Palm Kernel Cake Marketing: Constraints and Prospects

Ahmad Borhan A Nordin*; R Venugopal*; Nasir Amiruddin* and Mohd Arif Simeh*

ABSTRACT

Standardization or product specification is an important measure to ensure that only high quality product reaches the market place. The formation of palm kernel cake (PKC) trade specifications and the requirements of quality testing plus regular inspections had assured the quality of PKC was under control throughout the years. The changing preferences by customers and the advancement of technology validate the revision of such specifications. The study reviews the quality performance of PKC within its trade specifications in the previous years and the possibility of improving its quality to a higher level. Moreover, it reveals the economic significance of elevating the quality of PKC through innovative processing system that produces its raw materials i.e. *palm kernel.*

INTRODUCTION

The quality of a product plays a strategically important role that can be the icon of the company and the industry as well. Product specification or standardization is an important step towards verifying that only high quality product reaches the market place. Nutrients property, hygienic or health harmlessness and homogeneity or stability of the product are important aspects in qualifying animal feed materials such as PKC as a quality product.

PKC has long been utilized either as additional ingredients in animal compound feeds or as straight animal feeds particularly for ruminants. PKC is also an important product from the oil palm industry that generate substantial export earnings for Malaysia, which was approximately RM 337.9 million in 2003. About 1.81 million tonnes of PKC was exported in 2003 and nearly 90% of them were sent to European countries, mostly Netherlands and Germany.

The quality of PKC as feedstuff must be ascertained safe and healthy because it is given to animals that subsequently will provide food for human consumption. In fact, the animal feed sector is at the beginning of the animal production chain. Animal health problems with bovine spongiform encephalopathy (BSE), dioxin contamination in Brazilian citrus pulp (1998) and in Belgian feed fats (1999) had raised awareness on the safety of animal feed in Europe. These situations have drawn attention of legislators in European countries to scrutinize food quality and safety problems including the animal feed sector that forms an important link in the food production chain. Policies based on *Farm to Table* or *Feed to Food* concept have gained acceptance worldwide and practiced

* Malaysian Palm Oil Board,
P. O. Box 10620,
50720 Kuala Lumpur,
Malaysia.

by many countries, especially in Europe.

Complaints on the quality of PKC by European importers had been highlighted since 1980s such as possible presence of aflatoxin, followed by high level of dirt and shell in 1990s. Survey conducted by Siew and Noraini (1989) showed that aflatoxin was undetected, while other parameters conformed to the specifications. However, the quality of PKC was really questionable when its consignment was found to be contaminated with scrap metals such as bolts and nuts in 2000 and further suspected when more than 2 parts per million (ppm) of arsenic was discovered in 2003. The former incidence had been discussed deliberately in local industry forum although the authority had suggested the application of magnetic trap to prevent the recurrence of it. These bad incidences, although the probability of their occurrence is very small, can tarnish the quality reputation of Malaysian PKC. Malaysian Palm Oil Board (MPOB) closely monitors the quality of PKC traded in the country. Every consignment of PKC must undergo quality testing by independent labs or surveyors, which are contracted by traders and approved by MPOB. The report must be submitted to MPOB for product's traceability in any necessary situation. Furthermore, MPOB officials make regular visits to kernel crushing mills, warehouses and ports of shipments nationwide, where samples of PKC are taken for quality testing. This exercise acts as a measure to assure the quality of PKC is always in good condition and within its specification limits.

Besides quality assurance, emphasis is also given on the quality improvement of PKC. Continuous quality development seeks improvement of machinery, raw materials, labour utilization and innovation in production or processing methods. The quality improvement is pursued through research studies and experiments that have been carried out continuously by government agencies, especially MPOB.

OBJECTIVE

The purpose of the study is to assess the quality of PKC in the recent years and to find out the effectiveness of its trade specifications. In addition, the study will also highlight on approaches that can bring up the PKC to a premium quality standard. Finally, the study will recommend new specification and evaluates its economic implications.

METHODOLOGY

Previous data of PKC quality measurements obtained from the Quality Control Unit of MPOB since 1994 that include various parameters such as dirt and shell (D&S), moisture, oil and protein content is compiled and analysed using statistical tools. These parameters are compulsory information provided either by PKC sellers or buyers through surveyors on quality of traded PKC in the country and submitted to MPOB. The measurements are either taken from a composite sample of PKC consignments or several measurements from a cargo of PKC that comprises of export and domestic transactions. The information will be used to portray the quality of traded Malaysian PKC over the years generally as compared to trade specifications. Data from routine inspections by Quality Control Unit will also be utilized in the analysis.

There are two trade specifications for PKC *i.e.* domestic and export contracts. The domestic contract is based on MEOMA 12 Specifications as shown in *Table 1*, which covers trading transactions between kernel crushing mills and local exporters.

