**A COMPARATIVE EVALUATION OF LEAF MEALS OF PAWPAW (*C. Papaya*),
SWORDBEAN (*C. gladiata*), JACKBEAN (*C. ensiformis*) AND PIGEONPEA (*C. cajan*)
AS FEED INGREDIENTS AND YOLK COLOURING AGENTS IN LAYERS' DIETS**

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ABSTRACT

Leaf meals of the above-named tropical plants at 0.2, 3, 4 and 5% dietary levels were investigated for their values as feed ingredients and egg yolk pigments in white maize based layer diets. Each diet was fed as 5 replicates of 15 hyaline layers for 14 weeks. Pawpaw leaf meal (P<M) at 4% and 5% dietary levels significantly ($P<0.05$) depressed feed intake without affecting egg production and body weights. It, however, had no colouring affecting on egg yolk. Swordbean leaf meal (SBIM), jackbean leaf meal (JB<M) and pigeonpea leaf meal (PPLM) compared favourably with the control group in terms of feed intake, egg production and body weights. SBLM exceptionally improved egg yolk colour, scoring 4, 5, 8 and 12 on the Roche egg yolk colour fan at 2, 3, 4 and 5% dietary levels respectively. JBLM and PPLM only gave a score of 4 and 5% dietary level.

SBLM appears to be very high in biological available xanthophylls and should be considered for development as commercial egg yolk pigmenter.

Key words: Pawpaw leaf meal, Swordbean leaf meal, Jackbean leaf meal, Pigeon pea leaf meal.

INTRODUCTION

The most important factor in judgement of quality of eggs by consumers is the colour of the yolk. The colour of egg yolk varies from pale yellow to deep orange and this depends entirely on the pigment content of the layers feed. The most important sources of pigments in the feed of laying poultry are yellow maize, lucerne (alfalfa) and marigold extracts (Middendorff *et al.*, 1980). Lucerne, unfortunately does not thrive in Nigeria and most humid tropical countries and the recent ban on the importa-

tion of yellow maize by the Nigerian Government, has rendered the Nigerian poultry industry dependent on white maize. Glowtein, a marigold commercial extract, imported for egg yolk pigmentation in the country has become too expensive for profitable poultry farming. As a result most eggs sold in the market have white yolks.

Because of the importance attached to egg yolk pigmentation, a series of research has been done in the recent past in an effort to discover other natural sources of pigments, the xanthophylls. Among the materials already studied

are red pepper (Grandi *et al.*, 1978; Ogunmodede and Eyo, 1977), tomato pomace (Reddy, 1975), stylosanthes gracilis (Onwudike and Adegbola, 1977), alfalfa meals, bermuda meal and corn gluten meal (Ralph *et al.*, 1973). It is, however, important to stress that materials discovered to have potential as egg yolk pigments should also be readily and locally available for the discovery to have any commercial significance.

The study herein reported was the beginning of a series designed to categorize the leaf meals of the common tropical plants, particularly legumes, as feed ingredients and egg yolk colouring agents in layers' diets. Swordbean (*C. gladiata*), jackbean (*C. ensiformis*) and pawpaw (*C. papaya*) have been described by Pursegrove (1982), and pigeonpea (*C. cajan*) by Whiteman *et al.*, 1985).

Materials and Methods

Fresh green leaves of the plants were harvested from the University farm, where the plants were being multiplied. They were partially dried in the sun and

then overnight in the oven at 55 °C before milling. Cutting and processing of the leaves were done monthly as the previous stock was about to be exhausted. Respective samples of the leaf meals were composited and analyzed for proximate chemical composition (AOAC, 1980).

Rations based on white maize, groundnut cake, fish meal, wheat bran, dried brewers' grains and mineral/vitamin sources, were formulated to contain 0, 2, 3, 4 and 5% respectively of leaf meals. Ingredient composition of the rations are shown in Table 2.

Each diet was fed to five replicates of fifteen hyaline layers in their 5th month of laying life for 14 weeks. Feed intake, per cent hen-day egg production, body-weight changes, and egg weights were recorded. Samples of eggs from each replicate were collected weekly, broken and scored for yolk colour intensity using a Hoffman La Roche colour fan developed by Vuilleumier (1969). The birds were weighed at the beginning and at the end of the trials.

Table 1.

CHEMICAL COMPOSITION OF THE LEAF MEALS

	PLM	SBLM	JBLM	PPLM
Dry matter, %	18.20	21.42	21.56	22.18
g/100g DM.				
Crude protein	25.16	21.88	20.92	23.34
Crude fibre,	16.40	20.95	21.44	24.80
Ether extracts	8.90	3.65	3.32	4.86
Ash,	10.65	18.20	16.60	5.50
Ca	1.20	1.63	1.44	1.39
P	0.16	0.11	0.12	0.31
Mg	0.65	0.27	0.23	0.42
Gross energy (Kcal/g)	6.40	4.98	4.67	5.22

Table 2.

INGREDIENT COMPOSITION OF TREATMENT RATIONS*

<i>Ingredients (%)</i>	<i>Control</i>	<i>2%</i>	<i>3%</i>	<i>4%</i>	<i>5%</i>
White maize	50.00	50.00	50.00	50.00	50.00
Groundnut cake	20.00	19.00	18.50	18.00	17.50
Fishmeal (Local)	5.00	5.00	5.00	5.00	5.00
Leaf meal	0.00	2.00	3.00	4.00	5.00
Wheat bran	10.00	9.00	8.50	8.00	7.50
Dried brewers' grains	5.00	5.00	5.00	5.00	5.00
Bone meal	5.00	5.00	5.00	5.00	5.00
Limestone	4.50	4.50	4.50	4.50	4.50
Common Salt	0.25	0.25	0.25	0.25	0.25
VIT/TM Premix	0.25	0.25	0.25	0.25	0.25
TOTAL	100.00	100.00	100.00	100.00	100.00

* Analysed Crude protein of rations ranged from 16.92% for JBLM ration to 17.45% or PLM ration

Data were analyzed using analysis of variance as outlined by Snedecor and Cochran (1978). Where significant treatment difference were detected, means were compared using Least Significance Difference (LSD) as described by Snedecor and Cochran (1978).

