per stroma (fewer in culture). Ascii unitunicate, long cylindric, 75-105 x 2.1-3.1 μm, as many as 200 per perithecium. Ascospores hyaline, 90-110 x 1.2 μm, ninchuka-form; with expanded fusoid end parts, each 3-4 septate, 20-30 x 1.2 μm, joined end-to-end in pairs by a persistent 60-70 x 0.1 μm filiform connective; not separating into secondary spores, but germinating directly into hyphae. Anamorph (Acremonium) developing in 1-ascospore isolates): mycelium of uninucleate cells 1.0-1.5 μm diam, hyaline, producing monophialidic cells 30-50 x 2.0-3.0 μm in a simple to highly branched conidigenous system. Conidia hyaline, ellipsoid-cylindric, slightly curved, smooth walled, 0-1 septate (cells uninucleate), 2.5-10 x 1.5-3 μm.

Type: on seed of Beilschmiedia erythrophloia Hay., coll. at National Taiwan University Experimental Forest, Chi-Tou, Nan-Tou Co., Taiwan, R.O.C., by C.-H. Su and H.-H. Wang; holotype NTU 850106 [TAI], Jan. 1985; representative coll. (as permanent slide) [TAI], June 1984; representative cultures ATCC, CBS, CMI, FIRDI, IFO.

Phytocordyceps ninchukispora stromata, perithecia, and asci have a strong family resemblance to those of species of Cordyceps (Mains 1954; Kobayasi 1982) and Claviceps (Rogerson 1970). The ninchuka-form ascospore, however, is unique and readily distinguishable from any ascospore described for any of the very numerous published species of Cordyceps and its segregates and of the several species of Claviceps.

Most species of the Clavicipitaceae have insects, spiders, or other fungi as hosts, plus the graminicolous and cypericolous hosts of Claviceps species. Other genera previously described from fruit substrates include Shimizuuymcides Kobayasi (1981) with species on fruits of Smilax sieboldi and S. china (Smilaceae), and Neocordyceps Kobayasi (1984) with a species on fruits of Tripterospermum japonicum (Gentianaceae). The immersed perithecia and typically
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Fig. 2. Phytocordyceps ninchukisporae (NTU 880106)
A. Perithecia on stroma in cross-section. B. Perithecium
with asci.
fusiform ascospores of these two fungus genera readily serve as characters distinguishing them from *Phytocordyceps*.

Very few species among the Clavicipitaceae have been reported to produce mature stromata in culture (Kobayasi 1941; Basith and Madelin 1968; Pacioni and Frizzi 1978). *Phytocordyceps ninchukispora* has been induced to produce stromata and mature perithecia consistently and abundantly on supplemented potato/dextrose agar. Initial success involved extracts of fallen leaves from 13 species of trees representing 7 dicotyledonous families; the extract of each species sample was individually effective as a PDA supplement. Fractionation, paper-disc diffusion, and chromatography techniques subsequently were used to identify asparagine and tetracycline or its analogues as the effective extract components. The details of this biochemical work form part of the doctoral thesis of C.-H. Su (1985), based on research studies in the Graduate Institute of Agricultural Chemistry, National Taiwan University, Taipei, Taiwan, ROC.

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sworth, F. K. Sparrow,
Paecilomyces farinosus,
memorabilis. Canad. J.

**Fig. 1. Phytocordyceps ninchukiaspora** (NTU 850106)

A. Top part of ascus. B. Ascus. C. Ascospore.
D. Germinating ascospore. E. Conidiophores and conidia.
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中文摘要

植生蟲草屬（Phytocordyceps C.-H. Su et H.-H. Wang）為最近於台灣發現之新真菌屬。
本文以其單一種進行描述。本屬之典型特徵
為具有雙節棍型子囊孢子，係由兩端具有成活力
多隔膜、梭形之兩部份，由一持久性，無
細胞核之細長狀狀部份加以連繫（頭尾相連）

本屬模式種稱為雙節棍孢子植生蟲草（P.
iminchukispora Su et Wang sp. nov.）其寄主為瓊楠
（Beilschmiedia erythrophloia Hay.）係樟科之
落葉喬木，與形態近之蟲草屬（Cordyceps）及
麥角菌屬（Claviceps）之寄主，諸如：昆蟲、
蜘蛛、真菌、或禾本科及莎草科植物有顯著不
同。本屬之無性世代為Acremonium之一種。經
由單一子囊孢子萌發產生純培養菌株交配後可
得具有成熟子囊殼之菌座。