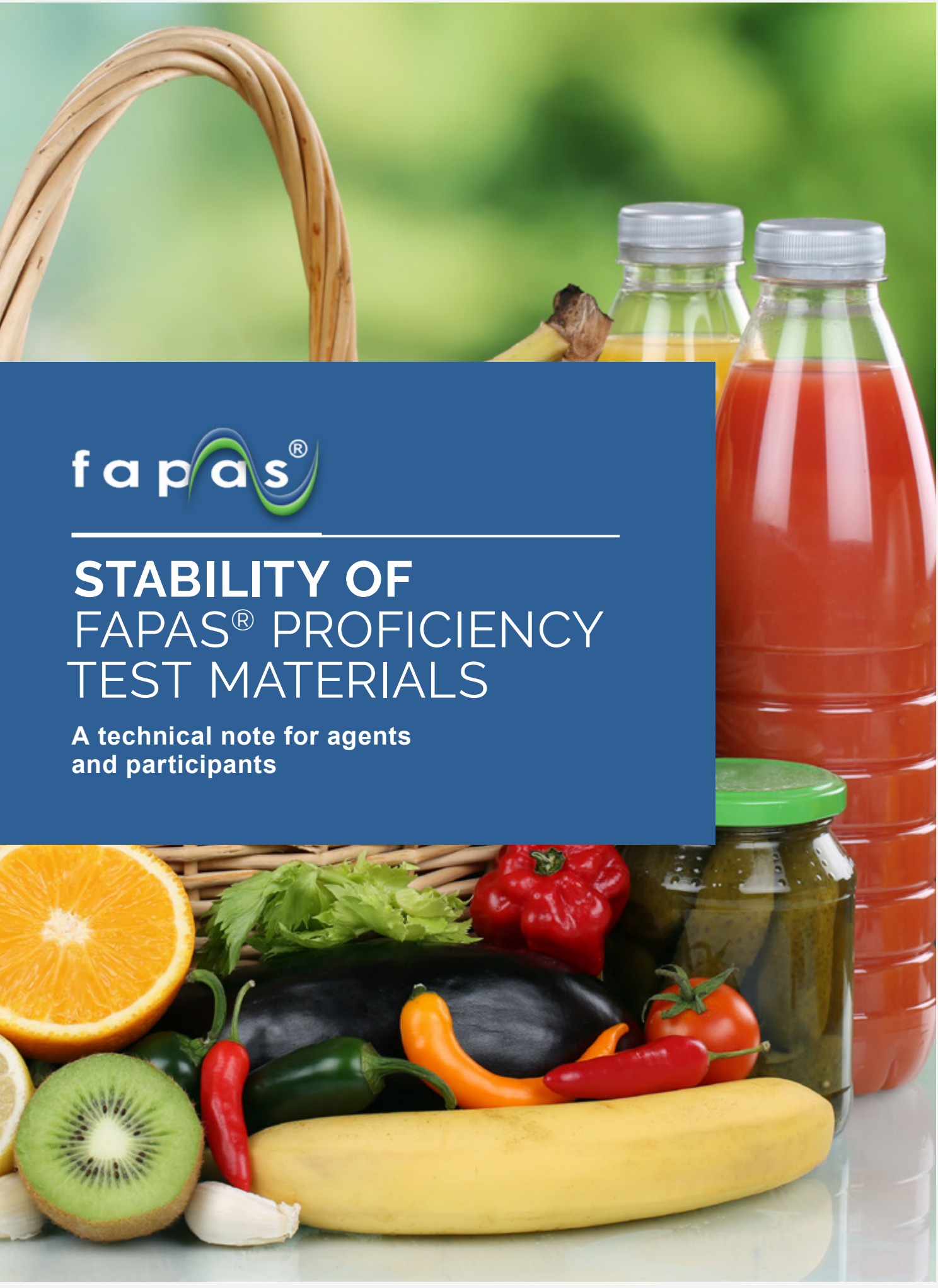

STABILITY OF FAPAS® PROFICIENCY TEST MATERIALS

A technical note for agents and participants

Definition of stability in the context of proficiency testing (PT)

A proficiency test material must be stable for the duration of the proficiency test. This period of time includes;

- The time between its preparation and dispatch to participants
- The transportation time and conditions between leaving Fapas® and arriving at the participant's laboratory
- The time between arrival at the participant's laboratory and its analysis
- The stability during analysis and before final reporting of the result

The stability of a PT material has evidence to define its stability. This is a requirement of ISO/IEC 17043, the international standard for proficiency testing providers.

