Performance and carcass quality of broiler chickens fed diet containing pineapple waste meal fermented by “ragi tape”

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Abstract. The study was conducted to determine the effect of pineapple waste meal fermented by "ragi tape" (FPW) in diets on the performance and carcass quality of broilers. The "ragi tape" was a traditional commercial product of yeast. Five dietary treatments containing 0, 5, 10, 15 and 20% levels of FPW with four replicates were fed to 250 broiler chickens for 42 days in a completely randomized design. Feed and water were provided *ad libitum*. The variables were performance parameters and carcass quality. Results showed that the performance in finisher, carcass percentage and abdominal fat percentage were significantly affected by dietary treatments. Carcass percentage and abdominal fat percentage were significantly decrease in the proportion of 20% of FPW. However, the carcass percentage in treatments R0 – R4 were still in a good category. The higher the levels of FPW the lower the abdominal fat percentage signed that FPW treatments up to 20% resulted good category of broiler carcass. Income over feed cost and broiler cost analysis in 20% FPW treatment obtained the highest income and the lowest was 0% FPW treatment. It can be concluded that FPW can be fed to broiler chickens at up to 20% level.

Keywords: Broiler, Carcass, Fermentation, Performance, Pineapple

1. Introduction

Nutritionist in recent time have been focused in research of agro-industrial wastes in animal nutrition especially for monogastric animals. In fact, many feeds that can be fed alternatively at cheaper cost to monogastric livestock are based on the use of agro-industrial waste that are of no food value to humans [1]. Onwuka, *et al*. [2] stated that a major strategy to develop the livestock industry in developing countries could be the use of agricultural by-products like pineapple waste, corn cobs and brewers dry grain. Pineapple waste is agro by-products from pineapple fruit.

Pineapple waste occurs as pineapple peels and core, making about 40-50% of the fresh fruit [3]. It contains mainly the sugars of sucrose, fructose and glucose [4]. Also, it contains low amounts of protein, fat, ash [5]. Pineapple peel is rich in cellulose, hemicellulose and other carbohydrates. Raw pineapple waste (on DM basis) contains about 4% crude protein, 60−72% NDF, 40−75% soluble sugars (70% sucrose, 20% glucose and 10% fructose) as well as pectin, but it is poor in minerals [6, 7], except Ca. It is locally available.

Traditional market wastes and restaurant wastes of agro-product like pineapple fruit represent a serious problem since it is usually causes major environmental problems. The process of pineapple to juice and dried pineapple fruits release in significant quantities of by-products, such as: peels, crowns and hearts. Nurhayati [8] reported that pineapple peel is produced from pineapple fruit processing. Approximately 27% of pineapple fruit is pineapple peel. The accumulation of pineapple waste in the neighbourhoods constitutes a source of environmental pollution. If fresh pineapple peels are not consumed, it often gets mouldy and sour, and therefore unlike heptonly to be used as an animal feedstuff. Therefore, some studies were conducted to develop a procedure for converting pineapple waste into animal feed [9, 10].

Problems related with the fresh form, were overcome by the sun drying technique of pineapple peels developed by Aboh, *et al.* [11]. It gave dried peels of good quality, however, the dried peels are too compact and hard for its ingestion by animals. Researchers reported that pineapple wastes have been described as equivalent to cereal grains for ruminants [6] or as a low-nutrient feed [12].

Pineapple wastes are recommended as tremendous sources of organic raw materials and are potentially available for conversion into useful products such as animal feeds [13]. However there is a constraint to use it as poultry feedstuff due to it contains 19.8% of cellulose and 11.7% of hemicelluloses [14]. 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 [11]. In any case, the high amount of fibre makes pineapple wastes more suitable to ruminants than to pigs and poultry. The bulkiness of the fresh products limits intake. Inclusion of 15 percent pineapple bran in chick diets depressed the feed conversion ratio and 20 percent inclusion decreased weight [15]. The final average live weight gains and feed conversion rate of growing rabbits significantly reduced as inclusion level of pineapple waste increased [16, 17]. However, Lamidi, *et al*. [18] found that broiler chickens could tolerate up to 10% pineapple waste in their diets without any deleterious effect. Olosunde [19] reported that sheep could tolerate up to 45% pineapple waste but 30% was superior when substituted for corn bran.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.

It has been reported that pineapple waste contains high amounts of crude fiber and suitable sugars for growth of microorganisms. Similar to rice husk, pineapple peel also need pretreatment before offering to the poultry [13]. *Trichoderma harzianum* might be used to ferment agricultural by products those rich in fiber content to increase their quality by increasing crude protein content and reducing crude fiber content. Rice husk and pineapple peel had higher quality after fermenting with 12% of *Trichoderma harzianum*. Banana peel was not suggested to ferment with *Trichoderma harzianum* [20].

