

LEUCAENA LEUCOCEPHALA SEEDMEAL IN THE DIETS OF LAYING HENS AND ITS EFFECT ON EGG YOLK PIGMENTATION

A.C. OKONKWO and D.A. ADIKPE

Department of Animal Science University of Maiduguri, P.M.B. 1069, Maiduguri Nigeria.

(Received 15 November 1988; accepted for publication 24 February 1989)

ABSTRACT

The performance of layers on various dietary levels of *Leucaena leucocephala* seedmeal (LSM) was investigated. One hundred and fifty Dutch Golden Line pullets in their third month of lay, were randomly allotted to five treatments, in which LSM was incorporated at levels of 0, 2, 4, 6 and 8%. The study lasted thirteen weeks: ten weeks on experimental and three weeks on basal diets. Egg yolk colour, average daily feed intake, percent egg production, egg weight, feed conversion ratio and liveweight gain were performance indices. Egg yolk colour was significantly ($P < 0.05$) enhanced by LSM (at all levels) over control. Layers on 2% and 4% LSM produced significantly ($P < 0.05$) more eggs than hens on 0, 6 and 8% LSM; the highest production was recorded by hens on 4% LSM. This trend was maintained even after treatment withdrawal. Eggs from pullets on 4% and 6% LSM were significantly ($P < 0.05$) heavier than eggs from the rest of the treatments. Although the difference between 4% and 6% was not significant the heaviest eggs were collected from birds on 4% LSM. Data collected in this study tend to recommend incorporation of LSM in layers' diets at levels not more than 4%.

Key Words: *Leucaena* seedmeal; layers diets; egg yolk; pigmentation.

INTRODUCTION

Escalating cost and unsteady availability of livestock feedstuffs in Nigeria have created the need to search for cheaper alternate sources, which are abundant all year round. *Leucaena leucocephala* (ipil-ipil), a legume which thrives throughout the year in the sub-sahelian region, promises to be one of such sources. It has been found to be useful as animal feed, firewood, ground cover, fertilizer and wind breaker (De Witt, 1961; Aziz, 1981; Kang *et al.*, 1985), in addition to its enormous potential in reafforestation and agroforestry (ILCA, 1986).

Leucaena, being a legume, is rich in

protein and other nutrients. Its seeds are high in crude protein, ranging from 32.6% for whole mature seeds to 45.2% for dehulled seeds (Adeneye, 1979). Information (Castillo, 1964; Springhall and Ross, 1965a, 1965b; Mateo *et al.*, 1970; Shiroma and Akashi, 1976; D'Mello and Taplinn 1978; Jones, 1979) showed that *Leucaena* leaves have been fed to livestock with some degree of success. However, its use at high dietary levels from 40% upwards, has been limited by a toxic amino acid named mimosine present in its leaves, stems and seeds (Librojo and Hatchcock, 1974; Glasby, 1975). While some animals are susceptible to the toxic effects of mimosine (Hegarty *et*

al., 1964; Jones *et al.*, 1976; Blood *et al.*, 1979; Liener, 1980), poultry has been reported to develop a high level of tolerance for this amino acid (Springhall and Ross, 1965a, 1965b; D'Mello and Taplin, 1978).

Apart from the early work of Bice (1942, 1943) and later that, of McDowell (1972) no other investigation is known to evaluate *Leucaena* seedmeal as a poultry feed ingredient. It is a legume that is quite abundant in Nigeria, especially in the sub-sahelian zone. The study reported here was designed to evaluate *Leucaena leucocephala* seedmeal as an ingredient in layers' diets by testing its effects at various dietary levels on egg production, egg weight, yolk pigmentation, average daily feed intake, feed conversion efficiency and liveweight gain.

MATERIALS AND METHOD

One hundred and fifty Dutch Golden Line pullets in their third month of egg production were weighed individually and randomly distributed among five dietary treatments. Each treatment consisted of 30 pullets, which were further subdivided into three replicates of 10 each; the pullets were paired in 75 cages. *Leucaena leucocephala* seedmeal was incorporated at levels of 0, 2, 4, 6 and 8% in the diets; the 0% was the normal layers' mash, which served as the control.

After adjusting the birds to the experimental diets for 4 days, the feeding trial ran for 70 days (Phase One), followed by a period of 21 days, during which the treated diets were replaced with regular layers' mash (Phase Two). The experimental diets were withdrawn in order to determine the period of time during which the seedmeal would continue to assert its effects on the parameters under investigation.

