Listeria monocytogenes Outbreak Associated with Sprouts

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Overview

- *Listeria monocytogenes*
- *Listeria* in produce & sprouts
- Outbreak investigation
- Summary

Human Listeriosis

- **Clinical spectrum**
  - Gastroenteritis (diarrhea)
  - Invasive disease, third trimester abortions
- **Burden of human disease (CDC FoodNet)**
  - ~2500 estimated cases in the US/year
  - ~92% cases are hospitalized
  - ~20-30% mortality (~500 deaths/year)
- **Primarily affects**
  - Persons <1 y.o. and > 60 y.o. or those with underlying immuno-compromised conditions
  - However, can affect normally healthy persons
- **Distribution of cases**
  - Most case reports considered sporadic
  - Large outbreaks have occurred

Listeria monocytogenes

- Considered “ubiquitous” in nature.

- *L. monocytogenes* can survive in stressful environments;
  - ✓ very acidic (pH 2.5)
  - ✓ high salt (10 to 15%)
  - ✓ extreme temperatures (-0.4 to 50°C)

- Source: 99% of cases are foodborne.
  - ✓ Contamination is often linked to processing plants, but the role of contamination in retail establishments and in consumer homes is not well understood.

L. monocytogenes Prevalence

Non-Food Processing Environments:

- Pristine environments: 1.3% (n=900) (Sauders, 2006)
- Urban environments: 7.3% (n=900) (Sauders, 2006)
- Ruminant farms (Nightingale, 2004)
  - Bovine farms with listeriosis cases: 24.35% (n=616)
  - Bovine farms without listeriosis cases: 20.06% (n=643)
  - Small ruminant farms with listeriosis: 32.92% (n=322)
  - Small ruminant farms without listeriosis: 5.89% (n=475)

Food/Food Processing Environments

- Raw foods
- Food processing environments: from <0.1% to 30% or more
- Ready-To-Eat foods: 0.17 – 4.7 % (Gombas et al., 2003)

Listeria in Produce – Human Disease

- **1922-1960:** Reports link listeriosis in animals to contaminated silage, but no links to human listeriosis identified.
- **1981:** Report that 18 of 41 humans who consumed coleslaw that contained cabbage contaminated with *L. monocytogenes* died (Canada).
- **1988:** Five case of listeriosis linked to frozen broccoli and cauliflower (US).
- **1989:** One case of listeriosis linked to salted mushrooms (Finland).

Occurrence of *Listeria* in Produce

- 2003 FDA *L. monocytogenes* risk assessment identified produce as an uncommon cause of listeriosis outbreaks, however it noted that some human cases have occurred.
  - Vegetables: low predicted relative-risk of causing listeriosis in the US on a per-serving basis, slight higher risk on a per-annum basis.
  - Estimated that median number of cases of listeriosis from vegetables in the US was less than 1 case per year.

- Limited surveys in US have indicated the prevalence of *L. monocytogenes* in various produce ranges from 3-50%
  - Potatoes, radishes, other root crops appear to have higher prevalences of Lm (27-50%)

