European Partnership on Metrology
Call 2023 –Fundamental Metrology, Industry, Normative and Research Potential

Selected Research Topic number: **SRT-r05**
Version: 1.0

Title: Metrology for standardised moisture content measurements in plant-origin bulk materials in support of International and European food safety and trade

Abstract

Understanding the moisture content in plant-origin bulk materials is important for international and European food safety and trade as it can be used to estimate the material's quality, storage conditions, price and safety of consumption and use. Measurement of the moisture content in cereal grain, wood pellets, straw and other plant-based products is undertaken on a daily basis in many industrial and scientific laboratories. However, KCDB supported CMCs are not yet available for measuring the moisture content in plant matrix CRMs. Therefore, a standardised Karl Fischer volume titration method needs to be developed for measuring the moisture content in plant matrix CRMs in order to provide traceability to the SI and to support CMC claims.

Keywords

Certified reference materials, Karl Fischer volume titration, measurement comparison, moisture content, moisture measurement, plant-origin bulk materials, traceability

Background to the Metrological Challenges

Moisture content is one of the most important characteristics of plant-origin bulk materials (e.g. cereal grain, wood pellets, straw). Therefore, it is often strictly monitored and controlled as it has an impact on the price, quality, storage and safety of these materials. With this information, these materials and products can be stored under optimal conditions, and in the case of cereals, food safety can be ensured. Consequently, accurate and fast moisture measurements are essential for international and European food safety and trade. The need for such measurements is emphasised by the scale of the market as the EU, for example, produced 297.5 million tonnes of cereal in 2021.

Industrial laboratories and National Metrology Institutes usually use reference methods, absolute methods or standardised methods (e.g. ISO 712, ISO 6540, ISO 24557, etc.) to determine the moisture content of plant-origin bulk materials. However, KCDB supported CMCs are not yet available for measuring the moisture content in plant matrix CRMs. In contrast to these methods, Karl Fischer volume titration is a precise and absolute method that provides water-specific measurements. Therefore, a standardised Karl Fischer volume titration method needs to be developed for moisture content measurements in plant matrix CRMs in order to provide traceability to the SI and to support CMC claims. This method also needs to be validated against the ISO 712 reference method. This method is expected to be faster than the reference methods given in the standards, which would help to reduce costs and to improve food safety. To support this new method, plant matrix CRMs need to be developed and validated at international level in order to provide traceability to the SI and a measurement comparison needs to be undertaken in order to establish the performance and limitations of the method and the CRMs that will be used as plant-origin bulk materials simulants. A "grain-simulant" CRM for moisture content, with guaranteed stability, is also required for use in the calibration of the instruments that are used to measure moisture in harvested and stored bulk materials of plant-origin. In addition, a EURAMET calibration and measurement guide needs to be developed.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the development of metrology capability for standardised moisture content measurements in plant-origin bulk materials.

The specific objectives are

1. To develop the Karl Fischer volume titration method for use in measuring the moisture content of plant-origin bulk materials. The standardised method should provide metrologically traceable measurements with target uncertainties of ±0.3 % absolute. In addition, the method should be validated by comparing the results with those obtained for wheat using the ISO 712 reference method.
2. To develop plant matrix CRMs representing the most commonly handled materials, which will provide traceability to the SI. The CRMs should have target uncertainties of ±0.3 % absolute and be suitable for use with the Karl Fischer volume titration method developed in objective 1.
3. To develop "grain-simulants" CRM for moisture content, with guaranteed stability over a specified and determined time frame, for use in the calibration of the instruments that are used to measure moisture in harvested and stored bulk materials of plant-origin. The CRMs should have target uncertainties of at least ±0.3 % absolute.
4. To organise and conduct a measurement comparison in order to establish the performance and limitations of the Karl Fischer volume titration method developed in objective 1 and the CRMs prepared in objective 2. In addition, these CRMs should be validated, at international level, for use with automated Karl Fischer titrators.
5. To facilitate the take up and long-term operation of the capabilities, technology and measurement infrastructure for standardised moisture content measurements in plant-origin bulk materials developed in the project, by the measurement supply chain (NMIs/DIs, calibration and testing laboratories), and end users (e.g. industry, instrument manufacturers, regulators). The approach should be discussed within the consortium and with other EURAMET NMIs/DIs, e.g. via ISO TC34 and the EMN for Safe and Sustainable Food, to ensure that a coordinated and optimised approach to the development of traceability in this field is developed for Europe as a whole. A EURAMET calibration and measurement guide should also be developed.

Joint Research Proposals submitted against this SRT should identify

- the particular metrology needs of stakeholders in the region,
- the research capabilities that should be developed (as clear technical objectives),
- the area for which the capabilities will be built (Green Deal, Digital Transformation, Health, Integrated European Metrology, Industry, Normative or Fundamental Metrology) and in which future main call the developed research capabilities are planned to be employed,
- the impact the developed research capabilities will have on the industrial competitiveness and societal needs of the region,
- how the research capability will be sustained and further developed after the project ends.

Proposers should establish the current state of the art and explain how their proposed research goes beyond this. In particular, proposers should outline the achievements of the EMRP project SIB64 METefnet, EMPIR projects 19ENG09 BIOFMET and 20NET02 Food-MetNet and the Partnership project 21GRD08 SoMMet and how their proposal will build on those.

The development of the research potential should be to a level that would enable participation in other TPs.

Proposers should note that the programme funds the activity of researchers to develop the capability, not the required infrastructure and capital equipment, which must be provided from other sources.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.7 M€ and has defined an upper limit of 0.9 M€ for this project.

EURAMET also expects the EU Contribution to the external funded beneficiaries to not exceed 20 % of the total EU Contribution across all selected projects in this TP.

Any industrial beneficiaries that will receive significant benefit from the results of the proposed project are expected to be beneficiaries without receiving funding or associated partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the 'end user' community, describing how the project partners will engage with relevant communities during the project to facilitate

knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Provide a lasting improvement in the European metrological capability and infrastructure beyond the lifetime of the project,
- Facilitate improved industrial capability or improved quality of life for European citizens in terms of personal health, protection of the environment and the climate, or energy security,
- Transfer knowledge to the food and agricultural sectors and the metrology community.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of the Partnership to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work.

Time-scale

The project should be of up to 3 years duration.