Feed and drinking water were provided to the hens *ad libitum*. Parameters studied were egg production, egg weight, yolk pig-

mentation, daily weight gain, feed intake and feed conversion efficiency. Determination of egg yolk colour was by the Roche Fan Score method (Vuilleumier, 1969). All data collected were subjected to a one-way analysis of variance; means were separated and compared using the F-test level of significance and Fishers' least significant test (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

Chemical analysis of the *Leucaena* seedmeal (LSM) used in this study showed that it contained 92.4% dry matter, 34.2% crude protein, 4.5% ether extract, 34.2% crude fibre, 3.8% ash, 0.21% calcium, and 0.43% phosphorus. The value for dry matter was higher, while the ash value was lower than the values reported by Adeneye (1979) for *Leucaena* samples obtained from various areas of Western Nigeria. Soil and climatic conditions, and perhaps, processing methods may have been responsible for these differences. Values for the rest of the components (except Ca and P whose values were not reported) however compare favourably with those of Adeneye (1979).

Results obtained in phases 1 and 2 of this study are summarized in tables 1 and 2 respectively. Egg yolks from birds on LSM diets gave significantly ($P < 0.05$) higher RFS values than those from birds on control diet. LSM at 4, 6 and 8% levels was significantly ($P < 0.05$) stronger and pigmented than at the 2% level. Differences between these parameters for birds on 4, 6 and 8% LSM were not significant.

During the second phase of the investigation, egg yolks from hens previously on LSM-treated diets lost colour rapidly with the exception of those on 8%, while yolks from the control diet, maintained a steady RFS value. Although yolks from LSM-treated groups lost pigmentation rapidly, their RFS values were nevertheless significantly ($P < .05$) greater

Table 1
Effects of Leucaena seedmeal (LSM) on egg yolk colour (RFS), average daily feed intake (ADFI), per cent egg production, egg weight, feed conversion ratio (FCR), and body weight gain (Phase one)

	BD ¹	2% LSM	4% LSM	6% LSM	8% LSM
RFS ² (abs. units)	4.8 ^a ± 0.19	6.7 ^a ± 0.19	8.5 ^c ± 0.20	8.5 ^c ± 0.20	8.6 ^c ± 0.20
ADFI (g/dy/bird)	112.1 ± 0.61	112.7 ± 0.70	114.0 ± 0.61	110.4 ± 0.64	110.5 ± 0.79
% egg prod.	60.4 ^a ± 1.87	65.6 ^b ± 2.20	66.9 ^b ± 2.80	59.8 ^a ± 1.70	60.1 ^a ± 1.68
Average egg wt. (g)	59.1 ^a ± 0.57	59.7 ^a ± 0.53	64.8 ^b ± 0.69	62.6 ^b ± 0.68	59.2 ^a ± 0.54
FCR	0.54 ± 0.36	0.54 ± 0.34	0.54 ± 0.36	0.54 ± 0.34	0.53 ± 0.30
Body wt. gain (% wt. loss)	2.2 ^a ± 0.08	5.4 ^b ± 0.13	5.6 ^b ± 0.18	5.9 ^b ± 0.18	6.1 ^b ± 0.19

1. Basal diet

2. Roche Fan Score

± Standard error of mean

a,b,c, Means in the same row bearing different superscripts are different (P < 0.05).

Table 2
Effects of Leucaena seedmeal (LSM) on egg yolk colour (RFS), average daily feed intake (ADFI), per cent egg production, egg weight, feed conversion ratio (FCR), and body weight gain (Phase two)

	BD ¹	2% LSM	4% LSM	6% LSM	8% LSM
RFS ¹ (abs. units)	4.4 ^a ± 0.47	5.7 ^b ± 0.46	5.9 ^b ± 0.47	5.8 ^b ± 0.49	7.0 ^c ± 0.47
ADFI (g/dy/bird)	112.5 ^a ± 5.03	104.1 ^b ± 3.99	108.6 ^b ± 3.83	106.2 ^b ± 4.77	103.6 ^b ± 3.65
% egg prod.	61.4 ^a ± 3.20	60.2 ^a ± 3.24	64.7 ^b ± 3.43	60.3 ^a ± 3.26	59.8 ^a ± 3.22
Average egg wt. (g)	59.8 ± 1.61	58.4 ± 1.93	60.3 ± 1.85	59.5 ± 1.65	58.6 ± 1.94
FCR	0.54 ± 0.32	0.56 ± 0.48	0.578 ± 0.40	0.54 ± 0.43	0.55 ± 0.38
Body wt. gain (% wt. loss)	1.0 ^a ± 0.04	1.2 ^a ± 0.04	1.2 ^a ± 0.05	1.9 ^b ± 0.07	1.9 ^b ± 0.07

1. Basal diet

2. Roche Fan Score

± Standard error of mean

a,b,c, Means in the same row bearing different superscripts are different (P < 0.05).

than control value, while the 8% LSM diet produced yolks with significantly ($P < .05$) higher RFS value than Birds on 2, 4 and 6% LSM diets.

