

정치하는 엄마들



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**LIFE
ENVIRONMENT
HEALTH**





우리나라 강과 호수는?





자연현상

사람
활동

기후변화

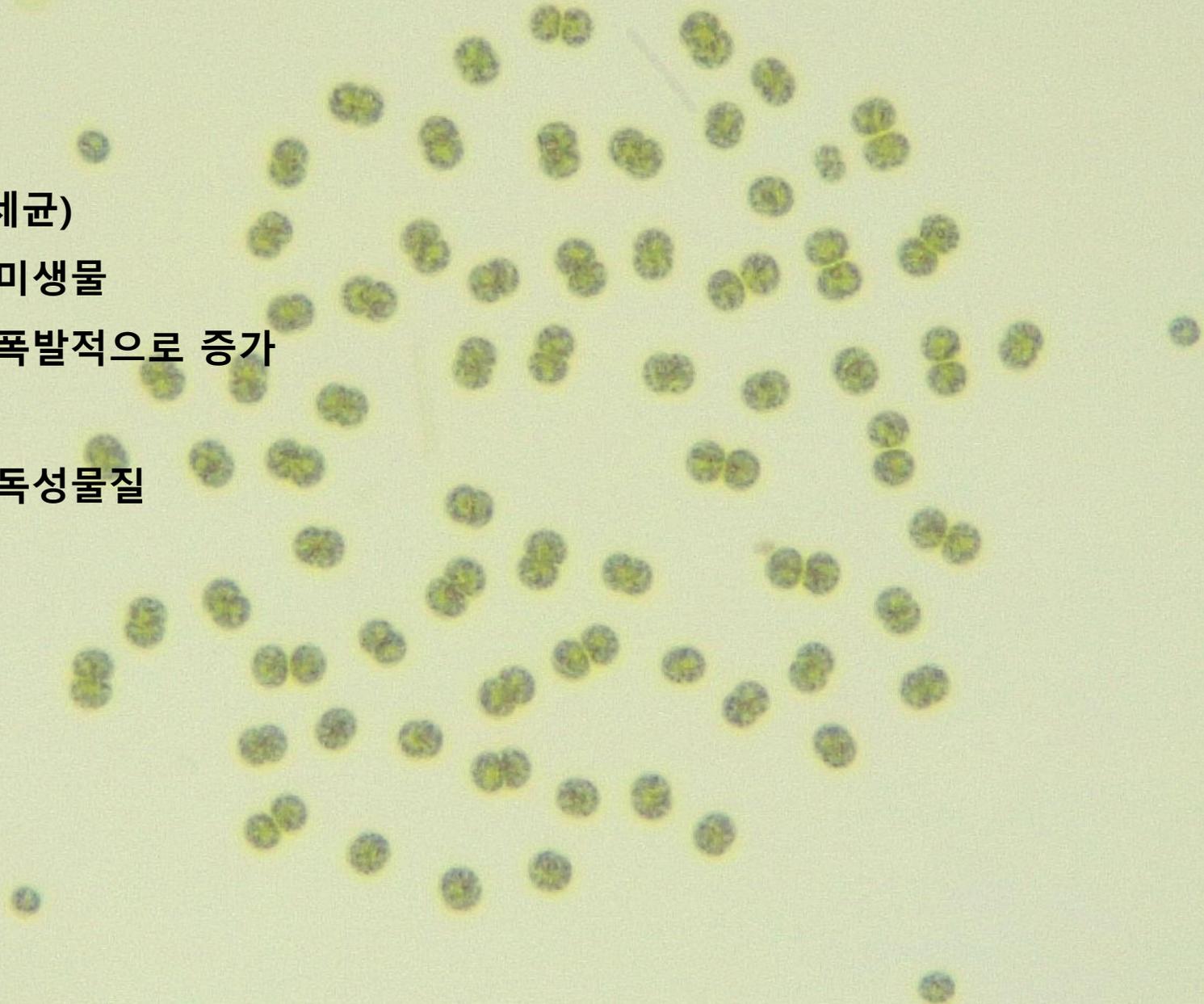
녹조

Part 1.

녹조란?

녹조

- Cyanobacteria (남세균)
 - 광합성 가능한 미생물
- 남세균의 세포수가 폭발적으로 증가
 - 녹조
- 남세균이 생성하는 독성물질
 - Cyanotoxins



