PRM Implementation: Quality Control

-----Quality Control in Laboratory Testing

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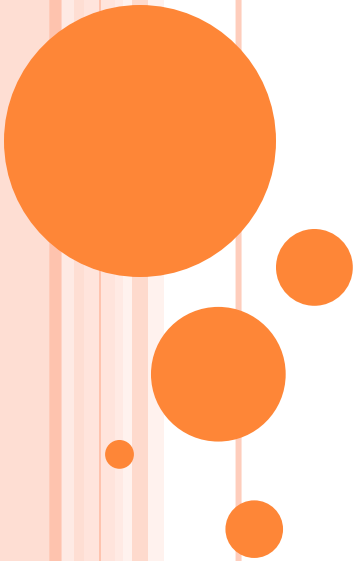
Overview



1. Concept of quality control (QC)

- QC procedures are specific tools that used to obtain reliable laboratory data based on modern scientific management and statistical methods.
- QC guarantees that the analytical errors are within allowed values and good accuracy and precision are obtained to ensure the intended use of the data.

2. Essence of QC

- Guarantee the traceability of testing results
- Achieving controllability of testing quality

QC in laboratory is the whole procedures that conducting “quality management system documentation”, implementing “Quality Policy”, fulfilling “Quality target”, keep “quality management system ” and constant improvement of these procedures.

The aim of QC is reduce experimental error

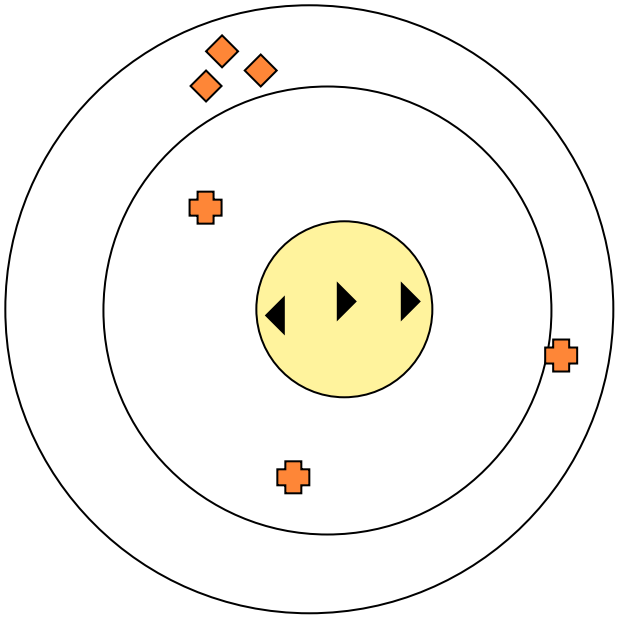
3. Classification of Error

Error=observed value-true value

- Systematic Error
- Random Error

Systematic error affect accuracy, random error affect precision.

- Good precision do not ensure high accuracy;
- Bad precision, bad accuracy;
- Good precision result in good accuracy if there is no systematic error.



4. Relationship between measuring and error

- Accuracy is relative, absolute accuracy do not exist.
- Errors are controllable, and controllable errors are acceptable.
- Laboratory Technicians should be familiar with all the procedures involved in testing.
- Testing quality can be improved by effective quality management and control.

Quality Control Measures in Laboratory

Within laboratory QC

- In-house QC
- Discover random errors and new systematic errors
- Evaluation of the stability of testing quality is the fundamental and necessity of laboratory testing.

Inter-laboratories QC

- External QC
- Discover systematic errors and the comparability between different labs
- Evaluate the testing system and analysis ability
- Compare with standard laboratory is an effective way of calibration

Within-laboratory QC

1. Validation of new analytical method

2. QC in the process of testing

1. Validation of new analytical method

- Laboratory should validate the performance of a new method.

- Validation parameters including :

Accuracy, precision, sensitivity, linear range, et. al

If there is missing of detailed procedures in the new method, which could affect the testing results, the detailed procedures should be written into Standard Operating Procedure (SOP) as supplement to standard method.

SOP

- Detailed description of key conditions and procedures
- Description of method deviation

A. Selection of matrix

- International organizations and domestic administrations have specified representative matrices for method validation.
- Appropriate matrices can be chosen from the table according to the matrix category.

Category	Matrix	Representative variety
meat	muscle tissue	pork, mutton, horsemeat, chicken, duck meat, turkey
	fishery products	haddock, salmon, trout, shrimp, crab, shellfish
	organ	liver, kidney
	fat	fat
high water content plant origin food	bulb vegetable	onion
	Fruited vegetable/melon	tomato, cucumber, green pepper
	Leafy vegetable	lettuce, spinach
	stem vegetable	leek, celery, asparagus
	Fresh legume vegetable	pea with pod, beggerweed, snow bean, broad bean, kidney bean
bakery product	cake	cake, moon cake
	bread	bread
	biscuit	biscuit
flavoring	soybean sauce	soybean sauce, oyster sauce, fish sauce

B. Selection of blank matrix

Ideal blank sample should be the same matrix category with the sample to be tested. There should be no target analytes in the blank sample and the constitutions should not interfere the testing.

