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ANCIENT AND MODERN METHODS OF DIAGNOSIS OF POISONING IN HUMAN BEING - A REVIEW

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ABSTRACT

In the last decade mortality by poisoning is increasing continuously. Cases of acute as well as chronic toxicity are increasing in number. New poisons are emerging day by day. Ancient poisons are already in stream. For the best and real time tested treatment of poisoning, an accurate and fast diagnosis is the main key. This research article is aimed to collect, organise and highlight on the role of ancient as well as modern methods of diagnosis of poisoning for convenience of treatment & diagnosis of various consequences related to poisoning in human being.

KEYWORDS: Poisoning, poisons, ancient methods, modern methods, diagnosis.

INTRODUCTION

Poisons are used since span of human existence, for many purposes. Ancient tribes used poisons as weapons, hunting tools, anti-venoms and medicines, etc.[1] Acharya Sushruta have been mentioned various acute and chronic poisonings.[2] Kautilya suggested means for employing poisons as well as precautions against assassination.[3]Over the centuries, use of poisons for harmful uses are continued to increase. In the modern world poisons are also used for constructive uses like preservatives, disinfectants, cleaning solutions, pesticides, etc.[4] Poison can induce any type of hazardous effects in human beings.[5] It may results in acute as well as chronic illnesses or even in death. The effects of poison in living organism are generally referred as poisoning.[6]

Poisonings have both medical and legal aspects. Physician should urgently treat these cases and inform relevant government authorities.[7] Detection of poison in a material or a human body contents is an important aspect of forensic toxicology. Diagnosis of poisoning is always a difficult task for clinicians. Ancient scriptures of Ayurveda like Sushrutasamhita, Ashtanga sangraha, Ashtangahrudaya,etc. have been described many diagnostic methods of poisoning. Advance modern techniques for detection of poison are playing a great role in modern toxicology. Diagnosis decides the management, treatment, causes of death, time since death, etc., in a particular poisoning.[8] In the recent era many poisons used in ancient era are still in use. So many new poisons in different forms are emerging day by day. So to collect, arrange and focus on the role of methods of diagnosis of poisoning in human being is a need.

MATERIALS AND METHODS

Literature reviewed from Ayurvedic Scriptures like Sushrutsamhita, Charaksamhita, Ashtang sangraha, Ashtanghrudaya, Kautilya Arthshastra, etc., books of modern toxicology, online published studies. All data is compiled, analysed and discussed.

A) Ancient methods of diagnosis of poisoning

In the Scriptures of Ayurveda all the *adhishthana* (origin sources) of various poisons (i.e., plants, animals, artificially prepared etc.), various modes of poisoning (food materials, drinking liquids, etc.), sign and symptoms of poisoning, *vishanidan* (diagnosis of poisoning) and chikitsa (treatment) of poisoning is mentioned in detail. Chronic poisoning is described as Garavisha and Dushivisha. In the ancient era human beings and other living organisms was supposed to be poisoned by the enemies through foods,clothes, bed seats, etc. So our divine sages developed some methods for the diagnosis of the poisoning which are as following:

1. Agniparikshana of poisoned material.
2. Panchbhautic parikshan of poisoned material.
3. Examination of poisoned material in animals and birds.
4. Bhautic parikshan (physical characteristics of poisonous materials).

5. Lakshananusar parikshan (according to sign and symptoms).
a. sign and symptoms of sthawar and jangam visha (sign and symptoms of vegetable, metallic and animal poison).
b. sign and symptoms according to mode of administration.
c. sign and symptoms according to site of poison.
d. sign and symptoms according to use of poisoned material.
e. sign and symptoms of garvisha and dushivisha(s & s of chronic poisoning).
6. ashumrut parikshan (examination in the dead body).

1. Agniparikshana **(examination on fire)**[9,10]
Poisoned materials burns with single point flame (not with normal spreading flame), become like peacocks neck, interrupted and slow emit flames of different colors like rainbow and gives out cracking sound. The emerged smoke has cadaveric smell.

2. Panchbhautik parikshan of visha**(examination of elements of poison)**[11,12]
- ***Shabda parikshan***(examination of sound)- poisoned food burns making loud cracks.
- ***Rupa parikshana*** (examination of appearance)- when cast into the fire poisoned material acquires the colors of peacocks neck.
- ***Gandha parikshana*** (examination of smell)- on burning poisoned material emits irritating fumes.
- ***Rasa parikshan*** (examination of test)- lacks its natural taste.
- ***Sparsh parikshana***(examination by touch)- contact with poisoned food causes burning sensation and nails falling of hands.

