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MORGUE AND POST-MORTEM: ANALYSIS AFTER DEATH

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ABSTRACT

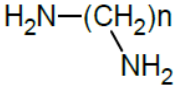
The Hospital Morgue is a facility for the viewing and/or identification of a body and the temporary holding / storage of bodies prior to transfer to a Mortuary. Morgues keep dead bodies until they can be identified or undergo an autopsy. Hospitals include morgues for the bodies of patients who have died until they can be taken away to a funeral home. The morgue keeps the body refrigerated to prevent biological decay. Autopsy, also called necropsy, post-mortem, or post-mortem examination, dissection and examination of a dead body and its organs and structures. An autopsy may be performed to determine the cause of death, to observe the effects of disease, and to establish the evolution and mechanisms of disease processes. These dead bodies are of immense importance for scientific research purposes as they wield Cadaverine and Putrescine gases, diamino alkanes in volatile species. Basically, these are obnoxious smelling volatile gases, Cadavers are liberated from deadly human bodies or decomposed matters. Cadavers are volatile gases and are used by Medical Students for studying the anatomy, to identify disease sites and to determine the cause of deaths. These gases are obtained from unclaimed bodies. Cadaverine are alpha alkane, omega diamine straight chain core with amino substituents at 1st and 5th positions. Putrescine is a four-carbon alkane omega diamine, obtained by amino acid breakdown and have foul odour of putrefying fish. Various usage of these gases in medical field are multifunctional role in cell-growth, differentiation, and cell growth, RNA stabilization and transitional frame-shifting etc.

KEYWORDS: Morgue, Post-mortem, Mortuary, dead bodies. Autopsy, necropsy, biological decay, Cadaver-graft, bio-based polyamides, microbial fermentation, amino acid breakdown, self-digestion, bloating, putrefaction, unclaimed bodies, warranted, Plastination, polymerization reaction, Metabolism, Anaerobiosis, biosynthesis, Methionine, Duraboline, Toxicity, Catabolism, EMT (Endothelial to Mesenchymal transition) genes, putrefying flesh, DSM, Biochemistry, ODC (Ornithine Decarboxylase), flexible polycationic nature, cellular processes, RNA stabilization, Transitional frame-shifting.

INTRODUCTION

An **autopsy** (**post-mortem examination**, **obduction**, **necropsy**, or **autopsia cadaverum**) is a surgical procedure that consists of a thorough examination of a corpse by dissection to determine the cause, mode, and manner of death or to evaluate any disease or injury that may be present for research or educational purposes. (The term "necropsy" is generally reserved for non-human animals). Autopsies are usually performed by a specialized medical doctor called a pathologist. In most cases, a medical examiner or coroner can determine cause of death and only a small portion of deaths require an autopsy.

Morgues keep dead bodies until they can be identified or undergo an autopsy. Hospitals include morgues for the bodies of patients who have died until they can be taken away to a funeral home. The morgue keeps the body refrigerated to prevent biological decay. Post-mortem, an examination of a dead body to determine the cause of death. The important gases that are collected from these dead bodies are implemented in various parts of scientific research. One of such gas is diamino alkanes in volatile species, Cadaver gas. Diamine is an amine with exactly two amino groups. Diamines are used as monomers to prepare polyamides, polyimides, and polyureas. The term diamine refers mostly to primary diamines, as those are the most reactive. Common formula for primary diamines is as follows:



When n=0: hydrazine, n=1: methane diamine, n=2: ethylene diamine, n=3: diaminopropane, n=4: putrescine, n=5: cadaverine. N=6: hexamethylenediamine.