TABLE 1. MEOMA 12 SPECIFICATION – DOMESTIC CONTRACT

Parameter	Specifications
Protein	14% min
Oil	8% min
Moisture	9.5% max
Dirt and shell	15% max, above 18% rejectable

Source: MEOMA Handbook 2003-2004.

Basically, protein content and oil content represent the nutrients property of PKC, while moisture level and D&S content indicate hygienic and health aspects of PKC. The latter two parameters indirectly imply the proper processing, storage and handling practices of PKC.

Table 2 shows the PKC specifications that are employed in export transactions. There are only two parameters in MEOMA 11 Specification, *i.e.* profat content, which is actually a combination of protein and fat, while another one is the moisture level.

TABLE 2. MEOMA 11 SPECIFICATION – EXPORT CONTRACT

Parameter	Specifications
Profat, % min. by weight	21
Moisture, % max. by weight	10 at time of shipment

Source: MEOMA Handbook 2003-2004.

Additional information and feedback on the quality of PKC is obtained through discussions via telephone with local surveyors that perform quality control testing and also by visiting several palm kernel (PK) crushers in order to observe processing operations, storage and transportation of PKC.

RESULTS AND DISCUSSION

The number of measurements recorded by the surveyors and submitted to MPOB had increased from 250 in 1994 to 636 in 2000 and 1129 in 2003, which corresponded to the increasing amount of traded PKC over the same period. Usually, measurements of PKC quality were based on specific parameter according to mutual agreements between sellers and buyers either for export or domestic transactions. Moisture, oil and D&S content were mostly recorded in the contract while protein content was the least one and only available since 1998.

Figure 1 shows percentages non-conforming measurements of each parameter out of total of non-conformance cases from 1994 to 2003. The bar chart shows the oil content parameter is the leading non-conformance specification in PKC with average percentage of 54% over the years, followed by D&S of nearly 30%, moisture of 16% and protein of slightly less than 3%.

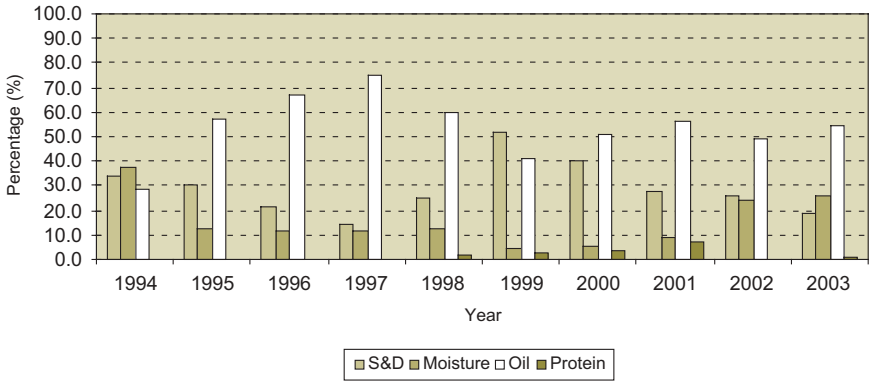

Figure 1. Percentages of non-conforming measurements of palm kernel cake (PKC) quality.

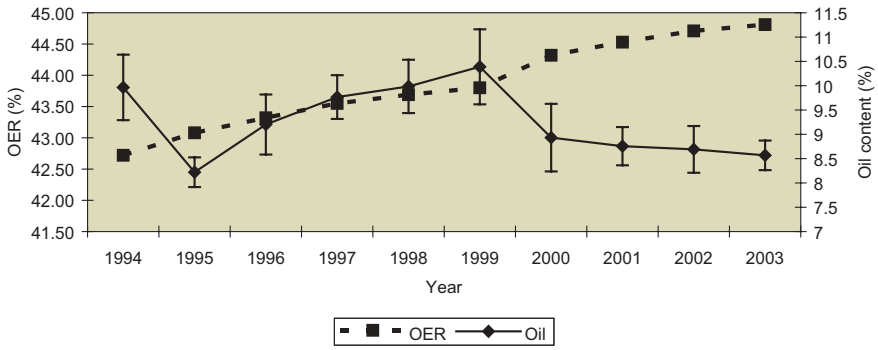

Figure 2. Trends of palm kernel oil yield and palm kernel cake oil content, 1994 – 2003.

Oil Content

The oil content is stated specifically for domestic trade and only included in export transaction as a combination with protein, which is known as profat. The specification is stipulated at the minimum level of 8% for domestic trade. The oil content retained in PKC is a good source of energy for the feed uses. However, since PK is considered as oil driven product, the producers emphasize on extracting more oil than concern about the oil residue in PKC. Hence, the increment by approximately 2% of oil yield in a decade had reduced the oil content in the PKC and caused higher number of non-conformance cases every year.

