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Coprophilous Fungi and Their Role in Decolorization of Malachite Green Prevalent in Dye Industries of Jaipur, Rajasthan

[1]Dr. Sanju Jainth and [2]Dr. Asha Saini

[1,2]Research Scholar from Biotechnology Department, Mahatma Jyoti Rao University, Jaipur

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ABSTRACT

The present research is based on degradation of a triphenylmethane dye malachite green using coprophilous fungi. The present work utilizes malachite green in screening experiments and its degradation using varied species of coprophilous fungi obtained from dung samples of different herbivores viz. cow, goat, camel, elephant, horse found in Jaipur. For this purpose, the dye effluent from industries of Sanganer were collected and concentrations of Malachite Green dye were determined. These concentrations of MG were used for degradation using coprophilous fungal spp in vitro

A total of 9 coprophilous fungal species were isolated from these dung samples. The cowdung sample showed maximum number of coprophilous fungi (8) followed by horse dung sample (6). Minimum number of coprophilous fungi were found in elephant dung sample (3). The coprophilous fungal spp found in herbivore dung samples were *Rhizopus stolonifer, Mucor racemosus, Oidiodendron grieseum, Geotrichum candidum, Phoma betae, Chaetomium globosum, Microascus cinereus, Chrysosporium tropicum & Scopulariopsis brevicaulis.* Some species were specifically found in particular dung sample only while some fungal spp were common to maximum herbivore dung samples.

The present study lays down the best degradation by *Rhizopus stolonifer* at varied MG dye concentrations of 4ppm, 7ppm and 10 ppm. It can be inferred that varied concentration range from 1ppm to 10 ppm can be easily degraded by *R. stolonifer*. By experimental studies it has been concluded that low concentrations of MG (1ppm to 4ppm) can be easily degraded within 3 days. The concentrations ranging from 5ppm to 7ppm can be degraded till 5 days and higher concentrations 8ppm to 10 ppm can be degraded within 9 days. This proves that *R. stolonifer* is the best decolorizer and degrader of MG utilized in textile dye industry in general concentrations of 1 to 10 ppm. Further investigations can be utilized in screening of varied concentrations of other textile dyes using *Rhizopus stolonifer*.

The future scope of the study is the degradation of varied textile dyes using coprophilous spp of fungi which are easily available in herbivore dung samples. The different textile dyes at various concentrations can be screened and decolorized using coprophilous spp. Thus biodegradation using coprophilous fungi with cost effective and cheap methodology can prove a boon in decolorization experiments and treatment of textile wastewaters.

INTRODUCTION

Textile industries of Sanganer, Jaipur, releases many dyes out of which our study is based on MG (Malachite Green).

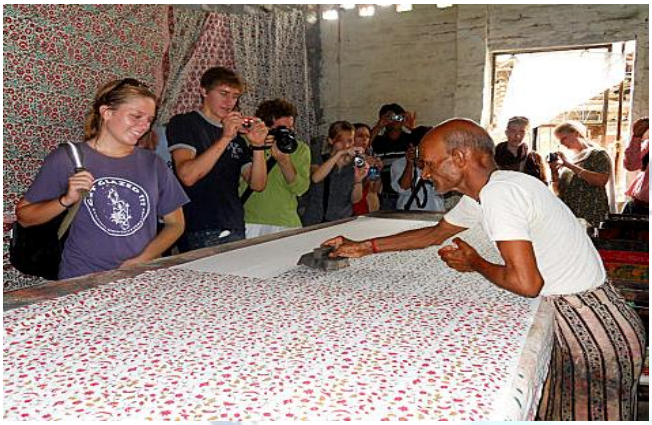


Fig.1: Block and screen printing unit in Sanganer, Jaipur

Discharge of wastewater containing dyes causes water pollution and is untreated causing contamination in water used in agricultural purposes as well as washing and drinking purposes.

Fig.2: Discharge of untreated dye wastewater

The treatment of dye wastewater is necessary and it is done by physico-chemical methods which are expensive and more water utilizing. However, biological treatment using microbes and plants is easy, ecofriendly and cheap. It uses fungi, bacteria, algae and certain plants like Phragmitis etc. Fungi are considered as best decolorisers.

Coprophilous fungi

These are (dung-loving fungi) are a type of saprobic fungi that grow on animal dung. The hardy spores of coprophilous species are unwittingly consumed by herbivores from vegetation, and are excreted along with the plant matter. The fungi then flourish in the feces, before releasing their spores to the surrounding area. The distribution of coprophilous fungi is closely linked to the distribution of the herbivores on which they rely, such as rabbits, deer, cattle, horses and sheep. Some species rely on a specific species for dung; for instance, *Coprinus radiatus* and *Panaeolus campanulatus* grow almost exclusively on horse faeces, while others, such as *Panaeolus sphinctrinus*, can grow on any feces or even just particularly fertile soil. Further, some species (such as *Conocybe rickenii*) can be found in large numbers in areas where manure has been used as a soil fertilizer, such as in gardens. Some coprophilous fungi are also known to grow from the dung of omnivores (such as *Chaetomium globisporum* from rat droppings) or even carnivores (such as *Chaetomium rajasthanense*, from tiger feces).

