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PRELIMINARY STUDY OF MACROFUNGI IN HELAN MOUNTAIN NATIONAL RESERVE AREA

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Abstract

More than 180 fungal specimens were collected from Helan Mountain National Reserve Area from 2012 to 2014 for primarily to study the fungal species diversity. According to the classification system with reference to the China catalogue of Macrofungi in species diversity catalogue of Fungi at Helan Mountain National Reserve Area was written, involving in 80 species belonging to 43 genera, 22 families, 5 orders and 2 classes in the Basidiomycotina, and 6 species belonging to 2 genera, 2 families, 2 orders and 2 classes in Ascomycotina, totally from 87 species, 45 genera, 7 orders, 24 families and 2 subdivisions. Among them, 49 species were edible and 22 species were medicinal, and 18 species were both edible and medicinal, and 7 species were poisonous, and 32 species were wood-rotting, and 5 species were mycorrhizal fungi, and 3 species were newly-recorded ones in Inner Mongolia. There are still some specimens that have not been identified yet because of lack of literature.

Introduction

The Helan Mountain Range research site has a unique geographical position connecting the climate and flora of the Mongolian Plateau with Northern China. It is therefore important to study the macro-fungi community of the Helan Mountains as a source of biodiversity and a hot spot linking these two wide and ecologically distinct areas.

Due to the effects of topography and forest environment, there are noticeable differences in climate between the front and the back of mountain, as well as between the mountain top and foot. From the standpoint of floristic composition, this region belongs to the Eurasian steppe flora. It is located at the junction among Ulanqab Plateau on Mongolian Plateau steppe, Yinshan on Loess Plateau steppe and Ordos Plateau, covering complex vegetation types and varied plant communities, where plant distribution reveals evident horizontal zonality and vertical zonality. Such unique geographical position and ecological background contribute to rich combinations between diverse plant species and geographical elements (Zhao *et al*. 2012). Here, natural vegetation was relatively and completely preserved, with abundant animal and plant resources, thus this area is a rare typical natural ecological area and natural scenic spot beyond the Great Wall, and also the most ideal district for the study of plant and fungal flora at Yinshan Mountains (Fan *et al.* 2010). However, no survey on fungi in this region has been reported yet. Accordingly, we conducted a special investigation of macro-fungi in this region from 2012.

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The Helan Mountain Range stretches over 6000 km^2 from southwest to northeast. For more than 200 km between the eastern Yinchuan Plain in Ningxia and the western Alashan Plateau, along the border of Ningxia and Inner Mongolia (38°21'-39°22' N, 105°44'-106°42' E) and is about 20 - 40 km wide, with an average elevation of 2000 m and the highest peak, called "Obogda" at 3556 m a.s.l. (Liu *et al*. 2005). The Helan Mountains form a climatic and vegetation boundary in north-west China. The eastern side has a steppe climate and vegetation while western areas face desert climate and desert vegetation with an alpine forest ecosystem, both formed on nutrients poor sandy arid soils in higher elevations. The annual average temperature at the foot of the mountain is 8.5ºC with an annual rainfall from 202.8 mm in the south to 183.3 mm in the north (Yu *et al*. 2000).

Materials and Methods

The experimental fruiting bodies and sporophytes of more than 180 fungal specimens were collected by authors from three times of collections at Helan Mountain National Reserve Area from 2012 to 2014 and 289 samples were obtained. Voucher specimens were preserved in the specimen room of Department of Biological Science and Technology, Baotou Teacher's College, china.

According to the traditional classification methods, morphological characteristics of the 289 collected matured fruiting bodies and their spores were observed and detailed field record. For accurate detailed information on the color and habit as well as anatomy of fruiting bodies, fresh materials were collected, noted, photographed and illustrated by the author in the field. Then the fresh materials were dried as soon as possible using a mushroom dryer. Anatomical studies of basidiocarps were conducted using a light microscope at 1000× using 5% KOH or Melzers' solution. For comparison, materials of similar or closely related taxa collected from other areas were also studied with respect to traditional taxonomy and molecular biology (Yang 1997 and Weiss *et al*.1998). Quantitative characteristics were described based on 2-5 fruiting bodies, and spore size was on average of 30 spores (Tolgor 1997, 1999).