New York State Dept. of Agriculture & Markets

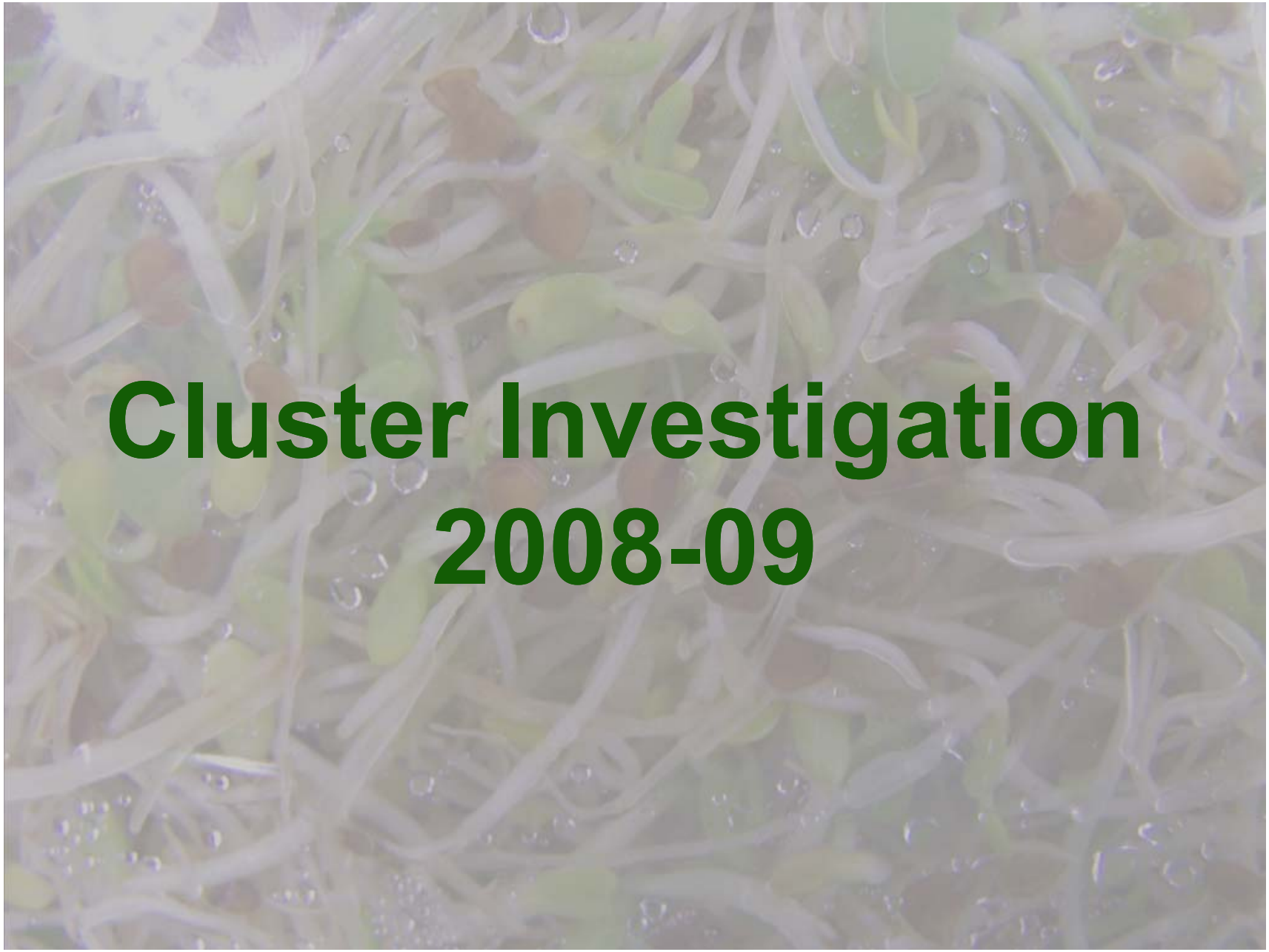
Listeria monocytogenes regulatory screening tests for produce or produce containing foods (Jan 2008- Apr 2009)

Commodity tested	Commodity Code	Number Screened	Number with LM Present	% LM Positive
Fresh fruit/juices	270	5	0	0.0%
Nuts & nut products*	360	1	1	100.0%
Fresh vegetables (sprouts)	390	35	4	11.4%
Dried/dehyrdated vegetables	420	2	0	0.0%
Cured and processed vegetab	430	5	0	0.0%
Apple cider	530	1	0	0.0%
Multiple food combinations				
Sandwiches/salads/dips	450	70	0	0.0%
	453	50	1	2.0%
	459	2	0	0.0%
Total		**171**	**6**	**3.5%**

Note: Apples, dried fruit, fruit products, grapes, jams/jellies, lettuce, maple syrup, onions, and potatoes were included in the search, but none were tested in the time period surveyed.

Why do we eat sprouts?

- Ancient Chinese physicians recognized and prescribed sprouts for curing many disorders over 5,000 years ago.
- Accounts of sprouting appear in the Bible in the Book of Daniel.
- Sailors in the 1700s were riddled by scurvy (lack of Vitamin C) and consumed limes, lemons and varieties of sprouts (all abundant holders of Vitamin C), plus other fresh fruits and vegetables to protect the sailors' health.
- More recently, sprouts have been shown to be rich in substances that promote antioxidant activity and may offer cancer protection.