The spores of many dung fungi are on the dung at the time it is dropped by an animal, for the animal will have swallowed many fungal spores in the course of feeding. Once released from their dung-inhabiting fruiting bodies, the spores of many dung fungi end up falling onto grass and leaves. Many species of dung fungi have spores with thick walls, which weaken during passage through an animal's gut and so ready the spores for germination, once they have been deposited with the animal's droppings. At the time the dung drops to the ground there are likely to be a number of fungal species with spores ready to germinate. Many of these germinate at much the same time but the mycelia then grow at varying speeds. Thus, in some cases the sequence of fruiting body appearances reflects the speed of mycelial growth, and how quickly a mycelium can accumulate enough resources to allow the production of fruiting bodies. Some dung fungi, though slow growing, are very antagonistic to other species and able to destroy or severely inhibit other mycelia. Fungal activity in dung appears to be adversely affected by water content.

The succession of fungi sporulating on dung frequently departs from the idealized pattern and it may be drastically altered if the dung is mechanically disturbed during decomposition. Coprophilous fungi are highly specialized for growth on dung, and some never occur elsewhere. While some dung fungi show few modifications peculiar to their habitat, most do have some unique features. Many exhibit some very specialized structures to ensure survival in their unique habitat.

1. Herbivores do not graze near their own dung; therefore, the spores must be propelled beyond this "zone of repugnance." Thus, the spores or spore masses are relatively large and heavy. In the Zygomycete *Pilobolus*, for instance, the entire sporangium is discharged as a unit . In the bird's nest fungus, *Cyathus stercoreus*, the peridioles (the "eggs") containing many spores are violently discharged when a raindrop hits the peridium (the "nest"). The spores/masses, because of their weight, do not remain in the air long, but follow a parabolic trajectory landing on nearby grass without the aid of air currents. The sporangium and sporangiophore of *Pilobolus* measure about 0.5-1.0 cm, yet the sporangium has been propelled as much as 1.8 m vertically and 2.1 m horizontally.

2. Some coprophilous fungi exhibit a phototropic response that determines the direction the spore mass will be projected and ensures that the spores clear the substrate. Spore discharge is always during the day. The entire sporangium of *Pilobolus*, for example, grows toward the light source. To demonstrate this phototropic response, place the mature culture of *Pilobolus* inside a container with a hole punched into one side of the container top. Wrap the container inside aluminum foil and punch another hole in the foil aligned over the container hole. Place transparent tape over the hole, and set the container in a window. The following day, remove the foil and container. The majority of the ejected sporangia will be found stuck to the tape or around the light source in the container top.

3. The spores are dark to protect them from ultraviolet light until they are consumed by a herbivore. In some fungi, melanin is present in the spore walls; in others, a dark membrane covers the spore mass. *Coprinus comatus*, a mushroom that fruits on dung, exhibits these dark spores.

4. The spores/mass are often mucilagenous so that they stick to vegetation upon impact, and the mucilage, when dry, cements firmly. In *Cyathus*, the peridiole has a sticky piece of hypha, the funiculus, which attaches to vegetation upon impact and wraps the peridiole firmly around it. Other coprophilous fungi, such as *Mucor hiemalis*, form a sticky droplet around their spores. When an insect visits the dung, the spores stick to the insect's body. If the insect rests again on other vegetation or another dung heap, the spores rub off and adhere to the new environment.

5. Many of the coprophilous fungal spores will not germinate until after passing through an herbivore's digestive tract: They must be heated inside the gut, digested by the gut enzymes and/or bacteria, or stimulated by the higher pH of dung.

The present research is based on degradation of a triphenylmethane dye malachite green using coprophilous fungi. The present work utilizes malachite green in screening experiments and its degradation using varied species of coprophilous fungi obtained from dung samples of different herbivores viz. cow, goat, camel, elephant, horse found in Jaipur. For this purpose, the dye effluent from industries of Sanganer were collected and concentrations of Malachite Green dye were determined. These concentrations of MG were used for degradation using coprophilous fungal spp in vitro.

Aims and Objectives of the present research

The aims and objectives of the present research are as follows:

1. Isolation of various species of coprophilous fungi from dung of herbivores viz. elephant, cow, horse, camel and goat present in Jaipur.
2. Utilization of isolated species of coprophilous fungi for degrading malachite green dye of different concentrations obtained according to dye wastewater effluent from dye industries of Jaipur.
3. Screening of coprophilous fungal spp for decolorization of different concentrations (ppm) of MG obtained according to dye wastewater effluent from textile industries of Jaipur.
4. Recording the time taken (duration in days) by each fungal spp for degradation of different concentrations of MG.
5. Comparative analysis of rate of dye degradation by different coprophilous fungal species.
6. Isolation of the fastest coprophilous fungus as a dye degrader .
7. Study of the significance of fastest dye degrader in biotechnology.

MATERIALS AND METHODS

The present research work has utilized dung samples of herbivores viz. Cow, Horse, Elephant, Goat and Camel from different areas in Jaipur, for inoculation in Potato

Dextrose agar medium. These dung samples were inoculated in PDA to obtain coprophilous fungi.