Figure 2 shows that the PK oil yield had increased from 42.72% in 1994 to 44.32% in 2000 and 44.81% in 2003. The increasing trend was mainly due to improvement in pressing technology and further boosted by the application of double pressing system, which is highly favoured by the PK crushers.

Figure 2 also shows the declining trend of oil content in PKC from between 10% – 11% in 1999 to 8% - 9% in 2003, which indicated increasing number of lower measurements of oil content in PKC.

Table 3 shows that 73% of the measurements of oil content conformed to the specification in 1994 but declined to 48.5% in 2003. It shows also that since 1998 more than half of the measurements were consistently less than the minimum limit.

Statistics in *Table 4* shows that the average oil content was high at 10.39% in 1999 but slowly declined to 8.57% in 2003. Concomitantly, the standard deviation also has decreased from 6.80% to 2.70% over the same period. The smaller spread value indicates that Malaysian PKC is becoming more homogeneous in term of oil content, although it is produced from different producers.

TABLE 3. PERCENTAGES OF OIL CONTENT ABOVE 8% IN PALM KERNEL CAKE, 1994 – 2003

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Higher than 8%	73.4	41.2	51.8	66.8	48.8	48.8	41.3	48.4	46.7	48.5

Protein

Protein is the important nutrient component in a feed ingredient and PKC is categorized as low grade protein feed. It contains about 14% to 16% of crude protein. The domestic contract stipulates a minimum level of 14% for protein content in PKC. *Figure 3* shows the protein content in PKC has not fluctuated much and revolved around 14.5% since 1998. Therefore, any misperception about declining content of protein in PKC caused by double pressing system should be cleared and the specification of 14% is still relevant.

Table 5 shows the average value was never less than the minimum limit of 14% since 1998, and its variances was rather trivial that indicates consistency of protein content in PKC.

Moisture

Moisture level is an important parameter that dictates the quality of PKC and avoids product deterioration. The maximum level of moisture is stipulated in both contracts *i.e.* at 9.5% in MEOMA 12 and 10% at the point of shipment for MEOMA 11. *Figure 4* shows the downward trend of moisture content in PKC from between 9% - 10% in 1994 to 6% -7% in 2000 before increasing slightly to 7% - 8% in 2002 and 2003. Overall, the moisture levels conform to MEOMA specification either for domestic or export transactions.

Table 6 shows that the moisture level had declined from 9.22% in 1994 to 6.31% in 2000 and moved up to 7.39% in 2003, still below the stipulated specifications. The variation reduction from 3.83% in 1998 to 2.60% in 2003 explained that the moisture levels amongst Malaysian PKC do not differ much.

The moisture level in PK can also influence the moisture level of PKC. In order to ensure the raw material has low moisture level, PK contract also include moisture specification at maximum level of 10%. *Figure 5* shows the trend of moisture content in PK and PKC, which is generally parallel that exhibits the influence of raw material on processed products. The average moisture level was fluctuating within the maximum limit of 10%, while the variation was not changing much since 1994. Overall, the moisture level of PK did not show much improvement in the

TABLE 4. STATISTICS OF OIL CONTENT IN PALM KERNEL CAKE FROM 1994 - 2003

Statistics \ Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
N[1]	181	182	164	178	334	301	232	287	186	305
Mean	9.97	8.22	9.20	9.77	9.98	10.39	8.93	8.76	8.69	8.57
S.D.[2]	4.59	2.08	4.00	3.04	5.09	6.80	5.37	3.38	3.32	2.70

Notes: [1] Number of cases.
[2] Standard deviation.

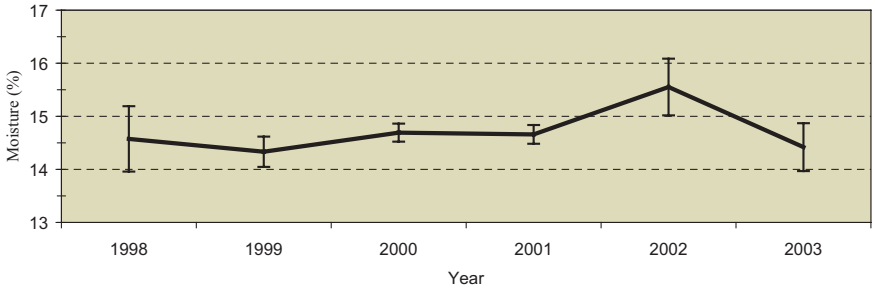

Figure 3. Trend of protein content in palm kernel cake, 1998-2003.

