

EFFECT OF CLINOPTILOLITE SUPPLEMENTATION ON THE NUTRITIVE VALUE OF OIL PALM FRONDS

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Abstract. In this paper, the effect of clinoptilolite with and without supplementation on the nutritive value of oil palm fronds (OPF) was studied. Five different levels of clinoptilolite (0-5%) were supplemented on OPF and the effects on the nutritive values were determined; dry matter (DM), total nitrogen (N), crude protein (CP), crude fat (EE), crude fibre (CF), total ash (ASH), calcium (Ca) and phosphorus (P) using the AOAC standard methods. Nitrogen free extract (NFE), total digestible nutrient (TDN) and metabolizable energy (ME) were calculated by differences. Increasing levels of clinoptilolite resulted in some changes in the nutritive values of OPF, except in its EE content.

Keywords: clinoptilolite, oil palm fronds (OPF), nutritive value, zeolite

1.0 INTRODUCTION

Oil palm was originated from West Africa and it was cultivated in Malaysia for its oil. Several by-products from oil palm industry can be utilized as feeds for livestock. These include oil palm fronds (OPF), oil palm trunks (OPT), palm press fibre (PPF), palm kernel cake (PKC) or palm kernel expeller (PKE). Oil palm frond is the most widely used as an ingredient in animal feedstuff in Malaysia [1-3]. Supplementation of mineral and vitamins are of concern currently in view of issues related to cost and ineffectiveness in enhancing livestock performance. Lately, clinoptilolite (widely known as zeolite) has been promoted as an effective product to accelerate growth rate, nutrient digestibility and adsorption in various livestock species. Improvements in growth and health performance have been reported in pregnant sows [4-5], grower hogs [6-7] and weaned hogs [7-8].

Several processing techniques have been developed to improve nutritive values of high fibrous material, including OPF. These include urea and molasses treatment [9], alkali treatment, steaming under high temperature and high pressure, pelletizing and enzymatic degradation [3]. These treatments are carried out to degrade indigestible and fibrous components in those materials. Therefore, it is our aim to study the effects of varying levels of clinoptilolite supplementation on the nutritive values of OPF based on chemical analysis.

2.0 EXPERIMENTAL

2.1 Analytical and Statistical Analysis

Nutritive values of OPF were analysed based on the Association of Official Analytical Chemists (AOAC) [10]. The analyses were done at the Animal Feed Laboratory, Malaysia Veterinary Institute, Kluang Johor. The clinoptilolite was imported from Indonesia and it was supplied by Provet Group of Companies Sdn. Bhd., Selangor.

The OPF samples were collected from an oil palm plantation in Pagoh, Johor. Five levels of clinoptilolite supplementation were evaluated (1 – 5%), apart from one without supplementation (0%).

The data were analysed by using one-way ANOVA and pairwise comparison technique in SPSS 20.0 (SPSS Inc. Chicago, IL, USA). The differences among treatments were evaluated by the least significant difference post hoc multiple comparison test. The significance level was set at 0.05.

Table 1: Analysis used for determining nutritive value of OPF

Parameter	Abbrev.	Method
Dry matter	DM	AOAC Official Method 2001.12
Total nitrogen	N	AOAC Official Method 2001.11
Crude protein	CP	AOAC Official Method 2001.11
Crude fat	EE	AOAC Official Method 991.36
Crude fibre	CF	AOAC Official Method 950.02
Total ash	Ash	AOAC Official Method 942.05
Calcium	Ca	AOAC Official Method 927.02
Phosphorus	P	AOAC Official Method 964.06
Nitrogen free extract	NFE	Calculation [11]
Total digestible nutrient	TDN	Calculation [11]
Metabolism energy	ME	Calculation [12]

3.0 RESULTS AND DISCUSSION

Table 2 shows the proximate analysis of OPF supplemented with varying levels of clinoptilolite (1-5%).

Table 2: The nutritive values of oil palm fronds and OPF-supplemented with clinoptilolite.

Parameter	OPF	OPF1	OPF2	OPF3	OPF4	OPF5	ANOVA*
Dry matter	90.73	92.50	93.17	92.13	92.77	92.93	0.006
Total nitrogen	0.66	0.62	0.71	0.70	0.58	0.60	0.000
Crude protein	4.13	3.90	4.47	4.40	3.63	3.77	0.000
Crude fat	0.40	0.57	0.63	0.57	0.53	0.50	0.311
Crude fibre	35.33	27.73	32.13	27.30	32.17	23.77	0.000
Total ash	41.17	55.27	55.63	51.67	56.00	57.67	0.000
Calcium	0.33	0.98	0.55	0.23	0.23	0.43	0.000

Phosphorus	0.56	0.89	0.89	0.89	0.89	0.93	0.000
NFE	18.90	12.53	7.17	16.13	7.70	14.27	0.000
TDN	85.60	66.43	78.30	64.53	83.07	55.27	0.000
ME	13.20	10.04	12.00	9.73	12.79	8.20	0.000

