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Bacteriological Quality of Livestock Farm Oriented Wastewater as a Source of Surface Water Pollution

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A B S T R A C T

The lack of proper wastewater treatment facility for the wastewater produced in the livestock farms, find their way to contaminate the surface water bodies. The present study was undertaken to evaluate the bacteriological status of livestock farm oriented wastewater in and around Khanapara, Guwahati, Assam. For the present study, five farms were selected Wastewater samples from these livestock farms were analysed to find out bacteriological quality using standard analytical methods. The wastewater samples were collected on a monthly basis for a period of 7 months. The mean coliform count (log cfu/ml) of wastewater samples in March, April, May, June, July, August, and September were 8.98±0.02, 9.02±0.02, 8.98±0.02, 8.95±0.03, 8.94±0.02, 8.88±0.03 and8.94±0.03 respectively. Escherichia coli was found to be present in all the samples. Mean coliform count of the samples ranged from 8.88 log cfu/ml to 9.02 log cfu/ml. Thus, the present study on farm wastewater sources in and around Khanapara indicated that proper wastewater treatment is required in the livestock farms to prevent surface water pollution.

Introduction

Wastewater is liquid waste discharged by domestic residences, commercial properties, industry and agriculture which often contains some contaminants that result from the mixing of waste water from different sources. It is referred to any water whose quality has been adversely being abused by anthropogenic influence (Akter *et al.*, 1999), which includes animal farm waste water, liquid waste discharged from domestic home, industries, agricultural and commercial sectors, etc. Water is the elixir of life and abounds on

earth, but this vast natural resource has been depleted and turned into scarce commodity with increased usage catering to the needs of ever expanding population. Water is the most essential commodity for existence of life and is one of the most important renewable resources. Life and water may be aptly said to be two faces of the same coin. The major proportion of all water quality degradation worldwide is due to anthropogenic causes (Faniran *et al.,* 1994). There is almost a global shortage of water and the world's most urgent and front rank problem today is supply and maintenance of clean drinking water. Water is one of the precious resources on earth and is the basic need of all life forms. It is classified into surface and ground water resources.

The water from surface source provides sustenance to plants, animals, constituents of the habitat for aquatic animals and to meet importance of agricultural and industrial need (Prasad and Gaur, 1992). Due to rapid urbanization and developments in the animal husbandry sector, many water bodies have been greatly affected. The livestock business is among the most damaging sectors to the earth's increasingly scarce water resources, contributing among other things to water pollution from animal wastes, antibiotics and hormones, chemicals from tanneries, fertilizers and pesticides used to spray feed crops.

The elements released from the livestock farmers such as nitrates, chlorides, sulphates when present in small amounts don't have any negative impacts but high level of these elements and prolonged exposure can lead to many health problems by being carcinogens and cumulative poisons.

Water pollution from livestock farms not only damages the environment but can also kill and sicken animals and human. Since these farms exercise little restraint when it comes to water usage they tend to release wastewater to the water bodies even when neighbouring communities are experiencing water shortage. Because small sustainable farms are more integrated with their surrounding communities, they pay closer attention to the ways that they use water and how their practices affect local water supplies. Most water pollution from industrial farms results from the storage and disposal of animal waste. Agricultural water pollution can have a variety of negative effects. Not only do substantial environmental problems result, but many of the pollutants produced by farms can make water unsafe for human consumption. Worldwide, dairy farms generate large volumes of wastewaters or effluents (DE) which, if discharged directly into watercourses, can have significant environmental impacts (Ribaudo *et al.,* 2003., Barrington and Piche', 1992., Craggs *et al.,* 2003).

Different developing countries including India lack proper waste treatment and their disposal. This has led to the release of waste and waste water from livestock farms directly to the nearby land and water bodies thus playing a crucial role in creating surface and ground water pollution. Though many countries have developed different techniques and strategies to mitigate the problem but it is in infant stage in India, particularly for the huge amount of wastewater produced from livestock farms. India has been facing newer and abundant threats due to the rapidly increasing pollution of surface water bodies. This is mostly due to the lack of knowledge and scientific procedures to dispose of wastes.

Although surface water pollution studies have received tremendous momentum in recent times, unfortunately it is in infant stage in Assam. Quality monitoring of waste water released from farms has generally been overlooked for various reasons. A perusal of

literature revealed that systematic investigation for monitoring the quality of wastewater from different farms has not been well documented. The present work has been undertaken with a view to evaluate the bacteriological status of wastewater that are liberated from different farms to cause surface water pollution and to strengthen the data base on farm oriented wastewater.

Materials and Methods

Sampling station

Intensive Cattle Development Project (ICDP), Khanapara, Guwahati

The wastewater discharged from the farm at ICDP is carried out from the farm by a drain. The samples were collected from surface water body receiving the wastewater.