Cluster Investigation 2008-09

PulseNet *Listeria* data (2008)

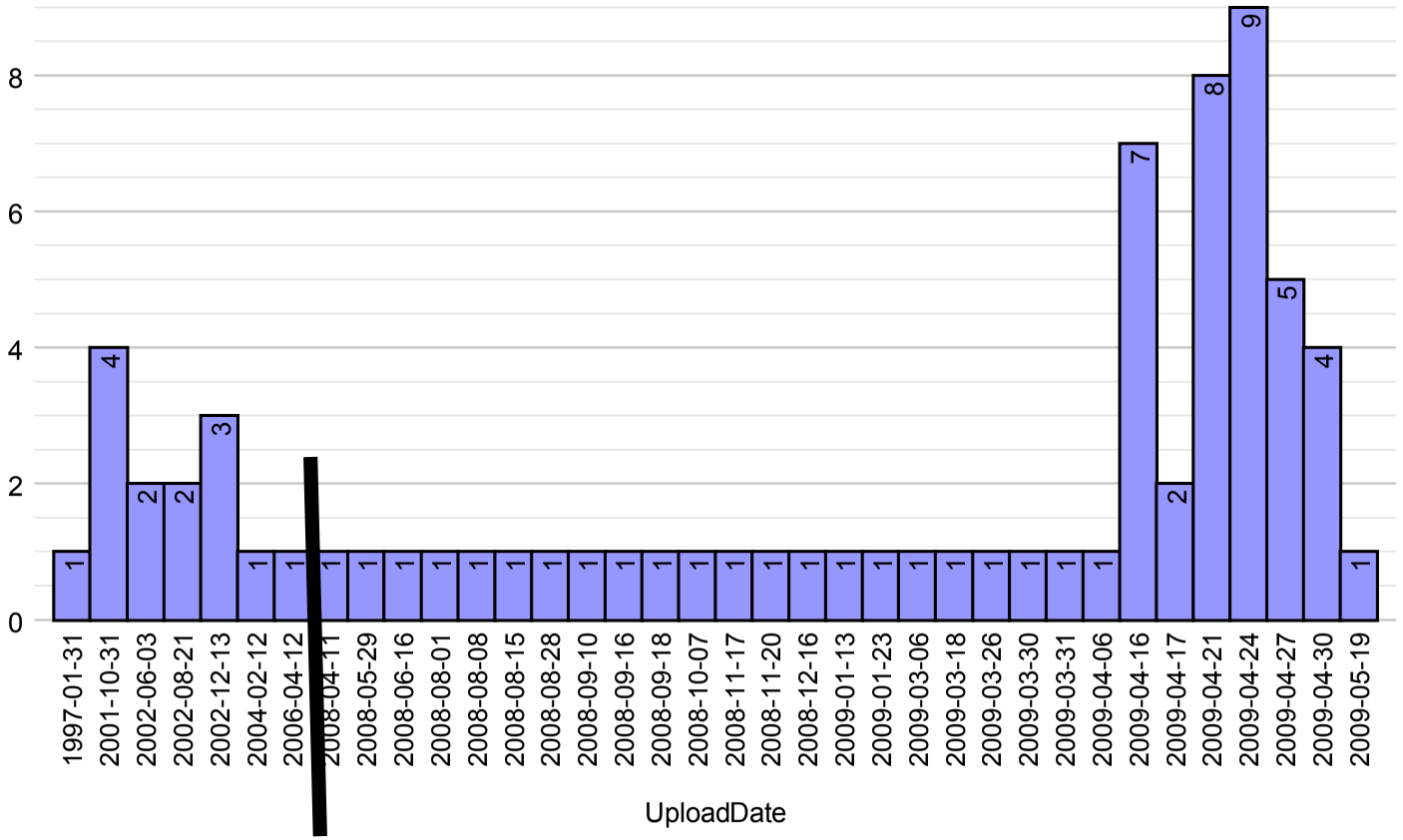
Source	Frequency
Human	522
Unknown	21
Food	256
Environmental	234
TOTAL	1033

Source: CDC national PulseNet data, Northeast Regional Working Group Project

Timeline of events

- **1997-2006**
  - GX6A16.0282 reported 14 times
- **March 2008-March 2009**
  - 20 cases of listeriosis
  - Indistinguishable AscI and ApaI PFGE patterns
  - CA (1), MA(6), NY(6); NJ(4); MD(1); ME(1); NH(1)
  - Two separate temporal clusters; some cases not in obvious clusters

Temporal Distribution of GX6A16.0282 (1997-2009)



Patient Demographics

- Age range: 20–89 years
- 65% are female
  - 21% were pregnant at the time of infection
- All twenty patients were hospitalized for their illnesses.

