

ACADEMICIA
**An International
 Multidisciplinary
 Research Journal**
 (Double Blind Refereed & Peer Reviewed Journal)



DOI: 10.5958/2249-7137.2021.00626.1

**SCIENCE IN LITERATURE: USE OF CHEMISTRY IN THE DETECTIVE
 FICTIONS OF AGATHA CHRISTIE**

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ABSTRACT

Literature reflects life and science unravels the mysteries of life. Yet, literature and science always have been in the two different ends of mindset. Apart from science fiction few authors have used science as a character in their creation. This article takes a look at the works of the celebrated detective fiction writer Agatha Christie as an example where this stereotype of opposition of these two themes has been broken effectively. She has used science as an important element in her novels and short stories. Agatha Christie was trained as a pharmacist and worked as one in the World War I. She used her knowledge as a pharmacist and uses and effects of different drugs in many of her detective novels. This article reviews the extensive use of scientific knowledge and specially that of all branches of Chemistry: organic, inorganic and biochemistry in her work in a quantitative and objective way. It shows that the use of chemistry by the author is more extensive than previously analyzed. She has used chemicals not only as poisons but has used them in more innovative manner, respecting their unique properties. Interestingly, the use of science has elevated her creation, rather than weighing it down as is evident from her ongoing popularity.

KEYWORDS: *Agatha Christie, chemistry, literature, poison, science.*

ACKNOWLEDGEMENTS: This article was written with no financial assistance. The author acknowledges Shri Shikshayatan College for their support. Last but definitely not the least the author acknowledges Agatha Christie for being the writer she is

Science in Literature: Use of Chemistry in the Detective Fictions of Agatha Christie

INTRODUCTION

Agatha Christie has used science, specifically chemistry as a central pivot in many of her works. Agatha Christie is known as one of the best crime writers in the world with millions of her books being sold even today after 44 years of her death. She was famous for using poisons as one of her most preferred ways of creating a plot and weaving her novels around it (Klein, 1994: 58-59). She served as a pharmacist in the 1st world war and her training made her well conversant with the sources, pharmacology and toxicological effect of drugs (Christie, 1977). There have been studies related to the use of chemistry in her writings but they are qualitative and though credits her scientific knowledge but does not explore the extent of her use of that knowledge in her writings (Bargainnier, 1980: 167-189 ; Maida and Spornick, 1982: 68-84). Also all studies have looked at how she has used chemicals as poison but none has studied how she has used chemistry in its various forms throughout her writings (Harkup, 2015). This article takes a quantitative and objective look at how extensively and to what extent she has used her knowledge of all branches of Chemistry; inorganic, organic and biochemistry to make her stories interesting.

METHODOLOGY: The novels and short stories of Agatha Christie were first classified according to their method of committing the crime. Then the writings that use chemicals or other forms thereof were classified according to the chemical used. This article makes no distinction between how she has used the chemicals, be it killing the victim, drugging the victim and many other uses. The results were analysed with the software MS-EXCEL.

RESULTS AND DISCUSSION: Agatha Christie has written 67 detective novels and has 15 short story and play collections (McAllister and Riley, 1989: 352-354). She created many fictional detectives, amongst which the most famous are Hercule Poirot and Miss Marple. Figure 1 gives a pictorial presentation of the different methods of murder used by Agatha Christie in her novels and short stories. It is seen that poisons is the main method used by Agatha Christie. She has used as many as 31 different chemicals in her writings as poisons or otherwise with very accurate symptoms and effect and ways of procuring them, either from shops or from natural sources.

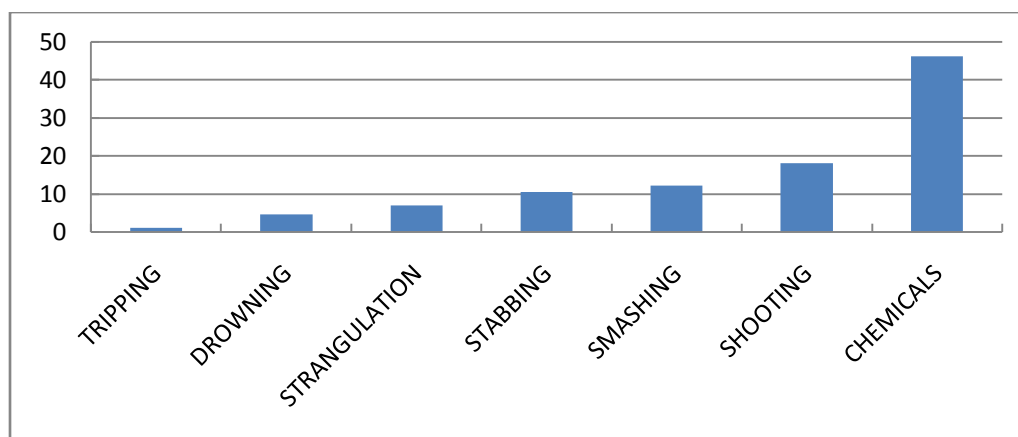


Figure 1. Various methods of committing murders employed by Agatha Christie in her novels and short stories (in percentage)