Aliphatic diamines: [Linear: 1 carbon: methane diamine (diaminomethane), 2 carbons: ethylene diamine (1,2-diaminomethane), 3 carbons: 1,3-diaminopropane (propane-1,3-diamine), 4 carbons: putrescine (butane-1,4-diamine), 5 carbons: cadaverine (pentane-1,5-diamine), 6 carbons: hexamethylenediamine (hexane-1,6-diamine), trimethylhexamethylenediamine. Branched: Derivatives of ethylene diamine are prominent: 1,2-diaminopropane, which is chiral, diphenylethylenediamine, which is C2-symmetric, trans-1,2-diaminocyclohexane, which is C2-symmetric] Cyclic [1,4-Diazacycloheptane, 1,4-Diazacycloheptane] Xylylenediamines [o-xylylenediamine or OXD, mxylylenediamine or MXD, p-xylylenediamine or PXD]

Aromatic diamines [o-phenylenediamine or OPD, m-phenylenediamine or MPD, p-phenylenediamine or PPD]

A cadaver is a dead human body that is used by medical students, physicians and other scientists to study anatomy, identify disease sites, determine causes of death, and provide tissue to repair a defect in a living human being. Students in medical school study and dissect cadavers as a part of their education. Others who study cadavers include archaeologists and artists. The Cadavers are mostly used in Courts of Law, where it is referred to a dead body as well as by recovery items searching for bodies in Natural Disaster. Justification: Do you know why it is so called?

The word comes from the Latin word Cadere which means to fall. A cadaver graft (also called ―post-mortem graft) is the grafting of tissue from a dead body onto a living human to repair a defect or disfigurement. Cadavers can be observed for their stages of decomposition, helping to determine how long a body has been dead. Cadavers have been used in art to depict the human body in paintings and drawings more accurately. They are obnoxious invisible volatile compounds.

ORIGIN AND HISTORY

By the 1880s the fame of the Paris morgue, and admiration of its now-efficient administrative structures, had spread across the world. The word morgue began to be used to describe places where the dead were kept in both Britain and America, replacing the older "dead house" and becoming synonymous with mortuary. The first real dissections for the study of disease were carried out about 300 BCE by the Alexandrian physicians Herophilus and Erasistratus, but it was the Greek physician Galen of Pergamum in the late 2nd century CE who was the first to correlate the patient's symptoms (complaints) and signs (what can be seen and felt) with what was found upon examining the "affected part of the deceased." This was a significant advance that eventually led to the autopsy and broke an ancient barrier to progress in medicine. The history of the use of cadavers is one that is filled with controversy, scientific advancements, and new discoveries. It all started in 3rd century ancient Greece with two physicians by the name of Herophilus of Chalcedon and Erasistratus of CEOs. They practiced the dissection of cadavers in Alexandria, and it was the dominant means of learning anatomy. After both of these men died the popularity of anatomical dissection decreased until it wasn't used at all. It wasn't revived until the 12th century and it became increasingly popular in the 17th century and has been used ever since. In light of the new discoveries and advancements that were being made religious moderation of dissection relaxed significantly, however the public perception of it was still negative. Because of this perception, the only legal source of cadavers was the corpses of criminals who were executed, usually by hanging. Many of the offenders whose crimes―warranted dissection and their families even considered dissection to be more terrifying and demeaning than the crime or death penalty itself. There were many fights and sometimes even riots when relatives and friends of the deceased and soon to be dissected tried to stop the delivery of corpses from the place of hanging to the anatomists. The government at the time (17th century) took advantage of these qualms by using dissection as a threat against committing serious crimes. They even increased the number of crimes that were punished by hanging to over 200 offenses. Nevertheless, as dissection of cadavers became even more popular, anatomists were forced to find other ways to obtain cadavers. It was found that the cost of dying was incredibly high and a large amount of funeral homes were scamming people into paying more than they had to. These exposures didn't necessarily remove stigma but created fear that a person and their families would be victimized by scheming funeral directors, therefore making people reconsider body donation. Currently, body donation isn't surrounded by stigma but can be considered as celebrated. Body donation has not only led to scientific advancements and discoveries, it has also led to lives being saved.[1]

- **Stages of Decomposition:** The first stage is **Autolysis**: More commonly known as self-digestion, during which the body's cells are destroyed through the action of their own digestive enzymes. However, these enzymes are released into the cells because of active processes ceasing in the cells, not as an active process. In other words, though autolysis resembles the active process of digestion of nutrients by live cells, the dead cells are not actively digesting themselves as is often claimed in popular literature and as the synonym of autolysis-self-digestion-seems to imply. As a result of autolysis liquid is created that seeps between the layers of skin and results in peeling of the skin. During this stage, flies (when present) begin to lay eggs in the openings of the body: eyes, nostrils, mouth, ears, open wounds, and other orifices**.**
- The second stage of Decomposition is **Bloating**: Bacteria in the gut begins to break down the tissues of the body, releasing gas that accumulates in the intestines, which becomes trapped because of the early collapse of the small intestine. This bloating

occurs largely in the abdomen, and sometimes in the mouth, tongue, and genitals. This usually happens around the second week of decomposition. Gas accumulation and bloating will continue until the body is decomposed sufficiently for the gas to escape.

