

# The trueness criterion: an alternative concept for the evaluation of proficiency tests

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## Introduction

Proficiency testing (PT) is a key element of external quality assurance in analytical laboratories according to ISO/IEC 17025. In practice, data from PTs are used to ensure and demonstrate the validity of analytical methods.

The food market stakeholders require analytical results, which are used for crucial decisions on whether or not...

- ... the quality of products is adequate.
- ... delivered goods are marketable (release-analysis).
- ... the applied pesticides are below the MRL.
- ... products are ready for consumption.

In day-to-day routine, analytical results are used as "one-off" results to answer the question

*"What concentration levels are really present in the sample?"*

Food safety thus requires

- **Reliable** results,
- **True** results, which represent the actual analyte concentration in the analysed sample,
- **Repeatable** results, with a possibly lowest intra- and inter-day variation.

Consequently, the accepted results of laboratories participating in PTs should not significantly deviate of the true level. Therefore, the target deviation applied in a PT has to be quite narrow.

## One approach related to the assessment of ...



... the analytical performance of laboratories is the **COMPARABILITY CRITERION**

- The results of the labs are compared with the **average of the results of all participants**.
- Reference value: statistically derived mean, calculated of the results of the participants.
- Applied model: z-score.
- Fit for purpose criterion: 2-fold target standard deviation according to Horwitz [1].

## Another approach considers ...



... the true analyte level in the test sample – **TRUENESS CRITERION**

- The results of the labs are compared with the **actual analyte concentration in the sample**.
- Reference: spiked value.
- Applied model: 70–120% model.
- fit for purpose criterion: 70 up to 120% recovery of the spiked level.

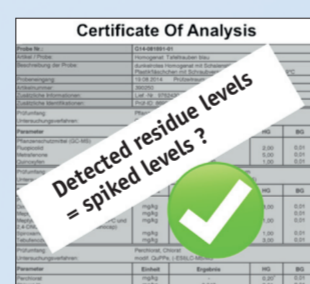
The application of the trueness criterion requires:



Absence of analytes in the raw material

**Degradation**

Stability of the analytes in the test material

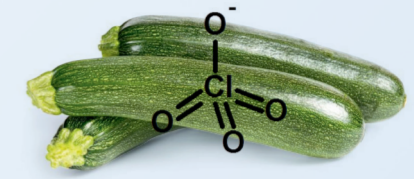


Verification of the true analyte level in the test samples

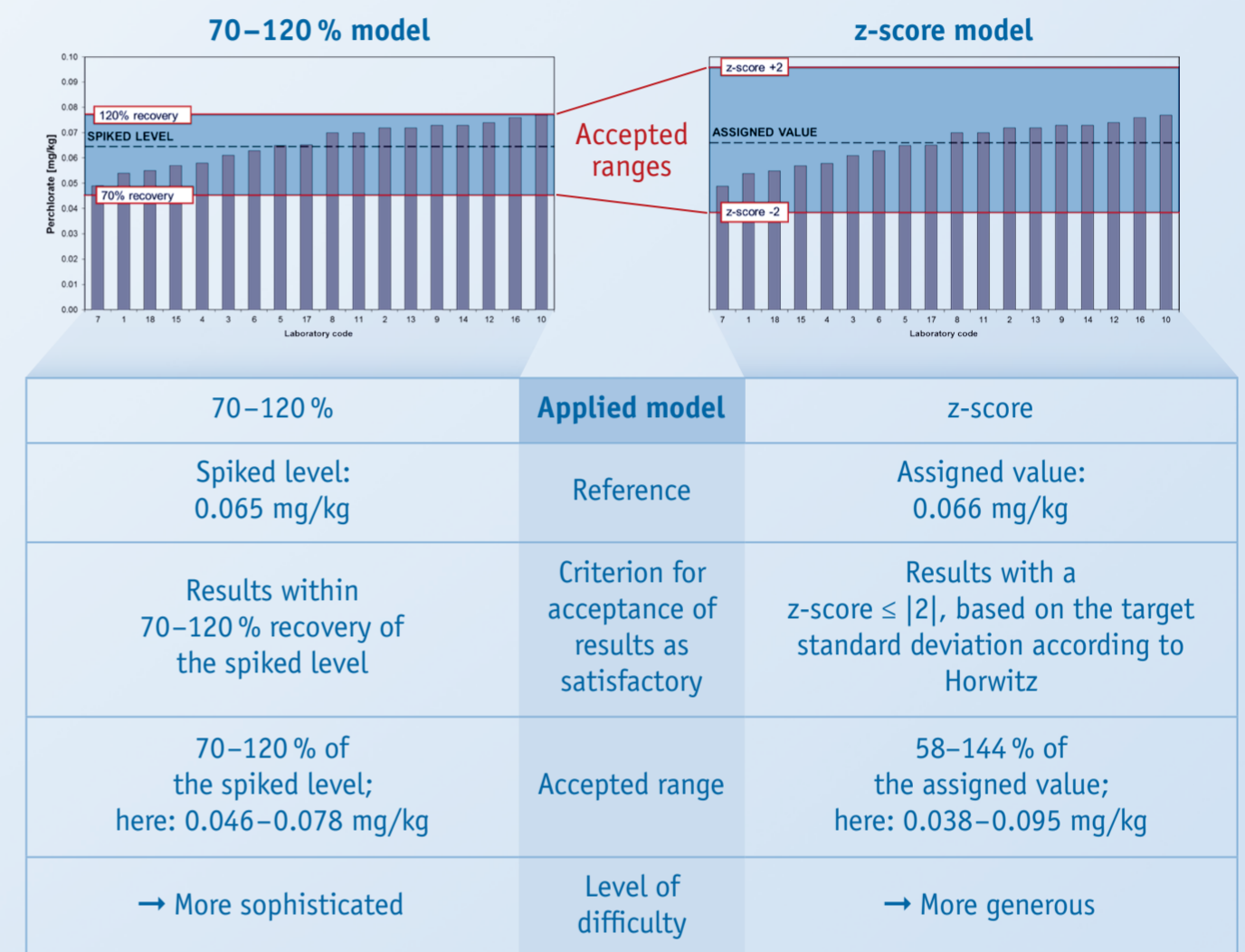
## Trueness vs. z-score – Examples of Proficiency tests