Instructional cattle farm

College of Veterinary Science, Assam Agricultural University, Khanapara Campus. It houses a dairy farm and a bull shed. The samples were collected from surface water body receiving the wastewater.

Private farm I

It is a dairy farm located at Khanapara. The samples were collected from surface water body receiving the wastewater.

Private farm II

It is a dairy farm located at Khanapara. The samples were collected from surface water body receiving the wastewater.

Private farm III

It is a dairy farm located at Khanapara. The samples were collected from surface water body receiving the wastewater.

Sampling sources

A total of 5 different sampling sources as described earlier were used for collection. Of these 5 sources, 2 were Government farms and 3 were organized private farms (Table 1).

Collection of sample

The samples were collected, stored and preserved as per methods described by American Public Health Association (APHA, 1998). The water samples were collected once a month in pre-cleaned polyethylene (plastic) containers of 2500 ml capacity covering all the seasons starting from March 2011 to September 2011. The containers were pre-cleaned and rinsed with distilled water several times and dried thoroughly before use. Water samples were collected in sterilized glass bottles for bacteriological analysis. The containers were filled and stoppered tightly to avoid air contact and agitation during transport. The samples were collected from different locations in and around the point of discharge and natural water bodies receiving the waste water.

Storage and preservation of samples

Standard procedure (APHA, 1998) was followed for storage and preservation of samples. The parameters, viz, temperature, turbidity, electrical conductivity, pH, Dissolved Oxygen were measured at the time of collection of the samples.

Chemicals and reagents

In the present study all chemicals used were from E. Marck and were of analytical grade. The solutions used in the study were made in double distilled deionised water.

In the study Borosil glassware and Tarson plastic wares were used. The equipment's were calibrated carefully using standard

methods as described by APHA (1998). Adequate precautions were taken to avoid possible contamination of containers, beakers, flasks etc. Stock standard solutions were prepared by dissolving ultrapure metals/compounds (99 99% pure).

Management of farm wastewater

The farm wastewater management systems in different farms were studied by preparing questionnaires.

Bacteriological study of farm wastewater

The bacteriological quality of the wastewater samples was determined in terms of Coliform Count.

Coliform count

All the samples were diluted and inoculated in McConkey Lactose Agar media by pour plate method. Plates were incubated aerobically at 37°C and colonies were counted in a colony counter. The number of colonies were expressed in log cfu/ml.

Identification and isolation of bacteria

Media

All the collected samples were subjected for bacteriological investigation. Samples were inoculated into McConkey Lactose agar (5-10%) media by streak plate technique as per the method described by Edwards and Ewing (1972). Plates were incubated aerobically at 37°C for 24 hrs and colonies were counted.

Then after incubation, colony morphologies were studied and colonies were counted. Purification of the colonies were done by inoculating a single colony into the following nutrient media according to the type of bacteria.

Brilliant Green Agar (BGA).

Eosin Methylene Blue Agar (EMB)

Salmonella Shigella Agar (SSA)

Blood Agar (BA)

Maintenance of cultures

After purification the bacterial colonies were picked up and streaked onto NA slants, which were further incubated at 37°C for 24hrs. These slants were then sealed with paraffin and preserved at 4°C, The organisms were sub cultured on fresh NA slants at every six weeks interval to maintain their viability.

Characterization and identification of the organism

Characterization and identification of the organism were made as per Edwards and Ewing (1972) on the basis of the following:

Colony Morphology

Cell morphology and staining characteristics

Biochemical tests (a) Different sugar fermentation (Glucose/ lactose) (b) Indole test (c) Methyl! Red test (d) Voges Proskauer test (e) Citrate utilization test (f) Acid butt test and H_2S production test.

Statistical analysis of the recorded data has been done by 2 way ANOVA as per standard methods described by Snedecor and Cochran (1994),

Results and Discussion

The data on bacteriological quality of livestock farm oriented waste water from five different sources in different animal farms in and around Khanapara were recorded for a

period of seven months(from March 2011 to September 2011) on a monthly basis.

Determination of farm waste water management

In the present study it has been recorded that 100% of the livestock farms directly discharge their wastewater into the nearby water body, don't adopt any measure to clean the water body where the wastewater is discharged, use disinfectants to clean the farm premises and discharge the medicinal residues into the water bodies. None (0%) of them have any wastewater treatment plant and a daily routine to clean the water body. 60% of the livestock farms have tube wells, wells etc.

Determination of bacteriological study (Coliform count)

Coliform Count: The mean coliform count (log cfu/ml) of wastewater samples in March, April, May, June, July, August and September were 8.98±0.02, 9.02±0.02, 8.98±0.02, 8.95±0.03, 8.94±0.02, 8.88±0.03 and 8.88±0.03 respectively.

