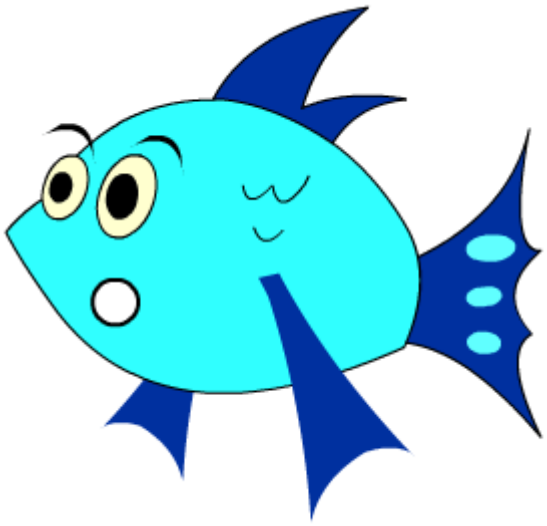

The fishy smell - origin and chemistry

One of the characteristics of bacterial vaginosis (BV) is the unpleasant smell from the vaginal discharge described as similar to the smell from rotten fish. For women affected by BV, this odor is the main direct nuisance encountered.

The description “smell like fish” is very precise, as the component mainly responsible for the smell is trimethylamine (TMA) – the same component present in rotten seawater fish, and here constitute a major part of the smell picture in these fish.

Tri-methyl amine is a small molecule consisting of three units of methyl (CH_3) all linked to the same nitrogen (N)-atom. The formula is thus $N(CH_3)_3$.

The same component also exists in an oxidized form TMA oxide. This compound has very little smelling capacity.

Not only women affected by BV can have a fish smell problem. There is a syndrome called trimethylaminuria – or fish odour syndrome (Rehman, 1999). Affected people excrete TMA in breath, sweat, saliva and vaginal excretions. Most knowledge about how TMA and its oxide are metabolized in the human body comes from studies of this syndrome.

In short – the trimethylamine smells like fish, and can be recognized by human nose at a concentration less than 1 ppm (mg/kg). Trimethylamine has a 100-fold greater olfactory (smelling) potency than the oxide.

For normal people TMA is oxidized in the liver to TMA oxide, and excreted in urine, vaginal secretions etc. People with trimethylaminuria lack the capacity to transform TMA to the non-smelling oxide form.

Sources

Trimethylamin oxid is a compound found in abundance in seawater fishes. Moreover it is a component that can be produced by microbial activity (normally in the gut) from certain nitrogen-containing compounds:

- Choline from egg yolk, soy beans, peas, beans, peanuts, liver, kidney and other offal, and brassicas such as rapeseed.
- Carnitine from red meat (beef, pork).

Transformation

Trimethylamine oxide thus normally circulates in the bloodstream, and is excreted in the urine.

Bacteria present in the vagina may convert the TMAO to TMA, and the smell of fish occurs in vaginal secretions. Cruden and Galask (1988) found, that *Mobiluncus* spp. quantitatively converts TMAO to TMA, whereas the same activity could not be identified with *Gardnerella* spp. No recent studies have given other information. This research points out *Mobiluncus* to be the origin of the fishy smell.

TMA is a weak base. At low pH TMA is converted from a volatile base form to a soluble acid form, reducing the recognisable smell (Philips & Shephard, 2011). Any acidification will reduce the smell. When lactose is administered into a vagina affected by BV, the lactose-fermenting organisms present in the vagina start converting lactose into lactic acid; this process is accomplished within hours to days. The smell from present TMA is reduced due to the acidification. The low pH and availability of fermentable carbohydrates provide a favourable environment for lactic acid bacteria, which, over days to weeks, will dominate the vaginal microbiota. There are no active killing processes aimed at eliminating unwanted bacteria, such as *Mobiluncus spp*, but in a hostile environment with a low pH and dominant, competing microbiota, they will be eliminated within weeks to months. Then the TMA is no longer present in the vaginal discharge.

Semen has a high pH and large buffering capacity (ability to move the pH). Therefore the perception of the smell problem is intensified after unprotected intercourse,

In short: TMAO/TMA is supplied by eating marine fish or products rich in choline and carnitine. The liver normally ensures, that the supply is kept in the TMAO form. Bacteria characteristic for bacterial vaginosis convert TMAO supplied in the bloodstream to TMA, the origin of the smell. With elevated pH the fishy smell is prominent, while lowering of the pH cause an immediate reduction of the smell.

References:

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