


HYDROGEN PEROXIDE (>60% SOLUTION IN WATER)**ICSC: 0164****Date of Peer****Review:****April 2000**Hydroperoxide
Hydrogen dioxide
Dihydrogen dioxideCAS # 7722-84-1 H₂O₂
RTECS # See Notes Molecular mass: 34.0
UN # 2015
EC Index # 008-003-00-9

TYPES OF HAZARD / EXPOSURE	ACUTE HAZARDS / SYMPTOMS	PREVENTION	FIRST AID / FIRE FIGHTING
FIRE	Not combustible. The substance may ignite combustible materials. Many reactions may cause fire or explosion.	NO contact with combustibles or reducing agents. NO contact with hot surfaces.	In case of fire in the surroundings: water in large amounts, water spray.
EXPLOSION	Risk of fire and explosion on contact with heat or metal catalysts.		In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
Inhalation	Sore throat. Cough. Dizziness. Headache. Nausea. Shortness of breath.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Refer for medical attention.
Skin	Corrosive. White spots. Redness. Skin burns. Pain.	Protective gloves. Protective clothing.	First rinse with plenty of water, then remove contaminated clothes and rinse again. Refer for medical attention.
Eyes	Corrosive. Redness. Pain. Blurred vision. Severe deep burns.	Safety goggles, or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Sore throat. Abdominal pain. Abdominal distension. Nausea. Vomiting.	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.
SPILLAGE DISPOSAL		PACKAGING & LABELLING	

Ventilation. Wash away spilled liquid with plenty of water. Do NOT absorb in saw-dust or other combustible absorbents. Do NOT let this chemical enter the environment. Personal protection: chemical protection suit including self-contained breathing apparatus.	Special material. EU Classification Symbol: O, C R: 5-8-20/22-35 S: (1/2-)-17-26-28-36/37/39-45 Note: [B] UN Classification UN Hazard Class: 5.1 UN Subsidiary Risks: 8 UN Pack Group: I
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EMERGENCY RESPONSE	STORAGE
Transport Emergency Card: TEC (R)-51S2015 NFPA Code: H 2; F 0; R 3; OX	Separated from combustible and reducing substances, food and feedstuffs, strong bases, metals. Cool. Keep in the dark. Store in vented containers. Store only if stabilized.

    	<p>Prepared in the context of cooperation between the International Programme on Chemical Safety and the Commission of the European Communities © IPCS, CEC 2005</p> <p>SEE IMPORTANT INFORMATION ON BACK</p>
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HYDROGEN PEROXIDE (>60% SOLUTION IN WATER)	ICSC: 0164
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IMPORTANT DATA

<p>PHYSICAL STATE; APPEARANCE: COLOURLESS LIQUID.</p> <p>CHEMICAL DANGERS: The substance decomposes on warming or under influence of light producing oxygen, which increases fire hazard. The substance is a strong oxidant and reacts violently with combustible and reducing materials causing fire and explosion hazard particularly in the presence of metals. Attacks many organic substances, e.g., textile and paper.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 1 ppm as TWA; A3 (confirmed animal carcinogen with unknown relevance to humans); (ACGIH 2004). MAK: 0.5 ppm, 7.1 mg/m³; Peak limitation category: I(1); Carcinogen category: 4; Pregnancy risk group: C; (DFG 2005).</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its vapour and by ingestion.</p> <p>INHALATION RISK: A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance is corrosive to the eyes and the skin. The vapour is irritating to the respiratory tract. Ingestion of this substance may produce oxygen bubbles (embolism) in the blood, resulting in shock.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Lungs may be affected by inhalation of high concentrations. The substance may have effects on the hair, resulting in bleaching.</p>
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PHYSICAL PROPERTIES

