



Rijksinstituut voor Volksgezondheid  
en Milieu  
*Ministerie van Volksgezondheid,  
Welzijn en Sport*

## Food-borne viruses and transformation of food- practices

Marion Koopmans  
@MarionKoopmans

**Erasmus MC**  
Universitair Medisch Centrum Rotterdam



juillet 3, 2013



Fecal oral transmission  
Food handler  
High incidence  
Human pathogens  
End of chain  
Local, endemic

Norovirus, Hepatitis A



Fecal oral transmission  
Food production phase  
High incidence  
Human and animal pathogens  
Globalisation  
Mixed infections > risk  
Early in chain  
Diffuse widespread

Norovirus, rotavirus,  
Hepatitis A  
hepatitis E, enterovirus



Oral transmission and food  
handling  
Zoonotic  
Early in chain  
Rare  
Globalisation  
Emerging infections

Avian influenza, SARS,  
Nipah, Ebola

## Virus group

## Families

## Foodborne

**Z = zoonoses**

**dsDNA**

**African swine fever-like viruses**  
**Hepadnaviridae**  
**Papovaviridae**  
**Iridoviridae**  
**Herpesviridae**

**Poxviridae**  
**Adenoviridae**

**Z**

**ssDNA**

**Circoviridae**

**Parvoviridae**

**dsRNA**

**Reoviridae**  
**Birnaviridae**

**Z**  
**Z**

**- strand RNA**

**Rhabdoviridae**  
**Filoviridae**  
**Bunyaviridae**  
**Arenaviridae**

**Orthomyxoviric**  
**Paramyxoviridae**

**Z**  
**Z**

**+ strand RNA**

**Arteriviridae**  
**Togaviridae**

**Flaviviridae**  
**Hep E**  
**Coronaviridae**  
**Caliciviridae**  
**Picornaviridae**  
**Astroviridae**

**Z**  
**Z**  
**Z**  
**Z?**  
**Z**





SEARCH

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## Safety

Home Safety Recalls, Market Withdrawals, & Safety Alerts



### Recall -- Firm Press Release

FDA posts press releases and other notices of recalls and market withdrawals from the firms involved as a service to consumers, the media, and other interested parties. FDA does not endorse either the product or the company.

#### UPDATED RELEASE #2 Harris Teeter Lot Code and Best By Correction Townsend Farms Voluntarily Recalls Limited Lots of Frozen Organic Antioxidant Blend Products Due To Possible Health Risk

##### Contact:

Consumer:  
(800) 875-5291  
[townsendfarms5148@stericycle.com](mailto:townsendfarms5148@stericycle.com)

**FOR IMMEDIATE RELEASE - June 4, 2013** - Townsend Farms, Inc. of Fairview, Oregon, has announced that it is voluntarily recalling certain lots of its frozen Organic Antioxidant Blend, out of an abundance of caution, because it has the potential to be contaminated with Hepatitis A virus, based on an ongoing epidemiological and traceback investigation by the FDA and the CDC of an illness outbreak. No other Townsend Farms products, frozen or fresh, are covered by this voluntary recall or linked to the illness outbreak at this time. [This release confirms the correct Lot codes for Harris Teeter Products.](#)

The product was sold at Costco warehouse stores under the product name **Townsend Farms Organic Antioxidant Blend, 3 lb. bag** and UPC 0 78414 404448. The recalled codes are located on the back of the package with the words "BEST BY"; followed by the code T012415 sequentially through T053115, followed by a letter. All of these letter designations are included in this recall for the lot codes listed above. Photos of the package are attached.

The product was also sold at Harris Teeter stores from April 19 until May 7, 2013, under the product name **Harris Teeter Organic Antioxidant Berry Blend, 10 oz. bag** UPC 0 72036 70463 4. The correct "Lot" and "best by" codes are as follows: **Lot Codes T041613E, T041613C and a "BEST BY" code of 101614**. Photos of the packaging are attached.

Townsend Farms is implementing this voluntary recall after learning that one of the ingredients of the frozen Organic Antioxidant Blend, pomegranate seeds processed in Turkey, may be linked to an illness outbreak outside of the United States. Thirty-four cases of Hepatitis A are being investigated to date in the U.S.; all are recovering. At this time, Hepatitis A has not been found in the product, but Townsend Farms is taking this precautionary action in consultation with the FDA, as the investigation continues.

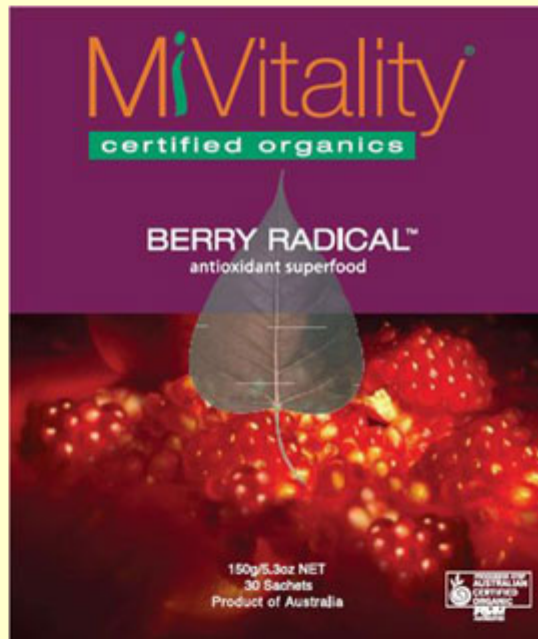
Hepatitis A is a contagious liver disease that results from exposure to the Hepatitis A virus, including from food. It can range from a mild illness lasting a few weeks to a serious illness lasting several months. Illness generally occurs within 15 to 50 days of exposure and includes fatigue, abdominal pain, jaundice, abnormal liver tests, dark urine and pale stool. Hepatitis A vaccination can prevent illness if given within two weeks of exposure to a contaminated food. In rare cases, particularly consumers who have a pre-existing severe illness or are immune compromised, Hepatitis A infection can progress to liver failure.

