Determination of quality parameters in meat: **A comparison of performance from two independent PT schemes.**

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Introduction

During the last twelve months, LGC Standards and API Group have worked together in the provision of proficiency testing (PT) schemes for the analysis of food chemistry materials, both companies having accreditation to ISO/IEC 17043.

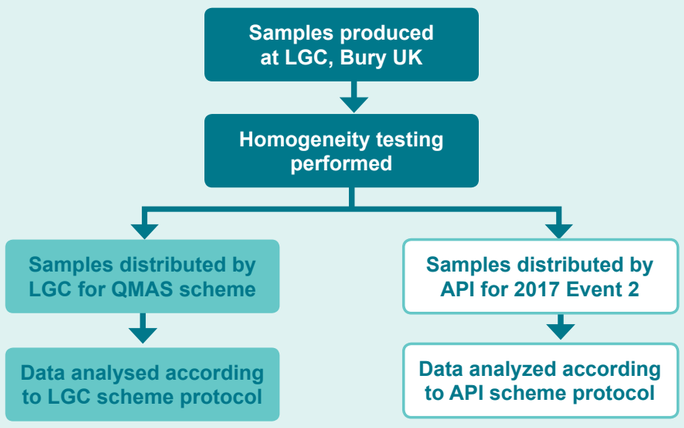
The API Group Food Chemistry scheme, specifically the samples offered for meat chemical analysis, has been offered since 2001, covering three testing rounds per year. The QMAS scheme operated by LGC Standards, has been in operation since 2000, and offers four testing rounds.

The data returned by the participants from a single PT 'round' within both the API Meat Chemistry scheme and the LGC Standards' QMAS scheme, using the same test materials, has been compared.

Production process

The test materials analysed for the purposes of this comparison was a mix of powdered beef and pork in a 50:50 ratio, rehydrated with water. All materials were manufactured in the same lot/batch by LGC and provided to customers of both programs between the months of May and July 2017 for analysis.

Fig 1. The operational process for the combined PT material



Statistics

The assigned values for each measurand were calculated from the robust mean of the participant data returned. API group carried out this procedure using a winsorized mean (outliers were trimmed to ± 2.5IQR), whilst LGC used the median. The spread of data (robust SD) was calculated as the winsorized standard deviation by API group and as the normalised median of absolute differences from the median (MADe) by LGC.

The standard deviation for proficiency assessment (SDPA) was determined in a similar way by the two providers, a mix of fit-for-purpose criteria and the robust standard deviation (SD). API base the selection of the SDPA on the measurand and participant performance in the current round, whereas where LGC apply fit-for-purpose criteria, this is done irrespective of the performance of participants in the current round.

Both PT schemes used z scores as the means of evaluating satisfactory performance.

Participants

The participants for the API Group scheme were predominantly, 87%, from North America, whilst the participants of the LGC QMAS scheme were located in 30 countries worldwide, with the highest numbers from Italy, Brazil and Thailand.

Fig 2. Geographical distribution of participants for the LGC QMAS scheme

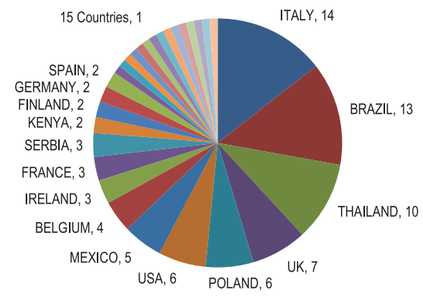
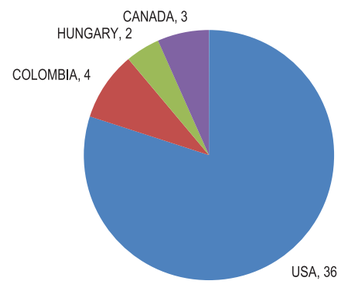


Fig 3. Geographical distribution of participants for the API Meat scheme



The largest number of results was returned for the 'basic' proximate measurands, fat, salt, moisture and protein, whilst only approximately 30-50% of the participants returned results for the elemental analysis. The number of results for 'Ash' varied from provider to provider as only 50% of API participants returned result for this measurand, whereas the figure for LGC participants was closer to 90%.

Data analysis
Assigned values

The assigned values calculated from the data, reported by the participants in the two PT schemes, showed very good agreement (differences ≤ 3.5%) for five of the eight measurands available in both schemes. Larger differences (≥ 7.0%) were observed between the assigned values for the determination of the elements, sodium, calcium and potassium.

The observed differences in assigned values, may be at least in part, methodological as comparison of the results from participants which used ICP showed significantly better agreement. For example, the difference between the participants using ICP techniques for potassium was just 5.1% relative to the API result, less than 40% of the difference between the robust mean results of all participants.

