

# Inter-laboratory Comparison: Participation of the Analytical Testing Services Laboratory, MPOB, at National and International Level

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## INTRODUCTION

Inter-laboratory comparison is one of the quality control procedures recommended by the Laboratory Accreditation Scheme of Malaysia (SAMM) MS ISO/IEC 17025:2005 (Clause 5.9.1) to monitor the validity of tests offered as services to clients. It provides one of the most expedient means of assessing the bias of one laboratory's testing relative to other laboratories in the industry (Kishore Nadkarni *et al.*, 2004). In fact, a combination of the data derived from statistical quality control and from the proficiency testing programs can satisfy the relatively new requirements for determining the measurement uncertainties.

Inter-laboratory comparison, also known as proficiency testing (PT) programs, cross-checks and round robin tests, is an organised comparison study among laboratories. The organiser prepares and sends the same samples to all participating laboratories for analysis. The results of analyses will be sent back to the organisers where they will be compared by statistical tools. The participating laboratories

will be classified based on the gap between their results and the reference value set by the organisers.

The necessity for all SAMM-accredited laboratories to participate in PT programs is also highlighted in SAMM Policy 4 (SP4). The policy states that all laboratories need to demonstrate their technical competence by satisfactory participation in PT programs, where available. There are international PT programs available, which are organised by accreditation bodies and non-profit organisations such

as the American Oil Chemists' Society (AOCS), Asia Pacific Laboratory Accreditation Cooperation (APLAC) and American Society for Testing and Materials (ASTM). Meanwhile at the national level, PT programs are coordinated by the Malaysian Department of Chemistry, Standards and Industrial Research Institute of Malaysia and private organisations.

## INTER-LABORATORY COMPARISON

The Analytical Testing Services (ATS) Laboratory, operating under the Advanced Oleochemical Technology Division (AOTD), Malaysian Palm Oil Board (MPOB), is an accredited laboratory under the SAMM MS ISO/IEC 17025:2005 system. As part of the accreditation requirements, the ATS Laboratory has been participating in PT programs since 1996. *Table 1* shows the list of PT programs in which the laboratory has partici-

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**TABLE 1. PARTICIPATION OF ATS LABORATORY IN PT PROGRAMS BASED ON TESTS REGISTERED UNDER SAMM MS ISO/IEC 17025:2005**

Type of tests	Participation in PT Programs
Free fatty acid/Acid value (FFA)	AOCS LPP Palm Oil Kimia Malaysia PT Program
Moisture and volatile matter	Internal cross-checks
Lovibond colour	AOCS LPP Palm Oil
Iodine value (IV)	AOCS LPP Palm Oil Kimia Malaysia PT Program
Slip melting point (SMP)	AOCS LPP Palm Oil Kimia Malaysia PT Program
Fatty acid composition (FAC)	AOCS LPP Gas Chromatography
Deterioration of bleachability index (DOBI)	Sime Darby Research Inter-Lab Cross-Checks

pated for the tests registered under SAMM MS ISO/IEC 17025:2005.

At the international level, the laboratory has been participating in the American Oil Chemists' Society Laboratory Proficiency Program (AOCS LPP) since 1996. AOCS LPP is an international collaborative proficiency testing program for oils and fats-related commodities, oilseeds, oilseed meals and edible fats (<http://www.aocs.org>). More than 500 chemists participate in the program to verify their laboratories' quality control. Participants use AOCS or similar methods to analyse the sample and then compare their results with a large cross-section of other laboratories using the same method and sample.

The Approved Chemist Program recognises the most accomplished participants in AOCS LPP. The AOCS Examination Board determines approval using the following criteria:

- a combined score of less than 1.4 or less than 1.3 with one outlier, and
- absolutely no missing samples or required results.

If these criteria are met, participants will be awarded with the Approved Chemist status. The status is a recognition of proficient use of AOCS methodologies in the Laboratory Proficiency Program. Furthermore, the status entitles laboratories to act as a referee for those analyses consistent with the Laboratory Proficiency Program series for which Approved Chemist status is granted. Approved Chemist listings are published yearly in *INFORM* magazine, the AOCS Directory and on the AOCS home page.

