

Stable isotope techniques for verifying the declared geographical origin of food in legal cases – scientific opinion

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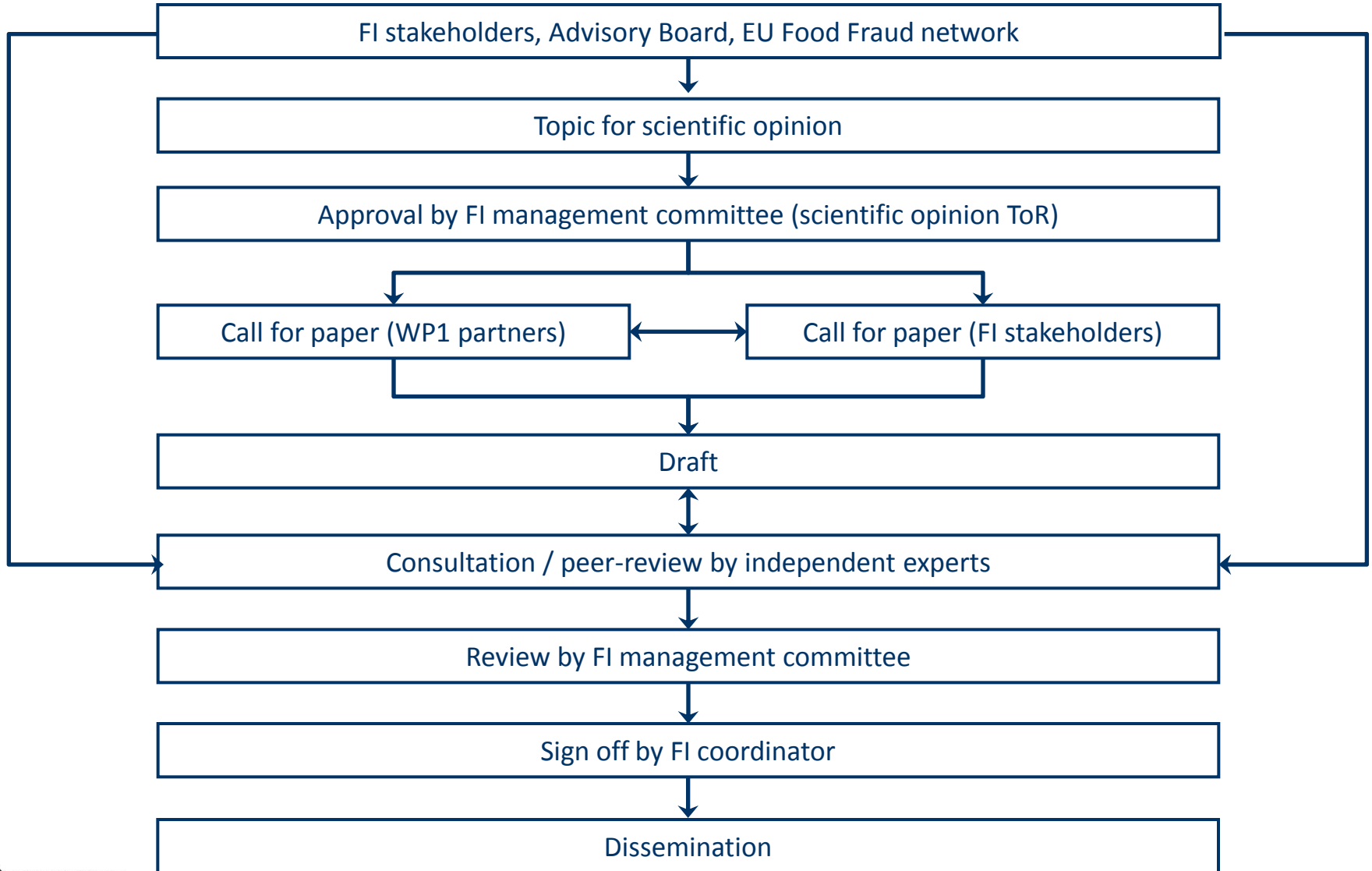
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What is a scientific opinion?

generally refers to the collection of the opinions of many different scientific organizations and entities and individual scientists in the relevant field.

