

For Human Health and Trust: Ensuring a Safe Food and Water Supply

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Abstract

Is the food you ate and the water you drank today safe? We don't often ask this question because we believe that the food and water supply has undergone rigorous and reliable testing. In order to maintain and build on this trust, we, as a National Metrology Institute (NMI), must continue to establish measurement standards for food and water to ensure the public health and food safety. The development of food and water Certified Reference Materials (CRMs) by NMIs has contributed to the improvement of measurement capabilities in food and water testing laboratories. However, there are still many challenges in the development of CRMs for new, complex, and diverse food products, including limitations in developing CRMs that cover all food matrices and difficulties associated with processing. Developing CRMs to establish measurement standards for future food products is also a challenge we face. Additionally, improving the understanding of traceability and uncertainties in testing laboratories, as well as enhancing the accuracy of measurements, remains an ongoing task. To address these challenges, KRISS has developed various food CRMs with the strategy of developing representative CRMs for each category to cover the entire food matrix. In the broader categories of grains, beans, meat, seafood, vegetables, herbs, fruits, and baby food, KRISS has developed and distributed representative CRMs for each matrix, such as wheat flour, soybean, pork, oyster, kimchi cabbage, ginseng, apple, and infant formula CRMs, to cover the entire food matrix. The development of CRMs for alternative proteins, such as plant-based proteins, cultured meat, or insect protein, and health-oriented foods is also planned to establish measurement standards for future food products. Currently, KRISS has developed various water CRMs for water quality control in power plants. Additionally, KRISS plans to develop water CRMs for categories such as drinking water, streams, lakes, rivers, and seawater, using the same approach as food CRM development. In the process of developing food and water CRMs for various matrices, studies are underway to address the challenges of low sensitivity, overcoming detection limits, eliminating interferences, addressing processing difficulties, and developing new measurement technologies. Moreover, one of the metrology challenges is to secure the measurement reliability of food and water testing laboratories and to continuously improve their measurement capabilities. For this purpose, KRISS is conducting Proficiency Testing (PT) programs using multiple measurement networks. When performing PT, KRISS provides the accuracy-based PT program with a metrological traceable reference value and requires participating laboratories to report traceability and uncertainties to improve the understanding of traceability and uncertainties. KRISS believes that these efforts will greatly contribute to ensuring public health and safety by building trust in the global food and water consumed by humans in the future.

Challenges and Results

Challenges

- Cover all food matrices
- Food matrix which has difficulties associated with processing
 - ✓ High-fat containing sample
 - ✓ Temperature sensitive materials
 - ✓ Samples with volatile component
 - ✓ Soft, elastic, or fibrous material
- Establish measurement standards for future food products
 - ✓ Insect protein
 - ✓ Cultured meat
 - ✓ Plant-based proteins
 - ✓ Health-oriented foods driven by people's dietary habits and environmental responsibility
- Develop water CRMs for water quality control in several categories
- Address challenges
 - ✓ Low sensitivity
 - ✓ Overcoming detection limits
 - ✓ Eliminating interferences
 - ✓ Developing new measurement technologies
- Secure the measurement reliability of food and water testing laboratories
 - ✓ Improve measurement capability
 - ✓ Improve understanding of traceability and uncertainties

Develop Representative CRM

KRISS CRM 108-01-006
Wheat flour

KRISS CRM 108-01-008
Rice

KRISS CRM 108-01-005
Soybean

KRISS CRM 108-05-014
Kimchi cabbage

Food CRMs for each categories (matrix)

- ✓ Grains
- ✓ Beans
- ✓ Vegetables
- ✓ Herb
- ✓ Seafood
- ✓ Meats
- ✓ Fruits
- ✓ Baby food
- ✓ Future food

KRISS CRM 108-05-019
Apple

KRISS CRM 108-03-008
Pork

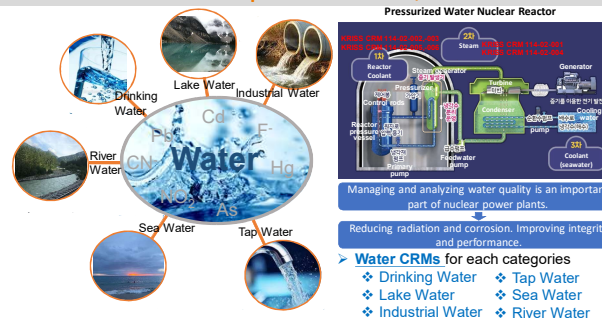
KRISS CRM 108-04-004
Oyster

KRISS CRM 108-10-006
Ginseng

Conclusion

KRISS believes that by developing CRMs, addressing technical challenges, and improving measurement capability of testing labs, we're helping to ensure public health and safety. This work and effort will help build trust in the global food and water supply, which is more important than ever.

Develop Water CRM for QC

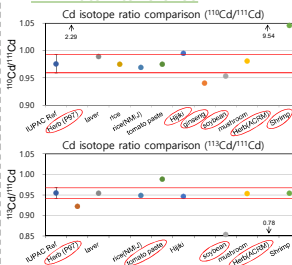


Processing Difficulties

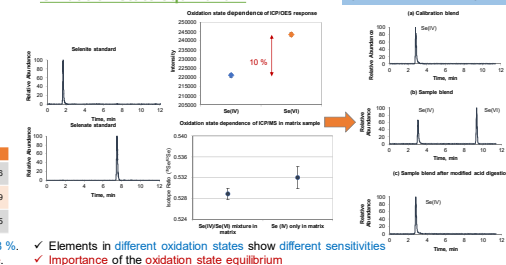


Accurate and Reliable Determination

Eliminate interference



Oxidation state equilibrium



Measurement Reliability of Testing Laboratories

Accuracy-based PT program

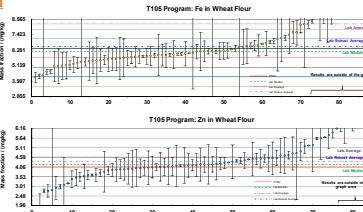
- Measurement capability
- Traceability
- Uncertainties

International PT (APMP-APAC Joint PT)

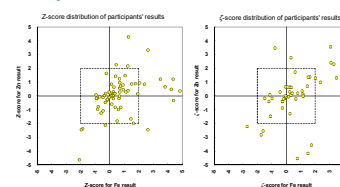


Domestic PT (>2000 labs, >18 years)

Year	Participants	Results	Uncertainty
2004	2000	1.00	0.05
2005	2000	1.00	0.05
2006	2000	1.00	0.05
2007	2000	1.00	0.05
2008	2000	1.00	0.05
2009	2000	1.00	0.05
2010	2000	1.00	0.05
2011	2000	1.00	0.05
2012	2000	1.00	0.05
2013	2000	1.00	0.05
2014	2000	1.00	0.05
2015	2000	1.00	0.05
2016	2000	1.00	0.05
2017	2000	1.00	0.05
2018	2000	1.00	0.05
2019	2000	1.00	0.05
2020	2000	1.00	0.05



Significant differences of consensus values from PTRVs



- ✓ The use of metrologically traceable reference values as PT assigned value instead of consensus values allows reliable assessment without any influence of bias caused by outliers from participants' results.

- ✓ More participants with $|z| \leq 2.0$ (inside the square) are other than $|z| \leq 2.0$.
- ✓ the participant's uncertainty evaluation is underestimated
- ✓ more use of E_r scores in addition to the assessment with the z-scores
- ✓ Help the participating laboratories review their uncertainty and confirm their evaluation of uncertainty.