3. Examination of poisoned material in animals and birds[13,14]
After animal experiments our sages conclude that the voice of *kokila* (cukoo) changed, gait of swan gets altered, *bhringraja* bird (domestic crane) becomes exciated, *karkavaku*(cock) hoots loudly, *suka* (green parakeet) and *sarikaa* (mynah) makes long loud sounds. *Chamikara* vomits. *Karandava* (white breasted goose) fly away. *Jeevanjeeva* birds either dies or faints. *Nakula* (moongoose) gets horripilated. Vanara(Monkey) eliminates faeces. *Prushta* (spotted deer) weeps. *Mayoora* (peacock) gets elated.

4. *Bhautik parikshan* (physical characteristics)
- ***Vishjushta anna*** **(poisoned foods):**[15]

Food mixed with poison requires long time to cook. Cooked one becomes stale. Loses its natural odor, color, smell, taste. It becomes hard. Also it becomes very moist and appear to be full of glistening particles. Condiments mixed with poison dried very quickly. Poisoned materials burns with single point flame (not with normal spreading flame).

- **Layers from liquid materials (*raji*):**[16,17]

Poisoned liquids show the following characteristics:
Kwatha (decoction) becomes dark, black or blue colored. Poisoned water get distorted with more or less of the natural features, images not appear at all. Accumulation of foam, appearance of dividing lines and different kinds of striae, confirms poisoning. Appearance of blue lines in mansrasa (meat soup), coppery red lines in dugdha (milk), black lines in madya (alcohol), bluish lines in takra (buttermilk), green lines in madhu (honey), light brown lines in ghreeta (ghee), light red lines in taila (oil) confirms the poisoning in respected materials.

5. Lakshnanusar parikshan (according to sign and symptoms)-
In Ayurved science, poison has been divided into two major parts,i.e., sthawarvisha (vegetable and metallic poison) and jangam visha (animated poison).

a. Sign and sumptoms of sthawar & jangama visha
- **Lakshana of *sthawar visha* (**vegetable& metallic poison):[18] contact by any route causes fever, hiccup, sensitivity in teeth, spasm in throat, frothy saliva, vomiting, anorexia, dyspnea etc.
- **Lakshnas of *jangam visha*** (animal poisoning):[19] sleep, drowsiness, exhaustion, burning sensation, inflammation, horripilation, edema and diarrhea.

b. Sign and symptoms according to mode of administration:
- ***Vishdhuma*** (poisonous fumes): inhalation of poisonous fumes or smoke causes fainting, watering of eyes and mouth, headache, running nose and disturbances of the vision.[20]
- **Vapour of poisoned food:** cardiac pain, abnormal movement of eyes and headache.[21]
- ***Vishjushta dantkashta*** (poisoned tooth brush): causes dryness and swelling of palate, teeth, tongue and lips.[22]
- **Vishjushta anjana** (poisoned collyrium): application causes accumulation of dirt in eyes, redness, pain, distortion of vision and even blindness.[23]
- **Vishjushta nasyamdhum** (poisoned snuff and smoke): causes headache, discharge of kapha (watery fluid), bleeding through the natural orifices (nose, mouth and eyes).[24]
- **Poisoned ear drops-** causes swelling, pain, ulcers and defects of hearing.[25]
- **Smelling poisoned flowers-**causes headache, tears in the eyes and loss of sensation of smell.[26]

c. Sign and symptoms according to the site of poison
- **Visha in mouth** (ingestion): causes tingling sensation in lips, burning sensation inside the mouth, hardness at the root of tongue, lockjaw, more salivation, loss of sensation of taste, pricking pain.[27]

