AN EFFICIENT METHOD OF SLIDE PREPARATION FOR STUDY OF BREAD MOULD ACROSS SCHOOL CURRICULUM

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This paper systematically describes a simple technique for slide preparation. For slide preparation, a moist chamber is developed and a slide is kept inside it. Instead of fungal media, a tiny piece of bread has been suggested in the technique to be kept on the slide. Bread serves as media in this technique for fungal growth. The moist chamber is placed at room temperature ranging from 28–32°C for 5 to 6 hours per day with high humidity of rainy season. The growth emerging from the substrate (bread piece) is observed under the microscope. The technique is useful for students, from school to college level, for studying fungal morphology. This is an experiential learning activity that helps develop skills and several competencies such as slide preparation, microscope handling, the ability to differentiate and classify fungi on the basis of microscopic study. The students also develop competencies to record and report the observation and take part in the discussion for achieving these learning outcomes.

Keywords: Slide preparation, Mould, Fungi, Moist chamber

Introduction

Syllabi and textbooks based on current curriculum recommend activity-based learning (NCF, 2005). Position paper in teaching of science (NCERT, 2006) addresses activities to be carried out by the students for life-long learning of concepts in science. Performing experiments is crucial for fostering interest and promoting a deeper understanding of science. The understanding of a concept in science depends on teachers' effective use of available resources in teaching and learning process (Soares et al., 2017; Bušljeta, 2013) for achieving the goals of curriculum. Innovations in the pedagogy allows teachers' involvement in making learning more interesting and effective in classroom teaching (Chigbu, Ngwevu and Jojo, 2023). Innovations bring creativity in everyday teaching-learning practices of a teacher (Cremin, 2009; Craft, 2009).

Concepts of Fungi in School Textbooks

Studying the morphology of fungi in one way or the other has been a part of the school curriculum. The concept of fungi has been addressed properly in the textbooks of science from Classes 6 to 10 and biology for Classes 11 and 12. The textbook of Class 7 mentions about the bread mould in its Activity 1.2, in which a moistened piece of bread kept in moist warm place allows growth of fungi after 2–3 days. The activity also provides an understanding on saprophytic nutrition in fungi as a result of nutrients present in the decaying bread. A picture of decaying bread is also a part

of the textbook. Apart from the questions asked by the two characters *Paheli* and *Boojho* about fungi may trigger curiosity in the mind of learners. Formation of asexual spores is a part of textbook that guides learners to repeat the activity and observe formation of spores in bread mould without introducing the microscope in the textbook (NCERT, 2007). That means since the spores may be observed under the microscope only, the teacher may accordingly innovate pedagogy for teaching and learning of the concept. In Class 8 textbook of science, there is a chapter on microorganisms that depicts illustrations on morphological features of fungi including *Rhizopus* sp., *Penicillium* sp. and *Aspergillus* sp. The chapter also talks about production of antibiotic penicillin using a mould. The chapter also introduces wheat rust caused by fungi (NCERT, 2008). In Class 9, fungi have been mentioned as a group of heterotrophic organisms and the illustration shows morphology of the mould *Penicillium* sp. (NCERT, 2006a). In Class 11 textbook of biology, a group of organisms have been mentioned as kingdom fungi under the Whittaker's five kingdom classification of living organisms (NCERT, 2006b). In Class 12, spore formation in fungi is covered. Further, there is mention of applications of fungi such as for production of antibiotics, fermented beverages, immunosuppressive agents, biocontrol agents for controlling pests and diseases, and biofertilisers (NCERT, 2006c). In this way, the concept of fungal morphology and related concepts are very well covered in the textbook of science from Classes 6 to 10 and in the textbook of biology form Classes 11 and 12.

Concepts of Fungi in College and University Education

School education is a readiness programme for tertiary education. The fungi have always been a part of biology and related courses at undergraduate and post-graduate levels. In higher classes, when specialising in fungi, the fungal species and varieties are identified only after the microscopic study of clear slides of the fungal organisms. Understanding of fungal morphology needs a rigorous microscopic study. Genera and/or species in various groups of fungi can be distinguished only on the basis of characteristics of their fruiting bodies or spores. For other genera and species, such characters enhance the ease and accuracy of identification. Therefore, it is pertinent to study the bread moulds for their morphological features under the microscope from early stages in school education gradually.

Addressing Skill Development and Achieving Learning Outcomes by Preparing Slide of Bread Mould

NCERT has defined the learning outcomes in science at elementary stage (NCERT, 2017). For developing competencies and related skills for understanding the concept properly, achievement of learning outcomes is necessary. The content related to fungi, from Classes 6 to 12, develops competency among students and they achieve the learning outcomes such as the ability to differentiate, classify, relate fungi and so on. They start exhibiting values of fungi. They also learn skills of making slides of bread mould, including *Mucor* sp., *Rhizopus* sp., *Aspergillus* sp. or *Penicillium* sp.

