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Reducing CO poisoning by using dry hemoglobin

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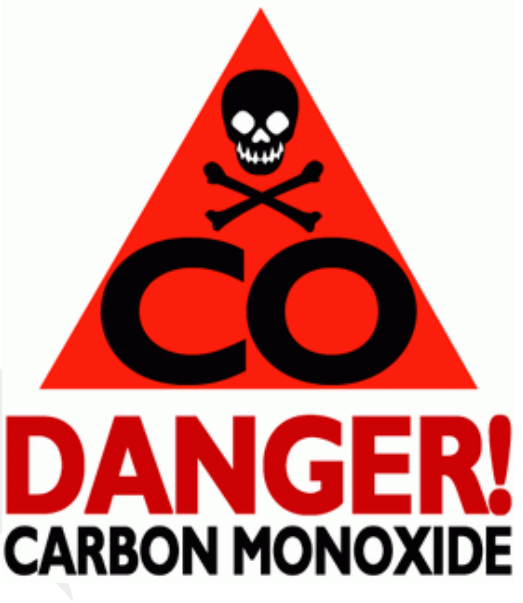
Contents

Abstract

- Carbon monoxide (CO) – the “silent killer”
- CO + Hb → COHb
- CO binds to Hb 200 times more strongly than O2.
- *Symptoms*: fatigue, headache, nausea, drowsiness, DEATH!
- Children are more severely affected by CO poisoning and may show earlier symptoms



Conventional CO poisoning treatment

- Treatment of poisoning generally consists of giving 100% oxygen along with supportive care. This should generally be carried out until symptoms are no longer present and the HbCO level is less than 10% normal.

- Treatment depends on the severity of the carbon monoxide exposure.
- Mild exposure is treated with oxygen and monitoring of carbon monoxide levels.
- Severe carbon monoxide poisoning may require high doses of oxygen therapy.

Purpose of the project

- To find an adsorbent for CO gas to be used instead of the universal adsorbent - active carbon
- To improve the value of healthcare by developing and implementing dry hemoglobin and fish food as a new system in absorbing CO gas from human body
- Benefits to healthcare providers, by involving them in service innovation and giving them appropriate tools for treating intoxicated individuals

Purpose of the project

- Benefits to everyone that has been intoxicated by carbon monoxide, by enabling new services and method in place

- Benefits to hospital, government and tax payers, by reducing costs in treating such intoxications as well as shortening healthcare providers time needed for providing such treatment

Procedures used

- Cow blood has been collected from a butcher and afterwards it was mixed with citrate buffer in a ratio 1:5 to prevent coagulation of the blood.
- **1st sample:** the blood is centrifuged in order to remove plasma and debris. After some further centrifugation, the hemoglobin was released into the liquid. After that, the sample was dried and the dried hemoglobin was collected in the form of dust
- **2nd sample:** we removed the plasma and debris from the blood and we derived dry erythrocytes, which is essentially dry blood

Procedures used

- **3rd sample**: fish food (known as high protein content)
- **4th sample:** active carbon

- The absorption capacity of hemoglobin in an aqueous state was tested

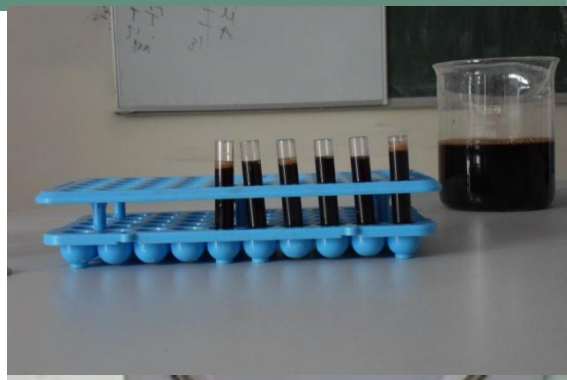
- The aforementioned samples absorption capacities were compared to the absorption capacities of active carbon and gas mask filter

Materials and methods

1) Blood sample is collected from a butcher shop in Prishtina and then mixed with some citrate buffer to prevent blood coagulation

2) Pure hemoglobin is isolated from the blood sample by using centrifuge several times

3) Carbonmonoxide (CO) gas is obtained by heating formic acid (HCOOH) in Sulfuric acid catalyst



