Quality Improvements in the Production of Malaysian Palm Oil

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INTRODUCTION

Crude palm oil has been consumed as a food in Africa since 5000 years ago. In Malaysia, the oil palm was introduced in 1870 as an ornamental plant; it was reintroduced as a commercial crop in the 1960's. Since then, the Malaysian palm oil industry has expanded. Malaysia contributes approximately 17.4% of the world's supply of oils and fats, and exported approximately 9.1 million tonnes of palm oil in 1997. Malaysia exported processed palm oil to over 100 countries.

Palm Oil Research Institute of Malaysia (PORIM) was established in 1979 to carry out research and development for the industry. Since consumers are increasingly sophisticated and demand higher quality products, PORIM has played a significant part in ensuring the quality of the palm oil products that Malaysia has produced and exported. While ensuring quality is necessary at the processing stage, it begins with seedling selection and continues with plantation management, milling of the fresh fruit bunch (FFB), transportation and storage, refining and processing, and providing technical advisory services (TAS) directly to consumers.

SEEDLING SELECTION

The choice of planting materials is important to ensure high oil yield and quality. The quality of oil palm planting material in Malaysia is governed by the Standard and Industrial Research Institute of Malaysia (SIRIM) and the Palm Oil Registration and Licensing Authority (PORLA). High-quality planting material will produce high-quality oil. Cross-breeding of *dura* (D) and *pisifera* (P) varieties produced the desired D x P = T (*tenera*) seeds. Seeds are first planted in nurseries to produce seedlings. Poor-quality seedlings are culled at three months, when developmental abnormalities are observed. The abnormalities can be genetic, or due to pest, disease or even errors in nursery management. Normally, 30%-40% of the seedlings are discarded. The seedlings are ready for field planting at 7-8 months (Rajanaidu, 1994; Hardon, 1984a).

HARVESTING AND HANDLING OF FFB

PORIM has also made guidelines for harvesting FFB. The maximum amount of the best quality oil in a bunch is obtained when no unripe bunches are harvested, all loose fruit is collected, minimal fruit damage or bruising occurs during harvesting and infield transportation of the FFB, minimal contamination occurs from dirt adhering to the FFB, the stalk is kept as short as possible, and the minimum time elapses between harvesting and sterilization at the mills. Over ripe fruit, excessive bruises, and lengthy post harvest delays will lead to a high free fatty acid (FFA) content, reducing oil yield and quality. The FFB is ready for harvest when one or two fruits drop from the bunch. The optimal harvest frequency is once every 10-15 days or 2-3 times a month (Hardon, 1984b).

MILLING

Once harvested, the ripe FFB must be transported as soon as possible to palm oil mills for immediate processing. It is important that during harvesting,

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handling and transportation, the FFB is not damaged. Damaged palm fruit gives low quality crude palm oil (CPO). At the mill, the FFB is immediately sterilized to prevent enzymic deterioration of the oil. The sterilization process, 140°C for 90 min., helps to loosen the fruit from the bunch. The heat helps break up the oil-bearing cells of the fruit mesocarp to release the oil during the digestion process.

In order to maintain CPO quality and to keep it uncontaminated by kernel oil, the pressure during the extraction process is controlled so that the nuts (kernels) will not be ruptured. This results in double pressing; initially, a low pressure press recovers some of the CPO, then the nut is separated from the mesocarp mash. The second press squeezes out the balance of the oil from the fibers. The CPO slurry collected from the two presses proceeds through a clarification process because it contains 35%-45% oil, 45%-55% water, and varying amounts of fibrous material. Clarification is carried out at a temperature of approximately 90°C. Since the oil floats, it can be skimmed off and centrifuged. The resultant CPO will have final moisture and dirt contents below 0.1 and 0.01%, respectively (Ma, 1994).

Standards and Specifications

PORIM, with a joint effort from Palm Oil Refiners Association of Malaysia (PORAM), the Malaysian Edible Oil Manufacturers' Association (MEOMA), Malaysian Oil Palm Growers Council (MOPGC), Palm Oil Millers Association of Malaysia (POMA), and other related organizations, has produced a commercial specification for CPO (MEOMA, 1996; PORAM, 1989). These specifications were derived after thousands of representative sample analyses, observations, and studies were made (*Table 1*). The PORAM specifications for palm oil and its products have now been accepted internationally by traders and buyers. Both PORIM and SIRIM had also established standards for palm oil products, and these standards have already been accepted and adopted by Codex Alimentarius. Among the standards now available are MS814:1983, MS Specification of Palm Oil; MS815:1983, MS Specification of Palm Stearin; and MS816:1983, MS Specification on Palm Olein.

