CONCLUSION
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The DO content of the upstream water was always more than 6.0 mg/l which is above the optimum level set by ICMR standards (5.0 mg/l), throughout the monitoring period. The DO content of HPF effluent was lesser than 0.1 mg/l for most of the monitoring period. It even touched the zero level, which is not ideal for aquatic life. The recent episode of mass fish kill of March 16-18, 1992 supports this conclusion. In GRF, it remained very low, below the optimum level of 5.0 mg/l, throughout the monitoring period. In certain months, it even became zero.

Eventhough certain metallic contents of the upstream water such as lead, iron, copper and cadmium were slightly higher than the limits of ISI standards (1983) and WHO standards (1971) only at certain periods of monitoring, the other physico-chemical factors were within the limits set by various agencies. In case of HPF, heavy metal contents like manganese, iron, copper, cadmium, lead were found to be exceeding the highest desirable limits of WHO and ISI standards (1983). In GRF effluent, zinc, copper, cadmium, manganese, were found to be exceeding the highest desirable level of ISI standards (1983).
The higher lignin content of HPF throughout the monitoring period mostly contributed towards its coffee decoction or dark brown colour of the effluent. It has to be removed or minimised before discharging to the river water, as it is aesthetically unacceptable. In GRF, the lignin content was found to be low. The hardness as CaCO₃ value of upstream water was higher than the W.H.O. standards (1971) limit in certain months only. However, they were within the limits of ISI standards (1983). In HPF effluent also the total hardness as CaCO₃ value was exceeding the highest desirable limits prescribed by various agencies.

Several other characteristics such as Total Dissolved Solids (TDS), chlorides, sulphates, calcium, magnesium were exceeding the highest desirable limits of both the standards in case of HPF. GRF effluent was characterised with significantly high concentration of Total Dissolved Solids (TDS), sulphates, chlorides throughout the monitoring period. Their sulphite content remained low. However, the sulphates were higher than 900 mg/l for the entire period and found to be always exceeding all the limits set by both WHO and ISI standards (1983).

The sediments of both the effluent canals were characterised by much higher levels of heavy metals and
other physico-chemical variables than that of the river Tungabhadra. Their very high electrical conductivity values indicate their higher dissolved ion contents. HPF sediment recorded higher quantity of zinc, manganese, copper and lead. The GRF sediment was having very high levels of zinc and it exhibited more copper and lead contents than the former. However, manganese and nickel contents were less. Solid waste (coal ash) revealed its higher quantities of zinc, copper, manganese, cadmium, lead and also higher level of dissolved ions as indicated by their higher electrical conductivity values.

The present investigation confirmed the antimitotic, cytotoxic and clastogenic effects of both the effluents on plants. The various cytotoxic and cytological abnormalities caused were very similar to those induced by many mutagenic agents and hence screening of such industrial effluents for their potential mutagenic is essential. The mitodepressive effects of both the effluents were pronounced at all concentrations. The significant cytotoxic effects observed were (i) mictoclassic and (ii) chromatoclassic effects. The prolonged treatment with high doses lead to ultimate lethality. The abnormalities encountered were rather unique. They were dependent on the physico-chemical factors as well as heavy metal contents of the effluents.
Hence, the present results together with earlier reports on the effects of other industrial effluents weigh against the wide application of such polluted waters for drinking and agricultural purposes. At the same time, they point out the necessity of monitoring the effect of such pollutants regularly, to undertake curative measures to check further damage to the ecosystem.

It was conclusively found that the treatment of effluents undertaken by the industries were totally inadequate. Increased emphasis must be given to the proper pretreatment of these industrial effluents before being discharged to River Tungabhadra.

The industry should remove all the coal ash and other solid waste dumped near the village Nalavagal on the bank of Tungabhadra. The area should be covered by vegetation to check transportation of solid wastes to the neighbouring areas and the river water. The removal of solid wastes dumped near the Nalavagal school will be essential from the point of health of school children.