FI: collection of expert opinions to provide scientific advices to stakeholders in the area of food integrity

FI process



First Scientific opinion:

Stable isotope techniques for verifying the declared geographical origin of food in legal cases

Background of SIRA:

- Several application in food authentication (official methods)
- Plethora of research articles on application for determining geographical origin of food

Aims of scientific opinion:

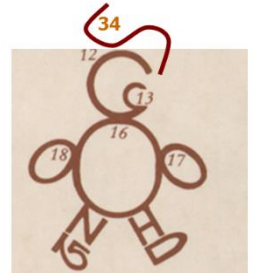
- use in court cases
- feasibility to provide robust evidence for prosecution



Terms of Reference

The experts should focus on the following aspects:

- Selectivity, specificity, robustness
- comparison with alternative methods: advantages/limitations
- strategies
- examples of previous uses by the legal system
- best practice guide for stakeholders



$^2\text{H}/^1\text{H}$, D/H

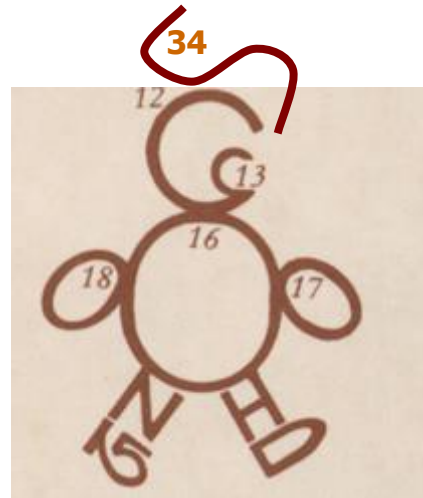
$^{13}\text{C}/^{12}\text{C}$

$^{15}\text{N}/^{14}\text{N}$

$^{18}\text{O}/^{16}\text{O}$

$^{34}\text{S}/^{32}\text{S}$

Stable isotopes ratios



$^{87}\text{Sr}/^{86}\text{Sr}$

Geography

Climate

Agriculture

Geology

Advantages: 1. Stable isotope ratios methods as official standards

Year	Method	product	Method	Isotope Ratio	Fraud
1987	OIV	wine, must	SNIF-NMR	D/H	sugar addition (beet, cane)
1990	EU Reg 2676/90, encl. 8	wine, must	SNIF-NMR	D/H	sugar addition (beet, cane)
1991	AOAC 998,12	honey	IRMS	$^{13}\text{C}/^{12}\text{C}$	sugar addition (cane)
1993	ENV 12140, 13070	fruit juice	IRMS	$^{13}\text{C}/^{12}\text{C}$	sugar addition (cane)
1995	AOAC 995,17	fruit juice	SNIF-NMR	D/H	sugar addition (beet, cane)
1996	OIV 2/96	wine, must	IRMS	$^{18}\text{O}/^{16}\text{O}$	addition of water/mislabelling
1997	EU Reg 2676/90, 822/97	wine, must	IRMS	$^{18}\text{O}/^{16}\text{O}$	addition of water/mislabelling
1997	ENV 12141	fruit juice	IRMS	$^{18}\text{O}/^{16}\text{O}$	addition of water/mislabelling
2000	AOAC 2000.19	maple syrup	SNIF-NMR	D/H	sugar addition (beet, cane)
2000	OIV 71/2000	vinegar	SNIF-NMR, IRMS	D/H, $^{13}\text{C}/^{12}\text{C}$	sugar addition (beet, cane)
2001	OIV 17/2001	wine, must	IRMS	$^{13}\text{C}/^{12}\text{C}$	sugar addition (cane)
2003	EU Reg. 2676/90, 440/03	wine, must	IRMS	$^{13}\text{C}/^{12}\text{C}$	sugar addition (cane)
2003	OIV MA-F-AS314-03	wine	IRMS	$^{13}\text{C}/^{12}\text{C}$	technogenic CO_2
2004	AOAC 2004,01	fruit juice, maple syrup	SNIF-NMR	D/H	sugar addition (beet, cane)
2006	AOAC 2006,05	vanillin	SNIF-NMR	D/H	synthetic vanillin
2007	OIV-MA-AS312-07	wine	IRMS	$^{13}\text{C}/^{12}\text{C}$	addition of glycerol
2011	EU Reg 584/2011	Grana Padano DOP	IRMS	D/H, $^{13}\text{C}/^{12}\text{C}$, $^{15}\text{N}/^{14}\text{N}$, $^{34}\text{S}/^{32}\text{S}$	mislabelling
2013	EN 16466-1, 2, 3	vinegar	SNIF-NMR, IRMS	D/H, $^{13}\text{C}/^{12}\text{C}$, $^{18}\text{O}/^{16}\text{O}$	water and sugar addition (beet, cane)
2013	OIV 510, 511/2013	vinegar	IRMS	$^{13}\text{C}/^{12}\text{C}$, $^{18}\text{O}/^{16}\text{O}$	water and sugar addition (cane)



Methods usable in official controls

EU Regulation 822/2004

- EU regulation and OIV methods for grape products
- internationally recognised rules or protocols (e.g. CEN)
- methods agreed in national legislation
- scientific protocols, after validation according to ISO 5725:1994 or the IUPAC International Harmonised Protocol

