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Effect of Doun Palm Mesocarp Meal (*Hyphaene Thebaica*) As Partial Replacement for Maize on Growth Performance and Haematological Indices of Weaned Pigs

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ABSTRACT

The aim of this study was to investigate the effect of Doum palm mesocarp meal (DPMM) as partial replacement for maize on the growth performance and heamatological indices of weaned pigs. A total of 50 crossbred pigs with an initial weight of 7.12 ± 0.01 kg and weaned at 21 days of age were individually housed in pens and fed five experimental diets. Diet 1 (Corn based diet without doum palm mesocarp meal, DPMM was used to partially replace maize at 5 %, 10 %, 15 % and 2% in diet 2, 3, 4 and 5 respectively. The experimental diet were adequate in all nutrients and fed *ad libitum* for 56 days in a completely randomized design. DPPM contained crude protein (6.09 %), crude fibre (11.49 %), ether extract (1.75 %), ash (6.26 %) and energy (2933.7 kcal/kg). Average weight gain, average daily feed intake and feed conversion ratio were not influenced (P>0.05) by dietary treatments. Pack cell volume, red blood cell, platelet, mean platelet volume, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, white blood cell, neutrophils, basophils, monocytes and lymphocytes were higher (P>0.05) in T3, T4 and T5 than in T1 and T2. All values were within optimum ranges for healthy pigs. Result showed that DPMM can be used to partially replace maize up to 20 % without negatively affecting the performance and health status of weaned pigs.

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Introduction

Agriculture, which produces food sourced from animals through its livestock sector, is essential for stability. Future efforts to feed the globe will also focus on ensuring long-term access to high-quality protein [1,2]. According to Ogungbesan et al., traditional feed ingredients include a variety of cereals such maize, guinea corn, millet, oats, wheat, wheat bran, rice bran, groundnut cake, soyabean meal, and fish meal [3]. To establish the nutritional value of agro-industrial by-products, however, extensive and ongoing efforts are being conducted due to the skyrocketing cost of feed and the decreasing supply of traditional feedstuffs [4]. Both animal production and human nutrition are seriously hampered by the lack of reliable supplies of high-quality feeds for animals [5]. Due to its high demand for human nutrition and agro-industrial needs, maize cannot be used as an element in conventional livestock feed (Rawlings et al., 2015).

A native of West India, Egypt, and sub-Saharan Africa, the doum fruit (Hyphaene thebaica) is a desert palm. It is an arborescent plant that belongs to the Arecaceae family of palms [6].According to Abdulsalam et al. [7]. the plant can reach a height of 6 to 9 feet and typically has forked stems with leaves that are 65 to 75 cm long and fan-shaped. The leaves of the palm tree are used to make writing paper, mats, and household utensils in addition to being utilized in building [8]. The palm tree's wood is also used to make numerous household items. The rectangular, yellow-orange fruit is the size of an apple and has a red outer peel, a thick, spongy, sweet, fibrous fruit pulp, and a big kernel [9]. The fruit's covering can be eaten, and it can either be ground into a powder or cut off in slices. The powder is frequently dried and then used as a flavoring element in meals [10].One of the most significant plant groups that provides humans with nutritional fibre, carbs, and anti-hypertension agents is the Doum palm.

The doum palm's roots are used to cure bilharzias, while the fruit is frequently chewed to lower blood pressure [7]. The powdered fruit pulp of the doum palm was used to make various alcoholic beverages, treat bilharzias, stop bleeding, particularly after childbirth, and act as a haematinic agent [11]. Datti et al. reported that doum palm fruit pulp contains crude protein, crude fibre, ether extract, ash and carbohydrate at 2.86 %, 12.87 %, 0.92 %, 6.24 % and 68.47 % respectively [12].

In view of the abundant potentials in doum palm, this current study aimed to examine the effect of doum palm mesocarp meal

as partial replacement for maize on growth and hematological indices of weaned pigs.

Materials and Methods

Investigation Site and Ethical Guidelines

The experiment was carried out at the livestock division of Sumitra Research Institute in Gujarat, India, that is situated at 23o 13' N and 72o 41' E. All management was carried out in accordance to the livestock ethical standard in India.

Collection, Preparation, Analysis of Test Ingredients and Experimental Diets

Dried matured fruits of doum palm were harvested from Sumitra Research Farm in Gujarat and collected in a flat clean plastic trays. It was then transferred to the department of taxonomy of the same institute where it was identified and issued a voucher specimen number (DPPM-004-AA). Fruits were crushed in a mortar to separate the mesocarp from the kernel, each sample were collected into separately into a clean plastic bucket. The mesocarp was further grinded into fine particles with a hammer mill and stored in a well labeled zip log. Samples were taken to the laboratory for proximate analysis before it was mixed with other feed ingredients in order to formulate the experimental diets.

