Hepatitis A virus

Hepatitis A virus
Family of *Picornaviridae*
Genus Hepatovirus

Virus

anses
French agency for food, environmental and occupational health & safety

Characteristics and sources of the Hepatitis A virus

Main microbiological characteristics

The hepatitis A virus (HAV) is a non-enveloped virus, 28 to 30 nm in diameter, whose genome is a single-stranded positive-sense RNA molecule approximately 7.5 kb in size. Three genotypes (I, II and III) each subdivided into two sub-genotypes, A and B, have so far been described in humans. There is only a single serotype, however. For this reason, re-infection with HAV has not been observed in subjects previously immunised.

Table 1. **Characteristics of HAV survival**

Parameters	Survival (extreme values)
Temperatures (°C)	–80°C, several months in any medium 24°C, 30 days in faeces 4°C, 330 days in mineral water
pH	3-12
Chlorine	0.5-1.5 mg/L, pH7, 5°C, 1 hour
Ethanol	70%, 10 minutes
Chlorhexidine digluconate	0.05%, 10 minutes

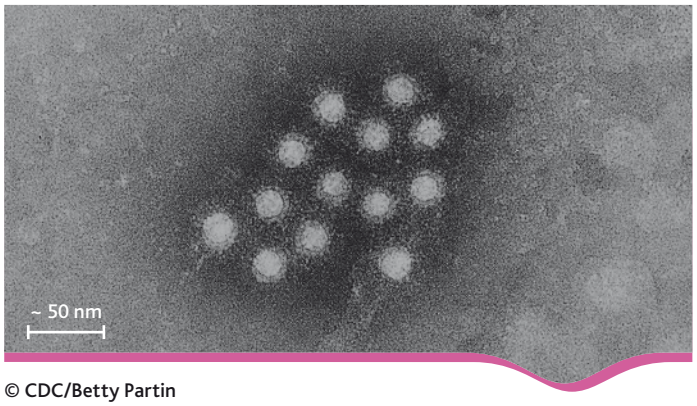
Sources of the hazard

Infected humans are considered to be the only reservoir of the virus (shedding in faeces). Since HAV is highly resistant under environmental conditions, it can survive and remain infectious for several weeks outside its host, especially in contaminated wastewater and agricultural produce irrigated by controlled flooding or sprinkling.

Transmission routes

The disease is spread by unwashed hands, the usual route for human-to-human transmission being *via* the faecal-oral route. Infection *via* ingestion of contaminated food or water is rare, the proportion of cases attributable to the food route in France being estimated at 5%. However, foodborne outbreaks have been attributed to shellfish or raw vegetables, contaminated at their respective production sites.

Though rarer, transmission can also occur by the parenteral route, from labile blood products or medicinal products derived from blood, or through sexual transmission of HAV as a result of oral-anal contact.



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In the case of wastewater and sewage sludge used in agriculture, the virological quality is assessed by screening for *E. coli* and enteroviruses. As for treated sludge (biosolids) used in agriculture, it must contain fewer than 3 enteroviruses per 10 g. However, the absence of this virus, or of enterobacteria, is not a reliable indicator of the absence of HAV contamination.

Recommendations for primary production

- **Strict requirements concerning good cropping practices in order to reduce the risk of contamination from raw materials (shellfish, fruits and vegetables) by potentially contaminated irrigation or seawater.**
- **Vaccination of personnel.**
- **The influence of weather events (heavy rain causing overflow of lift stations and sewage plants) on the pollution of water resources should be taken into account and preventative action plans should be set up to ensure their protection.**
- **In shellfish growing areas, this hazard should be taken into account in vulnerability profile studies and special attention should be paid to preventing contamination of water and to ensuring the traceability of produce. Local warning systems should be set up to give producers real-time information on any event likely to degrade water quality.**

Data sheet on foodborne biological hazards
January 2011

Foodborne human disease

Nature of the disease

The characteristics of the disease are presented in Table 2.

Susceptible population groups[1]**:** the frequency of symptomatic forms and the severity of clinical symptoms increase with age. Severe forms with fulminant hepatitis are mainly found in adult carriers of chronic hepatopathy. Spontaneous lethality (in the absence of treatment) for these severe forms is 70-90%.

Dose-response relationship[2]

Extrapolations of data obtained from other enteric viruses give an estimated risk of morbidity of $9x10^{-3}$, in a subject consuming 60 g of raw shellfish (weight of mollusc) contaminated by fewer than 10 infectious viruses.