Advantages: 2. Reference data set: Isotopic Databanks

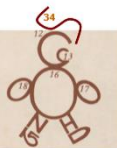
Robust databanks:

- updated every year
- methods officially recognized (OIV, CEN, validated)
- several court cases



based on regulations (e.g. EU wine databank)

created by product-specific association or consortia (e.g. AIJN for fruit juices, Grana Padano PDO and Parmigiano Reggiano PDO cheese; asparagus; beef, pork; eggs; olive oil)



Court cases



Several for wine – must from 1990:

criminal or civil court

Cheese:

- the consortium suspends the PDO licence for 6 months and asks for a fee.
- the producer can be prosecuted in the court (Legislative Decree no. 297/2004, published in the Official Gazette of 15.12.04)

Limitation: Isotopic Databanks

yearly update: who pays?

not public

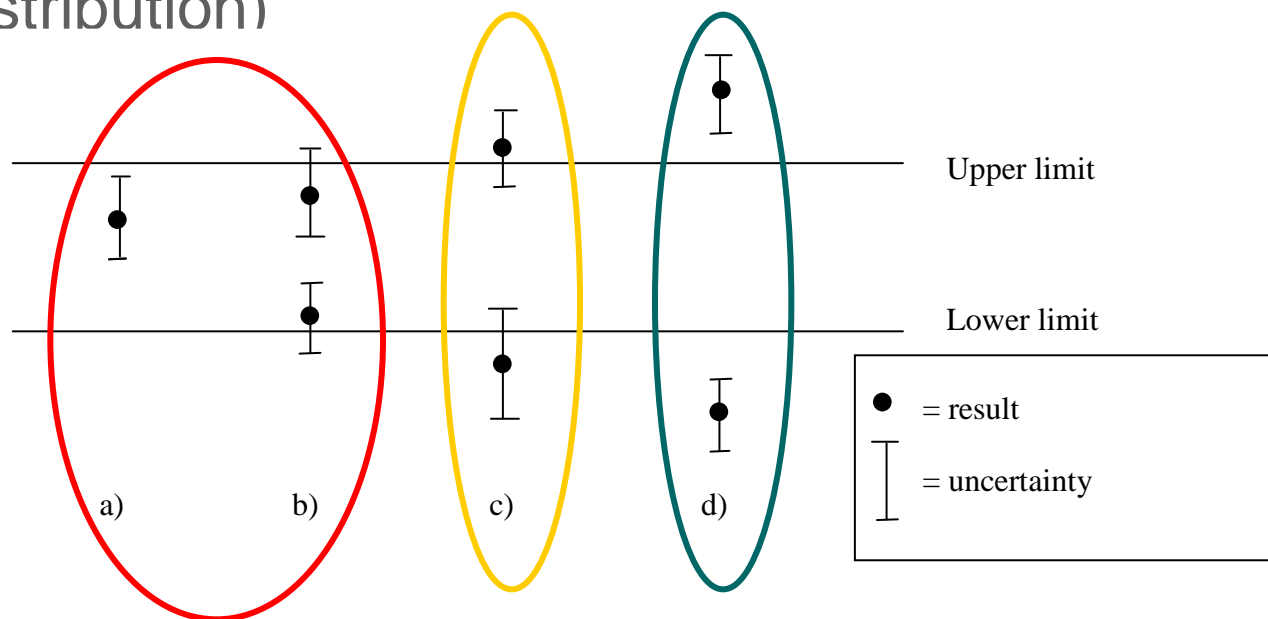
possible confounders (experts)

Alternative: isoscapes (not in the court..)



Strategy: Definition of limits and compliance

- selection of reference data
- computing 95% confidence limits (t-student two tailed distribution)



Case specific databanks and court cases

- non standard methods
- non extensive databank
- created within the framework of a project (i.e. the EU projects PURE JUICE and TRACE)
- on requirement, to detect particular fraud cases (i.e. butter circular trade or beluga caviar)

