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UTILIZATION OF VARIOUS AGRICULTURAL WASTES FOR CHICKEN MEAT PRODUCTION

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ABSTRACT

The relative responses which include body weight gain, feed consumption, feed conversion ratio and carcass yield of broilers fed with rations containing certain amounts of agricultural wastes were compared with those consuming the basal rations formulated using conventional feed ingredients. Growth, efficiency of feed utilization and meat production of the birds were satisfactory when appropriate levels of the wastes were included in the experimental rations.

Mixture of palm kernel cake and tapioca solid waste (1:10 weight ratio) of up to 15% could substitute 26.9% yellow corn and 9.5% roasted soybeans used in the basal ration. Rubber seed meal (19%), sheep ruminal content (5%), sundried layer manure (205), sundried broiler manure (15%), heated ground saga bean (5%), saga bean oil as supplement (5%) or as substitute (2%) were found applicable for ration formulation without any detrimental effect appearing in the experimental birds.

INTRODUCTION

It was estimated in 1979 that more than 40% of the agricultural and agroindustrial wastes in Java (Indonesia) were dispossed of or wasted due to the lack of knowledge and information on the possible utilization of such wastes (Siagian **et al.**, 1981). Since then, efforts were attempted to disclose the possibility in utilising the waste, especially for animal feeding (Karossi, 1983). In this communication, results of some investigation on the utilization of various agroindustrial and animal wastes for deeding to broilers are reported. The extracted oil from an non-conventional grain known as saga bean (**Adenanthera pavonina** Linn) which has high potential for animal feeding was also tested in addition to investigation on the whole beans.

MATERIALS AND METHODS

The non-conventional feedstuffs tested in this investigation comprised three groups, namely agroindustrial wastes, animal/abbatoir wastes and saga beans. The agroindustrial wastes included palm kernel cake (PKC), tapioca solid waste (TSW) and rubber seed meal (RSM) whereas the animal wastes were sheep ruminal content (SRC), cattle ruminal content (CRC), sundried layer manure (SLM) and sundried broiler manure (SBM). Ground whole saga bean (GSB), heat treated (15 minutes, 100°C) ground saga bean (HGSB) and saga bean oil obtained by hexane extraction were also tested. These were used either as supplemental or substitutional energy source of the experimental rations.

Prior to the ration formulations, the chemical compositions of the wastes were determined (AOAC, 1975) and the results are shown in Table 1. Based on these compositions appropriate rations were then prepared. The experimental rations contained one or a mixture of two wastes to substitute one or two conventional feed ingredients used in the basal rations. Three to four levels of incorporation were examined (Karossi and Subijatno, 1983., Karrossi *et al.*, 1983, Karossi, 1983). Experimental birds used was either Hubbard or AA CP707 strains and they were offered the experimental rations and water *ad libitum* during the period of investigation.

The body weight gain and feed consumption were recorded to determine the feed conversion ratio. Carcass yield was also estimated to obtain the meat production. All these data were then compared accordingly to the results from the control groups and expressed as relative response. Hence relative response (%) is equal to:

$$\frac{\text{Performance of birds consuming experimental ration}}{\text{Performance of birds consuming respective control ration}} \times 100\%$$

TABLE 1
CHEMICAL COMPOSITION OF AGRO-INDUSTRIAL AND ANIMAL WASTES AND SAGA BEANS UTILIZED AS FEED INGREDIENTS FOR BOILERS

