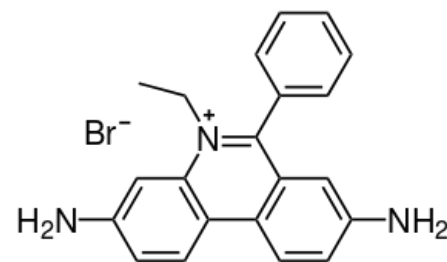


# Ethidium bromide

**Ethidium bromide**, (*3,8-Diamino-5-ethyl-6-phenylphenanthridine bromide*), abbreviated EtBr, is a fluorescent substance used for the detection of nucleic acids in agarose or polyacrylamide electrophoresis. It intercalates between the individual bases of the antiparallel strands of the DNA double helix, but also between the bases of single-stranded DNA and strands of RNA, albeit very weakly, which leads to potential deformation of the strand.<sup>[1]</sup>

Subsequently, after intercalation between nucleic acid bases and irradiation with UV light fluorescence occurs. Due to its interaction with DNA, EtBr is considered carcinogenic, mutagenic a teratogenic.<sup>[2]</sup>



Ethidium bromide

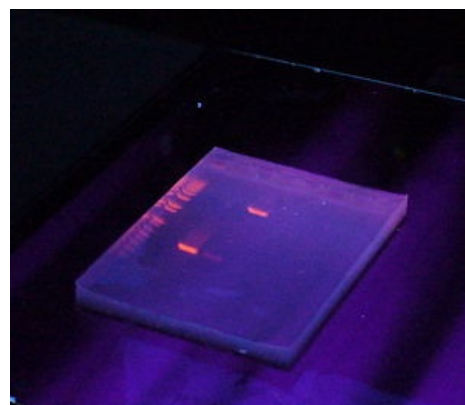
## Physico-chemical properties

Ethidium bromide is a cationic, aromatic compound with a phenanthridine nucleus. It is the basis of a number of other nucleic acid dyes. The absorption maximum of ethidium bromide depends on the environment in which it occurs - with decreasing polarity of the environment, the fluorescence ability of EtBr increases.<sup>[3]</sup> In an aqueous environment, it absorbs ultraviolet radiation with a wavelength between 210 and 285 nm and, thanks to its fluorescent properties, then emits orange light with a wavelength of 605 nm.<sup>[4]</sup> The fluorescence enhancement of EtBr when bound to nucleic acids is attributed to the non-polar nature of the nitrogenous bases themselves,<sup>[5]</sup> between which it intercalates - due to the repulsion of water molecules, which weaken the fluorescence.<sup>[6]</sup>

## Usage

EtBr was originally used to treat trypanosome infections of cattle.<sup>[7]</sup>

Today's use is mainly in the field of molecular biology to detect double-stranded DNA when evaluating PCR, restriction digestion or the efficiency of DNA isolation. EtBr can be applied directly to the sample, electrophoretic buffer or agarose or polyacrylamide gel.<sup>[8]</sup> Due to its biological effects, EtBr is used during experiments with neural stem cell transplantation as a gliotoxic agent in animal experiments and focal demyelination.<sup>[9]</sup>



Ethidium bromide under UV light during agarose electrophoresis evaluation..

## Health risks

Ethidium bromide is considered a mutagen and carcinogen and it is necessary for laboratories to handle it accordingly and dispose of it properly. Potential risks to laboratory workers when working with EtBr has been under discussion recently however and further research is necessary.<sup>[10]</sup> Although EtBr intercalates between the DNA double helix, thus deforming it and affecting processes such as replication (inhibition of DNA polymerase and topoisomerase 1)<sup>[11]</sup> and transcription, the mutagenic nature of the substance itself is not fully proven. In Ames test EtBr is positive, but only after it has been metabolized by liver enzymes from the homogenate. Therefore, it is assumed that the ultimate mutagenic character is due to some EtBr metabolite, which, however, has not yet been proven.<sup>[12]</sup>

## Links

## References

1. Sigma quality control; Sigma molecular biology laboratories.
2. Green, F.J., Sigma Aldrich Handbook of Stains, Dyes and Indicators, p. 318.
3. Methods in Enzymology, 32, 239 (1974).
4. Sabnis, R. W. (Ram Wasudeo) (2010). Handbook of biological dyes and stains : synthesis and industrial application. Hoboken, N.J.: Wiley. ISBN 978-0-470-40753-0.
5. Carey, Francis A. (2008). Organic Chemistry, ed. 6, Mc Graw Hill. p. 1206. ISBN 0072828374.
6. Ethidium bromide. (2018, January 18). In Wikipedia, The Free Encyclopedia. Retrieved 21:23, February 22, 2018, from [https://en.wikipedia.org/w/index.php?title=Ethidium\\_bromide&oldid=821114020](https://en.wikipedia.org/w/index.php?title=Ethidium_bromide&oldid=821114020)
7. STEVENSON, P.; SONES, KR.; GICHERU, MM., et al. Comparison of isometamidium chloride and homidium bromide as prophylactic drugs for trypanosomiasis in cattle at Nguruman, Kenya.. Acta Trop. May 1995, roč. 59, čís. 2, s. 77-84. PMID 7676909.
8. Příspěvatelé Wikipedie, Ethidium bromid [online], Wikipedie: Otevřená encyklopedie, c2016, Datum poslední revize 2. 08. 2016, 13:59 UTC, [citováno 22. 02. 2018] <[https://cs.wikipedia.org/w/index.php?title=Ethidium\\_bromid&oldid=13981419](https://cs.wikipedia.org/w/index.php?title=Ethidium_bromid&oldid=13981419)>
9. M. Tonavić, A. Baron Van Evercooren, in Encyclopedia of Neuroscience, 2009.

9. V. Repavcovic, A. Baron-van Evercooren, in *Encyclopedia of Neuroscience*, 2009
10. National Toxicology Program (August 15, 2005). "Executive Summary Ethidium Bromide: Evidence for Possible Carcinogenic Activity". Retrieved September 30, 2009.
11. Gentry AC, Juul S, Veigaard C, Knudsen BR, Osheroff N (2011). "The geometry of DNA supercoils modulates the DNA cleavage activity of human topoisomerase I". *Nucleic Acids Research*. 39 (3): 1014-1022. doi:10.1093/nar/gkq822.
12. J McCann; B N Ames (1975). "Detection of carcinogens as mutagens in the Salmonella/microsome test: assay of 300 chemicals". *PNAS*. 72 (12): 5135-5139. doi:10.1073/pnas.72.12.5135. PMC 388891 Freely accessible. PMID 1061098.