1. Cow dung sample: collected from cowshed at Tonk Road, Jaipur
2. Elephant dung sample: collected from tourist track in Amer, Jaipur
3. Horse dung sample: collected from a stable near Polo ground, Rambagh circle, Jaipur
4. Goat dung sample: collected from owner of goats at Moti Dungri Road, Jaipur
5. Camel dung sample: collected from owner of Camel at Ram Nagar extension, Sodala, Jaipur

The samples were collected by spatula from the relevant places in Jaipur in sterilized polythene bags. The samples were immediately brought to the laboratory. Each sample was diluted to 10-1 dilution using distilled water. Potato Dextrose agar medium was prepared as per standard rules. 20gm PDA powder was added to 1 liter distilled water during boiling and the solution was made transparent. Autoclaving of the PDA medium, petriplates and utilizable glasswares was carried out at 60lb pressure for 20 minutes. Pour plate method was carried out during inoculation of all the dung samples in petriplates. For this each diluted sample (1ml) was introduced in ¾ level of diluted PDA in test tube and stirred. This was then poured in petriplate which was lidded and rotated for mixing. Such method was used for all the five types of dung samples. 5 plates containing different dung samples whereas the 6th plate was only poured with PDA without inoculation and kept as control.

The incubation of the 6 petriplates after solidification was done at 30C until the colonies appear. Observation of petriplates was done daily.Colonies initiated after 3-4 days and developed after 10 days. These were identified using slide preparation and microscopic study. The morphological details were reviewed by past literatures. The permanent slides were prepared and sent to CSIR, New Delhi for final identification. The coprophilous fungal species after identification were isolated separately in PDA slants by colony touching and streaking. Incubation after 15 days gave pure cultures of coprophilous fungal species. In case of contamination, subculturing was done and reisolation was carried out. Thus pure culture slants of coprophilous fungal species was attained.

For dye degradation experiment, malachite green dye in powder form was utilized. The different concentrations of MG dye (ppm) was determined from the effluent of 3 textile dye industries of Sanganer . This showed the average concentrations of MG dye in wastewater which comes out via textile dye industries in Sanganer, Jaipur. Thus these concentrations of MG were used in screening experiment for degradation by coprophilous fungal spp. PDA medium was prepared and separate concentrations of MG dye powder was added to 100 ml PDA. Dye containing medium was poured in pteriplates until solidification. Pure cultures of each coprophilous fungal spp was streaked on each PDA containing plate with a definite concentration of MG (ppm). These plates were incubated at 30C and observations were recorded.

The observations were taken on the basis of MG dye concentration (ppm), coprophilous fungal spp used, no. of days of decolorization and color change. This gave an idea of the specific coprophilous fungus degrading a particular concentration of MG completely in shortest time interval. Thus the potentiality of coprophilous fungi in dye degradation can be assessed. Graphical representation and tabulated matter gave the detailed idea about fastest degrader of MG dye. The plates/photographs provided the general literature on coprophilous fungus morphology and structure . The present research on coprophilous fungi has given a knowledge on general fungal spp which develop on different types of herbivore dung. This also assesses the potential dye degrading fungus found in particular herbivore dung has specificity or variability.

OBSERVATIONS

Occurrence of coprophilous fungal species in dung samples of different herbivores

5 herbivores were selected from Jaipur for the collection of dung samples. These were domestic species of cow (*Bos primigenius indicus)*, horse (*Equus caballus)*, goat (*Capra hircus)*, camel(*Camelus dromidarus*) and elephant (*Elephas maximus*). A total of 9 coprophilous fungal species were isolated from these dung samples. The cowdung sample showed maximum number of coprophilous fungi (8) followed by horse dung sample(6). Minimum number of coprophilous fungi were found in elephant dung sample(3). The coprophilous fungal spp found in herbivore dung

samples were *Rhizopus stolonifer, Mucor racemosus, Oidiodendron grieseum, Geotrichum candidum, Phoma betae, Chaetomium globosum, Microascus cinereus, Chrysosporium tropicum & Scopulariopsis brevicaulis.* Some species were specifically found in particular dung sample only while some fungal spp were common to maximum herbivore dung samples.