REFINERS' CERTIFICATE OF COMPETENCY AND MILLS' CERTIFICATE OF COMPETENCY

As part of the continuous effort to improve the quality of palm oil exported worldwide, PORIM has instituted the Refiners' 'Certificate of Competency' (RCOC). This technical audit was introduced to determine whether a palm refinery or mill had the skill, equipment, and other resources to manufacture and produce palm oil and palm oil products to meet a consistent, high-quality standard (Berger *et al.*, 1989; Thiagarajan, 1993). During the audit, hygiene, laboratory control, and compliance with ISO 9000 requirements are assessed to determine whether or not they will permit reproducible production of high-quality palm oil or its derivatives (Berger *et al.*, 1989; Short Comm., 1984).

The Scoring Programme

The programme was introduced to industry in 1980; it was finally instituted in 1984 for the palm oil refineries (Short Comm., 1984; 1987), and 25 of the 27 refineries participated. Participation in the programme is voluntary (Berger *et al.*, 1989; Thiagarajan, 1993). To be objective, detailed assessments are made using defined criteria on an itemized marking sheet. Each criteria is given a weighted score (*Table 2*).

The scoring programme is divided into five main sections. Section One covers general cleanliness and hygiene on the premises and within the factory; it also considered staff efficiency. Section Two covers quality control in the laboratory and interaction between the laboratory and factory. Section Three addresses such factory operations as instrumentation, plant and process conditions, and quality assurance. Section Four, focuses on product storage and disposal; it includes an assessment of the tank yard and the packaging plant. Section Five considers safety and maintenance throughout the facility.

Table 2 indicates that the scoring programme for the RCOC was reviewed after the fifth year of implementation. Based on the experience and discussion with the industry, the weight given to various sections was adjusted. More detailed and stringent scores were imposed. Greater emphasis

TABLE 1. PORAM STANDARD SPECIFICATIONS FOR PROCESSED PALM OIL

Oil type	FFA (as palmitic)[a]	M&I	I.V. (Wijs)	M.P. (°C)[b]	Colour[c]	Total fatty matter	Saponifiable matter
Neutralized palm oil	0.25%[d]	0.1%[d]	50-55	33-59			
Neutralized and bleached palm oil	0.25%[d]	0.1%[d]	50-55	33-39	20 R[d]		
Refined bleached and deodorized (RBD)/ neutralized, bleached and deodorized (NBD) palm stearin	0.2%[d]	0.15%[d]	48	44	3 or 6 R[d]		
Crude palm oil	5.0%[d]	0.25%[d]	56[e]	24[d]			
Neutralized palm olein	0.25%[d]	0.1%[d]	56[e]	24[d]			
Neutralized and bleached palm olein	0.25%[d]	0.1%[d]	56[e]	24[d]	20 R[d]		
Refined bleached and deodorized (RBD)/ neutralized bleached and deodorized (NBD) palm olein	0.1%[d]	0.1%[d]	56[e]	24[d]	3 or 6 R[d]		
Double fractionated palm olein	0.1%[d]	0.1%[d]	60[e]	19[d]	3 R[d]		
Crude palm stearin	5.0%[d]	0.25%[d]	48[d]	44[e]			
Neutralized palm stearin	0.25%[d]	0.15%[d]	48[d]	44[e]			
Neutralized and bleached palm stearin	0.25%	0.15%[e]	48[d]	44[e]	20 R[d]		
Refined bleached and deodorized (RBD)/ neutralized bleached and deodorized (NBD) palm stearin	0.2%[d]	0.15%[d]	48[d]	44[e]	3 or 6 R[d]		
Palm acid oil	50%[e]	3%[d]				95%[e] (basis 97%)	
Palm fatty acid distillate	70%[e]	1.0%[d]					95%[e] (basis 97%)

[a]Molecular weight of palmitic acid is considered to be 256.

[b]Slip point, softening point, or rising point; AOCS Cc 3-25.

[c]Colour measurement based on Tintometer Model E AF 900 and Model D AF 702; 5 1/4" Lovibond cell.

[d]Maximum.

