APLAC Proficiency Testing Program
Essential and Toxic Elements in Bovine Liver
(APLAC T077)

1. OBJECTIVE

Elements are usually categorized into essential and toxic, depending on their levels and roles in the biochemical processes within the living organisms. Essential elements such as iron and zinc are required to support proper functioning and activities of cells, tissues and organs. On the other hand, toxic elements such as cadmium and lead that accumulate from the exposure or contamination from outside sources can produce adverse effects. Therefore, analyses of both essential and toxic elements are important in clinical, environmental, food and product testing laboratories. The aim of the present program is to evaluate the performance of laboratories for analysing two essential (iron and zinc) and two toxic (cadmium and lead) elements in bovine liver through interlaboratory comparison.

2. ORGANIZERS

Government Laboratory (GLHK) is the proficiency testing provider and Hong Kong Accreditation Service (HKAS) is the proposer.

3. RESPONSIBILITIES

GLHK is responsible for preparing, packaging and dispatching samples, performing homogeneity and stability tests, collecting test results from participating laboratories, conducting statistical analysis of data, handling participants' queries and issuing interim and final reports.

HKAS is responsible for proposing this program for approval by the APLAC Proficiency Testing Committee, inviting participants, circulating the draft report and final report to participants and acting as a contact point between APLAC, participating accreditation bodies / participants and GLHK.

4. APPLICATION FEE

Free of charge.

5. SELECTION of PARTICIPANTS

APLAC members as well as other non-APLAC members will be invited to participate in the programme. Invitations will be sent to all APLAC members and other accreditation bodies. Participating accreditation bodies will be asked to nominate laboratories to participate and indicate the accreditation status of the nominated laboratories for the test. The number of laboratories shall be preferably **limited to 50**. Therefore, a restriction on the number of participating laboratories from each accreditation body may need to be imposed. When the number of enrolments exceeds the limit, participants will be selected on a first come

first served basis and the organisers will, as far as possible, allow at least one laboratory to participate in this program from each accreditation body.

6. TEST MATERIAL

Preparation of test material was performed in accordance with ISO/IEC 17043:2010 [1]. In brief, about 3 kg of bovine liver purchased from local market was cut into slices. Fat and fatty tissues were removed with n-hexane. The defatted liver tissues were powdered, sieved and homogenized. The homogenized powder, in about 5 g portion each, was independently dispensed into clean amber bottles and disinfected by γ-irradiation at a dose of about 10 kGy. The approximate ranges of essential and trace elements are as follows:

Element	Approximate Conc. Range (mg/kg)
Iron (Fe)	100 to 1000
Zinc (Zn)	100 to 1000
Cadmium (Cd)	0.1 to 1
Lead (Pb)	0.1 to 1

7. HOMOGENEITY & STABILITY TESTS

Not less than ten samples were taken randomly from the prepared bottles of samples and analyzed in duplicate for determining the sample inhomogeneity in accordance with the recommendation stipulated in ISO13528:2005 [2]. A random sample will be analyzed in triplicate at room temperature (about 25 °C) and at an elevated temperature (about 37 °C) for monitoring the stability of analytes between sample dispatch and after submission of results.

8. REPORTING RESULTS

Participants will be provided with TWO sample bottles each containing about 5 g of dried bovine liver powder. They are requested to determine the concentrations (in mg/kg), on received basis, of two essential elements (Fe and Zn) and two trace elements (Cd and Pb) in the given sample with a method of their choice, which should be consistent with their routine procedures. Test results, expanded measurement uncertainties* and other technical details should also be reported in the given result sheets to GLHK. If the determination has been carried out in duplicate or triplicate, laboratories can, if they wish, report all the results obtained. In such case, the mean result will be used for performance assessment.

**Measurement uncertainty is best estimated within the individual laboratory environment. An estimate of uncertainty of measurement is normally based on the combination of a number of influencing parameters (components of uncertainty) such as errors in reference values, instrument errors, repeatability, thermal effects, weighing errors, inhomogeneity etc. As stipulated in ISO Guide to the Expression of Uncertainty in Measurement [3], the influence of each component of uncertainty on the measurement result should be*

quantified and expressed numerically as a standard deviation. These values are then combined according to the rules of the propagation of uncertainty to produce a combined standard deviation (combined standard uncertainty) and the combined standard uncertainty is multiplied by a coverage factor to produce an expanded uncertainty at the required level of confidence.

Participants should be aware that any submitted result is considered final and accordingly such data and units should be thoroughly checked before submission.

9. PERFORMANCE ASSESSMENT

Performance of the participating laboratories is assessed using z-score which is calculated as:

$$z = \frac{x_i - x}{\sigma}$$

where x_i = reported result of individual participant
x = consensus value from robust statistics
σ = standard deviation estimated from the Horwitz Equation

z-Score is commonly interpreted as:

(i)	$\|z\| \leq 2$	Satisfactory
(ii)	$2 < \|z\| < 3$	Questionable
(iii)	$\|z\| \geq 3$	Unsatisfactory

Laboratories having a $|z|$ score equal to or larger than 3 shall thoroughly investigate their results for the discrepancy and those having a z-score in the range $2 < |z| < 3$ are also encouraged to review their results.

10. SUBMISSION OF RESULTS

Participants should submit their results electronically to GLHK on or before the deadline. Results submitted after the deadline will not be accepted. Under no circumstances, correction or adjustment of analytical data will be accepted after the issuance of the interim report.

11. ISSUANCE OF REPORTS

Upon completion of data analysis, the organizers will issue an interim report to participants and their respective accreditation bodies for checking the correctness of analytical data. The draft final report will then be prepared and submitted to APLAC PT Committee for comment and approval. Upon approval by the APLAC PT Committee, an electronic copy of the Final Report will be distributed to participants and their respective accreditation bodies.

Relevant parts of the final report or its summary will be posted onto the websites of APLAC, GLHK and HKAS for public interests. Unique identities of participants will not be posted.

12. PROGRAM SCHEDULE

Event	Period
Preparation of sample	Mar – Apr 2010
Homogeneity testing	May 2010
Submission of proposal to APLAC PT Committee for approval	Jun 2010
Stability testing	Jul – Oct 2010
Invitation of participants	Aug – Sept 2010
Dispatch of samples	Oct 2010
Submission of results	Dec 2010
Statistical analysis of results	Dec 2010
Interim report	Jan 2011
Submission of draft report to APLAC PT Committee	Feb 2011
Approval of draft report by APLAC Proficiency Committee	Mar 2011
Distribution of final report	Mar 2011

13. CONFIDENTIALITY

The organizers (GLHK. HKAS and APLAC) strive to maintain strict confidentiality with respect to composition of the test sample distributed and the performance of all participating laboratories. To preserve this confidentiality, participants receive reports giving all results for that assessment but without identifying individual laboratories. The code number assigned to a participant in this program is only made known to the contact person or authorized person of his laboratory and/or the respective accreditation body.

This program is conducted in the belief that participants will perform the analysis and report results with scientific rigour. Collusion and falsification of results are clearly against the spirit of this program.

14. CONTACT PERSONS

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15. REFERENCES

1. International Standards Organization. ISO/IEC 17043:2010, Conformity assessment - General requirements for proficiency testing, ISO, Geneva, Switzerland.

2. International Standards Organization. ISO 13528:2005, Statistical methods for use in proficiency testing by interlaboratory comparisons, ISO, Geneva, Switzerland.

3. International Standards Organization. ISO/IEC G98:1995, Guide to the Expression of Uncertainty in Measurement (GUM), ISO, Geneva, Switzerland.