

Cellular Respiration: Case Study

Five members of an extended family were seen in the emergency room of a large metropolitan hospital. The patients were complaining of nausea, vomiting, weakness and abdominal pain. Patients ranged in age from 6 years old to 75 years old.

The family had been attending a celebration at a local restaurant which served authentic Nigerian food. One of the dishes served was made with garri cassava. Garri garri is a flour made from the cassava root. Cassava, like almonds, lima beans and the seeds of some fruits (apple, peach and apricot) contain compounds which when metabolized produce cyanide. Cassava must be carefully processed to remove the cyanic glycosides, otherwise when ingested cyanide poisoning results.

Cyanide is a relatively common environmental toxin. In addition to the foods mentioned above, cyanide is a component of cigarette smoke, and it is used in the manufacture of many common materials including paper, metals and textiles. Cyanide can cause harm when ingested, touched or inhaled. Inhaling cyanide causes the most damage. The concentration and duration of exposure determine the impact on health and vitality. Low levels of exposure result in dizziness, headaches, nausea, weakness, rapid breathing and rapid heart rate. Higher levels of exposure lead to convulsions, low blood pressure, loss of consciousness, slow heart and respiratory rate and death.

Cyanide poisoning causes death by rendering cells incapable of using oxygen. Oxygen plays a vital role in aerobic cellular respiration. As glucose is metabolized hydrogen ions and electrons are stripped from the molecule. These are passed to NAD^+ and then onto carrier molecules in the mitochondrial membrane (cristae). The last step for these ions and electrons is to be passed to oxygen, the terminal electron acceptor. Oxygen interacts with one of the carrier molecules (cytochrome A_3) in the electron transport chain; it binds the hydrogen ions and electrons to form water. Cyanide blocks the site where oxygen interacts with the cytochrome. If oxygen cannot bind and remove the hydrogen ions and electrons then the 'system' backs up, and ATP synthesis stops. When ATP synthesis stops cells stop working, tissues stop functioning and the organism dies. Cyanide kills at the level of the mitochondrion.

Unfortunately for these patients they ingested too much garri. They slipped into unconsciousness shortly after arriving at the hospital. Within the next 24 hours the patients experienced acute renal failure and subsequently died of cardiac arrest.