ALGAE BLOOM INGREDIENTS

Some Increasing With Climate Change



MORE HEAVY PRECIPITATION

Washes additional
nutrients into waters

녹조의 원인 - 환경오염

부영양화: 담수에서 N:P 비율이 중요

기후변화: CO2 상승, pH 변화, 온도↑, 강수량, 염류↑

수계변화: 정체, 수량, 생태계

WARMING WATER

Favors growth of
some types of
toxic algae

미국 이리호 - 녹조



유해 Cyanobacteria

■ 독성물질을 생성하는 cyanobacteria

- Cyanotoxin
- 각 cyanobacteria 마다 생성하는 물질의 종류와 양이 다름
- 대략 30종

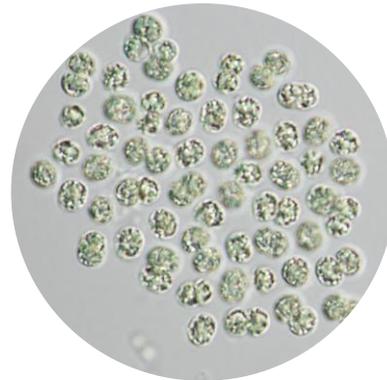


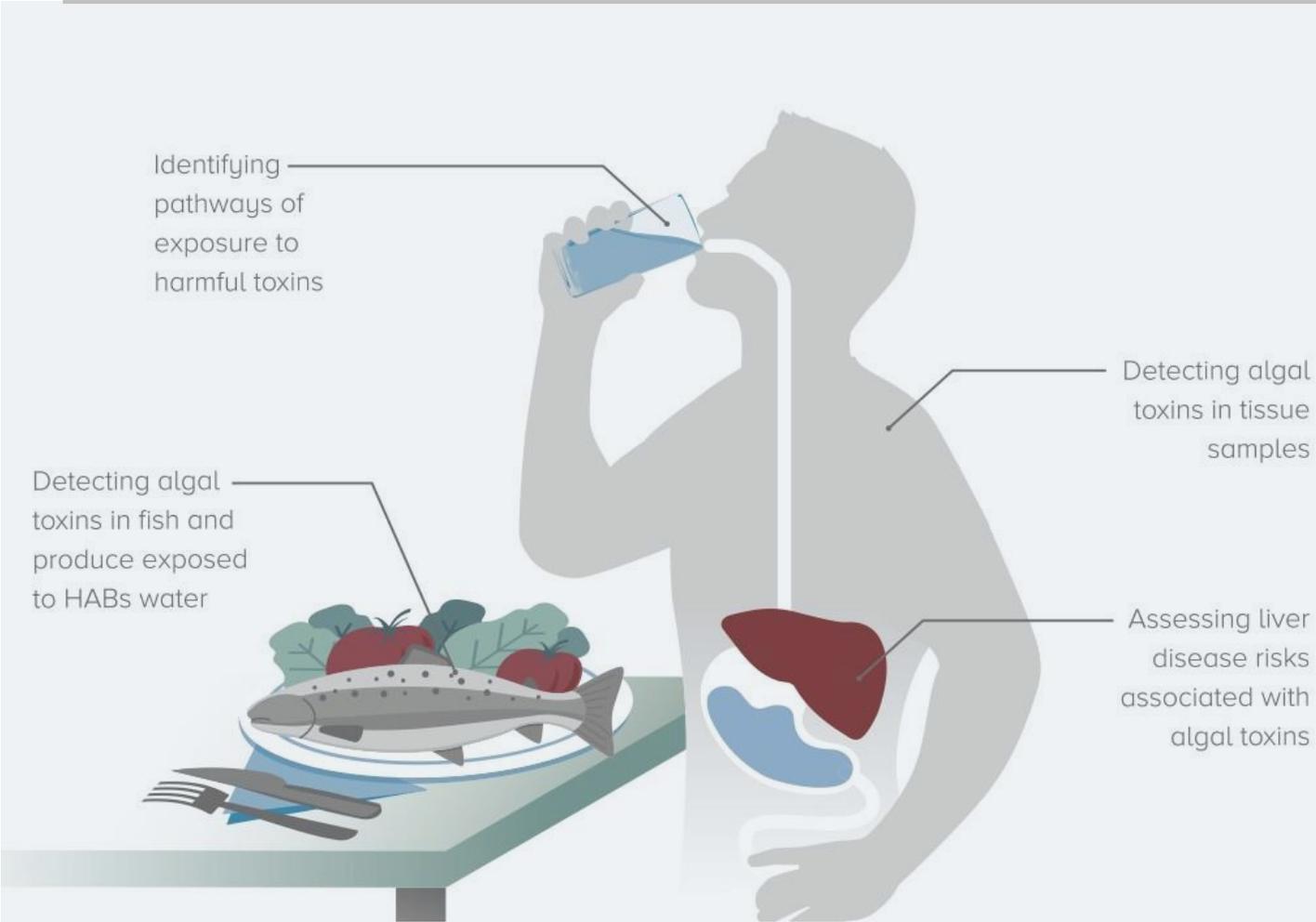
Table 1. Cyanotoxin Production Observed Across Cyanobacterial Genera **Microcystin**

Cyanobacterial Genera	ATX	CYN	MC	NOD	STX	References
<i>Anabaenopsis</i>			X			232
<i>Aphanizomenon</i>	X	X	X		X	115
<i>Chroosporum</i>		X				89,112
<i>Cylindrospermopsis</i>	X	X			X	92,97,233
<i>Cylindrospermum</i>	X		X		X	234
<i>Dolichospermum</i> (ex <i>Anabaena</i>)	X	X	X		X	81,235,236
<i>Fischerella</i>			X			232
<i>Geitlerinema</i>					X	234
<i>Gloeotrichia</i>			X			25
<i>Haplosiphon</i>			X			25
<i>Lyngbya</i>		X			X	96,237,238
<i>Microcystis</i>			X			83,131
<i>Nodularia</i>				X		239,240
<i>Nostoc</i>	X		X	X		82,241,242
<i>Oscillatoria</i>	X	X	X		X	243,244
<i>Phormidium</i>	X		X			82,241,245
<i>Planktothrix</i>	X		X			23,246
<i>Radiocystis</i>			X			25
<i>Raphidiopsis</i>	X	X	X			247
<i>Scytonema</i>			X		X	232
<i>Umezakia</i>		X	X			248

Cyanotoxins

Toxin	Short term health effects	Long term health effects
Microcystins	Gastrointestinal, liver inflammation, and hemorrhage and liver failure leading to death, pneumonia, dermatitis	Tumor promoter, liver failure leading to death
Nodularins	Similar to Microcystins	Similar to microcystins
Saxitoxins	Tingling, burning, numbness, drowsiness, incoherent speech, respiratory paralysis leading to death	Unknown
Anatoxins	Tingling, burning, numbness, drowsiness, incoherent speech, respiratory paralysis leading to death	Cardiac arrhythmia leading to death
Cylindrospermopsin	Gastrointestinal, liver inflammation and hemorrhage, pneumonia, dermatitis	Malaise, anorexia, liver failure leading to death
Lipopolysaccharide	Gastrointestinal, dermatitis	Unknown
Lyngbyatoxins	Dermatitis	Skin tumors
BMAA	Unknown	Potential link to neurodegenerative diseases

Cyanotoxin의 유입경로



Way of exposure	Kind of exposure
Skin contact	Toxic scum or mat material
	Raw water containing toxic blooms or free toxins
Drinking water	Treated water containing toxic blooms or free toxins
	Accidental ingestion of toxic scum
	Raw water containing toxic blooms or free toxins
Inhalation	Treated water containing toxic blooms or free toxins
	Toxins during water-sports, showering or work practices
Food consumption	Shellfish or finfish if containing toxins
	Plant products if containing toxins
Haemodialysis	Using water containing free toxins

마이크로시스틴 (Microcystin)

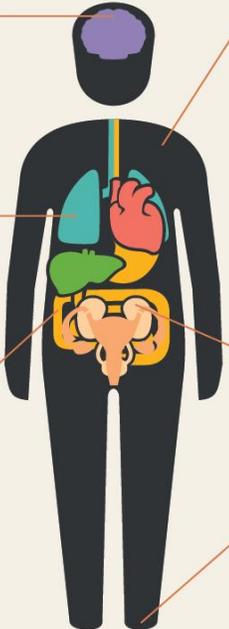
- 물과 매우 친한 화학물질
- 300°C이상에서 분해
- 급성
 - 몸살, 감기, 복통, 구토, 알러지
- 만성
 - 간염증, 간비대, 간암
 - 기타: 폐, 신경계, 생식에 영향



Health Impacts of Cyanotoxins

Note: Not all cyanotoxins lead to all of these health impacts. These listed impacts are caused by microcystins or cylindrospermopsin, the two cyanotoxins that EPA has issued Health Advisories for.