Figure-1: Autopsy.

- The third stage is **Putrefaction**: It is the final and longest stage. Putrefaction is where the larger structures of the body break down, and tissues liquefy. The digestive organs, brain, and lungs are the first to disintegrate. Under normal conditions, the organs are unidentifiable after three weeks. The muscles may be eaten by bacteria or devoured by animals. Eventually, sometimes after several years, all that remains is the skeleton. In acid-rich soils, the skeleton will eventually dissolve into its base chemicals.

Purposes: Autopsies are performed for either legal or medical purposes. Autopsies can be performed when any of the following information is desired:

- Determine if death was natural or unnatural
- Injury source and extent on the corpse
- Manner of death must be determined
- Time since death
- Establish identity of the deceased
- Retain relevant organs
- If it is an infant, determine live birth and viability

For example, a forensic autopsy is carried out when the cause of death may be a criminal matter, while a clinical or academic autopsy is performed to find the medical cause of death and is used in cases of unknown or uncertain death, or for research purposes. Autopsies can be further classified into cases where external examination suffices, and those where the body is dissected and internal examination is conducted. Permission from next of kin may be required for internal autopsy in some cases. Once an internal autopsy is complete, the body is reconstituted by sewing it back together.

Factors: The rate of Decomposition depends of Cadaver volatile compounds depends on the following points:

- Temperature
- Environment

The warmer and more humid the environment, the faster the body is broken down. The presence of carrion-consuming animals will also result in exposure of the skeleton as they consume parts of the decomposing body.

How long does a Cadaver Last?

A Cadaver settles over the three months after embalming, dehydrating to a normal size. By the time it's finished, it could last up to six years without decay. The face and hands are wrapped in black plastic to prevent them from drying, an eerie sight for medical students on their first day in the lab.[2]

Sources of Cadaver: Most common sources are body donation programs and ―unclaimed bodies—that is, bodies of individuals who die without relatives or friends to claim them for burial or without the means to afford burial. In some countries with a shortage of available bodies, anatomists import Cadavers, from other countries.

Effects of Cadavers on Human Body: This Obnoxious Smelling volatile gas has following irritable impacts on Human Health. Most of medical students complained of symptoms of acute exposure to formalin-treated cadavers such as:

- Unpleasant smell (91.2%),
- Dry or sore nose (74.2%),
- Running or congested nose (69.5%),
- Unusual thirst (53.9%),
- Itching in the eyes (81.3%),
- Redness in the eyes (72.4%),
- Excessive lacrimation (76.1%) etc.

Importance of Cadaver in dissection: For a cadaver to be viable and ideal for anatomical study and dissection, the body must be refrigerated or the preservation process must begin within 24 hours of death. This preservation may be accomplished by embalming using a mixture of embalming fluids, or with a relatively new method called Plastination. Both methods have advantages and disadvantages in regards to preparing bodies for anatomical dissection in the educational setting.[3]

Effect of Cadaver gas in medical field: In present-day times, cadavers have become more and more popular within the medical and surgical community to gain further knowledge on human gross anatomy. Surgeons have dissected and examined cadavers before surgical procedures on living patients to identify any possible deviations within the surgical area of interest. New types of surgical procedures can lead to numerous obstacles involved within the procedure which can be eliminated through prior knowledge from the dissection of a cadaver. Cadavers not only provide medical students and doctor's knowledge about the different functions of the human body, but they also provide multiple causes of malfunction within the human body. Galen (250 AD), a Greek physician, was one of the first to associate events that occurred during a human's life with the internal ramifications found later after death. A simple autopsy of a cadaver can help determine origins of deadly diseases or disorders. Autopsies also can provide information on how certain drugs or procedures have been effective within the cadaver and how humans respond to certain injuries. Appendectomies, the removal of the appendix, are performed 28,000 times a year in the United States and are still practiced on human cadavers and not with technology simulations. Gross anatomy, a common course in medical school studying the visual structures of the body, gives students the opportunity to have a hands-on learning environment. The need for cadavers has also grown outside of academic programs for research. Organizations like Science Care and the Anatomy Gifts Registry help send bodies where they are needed most.

