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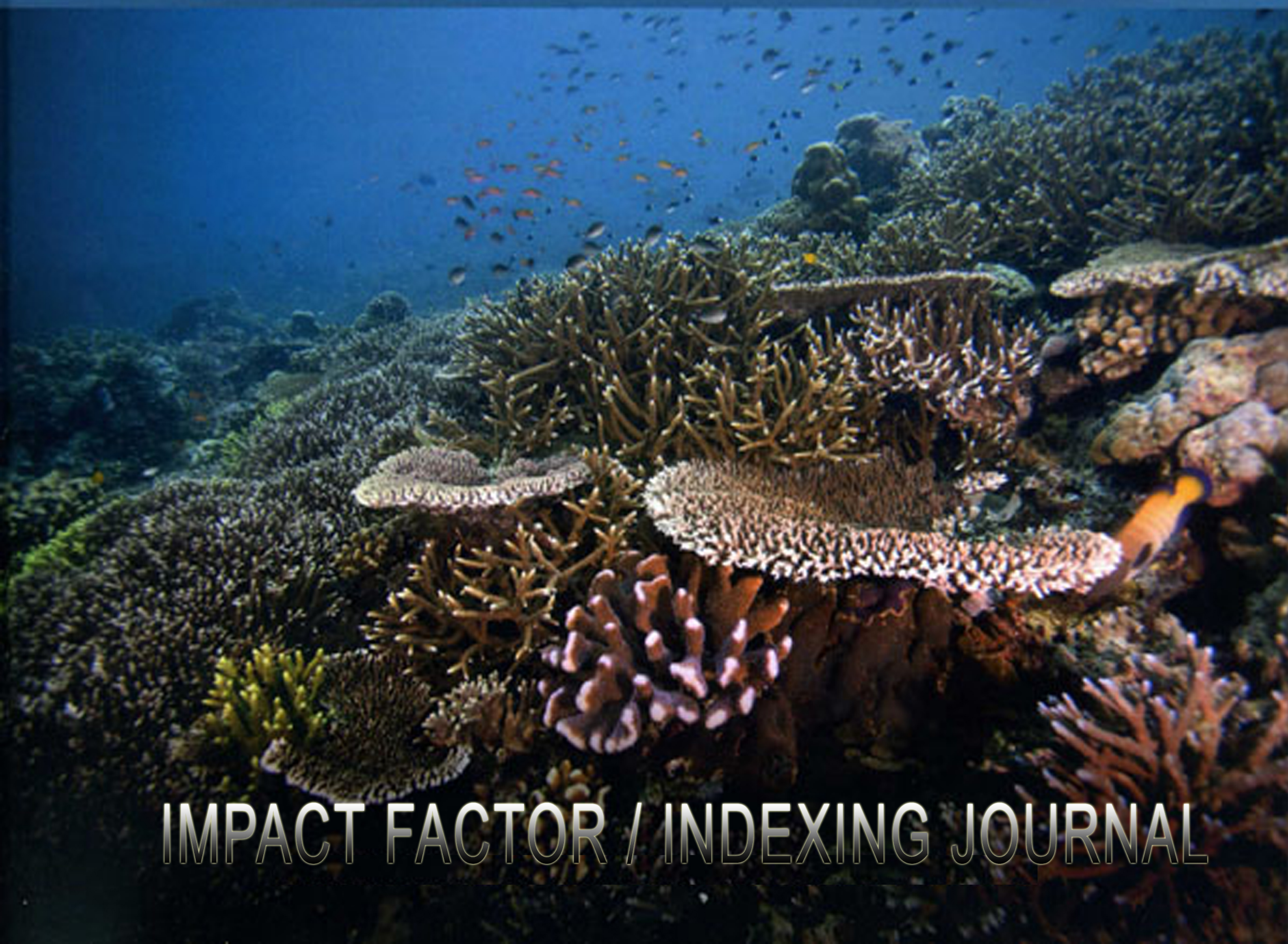

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Full Length Research Article

COMPARISON OF COAGULATION EFFICIENCY OF NATURAL COAGULANTS EXRACTED FROM DIFFERENT RURAL SPECIES

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ABSTRACT

This study is concerned with the coagulation activity of extracts of various rural species. The aim is to ascertain if rural varieties affect coagulation activity. Contents of dry matter and nitrogen are specified in solid samples, and the content of soluble nitrogen is determined in the extracts. These data are used to calculate the efficiency of extraction of nitrogen- containing compounds. The coagulation activity is assessed by jar test using synthetic turbid water, of the initial pH 9and turbidity 35 NTU. The increment of organic matter concentration after the coagulation is also determined.