IN HUMANS



Brain
Source: Ingestion
Symptoms:

- Headache
- Incoherent speech
- Drowsiness
- Loss of coordination

Respiratory System
Source: Inhalation
Symptoms:

- Dry cough
- Pneumonia
- Sore throat
- Shortness of breath
- Loss of coordination

Digestive System
Source: Ingestion, drinking contaminated water, or eating contaminated fish
Symptoms:

- Abdominal pain
- Nausea
- Vomiting
- Diarrhea
- Stomach cramps

Body
Source: Contact, e.g. swimming
Symptoms:

- Irritation in eyes, nose, and throat
- Blistering around the mouth
- Skin rash, including tingling, burning and numbness
- Fever
- Muscle aches (from ingestion)
- Weakness (from ingestion)

Organs
Source: Ingestion
Symptoms:

- Kidney damage
- Abnormal kidney function
- Liver inflammation

Nervous System
Source: Ingestion
Symptoms:

- Tingling
- Burning
- Numbness

IN PETS

Symptoms:

- Vomiting
- Fatigue
- Shortness of breath
- Difficulty breathing
- Coughing
- Convulsions
- Liver failure
- Respiratory paralysis leading to death



WHO microcystin 가이드라인

- **Microcystins**

- 음용수: 12 $\mu\text{g}/\text{L}$ (단기), 1 $\mu\text{g}/\text{L}$ (장기)
- 레저: 24 $\mu\text{g}/\text{L}$



World Health
Organization

우리나라 강의 7~8월 Microcystin 농도

#	장소	M C 농도 (ppb, µg/L)						평균	최소	최대
		7/28	7/30	8/4	8/6	8/11	8/13			
1	강정 고령보 상류	139.31	157.89	238.01	0.27	170.17	-	141.13	0.27	238.01
2	화원 유원지 부근	228.31	20.58	5.63	714.97	40.84	-	202.07	5.63	714.97
3	고령교	111.39	65.60	29.41	5.00	246.46	154.11	102.00	5.00	246.46
4	도동서원	28.46	23.76	88.88	3.48	117.98	982.41	207.50	3.48	982.41
5	이노정	-	-	-	-	972.68	-			972.68
6	국가산단취수구	428.92	201.15	30.39	4914.39	-	886.88	1292.35	30.39	4914.39
7	고령 연리들 지하관정	불검출	불검출	불검출	불검출	불검출	-			
8	고령 연리들 논	-	1.08	-	-	-	-			1.08
9	이방 양수장	0.21	0.60	1.00	-	-	-	0.60	0.21	1.00
10	합천창녕보 상류	1.19	1.26	1.07	555.68	4.90	123	94.22	1.07	555.68
11	창녕함안보 상류	774.54	362.49	1200.98	4226.41	272.53	3.77	1140.12	3.77	4226.41
12	본포취수장	682.01	8.20	1555.32	80.55	0.24	657.36	497.28	0.24	1555.32

#	장소	날짜	M C 농도 (ppb, µg/L)
13	영주댐 용각교 아래	8/12	0.62
14	영주댐 상류	8/12	20.91
15	상주보 선착장	8/12	5.84
16	낙단보 상류	8/12	-
17	구미보 상류	8/12	632.87
18	송선대교	8/17	불검출
19	해평취수구 앞	8/12	60.07
20	칠곡보 상류	8/12	재측정
21	성주대교	8/11	0.11

22	문산취수장	8/11	35.30
23	매곡취수장	8/11	435.50
24	남지철교 상류	8/17	불검출
25	칠서취수장	8/9	2.23
		8/17	8.25
26	물금매리 감노리	8/17	3.52
27	물금취수장	8/12	8.17
28	[금강] 용두양수장	8/12	1509.17
29	[금강] 옹포대교 수상스키장	8/12	1562.10
30	[금강] 어부 배터 선착장	8/12	2362.43







미국 Cyanotoxin 음용수 가이드라인

■ 미국 EPA 및 오하이오주

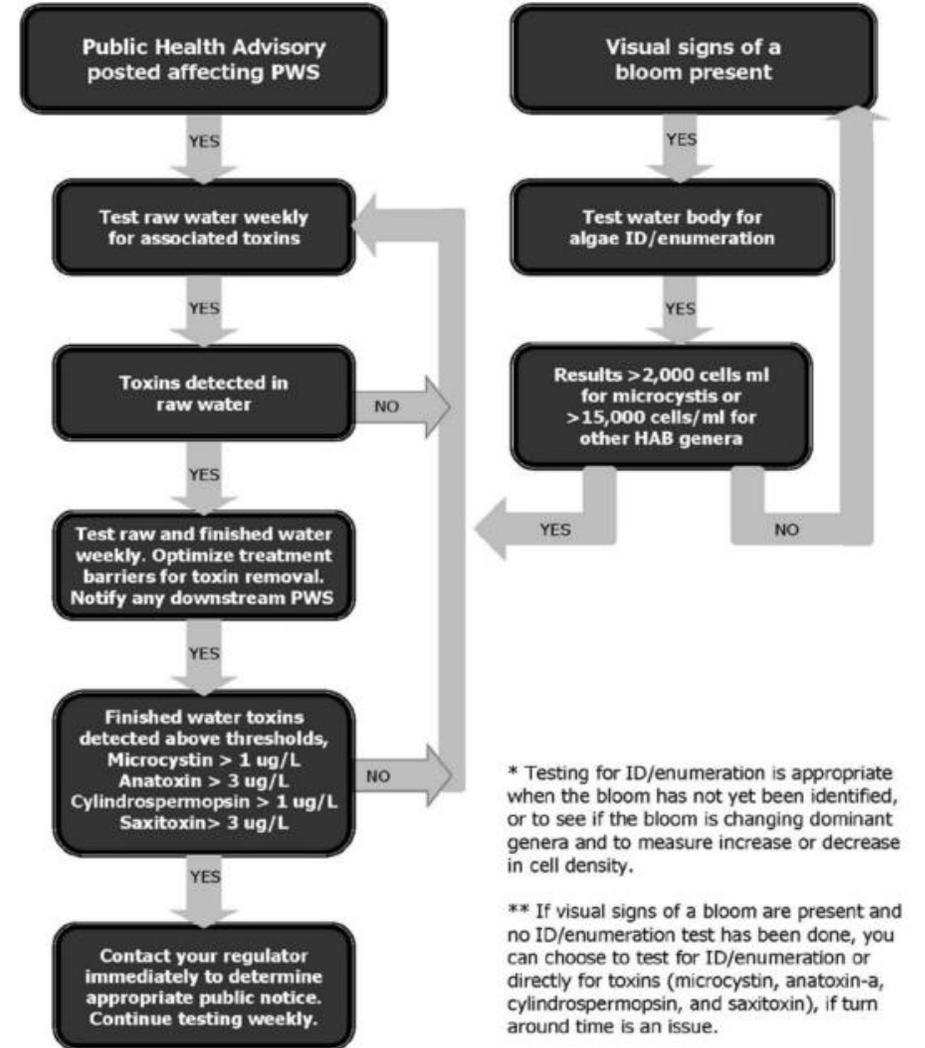
- Microcystins

- 0.3 µg/L (미취학 아동)

- 1.6 µg/L (성인)

■ 다른 Cyanotoxin도 측정함

- Anatoxin-a, Cylindrospermopsin, Saxitoxin





EXPOSED?

Shower immediately.
See a doctor or vet if
symptoms occur.

SYMPTOMS OF EXPOSURE

Vary depending on how the person or animal was exposed, and whether the HAB is in salt or fresh water.