Notes: *ANOVA value $p < 0.05$ = significantly different

Table 2 shows that supplementation of clinoptilolite resulted in increased dry matter (DM), crude fat (EE), total ash (Ash) and phosphorus (P) content in the OPF. However, total nitrogen (N), crude protein (CP), crude fibre (CF), calcium (Ca), nitrogen free extract (NFE), total digestible nutrient (TDN) and metabolizable energy (ME) were decreased with clinoptilolite supplementation. An analysis of one-way ANOVA by Pairwise Comparison using LSD technique shows all the nutritive values were significantly different ($p < 0.05$), but only EE was not significant for all pairs in the OPF.

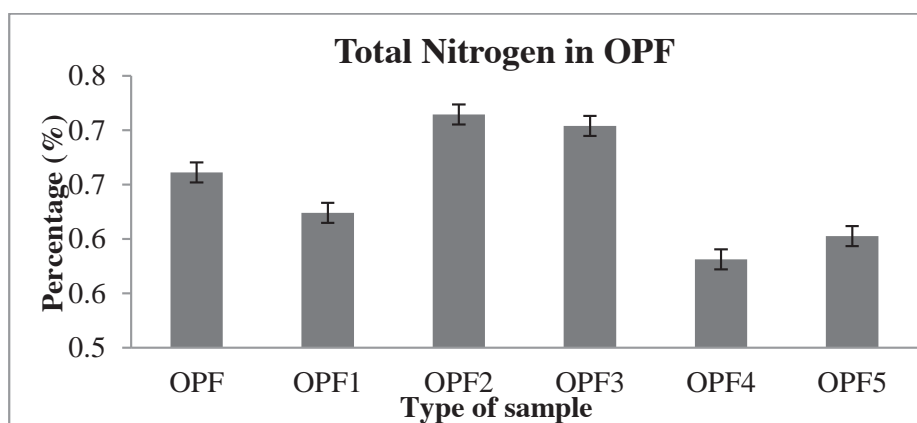


Figure 1: Total nitrogen (N) in oil palm fronds

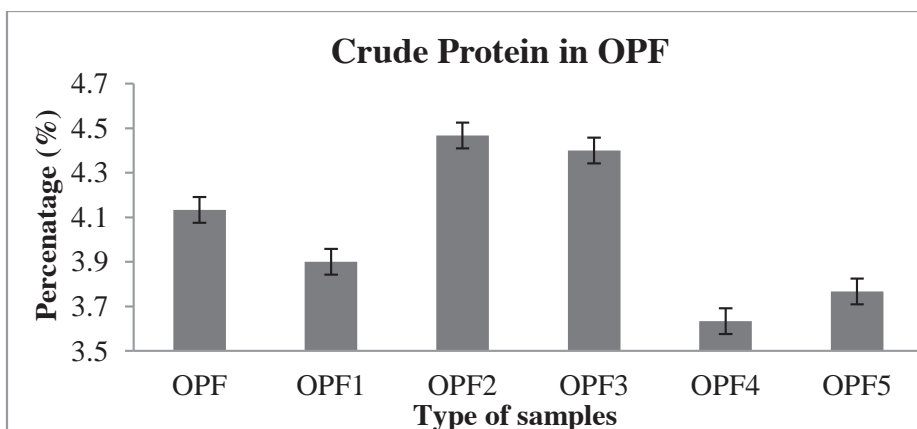


Figure 2: Crude protein (CP) in oil palm fronds

Figures 1 and 2 show the respective percentage of total N and CP in OPF based on Kjeldahl method [13]. It is evident that increasing levels of clinoptilolite, resulted in decreased percentage of total N and CP. This might be associated to the adsorption of ammonium (NH_4^+) by clinoptilolite during the Kjeldahl analysis which has high cation exchange capacity [14-16]. Based on one-way ANOVA, all CP were found to be significantly different ($p < 0.05$) for all pairs, affecting the CP content in all samples.

