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Quantitative Analysis of Carbon Monoxide in Frozen Foods

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Abstract

Carbon monoxide is used as a preservative in food to extend its freshness for a longer duration. Carbon monoxide is not harmful at small concentrations for humans and is present in minute quantities as a component of metabolism. But repeated exposure to Carbon Monoxide can have harmful effects like headaches, dizziness, nausea, vomiting, fatigue, unconsciousness, collapse and finally death. As the frozen foods are regularly consumed worldwide and frozen fish, frozen chicken, etc being the common and most preferred foods, the consumption of frozen foods is abundant. Hence the study was undertaken to quantitatively analyse the Carbon Monoxide present in frozen food using Gas Chromatography. To obtain standard readings, fresh samples were also analysed. The results showed that the fresh samples of food had approximately 145-150ng/gm of Carbon Monoxide while the levels of Carbon Monoxide in frozen food samples was found to be slightly above 1µg/gm.

Keywords: Frozen foods, carbon monoxide, gas chromatography.

Introduction

Carbon monoxide is considered to be a clear, odourless and tasteless gas. Though highly toxic when inhaled, it is present in low levels in animals as a component of normal metabolism. When carbon monoxide binds to the haemoglobin molecule in red blood cells, the result is an indefinite red colouration of meat[1].

Carbon monoxide is known as the "silent killer" as it has the capacity to take lives within minutes of its consumption. Most of the the time, the victims are not aware that they are poisones by CO. CO in high concentrations results in death whereas smaller concentrations with prolonged exposure results in a number of health hazards like headaches, nausea, vomitting, cardiovascular and neurological diseases[1].

Red colour of meat, poultry and fish is due to the presence of Myoglobin (Mb), an important muscle pigment that stores oxygen. When the flesh is exposed to atmosphere, oxygen reacts with Mb oxymyoglobin, hereby imparting the red colour to the flesh. However, excess oxygen and long periods of storage results in oxidation of oxymyoglobin to ferric myoglobin resulting in the fading of the red colour or conversion of red colour to brown[1-4].

In recent times, CO is being used as a preservative in meat, poultry and fish to maintain its its fresh red colour for an extended period of time, also to prevent its discolouration from red to undesired brown colour. Carbon monoxide reacts with the muscle pigments to form a very stable complex, carboxymyoglobin. Fresh, chilled or thawed frozen food can be treated with CO to obtain the desired colour effect on appearance[2-3].

Various methods have been prviously used to determine Carbon monoxide concentration from biological samples. Therefore study has been undertaken to know the quantity of CO present in packed frozen food supplied in malls and markets of Mumbai City using Gas Chromatography (GC).

Material and Methods

Sample preparation and design: To determine CO level, fresh samples were filleted and divided into two portions. One portion was immediately analysed and the other portion was treated with CO as follows:

In lab Treatment of fresh samples: Three of meat, poultry and fish each was vaccum packed and subsequently exposed to CO by injection into a corner of the packaging until the bag was filled with the gas. Upon resealing, the bag was placed in the refrigerator (4°C) for 24-48 hr to allow CO absorption by tissue.

Market Bought/packed samples: Individual packets each of meat, poultry and fish were bought from different markets of Mumbai and their CO content was determined.

Analysis: Each individual unit of meat, poultry and fish (fresh, treated and frozen)were thawed in their respective packet.100 gm of each sample was homogenised for 30 sec, 2 gm aliquot was placed in a vial followed by 4.2 ml of water and 5 ml of octanol and 0.5 ml of 5 %M sulphuric acid. The vials were capped, shaken and using a syringe brought to a final volume of 6.7ml.Vials were shaken again and then heated at 70°C for 1 hr. Analysis was then completed by injecting 100µl into GC system after bottle was cooled at room temperature[3-4].

Chromatographic Conditions: Gas chromatograph system of Agilent was used. The injection of 100µl was manually injected using a gastight syringe. Oven temperature was set at 30^0C for 2.5 min, ramped to 60^0C for the next 1 min and held constant till the end of the amnalysis. Helium was the carrier gas held at a constant flow of 1.5 ml. min^{-1}. All required safety precautions were taken[5-7].