Materials and methods

4) The initial concentration of CO gas is measured by a gas analyzer (Drager X am 7000) in ppm and contacted with certain amount of dry hemoglobin and recorded the percentage adsorption of CO gas

5) The adsorption of carbon monoxide gas by **liquid blood** and **gas mask** was also measured and compared with other adsorbent

Results

Experiment	Mass of adsorbents	Initial concentration of CO	Contact time
1	1 g	77 ppm	5-10-15 min
2	1 g	286 ppm	5-10-15 min
3	1 g	367 ppm	5-10-15 min
4	2 g	450 ppm	5-10-15 min
5	36 ml	464 ppm	15 min

Experiment 1: 1 g of each adsorbent is mixed with **77 ppm** of CO gas in a syringe and for every 5 minutes CO concentration is measured

Type of adsorbent	Initial Concentration of CO gas (ppm)	Concentration of CO gas after 5 minutes (ppm)	Concentration of CO gas after 10 minutes (ppm)	Concentration of CO gas after 15 minutes (ppm)	Percentage (%) of absorbed CO gas 5-10-15 minutes
Dry hemoglobin (A)	77	25	19	17	68-75-78
Red blood cells (B)	77	40	31	20	48-60-74
Fish food (C)	77	48	19	6	38-75-92
Active carbon (D)	77	39	20	14	49-74-82

Results

Experiment 2. 1 g of each adsorbent is mixed with **286 ppm** of CO gas in a syringe and for every 5 minutes CO concentration is measured

Type of adsorbent	Initial Concentration of CO gas (ppm)	Concentration of CO gas after 5 minutes (ppm)	Concentration of CO gas after 10 minutes (ppm)	Concentration of CO gas after 15 minutes (ppm)	Percentage (%) of absorbed CO gas 5-10-15 minutes
Dry hemoglobin (A)	286	78	54	35	73-81-88
Red blood cells (B)	286	123	95	62	57-67-78
Fish food (C)	286	61	18	9	78-94-96
Active carbon (D)	286	44	21	9	85-93-96

Results

Experiment 3. 1 g of each adsorbent is mixed with **367 ppm** of CO gas in a syringe and for every 5 minutes CO concentration is measured

Type of adsorbent	Initial Concentration of CO gas (ppm)	Concentration of CO gas after 5 minutes (ppm)	Concentration of CO gas after 10 minutes (ppm)	Concentration of CO gas after 15 minutes (ppm)	Percentage (%) of absorbed CO gas 5-10-15 minutes
Dry hemoglobin (A)	367	201	88	64	45-76-83
Red blood cells (B)	367	301	223	94	18-39-74
-Fish food (C)	367	181	81	50	51-78-86
Active carbon (D)	367	212	161	73	42-56-80

Results

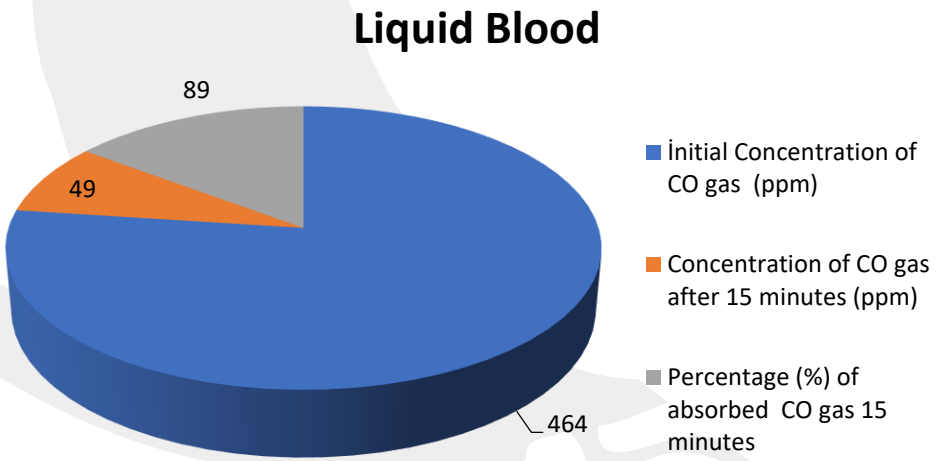
Experiment 4. 2 g of each adsorbent is mixed with **450 ppm** of CO gas in a syringe and for every 5 minutes CO concentration is measured

