Coprophilous Fungi and Their Significance

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Abstract: Coprophilous fungi (dung-loving fungi) are a type of saprobic fungi that grow on animal dung viz. rabbits, camel, horse, elephant, cow, goat, rhinoceros etc. The hardy spores of coprophilous species are unwittingly consumed by herbivores from vegetation, and are excreted along with the plant matter. In nature manure is recycled by unique fungi (coprophilic fungi), which are capable of growth on substrates with high nitrogen contents. They bind a lot of the nutrients and in a delayed release they are making these nutrients available for plants, animals and insects, thereby closing nutrient cycles. This may provide opportunities for processing of manure.

The presence of coprophilous fungi on rhino dung, chiefly *Sporormiella*, *Saccobolus*, *Ascodesmis*, *Cercophora*, and *Sordaria*, is documented for the first time. The *Sporormiella–Ascodesmis–Saccobolus* assemblage is abundant and characterizes the rhino dung in forest and grassland areas. The presence of coprophilous fungi spores allows for an examination of the relationship between rhinoceros ecology and the flora and other fauna in the region. The overall dataset is useful in interpreting the present and past distribution of rhino and other associated animals based on the relative abundance of different types of coprophilous fungi spores and their relationship to paleoherbivory and paleoecology in India and adjoining areas.

Keywords: coprophilous, dung, fungi, spores, manure, nutrients, nitrogen, significance

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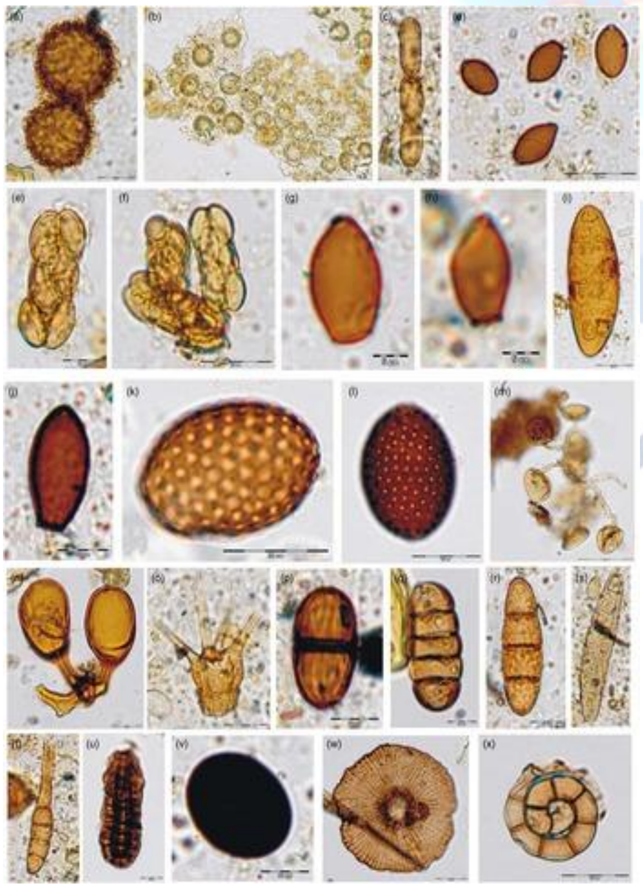
INTRODUCTION

Coprophilous fungi are a large group of saprotrophic fungi mostly found in herbivore dung. The number of these fungi undergoing investigation is continually increasing, and new species and genera continue to be described.

Dung-inhabiting fungi play an important ecological role in decomposing and recycling nutrients from animal dung. They produce a large array of bioactive secondary metabolites and have a potent enzymatic arsenal able to utilise even complex molecules. Bioactive secondary metabolites are actively involved in interaction with and defence against other organisms whose growth can be inhibited, resulting in an enhanced ecological fitness of producer strains. Currently, these antibiotics and bioactive secondary metabolites are of interest in medicine in particular, while very little information is available concerning their potential use in agriculture. This review introduces the ecology of dung-inhabiting fungi, with particular emphasis on the production of antibiotic compounds as a means to compete with other microorganisms. Owing to the fast pace of technological progress, new approaches to predicting the biosynthesis of bioactive metabolites are proposed.