Link to Food Sample?

- On April 6, 2009, New York State Department of Agriculture and Markets uploaded an isolate of *Listeria monocytogenes* from alfalfa sprouts that was indistinguishable from the outbreak strain.

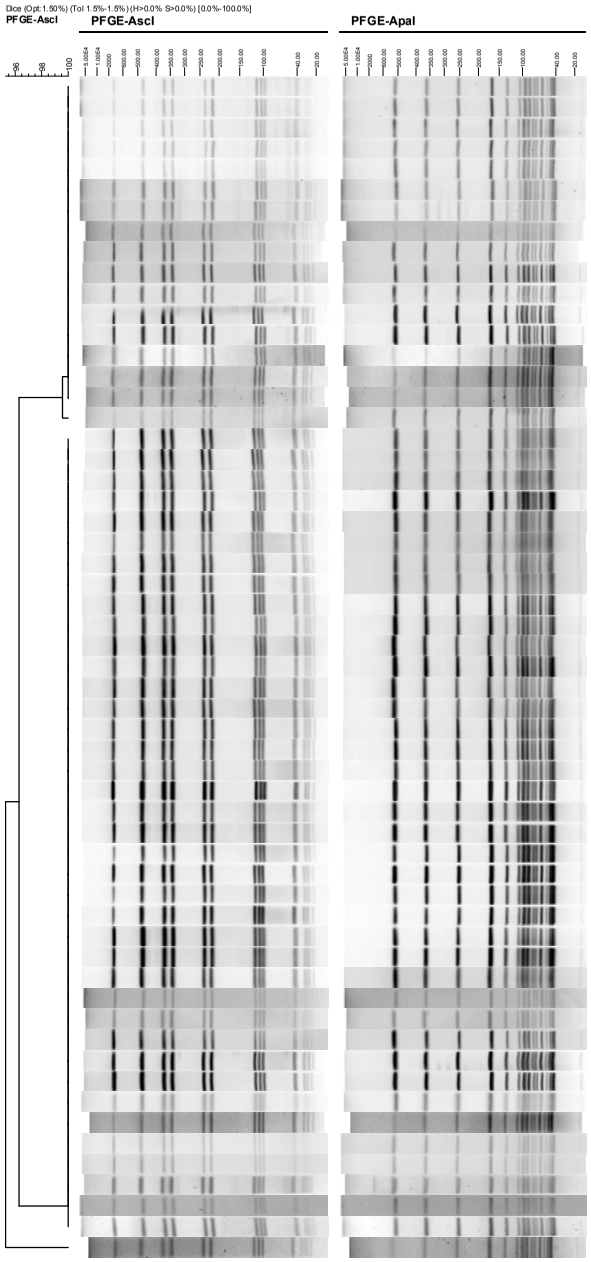
- The isolate was from a sprout sample that was collected through routine surveillance from a supermarket distributor in New York and was produced by Producer A in Bridgeport, CT.

Patient Interviews

- 10 patients were interviewed with questions regarding sprout consumption
  - four reported sprout consumption
  - three were unsure of sprout consumption
  - three denied any sprout consumption.

Inspection

- Investigators from the CT Department of Agriculture and FDA inspected the growing firm
- They collected environmental samples and food products for testing.
- The outbreak strain was found in alfalfa sprouts, clover sprouts, sprout blends environmental swabs and multiple environmental locations (e.g. a growing trench, spent irrigation water, etc) collected in the plant.
- One additional follow-up sample by NYSDAM was also found to contain the outbreak strain.