Sl. No	Chemical used (Total number of times used)	Name of the Fiction
1	Arsenic(5)	The Cornish Mystery, The Tuesday Night Club, The Lernean Hydra, After the Funeral, 4.50 from Paddington
2	Acid (Corrosive) (1)	Murder in Mesopotamia
3	Boracic Acid** (1)	Hickory Dickory Dock
4	Chloral Hydrate(3)	Seven Dials Mystery, And Then There Were None, The Clocks**

TABLE 1: CHEMICALS USED BY AGATHA CHRISTIE IN HER WORK (ALPHABETICALLY ORDERED)

5	Chloroform**(1)	The Plymouth Express
6	Cyanide (any form) (11)	The Adventure of the Egyptian Tomb , The Big Four, The Moving Finger, Wasp's Nest , The Blue Geranium , Yellow Iris , And Then There Were NoneX2, Sparkling Cyanide, A Pocket Full of Rye, The Mirror Cracked From Side To Side, Endless Night (KCN)X2
7	Ethyl Chloride**(1)	The Big Four
8	Iodine and Starch**(1)	Motive Vs. Opportunity
9	Litmus Papers**(1)	The Blue Geranium
10	Phosphorus (1)	Dumb Witne
11	Thallium(1)	The Pale Horse
12	Trinitrine (1)	The Chocolate Box
13	Veronal(3)	The Murder of Roger Ackroyd, Thirteen at Dinner , Hickory Dickory Dock
14	Biochemical Specimens	Cards On The TableX2 , Murder Is Easy , Death in The Air , The Flock of Geryon, The House of Lurking Death

** Chemicals not used for Murder

She has used some chemicals which are of inorganic origin, some organic chemicals of non plant origin and some phytochemicals, of plant origin. The use of phytotoxins have been discussed in many articles. In this article we will concentrate on the chemicals other than the phytotoxins that she has used in her stories. A detailed list is given in table 1.

a. INORGANIC CHEMISTRY: Cyanide in its many form, Potassium Cyanide (KCN), Sodium Cyanide (NaCN), Hydrogen Cyanide(HCN) or Prussic Acid has been used by Christie either orally or as vapour. Cyanides are inhibitor of cellular respiration causing anaerobic metabolism. Hence, the tissues are not able to use the oxygen in the blood and eventual brain death occurs. The lethal dose for KCN is as less as 200 milligrams (Trestrail, 2000:27-44). All her deaths by cyanides are shown as instantaneous death, without any additional medical explanations. Its characteristic smell of bitter almond has been used by her to detect cyanide in her novels (*The Big Four, The Mirror Cracked from Side to Side*).

Though mentioned as Arsenic (As, Atomic Weight 33) in her novels, the compound of Arsenic that is present in weedkiller are either Arsenic trioxide (As_2O_3) or Sodium Arsenite (Na_2AsO_4) (Monteith et al., 1939:10-43). Arsenic is a very toxic element. Usual symptoms of Arsenic poisoning are vomiting, abdominal pain very similar to gastric problems. Hence, it was a convenient tool for murderers, especially for slow poisoning (Ratnaike, 2003:391-396) where the symptoms of poisoning could be camouflaged as gastric problems.

In *Murder in Mesopotemia*, one of the murder takes place by drinking "corrosive acid" unknowingly by the victim. The acids used in archeological digs are usually acetic acid (CH_3COOH) and Hydrochloric acid (HCl) (Ramadan et al., 2010:97-110; Hamed et al., 2013:153-160). As acetic acid has a distinct smell of its own, it cannot be substituted for water,

hence though Agatha Christie does not mention which acid, it is safe to conclude that HCl was used.

Another acid she used is Boric Acid/Boracic Acid ($B(OH)_3$, Molecular Weight, 61.8) The fact that it is a weak acid, white powder, dissolves in water and in dilute solution can be used as eye drops is mentioned in the novel, *Hickory Dickory Dock*. It is also mentioned that large doses can cause acute abdominal pain, which was used by the author as a diversion.

Iodine (I_2 , Molecular Weight 253.81), present as triiodide (I_3^{-1}) ion, when added to starch (a polysaccharide containing Amylose and Amylopectine) has been used as vanishing ink. The Amylose reacts with the Iodide, giving Iodine, that gives an ink blue colour and then upon exposure to air, aerial oxidation takes place and Iodine again goes back to Iodide and the colour disappears. This fact was used by her in the short story *Motive V Opportunity*, where a pen was filled with a starch solution with a few drops of Iodine, which she calls “evanescent ink”, which makes a deep blue black fluid and disappears entirely in four or five days. It was used to forge a will in the story.