Coprophilous fungi from dung of Rhino

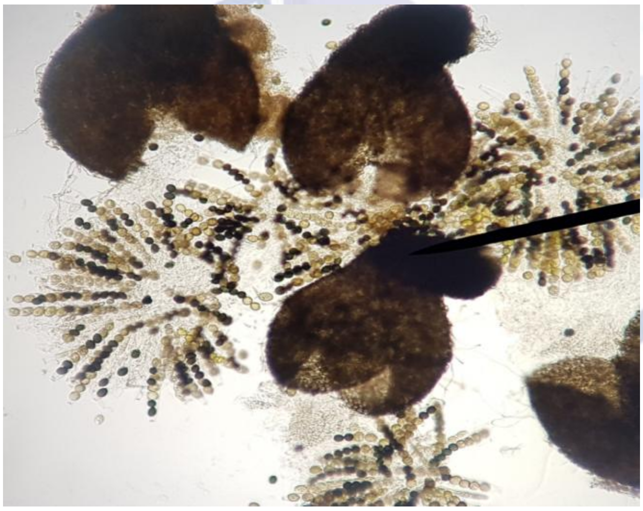
Coprophilous fungi should be considered as elite candidate organisms for the discovery of novel antifungal compounds, above all in view of their exploitation for crop protection.[1,2]

In China coprophilous fungi are still overlooked when using sporo-pollen assemblages for the reconstruction of paleo-environments. The sequential fruiting of coprophilous fungi on animal dung after deposition, particularly that of herbivores, has long been known and used as a good and easily demonstrable example of succession. When herbivores graze on vegetation, they ingest spores from coprophilous and non-coprophilous fungi along with vegetation. The spores of noncoprophilous fungi are killed by high temperatures and gastric juices in the gastrointestinal tract. of the herbivores while coprophilous fungal spores survive in the gut, undergo hydrolysis, and are passed out to germinate, grow and fruit on dung . However, any dung can yield fungi, but herbivore dung has been regarded as the best source of coprophilous fungi.[3,4]

Herbivore dung is a rich substratum of coprophilous fungi and supports high species diversity. Fruiting bodies of dung fungi appear in succession mostly following the sequence: Zygomycotina, Ascomycotina, and Basidiomycotina . Dung fungi play a vital role in the mineralization and decomposition of herbivore dung while, some display few modifications peculiar to their habitat. Fungi that grow on herbivore dung are full of fiber from dung biomass and have potential cellulolytic activity . Cellulose is a linear glucose polymer linked by β-1,4-glycosidic bond, forming a large component of plant biomass . Herbivore dung contains high amounts of readily available complex carbohydrates, made up of cellulose, hemicellulose, pectin, lignin, and high nitrogen content. In addition, they have a high moisture content, vitamin, growth factors, and minerals . The ruminal ecosystem represents the most potent fibrolytic fermentation system known. It is composed of a diverse population of obligate anaerobic fungi, bacteria, and protozoa . Coprophilous fungi in the rumen produce potent fibrolytic enzymes that can degrade recalcitrant plant polymers . The gut metabolism of herbivores is specifically adapted for highly specialized microbial processing of complex plant polysaccharides ingested . Since dung is egested with plant material, cells, and interwoven matrix of plant polymers from the herbivore rumen due to their incomplete digestion and consequently microbes on dung use them up. The array of enzymes in the rumen is not only from gut microbial diversity but also from the multiplicity of fibrolytic enzymes produced by individual microbes.[5,6]