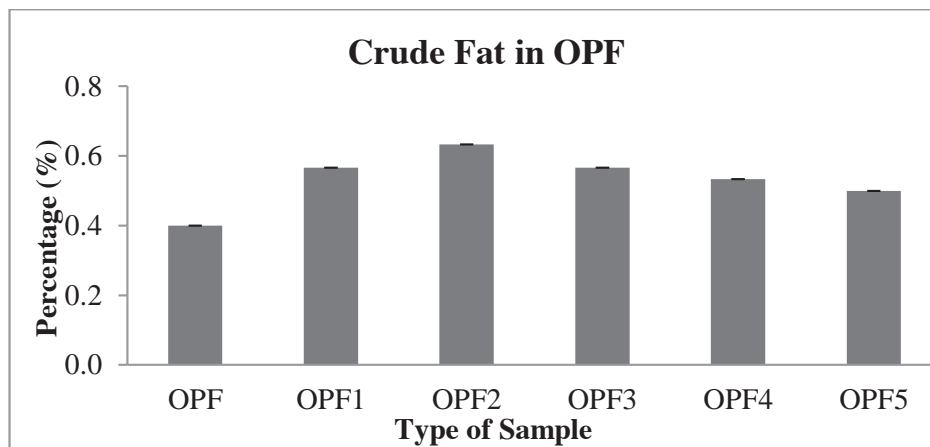


Figure 3: Crude fat (EE) in oil palm fronds

Figure 3 shows a small increment of crude fat when OPF is supplemented with clinoptilolite. Increasing levels of clinoptilolite in the OPF, did not significantly affecting EE contents in the sample as prove by one-way ANOVA (EE in OPF were not significantly different for all pairs ($p > 0.05$)).

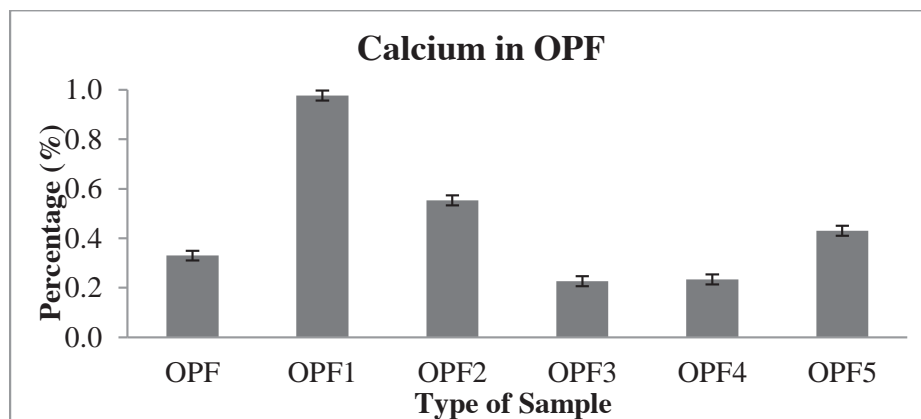


Figure 4: Calcium (Ca) content in oil palm fronds

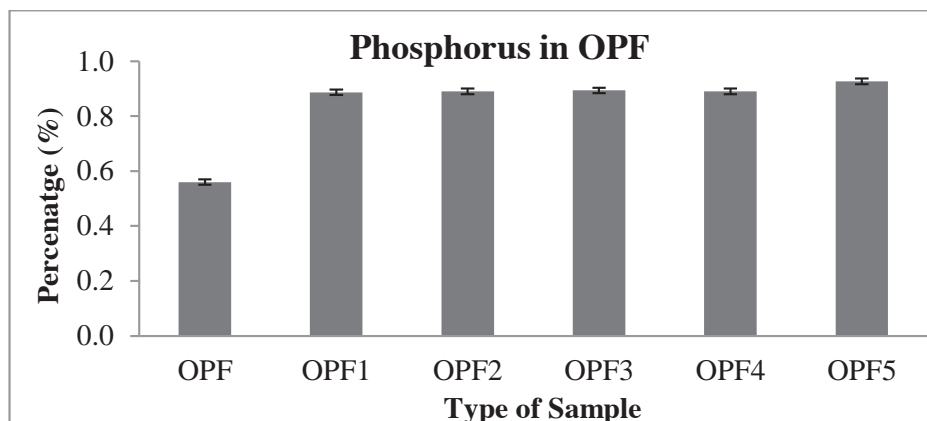


Figure 5: Phosphorus (P) content in oil palm fronds

Figures 4 and 5 show calcium (Ca) content was decreased while phosphorus (P) content was increased with increasing the percentage of clinoptilolite in the OPF and one-way ANOVA shows significantly different ($p < 0.05$) for all pairs. Since clinoptilolite is one of natural zeolite, it has high impurities of mineral (inorganic) substances which directly can increase Ca and P content in the OPF. However, Ca^{2+} loaded clinoptilolite by the process of ion exchange capacity has resulted in decreased amount of Ca^{2+} content, which is likely associated with Ca^{2+} adsorption by clinoptilolite. High cation exchange capacity and selectively adsorbing cations are placed in the following order: $\text{NH}_4^+ > \text{Pb}^{2+} > \text{Na}^+ > \text{Cd}^{2+} > \text{Cu}^{2+} \approx \text{Zn}^{2+}$ [16-17].

4.0 CONCLUSIONS

Supplementing varying levels of clinoptilolite resulted in significant differences in the nutritive value of OPF. Crude fat (EE) was not affected as clinoptilolite is a non-fat source. Addition of clinoptilolite to OPF had increased DM, EE, Ash and P contents, while decreasing total N, CP, CF, Ca, NFE, TDN and ME.

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