Pure culture technique is skill-based, laborious and requires highly equipped laboratories. NCERT has developed educational kits which provides essential materials for performing activities and simple experiments. The present paper deals with an innovative idea for slide preparation for study of fungal morphology under the microscope. This reports highlights innovation in moist chamber technique. In schools where science laboratory facilities are not available, modifications to the technique have been suggested to make the activity or experiment feasible even with limited resources.

Review of Literature

Moulds are outgrowth of fungal mycelium that is visible as thread-like structure with necked eyes on substrate (Anonymous, 2008). Bread mould have always been a part of science school curriculum (NCERT, 2007). Moist chamber technique has long been used as standard technique for studying the growth of fungi (Agrawal and Hasija, 1986; Vernon, 1931). Use of Petri dishes for developing moist chamber for growing various fungi from infected plant parts (Keyworth, 1951). The technique has recently been mentioned in publication of ICMR (2019). Coprophilous fungi have been isolated and studied using moist chamber method by Jain, Jain and Jain (2020).

Methodology

Materials required for the preparation of moist chamber are water, bread slice, needle, cotton, simple filter paper and glassware including Petri dish, slides and coverslips.

Preparation of Moist Chamber

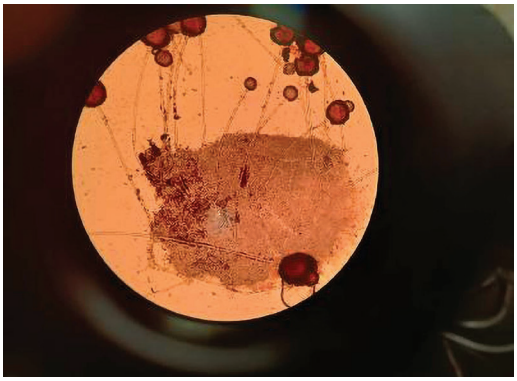
A moist chamber was prepared for the growth of fungi. For its preparation, a layer of cotton was spread in a small glass Petri dish and a round piece of filter paper was kept over it. The cotton and filter paper were moistened by pouring 15 mL of water into the Petri dish. A clean slide was kept on the filter paper and a tiny piece of moistened bread, approximately 1 mm × 1 mm in size, was kept on the slide. Petri dish was covered and kept at room temperature (approximately 28°C of day temperature for 5–6 hours with high humidity of rainy season) for 3–4 days of incubation.

Slide Preparation by Preservation of Fungal Growth

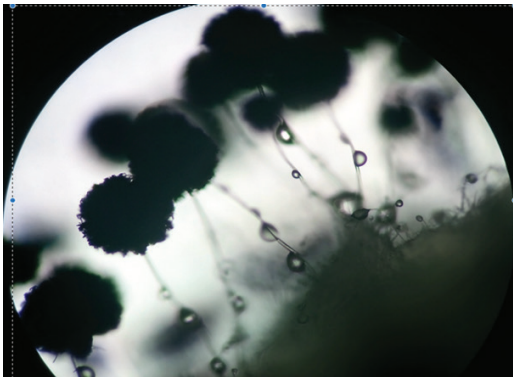
The growth of fungal mycelium coming out of the bread piece over the slide after incubation in a moist chamber was preserved by cutting the mycelium using a sharp blade at periphery of the bread piece and removing the thick bread piece from the slide. The growth of fungal mycelium was stained with diluted lactophenol cotton blue and mounted using a coverslip.

Results and Discussion

Slides prepared in this way were observed under the microscope. Natural growth of the bread mould was undisturbed and nicely visible under the microscope. The conidiophore and conidia of bread mould *Aspergillus* spp. were clearly visible at 10x and later 40x magnification. Usually agar plates are incubated and inoculated with the moulds for 3–4 days and slides are prepared by taking fungal growth from the agar plate



(a) Under 10x magnification



(b) Under 40x magnification

Fig. 1. Microscopic view of *Aspergillus* spp. appeared on bread piece (Modified Moist Chamber Technique)

and spread over on the slide using a needle and mounted with lactophenol cotton blue. During this procedure, most of the conidia gets displaced and attachment of conidia to conidiophore usually is not visible in slide under the microscope.

Most of the studies at higher level needs attachment of conidia to conidiophore in case of *Aspergillus*, *Penicillium* and any of the imperfect fungi for their identification.

Slide prepared by this method is very useful not only at school level but also for higher studies in the area of taxonomy.

Conclusion

This innovative method will be useful for the school where well-equipped laboratory is not available. The material required for the slide preparation are easily available. Educational kits of NCERT may also be used for the required glassware and material.

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