Results and Discussions

After classification and identification based on the classification system presented by Ainsworth *et al*. (1973) and with reference to that presented by Alexpoulos (1982), it was identified that the macrofungi at Helan Mountain National Reserve Area were from 80 species belonging to 43 genera, 22 families, 5 orders and 2 classes in the Basidiomycotina, 6 species belonging to 2 genera, 2 families, 2 orders and 2 classes in Ascomycotina, totally from 86 species, 45 genera, 7 orders, 24 families and 2 subdivisions. Among them, 49 species were edible fungi, 22 species were medicinal fungi, 18 species were both edible and medicinal fungi, 7 species were poisonous fungi, 32 species were wood-rotting fungi, 5 species were mycorrhizal fungi, 3 species were newly-recorded ones in Inner Mongolia (Shao 1983, Mao 2000, Lin 2005) Before our work, investigation on macrofungi at Helan Mountain National Reserve Area had rarely reported. This survey is the first systematic and comprehensive one on fungal diversity, and the results also reflected the fungal flora characteristics in this region. With reference to the microbial species catalogue database, the species diversity catalogue of macrofungi at Helan Mountain National Reserve Area was written as follows (http://wwwl.im.ac.cn/species/species new.).Species diversity was systematically listed as follows (Hawksworth and Sutton 1995).

Ascomycitina
Pyrenomycetes
Xylariales
Xylariaceae
Daldinia
1. *D. aemulans* Starb.
Discomycetes
Pezizales
Pezizaceae
Peziza
2. *P. sylvestris* (Boud.) Sacc. et Trott.
Helvellaceae
Helvella
3. *H. atra* Holmsk: Fr.
4. *H. lacunosa* Afz.: Fr.
5. *H. ephippium* Lev.
6. *H. elastica Bull.*: Fr.
Basidiomycotina
Hymenomycetes
Agaricales
Schizophyllaceae
Schizophyllum
7. *S. commune* Fr.
Pluteaceae
Volvariella
8. *V. parvula* (Weinm.) Speg.
Pluteaceae
Pluteus (Fr.) Quél.
9. *P. microsporus* (Denn.) Sing.
Tricholomataceae
Mycena
10. *M. arcangeliana* Bres.ap.Barsali
11. *M. abramsii* Murr.
Armillariella
12. *A. tabescens* (Scop.: Fr.) Sing.
Lentinus
13. *L. sordida* (Schum.: Fr.) Sing.
14. *L. caespitosa* (Bres.) Sing.
Collybia
15. *C. fusipes* (Bull :Fr.) Quél.
16. *C. iocephala* (Berk.et Curt.) Sing.
17. *C. dryophila*
18. *C. inocephala* (Berk.& M.A. Curtis) Singer
Marasmius
19. *M. Personatus* (Bolt.:Fr.) Fr.
Armillaria
20. *A. mellea* (Vahl: Fr.) Kummer
Tricholoma
21. *T. terreum* (Schaeff.: Fr.) Kummer
Clitocybe
22 .*C. odera*(BuIL:Fr.) Quél.
23. *C. candicans* (Pers.: Fr.) Kummer
24. *C. cyathiformis* (Bu11.: Fr.) Sing
25. *C. infundibuliformis* (Schaeff.:Fr.) Quél.
26. *C. phyllophila* (Pers.: Fr.)Kummer
27. *C. obsolota* (Batsch) Quél.
Flammulina
28. *F. velutiper* (Fr.) Sing.
Melanoleuca
29. *M. stridula* (Fr.) Sing.
30. *M. subalpine* (Brtiz.) Bres. & Stangl
31. *M. strictipes* (Karst.) Schaeff.
Pleurotaceae
Pleurotus
32. *P. ostreatus* (Jacp: Fr.)Kummer
Agaricaceae
Lepiota
33. *L. castanea* Quél.
34. *L. acutesquamosa* (Weinm.:Fr.) Gill.
35. *L. cristata* (Bolt.:Fr.) Quel.
36. *L. naucinus* (Fr.) Sing.
37. *L. cygnea* J.Lange
38. *L. gracilenta* (Krombh.) Quél.
39. *L. promineus* (Fr.) Sacc
40. *L. Americana* (Peck) Peck
Agaricus
41. *A. abruptibulbus* Peck
42. *A. radicata* Vittadini Sensu Bres
43. *A. purpurllus* (Moeller) Moeller
44. *Agaricus xanthodermus* Quél.
45. *A. comtulus* Sacc.
Coprinaceae
Psathyrella
46. *P. gracilis* (Fr.) Quél.
47. *P. subinceta* Fr.
48. *P. squamosa* (Karst.) Moser
Coprinus

49. *C. patouillardi* Quél.
50. *C. leiocephalus* P. D. Orton
51. *C. micaceus* (Bull.) Fr.
52. *C. domesticus* Fr.
53. *C. disseminatus* (Pers.:Fr.) Kuhner.

Bolbitiaceae
Conocybe
54. *C. subovalis* (Kuhn)Kuhn.Romagn.
Agrocybe
55. *A. pediades* (Fr.) Fayod.

Strophariaceae
Stropharia
56. *S. semiglobata* (Batsch) Quél.
57. *S. hornemannii* (Fr: Fr.)
58. *S. aeruginosa f. brunneola* Hongo

Cortinariaceae
Cortinarius
59. *C. armeniacus* (Schaeff.) Fr.
Inocybe
60. *I. patouillandii* Bres.
61 .*I. rimosa* (Bull.: Fr.) Quél.