Persons who may have consumed affected product should consult with their health care professional or local health department to determine if a vaccination is appropriate, and consumers with symptoms of Hepatitis A should contact their health care professionals or the local health department immediately. Consumers with the product should not consume the product. The product should be disposed of immediately. Please keep proof of product purchase.



## Recommended Products

### (1) World Beating Certified Organic Antioxidant Superfood



A unique combination of 10 of the world's most potent, antioxidant, superfoods. Contains certified organic, antioxidant-rich raw cacao (chocolate), fruits, berries and marine microalgae to support healthy immune function and protect cells.

Contains a wide spectrum of nature's most powerful antioxidants: which may slow processes associated with aging.

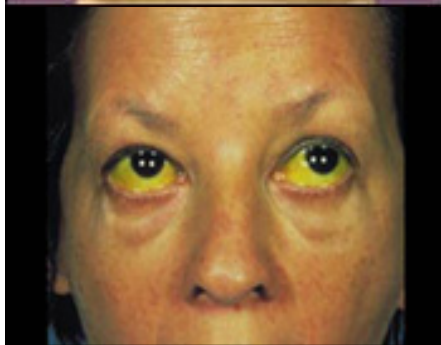
Berry Radical is a revolutionary certified organic, superfood designed to assist the body in attaining vibrant health, wellbeing and longevity. The ingredients in Berry Radical have been proven to assist the body in neutralising free radical damage

**STOP PRESS:** One serving of Berry Radical has recently been shown to contain over 7000 ORAC units -- Oxygen Radical Absorbance Capacity -- by independent Laboratory assessment. Your future health could be significantly safeguarded for the sake of **less than** GB£2 / US\$4 per day -- the cost of a single serving!

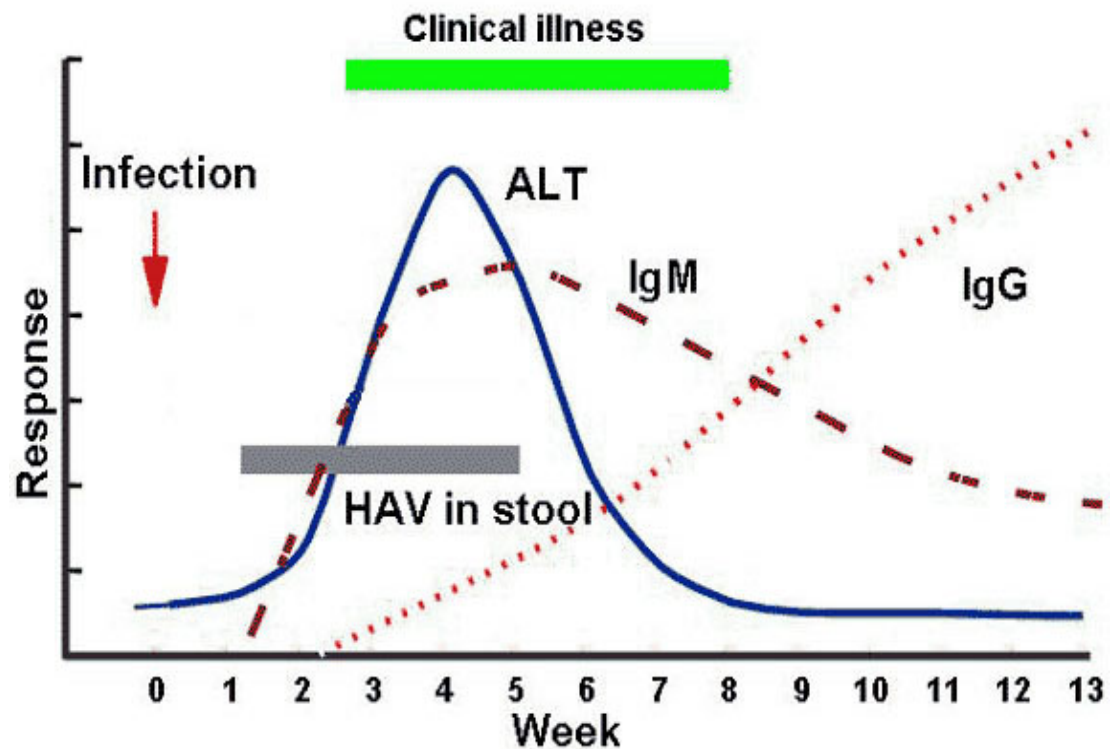
Berry mix United States, Argentina, Chile, and Turkey  
pomegranate seed mix from Egypt