INTRODUCTION

Water is undoubtedly the most vital element among the natural resources. In many developing countries, access to clean and safe water is a crucial issue. Many people die because of diarrhea which is caused by polluted water. Developing countries pay a high cost to import chemicals for water treatment (Municipal Infrastructure). This problem is critical in rural area. People of rural and peri-urban communities in Raipur, living in extreme poverty are often forced to rely on turbid pathogenic surface water sources for their domestic water. Surviving through subsistence living little can be spared for obtaining safe potable water. Under such circumstances, low-cost household (point-of-use) water treatment solutions are vital for the general health and well-being of a community. For the treatment of surface water, some traditional chemicals are used during the treatment of surface water at its various steps. Commonly used chemicals for various treatment units are synthetic organic and inorganic substances. In most of the cases, these are expensive since they are required in higher dose and do not shows cost effectiveness. Many of the chemicals are also associated with human health and environmental problems (Sutherland, 2010).

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So, there raised a voice to develop cost-effective, easier, and environmental friendly process of water clarification. They may be manufactured from plant seeds, leaves, and roots (Muyibi and Evison, 1995; Ocuda *et al*., 1999 and Šćiban *et al*., 2005). These natural organic polymers are interesting because, comparative to the use of synthetic organic polymers containing acrylamide monomers, there is no human health danger and the cost of these natural coagulants would be less expensive than the conventional chemicals alike since it is locally available in most rural communities of Raipur. Natural coagulants have bright future and are concerned by many researchers because of their abundant source, low price, environment friendly, multifunction, and biodegradable nature in water purification. Our previous investigations confirmed the fact that extracts of various natural species could be used as natural coagulants (Drinking water, 1990 and Antov *et al*., 2010).

The aims of the present study are

(1) to reduce the level of turbidity and bacteriological contaminants from water using locally available natural coagulants,
(2) to make the water treatment process easier and environmental friendly for household applications,
(3) to obtain natural coagulants from different rural species, in order to compare their coagulation activity.

Table 1. Results of the analysis of different rural samples

Rural Species	Dry matter (%)	Content of nitrogen (%dm)	Content of protein (%dm)	Content of soluble-nitrogen(mg/L)	Efficiency of extraction of nitrogen-containing Compounds (%)	Permanganate demand
1	81.2	2.9	20.5	377	98.7	21.5
2	88.5	4.3	26.12	315	77.0	23.1
3	88.9	3.6	22.2	350	97.5	22.9
4	92.1	2.5	18.4	344	88.7	23.9

EXPERIMENTAL

Model water- The coagulation activity is assessed by jar test using synthetic turbid water. As first, kaolin is ground in a ceramic mortar and sieved through the sieve with pore size of 0.4 mm. Smaller fraction is then taken to prepare a 10 g/L suspension in tap water. The suspension is stirred for 60 minutes on a magnetic stirrer, and left for 24 hours in order to achieve complete hydration of kaolin. Model water is prepared just before performing the coagulation test, by adding this 1% kaolin suspension to tap water in an amount of 5 mL/L to obtain the water with initial turbidity of 35 NTU (nephelometric turbidity units).

Coagulants- Natural coagulants are extracted from four types of seed in the rural area of Raipur.

Sample 1 – Strychnos potatoram,
Sample 2 – Vicia faba,
Sample 3 – Prosopis juliflora,
Sample 4 – Moringa Oleifera

Natural coagulants are obtained in the following way: seeds are ground and sieved through the sieve with pore size of 0.4 mm. An amount of a 10 g/L of the smaller fraction is suspended in distilled water. This suspension is stirred 10 minutes on a magnetic stirrer in order to extract active coagulants. After that, the suspension is filtered through filter paper Macherey-Nagel MN 651/120. Obtained filtrates, called crude extracts, are stored in a refrigerator at 258K. Contents of dry matter and nitrogen are specified in the solid samples, and the content of soluble nitrogen is determined in the extracts. These data are used to calculate the efficiency of extraction of nitrogen-containing compounds.

Analytical methods- Dry matter is determined by standard method at 378K (MEBAK, 1997). Kjeldahl method is used to determine the content of nitrogen in ground samples and crude extracts (MEBAK, 1997). The pH is measured using a pH meter (Model-sensION2, HACH, USA). For measuring water turbidity we use nephelometric method on a turbidimeter (Model-2100 P, HACH, USA) (Drinking water, 1990) and expressed in NTU. Content of organic matter before and after coagulation is determined as permanganate demand (Drinking water, 1990). The membrane filter (MF) technique can be used to test relatively large amount of samples and yield results more speedily than the multiple tube technique.