At the national level, the ATS Laboratory participates in PT programs such as Kimia Malaysia PT Programs and Sime Darby Research Inter-Laboratory Cross-Check programs. In the case of moisture and volatile matter analyses, there are no PT programs available. As stated in SP 4 (Section 4.4 g), in cases where PT programs are not available, the laboratory is required to demonstrate proficiency with internal performance-based data in compliance with SAMM MS ISO/IEC 17025:2005 (Section 5.9). The laboratory executes inter-personnel comparison where two analysts perform the same test on the same sample.

## OUTCOME OF THE PT PROGRAMS

The ATS Laboratory has been participating in several PT programs at the national and international levels since 1996, and has achieved excellent results every year. This shows that the laboratory has successfully met the SAMM MS ISO/IEC 17025:2005 requirements. Through AOCS LPP, the laboratory participates in three series of analyses: Gas chromatography (GC), *trans* by gas chromatography and palm oil series. For the gas chromatography series, participants perform FAC analysis, while for the palm oil series, five analyses need to be done: FFA, SMP, IV, cloud point (CP) and colour determinations.

Table 2 shows the combined scores obtained by the laboratory in the three series from 2008 until 2013. The combined score is the mean z-value for all required results. The z-value is calculated as follows [5]:

$$z - value = \frac{Analyst\ result - Mean}{Standard\ Deviation\ (S_r)}$$

**TABLE 2. COMBINED SCORES OBTAINED IN GAS CHROMATOGRAPHY, TRANS BY GC AND PALM OIL ANALYSES FROM 2008-2013**

Series	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013
Gas chromatography	0.21	0.25	0.13	0.15	0.15
Trans by GC	0.57	0.55	0.39	0.55	0.62
Palm oil (FFA, SMP, IV, CP, colour)	1.69	0.69	0.73	0.95	0.72
No. of participating laboratories	79	83	76	79	85

Combined scores approaching zero indicate improving performance while large combined scores indicate poor performance. The ATS Laboratory has obtained very good combined scores in gas chromatography analyses from 2008 until 2013.

Having met the AOCS Examination Board criteria, the ATS Laboratory has earned the Approved Chemist status every year since 2001. Additionally, AOCS also awards participants who are ranked among the top 10% of their program series based on the combined score, with 'Honourable Mention'. The laboratory was awarded with 'Honourable Mention' in gas chromatography analyses in the 2011-2012 LPP for achieving sixth place among 79 participants. As icing on the cake, the laboratory received the First Place Award in gas chro-

matography analyses in the 2012-2013 LPP for topping the series.

At the national level, the Kimia Malaysia PT Program is organised by the Malaysian Department of Chemistry every year and is open to laboratories in Malaysia. The ATS Laboratory participates in FODAS 10: Edible Oils and Fats scheme consisting of IV, SMP and FFA tests (<http://www.kimia.gov.my>). Table 3 shows the z-scores obtained by the laboratory for the three parameters from 2009 until 2012.

The interpretation of the z-score is given below:

- $|z| \leq 2$  means satisfactory performance
- $2 < |z| < 3$  means questionable performance
- $|z| \geq 3$  means unsatisfactory performance

The laboratory's z-scores from 2009 to 2012 were generally satisfactory except for the IV parameter in 2010. In this case, the laboratory obtained a z-score of 3.14 for sample A and 2.93 for sample B, which signified unsatisfactory and questionable performance, respectively. Consequently, the laboratory had to carry out appropriate corrective actions and take part in the next available PT program according to SP 4 (Section 4.5 Consequences of Poor Performance).

