



RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

Experience in determining the country of origin of strawberries

Finnish Food Authority

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Head of Chemistry Unit

Strawberry project seminar in Tallinn

24.11.2022

Mission

Safety and competitiveness together with the food chain

Vision 2030

Responsible food – good life

Goals for impact

Domestic food production and rural areas are economically viable

Animals and plants are healthy and well

Food is safe and healthy

Values

Mutual appreciation

Openness

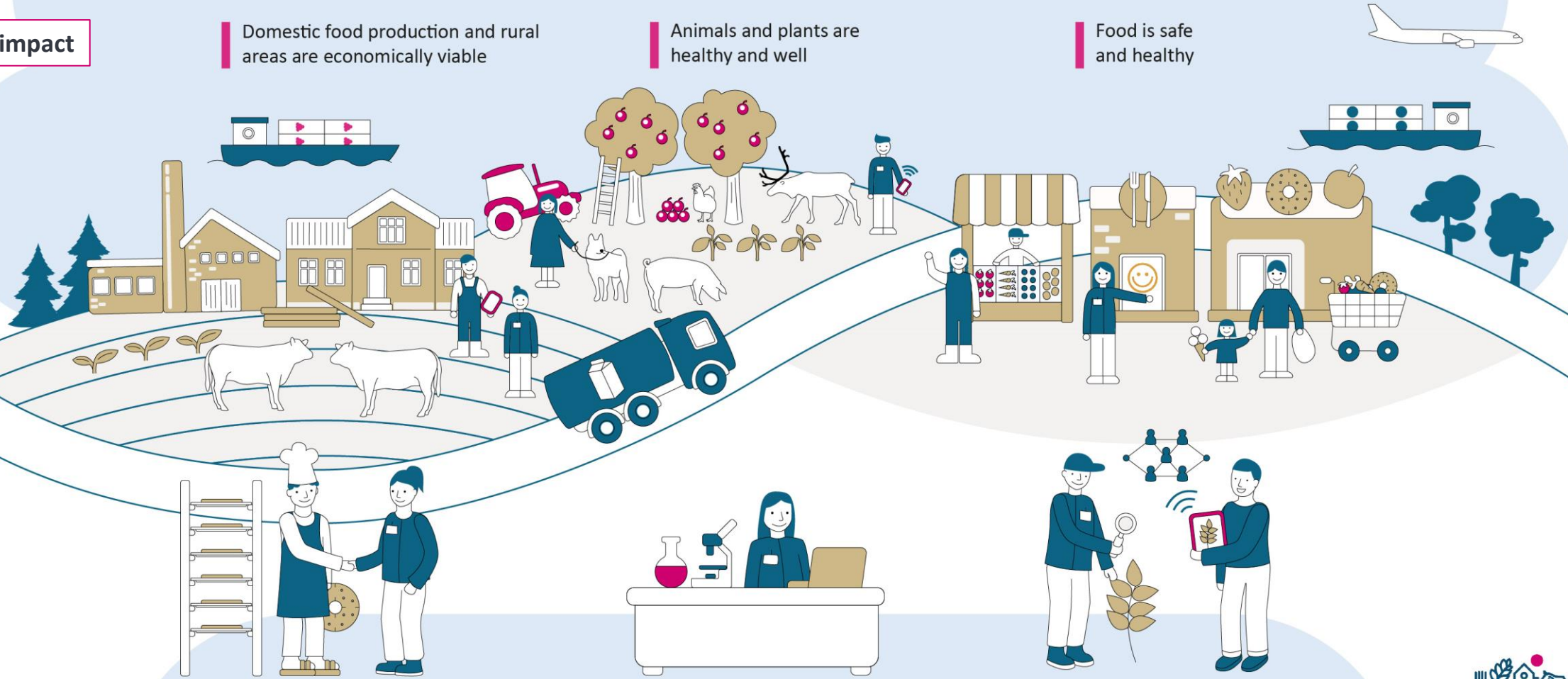
Solution-focused approach

Goals for enablement

We are customer- and service-oriented

