SHORT COMMUNICATION

Palm kernel cake as a potential ingredient in Muscovy ducks diet

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Abstract

A study was conducted to determine the feeding effect of three concentration levels of 0, 15 and 35% palm kernel cake (PKC) on productive performance of Muscovy ducks during growing period. A total of 72 males and 72 females two-week-old ducklings were randomly assigned to one of three experimental diets: corn-soybean meal basal diet (control); basal diet containing 15% PKC (PKC15); and basal diet containing 35% PKC (PKC35). Following five weeks of growing phase with experimental diet, no significant differences were observed in respect to body weight and weight gain among treatments. However, feed intake and feed to gain ratio was significantly higher in birds fed 35% PKC than those in other treatment groups. Male ducks had significantly superior weight gain and feed to gain ratio. This was mainly due to their higher feed intake level and not attributed to nutrient digestibility coefficients. Inclusion of 35% PKC decreased (P<0.05) the dry matter, energy and crude protein digestibility compared to 15% and control group. This reduction was mainly influenced by the shorter digesta passage time in 35% PKC fed birds (P<0.05). There were no significant differences between the control and 15% PKC birds as for all the investigated parameters. Therefore, it is suggested that PKC may be incorporated in Muscovy duck diet at 15% without any adverse effect on the overall performance and nutrients digestibility.

Introduction

Palm kernel cake (PKC) is a by-product of the palm oil industry. The total global production of PKC amounted to about 8.2 million metric ton in 2012 (MPOB, 2012). Because of its consistent availability and competitive price, PKC is widely used as a moderate source of protein and energy in different livestock such as dairy cow (Carvalho et al., 2006), pig (Adesehinwa, 2007), rabbit (Orunmuyi et al., 2006), laying hen (Chong et al., 2008) and broiler chickens (Mardhati et al., 2011).

On day 15, equal number of cages in each sex group was randomly allocated to one of three experimental diets: basal diet containing 15% PKC (PKC15) and basal diet containing 35% PKC (PKC35) (Table 1). The experimental diets were isocaloric and isonitrogenous and were formulated to meet the minimum requirements of the National Research Council (NRC, 1994). Water and feed were given ad libitum and continuous light was provided. Body weight, feed intake, weight gain and feed/gain were recorded at day 49. Body weight was measured individually, while feed intake was determined on group basis.

Balance trial

Starting from day 49, a one-week balance trial was carried out using six birds from each sex and diet groups with similar BW. The birds were placed in individual metabolism cages and allowed 3 days of adaptation followed by 3 days of total faeces collection (Din et al., 1979). Feed intake was determined in the same period. The faeces were weighed and dried in the oven at 60°C until constant weight. Representative samples of feed and excreta were analysed for proximate composition using the procedures of AOAC (2001). Digesta passage time was measured in the same birds after the completion of faeces collection by fasting for 16 h and subsequent feeding. The period between providing feed and the first droppings was recorded by visual observation (Rubio et al., 1990). Apparent digestibility of dry matter (DM), CP, gross energy, neutral detergent fibre
(NDF), acid detergent fibre (ADF) and minerals were determined according to the following formula (McNab, 1976):

\[
\text{Nutrient digestibility} = \frac{(\text{nutrient intake} - \text{nutrient excreted}) \times 100}{\text{nutrient intake}}
\]

**Statistical analysis**

Data were analysed using SPSS software package (SPSS, 1999). Data were subjected to 2-way ANOVA in a 3×2 factorial arrangement with diet and sex as the main effects and their interactions. When interactions were significant, a separate ANOVA was conducted within each main effect. Significant differences were separated using Duncan’s multiple range tests. The results were expressed as mean±SEM. Statistical significance was considered at P<0.05.

**Results and discussion**

There was no significant diet×sex interaction for all the parameters measured in this study.

**Growth performance**

Body weight, feed intake, weight gain and feed/gain of Muscovy ducks after five weeks feeding trial are summarised in Table 2. Feed intake and feed/gain were observed to be significantly higher in the groups fed 35% PKC compared to the control. No significant effect of diet on BW and weight gain were observed among treatments. Male birds showed higher feed intake, BW, weight gain and lower feed/gain than females (P<0.05).