[e]Minimum.

TABLE 2. THE MAIN SECTIONS OF THE SCORING PROGRAMME 1983-1993

Section	Maximum scores/marks			
	1983-1987	wt%	1988-1993	wt%
I General	60	21.7	80	22.2
II Quality control	90	32.6	95	26.4
III Factory operations	31	11.3	80	22.2
IV Storage and disposal of products	55	19.9	70	19.5
V Safety and maintenance	40	14.5	35	9.7
Total	276	100	360	100

was placed on the management section to ensure that the management is committed to overall improvements in quality assurance. The laboratory was also required to participate, and to perform well, in annual analytical cross-checked programmes with various laboratories within and outside of the country. The minimum passing score for the Certificate of Competency was set at 65%.

In 1994 the scoring programme was reviewed for the second time. Since Malaysian palm oil was gaining worldwide acceptance, many other aspects of processing that are pseudoquality in nature were introduced. The matters were not related to the inherent quality of palm oil; these conditions were instituted because customers became more critical, and palm oil quality was being scrutinized more closely. Within the factory, the quality checks are now simple routines. Personnel training and improvement has become essential. These aspects were incorporated in the section under general management. ISO 9000 is now one of the aspects strongly stressed during the audit. Factory and equipment cleanliness, and the general layout have now become a section. *Table 3* displays the new scores.

Auditing Process

The programme is very comprehensive and requires trained personnel to perform the auditing. It is an objective assessment. Two senior technical officers of PORIM, at least one of whom must have practical experience in refinery management, conduct the evaluation. Their skill, perceptiveness,

TABLE 3. SCORING PROGRAMME FOR RCOC FROM 1993

Section	Maximum marks/scores	wt%
General and management	120	23.6
Cleanliness	64	12.5
Factory operation	95	18.7
Storage and disposal	75	14.7
Quality control	110	21.6
Safety and maintenance	45	8.9
Total	509	100

and attention to detail comprise the heart the audit. They must be also follow the guides given in *Table 4*.

Again is should be emphasized that the factory's participation in this audit is purely voluntary. A mutually agreed upon date for the audit must be obtained first. On the day of the audit, the full commitment from the senior management of the factory is necessary. A short discussion with the factory management concerning the purpose of the visit, the audit plan and route, and brief information from previous audit findings is held before the audit evaluation is conducted. The factory management is also requested to assign senior officer(s) to accompany the PORIM team throughout the audit visit and tour of the factory and premises. The audit team is expected to be granted access to every part of the factory and laboratory. The audit or evaluation shall not be conducted if the PORIM team believes that there is a lack of commitment from management or the factory is not ready for inspection.

The inspection is to be as systematic and objective as possible. Record books, instruction charts, and instruction manuals are examined. The factory officer who accompanies the team may be questioned if the team feels that it is necessary. The team may also interview various staff members or operators to gauge their competency and commitment. The inspection is thorough and discrepancies are recorded for later discussion.

Upon inspection completion, the PORIM team will call for a final discussion with management. Professionalism and an open approach to this discussion are necessary so that the discrepancies

observed can be clearly defined without being negative. Improvement suggestions should also be discussed. The preliminary inspection findings are made verbally during this discussion. Management must be assured that anything observed and discussed during the audit are strictly confidential. The final and formal results and the report will be given to each factory after the RCOC committee has discussed them at PORIM Headquarters. Neither this report nor the score received by a refinery are made public.

The Evaluation Committee

All PORIM evaluation officers are members of this committee. The Director General of PORIM is the chairperson. The results and scores from all groups are examined by this committee to ensure that a minimum number of errors or evaluation discrepancies have been made. The scores are complied, and Certificates of Efficiency are granted to refineries that have attained scores greater than or equal to 65%. Certificates are normally issued

