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Effect of graded levels of dry pineapple peel on digestibility and growth performance of rabbit

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ABSTRACT

Objectives: A feeding trial was conducted to investigate the effect of the inclusion levels of sun dried pineapple peel (PP) in the diets, on the digestibility and growth performance of rabbits.

Methodology and Results: Diets R0 (control), R20, R30 and R40 were formulated by including 0, 20, 30 and 40% of PP. *Panicum maximum* C1 fodder supplemented the diet of each rabbit. Twenty-four growing rabbits, of 40 to 55 days old, with initial weight 765 ± 128g were used for 70-day trial. Faecal apparent digestibility of dry matter was measured in 12 rabbits during 7 days. The intakeof the diets based on PP was similar ($p>0.05$) to that in the control diet. Total feed intake ranged from 66 to 72 g DM/kg. The average dry matter digestibility (67.5%) was similar ($p>0.05$) in rabbits fed diet containing 20% PP and control diet. Average daily weight gain (15.5 to 16.7 g) and feed conversion ratio (5.48 to 6.08) were better in rabbits fed R0, R20 and R30 diets.

Conclusions and application of findings: Results from this study show that weaned rabbits are good consumers of dried PP. This study demonstrated that, the dried PP is a suitable feedstuff for rabbits. It can be included in rabbits' diets up to 20% without a significant adverse effect on feed intake, dry matter digestibility and growth performance.The PP meal is biologically efficient and environmentally sustainable. It successfully enhanced the rabbit's growth performance. To get optimum performance of rabbit, famers may not exceed 20% inclusion level in dietary. However, the present technologies do not take into account other equal practices or more important, in farm conditions. Therefore, it is important to include the economical viability aspect in the technologies during on farm research before starting its dissemination.

KEYWORDS: pineapple peel, chemical composition, intake, live weight gain, feed conversion ratio

INTRODUCTION

Poultry, pig and rabbit production represent the fastest way to overcome the shortage of animal protein consumption by human populations. Apart from their high rate of reproduction, these species are characterized by, the best efficiency of nutrient transformation into high quality animal protein. Compared to poultry and other livestock, rabbits have the ability to thrive on agricultural and agro-industrial by-products. Rabbit convert forages into meat more efficiently than ruminant animals (Cheeke, 1986). The flesh also has higher protein content than poultry, cattle and pigs (Youdeowei *et al.,* 1986). Interest in rabbit production has been increased during these recent years, because it occupies a unique niche in that it is a mini livestock that is easy to manage, highly prolific and has a short generation interval of 45 to 50 days. A major constraint to profitable rabbit production for poor farmers in the southern Benin is the limited feed availability throughout the year. The use of less traditional feeds such as by-products combined with roughage sources may provide farmers with a variety of feeding options. In that region, the production of pineapple has intensified in the last few years. The process of transformation of the pineapple in juice and dried pineapple fruits, releases in significant quantities of by-products (peels, crowns, hearts) which are estimated at more than 1000 t/year. Pineapple waste occurs as pineapple peels and core, making about 40-50% of the fresh fruit (Buckle, 1989) and contains mainly sucrose, fructose, glucose and other nutrients (Krueger *et al*., 1992). Their accumulation in the neighborhoods constitutes a source of environmental pollution. If fresh pineapple peels are not consumed, it often gets mouldy and sour, and therefore unlikely to be used as an animal feedstuff. Therefore, some studies were conducted to develop a procedure for converting pineapple waste into animal feed (Makinde *et al.,* 2011; Sruamsiri *et al*., 2007).

Problems related with the fresh form, were overcome by the sun drying technique of pineapple peels developed by Aboh *et al*. (2004) which gave dried peels of good quality. However, according to these authors, the dried peels are too compact and hard for its ingestion by animals. Therefore, to overcome this constraint, it is significant to explore some treatments to be applied to the peels such as crushing, to improve their ingestion without degrading the feedstuff value. The work is realized in the context of the increasing investigations on alternative feedstuffs and the scanty measurable data on the use of pineapple peel meal as dietary source of energy in rabbit nutrition. This study aimed to investigate the effect of the dietary level of PP on feed intake, dry matter digestibility and the growth performance of rabbits.

MATERIAL ET METHODS

Experimental Diets: Pineapple (Pain de Sucre) peels were obtained from small factories of pineapple juice and dry pineapple. Fresh pineapple peels collected was sun-dried at an average temperature of 30 °C on a concrete floor for ten days with constant turning until a constant weight was obtained. It was then incorporated into the experimental diets at four levels of 0, 20, 30 and 40%. Pineapple peels and other ingredients feed were crushed to obtain diets R0, R20, R30 and R40, respectively (table 1). *Panicum maximum* C1 fodder is supplemented to all the rabbits. The PP and each experimental diet were sampled for dry matter determination and proximate analysis. Trisulmycine® Forte (sulfadiazine) was used to control the coccidiosis.