<p>Boiling point: 141°C (90%), 125°C (70%) Melting point: -11°C (90%), -39°C (70%) Relative density (water = 1): 1.4 (90%), 1.3 (70%) Solubility in water: miscible</p>	<p>Relative density of the vapour/air-mixture at 20°C (air = 1): 1.0 Octanol/water partition coefficient as log Pow: -1.36</p>
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Vapour pressure, kPa at 20°C: 0.2 (90%), 0.1 (70%) Relative vapour density (air = 1): 1	
ENVIRONMENTAL DATA	
The substance is toxic to aquatic organisms.	
NOTES	
Rinse contaminated clothes (fire hazard) with plenty of water. RTECS MX900000 refers to >90% solution; MX0887000 refers to >30% solution. Other UN numbers: 2014 (hydrogen peroxide, aqueous solution 20-60%): hazard class 5.1, subsidiary hazard 8, pack group II; 2984 (hydrogen peroxide, aqueous solution 8-20%): hazard class 5.1, pack group III. Card has been partly updated in October 2004 and 2005. See sections Occupational Exposure Limits, EU classification, Emergency Response.	
ADDITIONAL INFORMATION	
LEGAL NOTICE Neither the CEC nor the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information	
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Hydrogen peroxide

International Programme on Chemical Safety
Poisons Information Monograph 946
Chemical

This Monograph contain the following sections completed: 1, 2, 3, 4.1, 7.2, 9 & 10.

1. NAME

1.1 Substance

Hydrogen peroxide

1.2 Group

Oxygen and compounds
Peroxide

1.3 Synonyms

Albone; Albone 35;
Albone 35CG; Albone 50;
Albone 50CG; Albone 70;
Albone 70CG; Dihydrogen dioxide;
Hioxyl; Hydrogen dioxide;
Hydroperoxide; Inhibine;
Interox; Kastone; Oxydol;
Perhydrol; Perone;
Perone 30; Perone 35;
Perone 50; Perossido di idrogeno;
Peroxan; Peroxide;
Peroxyde d'hydrogene; Superoxol;
T-Stuff; Wasserstoffperoxid;
Waterstofperoxyde

1.4 Identification numbers

1.4.1 CAS number

7722-84-1

1.4.2 Other numbers

UN2014 (DOT)
UN2015 (DOT)
UN2984 (DOT)

NIOSH/rtecs: MX0900000

1.5 Main brand names, main trade names

1.6 Main manufacturers, main importers

2. SUMMARY

2.1 Main risks and target organs

The dissociation of hydrogen peroxide is a violent and

exothermic reaction. Ingestion results in gastrointestinal irritation, the severity of which depends on the concentration of the solution. There is also a risk of gas embolism. A number of deaths have been reported in the literature. In most cases the exposures were to concentrated solutions of 30 to 40%.

Ingestion of the more concentrated solutions (>10%, but particularly 30 to 40% and above) should be regarded as serious because of the risk of more severe irritation. The risk of gas embolism is probably also increased with the concentrated solutions, although a large quantity of a dilute solution may also produce embolism. Death may occur within minutes of ingestion.

2.2 Summary of clinical effects

Ingestion: These effects may occur with solutions of 3% but usually only where a large quantity has been ingested, effects are generally more severe if a concentrated solution has been ingested.

Vomiting (the vomitus may be frothy due to the liberation of oxygen - risk of aspiration), haematemesis, 'burning' throat and gastric distension (due to the release of oxygen). Lethargy, coma, convulsions, shock, and respiratory arrest have been reported. Gastrointestinal bleeding and burns to the stomach and duodenum may occur. These are usually not severe and resolve with symptomatic treatment.

Gas embolism has been reported in adults and children. In severe cases ischaemic ECG changes and EMD (electromechanical dissociation) may be observed because of embolisation of the heart restricting blood flow.

Inhalation: Transient dyspnoea and cough, with concentrated solutions there may be more severe irritation and inflammation of the respiratory tract

Dermal: Irritant to the skin with paraesthesia, blistering and whitening; solutions >10% may cause burns. Bleaching of the skin usually resolved within a few hours.

Ocular: Irritation with a burning sensation, conjunctival hyperaemia, lacrimation and severe pain which resolves within a few hours. With more concentrated solutions effects may take up to 24 hours to resolve. There are rare cases of temporary corneal injury resulting from application of 3% solution to the eye (on contact lenses) including punctate staining of the cornea, decreased vision, corneal opacity and oedema.

