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Study of Diatom Flora of Kaalesar Ghat of Rapti River at Gorakhpur for Forensic Consideration

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Abstract

Diatoms are unique algae. They are scientifically known as Bacillariophyceae. Diatoms have been used in forensic science in a variety of ways, the most frequent being the diagnosis of death by drowning. When a person drowns, water will enter the lungs and then enter the bloodstream through ruptures in the peripheral alveoli before being carried to the other organs such as the liver and heart. Naturally, the microscopic contents of the water, which will include diatoms, will pass into the blood as well. The detection of diatoms in the organs can contribute to a diagnosis of death by drowning, a process referred to as the 'diatom test'. A study was conducted in the department of Forensic Science, SHUATS, Prayagraj which included the extraction and identification of diatoms from the collected water samples from three different sites of Kaalesar Ghat of Rapti River in Gorakhpur. The acid digestion method was used for diatom extraction. And, after analysis total 13 diatom species were found. The identified diatoms were of great ecological assessment that plays an important role in criminal investigations related to pre-mortem or ante-mortem drowning.

Keywords: Diatom • Drowning • D-mapping • Rapti-River

Introduction

Diatoms are unicellular, eukaryotic photosynthesizing algae that represent the most abundant source of oxygen producers in the biosphere. They produce nearly 50% of the air we breathe. Through carbon fixation, diatoms remove Carbon dioxide (CO_2) from the atmosphere. The CO_2 is converted to organic carbon in the form of sugar, and oxygen (O_2) is released [1]. They are arranged in division Baccillariophyta and widespread in both marine and freshwater habitat. They occur in wet or moist places where photosynthesis is possible. Diatoms ranging in size from approximately 5 microns to 1000 microns and of the most common types of phytoplankton. Diatoms are either plank-tonic (free-floating) or benthic (attached to a substratum) in nature. The most distinctive features of this unicellular organism are its extracellular coat or frustules, which is composed of silica [2]. They have distinct geometrical shapes. Diatom cells are ornamented by intricate and striking patterns of silica. Recent estimates indicate that there are in excess of 100,000 different species of diatoms and 200 genera. Diatoms are most often encountered in naturally occurring bodies of water such as lakes, rivers, oceans, seas. Diatom populations are constantly in flux and these fluxes are the result of complex and poorly understood nutrient and aquatic cycles [3].

Numerous studies have shown that diatoms are valuable supportive evidence in cases of drowning). The basic principle of "Diatom test" in drowning is based on correlation between diatoms which are present in the medium where the possible drowning was taken place and inhalation of water causes penetration of diatoms into the alveolar system and blood stream. These diatoms are deposited into the brain, kidneys and other organs for solving of drowning cases, hard bones (sternum and clavicle) as well as soft tissues (lungs and livers) of drowned bodies and sample of water in which possible drowning take place are usually sent to the Forensic Science Laboratory for detection of diatoms. Diatom communities are a popular tool for monitoring environmental conditions, past and present, and were commonly used in studies of water quality [4]. Scientist specializing in their study is sometimes called diatomists. Diatoms are considered very useful in examining potential biological trace evidence for forensic investigations and have been evaluated as the "golden standard" because they are known as golden-brown chloroplast. Due to their characteristic silica cell-wall, they are resistant to enzymes in victim who have drowned, and are normally small in size. Therefore, diatom test can help to diagnose the cause of death. Based on the study of drowning victims, where the diatoms are present in the medium, the penetration of diatoms into the alveolar system and bloodstream has been caused by the breathing in of water by the drowning victims and then leads to the penetration

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of diatoms into other organs and parts of the body, such as bone marrow, brain, kidney and lungs [5].

Methods

Collection of water samples

18 water samples for Diatom's study were collected from different sites of Rapti River at Kaalesar Ghat in Gorakhpur. Before collection in plastic bottle, it was washed with plenty of same water media 2-5 times. After thorough washing, water samples containing diatoms were collected (500ml) from three different sites of Kaalesar Ghat, naming S1, S2 and S3 (ranging 30 meters from adjacent one) [6].