Fig.3: ***Bos primigenius indicus***

Fig.4: ***Equus caballus***

Fig.5: ***Capra hircus***

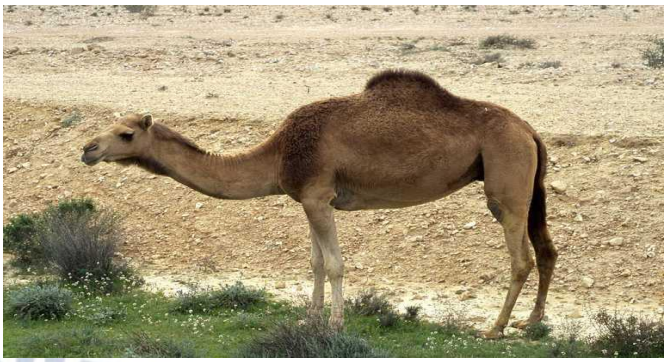


Fig.6: ***Camelus dromidarus***

Fig.7: ***Elephas maximus***

Coprophilous fungi isolated from dung samples :-

Fig.8: ***Rhizopus stolonifer*** **colony appear as black dots**

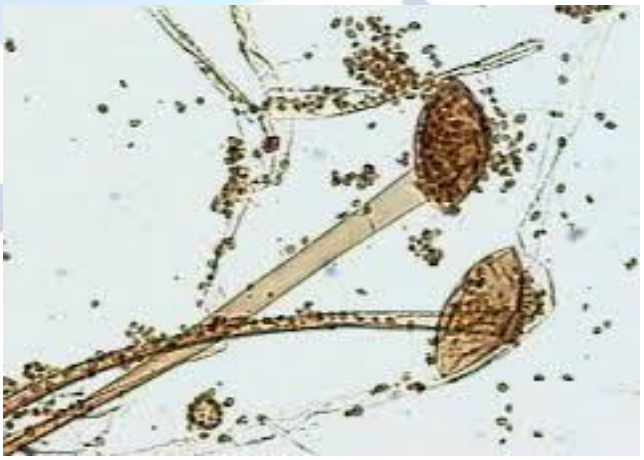


Fig 9.: Structure of ***Rhizopus stolonifer***

Fig.10: *Mucor racemosus* cotton candy like colony

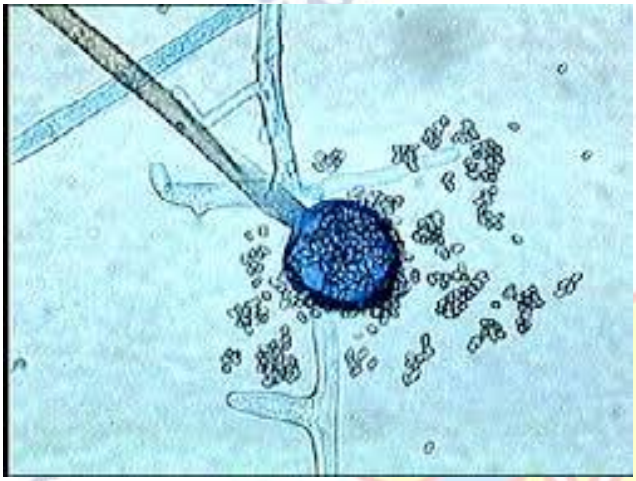


Fig 11. *Mucor racemosus*

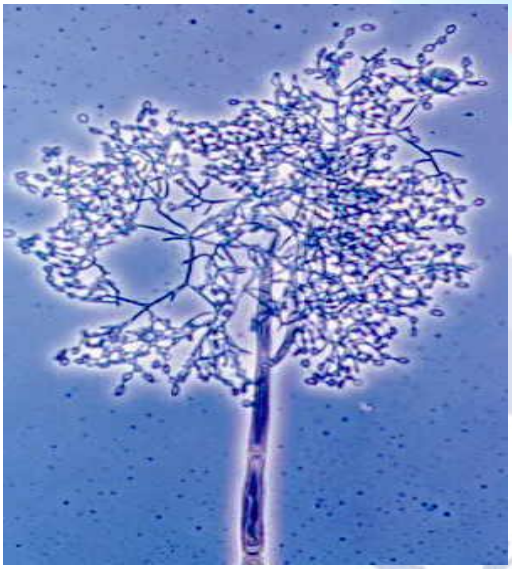


Fig.12. *Oidiodendron grieseum*

Fig.13: *Geotrichum candidum* colonies

Fig. 14. *Geotrichum candidum*

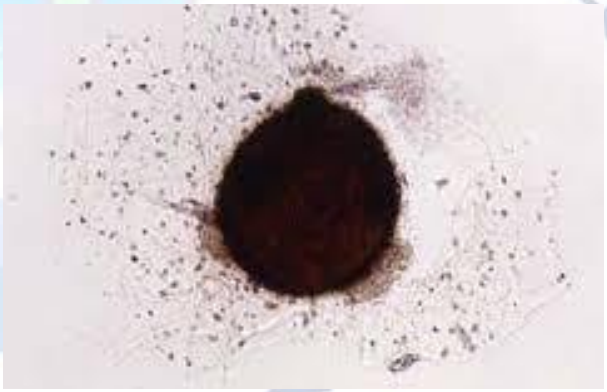


Fig. 15. *Phoma betae*

Fig.16: Colonies of *Chaetomium globosum*

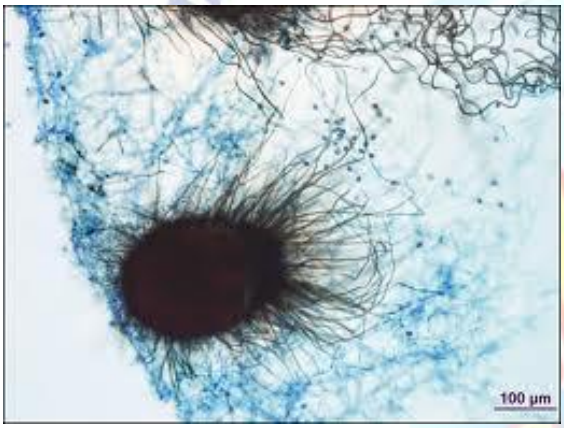


Fig. 17. *Chaetomium globosum*

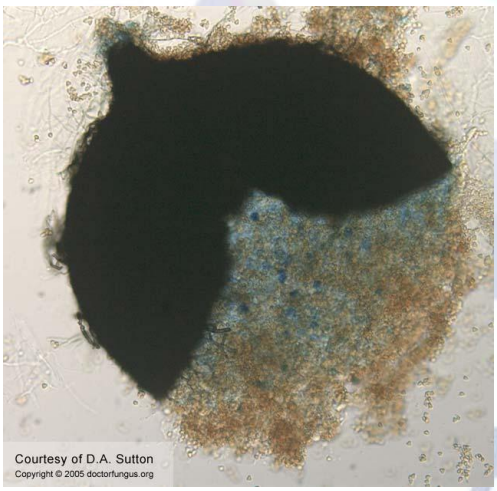