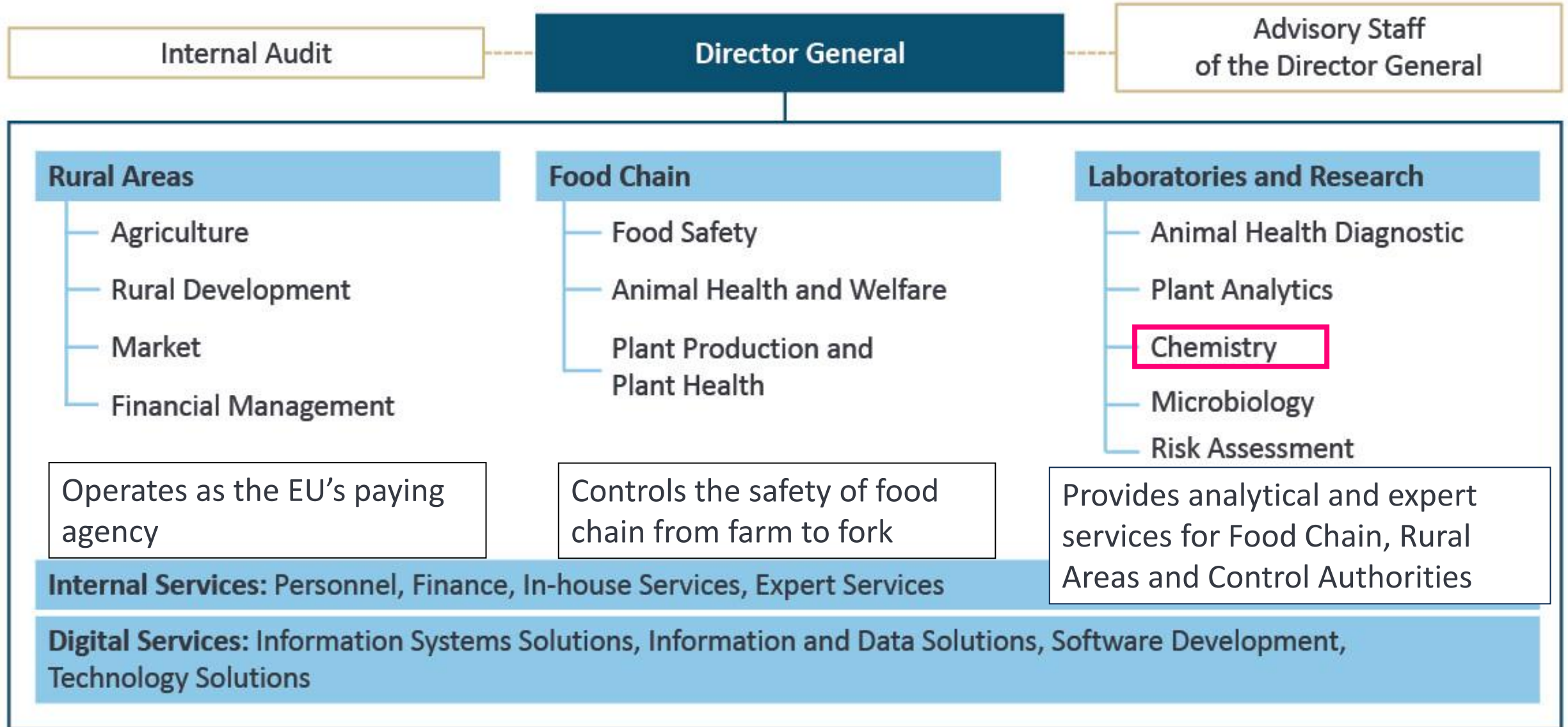
Knowledge, research and technologies serve the customers and the food system

We learn and renew together



**FINNISH FOOD
AUTHORITY**
Ruokavirasto • Livsmedelsverket

Finnish Food Safety Organisation





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Expertise and resources of Chemistry Unit



Chemistry Unit

- 20 Researchers and 33 Technicians
- Three sections:
 - Composition and Origin
 - Organic Residues
 - Inorganic Chemistry
- EU NRL (EC 625/2017) in 14 expertise areas
- Number of analyses (2021)

| | |
|--------------------------------------|--------|
| • Food safety: | 164200 |
| • Animal health and welfare: | 3300 |
| • Plant production and plant health: | 1700 |