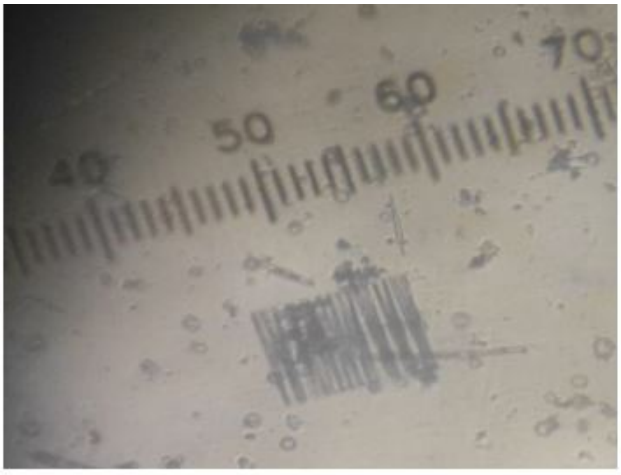
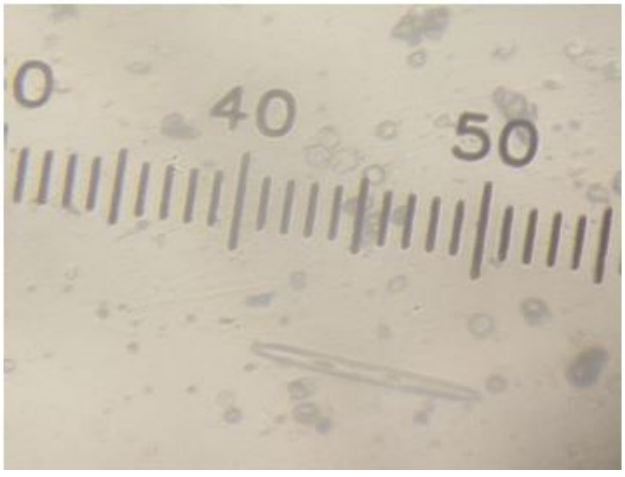
Extraction, isolation and microscopic examination

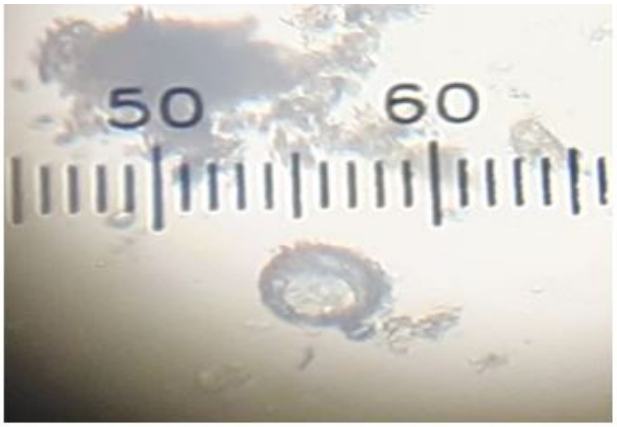
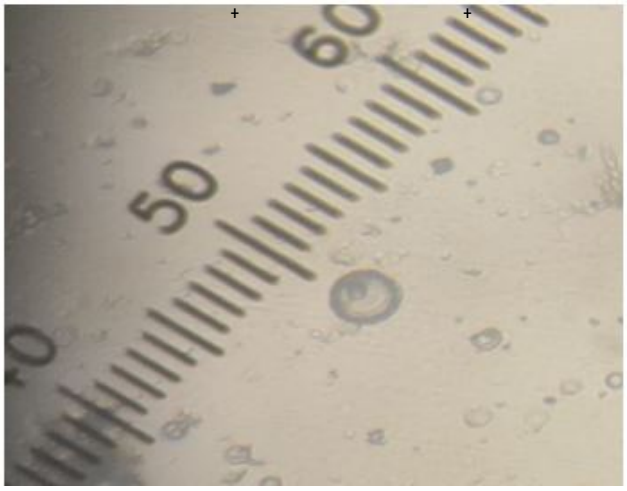
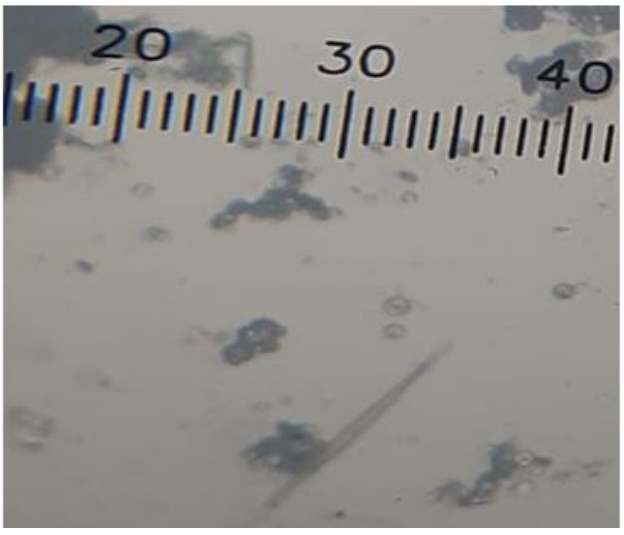
The collected water samples were brought to the laboratory for examination of diatoms. 500ml water sample was taken into the beaker from each bottle and 4-5 drops of Lugol's iodine was added in beaker. Lugol's iodine was used as preservative of water samples and left it for overnight, Ludes (1996). 50 ml of Conc.HNO_3, was added in 500ml water sample. They oxidize the organic matter present in the water sample except diatom cell wall because cell wall is resistant to them [7-10].