Average daily feed intake (ADFI) generally increased with time in the first phase. Although treatment effects were not significant hens on 4% LSM consumed slightly more feed than those on the rest of the treatments. It seems that the LSM did not greatly affect the acceptability of the diets. Upon withdrawal of LSM, birds on control consumed significantly ($P < 0.05$) more feed than those previously on LSM diets, and although there were no significant differences between ADFI of birds previously on LSM-treated diets, 4% LSM induced a higher feed consumption than the rest.

Total egg production data are presented as mean percent egg production. Since the pullets were in their third month of lay, egg output was slightly low at the start of the experiment. Production, however, increased rapidly for all the treatments as the study progressed; and egg output by birds on all the treatments peaked variously between the 6th and 9th weeks. In phase one, 2 and 4% LSM significantly ($P < 0.05$) increased mean percent egg production over 0, 6 and 8% LSM. In fact, 4% LSM with $66.9 \pm 2.80\%$ induced significantly ($P < 0.05$) the highest percent production, while 6 and 8% held egg output to control level (59.8 ± 1.7 ; 60.1 ± 1.68 ; and $60.4 \pm 1.87\%$ respectively). Withdrawal of LSM in phase two caused a general decline in percent production, except for the control which, as would be expected, maintained a steady output ($60.4 \pm 1.87\%$ for phase one and $61.4 \pm 3.30\%$ for phase two). Hens previously placed on 4% LSM produced significantly ($P < 0.05$) more eggs than those on the rest of the treatments; percent egg

production of hens previously on 2, 6 and 8% LSM did not differ significantly from control and did not show any residual treatment effects. Therefore LSM withdrawal did not depress egg production below control levels.

Mean egg weights increased in all the treatments as the birds got older. Pullets on 4 and 6% LSM produced significantly ($P < .05$) heavier egg (64.8 ± 0.69 and 62.6 ± 0.68 g respectively) than those on 0, 2 and 8% LSM (59.1 ± 0.57 , 59.7 ± 0.53 and 59.2 ± 0.54 g respectively).

Although there was no significant difference in egg weights of birds on 4 and 6% LSM, 4% LSM produced the heaviest egg weight (64.8 ± 0.69 g). Further increase in LSM concentration beyond 4% seemed to cause a decline in egg weight. In the second phase, mean egg weights did not show any significant treatment effects. Again, egg weights of birds on the control were steady and birds on all the other treatments gave egg weights which were similar to control. For example birds on 4% LSM recorded the highest egg weight value of 60.3 ± 1.85 g, which suggests that LSM at this level still exerted its effect on egg weights even 21 days after withdrawal. With respect to feed conversion ratio (FCR), treatment effects for both phases of the experiment were not significant.

Data for changes in liveweight were computed and presented as percent weight loss, since all the hens lost weight, throughout the entire period. At the end of the first phase, it was observed that birds placed on all the LSM diets registered significantly ($P < .05$) higher percent weight loss than those on 0% LSM; but there were no significant differences between percent weight loss values of birds on 2, 4, 6 and 8% LSM diets. Upon withdrawal of treatments, all the hens includ-

ing control still lost weight. Birds on 6 and 8% LSM had significantly ($P < .05$) higher percent weight loss than those on 0, 2 and 4% LSM. This weight loss observed across all treatments, could probably be due to the high mean ambient temperatures, which peaked at 37°C, in the poultry house at this period, and to diversion of dietary energy to egg production.

There was a total mortality of 6.25% recorded. Of this, 2% LSM accounted for 2.5%, while 0, 6 and 8% LSM accounted for the rest. There was no mortality among the hens on the 4% LSM. A mortality of 2.5% occurred during the first phase and was recorded among the hens on control and 2% LSM diets. Since mortality was also recorded for the control group, post mortem results could not be ascribed to mimosine toxicity since there were no clinical signs observed in any bird on LSM diets. It should also be borne in mind that high mimosine tolerance by the fowl had earlier been demonstrated (Springhall and Ross, 1965a, 1965b) with much higher levels of dietary *Leucaena* leafmeal.

CONCLUSION

Chemical analysis showed that *Leucaena leucocephala* seedmeal is rich in crude protein (34.2%), and has an ability to enhance egg yolk colour. It is therefore a potential poultry feed ingredient. Results suggested that egg yolk colour was greatly enhanced by incorporating *Leucaena* seedmeal at levels not more than 4% in the diets of layers.