What

- Composition
- Primary nutrients
- Trace elements
- Heavy metals
- Veterinary drugs
- Mycotoxins
- Hormones
- Pesticides
- Contaminants
- GMO
- Authenticity
- Isotope ratios

Which matrix

- Food
- Feed
- Fertilizers
- Animals
- Plants
- Plant protection agents

To whom

- Competent authorities: Finnish Food Authority
Food chain is the main customer
- Municipal authorities
- Food, feed and fertilizer business operators
- Partners (LUKE, SYKE THL)

Why

- Annual control programs
- Other control samples
- Monitoring
- Projects
- Scientific research
- Analyses made on request



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Food fraud investigations in Finland

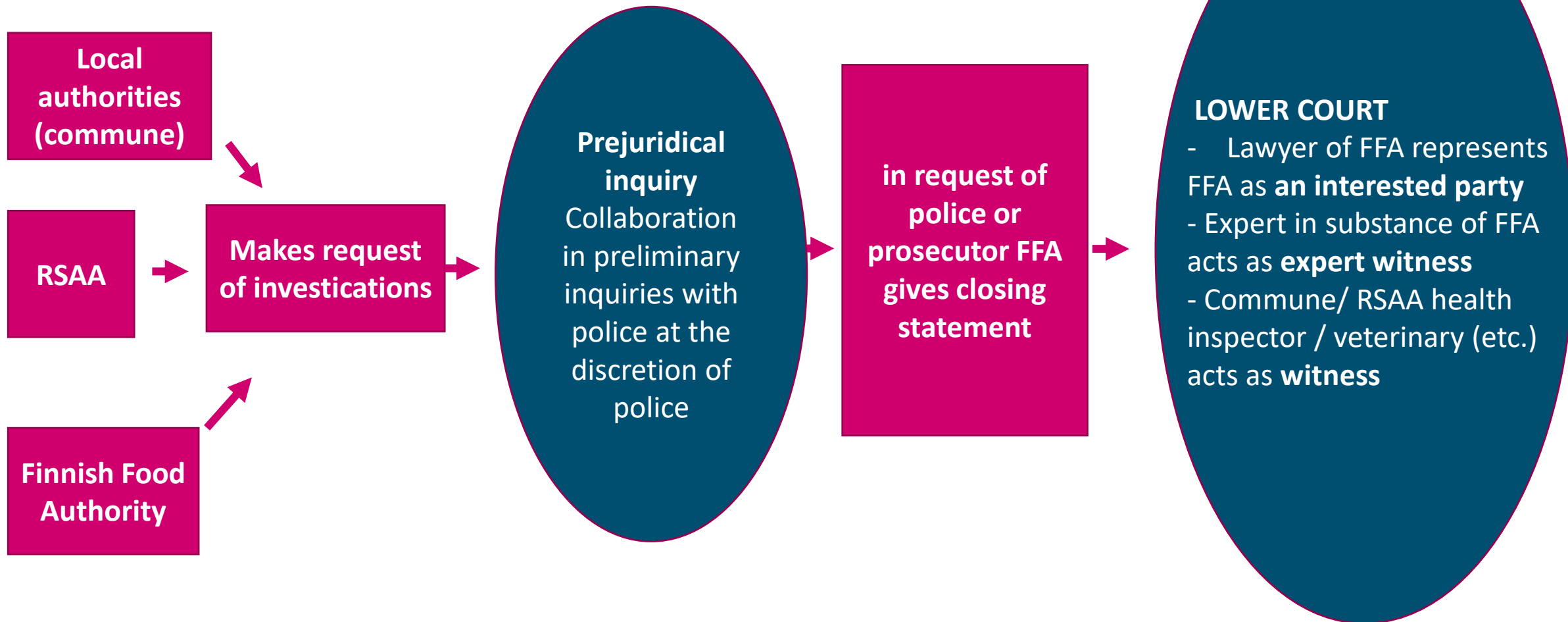


Investigation of food frauds in Finland

- Competent Authorities are more and more aware that food frauds are not accidental mistakes but can be well organized crimes in which penalties are still very mild
- Collaboration between control and competent authorities in Finland:
 - Tax Administration Unit, Police, Customs, Finnish Food Authority, Regional State Administrative Agency (6), Centre for Economic Development, Transport and the Environment (15), Communal Competent Authorities (62)
<https://www.vero.fi/en/grey-economy-crime/>
- Collaboration in EU level:
 - The EU Food Fraud Network https://ec.europa.eu/food/safety/food-fraud/ffn_en
 - Administrative Assistance and Cooperation System, AAC
https://ec.europa.eu/food/safety/food-fraud/aas_en
 - EU coordinated actions
https://ec.europa.eu/food/safety/food-fraud/coord-act_en



Proceeding of Criminal Action in Food Sector





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Food fraud investigations, laboratory side

Strawberry database of Finland



- Stable isotope technique to investigate geographical origin of Finnish strawberries
- Reference database of close to 500 samples from more than 150 locations
- Covering the whole growth area of strawberries in Finland
- Samples were collected during years 2017-2019
- Collaboration between Natural Resources institute Finland (Luke) and Finnish Food Authority together with German laboratory Agroisolab GMBH
- Databases contains profile of relative values of stable isotopes of $^2\text{H}/^1\text{H}$, $^{13}\text{C}/^{12}\text{C}$, $^{15}\text{N}/^{14}\text{N}$, $^{18}\text{O}/^{16}\text{O}$, $^{34}\text{S}/^{32}\text{S}$ in tissue water and kernel proteins
- Technique EA-IRMS (Element Analyser – Isotope Ratio Mass Spectrometry) ja HT-EA-IRMS (High Temperature Element Analyser – Isotope Ratio Mass Spectrometry)