# Clinical Illness



**JAUNDICE**

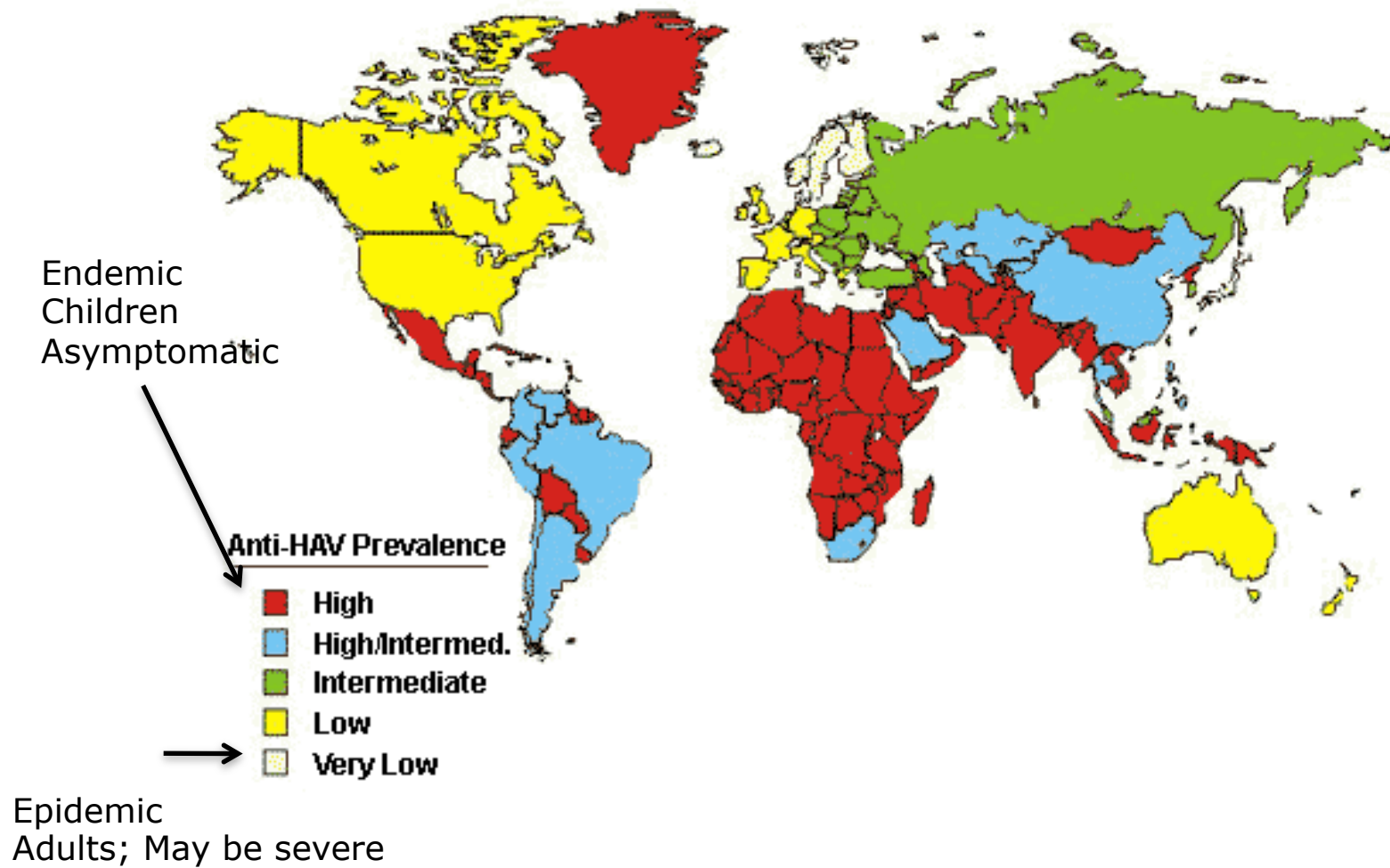


From CDC Slide Series 2003

Problem for food investigation:  
Major challenge for  
people to remember what  
they ate 30 days ago



## Prevalence of Antibodies to Hepatitis A Virus, 2006





## Geotagging:

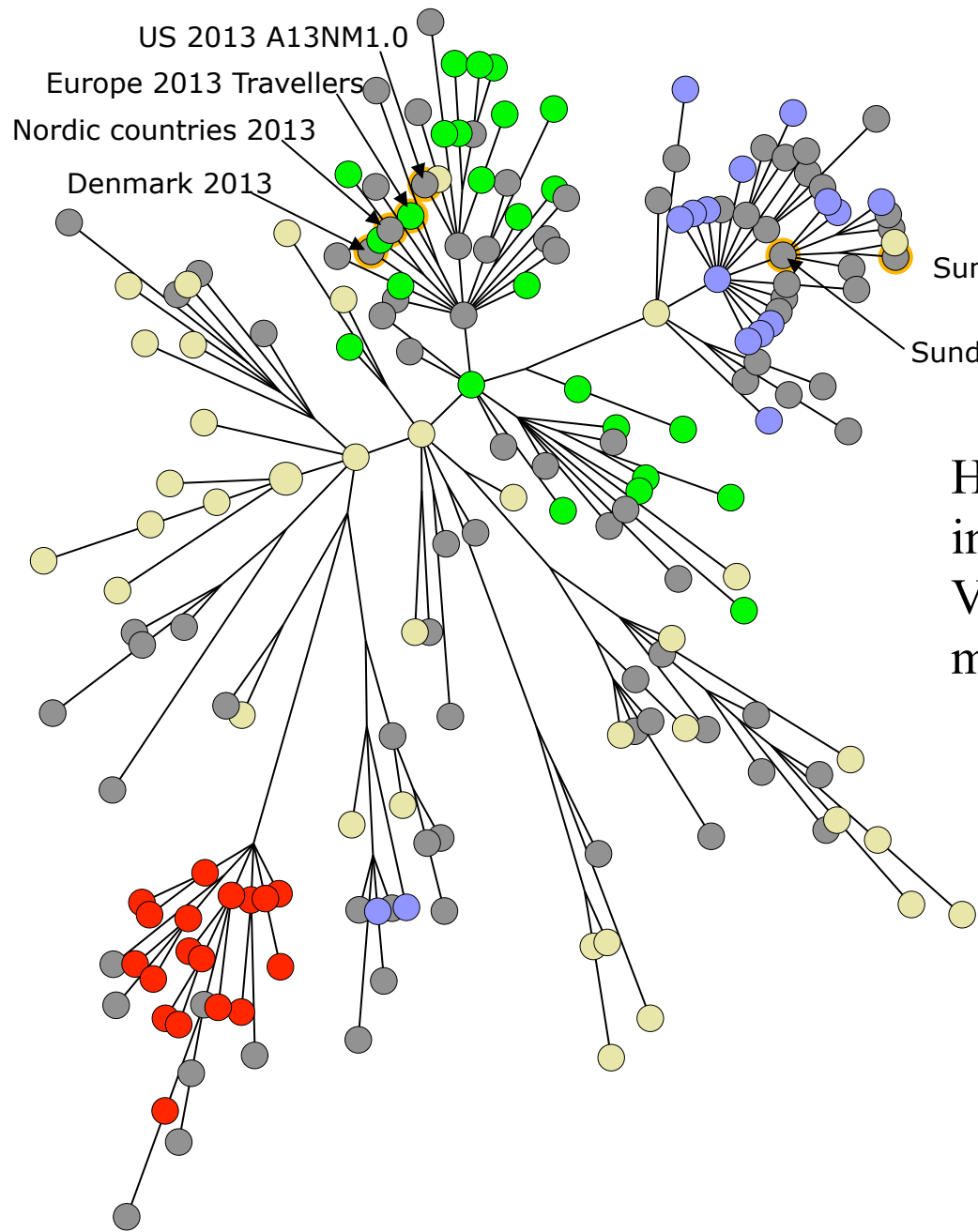
HAV genomes in endemic countries have a unique fingerprint