Symptoms of Phosphorus (P, Atomic Weight 30) poisoning resembles liver damage and this fact was used in the novel *Dumb Witness*, where Phosphorus was mixed with the victim’s medicine for liver trouble because the death would mimic one due to liver problems. The author also mentions a glow that was coming from the victim’s mouth (aura) when she was alive. This claim seems farfetched and cannot be corroborated in medical literature (Reddy et al., 2017:238-242).

Thallium (Tl, Atomic Weight 81) and its compounds are toxic and is absorbed by skin. It was commercially obtained as a rat poison. It was used successfully in the novel, *The Third Girl*. Her description of Thallium poisoning by adsorbtion was so accurate that it helped others recognize the poisoning in real life and save people (Sanders and Len Lovallo ,1989: 314-315; Emsley,2006:346-347).

b. **BIOCHEMISTRY:** There are a variety of uses of Biochemistry and Molecular Biology in her novels. Her search for unusual and rare poisons led her to this path. Boomslang poison, which is a poison from a large venomous tree snake found in South Africa was used in the novel, *Death In The Air* causing an instantaneous death. The poison is a combination of many proteins and it has been found that the main poison comes from a thermo labile glycoprotein (Kamiguti, 2000:163-170) and the recipient dies as a result of non coagulation of blood in external or internal bleeding.

In the novel, *Cards on the Table* the perpetrator uses bacterial strain of Anthrax and poisoned inoculation to murder her victim as also in the novel *Murder is Easy*. In the short story *The House of Lurking Death*, Ricin, which is a lectin obtained from castor oil causes four deaths. The lethal dose is 1mg/kg of body weight for humans. It is a heterdimeric protein that inhibits protein synthesis (Aplin and Eliseo, 1997: 260-261). In the short story *The Flock of Geryon*, the molecular biology of preparing culture of various bacilli was explained in simple terms and it was used to make cultures of various diseases to kill unsuspecting victims, the perpetrator happened to be a bacteriologist/chemist. This was at a time when molecular biology was not as popular as it is today and she did a great job in incorporating the essentials without confusing her readers.

C. ORGANIC CHEMISTRY: Six organic compounds, which are not plant based has been used by Agatha Christie. Chloral Hydrate, often used as a sedative, was used successfully in many novels, to drug or to kill. Overdose is characterised by nausea, vomiting, cardiac arrhythmia, coma and subsequent death. She has used it to cause death while sleeping in two cases and in one she has used it to drug the victim.

Veronal, a barbutarate, whose chemical name is diethyl barbuteic acid was used as a sleeping aid till the 1950s. It has a slight bitter taste and overdose of it results in death. The therapeutic dose is 1 gm. (Finlay, 1919: 115). The deaths by overdose of Veronal have also been shown by Agatha Christie as sleeping deaths (*Thirteen at Dinner, Taken at the Flood*).

Chloroform (CHCl_3) is widely used as a local anaesthetic. She has used chloroform to drug the victim in *The Plymouth Express*. Though it has been argued that it does not produce instant incapacitation (Payne, 1998:685-690). Ethyl Chloride was used in *The Big Four* to produce instant and short lived sedation.

Litmus, a mixture of different water soluble dyes is absorbed on a filter paper to prepare the litmus paper, which is used as an indicator, to test the acidity or alkalinity of the sample. It turns pink in acid and blue in alkaline solution and it is purple in neutral. This property of Litmus paper was used in a unique way to frighten the victim in the short story, *The Blue Geranium*. Red litmus paper was pasted over red flowers and it turned blue by the fumes of the smelling salt (which contains Ammonium Carbonate, $(\text{NH}_4)_2\text{CO}_3$ that spontaneously decomposes to Ammonia, which is a base). Hence apart from litmus she also uses the chemical nature of Ammonium Carbonate.

Trinitrine or Trinitro Glycerine is used as a vasodilator, to treat heart conditions. In the short story, *The Chocolate Box* it is mentioned that “ it lowers the blood pressure “and is used to treat heart conditions like angina pectoris and relieves the arterial tension”. Overdose results in methemoglobinemia which causes death. Trinitrine was used as a medicine by a member of the household and multiple tablets of the same was used inside chocolate, as a poison (Kaplan, 1985: 181-183) and the victim died due to cardiac arrest.

CONCLUSION: The study of Agatha Christie’s novels has shown that she has used poison as her preferred mode of crime in her novels. It was also observed that she has used chemistry not only as poison but also has used interesting features of many chemicals. She was aware of the latest use of drugs and diseases and being a pharmacist she was knowledgeable of the current medical advances, inoculations etc. Use of molecular biology, protein chemistry etc. in her work suggests that she was conversant with advances in science made at that time. She has used the poisons, depending on their ease of procurement and technique for its camouflage. Though there is no doubt she was aware of the effects and physical manifestations of each of the drug she used but only in 5% of her work, she has used the exact details and chemical properties of the drugs. May be the reason being that she did not want to confuse or burden the general readers by the jargons of chemistry, biochemistry. This article shows how science and literature has come together in the creations of Agatha Christie.

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