**Balance trial**

The birds fed with 35% PKC showed a lower gross energy, DM and CP digestibility than control and 15% PKC (P<0.05) (Table 3). There was no significant difference observed with regard to the digestibility of fibre components between treatments. Results on mineral retention showed no difference in the apparent calcium, copper and zinc retention between ducks fed control and PKC diets. However, increasing the level of PKC in the diet resulted in reduction of phosphorus retention and this phenomenon was only significant at 35% inclusion level of PKC.

The total faeces production and dry faeces of birds in 35% PKC group were higher compared to those in 15% PKC and control groups (P<0.05) (Table 4). However, the time of digesta passage was significantly longer in birds fed the control diet than those fed 35% PKC. No significant difference in total faeces, dry faeces, water content of excreta and time of digesta passage were observed between the control and 15% PKC birds.

The results of the present study demonstrated that feeding 15% PKC did not alter the BW, feed intake, weight gain and feed/gain ratio when compared to the control diet. However, inclusion rate of up to 35% PKC was associated with a significant increase in feed intake and depression in feed/gain ratio. There are no established information on the optimal inclusion rate of PKC in poultry’s diet and a range of

### Table 1. Nutrient composition of the experimental diets and palm kernel cake.

| Nutrient         | Control | PKC15 | PKC35 | PKC |
|------------------|---------|-------|-------|-----|
| Ingredients, %   |         |       |       |     |
| Corn             | 65.66   | 53.44 | 36.92 | -   |
| PKC              | -       | 15.00 | 35.00 | -   |
| Soybean meal     | 21.00   | 18.80 | 15.90 | -   |
| Fish meal        | 3.00    | 3.00  | 3.00  | -   |
| Wheat pollard    | 7.00    | 4.30  | 0.40  | -   |
| Palm oil         | 1.00    | 3.20  | 6.50  | -   |
| Salt             | 0.25    | 0.25  | 0.25  | -   |
| Premix 7         | 0.10    | 0.01  | 0.01  | -   |
| Dicalcium phosphate | 1.56 | 1.56  | 1.56  | -   |
| Limestone        | 0.35    | 0.34  | 0.33  | -   |
| DL-methionine    | 0.04    | 0.05  | 0.06  | -   |
| L-lysine         | 0.04    | 0.05  | 0.07  | -   |
| Calculated ME, kcal/kg | 2981 | 2945  | 2920  | 1850 |

**Analysed content**

| Item             | Control | PKC15 | PKC35 | PKC |
|------------------|---------|-------|-------|-----|
| DM, %            | 88.87   | 90.75 | 91.47 | 90.87 |
| CP, %            | 18.23   | 18.01 | 17.83 | 15.93 |
| Ether extract, % | 3.68    | 4.99  | 7.97  | 3.65 |
| NDF, %           | 18.19   | 20.52 | 31.90 | 67.28 |
| ADF, %           | 6.34    | 9.46  | 15.38 | 39.39 |
| Hemicellulose, % | 11.85   | 11.06 | 16.52 | 27.89 |
| Lignin, %        | 1.22    | 2.34  | 3.57  | 13.86 |
| Ash, %           | 8.38    | 6.64  | 6.85  | 5.08 |
| Ca, %            | 1.59    | 1.41  | 1.56  | 0.27 |
| P, %             | 0.88    | 0.87  | 0.81  | 0.48 |
| Cu, mg/kg        | 12.08   | 11.32 | 12.70 | 23.57 |
| Zn, mg/kg        | 75.25   | 69.42 | 71.37 | 54.18 |

PKC, basal diet containing 15% PKC; PKCS, basal diet containing 35% PKC; PKC, palm kernel cake; ME, metabolizable energy; DM, dry matter; CP, crude protein; NDF, neutral detergent fibre; ADF, acid detergent fibre. °Poultry mineral premix provided the following per kg of the diet: vitamin A (15,000 IU), vitamin D3 (2500 IU), vitamin B12 (1.5 μg), vitamin B1 (4.25 μg), vitamin B2 (3 mg), vitamin B3 (0.12 μg), vitamin K3 (2.35 mg), pantothenic acid (12.5 mg), niacin (1 mg), folic acid (1.2 mg), manganese (125 mg), zinc (75 mg), iron (59 mg), copper (8 mg), cobalt (0.12 μg), iodine (1.25 mg), and selenium (0.1 mg).