Fig. 18. *Microascus cinereus*

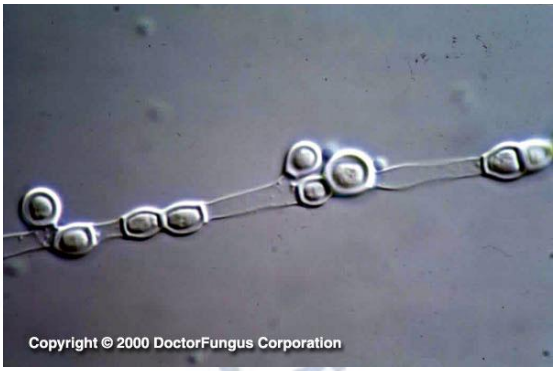


Fig 19. *Chrysosporium tropicum*

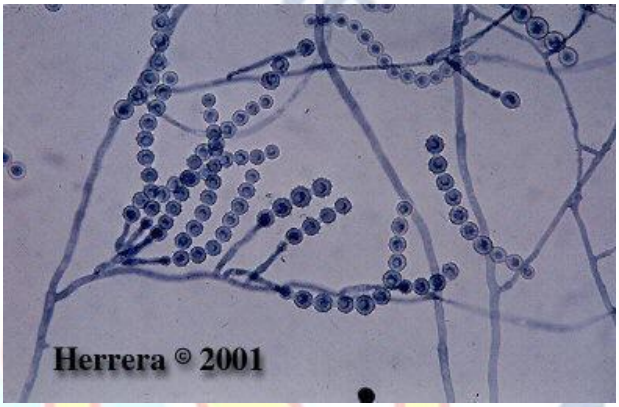


Fig. 20. *Scopulariopsis brevicaulis*

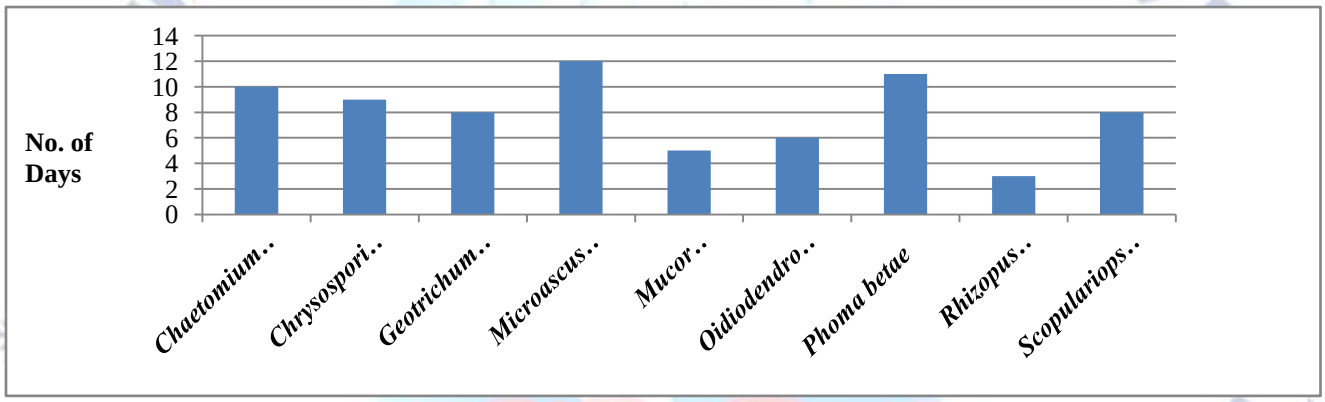
Table: 1. Occurrence of coprophilous fungal species isolated from five herbivores in Jaipur.

S. no.	Dung sample	*R. stolonifer*	*M. racemosus*	*O. griesium*	*G. candidum*	*P. betae*	*C. globosum*	*M. cinereus*	*C. tropicum*	*S. brevicaulis*
1.	Cow	+	+	+	+	+	+	-	+	+
2.	Horse	-	-	+	+	+	-	+	+	+

3.	Camel	_	-	+	-	-	+	+	+	-
4.	Goat	+	+	+	-	+	+	-	-	-
5.	Elephant	-	-	-	-	-	+	_	+	+

Table:2. Degradation of 4ppm MG dye concentration by coprophilous fungi

Fungal spp	*R. stolonifer*	*M. racemosus*	*O. griesium*	*G. candidum*	*P. betae*	*C. globosum*	*M. cinereus*	*C. tropicum*	*S. brevicaulis*
No. of days of 4ppm MG dye degradation	3	5	6	8	11	10	12	9	8