The use of microorganisms through fermentation to improve nutritional value of agro-industrial wastes, thereby offering the potential to make dramatic contributions to sustainable livestock production has been well documented [1, 21, 22]. The utilization of fungi for nutrient enhancement in agro-industrial waste by fermentation has been studied for years and their efficiency shown in substrates such as lignin, cellulose and hemicellulose polymers found in agro-industrial waste [23]. A*spergillus niger* and *Trichoderma viride* have been successfully used in a number of fermentation studies towards solid waste management, biomass energy conservation and production of secondary metabolites in various agro-industrial wastes [24, 25, 26].

Some studies were conducted to develop a procedure for converting pineapple waste into animal feed [9, 10]. In studies by Correia, *et al*. [27], *Rhizopus oligosporous* was used to produce enhanced levels of free phenolics from pineapple residue in combination with soy flour as potential nitrogen source.

"Ragi tape" was a traditional commercial product contained *Candida parapsilosis, C. melinii, C. lactosa. C. solani, Hansenula subpelliculosa, Rhizopus oligosporus, Aspergillus flavus, A. oryzae* and *Hansenula malanga* [28], that was could used to develop a procedure for converting pineapple waste into animal feed. However, there are no reported studies of the dietary of fermented pineapple waste in diet of broiler. This study aimed to investigate the effect of the dietary level of pineapple waste fermented by "ragi tape" on carcass percentage and abdominal fat percentage of broiler chickens.

2. Materials and Methods

2.1. Birds, Diets and Experimental Design

Fresh pineapple peels collected were washed and steamed for twenty five minutes. Then cooled and mixed with 30 g "ragi tape"/kg pineapple peels, incubated on three days at room temperature. "Ragi tape' was a traditional commercial product contained *Candida parapsicosis*, *Candida melinis*, *Hansenula supbeliculosa*, *Hansenula malanga*, *Aspergillus niger, A. oryzae* and *Saccharomyces cerevisiae*. Part of the fermented pineapple peels then were dried and ground to fine powder using mortar and pestle.

The PWF then incorporated into the experimental diets at five levels of 0, 5, 10 and 15 and 20%. Based diet and PWF were crushed to obtain diets R0, R1, R2, R3 and R4, respectively. The proximate analysis of fermented pineapple waste (PWF) was shown in Table 1. Based diet contain ingredients: yellow corn 55%, fish meal 12%, soybean cake 15%, rice bran 7%, coconut cake 10.5% and top mix 0.5%, and the nutrients composition is shown in Table 2.

A total of 250 unsexed broiler finisher (Cobb CP 707) have been used in this experiment. Birds were weighed and maintained under standar managemental practices. Feed and water were provided *ad libitum* throughout the experimental period, and these treatments were administrated for a 42 days period. Vaccination programme against Gumboro and ND were carried out as per schedule.

Parameters were evaluated: feed intake, weight gain, feed conversion ratio, carcass percentage and abdominal fat percentage. At 42 days the experiment, one representative bird from each pen was conventionaly slaughtered by cervical dislocation, bled and eviscerated. Then, carcass parameters (ready to cook) including dressing percentage and abdominal fat were determined.

Table 1. Chemical analysis of unfermented and Fermented pineapple waste

Nutrients	Unfermented PW	Fermented PW
Crude Protein (%)	0.92	7.87
Crude Fiber (%)	18,25	17.42
Fat (%)	0.80	1.53
Ca (%)	0.58	12.73
P (%)	0.4	0.82
GE (Kcal/kg)	2782	3830

Notes: PW = pineapple waste

Table 2. Diets and calculated analysis

Treatments	R0	R1	R2	R3	R4
Based Diet	100	95	90	85	80
Fermented Pineapple Waste	0	5	10	15	20
Calculated Analysis:					
Protein	21.85	21.15	20.45	19.75	19.05
Crude Fiber	4.86	5.48	6.11	6.74	7.37
Fat	6.32	6.08	5.84	5.60	5.37
Ca	2.31	2.83	3.35	3.87	4.40
P	1.27	1.25	1.22	1.20	1.18
GE (Kcal/kg)	3883	3880	3878	3875	3872

2.2. Statistical analysis

The data were subjected to analyze for variance technique using completely randomized design that was employed in one-way analysis of variance, and significant differences compared by Duncan's multiple range test [29]. All of statement of differences were performed at significance levels of 1% and 5%. The IBM SPSS Statistics 22 software was used for the statistical processing of data.

3. Results and Discussion

Data on performance and carcass quality of broilers affected by fermented pineapple waste (PWF) in diet is shown in Table 2. The results showed that carcass percentage and abdominal fat percentage were highly significant (P<0.01) affected by dietary treatments. Carcass percentage was significantly decrease in the proportion of 15% and 20% of PWF. However, the carcass percentage in treatments R0 – R4 were still in a good category. Abdominal fat percentage also was significant decrease in the proportion of 15% and 20% of PWF.