Definition of stability in the context of Quality Control materials (QC)

The stability of a QC includes the stability of a PT plus longer term (a few months or years) storage stability at Fapas® under ideal conditions. The stability of a QC is usually based on evidence of experience, not on experimentation.

Definition of stability in the context of Reference Materials (RM)

The stability of an RM includes the stability of a PT plus very long term (many years) storage stability at Fapas®. The stability of an RM has evidence derived directly from experimentation.

Types of stability evidence

Experience

Fapas® has been conducting PTs since 1990. There are several hundred years of combined staff experience and this experience is recorded in our quality system documentation, so that it is not lost when staff change. Many of the analysts who co-ordinate the PTs have themselves come from an analytical background, working in testing laboratories prior to joining Fapas®.

Advice

Fapas® has access to the knowledge of its expert advisors. This is both formal arrangements with our external Advisory Group as well as informal advice from our colleagues within Fera Science Limited who prepare and test the majority of our materials and relevant subcontractors as required.

Known chemistry

Some test materials or analytes are inherently stable. For example, canned meat test materials are produced in food-grade canning facilities which are designed to produce canned foods that would be stored in a home kitchen potentially for many years.

Heavy metals will not undergo change unless subject to processes in a nuclear reactor. DDT has been a banned substance for decades but is still monitored due to its known persistence in the environment.

Homogeneity mean vs consensus assigned value

The assigned value calculated as the consensus of participants' results is compared to the mean value derived from the homogeneity test. The homogeneity analysis is carried out prior to the dispatch of samples to participants. If the homogeneity mean value is more than 3 x σp above the assigned value, this might indicate instability of the material. (The value of σp is the standard deviation for proficiency assessment.) If this occurs, an investigation is undertaken to establish the cause of the difference.

Results distribution (asymmetry or skew)

Samples might experience different levels of instability if they are treated differently within a PT. For example, some samples will be in transit for only 2 days, some for 8 days. Some participants might not store the samples at the advised conditions on receipt. Some participants might start the analysis immediately on receipt of the samples, some might wait a few weeks. If there is instability, we could expect to see a skew (asymmetry) in the distribution of z-scores towards the negative (left) side of the histogram. This effect is demonstrated in Figure 1a and 1b below (artificially skewed for the purpose of demonstration).

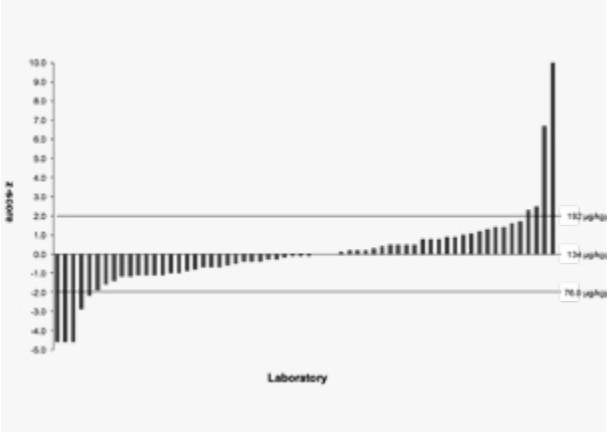

Figure 1a, symmetrical histogram of z-scores, no evidence of instability.