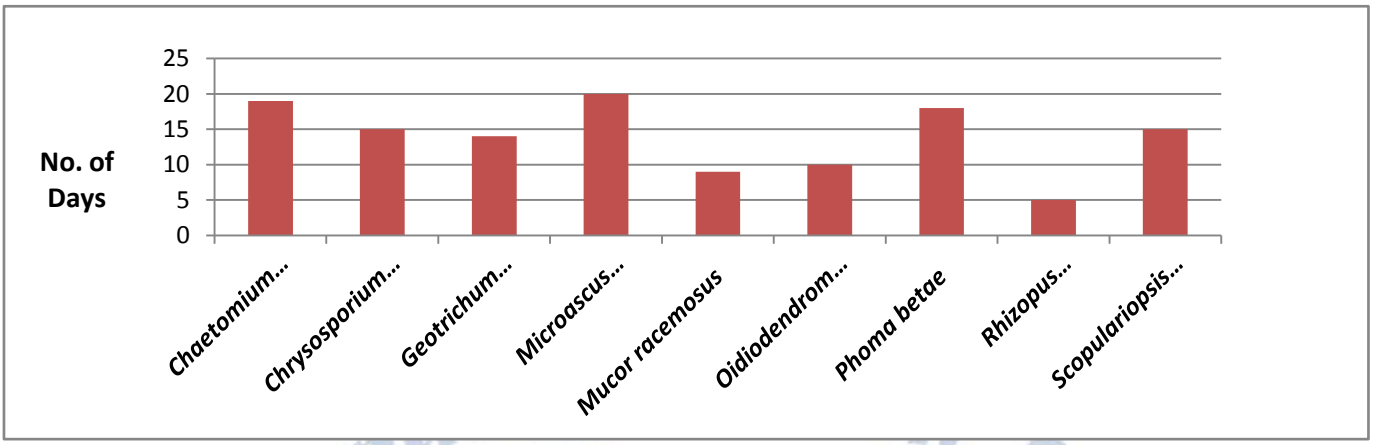


Graph.1: No. of days of 4ppm MG dye degradation by Coprophilous fungal spp

Rhizopus stolonifer was found to be fast degrader of 4ppm MG dye concentration followed by *Mucor racemosus*. Biosorption of dye was seen to be fastest and media color changed to transparent only in 3 days in case of *Rhizopus stolonifer*, while it was 5 days in case of *Mucor racemosus*. Other coprophilous fungi were slow degraders .

Table:3. Degradation of 7 ppm MG dye concentration by coprophilous fungi

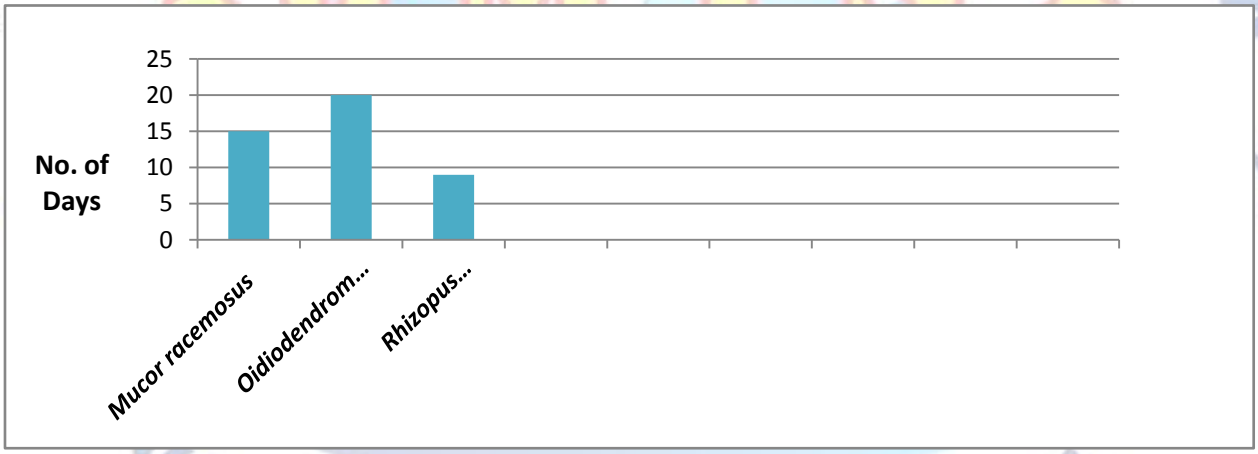
Fungal spp	*R. stolonifer*	*M. racemosus*	*O. griesium*	*G. candidum*	*P. betae*	*C. globosum*	*M. cinereus*	*C. tropicum*	*S. brevicaulis*
No. of days of 7ppm MG dye degradation	5	9	10	14	18	19	20	15	15



Graph:2. No. of days of 7ppm MG dye degradation by Coprophilous fungal spp

Table:4. Degradation of 10 ppm MG dye concentration by coprophilous fungi

Fungal spp	*R. stolonifer*	*M. racemosus*	*O. griesium*	*G. candidum*	*P. betae*	*C. globosum*	*M. cinereus*	*C. tropicum*	*S. brevicaulis*
No. of days of 10 ppm MG dye degradation	9	15	20	Very slow	Very slow	Very slow	Very slow	Very slow	Very slow



Graph 3: No. of days of 7ppm MG dye degradation by Coprophilous fungal spp

The degradation of dye was recorded upto 20 days after which the media turns dry. The fungus *Rhizopus stolonifer* became a slow degrader due to higher concentration of dye. More time period was required for decolorizing MG of 4ppm concentration. The medium dried out after 20 days and fungi taking degradation time of more than 20 days were very slow degraders (Table). These were *Geotrichum candidum, Phoma, Chaetomium, Microascus, Chrysosporium* and *Scopulariopsis.* At 10 ppm concentration of dye *Rhizopus stolonifer* was again the fastest degrader as compared to other coprophilous spp.