RESULTS AND DISCUSSION

The nutrient compositions of the leaf meals are shown in Table 1. It was interesting that PLM analyzed higher than the other three leaf meals in most of the important nutrients. Its relatively high energy content must be attributed to its high fat content (8.90%).

Data on the performance of the treatment groups are shown in Table 3. There were no appreciable changes in the body weights of the layers at the end of the

trial period. Feed intakes, however, declined with increase in the levels of the PLM in the diets. Both 4% and 5% dietary inclusions of PLM significantly ($P < 0.05$) depressed feed intake. Interestingly, the depression in feed intake did not affect egg production.

Hence, efficiency of egg production (feed/dozen eggs) was highly improved by PLM at those 2 levels. There were no differences in egg weights but PLM had little or no effect on egg yolk colour, scoring 1 (one) even at 5% dietary level. SBLM, JBLM and PPLM compared very favourably with the control group in feed intake, egg production, egg weights and body weights. SBLM, however, proved very effective as egg yolk pigmenter even at 2% dietary level, scoring

Table 3.
EFFECT OF PLM, SBLM, JBLM and PPLM ON BODY WEIGHTS
FEED INTAKE, HEN-DAY EGG PRODUCTION AND YOLK COLOUR

	Leaf meal levels*				
	0%	2%	3%	4%	5%
PLM 82.4, 106, 64.8, 0		12.2, 105, 66.1, 0	41.8, 100, 65.6, 1	0.0, 85 ^a , 65.2, 1	20.6 86 ^a , 65.2, 1
SBLM 82.4, 106, 64.8, 0		31.4, 108, 65.6, 4	24.2, 108, 65.8, 5	50.4, 106, 65.9, 8	34.1, 110, 65.3, 12
JBLM 82.4, 106, 64.8, 0		40.5, 104, 65.7, 1	50.6, 106, 65.4, 2	33.4, 106, 65.4, 4	24.2, 108, 65.5, 4
PPLM 82.4, 106, 64.8, 0		13.4, 108, 67.1, 1	24.2, 1.0, 66.9, 2	0.0, 108, 67.1, 4	42.3, 108, 66.4, 4
S.e.	—	2.14, .3, .47,	1.32, .32, 10, —	1.20, .62, 0.34, —	1.41, .65, .22, —

* First, Second, third and fourth figures within treatment levels represent body weight changes (gm), feed intake (gm), hen-day egg production (%) and score on Roche Yolk Colour fan respectively.

^a Means along the same columns with any superscript are different ($P < .05$).

4, 5, 8 and 12 on the colour fan at 2, 3, 4 and 5% dietary levels respectively. JBLM and PPLM only gave scores of 1, 2, 4 and 5 at dietary levels of 2, 3, 4 and 5% respectively.

It was difficult to explain the performance of the layers on PLM rations but one may be right to speculate that it was the enzyme, papain, in PLM that was responsible. This speculation is based on reports that enzyme-treatment of feeds, particularly protein enzymes, increases availability of proteins and vitamins (Sreekantiah *et al.*, 1969) and some commercial preparations of proteinases under certain conditions do stimulate growth of a variety of young animals, including calves, pigs and chickens (Nelson and Catron, 1977) and fish (Dabrowski and Glogowski, 1977).

Unlike PLM, JBLM and PPLM, SBLM appeared to be very good for egg yolk pigmentation. It took only 2% dietary inclusion to give a score of 4, a score considered quite acceptable by consumers for table eggs. And it took only an increase to 5% to give a score of 12, a deep yellow colour considered very suitable for pastries industry. This has shown that SBLM is not just only high in carotenoids but that the carotenoids are readily extractable by the layers for yolk pigmentation. Perhaps, PLM JBLM and PPLM performed the way they did because of their low carotenoid contents and/or low bio-availability of their carotenoids. Unavailability of carotenoids in plant materials tested for egg yolk pigmentation may be due to their existence in esterified forms (Coon and Couch, 1976) a factor that affects the use of marigold meal as egg yolk pigmenter (Atolagbe *et al.*, 1986).

The need to add xanthophyll-containing feedstuffs in the diets of laying hens had earlier been emphasized (Janky

et al., 1982). However, the search for those naturally xanthophyll-containing feedstuffs should be directed to sources that do not attract competition for them between man and animals, or sources that require high levels of dietary inclusion to effect appreciable change in yolk colour. That is why the use of local pepper as suggested by Ogunmodede and Eyo (1977) is of little interest to poultry farmers. *Stylosanthes gracilis* improves yolk colour but it has to be added at high levels and this depresses layer performance (Onwudike and Adegbola, 1977).

In conclusion, it is recommended that in the absence of yellow maize and other sources of xanthophyll in layers' diet, 2% SBLM in the diet can suffice to produce eggs with yellow colour intensity acceptable to consumers as table eggs. For a deeper yolk colour intensity with a score of 8 and above on the Roche yolk colour fan suitable for the bakery and other industries favouring deeper yellow yolks, dietary levels of 4 to 5% SBLM are recommended. PLM has no value as egg yolk pigmenter but may be used to reduce cost of egg production at 4 - 5% dietary levels. JBLM and PPLM should further be investigated to determine their appropriate dietary levels required to effect such level of egg yolk colour intensity.

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