Chemical Analysis: Proximate composition was determined according to the methods of AOAC (1990). Dry matter (DM) content of pineapple peels, diets and faeces samples were determined by drying at 70°C in oven until a constant weight. Nitrogen (N) contents in the diets and PP were determined by the Kjeldahl method. Crude protein (CP) was estimated as Kjeldahl N x 6.25. Phosphorus (P), Calcium (Ca), Magnesium (Mg) and ash were also determined

Animals and Fattening Trial: The experiment was arranged in a randomized complete block design with 4 diets and 6 replications. Twenty-four (24) weaned rabbits, of 40 to 55 days old, with initial weight 765 ± 128 g and mixed sexes were used for the 70-days

feeding trial. They were divided into 4 experimental groups of 6 rabbits, randomly allocated to the experimental diet after balancing for weight. They were housed in individual hutch measuring of 0.5 m x 0.5 m x 0.45 m, raised at 80 cm above the floor. Each hutch is provided with wire screen floor, which permit faeces and urine to drop. All animals have free access to drinking water, and the experimental diets were offered ad-libitum. An adaptation to experimental diet lasted for 14 days before experimental feeding. The daily feed intake was recorded per animal to calculate feed consumption. The animals were weighed individually at the beginning of the trial and every 14 days to calculate live weight gain. The live weights (LW) were recorded before feeding and watering. All these data were used to calculate the feed conversion ratio (FCR) according to this formula:

$$\text{FCR} = \frac{\text{Average daily dry matter intake (g)/head}}{\text{Average daly live weight gain (g)/head}}$$

Digestibility Trial: Twelve (12) rabbits, weighing 1767 ± 236 g were assigned to the four experimental diets. They were housed in individual hutches, but provided with material, which permits faeces collection and urine to drop. The left over diet and faeces were recorded daily per animal during 7 days. The daily feed intake was recorded per animal to calculate feed consumption. All these data were used to calculate apparent digestibility coefficient of dry matter for each diet according to this equation:

$$\text{Digestibil y} = \frac{\text{Dry matter intake - Dry matter excreted in faeces}}{\text{Dry matter intake}} X100$$

Statistical Analysis: Data collected were subjected to analysis of variance using STATISTICA (1998) software. When analysis of variance indicated significance for diet effects, specific differences between means were detected by the Newman-keuls range test.

RESULTS

Diets Nutritive Value: The proximate composition of pineapple peel meal, experimental diets and forage is presented in table 2. The crude protein contents of PP meal and experimental diets were 6.12% and 17.18 – 18.12% respectively. The ash and calcium contents in R20 diet were higher than those in other diet. The crude protein contents of *Panicum maximum* were about 5.34%.

Table 2: Proximate chemical composition (%) of diets

Diets	OM %	Ash	CP	P	Ca	Mg
Pineapple peel	92.07	7.93	6,12	0.13	1.09	0.42
R0	84.58	15.42	17.78	0.85	30.00	9.60
R20	80.50	19.50	18.12	0.77	38.00	10.08
R30	84.29	15.71	17.18	0.79	27.20	9.84
R40	84.34	15.66	17.62	0.75	20.80	11.28
Panicum maximum C1	90.14	9.86	5.34	nd	nd	nd

nd : non determined

Feed Intake and Dry Matter Digestibility: During the experiment, the voluntary feed intake of experimental diet was similar ($p>0.05$) to that in the control diet (table 3). Irrespective of the type of diets, rabbits consumed the same quantity of *Panicum maximum* C1 ($P>0.05$). The total feed intake, range from 68.5 to 73.5 g $DMkg^{-1}$ LW. However, experimental diet intake was higher (54 to 57 g $DMkg^{-1}$ LW) than forage intake (14 to 16 g $DMkg^{-1}$ LW). The apparent digestibility of DM was higher ($P<0.05$) in rabbits fed R20, R0 and R30 diets, but lower in R40 dietary treatment. In addition, the production of feaces decreased ($P<0.05$) in R40 dietary treatment compared to others treatments.

Table 3: Feed intake and apparent dry matter digestibility of rabbits fed diets with different levels of pineapple peel

	Experimental diets			
Parameters	**R20**	**R30**	**R40**	**R0**
Total feed intake (g DM/day)	90.06 a	94.2 a	90.4 a	95.7 a
Total daily feed Intake (g DM/kg LW)	68.5 a	69.1 a	73.5 a	71.3 a
Experimental diet daily intake (g DM/kg LW)	54.4 a	54.1 a	57.3 a	56.5 a
Panicum maximum daily intake (g DM/kg LW)	14.0 a	15.0 a	16.2 a	14.8 a
Ratio diet / forage (%)	79.7 a	78.3 ab	78.0 b	79.3 ab
Digestibility of DM (%)	67.7 a	63.6 ab	62.0 b	67.4 a
feaces (g DM/day)	35.1 a	37.6 a	27.3 b	34.2 a

a,b: Values in the same row with different letters are significantly different at p<0.05.