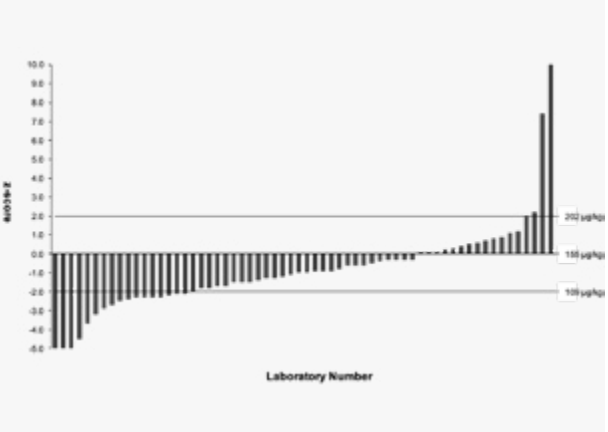

Figure 1b, skewed or asymmetrical histogram of z-scores. The direction of the skew might indicate instability.

In the event that a skew is observed in the data, an investigation is carried out into possible causes of the skew. This would include consideration of instability as well as analytical method dependency.

Percentage of z-scores ≤2

The percentage of z-scores ≤2 (the % 'satisfactory') is an indication of the general performance of laboratories in any one PT. If this percentage is low, it means that the participants have not succeeded very well but what are the causes of this poor performance? There might be several reasons for poor performance, including the difficulty of the analysis, challenging concentration levels, unusual matrix effects, the use of non-standard methods or instability.

Observation of a low percentage will consider all these aspects. A percentage of 55% or less of z-scores ≤2 (for an otherwise normal distribution) will indicate that stability should be investigated as a potential cause (Fapas® internal data assessment).

Distant country distribution

The Fapas® customer base includes laboratories located in over 140 countries. Although not all of these countries will be represented in any one PT, there will be countries that are very distant from the UK. It can take several days for samples to reach their final destination (including South East Asia, South Africa, South America, Pacific region) and several days longer than samples being shipped within Europe. Therefore, any instability due to longer transit times would be manifest in the results reported by those more distant countries.

A simple check of z-scores obtained by distant countries is carried out where any such instability is suspected. Figure 2a and 2b demonstrate this for a microbiology PT (M242e13, aerobic plate count in milk powder) where there is a large proportion of non-European laboratories with no evident clustering of results according to geographic region. The actual z-scores are provided in Table 1.

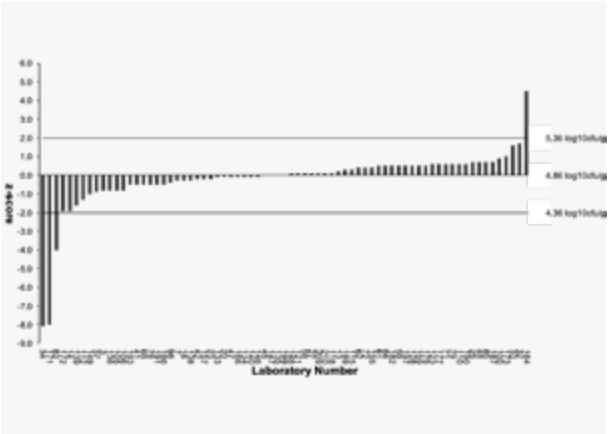

Figure 2a, histogram of z-scores in M242e13, aerobic plate count in milk powder. Apart from a few extreme results, the distribution is continuous.

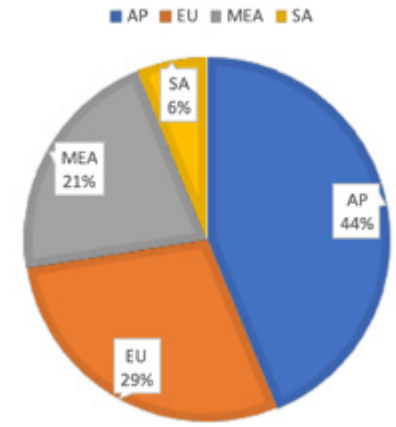

Figure 2b showing the geographic region distribution of laboratories in M242e13. AP is Asia Pacific (including India), EU is Europe (including Russia), MEA is Middle East and Africa, SA is South America.