TABLE 4. DETAILED FRAMEWORK OF RCOC SCORING

Section number	Section title	Duties
I	General and management	Management: quality policy, charting progress, documentation of quality target, *etc.* Training: programme and documentation Incoming raw materials: procedures, terms/procedures for nonconformance, *etc.* Quality audit: procedures, corrective action, *etc.* Staff efficiency: knowledgeability, record keeping, and instructions
II	Cleanliness	Hygiene/cleanliness of premises Hygiene/cleanliness within the factory
III	Factory operation	Instrumentation: records, gauges, calibration, *etc.* Plant process conditions: parameters determined by general guidelines and their measurement Quality assurance: quality targets at various stages, piping materials used, and data recording
IV	Storage and disposal	Tankyard: storage conditions, such as temperature, level, gauges, heating system, separate or dedicated tanks for various products, tank material, interaction with surveyors, piping insulation (PIG), documentation, *etc.* Packaging plant: operation, general cleanliness, piping and storage
V	Quality control	Laboratory: general appearance and organization, standard solutions, sample storage, routine analysis parameters, predictive tests, and global cross-checking of analytical results Factory interactions: information flow; documenting recording and verifying sampling methods, standards, *etc.*
VI	Safety and maintenance	This includes the general cleanliness of the plant, the layout, chemical handling, safety facilities and the use of safety equipment, maintenance system, and frequency of maintenance

annually since the audit is performed on an annual basis. However, considering that a number of refineries have successfully attained high scores year after year, the committee is now giving a two-year certificate to these select few. Occasionally, a refinery score less than 65%, and fails to obtain the certificate. The committee may conduct a second evaluation if the refinery makes such a request. Reevaluation or reinspection may also be carried out if the refinery was not ready at the time that the first inspection was scheduled and the committee believes that the reasons are justified. The audit evaluation or RCOC is a technical advisory service tool provided by PORIM to Malaysian palm oil industry, and has significantly contributed to the quality improvement of Malaysian palm oil and its products.

The Certificate

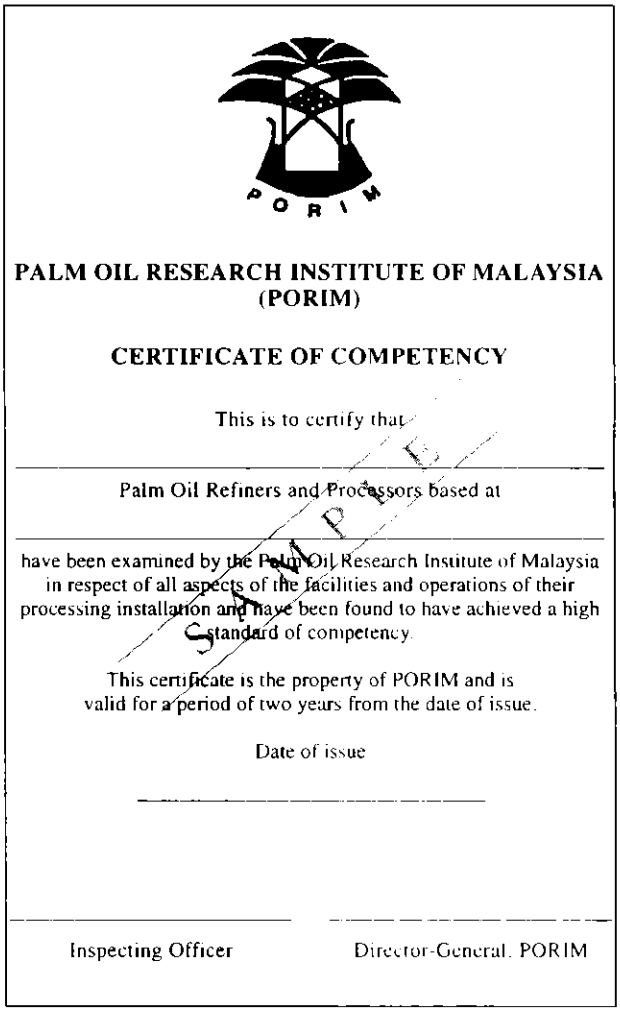
The certificate is displayed in *Figure 1*. The certificate has a valid duration, is clearly written, and is signed by both the Director General of PORIM and the Inspecting Team Leader. In essence, the certificate endorses the system and is not a certification of product quality. A valid certificate verifies that the systems employed by the refinery management, hygiene, process control, laboratory, or other areas relevant to operation are in good order. The refinery is sufficiently competent to produce and maintain production of high-quality palm oil and its derivatives. The refinery may use this certificate to promote customer confidence; consumers may be more confident of the refinery's capability to produce the high-quality products that they demand.