Intravenous: vomiting, pain at injection site, ventricular fibrillation, embolism of heart and lung tissue, haemolytic anaemia, renal failure and death.

Rectal: rectal bleeding, nausea, distension and difficulty urinating.

2.3 Diagnosis

Gastrointestinal (GI) irritation possibly accompanied by vomiting of frothy material and gas embolism can help the diagnosis if the exposure is not known. Whitening of the skin and mucous membranes and pain may be signs of exposure.

2.4 First aid measures and management principles

Ingestion: Gastric decontamination is not worthwhile for ingestion of hydrogen peroxide due to its rapid dissociation. Asymptomatic patients who have ingested only a small quantity of low concentrated solutions (3 to 6%) probably do not require treatment. Any patient with haematemesis, abdominal discomfort, persistent vomiting, central nervous system (CNS) or respiratory effects must be admitted.

Treatment is supportive. If gastric distension is severe a fine bore gastric tube may be passed to aid the release of gas. Endoscopy should be considered in patients with haematemesis or persistent vomiting or if the solution was >10%.

Patients with severe clinical effects require abdominal and chest X-rays. The Trendelenburg positioning (head down, elevated foot of bed) should be avoided since this may trap air in the apex of the right ventricle and cause obstruction of the blood flow. Monitor the ECG in severe cases. Ventilation may be required in patient with severe respiratory effects.

Hyperbaric oxygen therapy has been suggested for patients with evidence of cerebral embolism due to hydrogen peroxide.

Inhalation: remove from exposure; supportive care should be given.

Dermal: irrigate thoroughly with saline or water and treat symptomatically.

Ocular: irrigate thoroughly with running water or saline for 15 minutes. Refer to an ophthalmologist.

Intravenous: monitor ECG and check renal function. Perform X-rays.

Rectal: give supportive care; parenteral (then oral) steroids may be of benefit. Sigmoidoscopy is recommended to determine the extent of the injury.

3. PHYSICO-CHEMICAL PROPERTIES

3.1 Origin of the substance

3.2 Chemical structure

Chemical formula: H_2O_2
Molecular mass: 34

3.3 Physical properties

3.3.1 Colour

Colourless

3.3.2 State/Form

Liquid

3.3.3 Description

Hydrogen peroxide is an odourless liquid with a bitter taste; it is an oxidising agent which in the presence of organic matter or if permitted to become alkaline vigorously decomposes to oxygen and water. The strength of a solution may be described as a percentage or volume, where 1% hydrogen peroxide releases 3.3 volumes of oxygen during decomposition. Thus, a 3% solution is equivalent to 10 volume and a 6% solution to 20 volume, etc.

Boiling point: 115 to 157°C

Melting point: <50°C

Relative density (water = 1): 1.3

Solubility in water: Miscible

Vapour pressure, kPa at 30°C: 0.7

Relative vapour density (air = 1): 1.2

Relative density of the vapour/air-mixture at 20°C

(air = 1): 1.06

3.4 Hazardous characteristics

Hydrogen peroxide decomposes on warming producing oxygen which increases fire hazard. The substance is a strong oxidant and reacts violently with combustible and reducing materials causing fire and explosion hazard particularly in the presence of metals. Hydrogen peroxide attacks many organic substances, e.g. textile and paper.

4. USES

4.1 Uses

4.1.1 Uses

4.1.2 Description

Hydrogen peroxide is used as a 6% solution for bleaching hair and some disinfectant solutions for contact lenses contain 3% hydrogen peroxide. Chlorine free bleaches contain 6% hydrogen peroxide. Some newer fabric stain removers/bleaches contain 5 to 15% hydrogen peroxide. Industrial strengths of hydrogen peroxide are manufactured up to 90%. They are used mainly as bleaching and oxidising agents. Solutions of 90% are used as rocket fuel.

Hydrogen peroxide (35%) is also sold as a health aid for so-called 'hyperoxygenation therapy' for

everything from arthritis to AIDS and cancer. It is kept refrigerated, diluted for use, and taken regularly (Leikin et al., 1993).

