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NUTRITIONAL AND FUNCTIONAL METROLOGY IN FOOD

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Abstract: This paper will give an overview to the status of metrology in nutritional and functional components of food in China, covering traceability policy, CRMs, analytical methods, international comparisons, CMCs, and show a outlook.

Keywords: Nutrition, Function, Food, CRMs, Metrology

1. INTRODUCTION

Metrology, the science of measurement, has played a key role in the realization of its measurements to the highest level of accuracy and traceability to internationally recognized standards. Metrology in food aims to ensure traceability and international comparability of food measurements to provide technical foundation for wider agreements related to international trade, commerce and regulatory issues. In the past ten years, nutritional and functional components in food are gradually becoming a hot topic in the world. Concerns about the safety and quality of food have increased at both governmental and consumer levels. The Chinese government attaches great importance to and issued a series of laws and regulations, such as "Food nutrition labels standard management", "Labelling of foods for special nutrient", "Health food management approach", "Standard for using of nutritional fortification substances in foods" etc.. "Food nutrition labels standard management" and "Labelling of foods for special nutrient" require that labels on processed foods specify the amount of total fat, saturated fat, cholesterol, total carbohydrate, sugars, protein, vitamins, mineral in a single serving. The manufacturer may voluntarily provide information about any other vitamin, mineral, or nutrient. Nutritional and functional components contained in fortified food and Health food fall within a specified range or above a specified minimum. Consumers today are interested in the information appearing on product labels, and it is important that the information about food composition and nutritional value is clear, accurate and meaningful. ISO/IEC 17025 requirements laboratories to develop a quality assurance system to ensure that every analytical methods are validated with the best applicable means and are fit for the intended purposes. In response to these regulations, NIM began to produce pure and food-matrix CRMs with values assigned for nutritional and functional components, develop analytical methods, participate in international comparisons to support claims of National Calibration Measurement Capabilities (CMCs).

2. THE STATUS OF NUTRITIONAL AND FUNCTIONAL METROLOGY IN FOOD IN CHINA

2.1 Traceability Policy

To achieve comparability of results over time or from one location to another, it is essential to establish traceability which is the process of linking results to a reference. Traceability is now considered to be a key concept in food analysis. Traceability implies that measurement data are linked to stated references through an unbroken chain of comparisons, all with stated uncertainties.

The activities of the CCQM and its Working Groups ensure their data is traceable and consistent, and links field laboratories into the international metrology infrastructure of the CIPM MRA.

In fact, NMIs play an important role in providing traceable analytical results. NIM establishes metrological traceability policy, i.e.

1) Establishment of the unbroken traceability chain to national or international standards of measurement through equipment calibration or the use of CRMs, all having stated uncertainties.

2) Method validation to prove the measurement procedure is sufficiently accurate and makes meaningful statements on measurement traceability.

3) Participation of necessary international comparisons organized by BIPM, CCQM, CCM, APMP or between NMIs etc. and obtaining acceptable degree of equivalence is a powerful means to verified the validity of the measurement methods and its metrological traceability.

4) Uncertainty evaluation according to GUM.

5) Appropriate quality control measures. Any influencing factors in the measurement such as the purity of the reagent, the instrument conditions and conditions may cause contaminations and losses should be well controlled according to the results of method validation.

For NIM CRMs, the following basic approaches are used to ensure traceability of the property values provided.

Property values are made traceable to SI units through the primary methods or potential primary method, such as coulometry, gravimetry, isotope dilution with mass spectrometry (IDMS), and freezing point depression method.

For pure reference materials, the purity should be measured by purity or impurity measurement methods, including freezing point depression, DSC, HPLC, GC, MS,

Karl Fischer titration, thermogravimetry analysis etc..

For matrix reference materials, these factors including sampling, identify, extraction, sample cleanup are very important.

Certified values are typically assigned on the basis of a combination of results from two or more independent methods. Certified values can also be assigned by combining data with data provided by collaborating laboratories.

2.2 CRMs

By the end of Sept, 2011, more than 150 CRMs for food including calibration standards, pure and matrix CRMs are produced in China. More than 40 CRMs have values assigned for elemental components in food–matrics including cabbage, spinach, apple, bean, garlic powder, laver, spirulina, pollen, ginseng, astragalus, cushaw powder, carrot, green tea, rice flour, wheat flour, corn flour, soybean flour, pork muscle, chicken, milk power, bovine muscle powder, egg yolk powder etc.. About 90 organic nutritional and functional components in RM and CRMs have been developed. These materials have been value assigned using a combination of LC-UV, CE, DSC, LC/MS, and LC/MS/MS methods, or using a single method by collaborating laboratories.

