



## Aluminium Phosphide versus Zinc Phosphide Lethality – A Lurking Danger in Indian Rural Homes

Journal Homepage: [www.jist.org.in](http://www.jist.org.in); Email: [article@jist.org.in](mailto:article@jist.org.in)



Anita Yadav<sup>1</sup>, Rajkumar Dahiya<sup>2</sup>, Jagdish Ram Bhargav<sup>3</sup>, Adarsh Kumar<sup>4</sup>, Madhulika Sharma<sup>5</sup>, RK Sarin<sup>6</sup>

<sup>1</sup> PhD Student <sup>2</sup> Asst Director, <sup>3&6</sup> Director, <sup>4</sup> Professor, <sup>5</sup> Deputy Director

<sup>1,4</sup> Department of Forensic Medicine and Toxicology, AIIMS, New Delhi

<sup>2,3</sup> Forensic Science Laboratory Madhuban, Karnal, Haryana

<sup>5,6</sup> Forensic Science Laboratory, Rohini, New Delhi



### ARTICLE INFO

**Corresponding author:** Adarsh Kumar; Department of Forensic Medicine and Toxicology, AIIMS, New Delhi  
Email: [dradarshk@yahoo.com](mailto:dradarshk@yahoo.com), Tel-09868438856.

**How to Cite this article:** Yadav A, Dahiya R, Bhargav JR, Kumar A, Sharma M, Sarin RK. Aluminium Phosphide versus Zinc Phosphide Lethality – A Lurking Danger in Indian Rural Homes. *Journal of Indian Society of Toxicology* 2018;14(2):42-43. DOI: 10.31736/jist/v14.i2.2018.42-43

#### Keywords:

Aluminium Phosphide, Zinc Phosphide, grain preservative, Rodenticide, misuse

**Conflicts of Interest and Fundings:** Nil

Received on 4<sup>th</sup> June 2018

Accepted on 14<sup>th</sup> October 2018

Published on 31<sup>st</sup> December 2018

©2018 The Journal of Indian Society of Toxicology.

Published at JIPMER, Pondicherry, 605006, INDIA Subscription & payment related queries at: [toxicology@aims.amrita.edu](mailto:toxicology@aims.amrita.edu) and rest all types of queries related to the journal to be done at [drambika\\_editor@jist.org.in](mailto:drambika_editor@jist.org.in)

### ABSTRACT

India being an agricultural country the use of metal phosphides is very common specially aluminium phosphide as a grain preservative and zinc phosphide as a rodenticide. These are also misused as suicidal or homicidal poisoning agents. For this study 11 cases of alleged fatal phosphide poisoning received at AIIMS Mortuary were chosen. The rate of metabolism was observed based on the history given by relatives and Police Investigating officer during Post-mortem examination. Solubility of AIP and ZnP was analysed under control conditions on standards. The cause of death is the liberation of phosphine gas in both but mortality rate is very high in aluminium phosphide as compared to zinc phosphide because of various factors like chemical composition, solubility, rate of reaction, and other physical and chemical properties. As these are the lurking danger at rural homes in India, so awareness regarding the precautions to be taken for their use and storage need be spread.

### INTRODUCTION

Aluminium Phosphide & Zinc Phosphide are used as a grain preservative and rodenticide respectively in India. These agrochemical poisons are most commonly misused as a suicidal agent due to their cheap cost & easy availability. In these poisons death is due to liberation of phosphine gas which leaves behind non-toxic metal chlorides and hydroxides.<sup>1,2,3</sup>

#### Chemical Composition

Aluminium Phosphide (AIP) tablets are dark brown or greyish in colour and contain two compounds: aluminium phosphide and ammonium carbonate in a ratio of

56:44. Aluminium phosphide is the active component of the mixture whereas ammonium carbonate is added to prevent self-ignition of phosphine.<sup>1</sup> Zinc phosphide ( $Zn_3P_2$ ) is available as a gray black powder containing 75% of zinc phosphide and 25% of antimony potassium tartrate, an emetic to cause vomiting if the material is accidentally ingested by humans or domestic animals.<sup>1</sup>

#### Rate of Metabolism

Ingestion of aluminium and zinc phosphides results in the internal release of phosphine following contact of the phosphides with moist surfaces of the respiratory

**Table 1:** Time taken for symptoms or death to occur following inhalation of phosphine <sup>(5)</sup>

Dose		Severity of Effects
ppm	mg m-3	
7	10	No serious effects after 30-60 min
100-190	140-260	Serious effects after 30-60 min
290-430	400-600	Dangerous to life after 30-60 min
400-600	560-840	Death after 30-60 min
2000	2800	Death after 30-60 min

**Table 2 :** showing physical and Chemical properties of AlP and ZnP Discussion

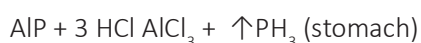
Properties	Aluminium Phosphide <sup>(4)</sup>	Zinc Phosphide <sup>(3)</sup>
Molecular weight	57.9552 g/mol	258.12 g/mol
Density	2.85 g/cm <sup>3</sup>	4.55 g/cm <sup>3</sup>
Bond Character	More Ionic bonding character	More Covalent bonding character
Rate of reaction	More solubility more rate of Reaction	Less solubility less rate of reaction
Crystal structure	Blende	Tetragonal

tract. Ingestion of zinc phosphide is less lethal as it reacts only with the acids present in the stomach which further depends on the condition of stomach i.e whether empty or full and the emetic agent present in it as additive.

Solubility: Formation of phosphine from aluminium phosphide after interaction with water occurs as follows:



Zinc phosphide is practically insoluble in water and alcohol. The following reaction releases phosphine when AlP and ZnP reacts with HCl in the body:



### Estimation of Liberated Phosphine

According to rate of reaction

1 gm of aluminium phosphide releases 0.58 gms of phosphine

1 gm of zinc phosphide releases 0.26 gms of phosphine

The cause of death is the liberation of phosphine gas in both but mortality rate is very high in aluminium phosphide as compared to zinc phosphide because of various factors like chemical composition, solubility, rate of reaction as well as other physical and chemical properties. Out of 11

cases of alleged phosphide deaths reported during 2013-15 at AIIMS Mortuary; 3 cases were of zinc phosphide and 8 were of aluminium phosphide poisoning. Symptoms usually occur within the first few hours of exposure. As per observations based on alleged history of progression of disease, deaths occurred within 12-24 hours of exposure, usually as a result of cardiovascular damage resulting in collapse, cardiac arrest and heart failure. Deaths after 24 hours are usually as a result of liver or renal failure.

### CONCLUSION

As these are the lurking danger at rural homes in India, so awareness regarding the precautions to be taken for their use and storage should be disseminated to public at large.

### REFERENCES

1. KrishanVij. Textbook of Forensic Medicine & Toxicology. Fourth edition, Elsevier publishers; 2008: 685-689.
2. Kapoor AK, Sinha US, Singh AK, Mehrotra Ravi. An epidemiological study of aluminium phosphide poisoning. Indian Int. J of For. Med & Tox. 2006;4(1):1970-73
3. Zinc phosphide available on en.m.wikipedia.org/wiki/Zinc\_phosphide assessed on 24/02/ 2018
4. Aluminium phospohide available on en.wikipedia.org/wiki/Aluminium\_phosphide assessed on 25/02/2018
5. Phosphine\_toxicological\_overview\_available at https:// assets.publishing.service.gov.uk/government/uploads/system/.. accessed on 26/10/2017