These tables also represent that:

Dye concentration is hence inversely proportional to rate of degradation

Dye concentration is directly proportional to time of degradation

RESULTS AND DISCUSSION

Jaipur Environ was selected for analysis of various dung samples

The dung samples of different animals (herbivores) were collected viz. domestic species of cow (*Bos primigenius indicus*), horse (*Equus caballus*), goat (*Capra hircus*), camel(*Camelus dromidarus*) and elephant (*Elephas maximus*). The environ was selected because warm temperatures are prevalent and the herbivore species (domestic animals) required in the study are easily available here. Camel is specific to Rajasthan, Elephants are found commonly in tourist areas, goat, cow and horse are also found with professional animal keepers.

Present investigation was performed during summer season

Size of the fragment of dung, and warmth and moisture characteristics influence the rate of appearance and the fungi that appear. Cooler temperatures and drier conditions will slow the rate of sporulation.

Competition occurs among fungal species in dung

Fungi that grow will be in strong competition soon after germination of their spores. Fungi will be competing with each other, and the various invaders colonising the resource. Competition will be intense, and we might expect all the aspects of a competitive interaction to be seen in dung. The fungal spp observed and analysed have undergone competition and survived. These species are the dominant ones which can resist varied environmental conditions.

Dung fungi have close relationship with herbivorous hosts

Dung fungi survive passage through the GIT, germinate and grow in the freshly deposited dung. They form adhesive spores that are actively and violently discharged. The spores are deposited on vegetation, and are then consumed by herbivores to complete the cycle. Dung fungi have a close relationship with their herbivorous hosts. Their life cycle is closely adapted to using dung: elements of dispersal, reproduction and growth offer insights into a complex interaction.

Maximum fungal composition was found in cow (*Bos primigenius indicus*) dung

The coprophilous fungal spp obtained in cowdung were *Rhizopus stolonifer, Mucor racemosus, Oidiodendron grieseum, Geotrichum candidum, Phoma betae, Chaetomium globosum, Chrysosporium tropicum* & *Scopulariopsis brevicaulis*. This accounts for the fact that cowdung provides maximum fungi which can be utilized for dye degradation experiments. Cowdung has significance in research and scientific fields. Its microbial composition makes it favorable in the field of biotechnology. The dung sample also gives an idea of the fungal spores intake by the animal.

9 coprophilous fungal species were isolated from 5 herbivore dung samples

The coprophilous fungal spp found in herbivore dung samples were *Rhizopus stolonifer, Mucor racemosus, Oidiodendron grieseum, Geotrichum candidum, Phoma betae, Chaetomium globosum, Microascus cinereus, Chrysosporium tropicum* & *Scopulariopsis brevicaulis*. These fungal spores have remained undigested in herbivores and excreted out in faecal matter ie. dung.

The dung heap is not inhabited exclusively by fungi

Vast populations of bacteria, protozoa, platyhelminths, nematodes, annelids, and arthropods coexist with the fungi. These compete for resources, and some parasitize or consume the fungi while others provide substrates for them. Also, these organisms can deplete the dung of nutritionally necessary compounds, such as nitrogenous ones, and can produce waste products that enhance or retard the growth and reproduction of some fungi. For instance, ammonia, a waste product of the bacterial degradation of proteins, stimulates sporangial production of *Pilobolus*, which grows better in the presence of other microbes. Thus, dung samples not consisting of fungal flora may be attributed to presence of other organisms like bacteria , protozoa, nematodes etc. which might have consumed the fungi.

Cowdung proves to be the best substrate for fungal growth while elephant is weak substrate

Fungi being more in cowdung shows that it is rich in nutritional compounds and devoid of high populations of bacteria, protozoa , platyhelminths, nematodes, annelids, and arthropods etc which cause its depletion and produce waste products making it contaminated. Thus, cowdung is a good growth substrate for fungi. Elephant dung samples contained many larvae which feed on fungal spores, hence decreasing fungal composition in it.

Malachite green- a triphenylamine dye is hazardous

MG has been selected due to its triphenylamine structure which causes injuries to humans and animals

by direct contact of inhalation and ingestion. It is released by various textile industries of Sanganer, Jaipur. Effects such as carcinogenesis, muta-genesis, teratogenesis, respiratory toxicity and reduced fertility in humans have been reported. The different concentrations of MG have thus been selected for degradation by coprophilous fungi in the present investigation.

Dye degradation rate is inversely proportional to the dye concentration

By the present research as the dye concentration was increased from 4ppm to 7ppm to 10 ppm the degradation rate decreased. Fungal spp showed biosorption by their cell walls and dye particles were broken down due to fungal enzymes. Biosorption potential of the fungus depends on degradation potential. More dye particles biosorbed will be degraded slowly. Less number of dye particles biosorbed will be degraded early. Therefore, low concentration 4ppm of MG dye was degraded by all the 9 coprophilous spp but this was species specific. *Rhizopus stolonifer* showed high degradation (in 3 days) while *Microascus* was a slowest degrader (12 days).