DISCUSSION

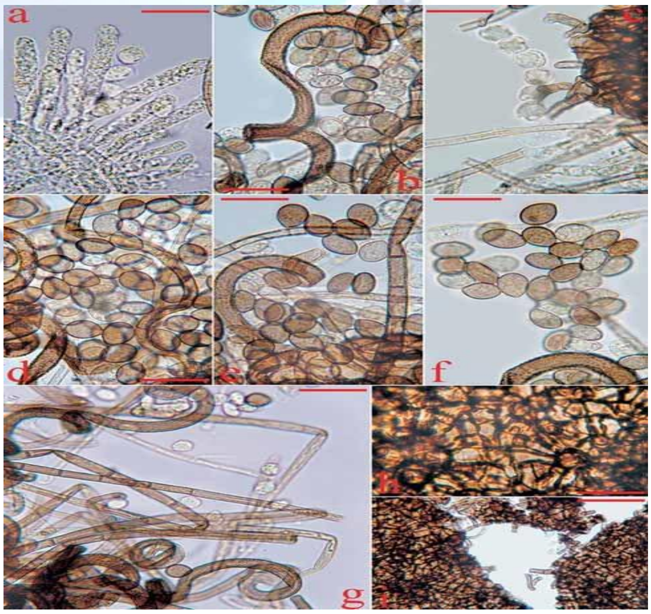
The genus *Sordaria* is a unique coprophilous fungus of Sordariaceae family belongs to the class ascomycetes and from the order Sordariales and is closely related to *Podospora* and *Neurospora*. All of these fungi nourish or reproduce on herbivore dung, but it can also be isolated from other substrates such as wood, seed or soil in countries where the temperature is high (under warm conditions). All above mentioned genera are widely used in the experimental class of genetics to study crossing over and gene conversion due to the unique arrangement of ascospores in an ascus as genetic model organisms. *Sordaria fimicola* is also used, to study the functioning and structure of perithecia, to observe the mechanisms of spore discharge. It is self-fertile (homothallic) and complete its life cycle within 10 days on a large variety of common growth media used in the research laboratories. Environmental factors such as temperature and nutrient resource affect the perithecial development. To grow *Sordaria* sp. on defined medium it continuously required varied amount of biotin and arginine for the production of perithecium.[7,8]



Sordaria Perithecium

Coprophilous fungi can act as indicators of habitat diversity .In addition, as a waste product from the digestive process, herbivorous impurities are mainly composed of the most resistant and undigested parts of plants which are feed ingredients such as cell wall polymers in the form of cellulose, hemicellulose, and lignin .Therefore, lytic enzyme of coprophilic fungi that are able to decompose plant cell walls have the potential to be utilized in various types of paper processing, textile, and food processing industries ,and hydrolysis of plant biomass into fermentable materials that produce sugar as a biofuel material .Some types of coprophilic fungi are also edible mushrooms that can be developed as protein providers ,and some of them are also poisonous mushrooms, especially containing hallucinogenic psychotropic compounds which can be taken as positive ingredients for the production of tranquilizers .[9,10]

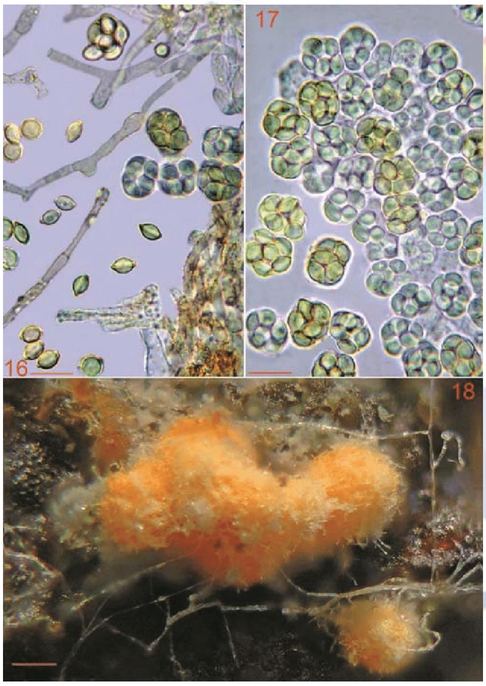
In a particular study, the majority of isolated coprophilous fungal species are belonging to Ascomycetes (17 species) followed by Deutromycetes (4 species), Zygomycetes (2 species), Basidiomycetes (1 species). The highest number of isolated species (19) was found associated with sheep dung's. Sheep dung is one of the best animal dung supported fungal growth . 17, 9 and 4 species were isolated from goat, cow and donkey, respectively. *Ascobolus* immerses has been found in all types of examined dung. *Rhizopus nigricans, Kerina nitida* and *Fusarium oxysporum* were found in three types of dung. *Chaetomium cochloides* and *Sacopolus depauperatus* were found in sheep dung and disappear from other types. The secondary metabolites of *Chaetomium* species can be used in some medical and agriculture applications. The lowest number of coprophilous fungi was isolated from donkey dung.[11,12]



Chaetomium

Many different species of coprophilous fungi were isolated around the world, such as *Sacopolus depauperatus* and *Podospora* spp. were isolated from animal dung in Brazil, *Ascobolus* spp and *Podospora* spp. from Falkland Islands, *Chaetomium* spp., *Ascobolus* spp., *Scopulariopsis* spp. and *Podospora* spp. from Thailand, *Kerina* spp. from Taiwan and *Fusarium oxysporum* from Yemen.[13]