Do you know the smelling of Cadaver?
Cadaver gases and compounds produced in a decomposing body emit distinct odours. While not all compounds produce odours, several compounds do have recognizable odours, including: Cadaverine and Putrescine smell like rotting flesh.

Uses of Cadaver: Every student has to use Cadaver painstakingly suture each body part back together. Professors would only accept the best and sincere efforts. The cadavers are then returned to their families to be cremated. However, the university took one step further!

Probability of getting affected by diseases from Cadaver: Infectious pathogens in cadavers that present particular risks include *Mycobacterium tuberculosis*, hepatitis B and C, the AIDS virus HIV, and prions that cause transmissible spongiform encephalopathies such as Creutzfeldt-Jakob disease (CJD) and Gerstmann-Straussler-Scheinker syndrome (GSS).[4]

Preservation of Cadaver Gas: A number of chemicals are used in various proportions to preserve cadavers. The main chemicals are typically: formaldehyde, phenol, methanol, and glycerine.... It is part of the embalming solution at a 3.0% concentration.

Plastination: Whole-body Plastination begins with much the same method as traditional embalming; a mixture of embalming fluids and water are pumped through the cadaver via arterial injection. After this step is complete, the anatomist may choose to dissect parts of the body to expose particular anatomical structures for study. After any desired dissection is completed, the cadaver is submerged in acetone. The acetone draws the moisture and soluble fats from the body and flows in to replace them. The cadaver is then placed in a bath of the plastic or resin of the practitioner's choice and the step known as forced impregnation begins. The bath generates a vacuum that causes acetone to vaporize, drawing the plastic or resin into the cells as it leaves. Once this is done the cadaver is positioned, the plastic inside it is cured, and the specimen is ready for use. The method of Cadaver preservation involves the replacement of fluids and soluble lipids in body with plastics. These are called Plastinates.[5]

Advantages and Disadvantages of Cadaver on using Plastination: Plastinates are advantageous in the study of anatomy as they provide durable, non-toxic specimens that are easy to store. However, they still have not truly gained ground against the traditionally embalmed cadaver. Plastinated cadavers are not accessible for some institutions, some educators believe the experience gained during embalmed cadaver dissection is more valuable, and some simply do not have the resources to acquire or use plastinate. While many cadavers were murderers provided by the state, few of these corpses were available for everyone to dissect.

Diamino Alkanes in Volatile Species

Cadaverine: Cadaverine is an alkane-alpha, omega-diamine comprising a straight-chain pentane core with amino substituents at positions 1 and 5. Cadaverine was first described in 1885 by the Berlin physician Ludwig Brieger (1849–1919). Cadaverine is a toxic diamine with the formula $NH_2(CH_2)_5NH_2$ having the molecular weight of 102.18 g/mol. Cadaverine is also known by the names 1,5-pentanediamine and pentamethylenediamine. Pentolinium and pentamethonium are both chemical derivatives of cadaverine. It is a lysine catabolite involved in plant growth and development. Cadaverine has a similar structure to the synthesized petrochemical hexamethylenediamine, and thus can be used to replace hexamethylenediamine in the production of polyamides or polyurethanes. Cadaverine is becoming an important

industrial chemical because it exhibits broad prospects for various applications, and especially for the synthesis of fully bio-based polyamides by polymerization with dicarboxylic acids derived from renewable sources. At present, cadaverine can be produced by direct microbial fermentation or whole-cell bioconversion. For direct microbial fermentation, cadaverine-producing strains are mainly engineered from the conventional L-lysine producers *Corynebacterium glutamicum* and *Escherichia coli*, because L-lysine is the direct precursor of cadaverine. It is formed through the direct decarboxylation of L-lysine catalysed by lysine decarboxylase, and that is widely distributed in prokaryotes and eukaryotes. Cadaverine plays an important role in cell survival at acidic pH and protects cells that are starved of inorganic phosphate, Pi, under anaerobic conditions. In plants, it is involved in regulating diverse processes such as plant growth and development, cell signalling, stress response, and insect defence. Cadaverine formation is also related to animal growth and tumorigenesis.[6]

Figure-2: 2D Structure.