Rabbit Health and Growth Performance: No mortality was recorded during the experiment and, no clinical symptom of disease was observed. The average initial live weights were similar (P >0.05) in all the dietary treatments. In general, the growth performance of rabbits reduced with the increase of the PP level in the diet (table 4). However, rabbits fed R20 and R30 diets grew similarly (P>0.05) with those fed the control diet in terms of average final live weight, average daily weight gain and feed conversion ratio. The rabbits fed R40 diet recorded the lowest (P<0.05) average final live weight and average daily weight gain and highest feed conversion ratio.

Table 4: Growth performance of rabbits

	Experimental diets			
Parameters	R20	R30	R40	R0
Initial weight (g)	737 a	823 a	783 a	783 a
Final weight (g)	1908 a	1870 a	1686 b	1904 a
Live weight gain (g/day)	16.7 a	15.5 a	12.9 c	16.0 a
Feed conversion ratio	5.48 b	6.08 ab	7.05 a	6.08 ab

a, b: Values in the same row with different letters are significantly different at p<0.05.

DISCUSSION

Feedstuff Processing and Quality: The sun drying of PP allows the conversion of that perishable feed into a stabilized product through the dehydration at suitable level. Aboh *et al*. (2011) got a stabilized product using the same method to keep cashew apple. The sun drying of PP would avoid the microbial attacks and the deterioration of the product quality related to the undesirable biochemical reactions. Also, the conservation by sun drying contributes to reduce the losses of the by-product and prevention of environment pollution. The values of the ash, calcium and magnesium recorded from sun dry PP in the present study indicated that it is a useful mineral source for rabbits. However, it crude protein content is poor. The PP crude protein value obtained is slightly higher than the value recorded (5.11%) by Adeyemi *et al*. (2010). In contrast, ash content is lower than that recorded (11.80%) by the same authors. Apart from the varietal differences between pineapples, another reason for this may be the supply of fertilizer. According to Adeyemi*et al*. (2010), PP crude fiber (27.95%) and gross energy (8.45 $MJkg^{-1}$) contents are higher and these finding indicates that PP is a good source of dietary fiber and energy.

Feed Intake and Growth Performance: During, about 70 days of feeding, experimental diets based on PP are palatable as control diet. It may indicate that this long-term post-ingestion of experimental diets feedback is positive. In addition, this result may express that diets based on PP as formulated, met feedstuff characteristics in relation to the gut capacity, rabbit's requirements and nutrient concentrations. However, the

crude protein contents (17-18%) of our experimental diets were relatively lower than that of conventional diets (18.8%) used by Kpodékon *et al*. (2009) and that based on unfermented pineapple peel (19.5-19.8%) formulated by Adeyemi *et al*. (2010). Regarding digestibility, inclusion of PP at 20% in the diet did not depress dry matter digestibility compared to the control. However, beyond 20% of PP in the diet, dry matter digestibility decreases. Dry matter digestibility obtained is lower than that recorded for the control diet (76%) formulated by Iyeghe-Erakpotobor *et al*. (2006), but similar to that recorded with 50% soybean cheese waste meal by the same author. No mortality was recorded during the experiment. This indicates that rabbits can consume, diet containing the dried PP, without major risk of intoxication during the growth period. The average live weight gains recorded for this experiment are higher than the best value reported (11 g day^{-1}) by Adeyemi *et al*. (2010) with 12.5 to 25% PP inclusion in rabbit diet. However, the present live weight gains are lower than 19.7 to 23.1 $gday^{-1}$and 19 to 22 g day^{-1} recorded respectively by, Houndonougbo *et al*. (2012) and Kpodékon *et al*. (2009) in Benin. The final average live weight gains and feed conversion rate of growing rabbits significantly reduced as inclusion level of PP increased. Adeyemi *et al*. (2010) and Fapohunda *et al*. (2008) observed the same trend when using PP in the rabbits feed. In addition, the feed conversion ratio recorded in this experiment is poorer compared to the average (IC=3.25 to 3.74) reported by Kpodékon *et al*. (2009) with a conventional diet. It is also higher than 3.78 to 4.64 reported in rabbit fed palm-press fibre (0 - 15%) based-diets. However, it is better than IC=7.8 to 8.2 recorded by Adeyemi *et al*. (2010) when using pineapple peel feed. The difference may due to the nutrient unbalance, mainly the energy contents of diets. To balance dietary CP contents, an increase in feed ingredient rich in CP such as soya bean cake and cotton cake in diets R30 and R40 can be done.

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