Table 1. Assigned values for eight measurands, calculated for the API and LGC PT schemes.

	Ash (%)	Calcium mg/100g	Fat (%)	Moisture (%)	Protein (%)	Potassium mg/100g	Salt (%)	Sodium (%)
LGC	1.71	23.0	15.24	58.1	24.9	435	0.51	0.230
API	1.77	17.9	15.25	58.0	25.0	378	0.50	0.214
% Diff	-3.5%	22.4%	-0.1%	0.2%	-0.6%	13.1%	1.2%	7.0%

Spread of data

The robust SD values calculated for each of the measurands (Table 2) were generally in good agreement, although 7/8 values were larger for the API scheme than for the LGC scheme. This observation may be a result of the different calculation methods applied by the two providers, or simply the relative size of the two datasets.

Table 2. Roust SD for eight measurands, calculated for the API and LGC PT schemes.

	Ash (%)	Calcium mg/100g	Fat (%)	Moisture (%)	Protein (%)	Potassium mg/100g	Salt (%)	Sodium (%)
Number of Labs	80	36	90	92	85	30	82	47
LGC	0.03	9.66	0.46	0.29	0.40	48.9	0.059	0.015
Number of Labs	21	13	41	42	32	10	30	15
API	0.09	6.73	0.683	0.70	0.47	78.9	0.081	0.044
Difference	-0.06	2.93	-0.223	-0.41	-0.07	-29.923	-0.022	-0.029

The robust SDs were used as the SDPA for a number of the measurands in both of the PT schemes (shown in **bold** in Table3). In 4/8 measurands (highlighted in blue) significant differences were observed in the size of the SDPAs used, either as a result of different fit-for-purpose criteria or the comparison between fit-for-purpose criteria from one scheme and the robust SD from the other.

Table 3. SDPA of measurands in the LGC QMAS and API meat PT samples

	Ash (%)	Calcium mg/100g	Fat (%)	Moisture (%)	Protein (%)	Potassium mg/100g	Salt (%)	Sodium (%)
LGC	0.1	**9.66**	0.609	0.4	0.497	**48.939**	0.15	0.1
API	**0.09**	**6.73**	**0.683**	1.16	1	**78.862**	**0.081**	**0.044**
Difference	0.01	2.94	-0.074	-0.76	-0.503	-29.923	0.069	0.056

Despite the differences in the magnitude of the SDPAs, used for performance assessment, in general the rate of satisfactory performance was high, typically 90% or above, for the participants in both of the schemes. In some cases, very high or very low, rates of satisfactory performance may indicate that fit-for-purpose criteria require review.

Table 4. Performance assessment of four measurands from the LGC QMAS and API meat PT samples

	Moisture (%)		Protein (%)		Salt (%)		Sodium (%)	
Provider	LGC	API	LGC	API	LGC	API	LGC	API
Number of Results	92	42	85	32	82	30	47	15
Assigned value	58.11	58	24.85	25.011	0.51	0.504	0.23	0.214
Robust SD	0.289	0.704	0.4	0.474	0.059	0.081	0.015	0.044
SDPA	0.4	1.16	0.497	1.00	0.15	0.081	0.1	0.044
% Satisfactory	87	100	89.4	96.9	90.1	90	95.7	80
% Questionable	3.3	0	2.4	0	2.5	0	0	6.7
% Unsatisfactory	9.8	0	8.2	3.1	7.4	10	10	13.3

Conclusions

The PT materials were suitable for the assessment of laboratories, according to the scheme designs of both LGC and API. Excellent agreement was observed between the participants of the two schemes for the measurement of six common 'proximates'.

Different statistical approaches were used by the two PT providers, in terms of calculation of the assigned value and the spread of data. Calculation of the 'alternative' statistics, API's method has been used on the data from the LGC scheme, unsurprisingly showed little difference in what are large, approximately normal, datasets. Significant differences would be observed for the robust mean and robust SD for calcium, and for the robust mean for potassium.

Table 4. Comparison of summary statistics for a single dataset, produced using the statistical procedures from the API and LGC PT schemes PT samples

	Fat (%)	Protein (%)	Salt (%)	Ash (%)	Moisture (%)	Calcium mg/100g	Potassium mg/100g
Results	90	85	82	80	92	36	30
Median	15.24	24.85	0.51	1.72	58.1	24.0	435
API Rmean	15.23	24.71	0.53	1.72	58.0	29.6	418
API Robust SD	0.616	0.624	0.106	0.056	0.523	19.19	70.0
MADe	0.497	0.40	0.074	0.037	0.32	9.25	56.9

The SDPAs used by the two providers were significantly different for some measurands, although the rate of satisfactory performance was largely unaffected. Potentially the fit-for-purpose criteria used for some of the measurands may need review.

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