Key	SourceSt	SourceSite	SourceType
CT___02033917	CT	Alfalfa Sprouts	Food
CT___02033918	CT	Alfalfa Sprouts	Food
CT___02033919	CT	Alfalfa Sprouts	Food
CT___02033920	CT	Alfalfa Sprouts	Food
CT___02033921	CT	Alfalfa Sprouts	Food
CT___02033931	CT	Factory swab	Environmental
CT___02033933	CT	Alfalfa Sprouts	Food
MA___08PF0425	MA	BLOOD	Human
MA___08PF1182	MA	BLOOD (SUBCULTURE)	Human
MA___08PF1521	NJ	BLOOD	Human
MA___08PF1749	CA	blood	Human
MA___08PF2122	NJ	BLOOD	Human
MA___09PF0297	NJ	Blood	Human
NH___2008027278	NH	blood	Human
NY___BAC0800002720	NY	Amniotic fluid	Human
NY___BAC0900001363	NY	Blood	Human
MA___08PF1952	MA		Human
FCF__507437-1	CT	Spent irriagation water	Environmental
FCF__507437-3	CT	Spent irriagation water	Environmental
FCF__507437-4	CT	Spent irriagation water	Environmental
FCF__507437-7	CT	Spent irriagation water	Environmental
FCF__507438-1	CT	Alfalfa sprouts	Food
FCF__507438-5	CT	Alfalfa sprouts	Food
FCF__507439-1	CT	Alfalfa sprouts	Food
FCF__507439-7	CT	Alfalfa sprouts	Food
FCF__507442-106	CT	Environmental Swab	Environmental
FCF__507442-11	CT	Environmental Swab	Environmental
FCF__507442-16	CT	Environmental Swab	Environmental
FCF__507442-2	CT	Environmental Swab	Environmental
FCF__507442-21	CT	Environmental Swab	Environmental
FCF__507442-57	CT	Environmental Swab	Environmental
FCF__507442-68	CT	Environmental Swab	Environmental
FCF__507442-93	CT	Environmental Swab	Environmental
FCF__507443	CT	alfalfa/clover sprouts in l.	Food
FCF__507443-1b	CT	alfalfa/clover sprouts in l.	Food
FCF__524837-1	CT	Spicy Sprout Blend	Food
FCF__524837-4	CT	Spicy Sprout Blend	Food
FCF__524838-3	CT	Clover Sprouts	Food
FCF__524838-7	CT	Clover Sprouts	Food
FCF__524839-1	CT	Broccosprouts	Food
FCF__524839-2	CT	Broccosprouts	Food
FCF__524840-10	CT	BroccoSprout Blend	Food
FCF__524840-2	CT	BroccoSprout Blend	Food
FCF__524844	CT	Crunchy Sprout Blend	Food
MA___08PF1125	MA	SPINAL FLUID	Human
MA___08PF1323	ME	BLOOD	Human
MA___09PF0062	MA	BLOOD	Human
MA___09PF0331	NJ	Blood	Human
MA___09PF0345	MA	Blood	Human
MD___MDA08223487	MD		Human
NY___BAC0900000221	NY	Blood	Human
NYAG_09B02865A-1	NY	Alfalfa Sprouts	Food
NYAG_09B02866A-6	NY	Clover Sprouts	Food
NYAG_NYAG09B0232.	CT	Alfalfa Sprouts	Food
NYC__nyc08-100647716	NY		Human
NYC__nyc09-100753729	NY		Human
NY___BAC0800004932	NY	Blood	Human

Human, food, and environmental AscI & ApaI Patterns

Regulatory Action

- On April 9, 2009, a voluntary recall of alfalfa and other sprout products was issued.
- Sprout production halted.
- On April 23, 2009, list of recalled products was expanded.

Summary

- This is the first reported outbreak of human listeriosis from sprouts.
- In this investigation, a single routine surevillance sample helped identify the source of the outbreak
- Some indication that for *Listeria* the window for cluster scanning should be larger than 120 days.

Summary

- Both health departments and regulatory agencies can make significant contributions to outbreak investigations.

- Regulatory agencies have responsibilities and resources that allow for;
  - Rapid trace back of product from retail to suppliers
  - Verification procedures for ensuring that recalled food has been removed from store shelves
  - Enhanced laboratory surge capacity and matrix familiarity for screening of foodborne pathogens

Another sprout outbreak?

- Producer B in MA with multiple food and environmental isolates with an indistinguishable pattern to recent human cases.

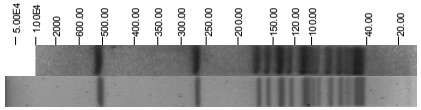
- Current cluster under investigation and epi follow-up.