Sequencing of HAV (from serum of patients during viremia) can be used to obtain strain sequence

Combined with background information of define likely source of infection (contact with a case, men who have sex with men, travellers)







Sundried Tomato strain 77  
 Sundried Tomato strain 06

HAV 1B with country of  
 infection information  
 VP1/2A region 324nt  
 maximum parsimony

- Egypt
- Morocco
- Turkey
- Other endemic countries
- Unkown or low-endemic countries

Vennema et al., unpublished

**Table 1** Summarized description of the production process of the vegetables in the countries (A, B and C) involved in the study as well as the number of analysed samples per country

Phase	Country	A	B	C			
Production	Agricultural production	Salads	Salads	Salads			
	Type of premise	Vegetable production company (SME)	Vegetable production company (SME)	Vegetable production company (SME)			
	Lettuce type	Romaine	Butterhead	Butterhead			
	Sampling points						
	Irrigation water	Yes	Yes	Yes			
	Harvester's hands	Yes	Yes	Yes			
	Seasonal worker's hands	Yes	Yes	No			
	Harvester's toilet	Yes	Yes	Yes			
	Toilet doorhandle	Yes	Yes	Yes			
	Cattle manure	Yes	No	No			
Processing	Type of premise	Minimally subjected to processes that may cause (cross-) contamination. Vegetables were only rinsed with water to keep them wet during transportation	Vegetable processing company (SME)	There was not a real processing involved on the farm (vegetables were only washed using running water). Sampling was not considered in the sampling schedule			
	Harvester's hands		Yes				
	Rinsing water		Yes				
	Mechanical knives swabs		Yes				
	Manual knives swabs		Yes	Only 'ad hoc' samples were collected			
Point-of-sale	Type of premise	Supermarket	Supermarket	Farmers market			
	Sampling points	Fresh lettuce heads	Fresh lettuce heads	Fresh lettuce heads			
	Type of ad hoc samples	Water (irrigation, rinsing), lettuce cleaning sponge, swabs (knife, transport track, plastic crates with or without produce)	Water (irrigation, rinsing, tap), swabs (wooden box, tap water battery in the toilet, hand gloves from food handlers, hand washing basin, hand washing batteries, toilette, desk for lettuce heads cutting), lettuce heads	Swabs (toilet and toilet doorhandle from farmers market, lettuce heads from production site, washed lettuce heads)			
		General	Ad hoc	General	Ad hoc	General	Ad hoc
Number of analysed samples		184	6	212	19	236	8



**Table 2** Summarized results of the data gathered from the ‘general’ sampling points of the leafy vegetable supply chains per phase, matrix and virus type

Point of interest	hAdV	pAdV	bPyV	HAV	HEV	NoV GI	NoV GII
<b>Production</b>							
Irrigation water	17/61 (27.9 %)	6/39 (15.4 %)	2/39 (5.1 %)	0/35	1/20 (5.0 %)	1/35	1/25 (4.0 %)
Toilets/latrines	3/15 (20.0 %)	n.d.	n.d.	1/9 (11.1 %)	n.d.	2/9 (22.2 %)	1/8 (12.5 %)
Toilet door handles	4/13 (30.8 %)	n.d.	n.d.	1/10 (10.0 %)	0/1	2/10 (20.0 %)	2/8 (25.0 %)
Harvesters hands	34/209 (16.3 %)	n.d.	n.d.	2/97 (2.1 %)	n.d.	0/94	1/101 (1.0 %)
Seasonal workers hands	1/30 (3.3 %)	n.d.	n.d.	0/1	n.d.	0/1	0/1
Manure	3/5 (60 %)	n.d.	n.d.	0/2	n.d.	n.d.	2/2
<b>Processing</b>							
Food handlers’ hands	0/33	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Conveyor belt	0/1	0/1	0/1	n.d.	n.d.	n.d.	n.d.
Rinsing water	2/11 (18.2 %)	0/5	0/5	0/1	n.d.	0/1	n.d.
Knives, manual	0/16	0/16	0/16	n.d.	n.d.	n.d.	n.d.
Knives mechanical	0/8	0/8	0/8	n.d.	n.d.	n.d.	n.d.
<b>Point-of-sale</b>							
Fresh lettuce	70/265 (26.4 %)	7/166 (4.2 %)	0/176	0/149	4/125 (3.2 %)	2/149 (1.3 %)	1/126 (0.8 %)