Isotope dilution liquid chromatography–mass spectrometry (IDMS) method was developed to assign the value of GBW10037 which for nicotinamide in infant formula. And, more IDMS methods were used in CCQM k62 international comparison and to assign the values for GBW(E)100227 vitamins. The CRM including vitamin B_1, vitamin B_2, vitamin B_6, nicotinic acid and 10 inorganic elements in infant formula is developed primarily for the determination of inorganic and organic components in China. The GBW(E)100227 of multivitamin/multielement tablet has been completed which has values assigned for ten elements and four vitamins, and IDMS methods developed as part of certification efforts were used to assign vitamin concentrations.

Five of the materials, GBW(E)100126 crude protein in whole wheat, GBW(E)100127 crude fat in whole wheat, GBW(E)100128 crude fiber in whole wheat, GBW(E)100009 nutritious compositions-containing protein, starch, total amino acid and individual amino acids in rice flour, GBW(E)100010 nutritious compositions-containing protein, starch, total amino acid and individual amino acids in wheat flour, were provided for the calibration of protein, fiber and amino acid in foodstuff. The GBW10030 has value assigned for cholesterol in egg yolk powder. Certified values are assigned for fatty acid in six edible oil, i.e. GBW(E)100120 soya bean oil, GBW(E)100121 colaz oil, GBW(E)100122 peanut oil, GBW(E)100123 sunflower oil, GBW(E)100124 corn oil, GBW(E)100125 sesame.

NIM also provided purity of nutritional and functional components CRMs, such as GBW(E)100037 melatonin, GBW(E)100038 genistein, GBW(E)100039 daidzein, GBW(E)100048 glycitein, GBW(E)090057 rutin, GBW(E)090058 gardenoside, GBW 09204 ginsenoside Rg_1, GBW 09205 ginsenoside Rb_1, GBW(E)100247 ferulic acid, GBW(E)100248 apigenin, GBW10038 niacinamide, GBW 10053 vitamin B_6, GBW(E)100247 vitamin B3, BW3600 vitamin B_1, BW3601 vitamin B_2, BW3602 vitamin B_5, BW3603 vitamin B_{12} etc..

17 kinds of individual amino acid and 17 amino acids mixture in 0.1mol/LHCl are also available.

2.3 International Comparisons and CMCs

Interlaboratory comparison among national metrology institutes (NMIs) is an efficient path for realizing traceability and achieving mutual recognition for measurement results. At the same time, the using methods can be validated. In recent year, CCQM have organized a number of key comparisons and pilot studies as well which focuses on food analysis. NIM has been actively participating in those CCQM comparisons. As for nutritional and functional components of key comparisons, i.e., CCQM-K56, Cu, Zn, Ca, Fe in Nonfat Soybean Powde, CCQM-K60 Total Se and selenomethionine in selenised wheat flour, CCQM-K62 Nutrients in infant formula, NIM's results are all within the degree of equivalence.

CMCs mean calibration and measurement capability. NIM has about 40 CMCs in nutritional and functional components in food analysis and high purity published in BIPM KCDB by the end of 2010.

2.4 In Progress and Future activities

More than 20 pure materials and 3 food-matrix materials are currently being developed. These pure CRM candidates include fatty acid, nucleotide, amino acid, antioxidant material and the like. Production of CRMs for health foods is continuing. Suites(i.e. pure, extract and nature-matrix) of CRMs for the following botanicals are being developed: *Panax quinquefolius*, *Epimedium brevicornum Maxim.*, and *Scutellaria baicalensis Georgi.*

3. OUTLOOK

The new developments in food science and technology provide more opportunities and challenges to nutritional and functional metrology. In recent years, there are increasing requirements for metrology in the field of nutrition and function, e.g.. evaluation of impact of nutritional and functional food to human being. Therefore, studying and establishing measurement methods of higher order, and enhancing the quality of traceability are the arduous work for nutritional and functional metrology.

To meet these needs, NIM should take actions: 1) further improving the quality assurance system, 2) developing new reference methods to characterize property of pure, food-matrix, nature-matrix materials, and 3) developing high level CRMs of food-matrix and nature-matrix.