



Summary of findings from toxicological report and suggested action levels; public health perspective; critical data needs

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TOXICOLOGICAL SUMMARY AND SUGGESTED ACTION LEVELS TO REDUCE POTENTIAL ADVERSE HEALTH EFFECTS OF SIX CYANOTOXINS

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Cyanotoxins Reviewed*

- **Microcystins** –LR (–RR, –YR and –LA)
 - **Liver toxin:** causes liver damage/failure.
 - Human cases: 76 mortalities from i.v. exposure
 - Animal cases: high mortality from oral exposure
 - MC-LR is a possible tumor promoter in humans
 - Stable in the environment
 - **Produced by:** cyanobacterial species of several genera, e.g., *Microcystis*, *Anabaena*, and *Planktothrix* (*Oscillatoria*)

*Literature through 2008 reviewed with few exceptions

Cyanotoxins Reviewed*

- **Anatoxin-a**
- **Neurotoxin:** causes convulsions and rapid death by respiratory paralysis.
 - Human cases: not documented
 - Animal cases: high mortality from oral exposure
 - Relatively stable in the environment
- **Produced by:** cyanobacterial species of several genera, e.g., *Anabaena*, *Planktothrix* (*Oscillatoria*), *Aphanizomenon*

*Literature through 2008 reviewed with few exceptions

Cyanotoxins Reviewed*

- **Cylindrospermopsin**

- **Liver and kidney toxin:** causes liver and kidney damage/failure.
 - Human cases: poisonings from drinking water
 - Animal cases: mortality from oral exposure
 - Stable in the environment
- **Produced by:** cyanobacterial species of several genera, e.g., *Cylindrospermopsis*, *Aphanizomenon*, *Raphidiopsis*, *Anabaena*

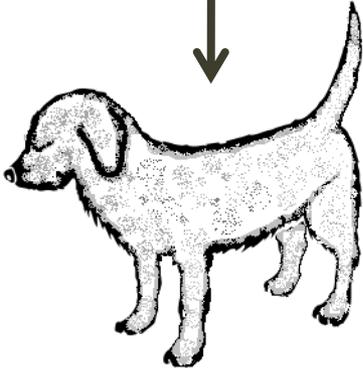
*Literature through 2008 reviewed with few exceptions

Overview of the Process

Reference Dose
Maximum recommended dose

Exposure
Amount of media consumed (e.g., water)

Action Level
Health-protective chemical concentration in media (e.g., mg/L)



Reference Dose

The Reference Dose (RfD): level of exposure over a given time period that is not expected to cause any adverse effects

1. Identify the best dose-response study
2. Identify a dose that effects very few test animals
3. Translate that animal dose to humans and domestic animals using Uncertainty Factors

Uncertainty Factors

$$\text{RfD} = \text{“No Effect Level”} \div \text{UF}$$

Human cumulative UF of 1000: “mouse to man” (10); sensitive people (10); incomplete data (10)

Domestic Animal UF of 100 (acute) to 10 (subchronic): interspecies extrapolation; incomplete data; severity of endpoint (acute)

Domestic Animal *exposure* UF of 3 was also applied due to the preferential consumption of cyanobacteria. In this case, estimated exposure was multiplied by 3

Exposure Scenarios

- Humans swimming
 - *Does not apply to drinking water*
- Human consumption of sport fish and shellfish
- Dogs & cattle drinking from natural/impounded waters
- Dogs & cattle consumption of crusts or mats

Action Levels

Health-protective chemical concentrations in the exposure media that should result in chemical intake below or equal to the RfDs.

- Algebraic relationship between concentration in exposure media and chemical dose, for example:

$$\frac{\text{Rec. water conc. (mg/L)} *}{\text{Swimmer dose (mg/kg} \cdot \text{d)}} \times \text{RfD (mg/kg} \cdot \text{d)} = \text{Action level (mg/L)}$$

**Set equal to 1 to solve*

- Risk management tool; Not criteria or regulation

Action Levels for Humans

Subchronic Exposure

	MCs ¹	ANA-a	CYN	Media (units)
Recreational Uses ²	0.8	90	4	Water (µg/L)
Sport Fish Consumption	10	5000	70	Fish (ng/g) ww ³

¹ Includes microcystins LA, LR, RR, and YR

² Not for drinking water

³ Wet weight or fresh weight

Action Levels for Dogs & Cattle

Subchronic and **Acute** Exposure

	MCs ¹	ANA-a	CYN	Media (units)
Dogs Water Intake	2	100	10	Water (µg/L)
	100	100	200	
Cattle Water Intake	0.9	40	5	Water (µg/L)
	50	40	60	
Dogs Crusts & Mats	0.01	0.3	0.04	Crusts/Mats (mg/kg) dw ²
	0.5	0.3	0.5	
Cattle Crusts & Mats	0.1	3	0.4	Crusts/Mats (mg/kg) dw ²
	5	3	5	

¹ Includes MCs LA, LR, RR, and YR; ² Dry sample weight

Limiting Subchronic Action Levels for Recreational Waters

	MCs ¹	ANA-a	CYN	Media (units)
Human Swimming	0.8	90	4	Water (µg/L)
Dog Drinking	2	100	10	Water (µg/L)
Cattle Drinking	0.9	40	5	Water (µg/L)

¹ Includes microcystins LA, LR, RR, and YR

Public Health Perspective

- Who can the public contact for clear answers?
- Effective risk communication
- Protection of animals (highest exposure group)
- Address practice of pumping bloom water for use in farming and ranching
- Non-contact water recreational scenarios
- Drinking water
- Educate doctors/vets of signs and symptoms

Critical Data Needs

- Toxicological data on other cyanotoxins, e.g., saxitoxin, anatoxin-a(s), MC analogs, lyngbyatoxin
- Exposure data for non-contact water recreation
- MC concentrations in sportfish and shellfish
- Measurement standards for cyanotoxins
- Database of California poisonings (dogs, livestock, wildlife)
- Effects on aquatic species and wildlife