- **Visha in aamashaya** (poisoned food in stomach)- causes perspiration, toxicity, fainting, vomiting, discoloration, distention of abdomen, burning sensation, loss of appetite, appearance of rashes (spots) all over the body. Flatulence, trembling and abnormality of sense organs.[28,29]
- **Visha in pakvashaya** (poisoned food in intestine)- causes thirst, burning sensation, fainting, diarrhea, gurgling noise in the abdomen, stupor, loss of strength, emaciation, pallor and enlargement of the abdomen.[30]

d. sign and symptoms according to use of poisoned material

- **vishjushta tailadi**(poisoned oil)- used for oil bath produce burning sensation in the skin, perspiration, ulcers, bleed and lacerations.[31]
- **poisoned oil for application on head** – produce headache, appearance of nodules, and falling of hairs.[32]
- **Poisoned comb**- causes falling of hair, headache, bleeding from passage and appearance of cysts on head.[33]
- **Poisoned wooden foot wear**- causes inflammation, discharge, numbness, and eruption of boils in feet.[34]
- **poisoned ornaments**- causes burning sensation, suppuration and tearing of poisoned material.[35]

i) Sign & Symptoms of Garvisha and dooshivisha

- **Garavisha** (artificially mixed poison)- garavisha is prepared by mixing more than a single poisonous or nonpoisonous drugs. It may produce swelling, anaemia, enlargement of abdomen, insanity, piles etc.[36]
- **Dushivisha** (weak poison)- this is the weak and latent poison. One suffering from dushivisha passes liquid stool of abnormal colour, has foul smell,tasteless sensation in mouth, thirst, fainting, vomiting and other symptoms of toxicity.[37]

6. ***Ashumrut parikshan*(examination in dead body):[38]**

- External and internal findings (sings) confirms the diagnosis of poisoning. For the homicidal purpose, poison was ingested with mixing in food materials. Black coloured hands, legs, teeth and nails in the dead body confirms it.
- Improper posture, scattered cloths and the number of episodes of diarrhoea occurred confirms death by *Dhatura* poisoning.
- Discharge of blood from bite site, indicates snake bite.
- Food materials found in the dead was subjected to birds for the confirmation of the poisoning.

B) Modern methods of diagnosis of poisoning

Various highly developed analytical methods have been used for diagnosis of poisoning. In the modern science mainly used methods for the diagnosis of poisoning are as follows:

1. Signs and symptoms in poisoned
2. Chemical screening tests
3. Chromatographic screenings
4. Ultraviolet - visible Spectroscopy
5. Atomic Absorption Spectroscopy (AAS)
6. Voltammetry/Polarography (Trace metal analyzer)
7. Immunoassay
8. Breath Alcohol Analyzer

1. Signs and symptoms in poisoned

For some extent poisoning can be diagnosed by signs and symptoms in the poisoned one. e.g., diagnosis of kerosene poisoning by kerosene smell, breathing difficulty, pain and burning in abdomen, vomiting, loose motions etc.[39]

Table 1: Showing common sign & symptoms in poisoning by related poisons[40]

Sr.no.	Sign & symptoms	Poisons
1.	Hypothermia	Opiates, alcohol, carbon monoxide, etc.
2.	hyperthermia	Cocaine, strychnine, dhatura, etc.
3.	Headache	Alcohol, cyanides, tobacco, nitrite, etc.
4.	Tachycardia	Carbon monoxide, atropine, nitrites, cannabis, amphetamines, etc.
5.	Delirium	Calotropis, Dhatura, Cannabis, Cocaine, etc.
6.	Hypertention	Amphetamines, zinc phosphide, ephedrine,etc.
7.	Dyspnoea	Carbon monoxide, strychnine, phosphine, etc.
8.	Pulmonary oedema	Organophosphates, chlorine, etc.
9.	Excessive Salivation	Organophosphates, alcohol, aconite, croton, tobacco, etc.
10.	Respiratory distress	Alcohol, opium, organophosphates, snake bite, etc.
11.	Arrhythmia/cardiac irregularities	Carbamates, aconite, oleander, digitalis, etc.
12.	Hypotension and shock	Aconite, arsenic, nitrites, organophosphate, snake bite, iron, etc.