- When the LOQ is lower than 1/3 limit value, the area (or height)of interfere peaks should lower than 1/10 of the area (or height) of LOQ
- When the LOQ is higher than 1/3 limit value, the area (or height)of interfere peaks should lower than 1/3 of the area (or height) of LOQ
- For illegal additive or banned pesticides and pharmaceuticals, the area (or height)of interfere peaks should lower than 1/3 of the area (or height) of MRPL(or LOQ by administration)
- When there is interferences in blank samples, the interference should be deducted

C. Accuracy

- **By Certified reference material (CRM)**

➢ Accuracy was evaluated by the use of CRM subjected to the entire analytical process in replicates ($n \geq 6$).

➢ The observed results should be within the allowable range of the CRM.

- **By matrix spike**

- Accuracy is evaluated by calculating recoveries of the analytes spiked into blank samples.
- Recoveries are determined by spiking experiment. Three spiking levels ($n \geq 6$ for each level) are needed.
- The recoveries should meet requirement of accuracy.

Spiking level setting:

- For restricted and banned pesticides, the recommended spiking levels are: LOQ, 2*LOQ, 10*LOQ.
- For pesticides having MRL, the recommended spiking levels are: 1/2MRL, MRL, 2MRL.
- For multiresidue analysis, there are different MRLs, under this circumstances, the recommended spiking levels are: 1/2MRL (lowest MRL), MRL (lowest MRL), 2MRL (higest MRL).

Table 1 Recovery requirement of different spiking levels

Spiking levels mg/kg	Recovery Range %	RSD %
≤0.001	50~120	≤35
>0.001≤0.01	60~120	≤30
>0.01≤0.1	70~120	≤20
>0.1≤1	70~110	≤15
>1	70~110	≤10

D. Precision (repeatability/ reproducibility)

- Internal repeatability can be evaluated by duplicate analysis of parallel spiked samples.
- Reproducibility between different laboratories can be evaluated by inter-laboratory comparison (e.g.3-5 labs).

Table 2 Repeatability at different residue levels

Concentration mg/kg	RSD %
≤0.001	≤36
>0.001≤0.01	≤32
>0.01≤0.1	≤22
>0.1≤1	≤18
>1	≤14

Table 3 Reproducibility at different residue levels

Concentration mg/kg	RSD %
≤0.001	≤54
>0.001≤0.01	≤46
>0.01≤0.1	≤34
>0.1≤1	≤25
>1	≤19

E. Specificity

The ability of discriminate between the analyte and other compounds.

F. Sensitivity

LOQ: >10*S/N, matrix based standard, not solvent standard

LOQ< MRL(official limit)-3*SD

LOQ should be validated (accuracy, precision)

G. Linearity

Calibration curve, residues < ±20%

- Cover concentration range of target analyte, including 0.5*MRL, MRL, 2*MRL
- Recoveries should be considered at lowest and highest calibration level
- Calibration function (non weighed, 1/x)

H. Single-level calibration

- Accurate results can be obtained when the response of analyte is close to that of single level standard (within ±30%).
- Satisfactory recovery (<100%) can be obtained at LCL

2. QC during the process of testing

A. Requirement of QC samples

- Known composition and content of analyte
- Can be used for repeatability
- Can be used to evaluate accuracy during testing

B. Control Samples in QC

Including but not limited to:

a. reagent blank

b. blank sample

c. CRM

d. incurred sample

e. spiked sample/fortified blank/blank spike

f. blind spike/blind sample (could be d or e)

C. Application of control samples

Control sample is analyzed in an identical manner as a sample and is used to document laboratory performance.

For each batch samples, control samples must be analyzed.

a, b and at least one of the other four control samples must be used.

D. Application of spiked sample

For single analyte analysis:

- Pesticide: spiking level close to LOQ
- pesticide with MRL: LOQ, 50-100% MRL
- Incurred sample: spiking level close to target residue level

For multiresidue analysis:

- Spike all or part of analytes (representative analytes)
- Spike all the analytes over a half-a-year/1-year period

E. Injection order

Appropriate sequence arrangement---avoid cross-contamination

- Recommended injection order: reagent blank, blank sample, spiked sample (incurred sample), blank sample(reagent blank)again, real sample, spiked sample(incurred sample)
- In one batch, control samples are analyzed in intervals (e.g. 10 samples interval) when the batch is large.

Inter-laboratory QC

Proficiency Test

- **Twice a year**
- **Over 100 laboratories nationwide**
- **Two matrices**
- **10 out of 80+ PRM pesticides**

Thank you!