Proximate analysis of doum palm mesocarp meal (DPMM) and experimental diets were carried out using Phoenix 5000 near infra-red feed analyzer (Model: BH-0097HH, Argentina). 100 g of each sample were placed in the sample cap and placed in the tray, the scan button is pressed and results are viewed on the visual display unit in 30 seconds. The machine has the following technical specifications; wavelength (1100 – 1500 nm), temperature and humidity (35 – 105 oF, < 85 %), power requirements (V-100 – 240, 50/60 Hz 2 A 250V, 2A) and lamp life (continuous operation).

Animal Care and Experimental Design

A total of 50 cross bred pigs (Landrace × Large white) with initial body weight of 7.12 ± 0.01 kg. The animals were weaned at 21 days of age and were purchased from a reputable farm in India. During the period of arrival, animals were given anti-stress (Glucomol® at 1g to 5 liters of water) quarantined for 2 weeks, treated with Oxytetracycline and Ivermectin injections adhering strictly to the manufacturers' recommendation as prophylactic treatment. Basal diet (adequate in all nutrients according to the animal's requirements by National Research Council in 2012) was fed to pigs during the time of acclimatization. Pigs were stratified according to their body weights before they were distributed into 5 pens (10 pigs per semi open sided pen) measuring (30 m × 17 m: length × breath) in a completely randomized experimental design and fed five experimental diets in Table 1:

Diet 1: Corn based diet with no DPMM
Diet 2: Doum palm pulp meal was used to replace maize at 5 %
Diet 3: Doum palm pulp meal was used to replace maize at 10 %
Diet 4: Doum palm pulp meal was used to replace maize at 15 %
Diet 5: Doum palm pulp meal was used to replace maize at 20 %

Experimental Duration and Measurements

The experiment lasted for 56 days and all standard management practices were strictly complied to. Feed intake was estimated as the difference between the feed served and the left over all expressed in kilogram. Weight gain was calculated by subtracting the final weight gain from their initial weight. Average daily weight gain was calculated by dividing the body weight gain by the number of experimental days while feed conversion ration were calculated by dividing the feed intake by the body weight gain.

Hematological Assessment

At the conclusion of the experiment, eight pigs from each treatment were selected for hematological assessment. A culinary vein was used to draw 2 mL of blood into labeled sample bottles treated with ethylene diamine tetra acetate (EDTA). Collected samples were taken to the laboratory and were analyzed using Sysmex automated blood analyzer, the procedure for analysis was carried out according the manufacturers instruction results are displayed on the monitor via the aid of a software in 60 seconds. The equipment has the following technical details; optical flow (40 L quartz), photometric range (– 0.15–4.00 abs), and reaction volume (400–700 L).

Statistical Determination

Applying the Statistical Analysis System Software (SAS), all collected data underwent a one-way analysis of variance. The SAS Turkey test was used to separate the means, and significant differences were identified at $P<0.05$ [13].

Table 1: Ingredient composition of experimental diet (% Dry matter)

Ingredients	Diet 1 (0 %)	Diet 2 (10 %)	Diet 3 (20 %)	Diet 4 (30 %)	Diet 5 (40 %)
Maize	50.00	45.00	40.00	35.00	30.00
DPMM	-	5.00	10.00	15.00	20.00
Wheat offal	12.00	12.00	12.00	12.00	12.00
Soya bean meal	16.50	16.50	16.50	16.50	16.50
Groundnut cake	15.00	15.00	15.00	15.00	15.00
Bone meal	4.00	4.00	4.00	4.00	4.00
Limestone	2.00	2.00	2.00	2.00	2.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
**Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Determined analysis					
Crude protein	19.65	19.51	19.37	19.23	19.09
Ether extract	4.39	4.28	4.18	4.08	3.98

Crude fibre	4.63	5.08	5.54	5.99	6.45
Calcium	1.97	1.97	1.97	1.97	1.97
Phosphorus	0.86	0.86	0.86	0.86	0.86
Lysine	1.14	1.14	1.14	1.14	1.14
Meth + Cysteine	0.84	0.84	0.84	0.84	0.84
Energy (Kcal/kg)	2821.0	2797.0	2774.0	2750.0	2727.0

PPM: Doum palm pulp meal ** Mineral/Vitamin premix supplied per kg diet: - vit A, 8,500 I.U; vit E, 10.91 mg; vit D3, 2500I.U, vit K, 3.2mg; vit B2, 5.0mg; Niacin, 40 mg; vit B12, 25 mg; choline chloride, 100 mg; Mn, 5.0 mg; Zn, 35.1mg; Cu, 2.0g; folic acid, 2.5mg; Fe, 5.8g; pantothenic acid, 10mg; biotin, 30.5g; antioxidant, 56mg (starter's mash)

