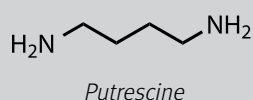
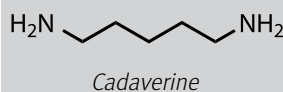


Did you know?

Putrescine has been shown to protect against seizures in tadpoles, a finding that may lead to treatments for epilepsy in the future.



Find out more

Check out the podcasts from *Chemistry World*. Each week a leading scientist or author tells the story behind a different compound.

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Magnificent molecules

In this issue: putrescine and cadaverine

Take a deep breath and hold your nose. Phillip Broadwith presents the compounds behind the smell of death

Crime novelists and war reporters often refer to the 'smell of death' when encountering a dead or decomposing body. The characteristic odours of rotting flesh are difficult to forget once experienced and are generally recognised as being worth avoiding, but what is it that makes a dead body smell so bad?

What's that smell?

Most of the smells we encounter are not caused by single compounds. The smell of a decomposing body is made up of all sorts of interesting molecules, but amines and sulfur-containing molecules are the stinkier components. Most of those amines come from breakdown of the proteins in the corpse, and two of them have such horrible odours that they have been named putrescine (after the process of putrefaction) and cadaverine (after the Latin word for a corpse: cadaver).

Putrescine and cadaverine are chemically very similar: they are both diamines – molecules that contain two amine groups. Both have short hydrocarbon chains with a primary amine group at each end. The difference is that putrescine has four carbon atoms in the chain between the two amines, whereas there are five in cadaverine.

These smells will be found anywhere protein is decomposing

– that's why the poo of meat-eating animals like cats and dogs smells much worse than that of herbivorous animals like rabbits or sheep: it contains more protein.

But these diamines are not just about corpses. They are produced in normal living tissue as well, where they help the process of cell division. The cadaverine and putrescine that our own, living bodies produce contribute a little to the smell of urine.

Putrid plastics

Putrescine is also produced on an industrial scale, although it is definitely not used in the perfume industry! It is, in fact, made into plastics. The industrial process for making certain plastics such as nylon is to take a diamine and another molecule that has a carboxylic acid group at either end (a diacid). Reacting these two molecules together makes long chain polymers, in which the diamine and diacid building blocks alternate, connected by amide bonds.

But where does industry get its putrescine from? You may have an image of chemists harvesting smelly amines from a pile of rotting bodies in a basement somewhere but this belongs firmly in science fiction. Industrially, putrescine is made from acrylonitrile (2-propenenitrile) and hydrogen cyanide. These two molecules are reacted together to make succinonitrile, which is similar to putrescine but contains fewer hydrogen atoms. Hydrogenation then turns the colourless waxy solid of succinonitrile into the foul-smelling putrescine.

If I were running that reactor plant I'd want to use up that putrescine as quickly as possible – the smell of death is not one you want to linger.