Ear, eye, nose,
skin, and throat
irritation, and
headache



Paralysis,
respiratory
illness, and
seizures



Abdominal pain,
diarrhea, liver and
kidney damage, and
vomiting



Drooling, diarrhea,
low energy, not
eating, stumbling,
tremors, and
vomiting

WHEN IN DOUBT, STAY OUT!

Stay away from the water when a suspected HAB is present.



DON'T
Play with scum
or mats on
the shore



DON'T
Let animals
drink water, eat
algae, or swim



DON'T
Swim



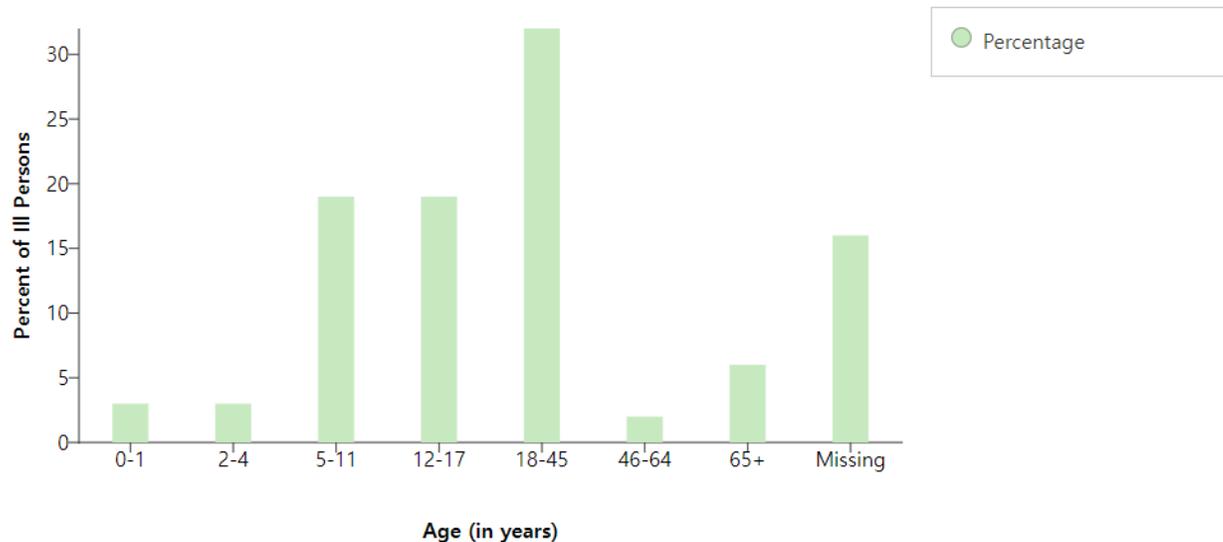
DON'T
Fish or wade



DON'T
Boat or kayak

CDC: HAB summary

One Health Harmful Algal Bloom System



CDC collects data about harmful algal bloom (HAB) events and associated human or animal illnesses in the United States through the One Health Harmful Algal Bloom System (OH HABS).

HAB-Associated Human Illnesses



2 out of 5 ill people were under the age of 18.



81% sought medical care. No deaths were reported.

Most (59%) of the HAB-associated human illnesses were classified as suspected cases.

HAB-Associated Animal Illnesses



56% of animals died.

Most (81%) of the HAB-associated animal illnesses were classified as probable cases.



14 states reported data for 2019

242 Harmful Algal Bloom Events

63 Human Illnesses

367 Animal Illnesses

Harmful Algal Bloom Events



3 out of 4 HAB events were in **fresh water**.



HAB events peaked in **August**.

Most (85%) HAB events were classified as confirmed events.

Environmental Testing



88% of HAB events were tested for toxins, algal species, or both.



Toxins were found in **half (53%)** of HAB events.

먹는물 수질기준 비교

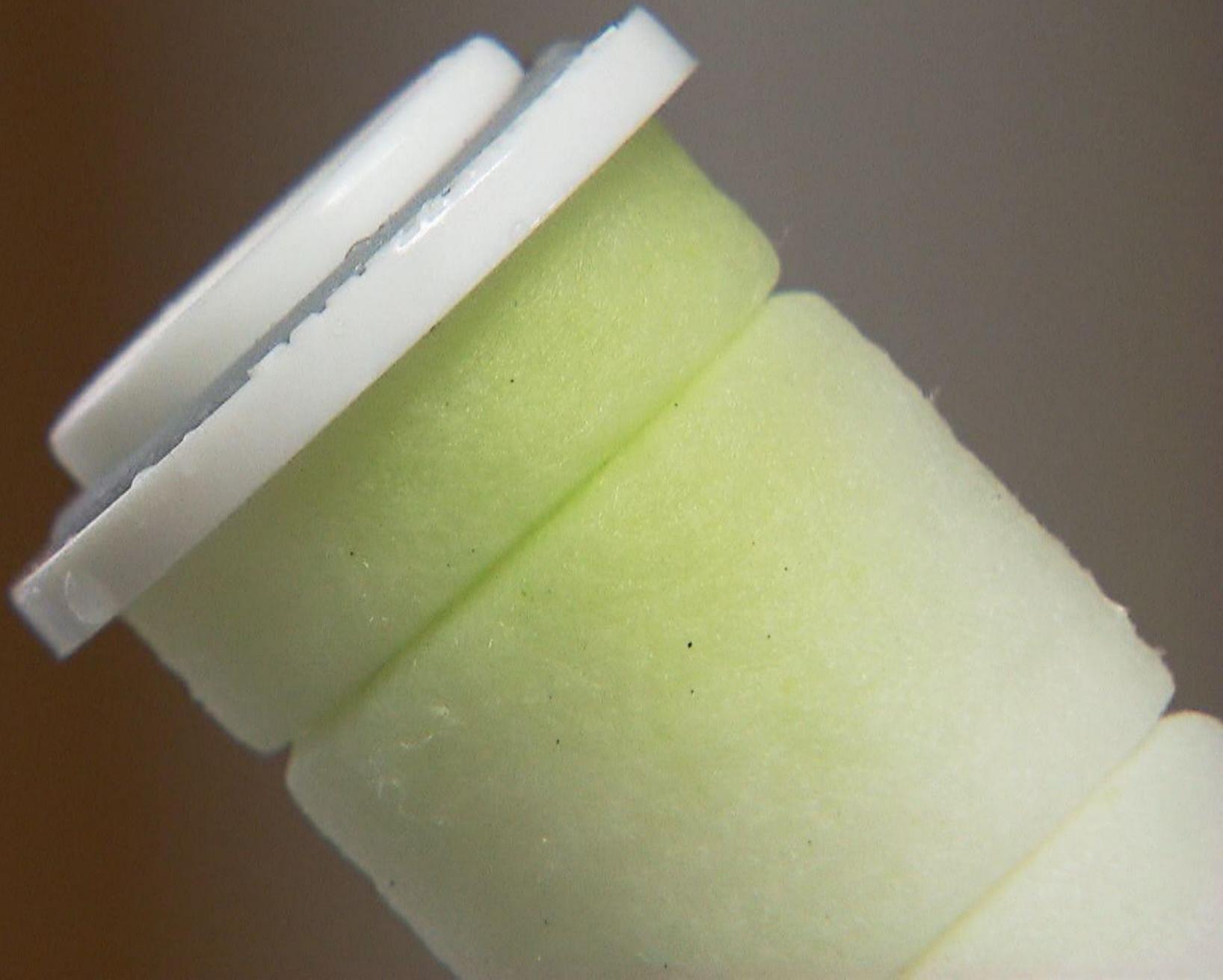
- 납: 10 ppb (ug/L)
- 비소: 10 ppb
- 페놀: 5 ppb
- 수은: 1 ppb
- Microcystins은 1 ppb ← 먹는물 수질감시항목





정수만 하면 끝?