Figure-3: 3D Structure.

Figure-4: Crystal Structure.

Chemistry: Chemical formula: CAS: 462-94-2, $C_5H_{14}N_2$, Molar mass: 102.81 g/mol, Density: 0.8730 g/mL, Melting point: 11.83℃ (53.29°F; 284.98K), Boiling point: 179.1°C (354.3°F; 452.2K), Solubility: Soluble in water, Appearance: Colourless to yellow oily liquid, Odour: Unbearably unpleasant to unpleasant, Acidity (pKa): 10.25, 9.13, Refractive index: 1.458.

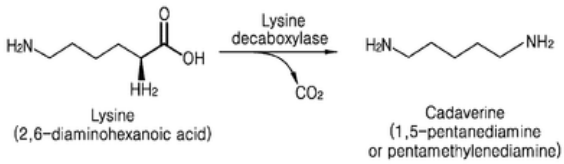


Figure-5: Lysine to Cadaverine.

Methods of Preparation: Cadaverine is a carrion odour produced by microbial metabolism of the amino acid lysine. Cadaverine is a foul-smelling diamine compound produced by the putrefaction of animal tissue. It is also produced by the process of decarboxylation of the amino acid, lysine (where, the raw material lysine is preferably a free base i.e. lysine base). Here, L-lysine is usually preferred. Cadaverine dicarboxylate is produced by performing an enzymatic (Lysine decarboxylase) decarboxylation reaction of a lysine solution while adding a dicarboxylic acid, containing 4 to 10 carbons to the lysine solution to maintain pH of the solution at a level sufficient for the enzymatic decarboxylation reaction to occur. For example, 4.0-8.0. According to the present invention, cadaverine dicarboxylate can be simply and efficiently produced in the way where the cadaverine dicarboxylate obtained by the present invention can be used in a polymerization reaction for producing nylon.

Structure

Cadaverine is a structural derivative ammonia.

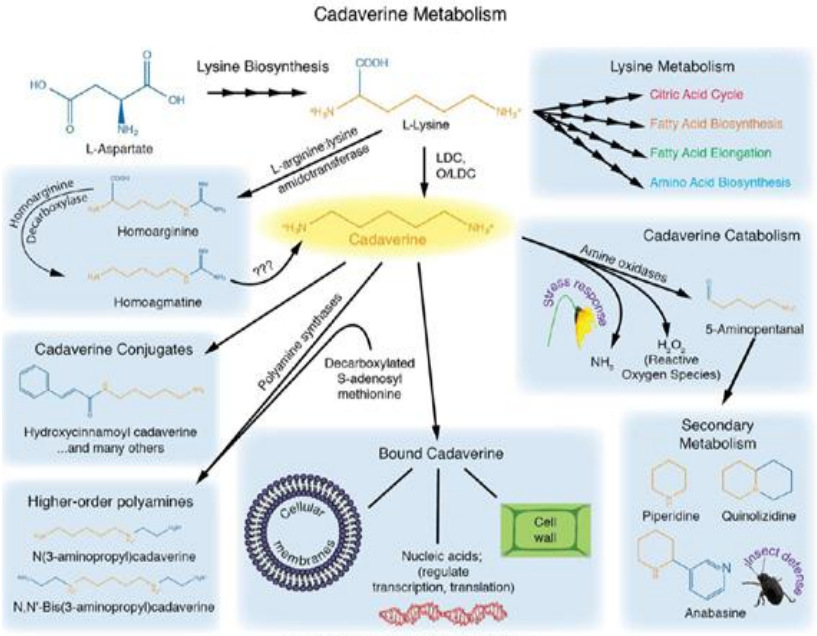


Figure-6: Cadaverine metabolism.