2.Chemical screening tests

Analytical detection of the poison in the samples is the most important proof of poisoning.[41] Samples from the suspected case are screened with the help of specific chemical reagents for the related poisons, e.g., diagnosis of barbiturates by cobaltous acetate, 5% iso-propylamine solutions.[42] These tests proves the presence of suspected poisons in poisoned material. Hallucinogenic drugs like LSD are easily detected under ultra- violet light. Many alkaloids can be detected by chemical reactions.[43]

3.Chromatographic screenings

These methods are used for qualitative as well as quantitative determination of the poison in the suspected samples. These are highly specific and fast acting techniques. These can be used as corroborative evidence.[44] These include followings:

a) **Thin layer chromatography:** this is only qualitative test. This is very useful in emergency to diagnose presence or absence of poison.[45]
b) **Liquid chromatography (LC)**
c) **Gas liquid chromatography (GLC)**

LC & GLC techniques are used for identification and quantification of solid, liquid as well as gaseous poisons. GLC is preferably used for analysis of volatile and thermo-stable pesticides, e.g., organophosphates, organochlorates, etc.[46]

d) **High performance liquid chromatography (HPLC)**

With the help of this technique minute traces of organic components of various mixtures can be separated and analysed. This is widely used for for qualitative and quantitative analysis of lipstick smears, heroin amphetamine, LSD green, pesticides, herbicides, alcohols, snake venoms, plant & animal poisons, etc.[47]

4) Ultraviolet - visible spectroscopy

This is a quick & inexpensive technique for qualitative and quantitative analysis of drugs like barbiturates,[48] benzodiazepines, morphin, tranquilizers, DDT, parathion, strychnine, aconitene, etc.[49]

5) Atomic absorption spectroscopy (AAS)

This is used for qualitative & quantitative analysis of poisoned sample. By this technique the quantity of a single poison can be determined in the mixture of multiple poisons. So this is widely used for determination of various poisons in the liquid materials.[50] AAS was implemented for the analysis of metals by A. Walsh et al.[51]

6) Voltammetry/polarography (trace metal analyzer)

With the help of this technique trace amount of poisons can be determined with their physical and chemical properties also. Ion concentrations of many corrosives can be measured. Accuracy, precision, low quantification limit & low price makes it very popular in poisons analysis.[52]

7) Immunoassay

It is accepted as the most practical method for determination and measurement of substances with high protein content and difficult to isolate.[53] Thsese are very simple but rapid techniques which do not require any pre- treatment of samples. The concentration of the suspected poison is measured by enzyme activity of the poison.[54] Insulin, barbiturate, benzodiazepine and opiate derivatives may be studied by this method.[55]

8) Breath Alcohol Analyser

This breath alcohol analyser is used to detect ethanol in breath air. With the help of this the concentrations of alcohol in the blood can be calculated. For conversion of breath alcohol concentration (BrAC) into blood alcohol concentration (BAC) constant blood to breath ratio of alcohol (2000:1 or 2300:1) is assumed.[56]

DISCUSSION

Poisons have been used since existence of human beings for various purposes. In the ancient era poisons were mostly used for hunting, to kill enemies, etc. So to protect human beings from poisoning, some methods were developed by divine sages. 'Panchbhautik Siddhant' is the basic of ancient science. Diagnosis of poisoning by agniparikshan, panchbhautik parikshan & bhautik parikshan are based on 'Panchbhautik Siddhant. Diagnosis by sign & symptoms according to nature of poison, mode of administration, route of administration, site of contact of poisoning shows the accurate & precise knowledge of toxicology in ancient era. Diagnosis of poisoning in dead (ashumrut parikshan) signifies the potential development of diagnostic methods in ancient era. Use of animals & birds for diagnosis of poisoning is not a legal method.

Day by day a lot of new poisons in various forms are emerged with the development of human beings. So the new techniques and methods for diagnosis of poisoning is a need. Diagnosis by sign & symptoms is the main key till now. With the help of chemical screenings & thin layer chromatography like techniques, a qualitative diagnosis of majority of poisons can be done. Other highly developed methods like gas liquid chromatography, high performance liquid chromatography, ultraviolet – visible spectroscopy, atomic absorption spectroscopy, etc., possesses high specificity & accuracy for qualitative as well as quantitative estimation of poisons in any sample. Bacterial toxins, poisons in the gaseous forms, in the mixture of various poisons in any form can be easily detected by modern methods. Alcohol breath analyzer is a quick, accurate & portable method.

CONCLUSION

Ancient methods for diagnosis of poisoning are quick, useful at the site of sampling. Loss of accuracy, specificity, & quantitative analysis are lacunae in the ancient methods. High sensitivity, drug specificity, requirement of very small quantity of the sample, qualitative as well as quantitative estimation of a poison from any form and from mixture of various poisons proves superiority of modern methods in acute as well as chronic poisoning. All the methods are very helpful in saving lives of poisoned human being as well as for the diagnosis of various factors & consequences related to poisoning. Advertisement and campaigns for handling of poisonous materials in peoples is a need in modern era also.