Waste Materials	Moisture (%)	Ether Extract (%)	Ash (%)	Crude Fiber (%)	Crude Protein (%)	Ca (%)	P (%)
Tapioca Solid Waste	10.56	0.45	1.30	12.60	2.10	0.22	0.03
Palm Kernel Cake	11.60	6.10	3.68	6.50	13.30	0.02	0.68
Rubber Seed Meal	9.51	11.97	6.32	20.43	34.12	0.075	0.84
Kapok Seed (Hurustiati, 1982)	11.7	6.98	7.27	20.50	29.60	0.43	1.00
Sheep Ruminal Content	8.28	3.59	16.37	24.38	14.41	0.52	1.08
Cattle Ruminal Content	14.63	1.53	18.12	30.84	7.11	0.34	0.44
Fodder Yeast	6.76	0.70	8.42	0.09	40.77	0.31	0.02
Sundried Layer Manure-	6.07	2.00	26.05	9.62	23.32	5.67	1.60
Sundried Broiler Manure	9.63	1.64	16.50	15.90	32.17	3.38	2.19
Dried Poultry Waste (Djamin, 1978)	7.36	2.13	26.90	13.72	24.21	7.78	2.56
Ground Saga Bean	9.39	11.85	3.51	10.98	16.28	0.535	0.19
Heat Treated Ground Saga Bean	4.82	12.14	3.86	12.73	16.66	0.614	0.20

RESULTS AND DISCUSSION

Utilization of agroindustrial wastes

According to the chemical compositions of the wastes (Table 1), the mixture of palm kernel cake (PKC) and tapioca solid waste (TSW) are expected to be able to substitute a portion of the yellow corn and the roasted soybean, whereas rubber seed meal was set to replace the soybean meal partially. Hurustiati (1982) reported that kapok seed could be used to replace a certain portion of coconut meal used in the basal ration.

The results of the present investigation (Table 2) show that the mixture of PKC and TSW (1:10 weight ratio) could be used up to 15% to replace yellow corn and roasted soybean of the basal ration since the performance of the birds consuming the tested rations was still comparable to the control birds (95% relative response on body weight gain) although the relative feed consumption (102%) and feed conversion (109%) were

TABLE 2
UTILIZATION OF AGROINDUSTRIAL WASTE IN BROLIER RATIONS

Ingredient of waste material origin	Level of inclusion (%) in ration	Strain of experimental birds	Relative response (%) compared to control			
			Body weight gain	Feed consumption	Feed Conversion Ratio	Carcass yield
Mixture of palm kernel cake (PKC) 10 parts and tapioca solid waste (TSW) 1 part	10	Hubbard	87	100	113	98
	15		87	98	113	100
	20		80	99	122	97
	30		72	104	143	98
Mixture of PKC (1 part) and TSW (1 part)	10	Hubbard	95	102	108	97
	15		92	100	108	98
	20		85	98	113	94
	30		77	94	122	91
Mixture of PKG (1 part) and TSW (10 parts)	10	Hubbard	92	100	108	101
	15		95	102	109	100
	20		90	99	109	100
	30		82	102	122	96
Rubber Seed Meal	9.5	AA CP-707	95	98	103	not
	19		95	94	99	determined
	28.5		59	79	134	
Kapok Seed (Hurustiati, 1982)	5	AA CP-707	98	102	103	100
	10		96	98	98	95
	15		98	100	100	98

slightly less economical. Utilization of this mixture at this rate corresponded with the replacement of 26.9% yellow corn and 9.5% roasted soybean compounded in the control ration (Table 3). Rubber seed meal (RSM) of up to 19% could replace soybean meal giving relative response compared to the control of 95% on body weight gain, 94% on feed consumption and also on feed conversion ratio. However, Buvanendran and Siriwerdene (1970) were able to use 20% of RSM and observed a better weight gain on their experimental birds. This might have been due to the fact that in their experiment coconut meal was used instead of soybean meal and that the protein quality of the former is inferior to the latter. The negative deviation on the performance of the experimental birds when higher level of RSM was incorporated in the dietary ration was probably due to insufficient supply of methionine and high level of crude fibre present as well as the present of residual anti-nutritional factors such as cyanide. Toh and Chia (1977) however suggested that the cyanide could be removed by mechanical extraction at 160°C or by long period of shortage of the meal. These results are comparable to those

of Hurustiati (1982) who found that incorporation of up to 15% of kapok seed resulted in a feed conversion ratio of 100% and feed consumption of 100% to the control group although a slightly less weight gain (98%) and carcass yield (98%). A higher incorporation of the seed had detrimental effects which may be associated with the presence of excessive gossypol (cyclopropenoid).