Metabolism of Cadaverine: Lysine serves as a precursor for cadaverine, and is critical for fatty acid metabolism, the citric acid cycle, and amino acid synthesis. Cadaverine can be conjugated to phenolics, or used to construct higher-order polyamines. Cadaverine can also be oxidized, or converted to quinolizidine alkaloids. Bound cadaverine may affect cell-wall properties, membrane stability, gene expression and nucleic acid stability. The metabolism of Cadaverine have been extensively studied in *E. coli*. Cadaverine metabolism was investigated in vitro in several organs of the mouse by measuring $14CO_2$ formation from labelled precursors. The liver showed the highest formation of 14CO from [1,5-14C]-Cadaverine, whereas brain demonstrated a much lower formation. Anaerobiosis or inhibition of monoamine oxidase (MAO) activity significantly reduced $14CO_2$ formation in every organ, but inhibition of diamine oxidase (DAO) activity had no effect in brain and kidney.[7]

Catabolism of Cadaverine

Biosynthesis: Cadaverine has independent single exclusive biosynthetic pathway in all organisms. The synthesis of Cadaverine from lysine is also proposed as by product of methionine synthesis through aspartate pathway. However, the lysine decarboxylation by LDC (Lysine decarboxylase) is taking place through pyridoxyal phosphate but there are few exceptions. Like under ornithine deficiency, ODC (Ornithine decarboxylase) can use lysine as an alternate substrate for Cadaverine synthesis. Biosynthesis of Cadaverine in Mice under the Influence of an Anabolic Steroid: Cadaverine (1, 5-diaminopentane) in the kidney and urine was investigated in mice treated with the anabolic steroid Durabolin (nandrolone phenpropionate). After administration of this steroid cadaverine was found in the kidneys, whereas this amine could not be detected in the kidney of controls and the urinary excretion of Cadaverine was elevated 50 times after the administration of Durabolin into the body of mice.

Catabolism: Catabolism of polyamines takes place through amine of oxidases, acting as enzymes. Oxidation of Cadaverine is primarily through diamine oxidase in apoplast, leading to the production of 5- aminobutanal, ammonia and H2O2. The diamines oxidase has a low rate of catabolising Cadaverine. The regulation of DAO (diamine oxidase) in different plants could be different.The Arabidopsis genome mapping revealed total 12 diamine oxidases genes out of which ATAO1 is characterized. Apparently there appears to be linked between inhibitors of Cadaverine synthesis and diamine oxidases and DFMO (Difluoromethylornithine). Non-specific effect on Cad synthesis indicates indirect regulation of polyamines contents depending on plant species and physical condition.

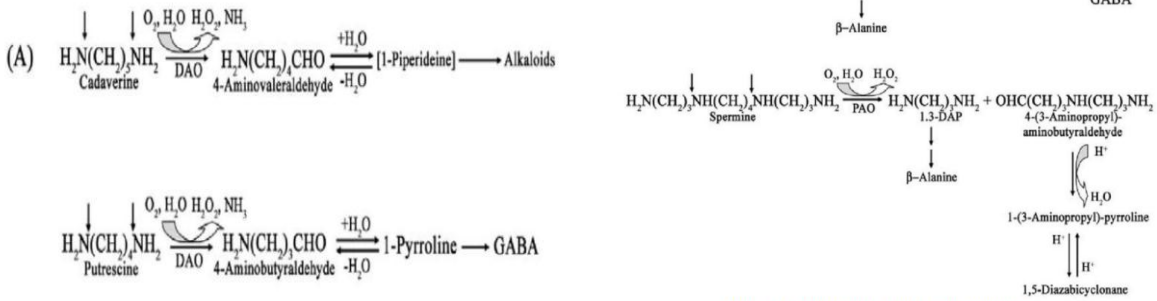


Figure-7: Cadaverine Biosynthesis and Catabolism.