Number of positives/number tested; *n.d.* no data



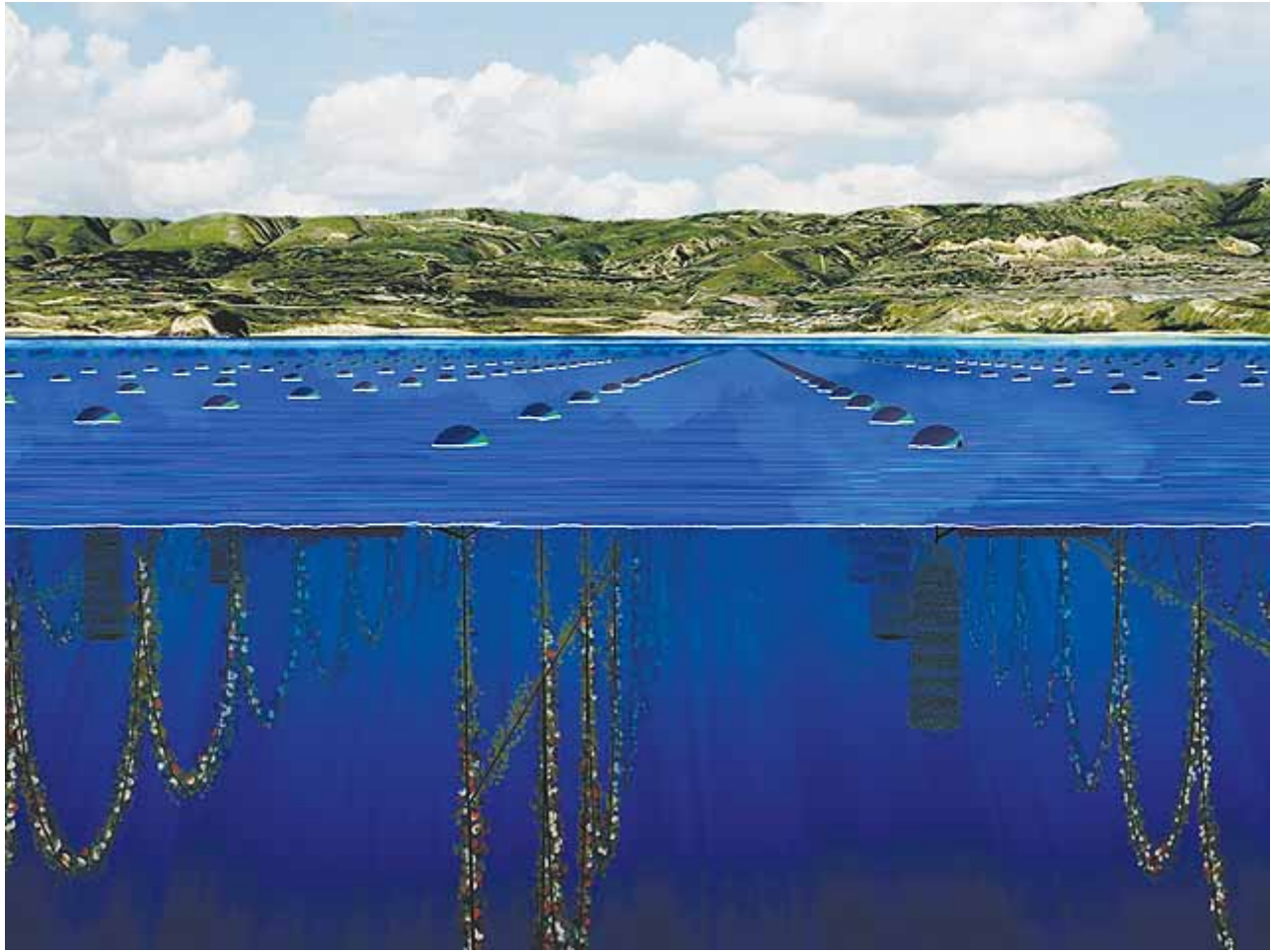
## Shedding and infectious dose

Contamination of fingers 1 mg

Transmission per contact 10%

	Shedding in feces per gram	ID50%	Infection Potential (persons)
<b>NoV</b>	<b><math>10^6 - 10^9</math></b>	<b>~10</b>	<b>10 - 10.000</b>
<b>HAV</b>	<b><math>10^6 - 10^8</math></b>	<b>~50</b>	<b>5 - 500</b>
<b>S. Typhi</b>	<b><math>10^6 - 10^9</math></b>	<b><math>10^5 - 10^7</math></b>	<b>0 - 1</b>

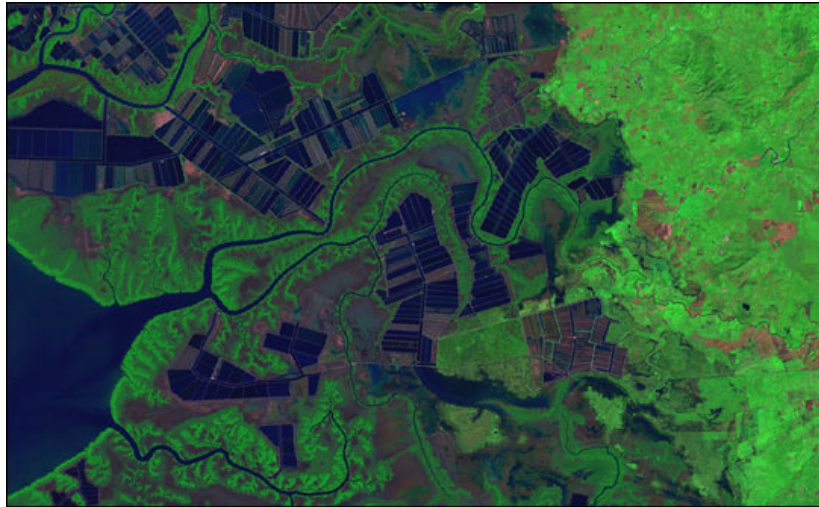




# Honduras



# Ecuador



November 19, 1999



March 6, 2006 (Terra ASTER)