REFERENCES

ADBENEYE, J.A. (1979) A note on the nutrient and mineral composition of *Leucaena leucocephala* in Western Nigeria. *Anim. Feed Sci. and Technol.* 4: 221-225.

- AZIZ, M. (1979). Tree of plenty — *Leucaena* in the Philippines. IDRC Reports (Canada). 8: 16-17.
- BICE, C.M. (1942). Emergency poultry rations, *Hawaii Agric. Exp. Sta. Rept.* 34.
- BICE, C.M. (1943). Kao haole seedmeal. *Hawaii Agric. Exp. Sta. Rept.* 36.
- BLOOD, D.C., Henderson, J.A. and Radiostitis, O.M. (1979). Trees and shrubs. In: *Veterinary Medicine*. 5th ed. p. 1018, Cassel Ltd; London.
- CASTILLO, L.S. (1964) *Leucaena glauca* benth for poultry and livestock. *Philipp. Agric.* 47: 393-411.
- DE WITT, H. (1961) typification and correct names of *Acacia villosa* Wild and *Leucaena glauca* (L.) Benth, *Taxon.* 10: 50-54.
- D'MELLO, J.P.F. and TAPLIN, D.E. (1978). *Leucaena leucocephala* in poultry diets for the tropics *Wld. Rev. Anim. Prod.* 14: 3-47.
- GLASBY, J. (1975). Encyclopaedia of the Alkaloids I: 189; II: 966. Plenum Press. New York and London.
- HEGARTY, M.P., SCKIMKEI, P.C. and COURT, R.D. (1964) Reaction of sheep to the consumption of *glauca* benth. and its toxic principle, mimosine. *Aust. J. Agric. Res.* 15: 153-167.
- INTERNATIONAL LIVESTOCK CENTRE FOR AFRICA (ILCA) NEWSLETTER. (1986). *Leucaena*: An end to toxicity in ruminants? 5: 1-8.
- JONES, R.J., BLUNT, C.C. and HOLMES, J.H.P. (1976) Enlarged thyroid glands in cattle grazing *leucaena* pastures. *Trop. Grassland.* 10: 113-116.
- JONES, R.J. (1979). The value of *Leucaena leucocephala* as a feed for ruminants in the tropics. *Wld. Amin. Rev.* 31: 13-23.
- KAGN, B.T., GRIMME, H. and LAWSON, T.L. (1985). Alley cropping sequentially cropped maize and cowpea with *Leucaena* on sandy soil in Southern Nigeria. *Plant and Soil.* 85: 267-269.
- LIBROJO, N.T. and HATCHCOCK, J.N. (1974). Metabolism of mimosine and other compounds from *Leucaena leucocephala* by these chicken. *Nutr. Rept. Int.* 9: 217-222.
- LIENER, I.E. (1980). Mimosine In: *toxic constituents of plant Foodstuffs*. 2nd ed. pp. 437-438.

- MATEO, J.P., LABADAN, M.M., ABILAYI, T.A. and ALANDY, R. (1970). Study of paired feeding using high levels of ipil-ipil leafmeal. *Philipp. Agric.* 54: 312-318.
- McDOWELL, R.E. (1972). Tropical Rations. In: *Improvement of Livestock production in warm climates*. pp. 252-255. W.H. Freeman and Co., San Francisco.
- OLUYEMI, J.A. and ROBERTS, F.A. (1982). Management of adult bird. In: *poultry production in warm wet climates* pp 158-160. (MacMillan tropical agriculture, horticulture and applied ecology series).
- SHIROMA, S. and AKASHI, A. (1976). Degradation of mimosine in *Leucaena leucocephala* by goat rumen microorganisms. *Japanese. J. Zootech. Sci.* 47: 739-747 (Eng. Abstr.).
- SNEDECOR, G.W. and COCHRAN, W.G. (1967). *Statistical Methods*. The Iowa State Univ. Press, Ames, Iowa.
- SPRINGHALL, J.A. and ROSS, E. (1965a). Preliminary studies with poultry rations for the Territory of Papua, New Guinea. 1. Grower rations with copra, sago and *Leucaena leucocephala*. *Papua New Guin. Agric. J.* 17: 117-121.
- SPRINGHALL, J.A. and ROSS, E. (1965b). Preliminary studies with poultry rations for the Territory of Papua, New Guinea. 2. Layer rations with copra, sago and *Leucaena leucocephala*. *Papua New Guin. Agric. J.* 17:122-126.
- VULLIEUMIER, J.P. (1969). The "Roche Yolk Colour Fan" An instrument for measuring yolk colour, *Poult. Sci.* 48: 767-779.