TABLE 5. STATISTICS OF PROTEIN CONTENT IN PALM KERNEL CAKE FROM 1998 - 2003

Statistics \ Year	1998	1999	2000	2001	2002	2003
N[1]	42	33	74	82	14	16
Mean	14.6	14.3	14.7	14.7	15.5	14.4
S.D.[2]	1.97	0.80	0.73	0.70	0.92	0.85
Below 14% (%)	14.3	33.3	18.9	22.0	nil	25.0

Notes: [1] Number of cases.
[2] Standard deviation.

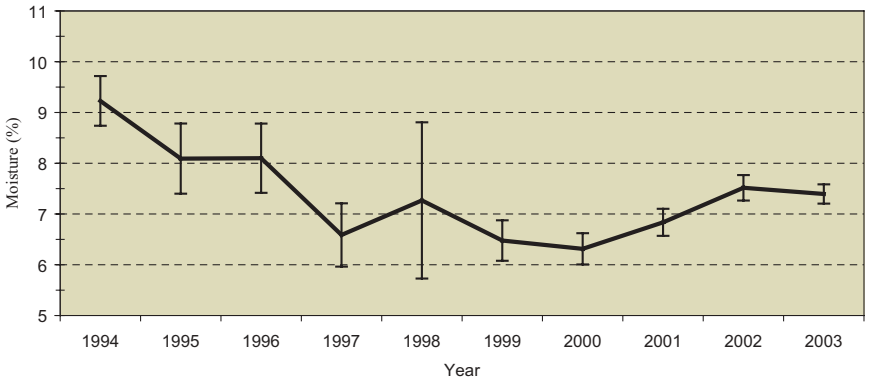

Figure 4. Trend of moisture level in palm kernel cake, 1994-2003.

TABLE 6. STATISTICS OF MOISTURE LEVEL IN PALM KERNEL CAKE FROM 1994 - 2003

Statistics \ Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
N[1]	112	64	61	58	197	191	198	277	370	514
Mean	9.22	8.09	8.10	6.59	7.27	6.48	6.31	6.84	7.52	7.39
S.D.[2]	2.62	2.77	2.66	2.37	3.83	2.80	2.19	2.28	2.45	2.20

Notes: [1] Number of cases.
[2] Standard deviation.

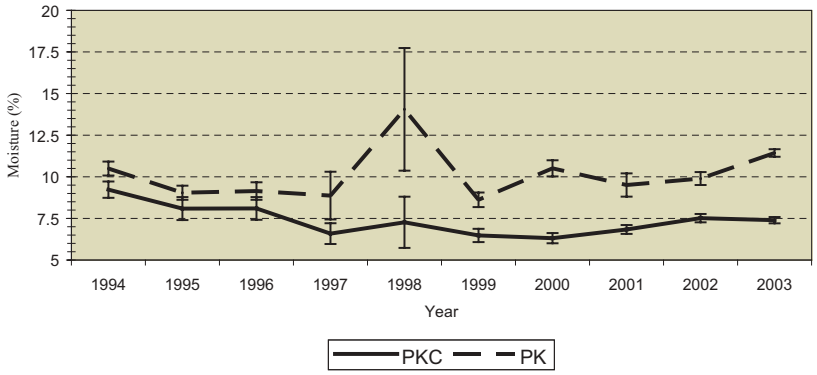

Figure 5. Trend of moisture content in palm kernel and palm kernel cake, 1994-2003.

previous decade. It was also obvious that high variation of moisture level in PK in 1998 was noticed also in PKC, which was caused by sudden higher amount of rainfall as compared to 1997 as shown in *Table 7*.

Therefore, it is appropriate that the moisture level for PK should also be considered if the moisture level in the PKC specification should be revised. In fact, low and stable moisture level in PK is highly preferred by the crushers in order to smoothen crushing operation.

TABLE 7. RECORDS OF TOTAL ANNUAL AMOUNT OF RAINFALL FROM 12 STATIONS IN MALAYSIA

Year	Total amount of rainfall (mm)
1995	34 618.3
1996	30 308.5
1997	25 080.9
1998	28 421.9
1999	33 794.8
2000	33 795.7

Source: Meteorological Department.

Dirt and Shell (D&S)

D&S content is basically a measure of impurities and foreign matters. The presence of shell in PKC is due to the shell retained in the PK. Wire mesh screens and magnetic traps are widely used in order to get rid of broken shells, scrap metals and extraneous dirt from entering into the machinery. Presently, the standard specification for maximum content of D&S in PKC is 15% and if higher than 18%, the consignment can be rejected. PK shells are hard and abrasive that can cause serious wear and tear of the feedmeal processing equipment, hence directly increase the maintenance cost.