- Database is updated annually with 5 to 10 samples
- Database is in use, 1-10 samples per year is sent for analyses of geographical origin





Laboratory go through: sample arrival

- Sample is sent to Finnish Food Authority, Chemistry unit with cover letter (Request of analysis)
- Sample is sent by for example food inspector from commune or by food operator
- After arrival, [strawberry] sample is frozen, and the information from the cover letter is recorded to the LIMS
- sample gets *Request Id number*, *sample number* and *list of parameters of requested analyses*

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TUTKIMUSLÄHETE
Kemialliseen analyysiin

Lähetetunnus _____ HKEM _____

Täytä koneella tai selvästi teksten.

| | |
|--|-------------------------|
| Tutkimuksen tilaaja: _____ | |
| Osoite: _____ | Puhelin: _____ |
| <input type="checkbox"/> Haluan, että tutkimustodistus lähetetään tähän sähköpostiosoitteeseen. Muutoin se lähetetään postitse. Sähköpostiosoite: _____ | |
| Näytteen lähettäjä (jos eri kuin tilaaja): _____ | |
| Osoite: _____ | Puhelin: _____ |
| <input type="checkbox"/> Haluan, että tutkimustodistus lähetetään tähän sähköpostiosoitteeseen. Muutoin se lähetetään postitse. Sähköpostiosoite: _____ | |
| Näytteenottoaika: _____ | Näytteenottoaika: _____ |
| Tutkimus on: <input type="checkbox"/> maksullinen <input type="checkbox"/> maksuton | |
| Tutkimustodistus lähetetään: <input type="checkbox"/> tutkimuksen tilaajalle <input type="checkbox"/> näytteen lähettäjälle | |
| Lasku lähetetään: <input type="checkbox"/> tutkimuksen tilaajalle <input type="checkbox"/> näytteen lähettäjälle | |
| <input type="checkbox"/> Muu, osoite: _____ | |

NÄYTTEIDÖT

| | |
|--|----------------------------------|
| Eläinlaji / Rehu / Lannoitevalmiste: _____ | Näytelaji / Näytematriisi: _____ |
| Elintarvike / Tuote: _____ | |
| Muu: _____ | |
| Asiakkaan näytekoodit: _____ | Lukumäärä: _____ |
| Halutut tutkimukset: _____ | |
| Näytteiden säilytys: _____ | |
| Lisätietoja: _____ | |

| | |
|---------------|---------------------------------------|
| Päiväys _____ | Allekirjoitus ja nimenselvennys _____ |
|---------------|---------------------------------------|

Näytteistä voidaan tehdä myös muita kuin tilaajan pyytämää tutkimuksia. Näitä tutkimuksia ei laskuteta tilaajalta. Ruokavirasto pidättää itsellään tutkimustulosten julkaisuoikeudet. Tulokset voidaan julkaista erilaisissa raportissa ja tilastoissa sekä kotimaisissa että kansainvälisissä tieteellisissä julkaisuissa.