Dye concentration is directly proportional to the degradation time

As the dye concentration was increased from 4 ppm to 7 ppm to 10 ppm, the degradation time also increased in number of days. Good degraders at 4ppm became slow in case of 7 ppm concentration. Some fungal species became very slow degraders in case of 10 ppm dye concentrations of MG.

Fungal Dye degradation is species specific

All the concentrations of MG dye (4ppm, 7 ppm and 10 ppm) were degraded by *Rhizopus stolonifer* at a faster rate in comparison to other fungal spp. *Mucor* was the second important degrader. Thus, dye concentration does not cause change in degradation by specific species of fungi. The potentiality of a species remains same but the time of degradation increases by increase in dye concentration.

***Rhizopus stolonifer* proved to be the most potential coprophilous fungus**

The degradation of MG was fastest by *R. stolonifer* in short time (no. of days). However when the concentration of dye was increased the fungal degradation became slower (no. of days), but the degradation rate was higher as compared to other coprophilous fungal spp. *Mucor* was found to be the second potential degrader after *Rhizopus stolonifer*.

CONCLUSION AND FUTURE SCOPE

Herbivorous dung proves to be best substrate for coprophilous fungal growth. It is one of the best in nutrient content of proteins, carbohydrates and the undigested spores of fungi survive after competition with various microbiota. These fungal spores are resistant to environmental changes and obtain warmth and moisture via dung, hence grow vigorously in dung. However, the present investigation was specially carried out during summer season to obtain maximum diversity of coprophilous fungi. Many fungal spores are ingested by platyhelminthes, nematodes, annelids, arthropods and larvae found in dung, hence survival of fungal spores occur after dominance by varied microbiota and worms. This proves that dung fungi are naturally associated to herbivorous hosts. Their life cycle is completed in dung and herbivore animal. In the present investigation maximum number of coprophilous fungal spp were found in cowdung These were 8 fungal spp. viz. *Rhizopus stolonifer, Mucor racemosus, Oidiodendron grieseum, Geotrichum candidum, Phoma betae, Chaetomium globosum, Chrysosporium tropicum* & *Scopulariopsis brevicaulis*.

According to the present research Malachite Green, a triphenylmethane dye can get degraded utilizing coprophilous fungal species also. Past researches have shown the utilization of ligninolytic fungi and soil borne fungi for degrading textile dyes including Malachite Green. However, the work on coprophilous fungi remained un-noticed. Therefore in the present study these coprophilous fungi are utilized and 3 different concentrations of MG dye found in textile effluent are decolorized. The hazards of MG is one of the highest causing damage directly to humans. Hence the dye has been selected for this research work. Coprophilous fungi can also degrade 4ppm and 7ppm of MG. The rate of degradation however becomes slow due to increased concentration of MG. This accounts for slow degradation taking more number of days as the dye concentration is increased from 4ppm to 7ppm to 10 ppm. At 10 ppm of MG fungal cultures dried out and the PDA media was also dry, so many fungi taking higher time (more than 20 days) were considered to be very slow degraders. *Rhizopus stolonifer* was the best

degrader followed by *Mucor racemosus*, as compared to other coprophilous spp.

The fungal degradation of dye was found to be species specific. Particular species with good degradation rate always remains a good degrader even if the dye concentration is increased upto certain limit. *Rhizopus stolonifer* was always the best degrader in comparison to other coprophilous fungi.The present study lays down the best degradation by *Rhizopus stolonifer* at varied MG dye concentrations of 4ppm, 7ppm and 10 ppm. It can be inferred that varied concentration range from 1ppm to 10 ppm can be easily degraded by *R. stolonifer*. By experimental studies it has been concluded that low concentrations of MG (1ppm to 4ppm) can be easily degraded within 3 days. The concentrations ranging from 5ppm to 7ppm can be degraded till 5 days and higher concentrations 8ppm to 10 ppm can be degraded within 9 days. This proves that *R. stolonifer* is the best decolorizer and degrader of MG utilized in textile dye industry in general concentrations of 1 to 10 ppm. Further investigations can be utilized in screening of varied concentrations of other textile dyes using *Rhizopus stolonifer*.

The second potential degrader was *Mucor racemosus* which is also able to degrade MG at varied concentrations of 1ppm to 10ppm. Low concentrations of MG (1ppm to 4ppm) can be easily degraded within 5 days. The concentrations ranging from 5ppm to 7ppm can be degraded till 9 days and higer concentrations 8ppm to 10 ppm can be degraded within 15 days. Thus, *Mucor racemosus* can be amongst the fair coprophilous spp to be used for screening of varied textile dyes.The future scope of the study is the degradation of varied textile dyes using coprophilous spp of fungi which are easily available in herbivore dung samples. The different textile dyes at various concentrations can be screened and decolorized using coprophilous spp. Thus biodegradation using coprophilous fungi with cost effective and cheap methodology can prove a boon in decolorization experiments and treatment of textile wastewaters.

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