z-score	Region	z-score	Region	z-score	Region	z-score	Region	z-score	Region
-1.9	AP	0.5	AP	-0.5	AP	0.3	EU	0.5	MEA
-0.1	AP	-0.1	AP	0.5	AP	NR	EU	NR	MEA
0.7	AP	-0.8	AP	0.0	AP	0.1	EU	-0.5	MEA
-8.1	AP	-0.3	AP	-0.8	EU	0.0	EU	0.1	MEA
0.0	AP	-1.6	AP	-0.3	EU	-1.0	EU	0.6	MEA
NR	AP	-0.1	AP	-0.3	EU	0.4	EU	-0.1	MEA
-0.1	AP	-0.1	AP	0.1	EU	0.5	EU	0.0	MEA
0.1	AP	0.1	AP	1.7	EU	0.5	EU	-0.1	MEA
0.5	AP	-8.0	AP	0.7	EU	NR	EU	-0.5	MEA
-4.0	AP	-1.9	AP	0.4	EU	0.1	EU	-0.5	MEA
0.5	AP	1.0	AP	0.6	EU	0.2	MEA	0.1	MEA
-0.8	AP	0.5	AP	0.4	EU	-0.2	MEA	-0.4	SA
-0.8	AP	0.6	AP	-0.5	EU	1.6	MEA	-0.2	SA
0.6	AP	0.7	AP	0.6	EU	-0.9	MEA	NR	SA
-1.3	AP	0.3	AP	0.7	EU	-0.5	MEA	NR	SA
NR	AP	0.6	AP	0.9	EU	-0.2	MEA	4.5	SA

Table 1, z-scores from PT M242e13 by geographic region, using the same key as in Figure 2b. 'NR' means no result was returned.

Experiment

For PTs where there is a known (predicted) risk of instability, specific experiments are carried out to establish stability. Such examples include (and are not limited to) sulphur dioxide in wine and peroxide value in olive oil, as well as all microbiology materials.

At its simplest level, the stability experiment involves re-analysing the test materials at a time point in keeping with the time period of the PT. This can be either immediately before the PT starts or during the course of the PT. In cases where the instability was not predicted, test materials can be analysed after the PT closes but before the report is issued.

For a reference material, a more involved formal stability experiment is undertaken. This involves an isochronous experimental design over a period of 8 weeks.

The isochronous (ISO Guide 35) design ensures that the analysis of the samples does not in itself bias the outcome of the experiment. The experimental data contributes to an understanding of both short-term (transportation conditions) stability and long-term (ideal storage conditions) stability. Data from a stability experiment designed for reference material purposes can also be used to support knowledge of PT materials.

Mitigation of potential instability

Where there is potential for instability of test materials, Fapas® can take several measures to mitigate the effect of instability so that it doesn't affect the outcome of the PT. These measures include:

- Use of -80 °C ice packs instead of -20 °C ice packs
- Freezing the test materials to -80 °C from -20 °C a few days before dispatch (this is done for veterinary drugs PTs)
- Careful choice of courier service
- Use of insulated boxes for shipping
- Use of some agents for onward dispatch in-country
- Shortened timescale for the PT itself
- Advising the timescale for laboratories to do the analysis
- Requiring the laboratories to report the date of analysis
- Advising participants to add a comment in results submission where sample shipment was delayed
- Issuing of 'information only' z-scores

Final Thoughts

In general, a single laboratory will enquire about their z-score being out of the satisfactory range. There is all the evidence from the many other laboratories (30 – 150 data points) which demonstrate that the PT was successful and not affected by instability.

Enquiries from some laboratories relate to the matrix, especially fish test materials, which may quickly develop a strong smell (odour) during transportation. It is important to recognise that, even if the matrix has started to degrade, the analyte being determined should still be stable. Our stability assessments are for the analytes, not the matrix.

fapas®
celebrating 30 years

PROFICIENCY TESTING

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