Caviar case



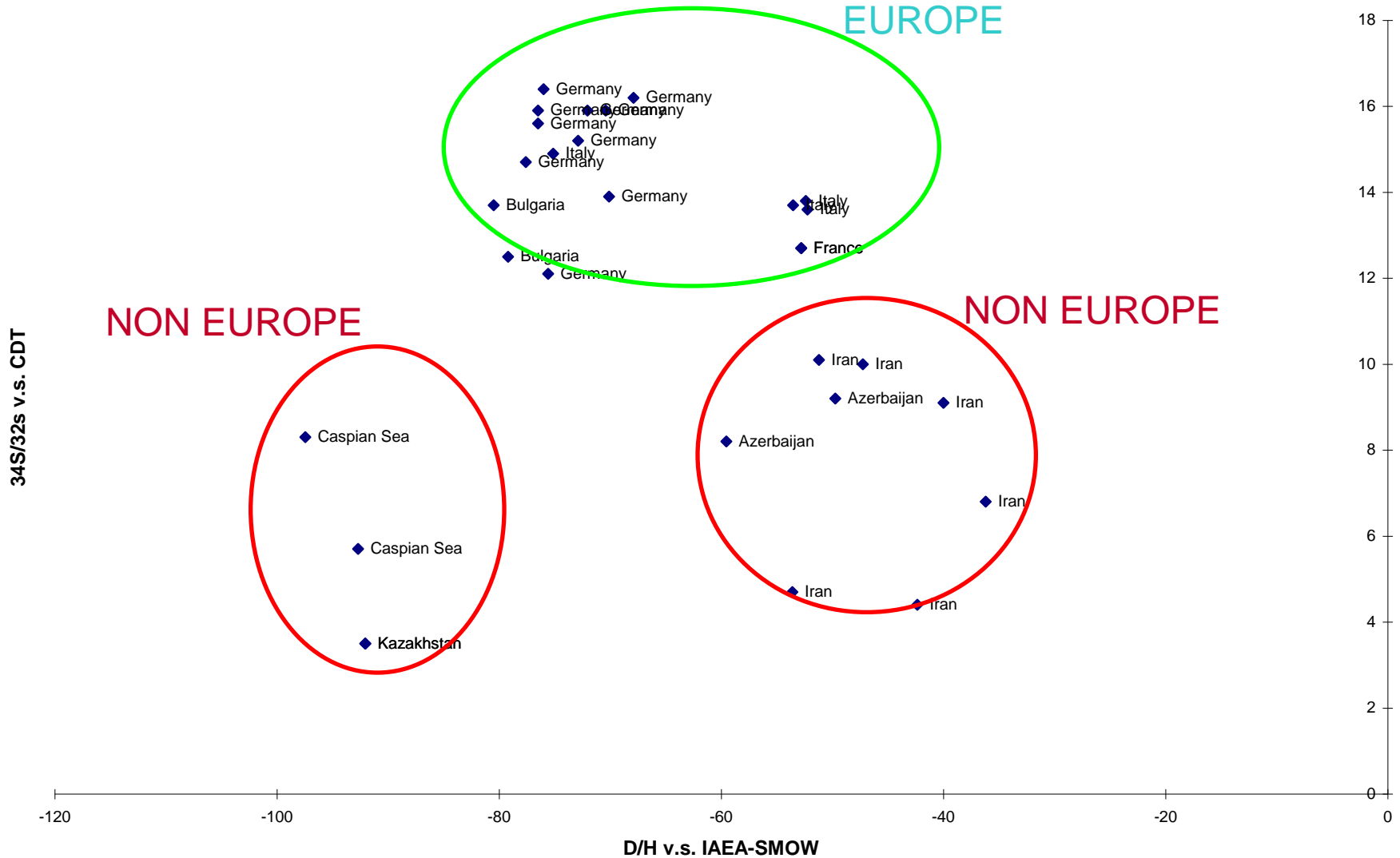
Suspicion of German customs: illegal beluga caviar was imported from the Caspian region and sold on the German market

Databank: Germany, Italy, France, Iran, Azerbaijan, Caspian sea; COHNS in the sample water and row proteins

The method was accepted from the court

The trader was imprisoned for one year + fee of around 150.000 €.

Differentiation of caviar using hydrogen (D/H) and sulfur (^{34}S)



Fruit Juices



Databank of EU project PURE JUICE stored by SGF International e.V. (Nieder-Olm, Germany)

Procedure of SGF:

- Non compliance has to be confirmed in two laboratories
- Agreement with producer
- If not, punitive review desist
- Only if producer does not sign it or gives reason for complaints after having signed it, SGF initiates a court case.



Ensuring the Integrity of the European food chain

Good practice guide to create and use a databank in legal system (....to be completed)

Robust databank (update, who pays)

Official standards

Accredited laboratories

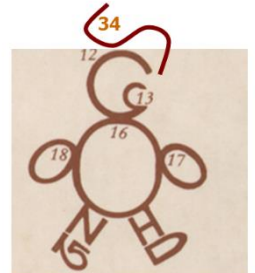
Successful court cases also with scientific methods and non extensive databanks

Multi-isotope evaluation, but univariate comparison, uncertainty

Terms of Reference: what is missing

The experts should focus on the following aspects:

- Selectivity, specificity, robustness
- comparison with alternative methods: advantages/limitations
- strategies
- examples of previous uses by the legal system*
- best practice guide for stakeholders*



*: to be completed

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