TABLE 3
PERCENTAGE OF REDUCTION (–) OR ADDITION (+) OF CONVENTIONAL FEEDSTUFFS (CORN AND ROASTED SOYBEAN) RESULTED FROM UTILIZATION OF TAPIOCA SOLID WASTE (TSW) – PALM KERNEL CAKE (PKC) MIXTURES FOR BROILER FEEDING

Experimental Ration	Corn	Roasted Soybean
Control	0	0
TSW : PKG (1:10)		
10%	–28.5	+ 8.0
15%	–42.8	+ 12.1
20%	–57.0	+ 26.1
30%	–85.5	+ 24.1
TSW : PKG (1:1)		
10%	–23.2	+ 0.9
15%	–34.8	+ 1.3
20%	–46.4	+ 1.7
30%	–69.9	+ 2.6
TSW : PKG (10:1)		
10%	–17.9	– 6.3
15%	–26.9	– 9.5
20%	–34.7	–12.6
30%	–53.7	–19.0

Utilization of animal wastes

The use of sheep ruminal content (SRC) and cattle ruminal content (CRC) and supplementation with fodder yeast (6%) to replace some of the conventional feedstuffs such as soybean meal, corn and fish meal were also studied. It was hoped that sun-dried layer manure and broiler manure could be incorporated to reduce the use of fish meal or coconut meal.

The results of the present investigation are shown in Table 4. It was found that SRC could only be used up to 5% to yield body weight gain (97%) close to control. Supplementation with fodder yeast (6%) did not improve the performance. However, incorporation of fodder yeast only will give a comparable feed consumption (103%) or conversion ratio (100%). When CRC at a level of 5% was used with or without supplementation of fodder yeast (6%), inferior body weight gain (91%) and feed conversion ratio (106) were observed.

TABLE 4
UTILIZATION OF ANIMAL WASTES IN BROILER RATIONS

Ingredient of waste material origin	Level of inclusion (%) in ration	Strain of experimental birds	Relative response (%) compared to control			
			Body weight gain	Feed consumption	Feed Conversion Ratio	Carcass yield
Sheep Ruminal Content (SRC)	5	AA CP-707	97	99	101	not determined
	10		91	101	109	
	15		87	96	110	
SRC supplemented with 6% Fodder Yeast (FY)	5	AA CP-707	97	101	102	not determined
	10		89	99	110	
	15		80	95	117	
	FY		102	103	100	
Cattle Ruminal with 6% FY	5	AA CP-707	91	97	106	not determined
	10		88	95	107	
	15		83	94	114	
	FY		98	99	100	
Sundried layer manure	5	Hubbard	117	117	100	98
	10		120	117	100	100
	15		120	117	96	98
	20		118	119	100	98
Sundried broiler manure	5	Hubbard	102	100	96	100
	10		96	101	104	102
	15		99	101	100	99
	20		99	104	104	100
Dried Poultry (Broiler) Waste (Djamin, 1978)	5	Indian River (male)	131	122	93	105
	7.5		123	115	93	104
	10		125	108	87	104

Thus the results indicate that SRC is more utilizable than CRC when given to broiler. This might be due to the favourable chemical composition of the former compared to the latter (Table 1). However Emmanuel (1978) suggested that SRC could be used up to 10%. His result showed a better feed conversion ration when prior immediate heat treatment (100°C in a force draught oven) of the sheep ruminal content was exercised.

The ration containing sun-dried layer manure (SLM) is superior to sun-dired broiler manure (SBM) in promoting the growth of the experimental birds. Inclusion of 20% SLM gave heavier body weight gain (118%), same feed conversion ratio (100%) and comparable carcass yield (98%) as compared with the control group. For the SBM, an inclusion of up to 15% was able to give comparable performance. This might have been associated with the higher crude fibre content of SBM and probably also with the difference in the protein quality of the manures despite the higher quantity of protein present in the SBM (Scott *et al.*, 1976). In connection with the pattern of the poultry management in the country where broilers are raised in a litter system while layer being raised in an individual cage, it is then more favourable to utilize the layer manure since its collection is easier and continously available during the year.