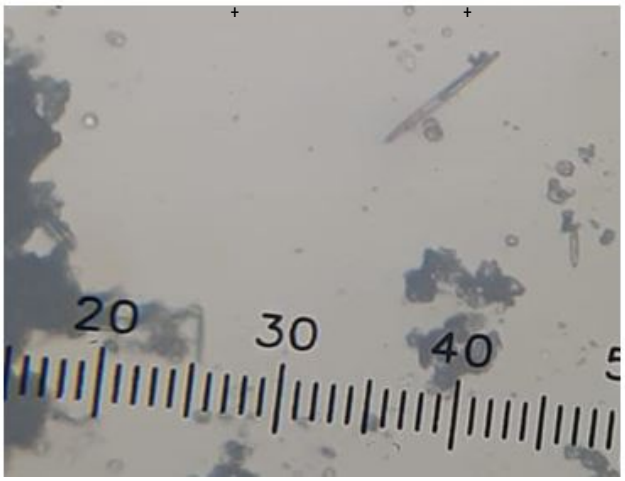
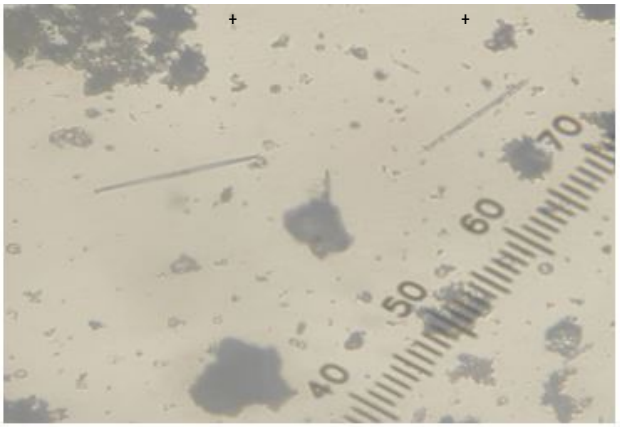
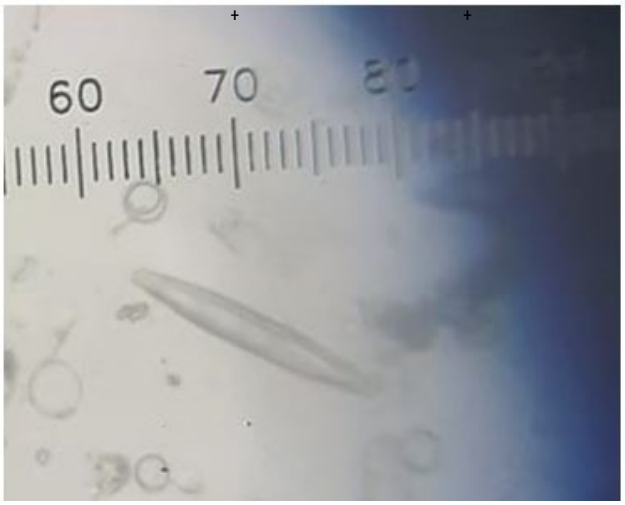
The next day samples were taken in tarson tubes & centrifuged at 1000-1500rpm for 5-7 minutes & the supernatant were discarded. This step was repeated till full of the water sample contained in the beaker was centrifuged. The pellets were formed at the bottom of tarson tube, the pellets were taken with the dropper and transferred at microscopic slides and left it for drying on the hot plate and cover it with cover slip then observed under compound microscope at 10x and 45x magnification, Taylor (2007). The same steps were repeated for all the water samples for morphological examination of diatoms [11-15].