January 6, 1987



April 29, 1991 (Landsat 5 TM)



**Table 7:** Estimated loss of original mangrove area in different regions (based on country data available in WRI, 1996)

<b>South and Southeast Asia</b>	<b>Loss of original area (%)</b>	<b>Africa</b>	<b>Loss of original area (%)</b>
Bangladesh	73	Angola	50
Brunei	17	Congo	0
India	85	Djibouti	70
Indonesia	45	Equatorial Guinea	60
Malaysia	32	Gabon	50
Myanmar	58	Guinea	60
Pakistan	78	Guinea Bassau	70
Singapore	76	Kenya	70
Thailand	87	Liberia	70
Vietnam	62	Madagascar	40
		Mozambique	60
		Somalia	70
		South Africa	50
		Tanzania	60
		Zaire	50
<b>Unweighted average</b>	<b>61</b>		<b>55</b>

Note: no data given for South America.

Lewis et al., 2003





## Viruses and aquaculture

- Replacement of wetlands and salt marshes by aqua culture
- Influx of water from rivers draining populated areas
- Human and animal waste, mixed > multiple exposures
- In regions with sewage treatment: incomplete and selective removal of viruses
- Storm surges and sewage overflow
- Additional viruses from aquatic wild life
- Active concentration of viruses from water by bivalves (100-fold concentration)


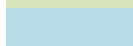



Country (source)	Samples analyzed	% positive	Reference
<b>Asia</b>			
11 countries	507	10.5% NoV*	Cheng et al., 2005
China	128	19% NoV	Kou et al., 2006
<b>Europe</b>			
Netherlands	42	17% NoV	Boxman et al., 2006
Italy	235	6% HAV, 14% NoV, 2 % both	Groci et al., 2007
Italy	170	14% HAV	Macaluso et al., 2006
Netherlands	64	22% EV	Lodder et al., 2005
France	52	40% EV	Dubois et al., 2004
Spain	60	47% AdV, 19% EV, 24% HAV	Muniain-Mujika et al., 2003
France, Netherlands, Ireland	87	9% NoV, 5% EV	Beuret et al., 2003
Spain	?	27% HAV, 44% EV	Romalde et al., 2002
Italy	100 before depuration 90 after depuration 100 market	20% (34% <sup>***</sup> ) HAV 11% HAV 23% HAV	Chironna et al., 2002
Italy	142	35% (13%)	De Medici et al., 2001
France	108	17% AV, 23% NoV, 19% EV, 27% RV	LeGyader et al., 2000
<b>South America</b>			
Brazil	27	22% HAV	Coelho et al., 2003
South America	17	24% HAV	Romalde et al., 2001

\* NoV = norovirus, HAV = hepatitis A virus, EV = enterovirus, AdV = adenovirus, AV = astrovirus, RV =

# NoV phylogenetic lineages

ORF 2 Genotypes	ORF 1 Genotypes	ORF 2 Genotypes	ORF 1 Genotypes
I.c1	I.p1	II.c1	II.p1
I.c2	I.p2	II.c2	II.p2
I.c3	I.p3	II.c3	II.p3
I.c4	I.p4	II.c4	II.p4
I.c5	I.p5	II.c5	II.p5
I.c6	I.p6	II.c6	II.p6
I.c7	I.p7	II.c7	II.p7
I.c8	I.p8	II.c8	II.p8
	I.pa	II.c9	II.p9
	I.pb	II.c10	II.p10 <sup>2</sup>
	I.pc <sup>1</sup>	II.c11	II.p11
	I.pd <sup>1</sup>	II.c12	II.p12
	I.pe <sup>1</sup>	II.c13	II.p13 <sup>2</sup>
	I.pf <sup>1</sup>	II.c14	II.p14 <sup>2</sup>
		II.c15	II.p15
		II.c16	II.p16
		II.c17	II.p17
		II.c18	II.p18
		II.c19	II.p19
		II.c20	II.p20
		II.c21	
			II.pa
			II.pb
			II.pc <sup>1</sup>
			II.pd
			II.pe
			II.pf <sup>1</sup>
			II.pg
			II.ph <sup>1</sup>
			II.pj
			II.pk <sup>1</sup>
			II.pm

-  Established NoV genotypes
-  Orphan capsid
-  Orphan polymerases > new introductions?

## Intensive farming under scrutiny as French oysters face viral wipeout

From Hugh Schofield in La-Trinité-sur-Mer, Brittany  
6 Jun 2010

French oyster farmers are facing ruin after a viral epidemic – which many believe is linked to intensive farming methods – struck for the third year in a row, wiping out millions of the baby shellfish.

From the Mediterranean coast, up to the Bay of Arcachon on the Atlantic and now Brittany, farmers have watched in dismay in recent weeks as the virus once again moved northwards, keeping pace with the rising sea temperature.

In 2008 and 2009 the industry was ravaged by the same epidemic, with many farms losing 80% to 100% of their stocks of naissains – first-year baby oysters. Because it takes three years to grow a commercially viable oyster, so far the economic impact of the crisis has been limited.

But now all pre-2008 production has been depleted, so major shortages are predicted next winter when demand peaks around Christmas and New Year. In France that is when 90% of oysters are sold.

The Committee to Save Oyster-Farming – an ad-hoc group set up in answer to the crisis – has warned that 40% of the country's 4,800 mainly family-run businesses could be forced to close, with the loss of thousands of jobs.

“Unofficially everyone thinks the hatcheries are to blame, even if no-one says so openly”

Jacques Cadoret

Ifremer – the state marine research agency – described the situation as “one of the worst crises in the history of French oyster-farming”.

Last month, hundreds of farmers staged a much-publicised protest in central Paris, dumping lorry-loads of oyster shells on one of the Seine River bridges. Their pressure paid off, because the French government has now promised a €150 million rescue package to tide the industry over the next three years.