Djamin reported (1978) the utilization of dried poultry (broiler) waste in an attempt to replace soybean and coconut meal partially. He found that inclusion of up to 10% resulted in better weight gain (125%), more efficient conversion of feed (87%) and heavier carcass (104%) as compared to the control group.

Utilization of saga bean

Heat treated (15 minutes, 100°C) ground saga bean or the untreated one is expected to be able to partially replace the yellow corn and soybean meal which are usually used in feed formulation. Similarly, saga bean oil obtained by extraction with n-hexane should be may be used for supplementing or substituting the conventional energy sources of a ration.

The results of the present experiments (Table 5) show that inclusion of 5% ground raw saga bean resulted in slightly lighter body weight gain (96%) and also slightly inefficient conversion of feed (104%) compared to the control group. However, heat treatment of the bean improved its nutritional quality since higher amounts could be incorporated (10%-20%). This in turn resulted in improved utilization as compsred with the group fed raw saga bean, although it was still not as good as the ground consuming the control ration.

From nutritional point of view, the determinal effects observed might have been due to insufficient supply of sulphur containing amino acid (Oey *et al.*, 1981) as well as threonine (Muchtadi, 1983) by th beans. Antinutritional substances had been identified to be present in the bean. Muchtadi (1983) observed the presence of antitrypsin and

TABLE 5
UTILIZATION OF SAGA BEAN (ADENANTHERA PAVONINA LINN) IN BROILER RATIONS

Ingredient	Level of inclusion (%) in ration	Strain of experimental birds	Relative response (%) compared to control			
			Body weight gain	Feed consumption	Feed Conversion Ratio	Carcass yield
Ground saga bean	5	AA CP-707	96	101	104	not available
	10		79	94	119	
	15		55	77	138	
	20		34	57	168	
Heat treated ground saga bean	5	AA CP-707	96	97	100	not available
	10		90	97	107	
	15		87	99	113	
	20		79	97	122	
Saga bean oil as supplement	2	Hubbard	98	98	100	100
	4		98	98	103	101
	5		99	98	100	98
Saga bean oil as substitute	2	Hubbard	100	101	104	97
	4		95	97	101	97
	5		87	95	108	95

antichymotrypsin activities in the bean and found a higher content of both antiproteolytic as compared to the amount present in soybean. When saga bean oil was used as energy supplement, as much as 5% of the oil could be incorporated giving comparable carcass yield, body weight gain and feed consumption, hence comparable feed conversion ratio, as compared to the control group. However, when saga bean was used as substitute for energy source, inclusion of no more than 2% gave comparable results to the control. If the level is increased to 5%, lighter body weight gain (87%) and less feed consumption (95%) are observed. In addition, an inefficient feed utilization (108%) and lower carcass (95%) yield resulted. These effects could be due to the protein-energy ratio of the dietary rations.

CONCLUSIONS

Replacements of conventional raw materials usually used in broiler ratin formulation with inconventional raw materials in appropriate levels, such as 15% mixture of palm kernel cake-tapioca solid waste (1:10), 19% rubber seed meal, 15% kapok seed meal, 5% ruminal content, 6% fodder yeast, 20% sundried layer manure, 15% sundried broiler manure, 10% dried poultry (broliler) waste, 5% heat treated ground saga bean, 5% saga bean oil as energy supplement or 2% saga bean oil as energy substitute, could result in comparable performance to as shown by the respective control group.

It was also shown that pretreatment, either physical (such as heat treatment) or possibly chemical and biological treatment of the raw material may improve the utilization by the animal. In conclusion, increase in broiler population and their productivities could be achieved by utilizing certain waste materials through proper feed formulation.

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