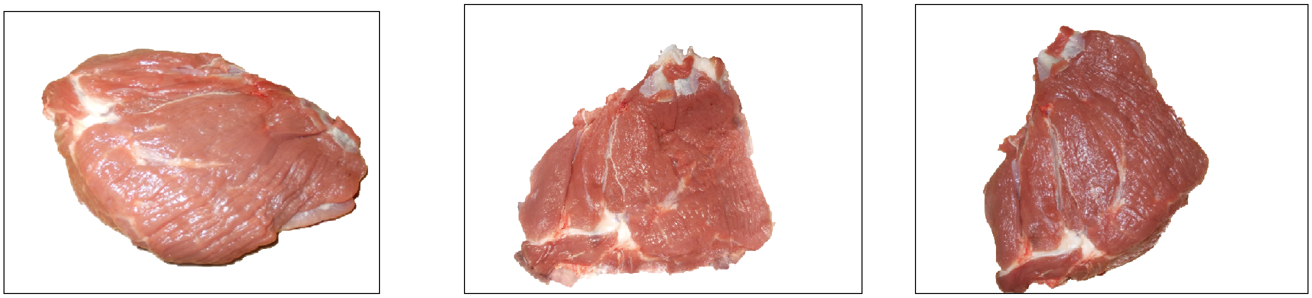
Results and Discussion

CO is present in low levels in animals as a component of normal metabolism. The amount of CO found in the market bought samples and lab treated samples were comparable to values reported by other researchers in Asia and other parts of the world. To obtain standard readings, fresh untreated samples of mutton, fish and chicken were also analysed. The results showed that the level of CO in Fresh untreated samples was ranging from 97-152 ng/g, whereas the level of CO in frozen food and lab treated samples was higher than 1µg/g. Slight colour changes toward a redish flesh were observed during treatment of the lab samples. The greatest colour change was observed in samples taken from the market.

Table-1
Sample Acquisition and description

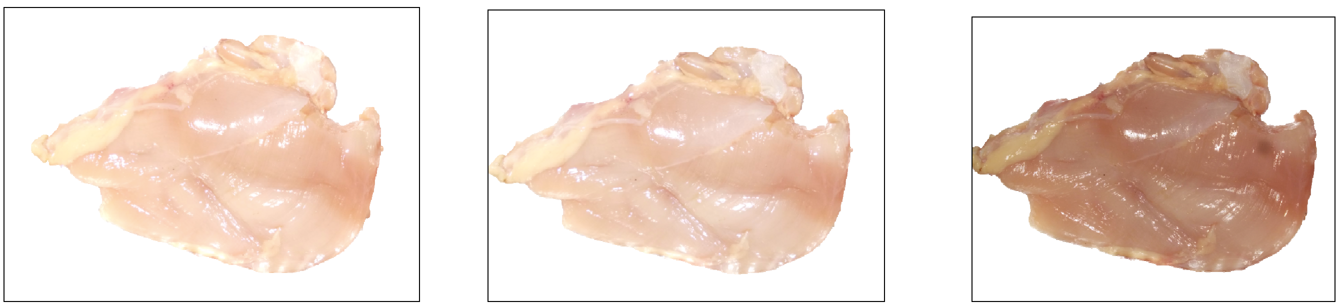
Sample no.	Source/ store	Product name	Form	Colour (visual observation)
1.	A	Mutton	Fresh	Cherry red
2.	B	Mutton	Fresh	Cherry red
3.	C	Mutton	Fresh	Cherry red
4.	A	Mutton	Fresh	Cherry red
5.	B	Mutton	Fresh	Cherry red
6.	C	Mutton	Fresh	Cherry red
7.	D	Mutton	Frozen	Dark cherry red
8.	E	Mutton	Frozen	Dark cherry red
9.	F	Mutton	Frozen	Dark cherry red
10.	A	Tuna	Fresh	Light Pinkish red
11.	B	Tuna	Fresh	Light Pinkish red
12.	C	Tuna	Fresh	Light Pinkish red
13.	A	Tuna	Fresh	Light Pinkish red
14.	B	Tuna	Fresh	Light Pinkish red
15.	C	Tuna	Fresh	Light Pinkish red
16.	D	Tuna	Frozen	Pinkish red
17.	E	Tuna	Frozen	Pinkish red
18.	F	Tuna	Frozen	Pinkish red
19.	A	Chicken	Fresh	Whitish pink
20.	B	Chicken	Fresh	Whitish pink
21.	C	Chicken	Fresh	Whitish pink
22.	A	Chicken	Fresh	Whitish pink
23.	B	Chicken	Fresh	Whitish pink
24.	C	Chicken	Fresh	Whitish pink
25.	D	Chicken	Frozen	Pink
26.	E	Chicken	Frozen	Pink
27.	F	Chicken	Frozen	Pink

Key:A: Andheri Market., B: Malad Market., C: Colaba market., D: Cold Storage at Andheri., E: Cold Storage at Malad., F: Cold Storage at Colaba.