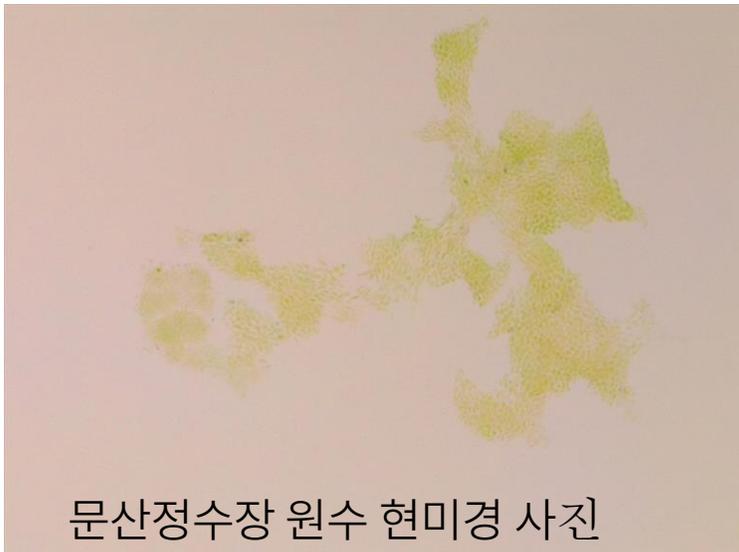




수돗물

7월 21일 대구 3곳의 정수장

	원수 (ppb)	정수 (ppb)
고산	0.438	0.226
매곡	0.405	0.281
문산	1.388	0.268



지역	지점	일시	분석결과 (ug/L, ppb)	OEHHA (0.03 ppb) 비교	USEPA 6세 미만 기준 (0.3 ppb) 비교
부산	부산 진구	08.12	검출한계 미만	-	
	부산 사상구	08.12	검출한계 미만	-	
	부산 수영구	08.12	0.061	2.03배	20.3%
	부산 동래구	08.12	검출한계 미만	-	-
	부산 해운대구	08.12	검출한계 미만	-	-
	부경대학교	08.25	검출한계 미만	-	-
경남	양산 물금	08.12	검출한계 미만	-	-
	김해 내동	08.13	0.056	1.86배	18.6%
	창원 진해구 A	07.29	0.175	5.83배	58.3%
	창원 진해구 B	07.29	검출한계 미만	-	-
	창원 진해구 C	07.29	0.092	3.06배	30.6%
	창원 진해구 D	07.29	검출한계 미만	-	-
	창원 진해구 E	07.29	검출한계 미만	-	-
	창원 마산 합포구	08.19	검출한계 미만	-	-
대구	창녕군 길곡면	08.04	검출한계 미만	-	-
	대구 수성구	07.30	0.064	2.13배	21.3%
	대구 동구	08.08	0.051	1.7배	17%
	달성군 구지면	07.30	검출한계 미만	-	-
	달성군 화원읍	07.14	검출한계 미만	-	-
경북	달성군 화원읍	08.05	검출한계 미만	-	-
	고령군 다산면	07.14	검출한계 미만	-	-
	상주시 낙동면	08.06	검출한계 미만	-	-



Part 2.

농업 및 축산업

농작물에 축적된 연구들

Table 4 (Continued)

Type of fresh produce	Irrigation source	Toxin in irrigation water		Tissue	Toxin concentration in samples (µg/g of vegetables)	Reference
		Type	Concentration (µg/L)			
Rice (<i>Oryza sativa</i>)	Aphanizomenon ovalisporum extracts	Cylindrospermopsin	2.5	Roots	14	Chen et al. 2004, Prieto et al. 2011
	Dianchi Lake (China)	MCs	120	Leaves	12.5	
				Seedling	2.94 ± 0.55/10 ³	