### Table 2. Effects of feeding different levels of palm kernel cake on body weight, feed intake, weight gain and feed/gain of Muscovy ducks fed from 2nd to 7th week of age.

| Item | BW, g | Feed intake, g/bird | Weight gain, g | Feed/gain |
|------|-------|---------------------|----------------|-----------|
| Diet |       |                     |                |           |
| Control | 2583 | 5135a               | 2140           | 2.42b     |
| PKC15 | 2573 | 5304a               | 2125           | 2.53b     |
| PKC35 | 2633 | 5663a               | 2186           | 2.63a     |
| SEM  | 88    | 174                 | 85             | 0.06      |
| Sex  |       |                     |                |           |
| Male | 3074a | 6112a               | 2578b          | 2.37b     |
| Female | 2119b| 4622b               | 1723b          | 2.68b     |
| SEM  | 51    | 100                 | 49             | 0.04      |

BW, body weight; PKC15, basal diet containing 15% PKC; PKC35, basal diet containing 35% PKC; PKC, palm kernel cake. *Initial body weight on day 15 was 253±11 g. °Means within the same column with different superscripts are significantly different (P<0.05).
studies ranged 10 to 50% is recommended by different studies. The available reports on feeding PKC to broiler chickens show some contradictory results. Although, Panigrahi and Powell (1991) showed that inclusion rate of up to 50% PKC did not decrease the broiler chickens growth performance, Onifade and Babatunde (1998) reported a significant depression in BW of chickens fed with 10% PRC. Part of these differences could be attributed to the types of PRC used in these studies. Ezieshi and Olorun (2008) showed that the method of extraction of PRC contribute to its quality and effects where the performance of birds fed mechanical extracted PRC is superior to those fed solvent extracted PRC. The present study results is in agreement with Onwudike (1986) and Ezieshi and Olorun (2004) demonstrated that inclusion of PRC in diet increase feed intake. This phenomenon may indirectly explained by the high oil content in PRC diet that is used for the compensation of its low energy value. Dietary oil content has been shown to enhance the palatability and intake of diet (Yeong et al., 1981).

The digestibility of DM, gross energy and CP decreased in birds fed 35% PKC when compared to those fed 15% PKC or control diet. Similar results were obtained by Onifade and Babatunde (1998) and Sundu et al. (2005). The authors found that the inclusion of increasing levels of PKC decreased nutrients digestibility. This reduction is explained by the high dietary fibre content in PRC diet. Palm kernel cake contains mainly linear and highly crystalline mannan with a small quantity of galactomannan in its cell wall (Daud and Jarvis, 1992; Dusterholt et al., 1992). Sundu et al. (2006) reported that the lower nutrients digestibility in PRC fed chickens could attributed mainly to the absence of any mannan degrading enzymes in the poultry digestive system.

One of the major effects of high dietary fibre is increasing faecal weight and reducing transit time in digestive tract. Studies by Zhang et al. (2013) and Fahey et al. (1992) demonstrated that high fibre intake increased defecation frequency and faecal weight. Increase in faecal weight attributed to either increased mass of undegraded fibre or increased in water retained by the degraded fibre (Selvendran et al., 1987). This further suggesting lower nutrient digestibility of ducks fed high amount of PRC. Therefore, the reduction in nutrient digestibility was accompanied by increase in feed intake of ducks with 35% PRC.

The mineral content of PRC presented in this study was in close agreement to those reported previously (Abdullah et al., 1995) which indicate a low ratio of calcium to phosphorus and a high concentration of copper. Most studies regarding the effects of feeding PRC on mineral utilisation focused on its high copper concentration (11 to 55 mg/kg) and its potential toxic effects in ruminants especially sheep (Alimon et al., 2011). The toxicity of Cu in ruminants manifests as haemolysis, suggesting different excretory pathways in poultry, since this effect is rarely reported. The general symptom of copper toxicity is impaired growth associated with reduced feed and water intake. There is no attempt on elucidate this reduction in feed intake upon copper toxicity. However, in present study, this phenomenon appears not to be the reason for growth reduction in ducks in 35% PRC group. As reported by Persia et al. (2004) and reviewed by Leeson (2009), toxic levels of copper for weight gain reduction in poultry is 640 ppm and feed utilisation is 780 ppm. Therefore, the high phosphate-P content of PRC might play a role here in reducing performance. In the present study, feeding 35% PRC was found to influence the P utilisation significantly. This could be attributed either to the interference of high dietary fibre to mineral utilisation as previously reported in chickens (Shan et al., 1993) and pigs (Moore et al., 1988) or high content of