Isolation and identification

In the present study, a total of 140 samples were subjected to bacteriological examination. All the samples were found to be bacteriologically positive yielding an equal number of *Escherichia coli* isolates. Isolates were identified on the basis of morphology, staining and biochemical characteristics typical of the bacteria Escherichia coli. 1) Morphology-Pink coloured colonies in McConkey Agar.

Colonies with metallic sheen in EMB Agar. 2) Staining-Gram Negative rods. 3) Biochemical Characteristics-a) Indole-Positive, b) Methyl Red-Positive c) Voges Proskauer-Negative d) Citrate utilization-Negative e) Sugar fermentation (Glucose and lactose)-Positive. The presence of coliform bacteria in aquatic environment indicates that the water has been contaminated and potential health risk exists for livestock exposed to this water.

The coliform group of microorganism include Escherichia colt, Enterobacter, Citrobacter and Klebsiella, and are all widely distributed in nature and found in the gut of warm blooded animals and human, therefore, their presence m water samples indicates microbial pollution through faeces or dung (Pande *et al.*,1983)

In the present study, the mean coliform count (log cfu/ml) of wastewater samples in March, April, May, June, July, August and September were 8 9840 02, 90240 02, 8 9840 02, 8 95+0 03, 8 9440 02, 8 88+0 03 and 8 94+0 03 respectively. Highly significant variation was observed between the different months.

The highest (9 02 +0 02 log cfu/ml) Cohform count was recorded in the month of April and the lowest (8 88 £0 03 log cfu/ml) count was recorded in the month of August.

In the month of April the bacterial population was very high because there was no rainfall but in the month of August as there was heavy rainfall dilution of the bacterial load took place. It has been observed that the coliform count decreased from the month of May till August. This may occur due to the rainfall thus leading to dilution of the coliform population in the water bodies. In the month of September the count Increases due to lack of rainfall thus concentrating the coliform population. Similar observations were made by Anandefai (2006) while studying the microbial status of River Yamuna. They recorded a higher bacterial load in the dry Weather in comparison to the wet weather They stated that reduction in bacterial Sounts occur during monsoon period due to flushing effect (Table 2 and 3).

Table.1 Distribution of sampling sources of wastewater

Sl. No.	Station	Location	Source type	Source number
1	Intensive Cattle Development Project(ICDP)	Khanapara	Surface Waterbody	S1
2	Instructional Cattle Farm	Khanapara	Surface Waterbody	S2
3	Private farm I	Khanapara	Surface Waterbody	S3
4	Private farm II	Khanapara	Surface Waterbody	S4
5	Private farm III	Khanapara	Surface Waterbody	S5

Table.2

	Questions	Response
1	Do you have any wastewater treatment plant?	0%
2	Do you directly discharge the wastewater into the nearby water body?	100%
3	Do you adopt any measure to clean the water body where the wastewater is discharged?	100%
4	Do you maintain a daily routine to clean the water body?	0%
5	Do you use disinfectants to clean the farm premises?	100%
6	Do you discharge the medicinal residues into the water bodies?	100%
7	Is there any well, tube well etc from where human beings get their water supply?	60%

Table.3 Monthwise coliform count (log cfu/ml) of wastewater samples

Month	S1	S2	S3	S4	S5	Overall
March	8.99±0.03	8.97±0.05	8.98±0.04	8.99±0.03	8.98±0.04	8.98^{a}±0.02
April	9.02±0.04	9.03±0.06	9.03±0.06	9.02±0.06	9.02±0.06	9.02^{b}±0.02
May	8.98±0.05	8.98±0.05	8.97±0.06	8.98±0.04	8.97±0.03	8.98^{a}±0.02
June	8.96±0.05	8.96±0.06	8.96±0.06	8.95±0.06	8.96±0.06	8.95^{a}±0.03
July	8.94±0.04	8.93±0.03	8.94±0.05	8.94±0.05	8.93±0.03	8.94^{a}±0.02
August	8.89±0.06	8.88±0.06	8.88±0.04	8.89±0.06	8 88±0.08	8.88^{c}±0.03
September	8.94±0.06	8.94±0.06	8.95±0.06	8.95±0.06	8 94±0.06	8.94^{a}±0.03

Different superscripts differ significantly ($P<0.05$)

The mean coliform count (log cfu/ml) of wastewater samples in March, April, May, June, July, August, and September were 8.98±0.02, 9.02±0.02, 8.98±0.02, 8.95±0.03, 8.94±0.02, 8.88±0.03 and 8.94±0.03 respectively. *Escherichia coli* was found to be present in all the samples. Mean coliform count of the samples ranged from 8.88 log cfu/ml to 9.02 log cfu/ml. Thus, the present study on farm wastewater sources in and around Khanapara indicated that proper wastewater treatment is required in the livestock farms to prevent surface water pollution.

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