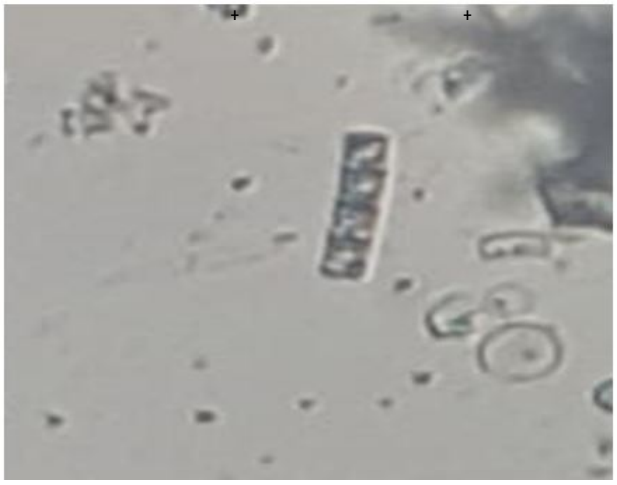
Results

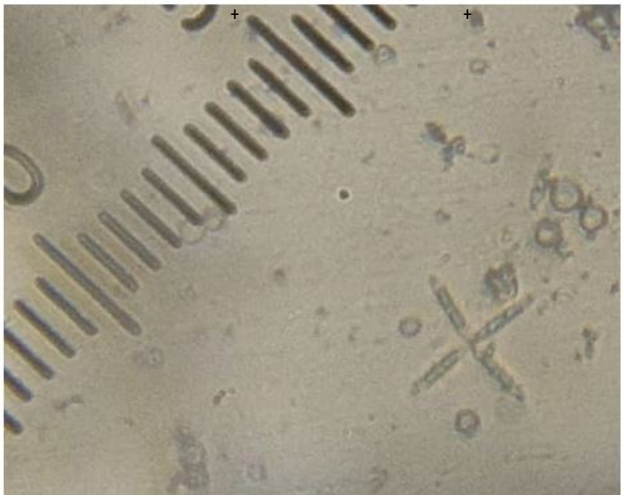
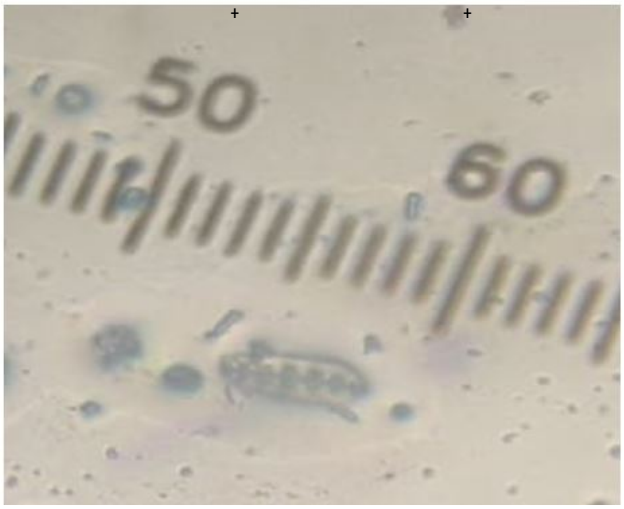
After Collection, Extraction and Isolation of diatoms from water sample, different diatoms were identified by using standard online database of diatoms. Their characteristic features such as Raphea, cell wall diameter, shape was examined for their identification [16,17].

Sr. No.	Diatoms	Photos of identified diatoms	S1	S2	S3
1.	*Fragilaria crotonensis*		+	+	+
2.	*Nitzschia filiformis*		+	+	+

3.	*Cyclotella gamma*		+	+	+
4.	*Spicaticribra kingstonii*		+	+	+
5.	*Nitzschia acicularis*		+	+	+

6.	*Ctenophora pulchella*		+	+	+	+	+
7.	*Synedra famelica*		+	+	+	+	+
8.	*Tryblionella gracilis*		+	+	+	+	+

9.	*Surirella striatula*		+	+	+	+	+
10.	*Aulacoseira islandica*		+	+	+	+	+
11.	*Pinnularia streptoraphe*		+	+	+	+	+

12.	*Asterionella formosa*		+	+	+	+	+	
13.	*Denticula tenuis*		+	+	+	+	+	

As per result in table no. 4.1 reported a total of 13 species of diatoms were identified at different mentioned sites of Kaalesar Ghat at Gorakhpur. A common type of diatoms at three different sites (30 mtrs. distance between each site) has shown that there are no variations in diatom at nearby areas [18]. This means that living diatoms often have specific salinity, temperature and other environmental tolerances.

Conclusion

Extraction and isolation of diatoms were done by the Acid digestion method, it was then identified by comparing them with the online data bank of Diatoms of North America.Diatoms are promising as trace evidence. The most frequent use of diatoms in forensic science is the diagnosis of death by drowning.

The present work revealed that the diatoms identified at Kaalesar Ghat of Rapti river are useful in spot findings of doubtful cases of drowning bodies. Diatomological mapping helps in generation of baseline data which aids in forensic investigation for diagnosis of drowning deaths, in location of diatoms diversity in particular location.

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