Chang Farms Isolates:

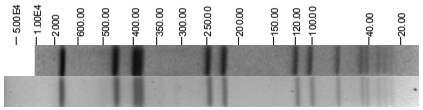
08B00801A-1 collected 1/28/08

09B04443A-1 collected 5/14/09

PFGE-ApaI



PFGE-AscI



08B00801A-1	New York	Bean Sprouts	Food	Produce
09B04443A-1	New York	Bean Sprouts	Food	Produce

Acknowledgements

State and local

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CDC

Matthew Biggerstaff

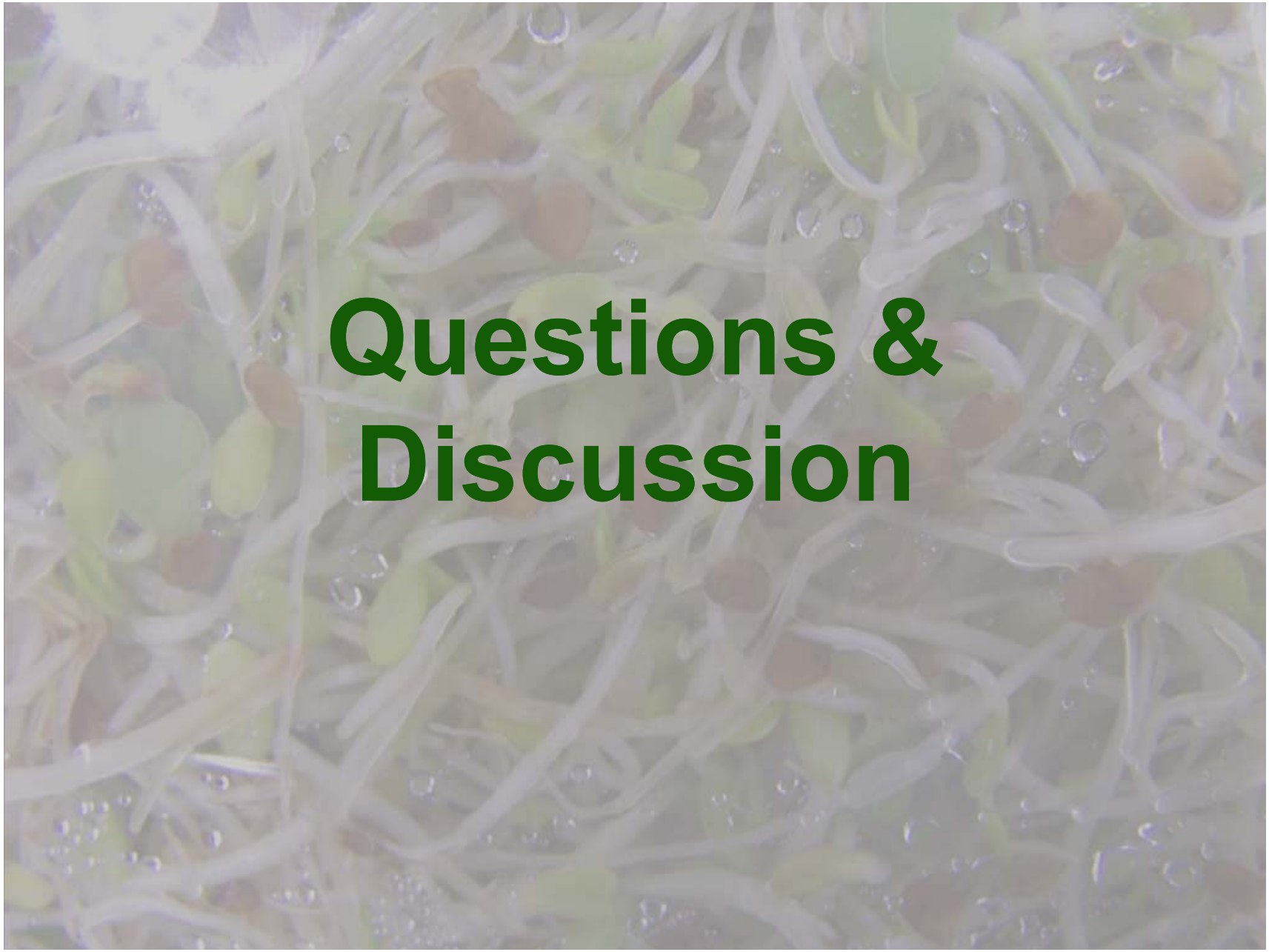
Lewis Graves

FDA

Paul Morin

Christine Keys

David Melka



Questions & Discussion