4.2 High risk circumstance of poisoning

4.3 Occupationally exposed populations

5. ROUTES OF EXPOSURE

5.1 Oral

Common route of exposure.

5.2 Inhalation

Hydrogen peroxide can be inhaled.

5.3 Dermal

Hydrogen peroxide is irritant to the skin.

5.4 Eye

Ocular exposure results in irritation with a burning sensation.

5.5 Parenteral

Intravenous injection of hydrogen peroxide has been reported.

5.6 Other

Rectal exposure is possible.

6. KINETICS

6.1 Absorption by route of exposure

6.2 Distribution by route of exposure

6.3 Biological half-life by route of exposure

6.4 Metabolism

6.5 Elimination and excretion

7. TOXICOLOGY

7.1 Mode of action

7.2 Toxicity

7.2.1 Human data

7.2.1.1 Adults

The dissociation of hydrogen peroxide is a violent and exothermic reaction. Ingestion results in gastrointestinal irritation, the severity of

which depends on the concentration of the solution. There is also a risk of gas embolism. A number of deaths have been reported in the literature. In most cases the exposures were to concentrated solutions of 30 to 40%.

Ingestion of the more concentrated solutions (>10%, but particularly 30 to 40% and above) should be regarded as serious because of the risk of more severe irritation. The risk of gas embolism is probably also increased with the concentrated solutions, although a large quantity of a dilute solution may also produce embolism (Cina et al., 1994). Death may occur within minutes of ingestion (Dickson and Caravati, 1994).

Most cases of ingestion of hydrogen peroxide result in only mild effects. Of 270 cases of hydrogen peroxide ingestion in one study only 24% required medical referral (Dickson and Caravati, 1994).

Cerebral infarction, believed to have resulted from gas embolisation of the cerebral vasculature, has been reported in an 84 year old man who took 30 ml of 35% hydrogen peroxide diluted in 100 to 300 mL of water (Sherman et al., 1994). Multiple brain embolism occurred in a 63 year old who ingested 120mL of 35% solution. He recovered (Ijichi et al., 1997).

Fatal doses:

Ingestion:

Ingestion of 240 mL of 35% hydrogen peroxide in a 49 year old female caused death in 78 hours later (Litovitz et al., 1995).

Intravenous:

0.8mL of a 35% solution diluted in 200mL normal saline (0.14% of hydrogen peroxide) once daily for 5 days in a 50 year old male (Leikin et al., 1993).

2mL (strength unknown) in a dialysis catheter caused abdominal pain, hypertension, collapse and coma within 1 hour. She made some improvement with hyperbaric oxygen by the 8th day, then had a cardiac arrest and convulsions. She recovered in the following week and then had another cardiac arrest and died 19 days post-injection (Litovitz et al., 1997).

7.2.1.2 Children

Fatal doses:

Ingestion:

225 mL of 3% in a 16 month old, he was found dead 10 hours later (Cina et al., 1994). About 100 to 170 mL of 35% in a 2 year old, taken off life-support 4 days later with hypoxic encephalopathy (Christensen et al., 1992).

Intravenous:
100mL of 3% hydrogen peroxide in a 7 month old child (Lubec et al., 1996).

- 7.2.2 Relevant animal data
- 7.2.3 Relevant in vitro data
- 7.2.4 Workplace standards
- 7.2.5 Acceptable daily intake (ADI)

7.3 Carcinogenicity

7.4 Teratogenicity

7.5 Mutagenicity

7.6 Interactions

8. TOXICOLOGICAL ANALYSES AND BIOMEDICAL INVESTIGATIONS

8.1 Material sampling plan

- 8.1.1 Sampling and specimen collection
 - 8.1.1.1 Toxicological analyses
 - 8.1.1.2 Biomedical analyses
 - 8.1.1.3 Arterial blood gas analysis
 - 8.1.1.4 Haematological analyses
 - 8.1.1.5 Other (unspecified) analyses
- 8.1.2 Storage of laboratory samples and specimens
 - 8.1.2.1 Toxicological analyses
 - 8.1.2.2 Biomedical analyses
 - 8.1.2.3 Arterial blood gas analysis
 - 8.1.2.4 Haematological analyses
 - 8.1.2.5 Other (unspecified) analyses
- 8.1.3 Transport of laboratory samples and specimens
 - 8.1.3.1 Toxicological analyses
 - 8.1.3.2 Biomedical analyses