Figure 6 shows the downward trend of D&S in PKC from between 15% - 16% in 1994 to 13% -14% in 2000, and further down between 12% - 13% in 2001, 2002 and 2003. *Table 8* shows the average percentage of D&S content in PKC from 15.8% in 1994 to 13.1% in 2003. Even though, the difference of about 2% over a period of 10 years indicates an improvement of PKC quality in terms of D&S content, it is however relatively slow. The standard deviation of D&S content had increased from 3.3% in 1994 to 5% in 1999, but later had declined to 3.3% again in 2003. In 1994, 50.4% of the measurement was above or equal to 15%, but reduced nearly half to 26.5% in 2003. In 2002, only 12.7% were above the maximum limit.

The downward trend of D&S content in PKC was chiefly caused by the D&S content in PK, which was specified at the minimum level of 6% and the maximum level of 10%. *Figure 7* shows the trend of D&S in PK had declined from an average of 6.1% in 1996 to 5.6% in 2003.

Therefore, it is rather compulsory that if the D&S specification for PKC need to be revised, then the D&S specification in PK contract must also be revised, or else the new specification for PKC will never be effective.

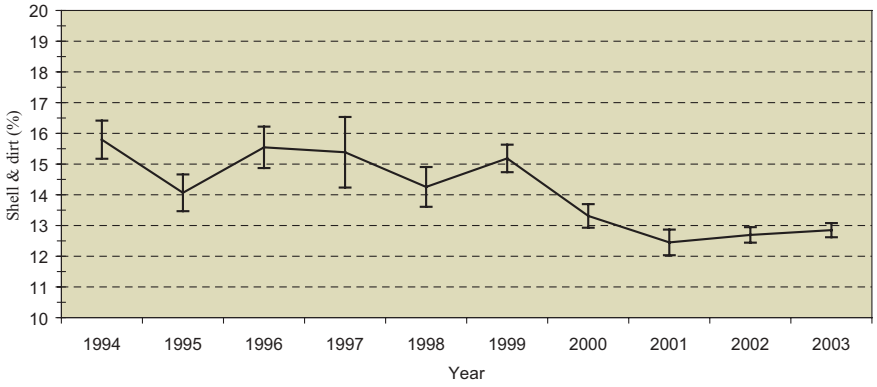

Figure 6. Trend of dirt and shell content in palm kernel cake, 1994-2003.

TABLE 8. STATISTICS OF DIRT AND SHELL CONTENT IN PALM KERNEL CAKE FROM 1994 - 2003

Year Statistics	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
N[1]	113	113	57	29	269	487	461	328	416	215
Mean	15.8	14.1	15.5	15.4	14.3	15.2	13.3	12.6	12.7	13.1
S.D.[2]	3.3	3.2	2.5	3.0	4.2	5.0	4.2	3.8	2.6	3.3
Above 15% (%)	50.4	31.9	45.6	37.9	26.9	40.2	23.3	22.0	12.7	26.5

Notes: [1] Number of cases.
[2] Standard deviation.

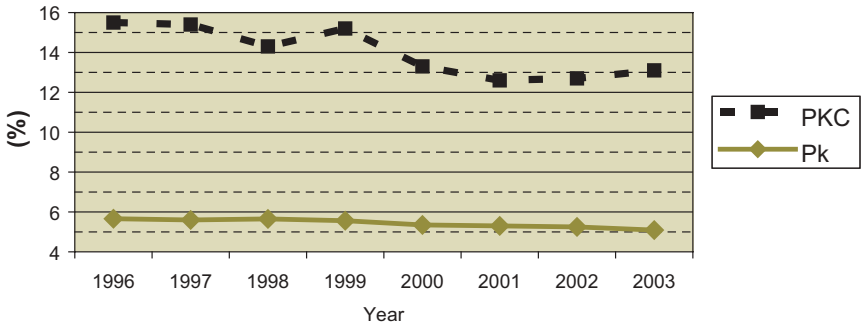

Figure 7. Trend of dirt and shell content in palm kernel and palm kernel cake, 1996-2003.

THE ECONOMICS OF PREMIUM QUALITY OF PALM KERNEL

PK is the sole raw material in the production of palm kernel oil (PKO) and PKC. Therefore, its quality must be subjected to highest possible level in order to produce quality PKO and PKC. Its specification as shown in *Table 9* has been used since the 1980s.

The increasing utilization of PKO in the oleochemical sector as well as PKC in the feedmeal sector has underscored the importance of producing quality PK. Therefore, the innovative processing system of producing better quality of PK introduced by MPOB should be considered seriously. The new machine can be installed at the mill to produce PK with less content of shell, and stipulated at 2% maximum level. The output is shell-free PK or also known as MPOB Quality Palm Kernel. The processing system can enhance the quality of PK products, improve and optimize the PK drying system for production of feed quality PKC (Rohaya and Osman, 2003). The machine has been produced locally and its manufacturer can be contacted directly or through MPOB.