Table 3. Effect of Fermented Pineapple Waste in Diet on Carcass Percentage and Abdominal Fat Percentage of Broilers

Variable	Treatments					SEM	P value
	0% PWF	5% PWF	10% PWF	15% PWF	20% PWF		
Feed Intake (g/h/d)							
Starter	82.00	81.74	80.60	80.30	80.65	.206	.021
Finisher	109.21	109.66	104.05	98.10	98.59	.876	.000
Weight Gain							
Starter	26.85	26.89	26.93	26.76	26.66	.088	.892
Finisher	40.84	44.86	41.57	39.33	39.88	.361	.000
Feed Conversion Ratio							
Starter	3.02^{ab}	3.04^{c}	3.00^{ab}	2.99^{a}	3.02^{ab}	.007	.142
Finisher	2.69^{b}	2.45^{a}	2.50^{a}	2.49^{a}	2.50^{a}	.016	.000
Carcass (%)	74.89^{b}	73.28^{ab}	73.27a^{b}	72.27^{ab}	71.26^{a}	.411	.063
Abdominal Fat (%)	2.34^{e}	1.76^{d}	1.50^{c}	1.30^{a}	1.19^{b}	.060	.000
IOFCC (Rp)	8,554^{a}	10,509^{b}	10,556^{b}	10,548^{b}	10,687^{b}	163	.022

Notes: g/h/d = gram/head/day; ^{abcd} means with the same letters on the same row are in not significantly difference (P>0.05)

In the case of unfermented pineapple waste, Aboh, *et al*. [11] reported that final average live weight gains and feed conversion rate of growing rabbits significantly reduced as inclusion level of pineapple peels increased. Moreover, Adeyemi, *et al.* [17] and Fapohunda, *et al.* [16] observed the same trend when using pineapple peels in the rabbits feed. The difference may due to the nutrient unbalance, mainly the protein contents of diets, and based on unfermented pineapple peel. In the present study, crude protein value in the fermented pineapple peel obtained was higher than the value recorded (5.11%) by Adeyemi et al. [17], resulted good category of broiler carcass until 20% FPW treatment. Omwango et al [30] found higher crude protein content in pineapple waste fermented using the fungi *A. niger* and *T. viride* than in the unfermented pineapple waste for the 48, 72 and 96 h fermentation periods. The post fermentation increase in crude protein content could be attributed to the possible secretion of some extra cellular enzymes (protein) such as amylases, xylanases and cellulases into the pineapple waste mash by the fermenting fungi in an attempt to make use of the carbohydrates in the mash as a carbon and energy source [31]). *A. niger* has been reported to have high specific activity for cellulases and hemi-cellulases [23]. Additionally, *T. viride* and *A. niger* have found use in the production of extra cellular enzymes including cellulase, amylase and xylanase [32]. Mandey et al. [33] reported that carcass yield was significantly affected by the treatments, in which the carcass yield was highest from the birds fed diet containing 10% banana leaves fermented by *Trichoderma viride* for 10 days (74.58%).

Fungi colonize substrates for utilization of available nutrients. They synthesize and excrete high quantities of hydrolytic extra cellular enzymes, which catalyze the breakdown of nutrients to products that enter the fungal mycelia across cell membrane to promote biosynthesis and fungal metabolic activities leading to growth [31]. Therefore, increase in the growth and proliferation of fungal biomass in the form of single cell protein (SCP) or microbial protein accounts for part of the increase in the protein content after fermentation [31].

The decreasing of abdominal fat in the present study may due to th Ca content and Ca : P balance in diet. Some reports suggest that high dietary Ca can adversely affect the utilization of fat [34], nitrogen and metabolisable energy [35] in broilers. Dietary Ca concentration had a significant effect on apparent fat digestibility. Fat digestibility was reduced by increasing Ca concentrations in all intestinal segments [36]. Aboh, *et al*. [11] reported that ash, calcium and magnesium in sun dried pineapple peel were a useful mineral source for rabbits. In this experiment, the higher the levels of PWF the lower the abdominal fat percentage signed that PWF treatments up to 20% resulted good category of broiler carcass.

The significant increase in protein content of the pineapple waste after fermentation with "ragi tape" and the decrease in crude fiber concludes that fermentation of pineapple waste by "ragi tape" enriches the nutrient content of the waste and this by product can be good supplement in compounding animal feed provided that it is acceptable and highly digestible.

4. Conclusion

It can be concluded that fermented pineapple waste can be fed to broiler chickens at up to 20% level with a promising good category of broiler carcass and abdominal fat, although IOFCC was more higher.

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