Laboratory go through: shipping of the samples

- Samples are kept frozen at $-20\text{ }^{\circ}\text{C}$ until sending to the commercial laboratory with a courier company; the shipping is done by aeroplane
- Commercial laboratory is contacted before sending the samples
 - shipping only during Monday - Tuesday to minimize possible logistical problems
- To keep the samples frozen over the shipping, the samples are stored into a cooling box filled with dry ice (solidified liquid CO_2 , $-78,5\text{ }^{\circ}\text{C}$)
- Typically, the results are got within two-three weeks from the commercial laboratory as a .pdf and excel-file



Laboratory go through: certificate of analysis

Results:

| sample | TW $\delta^2\text{H}$ [‰] v.s. VSMOW | TW $\delta^{18}\text{O}$ [‰] v.s. VSMOW | Kernels, ex $\delta^2\text{H}_{\text{org}}$ [‰] v.s. VSMOW | Kernels, ex $\delta^{18}\text{O}_{\text{org}}$ [‰] v.s. VSMOW | Kernels, ex $\delta^{13}\text{C}$ [‰] v.s. VPDB | Kernels, ex $\delta^{15}\text{N}$ [‰] v.s. Air | Kernels, ex $\delta^{34}\text{S}$ [‰] v.s. VCDT |
|--------|--|---|--|---|---|--|---|
| x | -59.8 ± 0.7 | -5.4 ± 0.3 | -120.4 ± 1.7 | 21.1 ± 1.0 | -26.9 ± 0.2 | 4.1 ± 1.7 | 4.8 ± 1.9 |

Quick evaluation:

- = likely to be from the declared origin
- = doubts, has to be verified with further information
- = unlikely, based on current evidence the sample is evaluated as mislabelled with respect to its provenance

- The isotopic data from the samples are evaluated with a discriminant analysis (DA) taking into account the current Finnish reference database.
- Or: within the current state of knowledge, taking into account the analysed isotope values, there is currently no significant indication of misdeclaration with the regard to the geographical origin.
- Results are added to FFA LIMS system and certificate of analysis is created

Laboratory go through: Elmo, certificate of analysis



- Original report from Agroisolab together with the report of FFA is sent to the customer.
- Invoicing is done at the same time as reporting
- The results states whether the origin of the product is Finnish or not



Laboratory go through: Certificate of analysis

- If the results state that there are doubts of origin or it states that strawberries are not likely to be Finnish origin, further actions might follow

LOWER COURT

- Lawyer of FFA represents FFA as **an interested party**
- Expert in substance of FFA acts as **expert witness**
- Commune/ RSAA health inspector / veterinary (etc.) acts as **witness**

- Researcher might be called to court to act as an expert witness
- What does the results prove
- Performance parameters of method
 - Reliability, measurement of uncertainty
 - Sample traceability



Further developments

Methods

- How to develop the methods further when when geographical origin can not be determined only by stable light isotopes (the difference between Finland and Estonia are sometimes too small)

New type of approaches

- How to explain the new type of methods in the court: how reliable they are, what they are based on



Geographical origin, methods development

- Database:
 - We aim to update the database with at least 10 samples per year
 - Method development in Ruokavirasto
 - We have developed a method to extract tissue water from strawberries and other plants
 - We have two IRMS equipment to analyse $\delta^2\text{H}$, $\delta^{18}\text{O}$, $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ from water and from solid samples
 - At least screening method to study the geographic origin of strawberries
 - Method development for other matrixes

- Scientific projects to study heavy stable isotopes (Sr) in determination of geographical origin



Photo: Simo Jokinen

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