Another local PT program that the ATS Laboratory participates in is the Sime Darby Research Inter-Lab Cross-Checks, which is also organised yearly (<http://www.plan-tation.simedarby.com>). The tests to be performed in this PT program are DOBI, FFA, volatile matters, impurities, copper, iron, UV-total oxidation (UV-Totox) and carotene

**TABLE 3. Z-SCORES OBTAINED FOR IV, FFA AND SMP ANALYSES FROM 2009-2012**

Parameter	Sample	2009	2010	2011	2012
IV	A	0.33	3.14	1.71	0.24
	B	0.69	2.93	-1.40	-0.31
FFA	A	-0.18	-0.44	0.08	1.29
	B	0.00	-0.17	-0.50	-0.14
SMP	A	0.32	-0.67	-0.81	0.27
	B	0.00	-1.00	-0.23	-0.73
No. of participating laboratories		56	54	52	54

content. Copper, iron, UV-Totox and carotene content tests are not registered in the laboratory's SMM MS ISO/IEC 17025:2005 scope of accreditation.

Table 4 shows the z-scores obtained by the laboratory for overall performance from 2009 until 2012. The laboratory's z-scores for overall performance in all tests were good and without outliers.

The criteria for the z-score given in this PT program are as follows:

- $|z| \leq 1$  means good performance
- $1 < |z| < 2$  means satisfactory performance
- $2 < |z| < 3$  means questionable performance
- $|z| \geq 3$  means outlier

## THE BENEFITS OF INTER-LABORATORY COMPARISONS

PT programs involve a formal evaluation to assess the ability and efficiency of a laboratory in complying

with the requirements of SMM MS ISO/IEC 17025. The ATS Laboratory is using PT programs as a quality control tool to ensure that the test methods offered as services are fit for this purpose, and that the results are technically valid. The competency of analysts is monitored and improved continuously. The results obtained from PT programs are also manipulated to estimate measurement uncertainties of the tests registered under SMM MS ISO/IEC 17025:2005, which is a normal practice (Koch *et al.*, 2012).

By participating in PT programs, the ATS Laboratory's credibility is assured with customers' level of confidence in and satisfaction with the analytical services offered improving. This is in line with the laboratory's vision to become a reference laboratory for analyses of palm oil and oleochemicals. Table 5 shows the number of samples received from customers from 2009 to 2013, which also includes overseas clients: from Indonesia, Thailand, Singapore, the Philippines,

Papua New Guinea, Yemen and Oman.

The excellent results obtained in the PT programs are attributed to the dedication and unwavering commitment by all laboratory personnel. Through PT programs, the personnel have demonstrated a good level of teamwork, mastery of skills and self-confidence.

## CONCLUSION

As part of the accreditation requirements, the ATS Laboratory has been participating in PT programs since 1996. The laboratory obtains excellent results every year in the AOCS LPP, Kimia Malaysia PT Program and the Sime Darby Research Inter-Lab Cross-Checks. To cap the excellent results, the laboratory received the First Place award in gas chromatography analyses in the 2012-2013 LPP for topping the other participating laboratories in the series. Besides complying with the requirements of SMM MS ISO/IEC 17025, the laboratory is also using PT pro-

TABLE 4. Z-SCORES OBTAINED FOR OVERALL PERFORMANCE FROM 2009-2012

Parameter	2009	2010	2011	2012	2013
Overall performance	0.69	0.60	0.40	0.40	0.93
No. of participating laboratories	7	7	9	12	16

TABLE 5. NUMBER OF SAMPLES RECEIVED BY THE ATS LABORATORY FROM 2009 TO 2013

Year	Customer		Total
	Internal (MPOB)	Industry	
2009	1 810	327	2 137
2010	1 945	329	2 274
2011	1 317	366	1 683
2012	580	189	769
2013	658	188	1 173

grams as a quality control tool to ensure the laboratory's credibility as a reference laboratory for analyses of palm oil and oleochemicals.

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The image shows the cover of the Journal of Oil Palm Research, Vol. 27 (1), March 2015. The cover features a central image of a palm fruit cross-section and a smaller image of a palm fruit. Text on the cover includes 'AVAILABLE ON-LINE', 'Journal of Oil Palm Research', 'Vol. 27 (1) March 2015', and a multi-faceted approach to *Ganoderma* control. A barcode is visible at the bottom left.

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