Type of adsorbent	Initial Concentration of CO gas (ppm)	Concentration of CO gas after 5 minutes (ppm)	Concentration of CO gas after 10 minutes (ppm)	Concentration of CO gas after 15 minutes (ppm)	Concentration of CO gas after 20 minutes (ppm)	Concentration of CO gas after 25 minutes (ppm)	Percentage (%) of absorbed CO gas 5-10-15 minutes
Dry hemoglobin (A)	450	135	54	13	8	8	70-88-97-98-98
Red blood cells (B)	450	180	142	101	87	79	60-68-78-81-82
Fish food (C)	450	88	80	74	64	32	80-82-84-86-93
Active carbon (D)	450	162	120	98	73	64	64-73-79-84-86

Results

Experiment 5. 464 ppm of CO gas is inserted into 36 ml of liquid blood and waited for 15 minutes

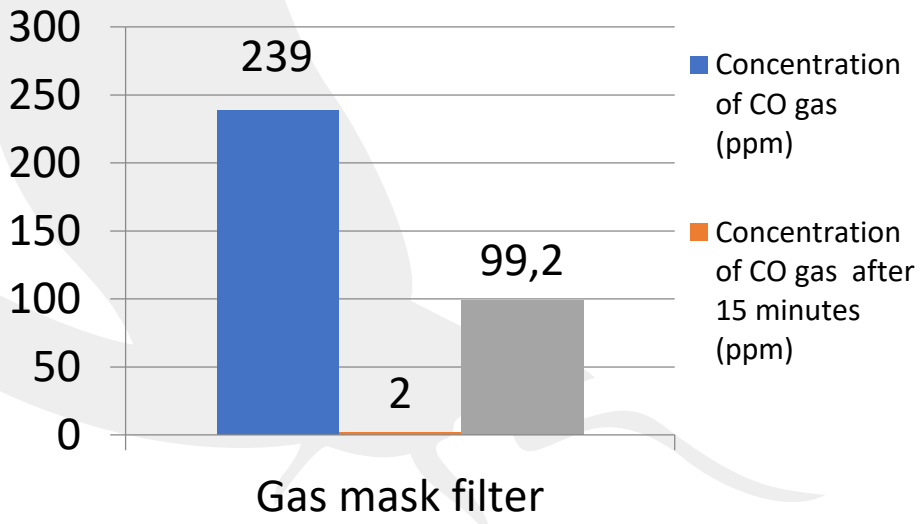
Type of adsorbent	Initial Concentration of CO gas (ppm)	Concentration of CO gas after 15 minutes (ppm)	Percentage (%) of absorbed CO gas 15 minutes
Liquid blood	464	49	89



Results

Experiment 6. 239 ppm of CO gas is inserted into gas mask and waited for 15 minutes then at the end we measured 2 ppm of CO gas.

Type of adsorbent	Initial Concentration of CO gas (ppm)	Concentration of CO gas after 15 minutes (ppm)	Percentage (%) of absorbed CO gas 15 minutes
Gas mask filter	239	2	99.2



Conclusions

We have discovered that:

- Hemoglobin, considered as a waste substance in butcher shops, is the perfect material against CO gas poisoning
- To isolate hemoglobin is a simple and less expensive process and the price of fish food is cheaper
- Hemoglobin outside the blood in its dry state and fish food are very effective carbon monoxide adsorbents
- Red blood cells are not as effective in reducing carbon monoxide as dry hemoglobin and fish food
- Liquid blood is not practical because blood components and products must be stored within the temperature range specified for that particular component or product

Recommendations

- Establish a linkage between butcher shops and the relevant authorities that deal with CO poisoning treatment
- Identify interested institutions able to isolate Hb and accumulate fish food for the up mentioned purposes
- Encourage healthcare policy makers to consider hemoglobin in its dry state and fish food because they are very effective carbon monoxide adsorbents

Recommendations

- Identify and support relevant institutions with similar field of research to continue researches on the efficiency of red blood cells in reducing carbon monoxide with dry hemoglobin and fish food

- Discover interested individuals willing to take further steps for the innovation of the conventional treatment of CO poisoned patients

- Thank you for your attention =)

References

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