- 8.1.3.3 Arterial blood gas analysis
- 8.1.3.4 Haematological analyses
- 8.1.3.5 Other (unspecified) analyses

8.2 Toxicological Analyses and Their Interpretation

- 8.2.1 Tests on toxic ingredient(s) of material
 - 8.2.1.1 Simple Qualitative Test(s)
 - 8.2.1.2 Advanced Qualitative Confirmation Test(s)
 - 8.2.1.3 Simple Quantitative Method(s)
 - 8.2.1.4 Advanced Quantitative Method(s)
- 8.2.2 Tests for biological specimens
 - 8.2.2.1 Simple Qualitative Test(s)
 - 8.2.2.2 Advanced Qualitative Confirmation Test(s)
 - 8.2.2.3 Simple Quantitative Method(s)
 - 8.2.2.4 Advanced Quantitative Method(s)
 - 8.2.2.5 Other Dedicated Method(s)
- 8.2.3 Interpretation of toxicological analyses

8.3 Biomedical investigations and their interpretation

- 8.3.1 Biochemical analysis
 - 8.3.1.1 Blood, plasma or serum
 - "Basic analyses"
 - "Dedicated analyses"
 - "Optional analyses"
 - 8.3.1.2 Urine
 - "Basic analyses"
 - "Dedicated analyses"
 - "Optional analyses"
 - 8.3.1.3 Other fluids
- 8.3.2 Arterial blood gas analyses
- 8.3.3 Haematological analyses
 - "Basic analyses"
 - "Dedicated analyses"
 - "Optional analyses"
- 8.3.4 Interpretation of biomedical investigations

8.4 Other biomedical (diagnostic) investigations and their interpretation

8.5 Overall interpretation of all toxicological analyses and

toxicological investigations

8.6 References

9. CLINICAL EFFECTS

9.1 Acute poisoning

9.1.1 Ingestion

These effects may occur with solutions of 3% but usually only where a large quantity has been ingested, effects are generally more severe if a concentrated solution has been ingested.

Vomiting (the vomitus may be frothy due to the liberation of oxygen - risk of aspiration), haematemesis, 'burning' throat and gastric distension (due to the release of oxygen). Lethargy, coma, convulsions, shock, and respiratory arrest have been reported (Giberson et al., 1989). Gastrointestinal bleeding and burns to the stomach and duodenum may occur. These are usually not severe and resolve with symptomatic treatment.

Gas embolism has been reported in adults (Luu et al., 1992) and children (Cina et al., 1994; Christensen et al., 1992; Litovitz et al., 1991; Rackoff and Merton, 1990). In severe cases ischaemic ECG changes and EMD (electromechanical dissociation) may be observed because of embolisation of the heart restricting blood flow (Christensen et al., 1992).

Cerebral infarction, believed to have resulted from gas embolisation of the cerebral vasculature, has been reported in an 84 year old man who took 30 mL of 35% hydrogen peroxide diluted in 100 to 300 mL of water (Sherman et al., 1994). Multiple brain embolism occurred in a 63 year old who ingested 120mL of 35% solution. He recovered (Ijichi et al., 1997).

9.1.2 Inhalation

Transient dyspnoea and cough, with concentrated solutions there may be more severe irritation and inflammation of the respiratory tract.

9.1.3 Skin exposure

Irritant to the skin with paraesthesia, blistering and whitening; solutions >10% may cause burns. Bleaching of the skin usually resolved within a few hours.