REFERENCES

1. https://en.wikipedia.org/wiki/History_of_poison.
2. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 2, Verse 33, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 32 [45]
3. Udayvir Shastri: Editor, Kautilaya Arthashasrta of Vishnugupta Kautalya Edited with 'Nayachandrika' Hindi Commentry, Volume 2, Ashumrutak Parikshan,Chapter no. 82, Verse 21-30.Bharat Bharti publication, Delhi, Second Edition.1969:135-137.
4. https://en.wikipedia.org/wiki/History_of_poison.
5. Dr. Mathiharan K, Dr. Patnaik AK.Modi's Medical Jurisprudence and Toxicology, Section 2, Poisons and their Medicolegal Aspects: Chapter 1,Lexis Nexis Publication, Dehli, Twenty Third Edition, 2006: 21-29.
6. Dr. Parikh C.K., Parikh's Textbook of Medical Jourisprudence Forensic Medicine and Toxicology, Section VIII, Introduction to Toxicology, CBS Publishers & Distributors, Dehli, Sixth Edition Reprint-2007; 8(9).
7. Dr. Mathiharan K, Dr. Patnaik AK.Modi's Medical Jurisprudence and Toxicology, Section 2,Diagnosis of Poisoning:Chapter 1,Lexis Nexis Publication, Dehli,Twenty Third Edition, 2006: 21-29
8. file:///C:/Users/DELL%20PC/Downloads/1996_3_1_14.pdf.
9. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 29-30, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 32 [45].
10. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/20-21, 9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 267.
11. Dr. Brahmanand Tripathi: Editor, Ashtanghrudayam of Shrimadvagbhata Edited with 'Nirmala Hindi commentary', Sutrasthan; Annarakshadhyay, Chapter 07, Verse, 13-14, Chaukhmba Sanskrit Pratishthan, Delhi: Reprint, 2007; 124.
12. Dr. U. R. Shekhar Namburi, editor. Agadtantra, Diagnosis of Poisoning, Chapter 05, 1st edition, Chaukhambha Sanskrit Sansthan Varanasi, 2013; 41 & 42.
13. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 31-33, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; [06,07].
14. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/23,9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 267-268.
15. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/10-11,9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 264.
16. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/12, 9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 264.
17. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with Ayurveda Tatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 44-45, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 08.
18. Dr. Brahmanand Tripathi, Editor, Charakasamhita of Agnivesha Edited with 'Charak-Chandrika' Hindi Commentary, Volume 2, Chikitsasthana; Vishachikitsaadhyaya, Chapter 23, verse 16, Chaukhmba Surbharati Prakashan, Delhi, Reprint, 2002; 749.
19. Dr. Brahmanand Tripathi, Editor, Charakasamhita of Agnivesha Edited with 'Charak-Chandrika' Hindi Commentary, Volume 2, Chikitsasthana; Vishachikitsaadhyaya, Chapter 23, verse 15, Chaukhmba Surbharati Prakashan, Delhi, Reprint, 2002; 749.
20. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 63-64, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 12.
21. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 34-35, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 32 [45].
22. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/34,9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 167.
23. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/37,9th edition, Chaukhmbha Orientalia, Varanasi 2005; 167.
24. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/39, 9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 167.
25. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 67, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 12.
26. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with Ayurveda Tatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 66, Chaukhmba Sanskrit

Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 12.
27. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/26, 9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 269.
28. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/27,9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 167.
29. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with Ayurveda Tatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 40, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 08.
30. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 42, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 08.
31. Prof.K.R.Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/41,9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 167.
32. Prof. K. R. Srikant Murthy, editor Ashtanga Sangraha of Vagbhata, Sutrasthana, Annaraksha Vidhi Adhyaya, 8/48, 9th edition, Chaukhmbha Orientalia, Varanasi, 2005; 167.
33. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 56, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 11.
34. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 72-73, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 13.
35. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 1, Verse 74, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 13.
36. Dr. Brahmanand Tripathi: Editor, Ashtanghrudayam of Shrimadvagbhata Edited with 'Nirmala Hindi commentary', Uttarasthan; Vishpratishedhadhyay, Chapter 35, Verse, 50-53, Chaukhmba Sanskrit Pratishthan, Delhi: Reprint, 2007; 1150.
37. Kaviraja Ambikadutta Shastri: Editor, Susrutsamhita of Maharsi-Susruta Edited with AyurvedaTatva-Sandipika, Kalpasthana; Sthavarvish-vidnyaniyam Adhyaya: Chapter 2, Verse 30-32, Chaukhmba Sanskrit Sansthan Publication, Varanasi, Second Edition, part 1, 2010; 33-34.
38. Udayvir Shastri: Editor, Kautilaya Arthashasrta of Vishnugupta Kautalya Edited with 'Nayachandrika' Hindi Commentry, Volume 2, Ashumrutak Parikshan, Chapter no. 82. Bharat Bharti publication, Delhi, Second Edition, 1969; 135-137.
39. Dr. Parikh C.K., Parikh's Textbook of Medical Jourisprudence Forensic Medicine and Toxicology, Section 10, Fuels, 52, CBS Publishers & Distributors, Dehli, Sixth Edition Reprint-2007; 10.39.
40. Bardale Rajesh, Principles of Forensic Medicine and Toxicology, Section 2, Toxicology:General Considerations:Chapter 33,The Health Science Publishers,Dehli,,Second Editon, 2017; 473-474.
41. Dr. Parikh C.K., Parikh's Textbook of Medical Jourisprudence Forensic Medicine and Toxicology,Section VIII, Introduction to Toxicology, CBS Publishers & Distributors, Dehli, Sixth Edition Reprint-2007; 8.11.
42. AK Jaiswal, Handbook of Forensic Analytical Toxicology, chapter no.4, Thin Layer Chromatography and its application, 1st edition, Jaypee publication Dehli, 2014; 139.
43. http://plato.mercyhurst.edu/chemistry/kjircitano/ChemPrincLaboratories/Drugs.
44. AK Jaiswal, Handbook of Forensic Analytical Toxicology, chapter no.5, Thin Layer Chromatography and its application, 1st edition, Jaypee publication Dehli, 2014; 214.
45. AK Jaiswal, Handbook of Forensic Analytical Toxicology, chapter no.5, Thin Layer Chromatography and its application, 1st edition, Jaypee publication Dehli, 2014; 214.
46. AK Jaiswal, Handbook of Forensic Analytical Toxicology, chapter no.6, Thin Layer Chromatography and its application, 1st edition, Jaypee publication Dehli, 256.
47. AK Jaiswal, Handbook of Forensic Analytical Toxicology, chapter no.7, Thin Layer Chromatography and its application, 1st edition, Jaypee publication Dehli, 324.
48. Dr. Mathiharan K, Dr. Patnaik AK.Modi's Medical Jurisprudence and Toxicology, Section 2, Poisons and their Medicolegal Aspects: Chapter 1,Lexis Nexis Publication, Dehli,Twenty Third Edition, 2006; 29.
49. AK Jaiswal, Handbook of Forensic Analytical Toxicology, chapter no.8, Thin Layer Chromatography and its application, 1st edition, Jaypee publication Dehli, 2014; 364-365.
50. AK Jaiswal, Handbook of Forensic Analytical Toxicology, chapter no.9, Thin Layer Chromatography and its application, 1st edition, Jaypee publication Dehli, 2014; 379-381.
51. https://www.eolss.net/Sample-Chapters/C09/E6-12-23-00.pdf.
52. AK Jaiswal, Handbook of Forensic Analytical Toxicology, chapter no.10, Thin Layer Chromatography and its application, 1st edition, Jaypee publication Dehli, 421-422.

53. Blanke RV, Poklis A, Analytic/Forensic Toxicology In: Amdur MO, Doull J, Klaassen CD editors. Cascarett and Doull's Toxicology The Basic Science of Poisons.4th ed. London: Pergamon Press, 1992; 905-923.
54. Dr. Mathiharan K, Dr. Patnaik AK., Modi's Medical Jurisprudence and Toxicology, Section 2, Poisons and their Medicolegal Aspects: Chapter 1,Lexis Nexis Publication, Dehli, Twenty Third Edition, 2006; 29.
55. http://plato.mercyhurst.edu/chemistry/kjircitano/ChemPrincLaboratories/Drugs.
56. AK Jaiswal, Handbook of Forensic Analytical Toxicology, chapter no.12, Breath Alcohol Analyser and its application, 1st edition, Jaypee publication Dehli, 2014; 442-444.