Ascobolus



Gymnoascus

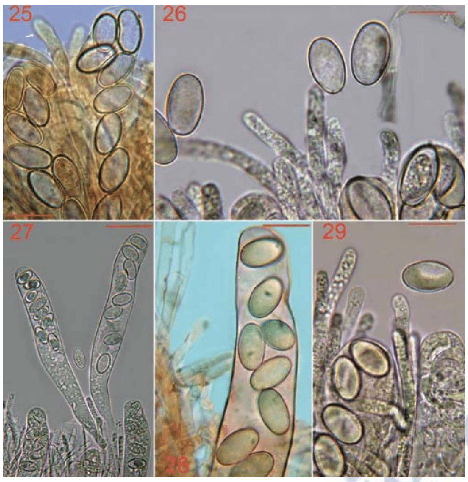
RESULTS

A particular research presents, for the first time, the screening of coprophilous fungi from koala faeces for antibacterial, antifungal and anti-quorum sensing activity. The research suggested that coprophilous fungi from koala faeces may represent a source of novel antimicrobials that warrant further exploration, especially given the paucity of research on this particular source. In another study Forty goat and donkey dung samples were collected from an animal farm in Khartoum during the period November 2004 and December 2005, to examine and verify coprophilous fungi diversity and succession under seasonal environmental conditions in Khartoum. Collected samples were incubated in humid chambers at laboratory temperatures 28° C. ± 5 The effects of dung moisture content, relative humidity, pH and the effect of light on fungal growth, fruiting bodies formation and succession were examined. The study revealed the following:

1. Goat and donkey dung samples produced a limited number of genera of coprophilous fungi, unlike the greater diversity of saprophytic fungi on other organic waste matter.
2. Goat and donkey dung samples revealed more or less the same genera of fungi with minor variations, such as *Calocera* sp. *Gymnoascus* sp. *Coprotus* sp. encountered on goat dung samples only, and *Coprinus* spp. numbers were more evident on donkey dung than on goat dung samples.
3. Goat and donkey dung samples showed a similar pattern of succession in the formation of their fruiting bodies; sporangia of the Zygomycotina species developed first after only two or three days, followed by the fruiting bodies of the Ascomycotina species, and later the fruiting bodies of the Basidiomycotina species. [14]
4. The seasonal sampling revealed more or less the same general pattern of diversity and succession, but the summer samples, April to July with ambient temperatures above 40° C, revealed a marked reduction in diversity and intensity of coprophilous fungi, examples being *Pilobolus* and *Coprinus* species which disappeared, departing from the classical pattern reported in literature from other regions of the world.

Pilobolus

5. Some specific fungi such as *Calocera* sp. *Thamnostylum* sp. *Iodophanus* sp. appeared only in the winter samples collected in December and January.



Iodophanus

6. The results on the effects of abiotic factors showed that best growth and sporulation of coprophilous fungi occurred at the moisture content 65 and 75% for goat and donkey respectively; at the relative humidity value 98%; at the slightly alkaline pH value 7.5 and that most of these fungi proved positively phototropic.[15]

7. Dung incubation at higher moisture contents of 85% and above, and at 100% R.H. encouraged bacterial and nematodes growth, thereby suppressing coprophilous fungi.

8. Mycoparasitism was observed on dung samples; *Coprinus* sp. reduced the diversity and intensity of coprophilous fungi on the samples, also *Piptocephalis* sp. attacked and suppressed *Mucor* sp. causing its disappearance within two days.

9. The role of coprophilous fungi in the natural decomposition of dung is markedly reduced by the effects of the high summer temperatures in Khartoum limiting the growth of some of these fungi.[16,17]

CONCLUSION

Usually Coprophilous fungi show strict succession of the genera fruiting on dung. They have a marked succession on herbivore dung, and it is quoted as the classic example of a fungal succession. There is an initial phase of Zygomycetes, e.g., *Mucor* sp., *Pilaria* sp. and *Pilobolus* sp., followed by Discomycetes, e.g., *Rhyparobius* sp. and *Ascobolus* sp.; then Pyrenomycetes, e.g., *Sordaria* sp. and *Podospora* sp.; followed by Basidiomycetes, e.g., *Coprinus* spp., which appear late in the succession. Usually some imperfect fungi develop simultaneously with other groups.[18]