Table 4 Cyanotoxins found in fresh produce

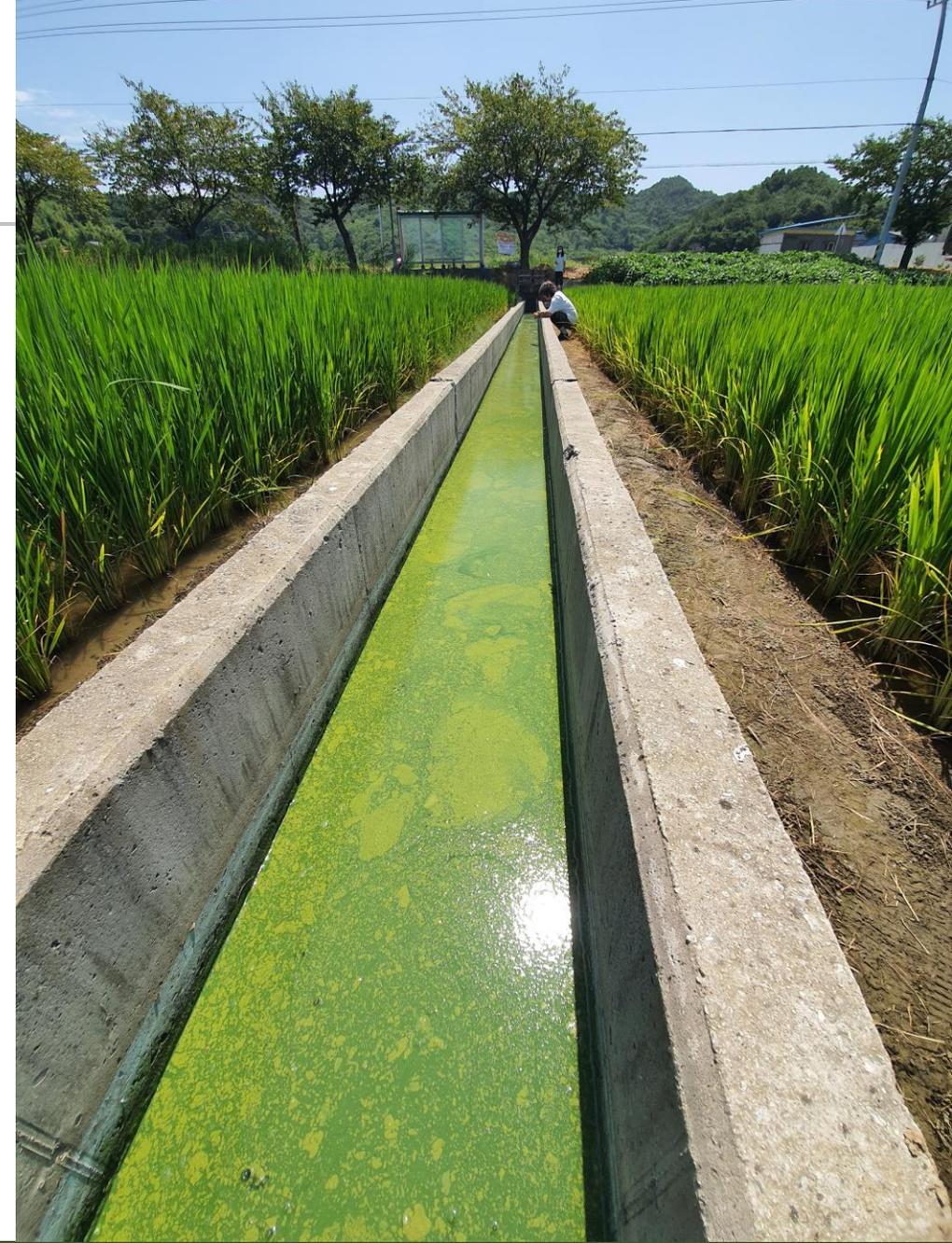
Type of fresh produce	Irrigation source	Toxin in irrigation water		Tissue	Toxin concentration in samples (µg/g of vegetables)	Reference	
		Type	Concentration (µg/L)				
Soya bean (<i>Glycine max</i> L. Merill.)	Lake Müggelsee (Germany)	MCs	5	Roots	0.125	Peubert et al.	
Sugar pea (<i>Pisum sativum</i> var. Saccharatum)	Lake Müggelsee (Germany)	Alfalfa (<i>Medicago sativa</i> L.)	Microcystins (MCs)	5	Roots	0.125	Peubert et al.
		Arugula	Groundwater (Saudi Arabia)	MCs	Varied	Leaves 0.18 Roots 0.24	Mohamed & Shehri 2009
Wheat (<i>Triticum durum</i>)	Microcystis bloom	Cabbage	Groundwater (Saudi Arabia)	MCs	Varied	Leaves 0.22	Mohamed & Shehri 2009
						Roots 0.3	
		Chick pea (<i>Cicer arietinum</i>)	Lake Müggelsee (Germany)	MCs	5	Roots 0.2	Peubert et al.
		French bean (<i>Phaseolus vulgaris</i>)	Lake Müggelsee (Germany)	MCs	5	Roots 0.30-0.50	Peubert et al.
Wheat (<i>Triticum aestivum</i> L.)	Lake Müggelsee bloom (Germany)	Green pea (<i>Pisum sativum</i>)	Lake Lalla Takerkoust (Morocco)	MCs	500	Roots 0.24	Peubert et al.
						1,050	6.23
					4,200	190.85	
White clover (<i>Trifolium repens</i> cv. Grasslands Kopu)	Lake Hakanoa (New Zealand)			MCs	1,050	Stem 0.88	
						4,200	79.19
					500	Leaves 0.41	
					1,050	5.52	
					4,200	156.8	
					5	Roots 0.25-0.48	
Lentil (<i>Lens culcanta</i>)	Lake Lalla Takerkoust (Morocco)			MCs	500	Roots 16	Peubert et al.
						1,050	24.52
					4,200	162.79	
					1,050	Stem 2.33	
					4,200	36.61	
					500	Leaves 0.33	
					1,050	7	
					4,200	98.37	
					5	Roots 0.14-0.26	
Lettuce	Lake Müggelsee (Germany)	Extraction from <i>Microcystis aeruginosa</i>		MCs	0.62	Leaves 8.31 ± 0.2	Codd et al.
						2.5	19.8 ± 4.1
					6.23	16.8 ± 6.3	Hereman & Binencour-Oliveira 2012,
					12.5	177.8 ± 3.4	Mohamed & Al Shehri 2009
					2,100	Shoots 0.79	
					2,100	Roots 0.78	
					2,100	0.59	
					2,100	0.18	

(Continued)

Table 4 (Continued)

Type of fresh produce	Irrigation source	Toxin in irrigation water		Tissue	Toxin concentration in samples (µg/g of vegetables)	Reference
		Type	Concentration (µg/L)			
	Water containing cyanobacteria	MCs	Not mentioned	Central leaves	248.7 ± 92	
				Distal leaves	88.3 ± 25	
				Basal leaves	94 ± 0	
				Leaves	0.12	
				Roots	0.17	
Apple tree (<i>Malus pumila</i>)	Dianchi Lake (China)	MCs	30	Shoots	16.20 ± 0.73	Chen et al. 2010
				300	27.50 ± 3.54	
			3,000		225 ± 25.62	
			30		14.76 ± 4.22	
			300		43.94 ± 9.83	
			3,000		510.23 ± 141.10	
Maize (<i>Zea mays</i>)	Lake Lalla Takerkoust (Morocco)	MCs	1,050	Roots	7.55	Peubert et al. 2007, Siagrane et al. 2009
				4,200	18.71	
			1,050	Stem	1.29	
			4,200		7.65	
			1,050	Leaves	1.01	
			4,200		5.82	
			5	Roots	0.03-0.05	
Parsley	Groundwater (Saudi Arabia)	MCs	Varied	Leaves	0.25	Mohamed & Al Shehri 2009
				Roots	0.3	
Perennial ryegrass (<i>Lolium perenne</i> cv Grasslands Samson)	Lake Hakanoa (New Zealand)	MCs	2,100	Roots	0.18-0.23	Crush et al. 2008
Radish	Groundwater (Saudi Arabia)	MCs	Varied	Leaves	0.23	Mohamed & Al Shehri 2009
				Roots	0.37	
Rape (<i>Brassica napus</i> L.)	Lake Hakanoa (New Zealand)	MCs	2,100	Roots	0.12-0.14	Chen et al. 2004, Crush et al. 2008
	Dianchi Lake (China)	MCs	24	Seedling	2.61 ± 0.32/10 ³	
			24		Non-detected	
			120		8.32 ± 1.58/10 ³	
			600		123.57 ± 19.19/10 ³	
			3,000		651.00 ± 78.71/10 ³	

(Continued)