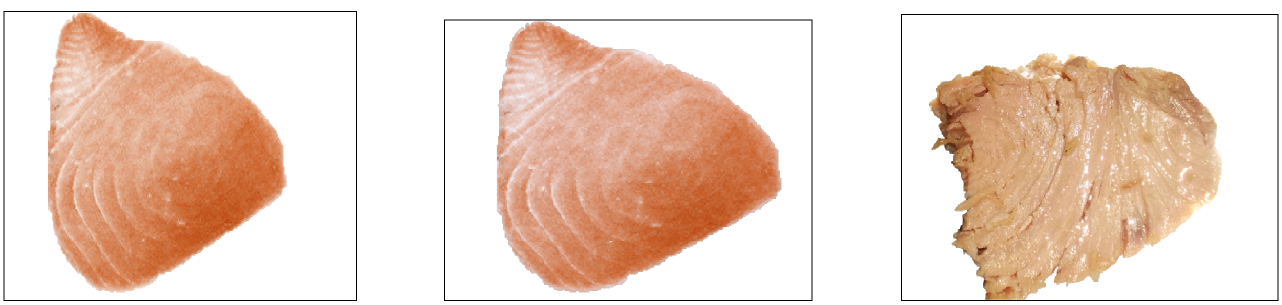
Fresh Untreated **Lab Treated** **Frozen**

Figure-1
Mutton



Fresh Untreated **Lab Treated** **Frozen**

Figure-2
Chicken



Fresh Untreated **Lab Treated** **Frozen**

Figure-3
Tuna Fish

Table-2
Level of CO in food samples

No.	Product	Co Treated/ Untreated/ Market Samples	Mean Co level Ng/g	Sd Values
1.	Meat	Fresh Untreated	97.01	0.3151
2.	Fish	Untreated	148.62	1.1909
3.	Poultry	Untreated	151.52	1.9144
4.	Meat	Lab treated	115.80	0.2828
5.	Fish	Lab treated	1149.83	0.2333
6.	Poultry	Lab treated	1149.55	0.6364
7.	Meat	Frozen Market sample	1682.66	0.9405
8.	Fish	Market sample	1194.50	7.7782
9.	Poultry	Market sample	1689.50	14.8492