RCOC Scores for the Past 12 Years

Over time, the standards have been gradually tightened. Reviews of audit requirements were made in order to guide the Malaysian palm oil industry in its goal of meeting more stringent customer requirements. It is remarkable to note that Malaysian refineries have still achieved high scores in spite of more rigorous standards. As a result, Malaysian palm oil products are known worldwide for their high quality. *Table 5* shows the number of participating refineries and the average score over the last 12 years. The RCOC programme is accepted by a majority of the Malaysian palm oil refineries. It serves a useful technical advisory function for refinery management. Presently, participating refineries represent over 90% of the Malaysian palm oil refinery capacity; these refineries account for 90% of the total Malaysian palm oil output.

Quality Improvement through ISO 9000

In general, the refineries implementing ISO 9000 have scores of a least 80%. In 1995, 14 refineries scored 80% or above and 18 in 1997 (*Table 6*). There were 11 refineries in 1995 and 18 in 1997 certified and implementing ISO 9000, four refineries ready for certification in 1999, and nine others at advanced stages of implementation. The remainder are still at the initial or planning stages. Implementation of the ISO 9000 Quality System has cleary improved the competence and capability


PORIM

PALM OIL RESEARCH INSTITUTE OF MALAYSIA (PORIM)

CERTIFICATE OF COMPETENCY

This is to certify that

Palm Oil Refiners and Processors based at

have been examined by the Palm Oil Research Institute of Malaysia in respect of all aspects of the facilities and operations of their processing installation and have been found to have achieved a high standard of competency.

This certificate is the property of PORIM and is valid for a period of two years from the date of issue.

Date of issue

Inspecting Officer

Director-General, PORIM

Figure 1. Sample of PORIM certificate of competency.

TABLE 5. AVERAGE SCORE FOR REFINERS' CERTIFICATE OF COMPETENCY

Year	Number of refineries	Average score	Number failed
1984	19	78.9	—
1985	21	79.9	—
1986	25	80.4	—
1987	25	82.2	1
1988	25	82.7[a]	—
1989	24	86.0	—
1990	25	86.4	—
1991	26	87.4	—
1992	21	88.6	—
1993	20	84.6	—
1994	25	80.3[a]	—
1995	25	81.5	—
1996/1997[b]	27	81.5	2[c]
1998/1999[b]	30	81.9	5[c]

[a] Reviewed and tightened marking scheme were used.
[b] The RCOC inspection done once/two years for those score > 70 marks.
[c] Deferred; the company restructure or shifting location.

TABLE 6. RANGE OF SCORES FOR RCOC (1995)

Range (%)	Number of Refineries 1995	1997	1998/99
>90	5	5	3
80-90	9	9	15
70-80	10	10	6
65-70	1	1	1
<65	—	—	1

of Malaysian palm oil refineries to produce high-quality palm oil. The inclusion of the essence of ISO 9000 in the RCOC audit programme has proven useful to industry as an audit and feedback system for continuous quality improvement.

Mills Certificate of Competency

The success of the RCOC has made it a viable model to introduce a similar concept to the palm oil mills, the Mills Certificate of Competency (MCC). The MCC has also been successful. Participation is still limited because of the high number of mills (over 270) coupled with the limited number of officers available to perform the evaluations, but it is expanding. Increased numbers will be permitted to join the programme in the near future.

Mills produce CPO that is sold to refiners and not exported. The Malaysian government discourages the export of CPO because of the excess refining capacity in Malaysia and due to the need to export more value-added products. Thus, the Malaysian refineries are the palm oil millers' customers. The CPO produced by the mills participating in the MCC is reported to be of consistently high quality. The MCC programme is part of the improvement programme to the quality assurance system for the Malaysian palm oil industry.

Future Direction

More refineries are expected to be certified with ISO 9000. While the ISO 9000 system itself emphasises continued inspection and improvement, future RCOC will also have to tailor to such needs. The incorporation of elements from HACCP and ISO 14000 into the RCOC scheme may next be on line.

CONCLUSION

The Certificate of Competency Programme and Mills Certificate of Efficiency have been accepted by Malaysian refiners and millers as important tools to improve quality of the production of Malaysia palm oil. Presently, the RCOC has been implemented in over 90% of Malaysian refineries, representing over 90% of the refined palm oil produced in Malaysia. The RCOC has been adapted with similar success by Malaysian palm oil mills as the MCC. Malaysian palm oil quality, with implementation of the RCOC and MCC, is geared to meet consumer quality expectations. Improvement and revision of the RCOC and MCC programmes are the main contribution to the continuous quality improvement in Malaysian palm oil production.

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