- 쌀, 콩, 밀, 상추, 사과, 옥수수, 파슬리



쌀에 축적된 독소

권역	지점	마이크로시스틴 농도 (µg/kg)	
		LC-M S/M S (M C-LR, -YR, -RR)	ELISA (M C s)
낙동강 20개 샘플	양산시 지점 (백미)	정량한계 미만	0.77
	양산시 지점 (현미)	M C-RR 1.19	1.37
	서낙동강 지점 1	정량한계 미만	정량한계 미만
	서낙동강 지점 2	정량한계 미만	정량한계 미만
	합천군 지점 1	정량한계 미만	정량한계 미만
	합천군 지점 2	정량한계 미만	0.51
	김해시 지점 1	정량한계 미만	정량한계 미만
	김해시 지점 2	정량한계 미만	정량한계 미만
	밀양시 지점	정량한계 미만	정량한계 미만
	창원시 지점1	정량한계 미만	정량한계 미만
	창원시 지점 2	정량한계 미만	0.76
	의령군 지점	정량한계 미만	0.84
	함안보 상류 지점	정량한계 미만	정량한계 미만
	함안군 지점	정량한계 미만	정량한계 미만
	구미시 지점	정량한계 미만	정량한계 미만
	창녕군 지점 1	정량한계 미만	정량한계 미만
	창녕군 지점 2	정량한계 미만	정량한계 미만
고령군 지점 1	M C-RR 1.69	1.92	
상주시 지점	정량한계 미만	정량한계 미만	
영산강 3개 샘플	영암군 지점 1	정량한계 미만	정량한계 미만
	영암군 지점 2	M C-RR 1.24	1.57
	영암군 지점 3	정량한계 미만	정량한계 미만

우리의 밥상은?

1.1 $\mu\text{g}/\text{kg}$

1.19 $\mu\text{g}/\text{kg}$

1.85 $\mu\text{g}/\text{kg}$

1.3 - 3.1 $\mu\text{g}/\text{kg}$



어패류

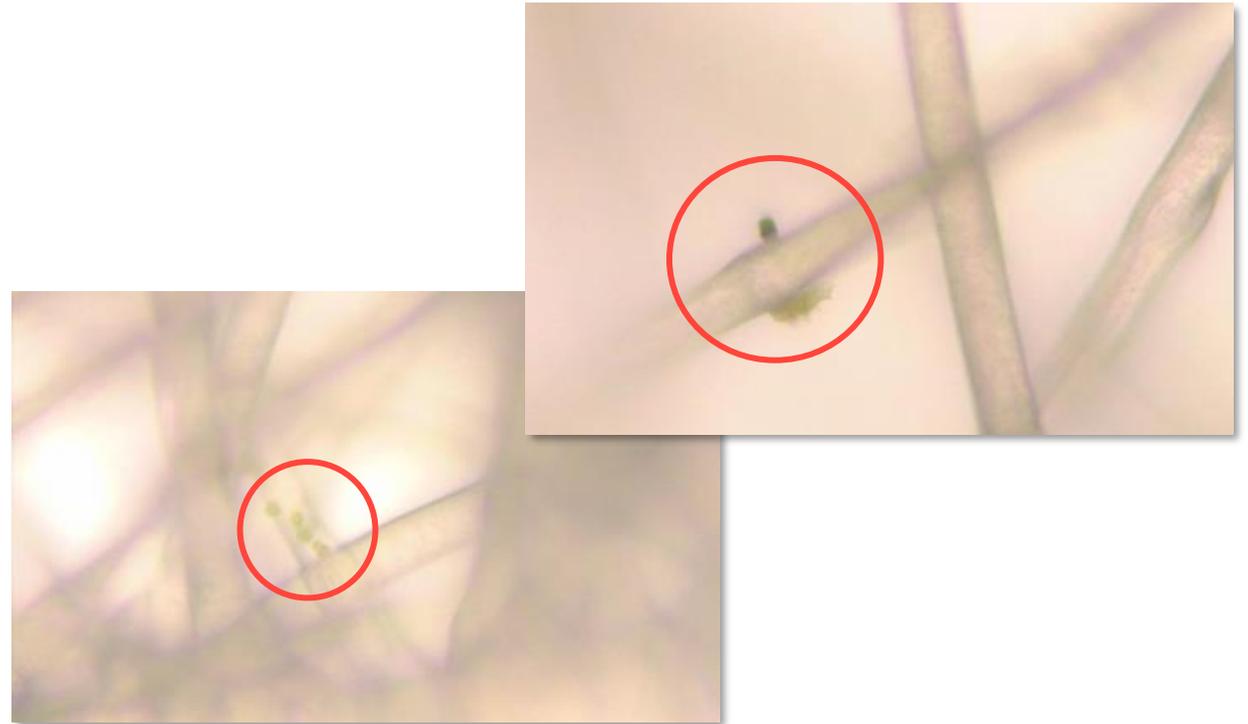
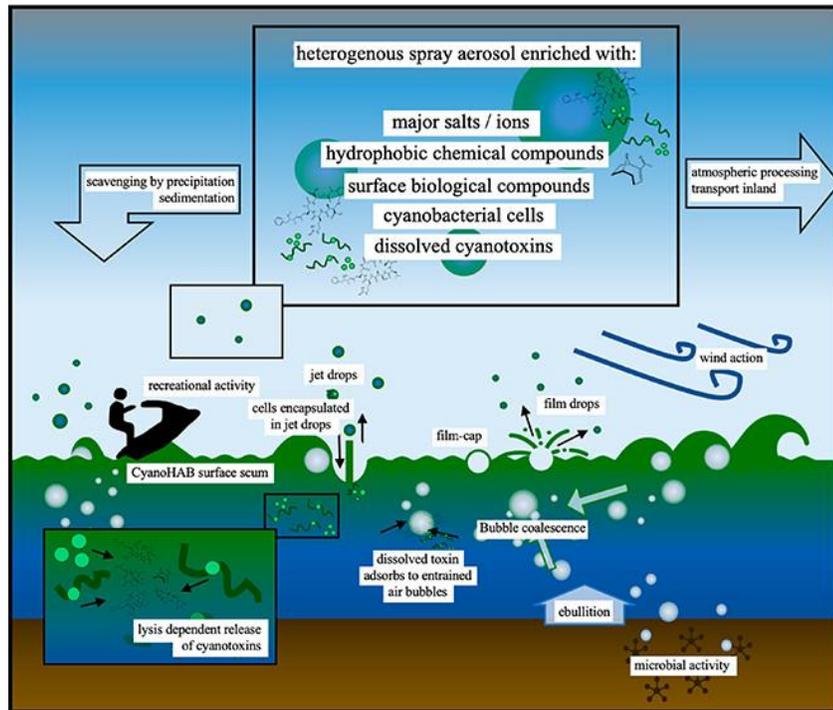
No.	어패류	구매 장소	측정 방법	Total	Anatoxin
1	빠가사리	8/9 어부 수확물	ELISA	20.23	-
			LC-MS/MS	17.8	3.84
2	참게	8/9 어부 수확물	ELISA	BDL	-
			LC-MS/MS	BDL	4.69
3	메기	8/9 어부 수확물	ELISA	5.26	-
			LC-MS/MS	4.21	BDL
4	붕어즙	낙동강	ELISA	-	-
			LC-MS/MS	1.1	-
5	조개		ELISA	-	-
			LC-MS/MS	BDL	-



