COMPARISON OF PROXIMATE ANALYSIS AND NEAR INFRARED REFLECTANCE TECHNOLOGY FOR ANALYZING THE QUALITY OF PALM KERNEL CAKE

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ABSTRACT

The purpose of the current study is to compare the means from reference method (proximate analysis) with test method (NIR). Six parameters were studied which are moisture, crude ash, crude protein, ether extracts, crude fiber and nitrogen free extract. PKC samples (n = 48) were randomly selected from Feed Analysis Laboratory, IVM Kluang since year 2009 to 2012. CP was determined by the Kjeldahl method, CF was measured using Fibertec methods (FOSS), and EE was measured using Soxtec methods (FOSS). Other parameters in proximate analysis were determined according to Association of Official Analytical Chemists, AOAC (1980). Each sample was also scanned with NIRFlex Model N-500 (Buchi). The data was analyzed using the SAS statistical program. Statistical significance of differences between mean were tested by paired t-test analysis. A *p-value* of less than 0.05 ($p<0.05$) were considered statistically significant. There was not significantly different in the results from reference and test method for CP, EE, CF and NFE. These statistical analyses suggest that both methods can produce same results for PKC sample. But there are significantly different for moisture and CA result. Further study need to be carried out after calibration for moisture and CA were improved.

Keywords: Palm Kernel Cake, Near Infrared Reflectance Technology, Proximate analysis

INTRODUCTION

Palm kernel cake (PKC) is already known as high-fiber, medium grade protein feed that best suited to ruminants. Based on the chemicals composition, PKC can be classified as an energy-feed (Alimon, 2012). Proximate analysis showed in Alimon (2004) the average dry matter of PKC is 88.0 to 94.0 %; ash is 3.0 to 12.0 %; crude protein content is 14.5 to 19.6 %; ether extract is 5.0 to 8.0 %; crude fiber is 13.0 to 20.0 %, and the average of nitrogen-free extract of PKC is 46.7 to 58.8 %. According to study done by Shariff *et al.* (2012) nutritive value of PKC were varied and some samples did not achieve the proper specification values. To obtain a balanced diet for livestock feeding, nutrient quality of PKC should be monitored regularly.

Conventionally, wet chemistry analysis is well-established and approved by AOAC as the reference method to determine the nutritional values in feedstuffs. However, the procedure is time-consuming, expensive and not environmental friendly. Simpler, less expensive technology with shorter turnover time was needed for feed testing. Proximate analysis is a quantitative method to determine different macronutrient in feed, it is the partition of feed into six categories, and the categories are moisture (crude water), crude ash (CA), crude protein (CP), ether extracts (EE), crude fiber (CF) and finally nitrogen free extract (NFE).

$$\%NFE = 100 - (\%CW + \%CP + \%CF + \%Ash + \%EE)$$

$$\%\ Dry\ Matter = 100 - \%\ moisture$$

Near infrared reflectance spectroscopy (NIRS) technology now is a common quality control tool in the feed industry. This technology is already approved by AOAC, it also proven as fast, accurate and inexpensive procedure once calibration equation is in place. The applications of this instrument vary such as in medical, agricultural, chemical industries and pharmaceuticals analyses. Present conventional method need to be replaced with rapid technology as NIR because conventional methods require longer time of analysis as well as laboratory expertise.

The objective of the present study is to determine whether near infrared reflectance technology is suitable to use as rapid method for analyzing palm kernel cake quality. Parameters studied were moisture, crude ash, crude protein, ether extracts, crude fiber and nitrogen free extract.

MATERIALS AND METHODS

Palm Kernel Cake samples

Palm kernel cake samples were collected from samples received by Feed Analysis Laboratory, IVM Kluang. A total of 48 PKC samples were randomly selected from year 2009 to 2012 for this study.

Proximate analyses

Crude protein content (*N x 6.25*) was determined by the Kjeldahl method. Crude fiber was measured using Fibertec methods (FOSS). Crude fat was measured using Soxtec methods (FOSS). Other parameters in proximate analysis were determined according to Association of Official Analytical Chemists, AOAC (1980).

NIR analysis

The Near Infra Red equipment used was a NIRFlex Model N-500 (Buchi), in conjunction with NIRCal® software version 5.1 and NIRWare®Management software (Buchi). Reflectance NIR spectra were recorded over the range 4000-10000 cm^{-1} (400-1000 nm) at 4 cm^{-1} interval. Ground PKC samples were placed into a glass Petri dish and spread it to cover the surface of the Petri dish.

Statistical analysis

The comparison between reference method (proximate analysis) and test method (NIR) results was analyzed using SPS statistical program. For the comparison of the means of two methods, paired t-test was applied, with assumption that there is no different in the mean values (μ_1 and μ_2 respectively) for each parameter.

RESULTS AND DISCUSSION

A paired t-test was conducted to compare the means of reference method (proximate analysis) and test method (NIR) for each parameter (Table 1).

Parameter	**Method**	**Mean, $\mu \pm S.D.$**	***p*-value**
Moisture (CW)	Proximate analysis	7.63 ± 1.69	0.00
	NIR	6.58 ± 1.20	
Crude Ash (CA)	Proximate analysis	7.50 ± 3.61	0.00
	NIR	6.65 ± 2.73	
Crude Protein (CP)	Proximate analysis	16.17 ± 2.57	0.15*
	NIR	15.89 ± 1.94	
Ether Extracts (EE)	Proximate analysis	4.70 ± 2.37	0.71*
	NIR	4.59 ± 1.78	
Crude Fiber (CF)	Proximate analysis	19.29 ± 5.66	0.12*
	NIR	18.34 ± 3.03	
Nitrogen Free Extract NFE)	Proximate analysis	52.13 ± 6.76	0.15*
	NIR	51.21 ± 5.90	

n = 48 samples for each parameters
*means between reference method and test method are not significantly different (p>0.05)

There were no significant different in the results between proximate analysis and NIR for CP, EE, CF and NFE. These statistical analyses suggest that both methods can produce same results for PKC sample. But there are significantly different for moisture and CA result. According to previous study done by Norlindawati *et al.* (2013), *Ratio Performance Deviation*, *RPD* values ($SD_{validation}SEP^{-1}$) for NFE are quite excellent and would be applicable for any application; CP value model is good and suitable for quality

control purposes, CA, CF, and EE can be classified as fair and applicable for screening only. *RPD* value for moisture performed poorly with this instrument.

NIR has the benefit of low cost and less time-consuming compared to conventional wet chemistry so there is great potential for adopting this rapid technology. However, calibration of CW and CA from this instrument should be improved and further study need to be carried out to determine the *RPD* value for both parameters. It is because the accuracy of NIR prediction is totally dependent upon instrument calibration and supported by good quality assurance.

CONCLUSION

NIR application is user friendly, it is much less expensive and time efficient instrument. However, improvement of calibration of moisture and crude ash are necessary before it can be applied as a rapid tool for determine PKC nutritional composition.

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