It can crack the nut of any size efficiently at the correct force. Although the kernel recovery rate may be slightly better in the range of 0.5%-1% than current nutcracker, it reduces losses of broken kernels significantly. It can lower the current losses of 4% of broken kernel to nearly 1%. Usually the smaller broken kernels weigh as lightly as shells and both will be sent to the boiler. Since the cracking is more efficient, less nuts will be cut into halves and subsequently reduce the proportion of broken kernels. The current commercial machines produce 15%-20% broken kernels as compared to the new machine that can produce 10% broken kernels. The broken kernels or damaged ones have a larger exposed surface than whole kernels, which can lead to attack by microorganisms, thus acidify at faster rate and cause higher level of free fatty acid (FFA).

The shell-free PK can also increase the nutritive value of PKC. Previously, Department of Veterinary Services (DVS) and Malaysia Agricultural Research and Development Institute (MARDI) had invented a technique, namely enhanced sieving technique that can reduce the shell content from 15% to 7% in the PKC. *Table 10* shows the comparison between PKC that has shell content of 15% and 7%.

It shows the crude protein increases while the crude fibre reduces that marks the benefits of reduced amount of shell content in PKC. Consequently, its application as feed for monogastric animals (poultry and pigs) is very promising. The normal PKC is less acceptable by poultry mainly because of high shell content, unfavourable fibre composition and low metabolisable energy (ME) *i.e.* 6.2 MJ for poultry (Chin, 2002). However, since PKC has chemical composition close to rice bran and wheat midding, it can be treated with microbial and enzymatic means to increase its nutritive value and make it more digestible by poultry. Improved PKC is tar-

TABLE 9. DOMESTIC SALES CONTRACT FOR MALAYSIAN PALM KERNELS

Parameter	Specifications
Moisture	7% Basis, 10% max. & above 10% rejectable
Dirt and shell	6% Basis, 10% max. & above 10% rejectable
FFA (as lauric acid)	5% Max.

Source: MEOMA Handbook 2003-2004.

TABLE 10: PROXIMATE ANALYSIS/SHELL CONTENT DETERMINATION OF NORMALLY PRODUCED PALM KERNEL CAKE (PKC) AND PALM KERNEL CAKE THAT HAS UNDERGONE FURTHER POST-PRESS SIEVING

Proximate values	Normal PKC	PKC with post-press sieving
Shell content (%)	15.00	7.00
Crude protein (%)	15.91	16.71
Moisture (%)	5.93	7.38
Crude fibre (%)	18.00	14.80
Crude fat (%)	8.19	9.82

Source: Chin (2002).

geted to provide 9 MJ of ME as compared to 14 MJ for maize and is targeted to replace 50% of imported maize in poultry diets, amounting to RM 500 million annually (Noraini, 2002). PKC, which is cheaper and cost about 40 sen/kg compared with corn and soyabean at about 70 sen and RM 1.50/kg respectively can lower the cost for chicken feed and give better margins. If the local demand of PKC can be promoted to consume more PKC, then PKC price will be less dependent to foreign market and insulated from the fluctuations of the world oilmeal prices

Mathematically, based on nutrients contents and prices of soyabean meal, corn and PKC, the relevant prices of Total Digestibility Nutrients (TDN), crude protein and crude fibre can be obtained. If the premium PKC is expected to contain 1% higher of protein level and similar content of TDN, plus 1% lower of fibre content, then its price can be expected to fetch RM 45/t higher than normal PKC as shown in *Table 11*. So, if the PKC produced from shell-free PK is assured of its premium quality, then it is possible to gain higher price relative to normal PKC.

The slight increment of kernel recovery rate can increase the trade volume of PK and its value as well, and will be compared against the required amount of investment for all the mills. The new machine is priced at RM 18 000 per unit or RM 60 000 per system that consists of three units with processing capacity of 6 t nuts per hour. If all 370 mills used the machine and produced shell-free PK, the total investment will be in between RM 6.6 million to RM 22.2 million. Several situations of PK trade volumes and values can be observed in *Table 12* if the kernel recovery rate of 5.36% in 2003 could be increased marginally i.e. between 0.01% to 0.1% with the application of the new machines. The annual fresh fruit bunches (FFB) production was set at 67.6 million tonnes that produced 3.62 million tonnes of PK. The price of PK was fixed at RM 732/t and the trade value was estimated at RM 2.652 billion.

The results as depicted in *Table 12* show that the increment of kernel recovery rate by only 0.01% could increase about 6760 t of PK or valued nearly RM 5 million. The additional trade value of PK was approximately RM 25 million, which exceeded the total maximum investment of RM 22.2 million, if the kernel recovery rate can increase by 0.05%. At an increment of 0.1% kernel recovery rate, the expected trade value of PK could rise above the estimated trade value by RM 50 million.