Part 3.
에어로졸화

Toxic Cyanobacteria: A Growing Threat to Water and Air Quality

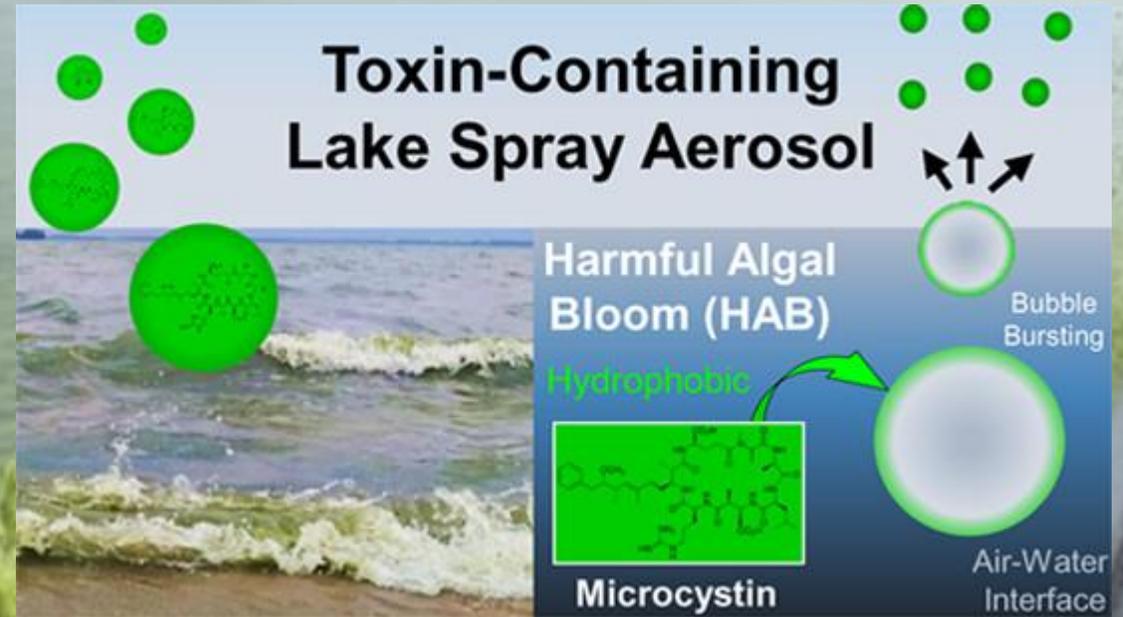
Haley E. Plaas and Hans W. Paerl*



마스크 현미경 관찰

공기중 녹조 독성물질

일시 (날씨)	지점	물속 MCs (µg/L)	공기 중 MCs (ng/m³)	수면 이격 거리 (샘플러 설치 높이 0.5m 동일)
8.22. (맑음)	대동 선착장 배 위	49.41	6.8	0m
	대동 선착장 작업장	-	5.4	3m
8.30. (비·흐림)	화원 유원지	366.44	3.68	3m
	낙동강 레포츠벨리	0.73	0.28	2m
	본포생태공원	1.77	4.69	1m
	대동 선착장	5.20	0.19	3m
	부산 00 APT	-	1.88	1.17km
	삼락생태공원	재실험	0.20	3m
9.02. (맑음)	합천군 저수지	5,337	-	-
	마을회관	-	0.1	15m
	마을 정자	-	2.4	5m
	진흥원 주차장	-	1.7	108m



Have fun on the water, but know that blue-green algae are in many Ohio lakes. Their toxins may be, too.

Be Alert! Avoid water that:

- looks like spilled paint
- has surface scums, mats or films
- is discolored or has colored streaks
- has green globs floating below the surface



Avoid swallowing lake water.

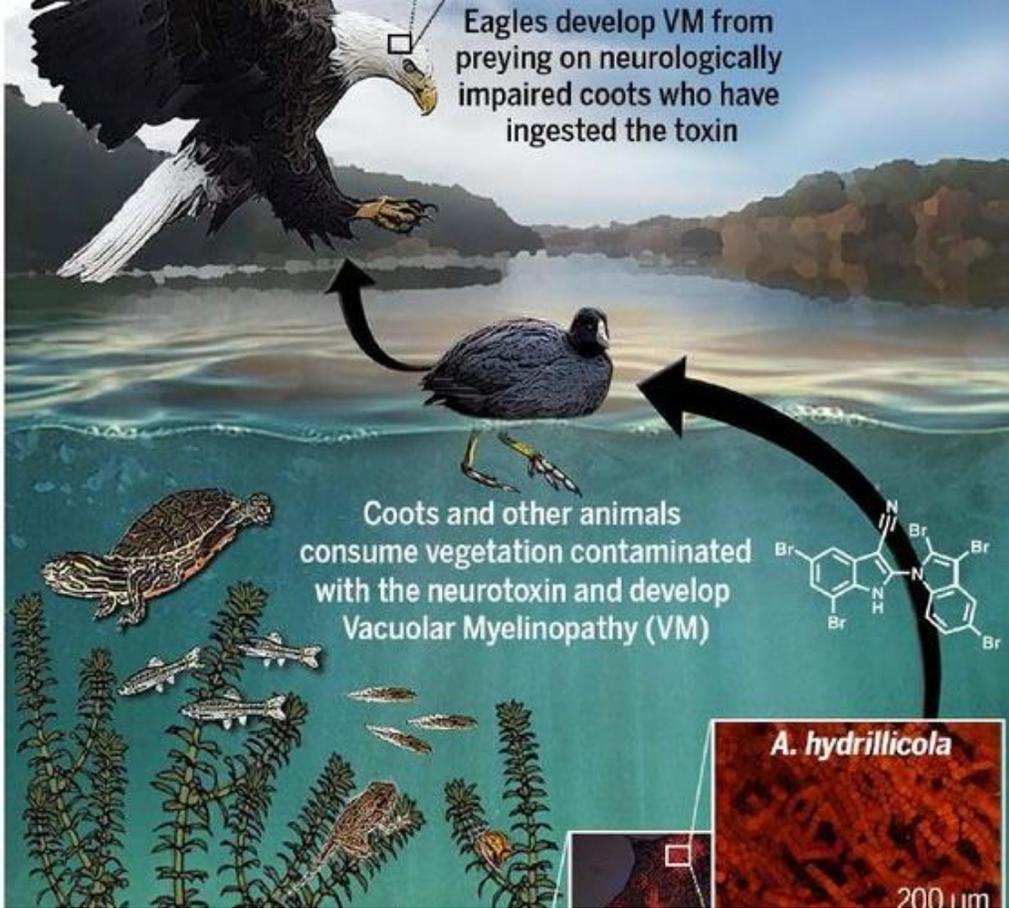
For more information, visit ohioalgaefo.com or call 1-800-OHBEACH.



DANGER

Avoid all contact with the water.

Algal toxins at UNSAFE levels have been detected.



생태계 + 반려견



환경

산업



감사합니다