Proximate composition of dried Doum palm mesocarp meal

Table 2 represents the proximate composition of Doum palm mesocarp meal (DPMM). The crude protein and ether extract of DPMM is 6.09 % and 1.75 % was higher than the value of 2.86 % and 0.92 % reported by [12, 6]. The crude fibre of 11.49 % obtained in this study was lower than 12.87 % recorded by (Siddeeg et al., 2019; Aboshora et al., 2017) [14, 15]. However, the ash and energy value of 6.26 %, 2933.7 kg/cal was greater than 6.24 % and 2800.3 kcal/kg reported by the same authors. This variation may be due to species, method of processing amongst others [16].

Table 2: Proximate Composition of Dried Doum Palm Mesocarp Meal

Parameters	Composition
Crude protein	6.09
Crude fibre	11.49
Ether extract	1.75
Ash	6.26
Energy (Kcal/kg)	2933.7

Growth Performance of Weaned Pigs Fed Doum Palm Mesocarp Meal as Partial Replacement for Maize

Data on growth performance of weaned pigs fed Doum palm pulp as partial replacement for maize is shown in Table 3. Weight gain, average daily feed intake and feed conversion ratio of pigs fed 5 % (diet 2), 10 % (diet 3), 15 % (diet 4) and 20 % (diet 5) doum palm pulp meal (DPPM) were similar ($P>0.05$) to those fed diet 1 (without doum palm pulp meal). The result suggests that the partial replacement of maize with DPPM up to 30 % is capable of supporting the growth of animals. Doum palm pulp meal have also been reported to contain phytochemicals such as; tannins, alkaloids, saponins amongst others which have beneficial effect in the gastro intestinal tracts of pigs [17, 18], they also stimulate the effective absorption of nutrients [19]. The outcome of this experiment in correlation with the reports of Ly et al. (2010) who observed no difference in the performance of pigs fed 50 % of sweet potato vines as a replacement for maize. Similar results was recorded by Williams et al [20]. (2023) when fermented cassava peel was used to replace maize at 50 %. On the contrary, Nyachoti et al. (2005) recorded a significant ($P<0.05$) in feed intake and average daily weight gain of cross bred pigs fed wheat dried distillers grain with solubles. This discrepancies can be attributed to the differences in nutritional composition of test material as well as processing method adopted [21].

Table 3: Growth Performance of Weaned Pigs Fed Doum Palm Mesocarp Meal as Partial Replacement for Maize

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM
Initial weight (kg/pig)	7.12	7.11	7.11	7.11	7.12	0.15
Final weight (kg/pig)	20.90	20.58	20.52	20.18	20.13	0.43
Weight gain (kg/pig)	13.71	13.67	13.65	13.62	13.60`	0.29
Average daily weight gain (kg/pig)	0.25	0.24	0.24	0.23	0.23	0.01
Total feed intake (kg/pig)	31.56	31.51	31.73	31.66	31.78	0.81
Average daily feed intake (kg/pig)	0.56	0.56	0.57	0.57	0.57	0.03
Feed conversion ratio	2.30	2.33	2.36	2.39	2.39	0.05

Diet 1: Corn based diet with no; Diet 2: Doum palm pulp meal was used to replace maize at 5 %;
Diet 3: Doum palm pulp meal was used to replace maize at 10 %; Diet 3: Doum palm pulp meal was used to replace maize at 15 %;
Diet 3: Doum palm pulp meal was used to replace maize at 20 %; SEM: standard error of mean

Haematological Parameters of Growing Pigs Fed Doum Palm Mesocarp Meal as Partial Replacement for Maize