Role of Cadaverine: On Plants: Cadaverine (Cad) a diamine, amino compound produced as a lysine catabolite is also implicated in growth and development of plants depending on environmental condition. For example, the Leguminosae have been shown to produce cadaverine and use it as a precursor in the biosynthesis of quinolizidine alkaloids, secondary metabolites that are involved in insect defence and also display therapeutic pharmacological properties. Cadaverine is also present in the environment; it can be produced by rhizosphere and phyllo sphere microbes. Markedly, exogenous cadaverine application causes alterations in root-system architecture.

On Animals: In Escherichia coli, Cadaverine is used to mediate acid stress (Haneburger et al., 2012), and the deathly odour of Cadaverine provides behavioural cues to animals (Rolen et al., 2003; Hussain et al., 2013). Cadaverine functions in a multitude of cellular processes critical to living organisms. Elevated levels of cadaverine have been found in the urine of some patients with defects in lysine metabolism. The odour commonly associated with bacterial vaginosis has been linked to cadaverine and putrescine.[8]

Toxicity: Cadaverine shows its toxicity in large doses. In rats, it has a low acute oral toxicity of 2,000 mg/kg body weight; its no-observed-adverse-effect level is 2,000 ppm (180 mg/kg body weight/day). Cadaverine are largely responsible for the foul odour of putrefying flesh, but also contribute to the odour of such processes as bad breath, etc.

Uses

- Cadaverine, found in some plants in trace amount as a result of stress on the plant is sold in some hunting supply stores as a poisonous liquid as it has the capability to attract strangers.
- It is also used as a tool for training search and dogs.

Clinical Significance: Elevated levels of Cadaverine have been found in the urine of some patients with defects in lysine metabolism. The odour commonly associated with bacterial vaginosis has been linked to Cadaverine. Its presence is responsible for the odours of urine and semen.

Treatment: List of EMT (Endothelial-to-mesenchymal transition) genes differentially regulated upon Cadaverine treatment.

Abbreviation	Gene name	Category
MMP2	Matrix Metalloproteinase Extracellular matrix and cell adhesion	2
MMP3	Matrix Metalloproteinase	3
MMP9	Matrix Metalloproteinase	9
Krt14	Keratin	4
CDH1	E-cadherin	1
Spp1	Secreted Phosphoprotein	1
FgfBp1	Fibroblast Growth Factor Binding Protein Cell growth and proliferation	1
Notch1	Notch	1
Tgfb3	Transforming Growth Factor Beta	3
Erbb3	Human Epidermal Growth Factor Receptor	3
Esr1	Oestrogen Receptor	1
IgfBp4	Insulin Like Growth Factor Binding Protein	4

Putrescine [110-60-1] A field experiment was conducted in the north western part of Kom Osheem district, Tamiya Town, El- Fayoum Governorate, Egypt to study the possibility of using potassium foliar spray of (K2SO4) at rate of 1000L⁄ ha-1 twice after one month from sowing and at one month later and putrescine (1,4-Diaminobutane dihydrochloride) foliar spray of 10 u M solution, The putrescine was sprayed in two equal doses, one dose after one month from the sorghum sowing and the second dose one month later at rate of 1000L⁄ ha-1., to mitigate the negative effect of irrigation with mixed water and drainage water on sorghum plants. Irrigation with the Nile fresh water was used for comparison. Soil pH, EC, soluble cations both soluble sulphate and chloride and SAR significantly increased due to using mixed or drainage water.

Introduction

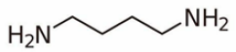


Figure-8: Structure.

Higher values of plant height, dry weight/plant, weight of grains/panicle, 1000-grain weight and both grain and stalk yields, as well as N, P, K, Ca and K/Na ratio in sorghum leaves and grains were recorded for the plants irrigated with the Nile fresh water.Or supplied with potassium and or putrescine. Plants irrigated with drainage water without potassium or putrescine recorded the lowest values, except for the 1000-grain weight which was not affected by putrescine. Effect of putrescine was more pronounced under mixed or drainage water. The treatment of using mixed water+potassium chloride+putrescine resulted in sorghum yield almost equal to that irrigated with the Nile fresh water. Foliar spraying with potassium and putrescine might mitigate the adverse effect of using saline water for irrigation.[9]

Structure of Putrescine: Putrescine is a four-carbon alkane-alpha, omega-diamine. It is obtained by the breakdown of amino acids and is responsible for the foul odour of putrefying flesh. It has a role as a fundamental metabolite and an antioxidant. It is a conjugate base of a 1, 4-butanediammonium.