Crepidotaceae
Crepidotus
62. *C. applanatus* (Pers.:Fr.) Kummer

Entolomaceae
Rhodophyllus
63. *R. nidorosus* (Fr.) Quél.

Boletaceae
Leccinum
64. *L. scabrum* (Bull.: Fr.) Gray

Russulaceae
Russula
65. *R. alutacea* (Pers.) Fr.
Lactarius
66. *L. torminosus* (Schaeff.: Fr.)Gray

Aphyllophorales
Ramariaceae
Ramaria
67. *R. ephemeroderma* Sacc.et Syd.
68. *R. bourdotiana* Maire
69. *R. abietina* (Pers:Fr.) Quél.
70. *R. subaurantiaca* Corner

Polyporaceae
Polyporellus
71. *P. brumalis* (Pers.) Karst.
Polyporus
72. *P. varius* pers.:Fr.
Hirschioporus
73. *H. borealis* (Fr.) Kolt. & Pouz.
Trametes
74. *T. trogii* Berkeley
75. *T. hirsutur* Fr.
Phellinus
76. *P. pomaceus* (Pers. ex Gray) Quél.
Coriolus
77. *C. unicolor* (L.: Fr.) Pat.

Ganodermaceae
Ganoderma
78. *G. monglicum* Pilat

Gasteromycetes
Hymenogastrales
Rhizopogonaceae
Rhizopogon
79. R. supericorensis Smith

Secotiaceae
Secotium
80. *S. agaricoides* (Czern.) Hollos

Lycoperdales
Geastraceae
Geastrum
81. *G. triplex* Jungh.
82. *G. saccatun* (Fr.) Fisch.
83. *G. minimum* Schwein.
84. *G. sessile* (Sowerby) Pouzar

Lycoperdaceae
Lycoperdon
85. *L. umbrinum* Pers.
86. *L. pusillus* Batsch: Pers.

Nidulariales
Nidulariaceae
Crucibulum
87. *C. laeve* (Huds.) Kambly, Gast.

Clitocybe obsoleta (Batsch) Quél., Mem. Soc. mul. Montbeliard, Ser. belongs to the genus *Clitocybe* (Fr.) Staude, the family *Tricholomataceae*, the order Agaricales. It has small fruiting bodies. The pileus is 2 - 5 cm in diameter, hemispheric, pale brown (darker at the center), and the

center is concave, like a shallow-funnel after gradually flattening out with growth; it is smooth on the surface.

The edge is involute and sinuate. The flesh is dirty-white and odorous. The gills are dirty-white, erect or nearly decurrent, relatively dense, and unequal in length. The stipe is 3 - 5 cm long, 0.5-0.7 cm in diameter, always crooked with the same color like that of pileus, and has small white scales, with white tomenta at the base.

Spores were colorless, smooth and oblong, (6.6 - 8.5) μm × (3.5 - 4.2) μm. Each basidium has four stalks.

Habitat: growing in groups or solitarily on decayed trees in the woodland in summer and autumn.

Distribution: Hong Kong, it is a species distributed in the north temperate zone.

Collybia iocephala (Berk. & M.A. Curtis) Singer, belongs to the genus *Collybia* (Fr.) Staude, the family *Tricholomataceae*, the order Agaricales. It has small fruiting bodies. The pileus is 1-3 cm in diameter, hemispheric or oblate hemispheric or nearly campaniform; it is violet, darker at the center, but fades when dried; the surface is smooth with wide grooves on the edge. The flesh is thin. The gills are pale violet, erect or crooked, relatively loose, unequally long. The stipe is thin and long, 3.0 - 5.5 cm long and 0.2 - 0.3 cm in diameter, which expands towards the base with white tomenta. Spores are colorless, smooth, ellipsoidal, (6.5 - 8.0) um × (3 - 4) μm.

Habitat: growing in groups or solitarily on the ground in the woodland in summer and autumn.

Distribution: Hong Kong, etc.; it is a species distributed in the north temper ate zone.

Geastrum sessile (Sowerby) Pouzar, belongs to the genus *Geastrum* Pers., the family *Geastraceae*, the order Phallales. It has small fruiting bodies, 2 - 3 cm in diameter, which are subglobose at the early stage, and split into 5 rays. Exoperidium is tawny or reddish-brown to dark brown, thin, and its inner side is dirty-white, thick, fleshy and smooth, becoming thin when dried; endoperidium is dirty-white to brown, smooth, sessile, darker at the top where the peristome is fibriform, globular, 0.8 - 1.8 cm in diameter. Spores are pale brown, spherical, with minute warts, 3 - 4 μm. Capillitia are pale in color and 4 - 5 μm in diameter.

Habitat: growing in the woodland in autumn.

Distribution: Ningxia, Hebei, etc.

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