Coagulation test- Using synthetic turbid water the coagulation activity is assessed by jar test, with the kaolin concentration of 50 mg/L and turbidity 35 NTU. By adding 1 mol/L NaOH just before performing coagulation test the pH of the model water is adjusted to pH 9. The jar test is carried out by adding different amounts of extracts to 250 mL of model water. Rapid mixing (200–250 rotation per minute, rpm) for 1–3 minutes and slow mixing (30–40 rpm) for 12–15 minutes and after that the system is left to sediment for 1 h. The same coagulation test is conducted with no coagulant (blank). After sedimentation for 1 h, residual turbidity is determined in 50 mL of upper clarified liquid, using turbidity meter and coagulation activity is calculated:

Coagulation activity (%) = (Mb – Ms) x 100 / Mb [1]

Here Mb and Ms are the turbidity of the blank and the sample, respectively.

RESULTS AND DISCUSSION

Considering the fact that several different samples are available as source for natural coagulants, the first step is to analyze them. Table1 shows the results of analyses of solid samples. As can be seen from these results, all of four samples have similar contents of dry matter. Sample 2 has a little bit higher content of dry matter, and sample 4 has some higher content of nitrogen. Previous investigations shows that proteins exhibited coagulation activity (Antov *et al*., 2010) and this is the reason why we analyzed the content of proteins. The protein content varied significantly between samples, and it could be said that sample 2 had by about 21.5 % higher content of proteins than sample 1. The fact that different rural samples had different contents of proteins and other compounds is confirmed in previous investigations. (Tepić *et al*., 2007) Table 1 gives the results of the analysis of extracts obtained from solid samples. The highest content of soluble nitrogen is found in sample1. Also, the sample 1shows best extraction efficiency (98.7 %). The efficiency of extraction determined for sample2 is not so good, although this sample had the highest content of proteins.

Samples1,2 and 4 show maximum of coagulation activity (about 50%) in the range of applied doses of coagulants from 2.0 mg/L to 3.5 mg/L. Sample 3 shows a lower coagulation activity (maximum about 33%) in comparison with other samples, but at a significantly lower dose of coagulant 2 mg/L. Content of organic matter in the water after coagulation tests perform with all samples is high compare to blank. Figure1 shows the influence of dose of different type of seed extracts on the coagulation activity. It can be seen that sample3 and sample 4 show very similar behavior, with maximum of coagulation activity at applied doses of extracts of 3.2 mg/L and 2.94 mg/L respectively. Sample 2 show maximum of coagulation activity at a dose of 1.89 mg/L. In comparison with other samples, sample 1 has different behavior. This extract is efficient at lower, as well as at higher doses. It has maximum of coagulation activity at a dose of 6.20 mg/L, and with six times lower dose (1.09 mg/L) the coagulation activity decreases by 22 % in comparison with the maximum. Good coagulation activity is achieved for all of the samples when an optimal dose of the coagulant is applied. Similar results are also obtained with extracts of other species (Choubey *et al*., 2012 and Choubey, 2013). Organic matter in water has a bad influence on water quality. Its presence in water can change color and clarity, and can lead to the appearance of specific smell and taste of water. Since natural coagulants are of organic nature, so they influence the content of organic matter after performing coagulation tests. Content of organic matter in the water after performing coagulation tests is assessed by determining the permanganate demand. With a dose of 3 mL/L of different coagulants jar tests are performed. After separating the upper clear parts, permanganate demand is determined in each of them. Simultaneously, permanganate demand is determined for the blank, and it is 9.5 mg $KMnO_4$/L. Content of organic matter increased in comparison with the blank. The reason for this is high doses of coagulants applied. Table1

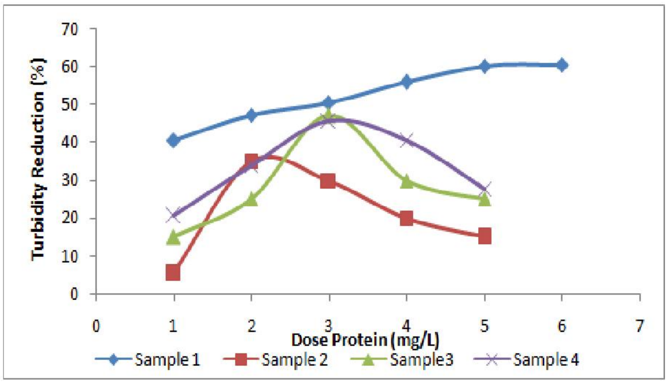

Figure 1. Effect of different dose of sample extracts on coagulation activity (CA)

Conclusion

Using some local available natural coagulants for example Strychnos potatoram, Vicia faba, Prosopis juliflora, Moringa Oleifera, performed all experiments, derive the following conclusions: For preparing coagulants for water clarification all investigated species show potential to be used. All natural coagulants decrease turbidity of model water by 5-65% which in the ratio of extraction of nitrogen- containing compounds present in them.

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