### Example 1: Perchlorate in courgette [2]

- Contaminant in fruits and vegetables
- Single-Residue Method
- LC-MS/MS
- Internal standard:  $^{18}\text{O}_4$ -labelled perchlorate



Comparison of the two models with respect to the accepted ranges – illustrated with results of an actual PT on perchlorate in courgette:



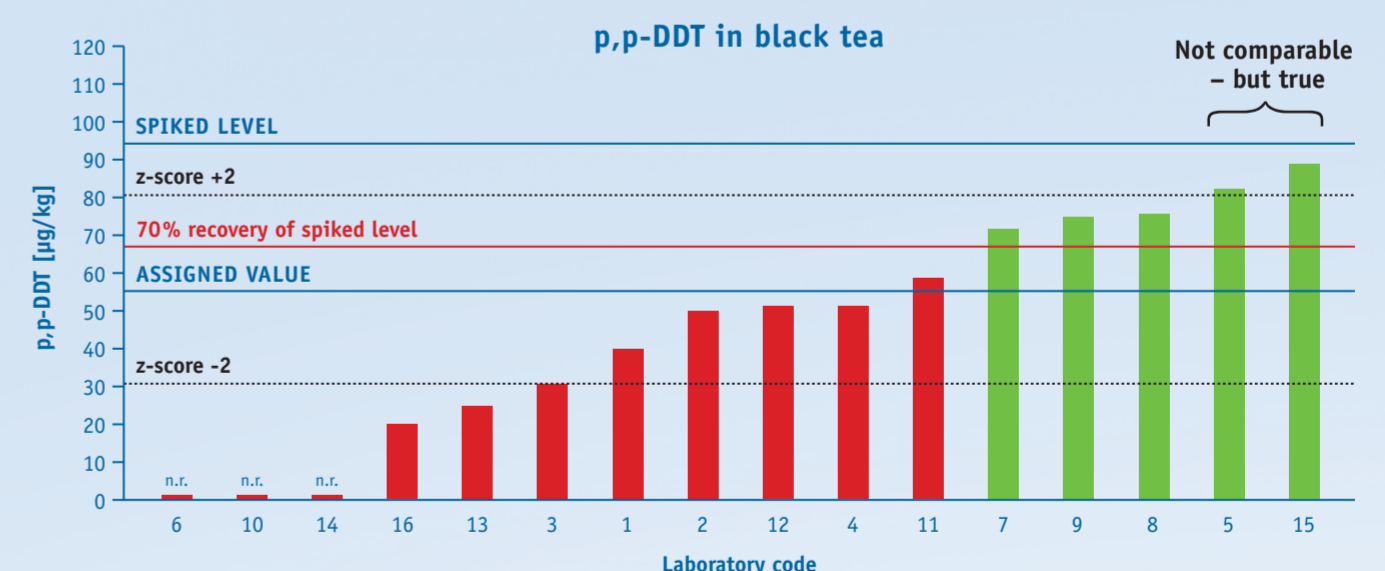
### Example 2: p,p-DDT in black tea [3]

- Black tea – a demanding matrix
- Pesticide multi-method analysis required
- p,p-DDT: GC-MS/MS
- Results are highly influenced by the appropriate condition of the liner



The application of the two models to the results of a PT on pesticides in tea results in completely different outcomes related to the evaluation of analytical performances of participating laboratories:

- Lab 5 and lab 15 would be categorised as non-satisfying (z-score > 2) according to the z-score model → not comparable.
- However, among the labs in this test, lab 5 and lab 15 are the ones that provided true results (within 70–120% recovery of the spiked level).



## Conclusion

The trueness criterion provides information related to the ability of a laboratory to reliably quantify the actual analyte concentration in the sample. The outcome of several PTs, even in complex matrixes, showed that a target range of 70 to 120% of the spiked level is feasible. Taking into consideration that PT samples are analysed with special care, a recovery of 70–120% is considered as an appropriate performance criterion as proposed by the SANCO Document 12571/2013 [4] for method validation.

The trueness criterion (70–120% model) takes into consideration the requirements of laboratories' clients in a more appropriate way and answers the question "What concentration levels are really present in the sample?". The additional information on the trueness of the results contributes significantly to the identification of shortcomings in order to improve the laboratories' analytical performances.