

Regional characteristics and food safety of honey collected in Japan

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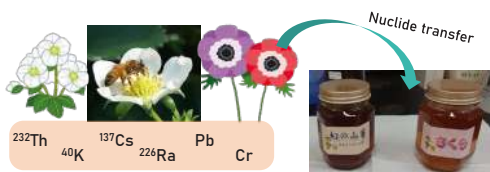


Conclusion

- Japanese Honey is safe in terms of both radioactivity and elemental analysis.
- Honey contains information that reflects the collection area.

Radionuclides and Elements

- The elements in honey are **useful as tracers** for assessing the environment around the honey-harvesting area.
- Evaluation of **potential health effects** associated with honey consumption is important.
- In Japan, the **TEPCO Fukushima Daiichi Nuclear Power Plant (FDNPP)** accident has occurred in 2011.



Purpose

We analyzed honey samples collected across Japan to investigated their **regional characteristics and food safety**.

Material and Methods



Commercial honey samples

Radioactivity analysis



Filling

The samples were placed in stainless steel containers and sealed.



Gamma-ray spectrometry

High-purity germanium semiconductor detector (PGT, Inc. IGC-10200NPR)

Elemental analysis



Acid decomposition

Two to 4 g of honey samples were decomposed by the HNO₃ in Teflon beaker.



Inductively Coupled Plasma Atomic Emission Spectrometry (ICAP6500 Duo, Thermo Scientific Inc.)

Calculated annual effective dose¹⁾

$$E_{eff} = A_c \times A_{ig} \times D_{cf}$$

E_{eff} : Annual effective dose [Sv/y]

A_c : Activity concentration [Bq/kg]

A_{ig} : Annual ingestion of honey [kg/y]

D_{cf} : Effective dose coefficient [Sv/Bq]

Value of effective dose coefficient

2.2×10^{-7} for ²³²Th 2.8×10^{-7} for ²²⁶Ra

1.3×10^{-8} for ¹³⁷Cs 6.2×10^{-9} for ⁴⁰K

Concentration distribution of radionuclides in Honey

- We detected natural radionuclides: ⁴⁰K, ²²⁶Ra and ²³²Th.

Artificial radionuclides ¹³⁷Cs in honey by radioactivity analysis.

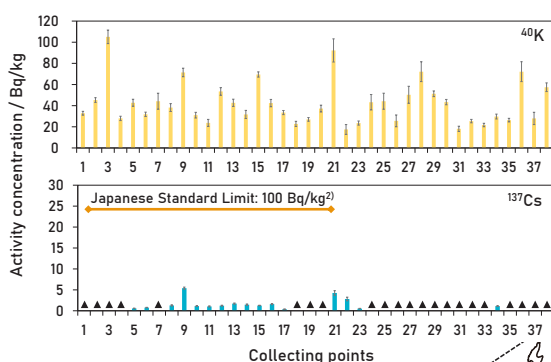


Fig. 2 Activity concentration of ⁴⁰K and ¹³⁷Cs in honey collected in Japan (▲: N.d.).

Regional variations were observed in the concentrations of radionuclides in honey.

<Standard limits for Caesium-137>⁶⁾

USA : 1200 Bq/kg

CODEX : 1000 Bq/kg

EU : 1250 Bq/kg

References

1) International Commission on Radiological Protection (ICRP), 1990, 'The 1990 Recommendations of the International Commission on Radiological Protection', ICRP Publication 60, Oxford, UK.

2) International Commission on Radiological Protection (ICRP), 1990, 'The 1990 Recommendations of the International Commission on Radiological Protection', ICRP Publication 60, Oxford, UK.

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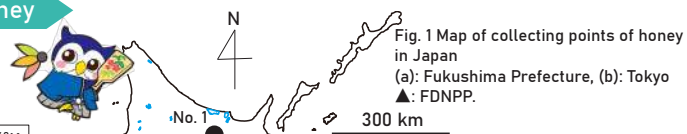


Fig. 1 Map of collecting points of honey in Japan
(a): Fukushima Prefecture, (b): Tokyo
▲: FDNPP.

Annual effective dose

- ①: 0.99 mSv (from food)
- ②: 0.48 mSv (from air)
- ③: 0.33 mSv (from surface)
- ④: 0.3 mSv (from cosmic)

Annual effective dose³⁾

Japan average: 2.1 mSv

World average: 2.4 mSv

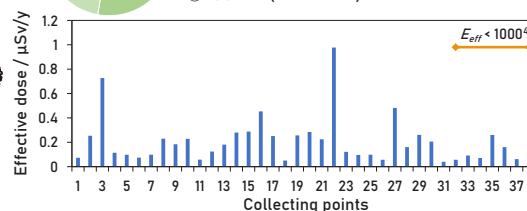
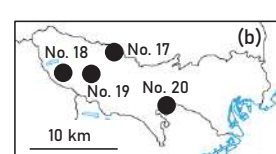
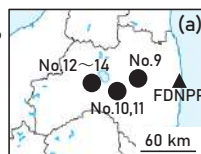


Fig. 3 Calculated annual effective dose for honey.



Heavy metal contents in Honey

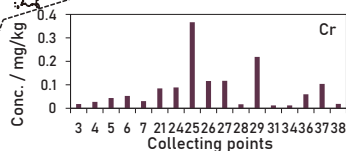


Fig. 4 Conc. of Cr in honey collected in Japan

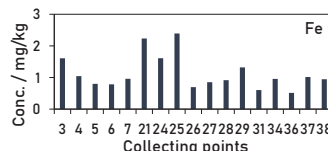


Fig. 5 Conc. of Fe in honey collected in Japan

Some research reported conc. of Cr between 0.01-1.07 ppm and value of Fe recommended under 15ppm⁹⁾.

Japanese honey is a **good quality**.

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Honey can contain radionuclides and heavy metals, making it a useful medium for assessing environmental conditions across relatively large areas through radioactivity and elemental analyses. Regarding the analysis of radioactivity in honey, previous studies have reported the detection of radioactive caesium originating from global fallout in the USA. Understanding the environmental distribution of radionuclides and assessing the potential health effects associated with honey consumption are important areas of investigation. In Japan, the TEPCO Fukushima Daiichi Nuclear Power Plant (FDNPP) accident, which occurred in 2011, released significant amounts of radioactive caesium (^{137}Cs : $T_{1/2} = 30.2\text{ y}$, ^{134}Cs : $T_{1/2} = 2.06\text{ y}$) and other radionuclides into the environment. Due to its long half-life, radioactive caesium persists in the environment. Following the FDNPP accident, radioactive caesium was detected in certain foods produced in Fukushima Prefecture. In this study, we analyzed honey samples collected across Japan to investigate their regional characteristics and food safety. Radioactivity analysis revealed the presence of ^{137}Cs in honey from Fukushima; however, the detected levels were below the Japanese food safety standard of 100 Bq/kg. Caesium-137 was also detected at low levels in honey samples from other regions of Japan. Given that honey is a food product, we also evaluated the potential health risks associated with daily honey consumption. The International Commission on Radiological Protection has established an annual effective dose limit of less than 1 mSv for the general public. The effective dose from consuming Fukushima honey was found to be well below this limit, indicating that it is safe for consumption. In addition to these findings, we present data on the radioactivity and elemental composition of honey samples from various regions of Japan, along with a discussion of their safety and regional characteristics.