Low tide on the sand flats at Le Po – a hamlet near Carnac in southern Brittany – exposes the poches or bags of oysters being cultivated by Bruno Lemoine. Last week he detected the first signs of the epidemic, with many of the



Oysters have been hit by the OsHV-1 virus

Tools

Listen out for the latest **POLCAST**  
**Podcast**  
Listen to the latest Herald Scotland PolCast

**NEWS GRAPHICS**  
Latest graphics from around the world

**Golf Breaks in Scotland**  
Wide range of Golf Break Packages Value for money prices  
[www.golfaroundscotland.com](http://www.golfaroundscotland.com)

**Garden Route Restaurants**  
Looking for a great meal in Knysna? Find Knysna restaurants here!  
[gardenroute.mydestinationinfo.com](http://gardenroute.mydestinationinfo.com)

**Pearl Necklace from \$15.9**  
Pearl Necklace Expensive? Not When You Discover Source! Check Out Now.  
[www.Pearls-Wholesaler.com](http://www.Pearls-Wholesaler.com)

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Stay in real comfort when you play on the finest links golf course.  
[dunvalanree.com](http://dunvalanree.com)

Ads by Google

dining room **THE BUSINESS Herald** Market Menu £25 - 3 courses

Oyster herpes virus

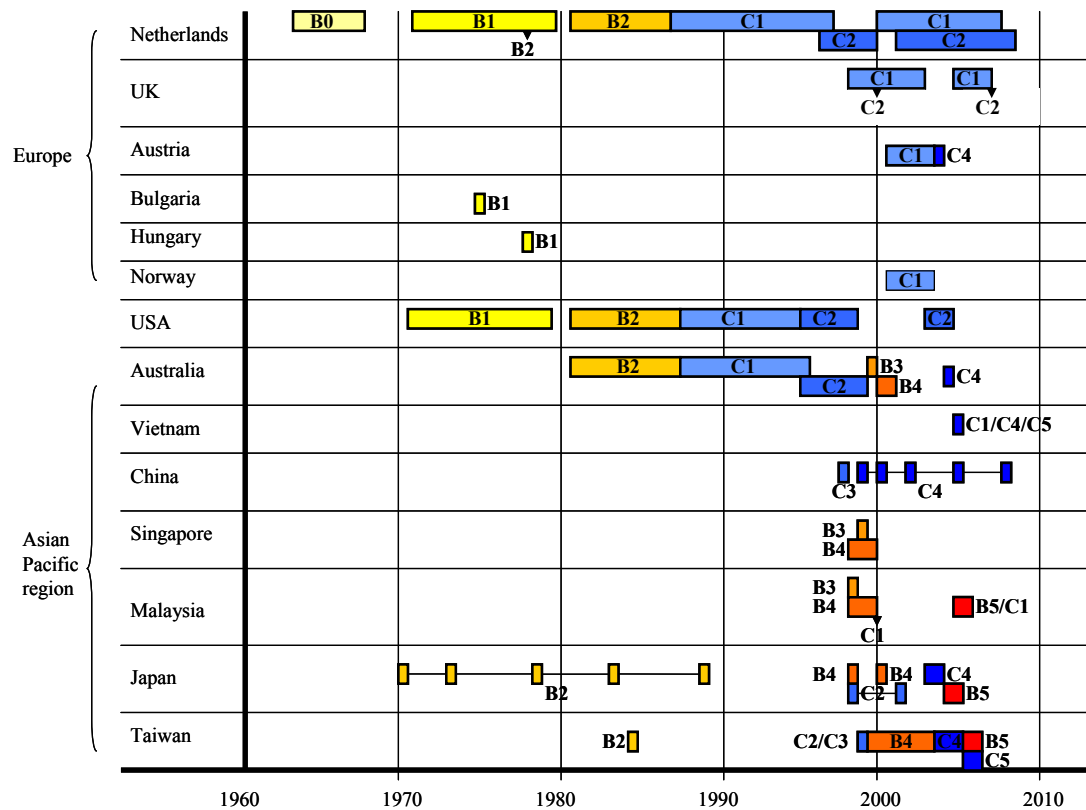
Massive die-out

Market shift

Top producers:  
China, Japan, Korea



# Genetic profiles of enterovirus type 71 in different geographic regions > risk of introduction?







# Indications for zoonotic transmission

MMWR, 2003 Oct 17;52(41):986-7.

**TABLE 1. Prevalence of IgG antibody to SARS-associated coronavirus in animal traders and persons in three control groups — Guangdong Province, China, 2003**

Group	No. tested	Testing positive	
		No.	(%)
Animal traders	508	66	(13.0)*
Hospital workers	137	4	(2.9)
Guangdong CDC <sup>†</sup> workers	63	1	(1.6)
Healthy adults at clinic	84	1	(1.2)

\* Chi square = 26.1; p<0.01, animal traders versus other groups.

<sup>†</sup> Center for Disease Control and Prevention.

**TABLE 2. Prevalence of IgG antibody to SARS-associated coronavirus in selected animal traders, by primary animal traded — Guangdong Province, China, 2003**

Primary animal traded*	No. traders	Testing positive		Relative risk	Relative risk (95% CI) <sup>†</sup>
		No.	(%)		
Masked palm civet	22	16	(72.7)	7.9	(5.0–12.6)
Wild boar	28	16	(57.1)	6.2	(3.8–10.3)
Muntjac deer	16	9	(56.3)	6.1	(3.4–10.9)
Hare	13	6	(46.2)	5.0	(2.5–10.2)
Pheasant	9	3	(33.3)	4.9	(0.7–24.8) <sup>§</sup>
Cat	43	8	(18.6)	2.0	(1.0–4.2)
Other fowl	25	3	(12.0)	1.3	(0.2–5.0) <sup>§</sup>
Snake	250	23	(9.2)	Reference group	

\* Categories not mutually exclusive, except for snakes.