Epidemiology

Hepatitis A is monitored in France based on mandatory notification set up in 2006. Cases are defined by the presence of anti-HAV IgM in the serum. From 2006 to 2009, 5024 cases of acute hepatitis A were reported. The annual rate of incidence of notified cases was similar over the four years, at about 2 per 100,000. Forty-one percent (1,879 cases) required hospitalisation and 3% (480) presented a severe form requiring a spell in intensive care. No deaths were reported in these notifications. The two main risk exposures reported in mandatory notifications (several possible exposures) were the presence of cases of hepatitis A in the immediate family circle/entourage and travel outside France in the 2 to 6 weeks preceding onset, reported for 49% and 42% of cases, respectively. Consumption of shellfish was reported for 25% of the cases notified, though it was not possible to attribute the onset of hepatitis A to this origin.

Since the 1990s, 10 outbreaks of foodborne hepatitis A have been investigated and reported on in France and no cases of mortality have been observed. Seven of these were attributed to the consumption of foods contaminated during production, six concerning shellfish and the seventh dried tomatoes. Three were related to the consumption of foods contaminated by a handler during their preparation.

The most recent data currently available in France on anti-HAV seroprevalence in the French population are taken from a national survey carried out in 1998-1999. Anti-HAV seroprevalence was estimated to be 14% for the group aged 16-20, 23% for those aged 21-25, 31% for those aged 26-30, 49% for those aged 31-35, 48% for those aged 36-40 and above 65% for those older than 40. The results of an analysis, currently under way, of a survey for the period 2009-2010, will provide more recent data on seroprevalence.

Role of food

Main foods to consider

Foodborne contamination, which is estimated to cause 2 to 5% of hepatitis A cases in the USA and 5% of cases in France, can be responsible for isolated cases or massive outbreaks of hepatitis A. Cases occurring less than 14 days apart are generally primary cases with the same source of foodborne contamination. Those observed more than 60 days after the start of the outbreak are secondary cases, related to direct transmission of the virus from person to person.

Foods at risk can be divided into two categories: first, foods that can be contaminated during production, such as produce cultivated by irrigation or produced by immersion involving contaminated water (bivalves, fruits (raspberries, strawberries, etc.), vegetables consumed raw (carrots, parsley, fennel, spring onions, tomatoes, etc.)) and secondly, foods that can be contaminated during handling without hygiene precautions being taken by an infected operator (potentially all types of handled food consumed raw or insufficiently cooked).

Inactivation treatments in primary production or industrial environments

Little information is available about the efficacy of industrial treatments on produce naturally contaminated by HAV. The information given below concerns laboratory experiments. Generally speaking, virucidal treatments are considered as effective if they result in 4 $\log_{10}$ reduction in viral titre.

Water for irrigation can be decontaminated by different types of treatment, biocidal (Table 3A) or physical (ultraviolet radiation at 400 J/m² to obtain 4 $\log_{10}$ reduction). Both of these types of treatment can also be applied to foods (Table 3B).

(1) Susceptible population group: people with a higher than average probability of developing symptoms of the disease, or severe forms of the disease, after exposure to a foodborne hazard [definition used for ANSES data sheets].

(2) For a given effect, the relationship between the dose and the response, i.e., the probability of this effect appearing in the population.

Table 2. **Characteristics of the disease**

Mean incubation period	Target population	Main symptoms		
			(%) Children	(%) Adults
30 days [15 à 50 days]	• Travellers in regions where HAV is highly or moderately endemic. • Close contact with an infected patient. • Subjects exposed occupationally (personnel working in sewers or sewage plants, personnel in day-care centres and paediatric institutions or services, laboratory technicians). • Prisoners, drug addicts, male homosexuals.	Influenza-like illness	48	63-78
		Digestive disorders (nausea, abdominal pains)	50-65	37-67
		Jaundice + increase in ALAT*	56-65	76-88
		• Cholestatic forms** • Exceptionally, extrahepatic symptoms (neurological, renal, essential thrombocytopenia, cryoglobulinemia) • No chronic forms		
Duration of symptoms	**Duration of infectious period (shedding)**	**Complications**		**Asymptomatic forms**
2 months [1 to 4 months]	Intermittent faecal shedding. 15 days to 1 month after contamination and up to 30 days (or even 5 months in infants) after the onset of clinical symptoms or an increase in ALAT*.	• Relapse forms (3 to 20%) • Severe fulminant forms (<0.5%) • Lethality: 0.2% to 0.4% of symptomatic cases but can exceed 2% after 40 years		Children (<5 yrs): 80 to 90% Adults: 20 to 30%

* ALAT = alanine amino-transferase.