All haematological values investigated were significantly ($P<0.05$) affected by the treatments (Table 4). The pack cell volume, haemoglobin, platelet, red blood cell and mean platelet volume of pigs in diet 3, 4 and 5 were similar ($P>0.05$) but significantly higher than those in diet 1 and 2. Pack cell volume, haemoglobin, platelet, mean corpuscular volume and red blood cell values were within the optimal ranges (20.08 – 39.00 %), (90.00 – 121.8 g/L), [66.95 – 137.7 ($\times10^9$/L)], (6.99 – 12.66 fl) and [4.69 – 12.00 ($\times10^{12}$/L)] reported by Etim et al. [22]. Normal pack cell volume value implies no shortage in blood (anaemia) [23]. Shittu et al.; Omokore and Alagbe explained that higher red blood cell and haemoglobin values suggest sufficient oxygen in the blood which translates to better nutrient availability in the body of animals [19, 24, 25]. The haemoglobin values indicate that the replacement of doum palm pulp meal in pig diets was nutritionally sufficient, thus preventing parasitic infections and damage of vital organs such as liver and kidney [26]. Decrease in the production of red blood cells could be as a result of renal disorders, chronic inflammatory disease, bone marrow disorders and nutritional deficiency [27]. The values of mean corpuscular volume (35.85 – 68.11 fl), mean corpuscular heamoglobin (9.70 – 35.00 pg) and mean corpuscular haemoglobin concentration (18.90 – 120.9 g/L) recorded in this experiment were higher than the normal range 30.80 – 65.00 fl, 8.50 – 30.00 pg and 15.09 – 15.06 g/L reported by Unigwe et al. [28]. This variation can be attributed to breed difference among the animals [29]. These results suggests that the experimental diets contains essential minerals capable of preventing pathological lesions in the liver and obstruction in kidney functions [30]. Low levels of mean corpuscular haemoglobin could result from copper deficiency, kidney disease and haemolysis [19, 31]. The key role of white blood cell is the production of antibodies against diseases [28]. The outcome of this experiment showed that doum palm pulp meal have immune-stimulatory properties [32]. Eosinophils responds to allergies and it releases cytotoxic substance that kills parasites, basophils contains histamine and heparine while neutrophils responds to inflammation and infection caused by bacteria and fungi [33-36]. Afolabi et al. reported that during phagocytosis, lymphocytes is the most abundant in the white blood cell followed by heterophils, eosinophils and monocytes respectively [37]. The neutrophils, basophils, monocytes and lymphocytes values were within the normal physiological range from 1.95 – 9.00 ($\times10^9$/L), 0.02 – 0.40 ($\times10^9$/L), 0.06 to 2.00 ($\times10^9$/L) and 10.09 to 15.00 ($\times10^9$/L) respectively for a growing pigs [38, 39].

Table 4: Haematological Parameters of Weaned Pigs Fed Doum Palm Mesocarp Meal as Partial Replacement for Maize

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM	Reference range*
Pack cell volume (%)	28.29^b	28.00^b	31.11^a	33.87^a	34.09^a	0.02	20.08 – 39.00
Haemoglobin (g/L)	97.00^b	97.56^b	98.11^b	106.55^a	106.71^a	1.10	90.00 – 121.8
Platelet ($\times10^9$/L)	100.2^b	100.6^b	120.4^a	124.6^a	125.6^a	1.56	66.95 – 137.7
Mean platelet volume (fl)	6.00^b	6.56^b	9.06^a	9.67^a	9.93^a	0.01	6.99 – 12.66
Red blood cell ($\times10^{12}$/L)	7.04^b	7.98^b	8.05^b	10.5^a	11.2^a	0.01	4.69 – 12.00
Mean corpuscular volume (fl)	39.00^b	39.05^b	39.55^b	48.12^a	49.88^a	0.62	35.85 – 68.11
Mean corpuscular haemoglobin (pg)	20.00^b	20.80^b	21.55^b	27.00^a	27.19^a	0.18	9.70 – 35.00
Mean corpuscular haemoglobin concentration (g/L)	48.02^b	48.11^b	49.04^b	56.07^a	56.94^a	0.76	18.90 – 120.9
White blood cell ($\times10^9$/L)	8.87^b	9.13^b	9.70^b	11.08^a	11.22^a	0.02	7.70 – 22.92
Neutrophils ($\times10^9$/L)	6.00^b	6.02^a	6.17^b	8.03^a	8.74^a	0.01	1.95 – 9.00
Basophils ($\times10^9$/L)	0.11^b	0.10^b	0.20^a	0.21^a	0.23^a	0.02	0.02 – 0.40
Monocytes ($\times10^9$/L)	1.03^c	1.19^b	1.20^b	1.39^a	1.40^a	0.01	0.06 – 2.00
Lymphocytes ($\times10^9$/L)	9.35^b	9.24^b	9.81^b	12.01^a	12.03^a	0.01	10.09 – 15.00

Conclusion

In conclusion, partial replacement of maize with DPMM did not negatively affect the growth and health status of pigs. It can be used up to 20 % to replace maize without posing any harm on the animal's health. The use of DPMM will further reduce the increasing competition for conventional feedstuffs such as maize between human being and animals.

Means with different superscripts along row are significantly ($P<0.05$) different; SEM: standard error of mean; *: as stated by Research Animal Resource (2009); Merck Veterinary Manual (2010); Diet 1: Corn based diet with no; Diet 2: Doum palm pulp meal was used to replace maize at 5 %; Diet 3: Doum palm pulp meal was used to replace maize at 10 %; Diet 3: Doum palm pulp meal was used to replace maize at 15 %; Diet 3: Doum palm pulp meal was used to replace maize at 20 % [40-42].

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