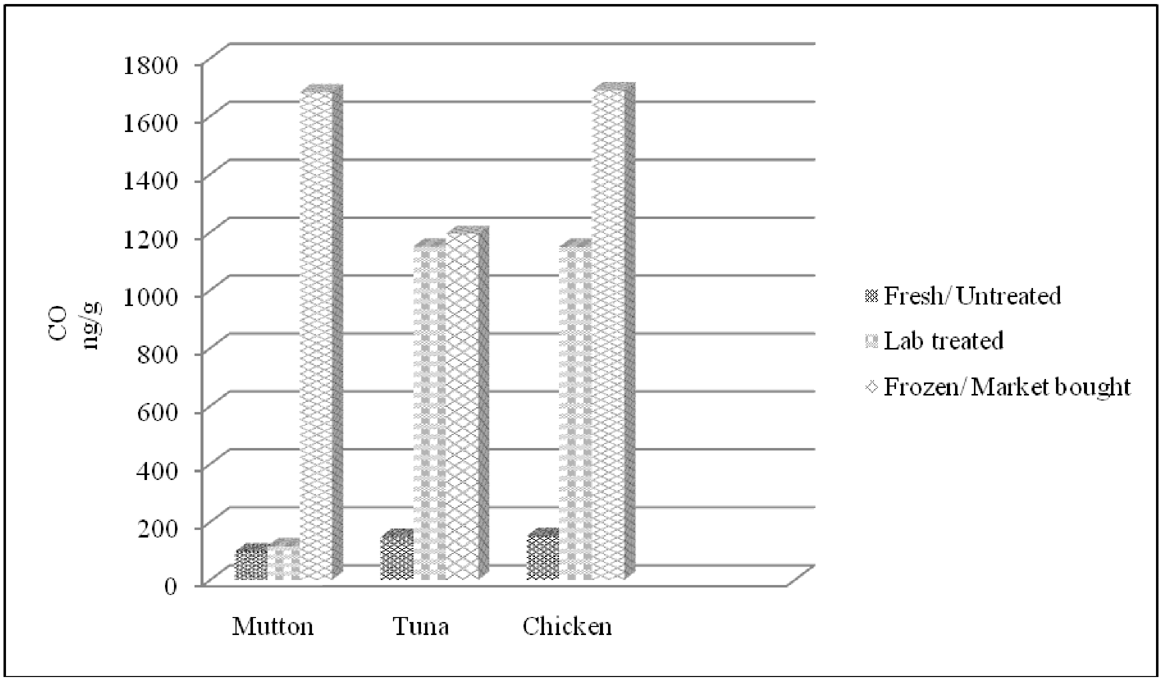


Figure-4
Comparative chart of CO values

Previous research has shown that CO can be determined by using a GC[3-4]. Forensic and Medical research in the past have give details regarding the quantification of CO by a GC[8]. The method of determining CO by use of a GC was used to minimize the sample handling. Octanol was added to suppress foaming. Sulphuric acid in the past has been reported effective in liberating CO from biological samples[4]. Potassium ferrycyanide is another option in place of sulphuric acid also effective in liberating CO. But as sulphuric acid is cheaper, it was preferred. Heating the homogenate accelerates and facilitates the release of CO. Optimum temperature and peak was observed with keeping temp at 30^0C for 2.5 mins.

The popularity of frozen foods in the Indian market has increased significantly over the pastdecade mainly due to the bright coloured appearance of food preferred by many consumers. This bright red colour has been associated with“freshness” by many consumers although not scientifically true. Many factors, including the fat content, actual species and cut, determine the colour of a piece of fish, meat and poultry.

Conclusion

In conclusion, the above method is potentially useful for the determination of carbon monoxide in frozen food in conjunction with other methods such as sensory assessment. All of the frozen, commercially CO-treated samples, which had a characteristic colour, were found to contain CO concentrations near or above 1 µg/g in the present study. Untreated samples had levels near or below 150 ng/g. The wide gap in values obtained for CO-treated versus untreated suggests the easy chemical confirmation of CO treatment using modern and available analytical instrumentation if needed.

As CO is often called a silent killer and as most people as per present lifestyle preserve the food stock at one time including the above mutton, chicken and tuna, they are unaware that they are exposed to CO which can create health hazards.

References

1. Raub J.A., Nolf M.M., Hampson N.B. and Thom S.R., carbon Monoxide poisoning- a public health perspective, *Elsevier. Toxicol.*, **145**, 1-14 **(2000)**
2. Tajima G. and Shikama K., Autoxidation of oxymoglobin. An overall stoichiometry including subsequent side reaction, *J. Bio. Chm.*, **262**, 12603-12606 **(1987)**
3. Smulevich G., Drogrhetti E., Focardi C., Coletta M., Viaccio C. and M. Nocentini, A rapid spectroscopic method to detect the fraudulent treatment of tuna fish with carbon monoxide, *Food. Chem.*, **101**, 1071-1077 **(2007)**
4. Nam K.C. and Ahn D.U., Carbon monoxide –heme pigment is responsible for the pink colour in irradiated raw Turkey, *Meat. Sci.*, **60(1)**, 25-33 **(2002)**
5. Anderson C.R. and Wu W.H., Analysis of Carbon Monoxide in Cthunnus spp.) and Mahi- Mahi (Coryphaena hippurus) by Gas chromatography/ Mass spectrometry, *J. Agr. Food. Chm.*, **53**, 7019-1923 **(2005)**

6. Bernardi C., Chiesa L.M., Sorncin S. and Biondi P. A., Determination of Carbon Monoxide in Tuna by Gas Chromatography with Microthermal Conductivity Detector, *J. of Chromatogr. Sci,* **46**, 392-394 **(2007)**

7. Oritani S., Zhu B., Ishida K., Shimotouge K., Quan L., Fujita M.Q. and Maeda H., Automated Determination of carboxyhemoglobin contents in Autopsy Materials using Headspace gas Chromatography/ Mass Spectrometry, *Forensic Sci. Int*., **113**, 375-379 **(2000)**

8. Hseih P.P., Chow C.J., Chu Y.J. and Chen W.L., Change in colour and quality of Tuna during treatment with carbon Monoxide, *J. Food. Drug. Anal*., **6**, 605-613 **(1998)**

9. Chow C.J., Hsieh P.P. and Hwang M.S., Quantative Determination of Carbon Monoxide Residue in Tuna Flesh, *J. Food. Drug. Anal*., **6**, 439-446 **(1998)**