** Forms of hepatitis A which include cessation or reduction of the production of bile through hepatocyte dysfunction.

Table 3A. **Efficacy of chemical treatments of water regarding HAV**

Treatment	CT values* ($mg.L^{-1}.min$) normally used for treating water
Ozone (O_3)	2 to 5
Chlorine dioxyde (ClO_2)	10 to 20
Hypochlorite (ClO)	15 to 30

* CT: the product of the concentration of the disinfectant multiplied by the contact time. It varies depending on water quality (variable organic load).

Table 3B. **Treatments capable of obtaining 4 log_{10} reduction in infectious titre of HAV in foods**

High pressure		
Strawberry purée: 375 MPa, 5 min.		
Spring onions: 375 MPa, 5 min.		
UV		
Spring onions: 40 to 240 J/m²		
Heat treatments		
Matrix	**Temperature (at core of product)**	
Milk (3.5% fat)	71°C/9 min or 80°C/25 s.	
Cream (18% fat)	71°C/13 min or 80°C/28 s.	
Cockles	85-90°C/1 min	
Mussels	90°C/2 min	
Strawberry purée (28% sugar)	80°C/5 min or 90°C/2 min	
Strawberry purée (52% sugar)	80°C/36 min or 90°C/12 min	
Chemical treatments		
Disinfectant	**Matrix**	**Number of log_{10} reduction in titre**
Free chlorine 10 mg/L, 10 min, pH7	Strawberries/Cherry tomatoes/Lettuce	2.2 / >2.3 / >2.3
Free chlorine 20 mg/L, 10 min, pH7	Strawberries/Cherry tomatoes	2.3 / >2.4
Free chlorine 200 mg/L, 5 min, pH7	Strawberries	2.6

Monitoring in food

It is difficult to cultivate HAV; detection and quantification are usually performed by molecular biology. No regulatory criteria have been established to date.

Concerning methods for analysing HAV in the environment and food, standardisation work is in progress at European level (molecular techniques and real-time RT-qPCR). Concerning water, analysis requires the filtering of a large volume of water to concentrate the enteric viruses (the XPT 90-451 standard).

Recommendations to operators

- **Kitchen staff or anyone else involved in handling foods, especially those intended to be eaten raw or lightly cooked, should be made aware of the risk of faecal-oral transmission and the need to observe strict hygiene measures. All personnel should understand the importance of not handling food if they present symptoms of hepatitis.**
- **It is recommended that personnel be vaccinated (according to the Opinion of the French High Council for Public Health). In addition, observing the procedures for cleaning and disinfecting and the choice of raw materials (origin, area of production, risk of viral contamination, etc.) contribute to better control of viral risk.**
- **Furthermore, it should be noted that European regulations include the obligation for certain categories of shellfish to undergo heat treatment.**

Domestic hygiene

The hepatitis A virus is resistant to conventional food storage methods (refrigeration and freezing). Before consumption, fruits and vegetables intended to be consumed raw should be abundantly rinsed with drinking water. Only shellfish from authorised and inspected areas may be consumed raw. Observation of normal hygiene rules helps to prevent transmission from person to person.

Recommendations to consumers

- **Personal and collective hygiene remains the basis for primary prevention. It is absolutely necessary that hands be washed thoroughly after using the toilet and before preparing or eating food.**
- **People infected with HAV must not handle food.**
- **Avoid consuming shellfish that do not come from authorised and inspected areas of production, unless they have been thoroughly cooked.**
- **In countries with poor hygiene levels or endemic regions, vegetables should only be consumed cooked or peeled and no water should be drunk that is potentially contaminated. In this case, drink only spring or mineral water in sealed bottles, boiled water (10 min) or micro-filtered water.**

References and links

General references

- AFSSA Report, Feb. 2007. *Bilan des connaissances relatives aux virus transmissibles à l'Homme par voie orale* [Current knowledge on viruses that can be transmitted to humans by the oral route], 446 pages, www.anses.fr.
- ANSES Report, Sep. 2010. *Contamination de coquillages marins par le virus de l'hépatite A - Recommandations pour l'amélioration de la maîtrise du risque* [Contamination of marine shellfish by the hepatitis A virus - Recommendations for improving risk control], 117 pages, www.anses.fr.
- Craven H, Duffy L, Fegan N, Hillier A. 2009, Semi-dried tomatoes and hepatitis A virus. CSIRO publication, 58 pages.

Useful links

- French NRL for the microbiology of shellfish, IFREMER Nantes, www.ifremer.fr
- French NCR for enteric viruses (HAV and HEV), Paris, www.cnr.vha-vhe.aphp.fr