Production of putrescine: Putrescine is produced on an industrial scale by hydrogenation of succinonitrile, which is produced by addition of hydrogen cyanide to acrylonitrile. Putrescine is reacted with adipic acid to yield the polyamide Nylon 46, which is marketed by DSM under the trade name Stanyl. Biotechnological production of putrescine from renewable feedstock is a promising alternative to the chemical synthesis. A metabolically engineered strain of Escherichia coli that produces putrescine at high titre in glucose mineral salts medium has been described.

Biochemistry of putrescine: Spermidine synthase uses Putrescine and S-adenosylmethioninamine (decarboxylated S-adenosyl methionine) to produce spermidine. Spermidine in turn is combined with another S-adenosylmethioninamine and gets converted to spermine.

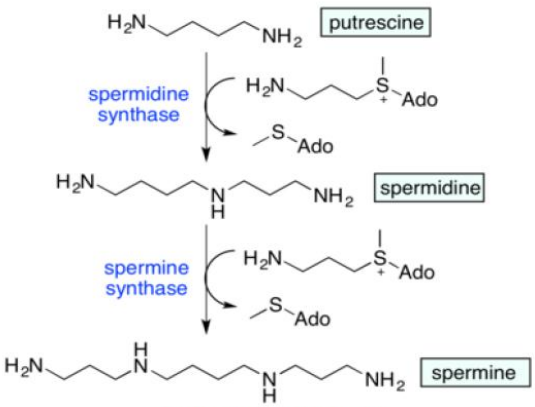


Figure-9: Biochemistry.

Putrescine is synthesized in small quantities by healthy living cells by the action of ornithine decarboxylase. Putrescine is synthesized biologically via two different pathways, both starting from arginine. In one pathway, arginine is converted into agmatine, with a reaction catalyzed by the enzyme arginine decarboxylase. (ADC); then agmatine is transformed into N-carbamoyl putrescine by agmatine imino hydroxylase (AIH). Finally, N-carbamoyl putrescine is converted into putrescine. In the second pathway, arginine is converted into ornithine and then ornithine is converted into putrescine by ornithine decarboxylase (ODC). The polyamines, of which putrescine is one of the simplest, appear to be growth factors necessary for cell division.

Toxicity: Putrescine is toxic in large doses. When heated to decomposition, putrescine emits toxic fumes of NOx. Uses: The natural polyamines (putrescine) are ubiquitous low molecular weight aliphatic amines that play multifunctional roles in cell growth, differentiation, and survival. Polyamines are unique because of their flexible polycationic nature that allows them to bind electrostatically to negatively charged macromolecules including nucleic acids, acidic proteins, and membranes. Polyamines (putrescine) regulate important cellular processes, including cell proliferation and viability. Genetic evidence indicates that polyamines are required for optimal growth of bacteria and are essential for aerobic growth in yeast. The cellular functions of polyamines also include intestinal mucosal maturation and cell migration. Polyamines have been shown to influence transcription, RNA stabilization, and translational frame shifting.[10]

CONCLUSION

An important component of the autopsy is the reconstitution of the body such that it can be viewed, if desired, by relatives of the deceased following the procedure. After the examination, the body has an open and empty thoracic cavity with chest flaps open on both sides, the top of the skull is missing, and the skull flaps are pulled over the face and neck. It is unusual to examine the face, arms, hands or legs internally.

In the UK, following the Human Tissue Act 2004 all organs and tissue must be returned to the body unless permission is given by the family to retain any tissue for further investigation. Normally the internal body cavity is lined with cotton, wool, or a similar material, and the organs are then placed into a plastic bag to prevent leakage and are returned to the body cavity. The chest flaps are then closed and sewn back together and the skull cap is sewed back in place. Then the body may be wrapped in a shroud, and it is common for relatives to not be able to tell the procedure has been done when the body is viewed in a funeral parlour after embalming.

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