Another advantage of shell-free PK is the increment of oil yield by 1% to 2%. The facts in 2003 are used to illustrate several scenarios

TABLE 11. CALCULATED VALUES FOR SELECTED FEEDS

Feeds	Crude protein (%)	Crude fibre (%)	TDN[1] (%)	Local price (RM/t)
Soyabean meal	48	7	78	1 065
Maize	8	1	80	700
PKC	14	18	65	199
Price (RM)	13.60	-27.50	7.80	
Improved PKC	15	17	65	244 (+45)

Note: [1] Total Digestibility Nutrient.

TABLE 12. TRADE VALUE OF PALM KERNEL (PK) WITH DIFFERENT LEVELS OF KERNEL RECOVERY RATE

Kernel recovery rate (%)	Quantity of palm kernel (million tonnes)	Expected trade value (RM bill.)	Difference (RM mil.)
5.36	3 623 595	2 652*	-
(+0.01) 5.37	3 630 355	2 657	5.0
(+0.02) 5.38	3 637 115	2 662	10.0
(+0.03) 5.39	3 643 876	2 667	15.0
(+0.04) 5.40	3 650 636	2 672	20.0
(+0.05) 5.41	3 657 397	2 677	25.0
(+0.10) 5.46	3 691 199	2 702	50.0

Note: * Estimated.

of higher oil yield with variations of D&S content. About 1.64 million tonnes of crude palm kernel oil (CPKO) was produced with an average oil yield of 44.8%, and based on that information, the quantity of PK was calculated nearly 3.7 million tonnes. The D&S content was assumed at stipulated level of 6% as shown in *Table 13*. The average price of CPKO was RM 1585/t and the trade value of CPKO was estimated at RM 2.605 billion.

At truly shell-free PK or zero percent D&S, the expected trade value for CPKO was lower than the estimated value due to lower volume of PK even though with 2% increment of oil yield. Similarly, at 1% D&S content, the amount of PK was approximately 3.48 million tonnes that produced 1.65 million tonnes of CPKO if the oil yield increased by 2%. However, the trade value of CPKO still below the estimated value by approximately RM 20 million.

At 2% of D&S content with improved oil yield performance by 2%, the expected trade value of CPKO revenue could be amounted to RM 2.613 billion, which was higher by RM 8 million. The additional trade value would exceed the maximum total investment of RM 22.2 million when the D&S content at 3% and also with 2% oil yield increment, which amounted approximately RM 36 million.

At the micro level, the shell-free PK as raw materials offer more benefits to the crushing plant operators in terms of better oil extraction rate, premium quality of products as well as reducing processing costs.

Table 14 shows major processing costs of PK, which is approximately totalled at RM 50/t. Utilities costs include fuel, electricity and water constitute about 40% of the processing cost, followed by other costs that take into account administration costs and others. Transportation cost consists of PK transportation cost because it is traded as ex-mill transaction and also delivery cost of PKO and PKC. The maintenance cost that make up approximately 20% of the processing cost refers to cost of repairing machines, replacing parts, *etc*.

Table 15 shows the expected gross crushing margin that can be gained by the crushers if shell-free PK is used as raw material. The price of PK is set at RM 1000/t, CPKO at RM 2354/t and PKC at RM 180/t, while the processing cost is fixed at RM 50/t PK. The cake recovery is fixed at 52% and the only variable is the oil extraction rate (OER) at 44%, 45% and 46%.

The result shows that 1% increase of OER will provide additional earning of approximately RM 23 for 1 t of processed PK. If the maintenance cost can be reduced by 50%, an extra RM 5 should be added and the gross rev-

TABLE 14. PROCESSING COST OF PALM KERNEL (1 t)

Cost Items	Value (RM)
Utilities	20
Maintenance	10
Transportation	5
Others	15
Total	**50**

TABLE 15. ESTIMATED GROSS CRUSHING MARGIN FOR PROCESSING PALM KERNEL (1 t)

Oil extraction rate (%)	Gross crushing margin(RM/ t palm kernel)
44	80
45	103
46	127