### Table 3. Effects of different levels of palm kernel cake on apparent nutrients digestibility for Muscovy ducks during growing phase.

| Item, % | Control | PKC15 | PKC35 | SEM | Male | Female | SEM |
|---------|---------|-------|-------|-----|------|--------|------|
| DM      | 78.73\(^a\) | 77.57\(^b\) | 74.31\(^c\) | 1.05 | 77.54 | 76.26 | 0.86 |
| Gross energy | 79.78\(^a\) | 79.49\(^b\) | 76.79\(^c\) | 0.78 | 79.59 | 76.79 | 0.64 |
| CP      | 76.78\(^a\) | 74.21\(^b\) | 68.54\(^c\) | 1.30 | 74.88\(^a\) | 71.47\(^b\) | 1.06 |
| NDF     | 51.93 | 51.69 | 55.78 | 1.63 | 53.59 | 52.68 | 1.33 |
| ADF     | 36.00 | 38.35 | 44.48 | 2.51 | 38.44 | 40.78 | 2.05 |
| Hemicellulose | 60.46 | 63.11 | 66.30 | 3.49 | 65.98 | 61.50 | 2.85 |
| Ca      | 48.50 | 49.05 | 46.73 | 2.10 | 52.69\(^a\) | 43.49\(^b\) | 1.72 |
| Cu      | 50.45\(^a\) | 47.77\(^b\) | 41.99\(^c\) | 1.19 | 46.17 | 47.34 | 0.97 |
| Zn      | 31.23 | 27.69 | 25.66 | 2.48 | 29.97 | 26.41 | 2.08 |
|         | 27.08 | 30.07 | 25.99 | 1.40 | 35.69\(^a\) | 19.75\(^b\) | 1.15 |

PKC15, basal diet containing 15% PKC; PKC35, basal diet containing 35% PKC; PKC, palm kernel cake; DM, dry matter; CP, crude protein; NDF, neutral detergent fibre; ADF, acid detergent fibre. \(^*\)Means within the same row with different superscripts are significantly different (P<0.05).

### Table 4. Total faeces, dry faeces, water content of faeces and passage time of digesta in Muscovy ducks fed different levels of palm kernel cake.

| Diet | Total faeces, g/d | Dry faeces, g | Water content of faeces, % | Passage time, min |
|------|------------------|---------------|---------------------------|-------------------|
| Control | 197\(^b\) | 37.3\(^a\) | 80.88 | 248\(^a\) |
| PKC15 | 188\(^b\) | 37.8\(^a\) | 79.75 | 235\(^a\) |
| PKC35 | 356\(^a\) | 48.1\(^a\) | 80.96 | 224\(^b\) |
| SEM | 8.29 | 1.31 | 1.14 | 5 |
| Sex | | | | |
| Male | 243\(^a\) | 46.9\(^a\) | 80.39 | 250\(^b\) |
| Female | 184\(^b\) | 35.3\(^b\) | 80.75 | 221\(^b\) |
| SEM | 6.77 | 1.07 | 0.93 | 4 |

PKC15, basal diet containing 15% PKC; PKC35, basal diet containing 35% PKC; PKC, palm kernel cake. \(^*\)Means within the same column with different superscript are significantly different (P<0.05).
phytate-P in PKC. Selle et al. (2010) reported that the majority of P in feedstuffs of plant origin is present as phytate-P and that this compound is only partially utilised by monogastrics. Whether the reduction in P digestibility is attributed to the interaction of dietary fibre with mineral or high content of phytate-P in PKC needs further investigation.

Conclusions

The inclusion of 15% PKC in diet of grower Muscovy ducks is recommended with no adverse effects. This is confirmed by the equal BW, feed intake, feed/gain, digestibility of CP and energy, mineral utilisation, feed passage time and faeces characteristics of these birds compared to the control.

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