<sup>†</sup> Confidence interval.

<sup>§</sup> Odds ratio and 95% CI by Fisher exact test.



## Emerging viruses and the food chain

- SARS – wild animals
  - Nipah – palm sap, fruits>pigs>people
  - Avian influenza- food handlers, blood
  - Filoviruses – hunters, food handlers
  - Monkeypox – hunters
  - Rift valley fever – animal products, slaughter
- 
- International foodcontamination events occur frequently
  - Can be vehicle for dissemination of infections, even if not primary mode of transmission





HOME / EUROPE / TRADE / UAE

## UAE's Camelicious Given EU Export Licence

EICMP will become the first Middle Eastern producer to export camel milk-based products to Europe.

By Neil Churchill February 10, 2013



The UAE-based producer of Camelicious products has announced that the country will become the first in the Middle East to export its dairy products to Europe after gaining its EU licence.

The Emirates Industry for Camel Milk & Products (EICMP) confirmed that after five years of talks the Gulf state can now sell its products to international customers, a development *Gulf Business* first reported on in June last year.



- 50 cases, high case fatality rate
- Human to human transmission
- Source of infection and modes of transmission remain obscure



## IF camels would be a reservoir of MERS coronavirus

Coronaviruses often have enteric tropism

Some patients have presented with diarrhea

Virus present in stool?

Fecal contamination during milking not uncommon

Pasteurisation (15', 73°)

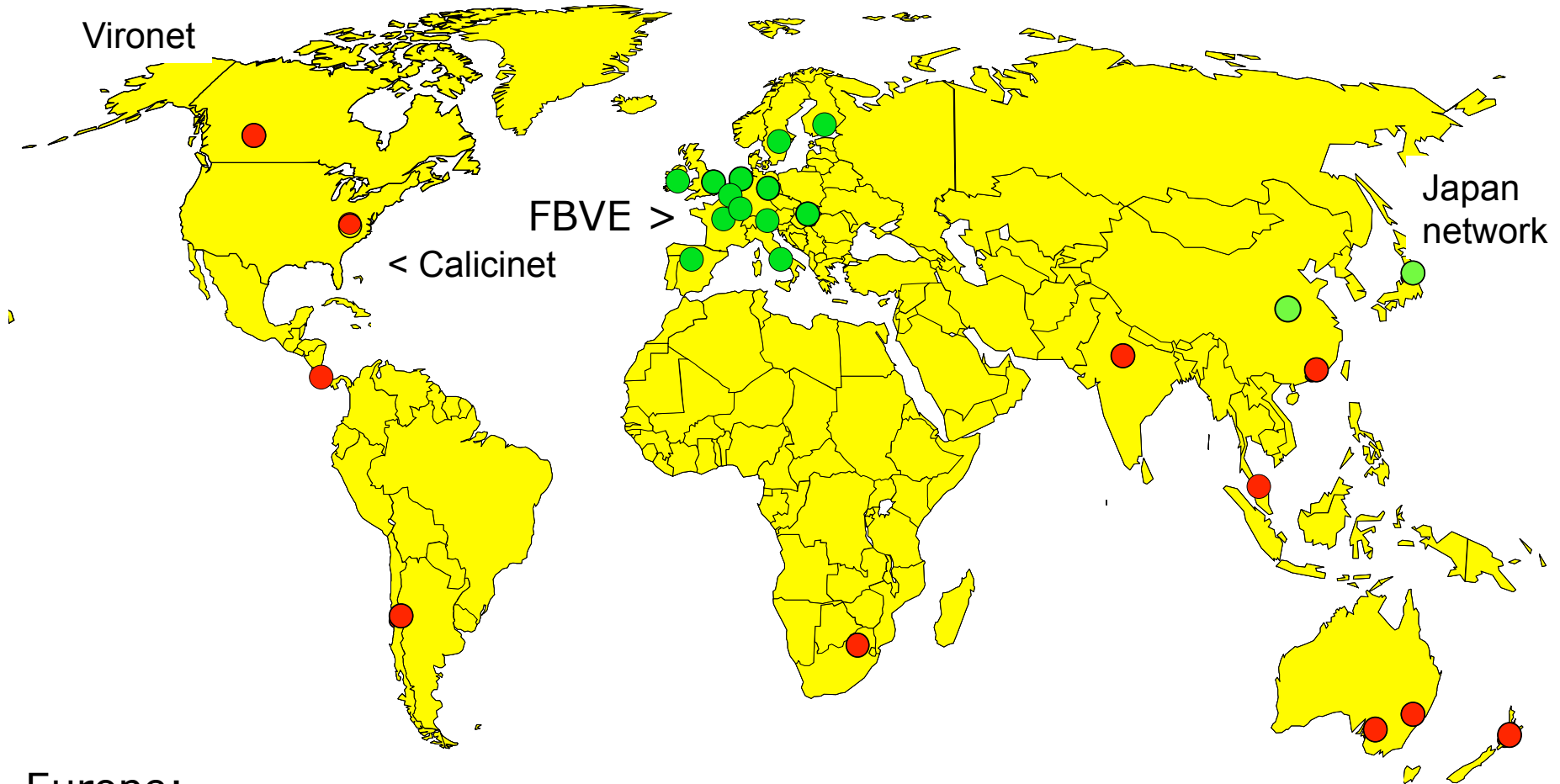
Camel milk often consumed raw

> Tx through milk can not be ruled out, particularly when consumed raw





# Participants of noronet and the Foodborne viruses in Europe network (noronet@rivm.nl)



Europe:  
Established in 1999 as Integrated lab and epi project  
study trends and their relevance  
Since 2006 global, lab-based

Australia/NZ  
network