TABLE 13. EXPECTED REVENUE WITH DIFFERENT LEVELS OF DIRT AND SHELL CONTENT AND OIL YIELD

D & S content (%)	Quantity of palm kernel (t)	Oil yield rate (%)	Quantity of CPKO (t)	Trade value (RM billion)	Difference (RM million)
6	3 669 105*	44.81	1 644 126	2.605*	-
0	3 448 959	(+2%) 46.81	1 614 458	2.559	-46
1	3 485 650	(+2%) 46.81	1 631 633	2.586	-19
2	3 522 341	(+1.5%) 46.31	1 631 196	2.585	-20
2	3 522 341	(+2%) 46.81	1 648 808	2.613	8
3	3 559 032	(+1%) 45.81	1 630 393	2.584	-21
3	3 559 032	(+1.5%) 46.31	1 648 188	2.612	7
3	3 559 032	(+2%) 46.81	1 665 983	2.641	36
4	3 595 723	(+1%) 45.81	1 647 201	2.611	6
4	3 595 723	(+1.5%) 46.31	1 665 179	2.639	34
4	3 595 723	(+2%) 46.81	1 683 158	2.668	63

Note: * Estimated.

enue would amount to RM 28 for 1 t of processed shell-free PK as compared to processing ordinary PK. High content of shell in PK can cause heavy wear and tear on the processing machine that increases the maintenance cost. The utilization of lower shell content in PK will alleviate the problems and enable better performance of the machine with reduction in maintenance cost.

Generally, the processing of shell-free PK will provide advantages not just to the crushing operators, but also to the PK producers or the millers. The benefits gained by the crushers can be transmitted to the millers through higher price of PK. Based on discussions with crushing operators, many of them showed their interests with shell-free or premium PK and are willing to pay better price for procuring the product. But they had doubts about the availability of the product and could not give definite premium price.

PK market is considered as *seller's market*, whereby the millers or the producers can choose any buyer with the right price. At the receiving end, the crushers have to accept whatever status of products supplied to them, especially in the current situation of excess crushing capacity. Nevertheless, several crushing operators recommended pricing system that correlate with PK quality *i.e.* additional 1% of the price if the supplied PK contain less 1% of D&S specification. For example, if the price is agreed at RM 1000/t with D&S at 5%, and if the consignment contains 4% of D&S content, then the buyer will pay extra RM 10 for 1 t of PK. The recommended pricing system exhibits also the commitment given by the crushing operators in buying quality PK as well as upgrading the quality of its products.

Although the millers may hesitate due to the assumption that earnings from selling PK may be reduced since amount of shell will be excluded, thus reduce the quantity of PK, but it will be compensated via other means. For instance, the premium price offered by the crushers, higher kernel recovery rate, minimum losses of broken kernels and efficient production system.

Table 16 shows the payback period for millers with different mill capacities operating 16 hr/day by using the new machine. The calculation takes into account only the extra earnings from additional 1% premium prices at various prices of PK to indicate the payback duration in the investment of the new machine priced RM 60 000 per three units. Overall, the payback period is less than two years from additional 1% premium price of PK. The investment is small and the payback period is quite fast and depends on the mill capacities and the price of PK. Considering the time period is rather short, it is strongly recommended that the millers should take up the technology.

CONCLUSION

Quality improvement of PK products, especially PKC can only be realized through cooperation, commitments and concerted efforts from the crushers, the millers and the authorities. Generally, the quality of PKC has improved since the last decade and moving towards on the right track, although it is relatively slow. The quality of PKC is still within control for oil content and protein content. The moisture level and D&S level are improving as compared to previous years. The positive trends of those parameters show that the quality of the product is well maintained and can be further upgraded to a better level.

The quality of PK can be improved through new processing method that benefits the nation as well as various sectors in the oil palm industry. A small investment by the millers in installing the machine could bring huge prospect in term of increasing oil yield of PK and elevating the quality of PKC to a premium level. The opportunity to increase the trade value in PK sector can be aided by revising both specifications for PK and PKC, especially on D&S content. In 2003, at the price of RM 1585/t of CPKO, about RM 36 million could be increased in trading of CPKO if the D&S content was at 3% level with improvement of 2% in oil yield. The opportunity loss was even greater in 2004, when the price of CPKO was RM 2306/t. Therefore, the D&S content in PK

TABLE 16. PAYBACK PERIOD FROM ADDITIONAL PREMIUM PRICE OF PALM KERNEL (months)

Price of palm kernel (RM/t)	1% Additional premium (RM/t)	Mill capacity (t/ FFB/hr) with 5% kernel extraction rate			
		20	30	40	50
600	6	24.0	16.0	12.0	9.6
700	7	20.6	13.7	10.3	8.2
800	8	18.0	12.0	9.0	7.2
900	9	16.0	10.7	8.0	6.4
1 000	10	14.4	9.6	7.2	5.8

should be lowered to 3% from 6%, while in PKC, the minimum level of 15% should be reduced to 7.5%, which is based on the same ratio (6:15) as for the current specifications. The moisture level, the oil content and the protein content should remain as 9.5%, 8% and 14%, respectively.

Finally, the government should provide incentive to the industry in the form of special loan in order to encourage them to convert to new machines and expedite the production of shell-free PK.

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