Coprophilous fungi inhabit herbivore feces, secreting enzymes to degrade the most recalcitrant parts of plant biomass that have resisted the digestive process. Consequently, the secretomes of coprophilous fungi have high potential to contain novel and efficient plant cell wall degrading enzymes of biotechnological interest.[19]

REFERENCES

1. Afra Ahmed Ismail Khiralla, (2007), A Study on the Ecological Group Coprophilous (Dung) Fungi in Khartoum. University of Khartoum.
2. Amandeep Kaur, NS Atri and Munruchi Kaur, (2014), Two new species of Panaeolus (Psathyrellaceae, Agaricales) from coprophilous habitats of Punjab, India. Journal on New Biological Reports 3(2):125-132.
3. Amandeep Kaur, N.S. Atri and Munruchi Kaur, (2014), Diversity of coprophilous species of Panaeolus (Psathyrellaceae, Agaricales) from Punjab, India. BIODI ERSITAS.vol.(15):115-130.
4. Amandeep K, Atri NS and Munruchi K, (2015), Taxonomic study on the coprophilous mushrooms from Punjab, India: new records of family Agaricaceae. Current Research in Environmental and Applied Mycology 5 (1): 27- 45.
5. Ann Bell, (2007), An illustrated guide to the coprophilous Ascomycetes of Australia. CZECH MYCOL.59(1):82.
6. Colleen Ebersohn and Albert Eicker, (1997), Determination of the coprophilous fungal fruit body successional phases and the delimitation of species association classes on dung substrates of African game animals.Bot_Bull.Acad.Sin.38: 183-190.
7. B.P. Pandey (2005), College Botany vol.1: Algae, Fungi and Bryophyta. Eugenia Bone, (2011), Mycophilia: Revaluations from the weird world of Mushrooms.
8. Hawksworth,(1974), Moist chamber methods for favourable fungal organisms.
9. Ibrahim Ali Altayyar, Abdulatif Salim Ismail and Samir Khalaf Abdullah, (2017), A Preliminary Study of Coprophilous fungi in North of Jordan.International Journal of Applied Medical and Biological Research. vol. 2(1): p11-15.
10. James B. Gloer and S.M. Truckenbrod, (1988), Interference Competition among Coprophilous Fungi: Production of (+)- Isoepoxydon by Poronia punctata. Applied and Environmental Microbiology.vol. 54 (4):861- 864. Lakshmi Thilagam, B.K. Nayak and Anima Nanda, (2015),
11. Studies on the diversity of coprophilous microfungi from hybrid cow dung samples.International Journal of Pharm Tech Research.vol.8(9):135-138.

12. Nils Lundqvist, (1960), Coprophilous Ascomycetes from Northern Spain. Sv.Not.Tidskr.,(54):4.
13. Mohammed N., Shinkafi S.A. and Enagi M.Y.,(2017), Isolation of CoprophilousMycoflora from Different Dung Types in Some Local Government Areas of Niger State, Nigeria.American Journal of Life Sciences.vol.5(3-1):24-29.
14. Paul Stamets,(2005), Mycelium Running: How Mushrooms can Help Save the World.
15. R. Watling and M.J. Richardson,(2010), Coprophilous fungi of the Falkland Islands.Edinburgh Journal of Botany 67(3):399-423.
16. Rohini Iyer, S.K. Ghosh and A.K. Sarbhoy,(1971), Studies on Coprophilous Fungi-I. Journal of Agricultural Research Institute.vol.39,B:2.
17. Robyn Peterson, Jasmine Grinyer and Helena Nevalainen, (2011), Secretome of the Coprophilous Fungus Doratomyces stemonitis C8, Isolated from Koala Feces. Applied and Environmental Microbiology.vol.77(11):3793-3801.
18. Torbati M., Arzanelou M.and Bakshi M.,(2016), Morphological and molecular identification of ascomycetous coprophilous fungi occurring on feces of some bird species. Current Research in Environmental and Applied Mycology.vol.6(3):210-217.
19. Youbert Ghosta, Alireza Poursafar and Jafar FathiQarachal, (2016), Study on Coprophilous fungi: new records for Iran mycobiota.Rostaniha 17(3):115-126.