9.1.4 Eye contact

Irritation with a burning sensation, conjunctival hyperaemia, lacrimation and severe pain which resolves within a few hours, with more concentrated solutions effects may take up to 24 hours

to resolve. There are rare cases of temporary corneal injury resulting from application of 3% solution to the eye (on contact lenses) including punctuate staining of the cornea, decreased vision, corneal opacity and oedema. Historically 1 to 3% solutions were applied to the eye as an antibacterial agent.

9.1.5 Parenteral exposure

Intravenous: vomiting, pain at injection site, ventricular fibrillation, embolism of heart and lung tissue, haemolytic anaemia, renal failure and death.

9.1.6 Other

Rectal: rectal bleeding, nausea, distension and difficulty urinating (Dickson and Caravati, 1994).

9.2 Chronic poisoning

9.2.1 Ingestion

9.2.2 Inhalation

9.2.3 Skin exposure

9.2.4 Eye contact

9.2.5 Parenteral exposure

9.2.6 Other

9.3 Course, prognosis, cause of death

9.4 Systematic description of clinical effects

9.4.1 Cardiovascular

9.4.2 Respiratory

9.4.3 Neurological

9.4.3.1 Central nervous system (CNS)

9.4.3.2 Peripheral nervous system

9.4.3.3 Autonomic nervous system

9.4.3.4 Skeletal and smooth muscle

9.4.4 Gastrointestinal

9.4.5 Hepatic

9.4.6 Urinary

9.4.6.1 Renal

9.4.6.2 Other

9.4.7 Endocrine and reproductive systems

- 9.4.8 Dermatological
- 9.4.9 Eye, ear, nose, throat: local effects
- 9.4.10 Haematological
- 9.4.11 Immunological
- 9.4.12 Metabolic
 - 9.4.12.1 Acid-base disturbances
 - 9.4.12.2 Fluid and electrolyte disturbances
 - 9.4.12.3 Others
- 9.4.13 Allergic reactions
- 9.4.14 Other clinical effects
- 9.4.15 Special risks

9.5 Other

9.6 Summary

10. MANAGEMENT

10.1 General principles

Ingestion: Gastric decontamination is not worthwhile for ingestion of hydrogen peroxide due to its rapid dissociation. Asymptomatic patients who have ingested only a small quantity of low concentrated solutions (3-6%) probably do not require treatment. Any patient with haematemesis, abdominal discomfort, persistent vomiting, central nervous system (CNS) or respiratory effects must be admitted.

Treatment is supportive, if gastric distension is severe a fine bore gastric tube may be passed to aid the release of gas. Endoscopy should be considered in patients with haematemesis or persistent vomiting or if the solution was >10%.

Patients with severe clinical effects require abdominal and chest X-rays. The Trendelenburg positioning (head down, elevated foot of bed) should be avoided since this may trap air in the apex of the right ventricle and cause obstruction of the blood flow (Henry et al., 1996). Monitor the ECG in severe cases. Ventilation may be required in patient with severe respiratory effects.

Hyperbaric oxygen therapy has been suggested for patients with evidence of cerebral embolism due to hydrogen peroxide (Sherman et al., 1994).

Inhalation: remove from exposure, supportive care

Dermal: Irrigate thoroughly with saline or water and treat symptomatically.

Ocular: Irrigate thoroughly with running water or saline for 15 minutes. Refer to an ophthalmologist.

Intravenous: monitor ECG and check renal function. Perform X-rays.

Rectal: supportive care, parenteral (then oral) steroids may be of benefit. Sigmoidoscopy is recommended to determine the extent of the injury (Dickson and Caravati, 1994).

10.2 Life supportive procedures and symptomatic/specific treatment

See section 10.1

10.3 Decontamination

Gastric decontamination is not worthwhile for ingestion of hydrogen peroxide due to its rapid dissociation.

10.4 Enhanced elimination

See section 10.1

10.5 Antidote treatment

10.5.1 Adults

No antidote available.

10.5.2 Children

No antidote available.

10.6 Management discussion

See section 10.1

11. ILLUSTRATIVE CASES

11.1 Case reports from literature

12. Additional information

12.1 Specific preventive measures

12.2 Other

13. REFERENCES

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