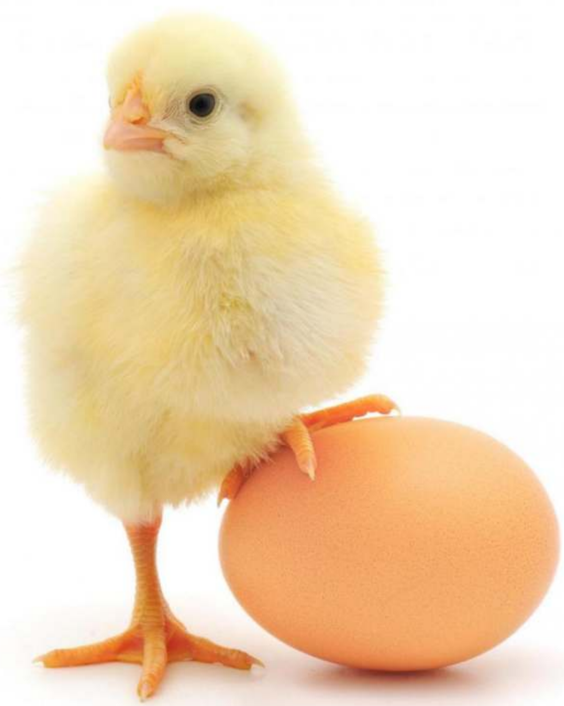
ISSN 1682-8356
ansinet.org/ijps



INTERNATIONAL JOURNAL OF POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 9 (5): 450-454, 2010
ISSN 1682-8356

Effect of Westwood (*Cirina forda*) Larva Meal on the Laying Performance and Egg Characteristics of Laying Hen in a Tropical Environment

O.A. Amao, I.O. Oladunjoye, V.A. Togun, K. Olubajo and O. Oyaniyi
Department of Animal Production and Health, Ladoke Akintola University of Technology,
P.M.B. 4000, Ogbomoso, Oyo State, Nigeria

Abstract: Two hundred and fifty Isa-Brown point of lay chicken of 30 weeks of age were used to determine the effect of substituting westwood (*Cirina forda*) larva meal (WWLM) for fish meal which is the most expensive feed ingredient in layer diet on laying performance of chicken. The birds were fed five diets in which WWLM replaced 0, 25, 50, 75 and 100% fish meal. Data collected were feed intake, weight change, egg production, feed efficiency and egg quality characteristics Data were analyzed using one-way analysis of variance. Proximate analysis showed that WWLM contained higher crude protein, crude fibre, ether extract, dry matter and ash than fish meal. Feed intake and weight gain were not significantly ($p<0.05$) affected by diets. Hen day production of birds fed 0% WWLM (77.86%), 25% WWLM (78.32%), 50% WWLM (77.82%) and 75% WWLM (77.37%) were similar but higher ($p<0.05$) than that of those fed 100% WWLM (73.39%). Birds fed 0, 25, 50 and 75% WWLM were also comparable in terms of egg weight and efficiency of feed utilization while those fed 100%WWLM were inferior with respect to these parameters. Egg shell thickness, yolk colour and Haugh unit were not significantly different among treatments. It was concluded that WWLM can replace up to 75% fish meal in the diet of laying chicken.

Key words: Westwood larva meal, fish meal, performance, egg quality, laying hen

INTRODUCTION

Feed shortage in Nigeria has continued to force poultry farmers to seek for alternative feed ingredients in order to alleviate the problem of high cost of conventional feed ingredients such as maize, groundnut cake, soybean cake and fish meal. Fish meal is a high quality animal protein source, which is getting more expensive due to increased demand resulting from expansion in livestock industry. Its ever-increasing price necessitates a search for non-conventional animal protein sources that can replace it. Many insects used as food in Africa are those that can be collected in large number, such as locusts, emerging termites and caterpillars. Westwood (*Cirina forda*) larva is another popular edible insect in many parts of Western Nigeria. This insect serves as a source of protein in the diets of many rural Africans (Ande, 2003; Fasoranti and Ajiboye, 1993).

Westwood is an edible insect, which belongs to the class *insecta*, order *Lepidoptera* and family *Sarturnidae*. It is the only member of the genus *Cirina* in African. Westwood larvae can be collected from the sheabutter tree (*Vittellaria paradoxa*) an economically important tree in the savanna belt and which belongs to the family *sapotacea*.

The nutritional value of westwood larva has been well documented (Ande, 2003). It is rich in crude protein ranging between 46.5 and 79.6% (Malaisse and Parent, 1980). Both larvae and prepuae of westwood are capable of meeting the mineral requirements of man (Ande, 2003; Swaminathan, 1986). However, larvae would be a better source of macronutrients, while the latter provides a better retinue of trace elements (Ande, 2003). It has nevertheless been cautioned that prepupae may not be good for hypertensive patients due to its significantly higher Na content (Ande, 2003). Westwood larva has also proved to be a better source of Ca. P and Mg, when compared with other food insects and some popular sources of mineral nutrients. Trace elements such as Cu, Zn and Mn also occur in relatively higher quantities in Westwood larva (Ande, 2003). Despite these virtues of westwood larva in terms of food value, existing works in poultry production seem to have neglected its possible use in compound feeds. In this work, an attempt was made to determine the effect of replacing fish meal with westwood larva meal on the performance and egg qualities of laying hens.

MATERIALS AND METHODS

Site of experiment: The experiment was conducted at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

Preparation of Westwood Larva Meal (WWLM): Westwood larva which was the test ingredients was obtained from open local markets. The insects were oven dried to 13% moisture content to extend the shelf life.

Corresponding Author: I.O. Oladunjoye, Department of Animal Production and Health, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Oyo State, Nigeria

Table 1: Gross composition of the experimental diets (%)

	0% WWLM	25% WWLM	50% WWLM	75% WWLM	100% WWLM
Ingredients	(A) (control)	(B)	(C)	(D)	(E)
Maize	40.00	40.00	40.00	40.00	40.00
Groundnut cake	3.00	3.00	3.00	3.00	3.00
Soy bean meal	3.00	3.00	3.00	3.00	3.00
Palm kernel cake	10.90	10.90	10.90	10.90	10.90
Fish meal	4.00	3.00	2.00	1.00	0.00
WWLM	0.00	1.00	2.00	3.00	4.00
Wheat offal	14.00	14.00	14.00	14.00	14.00
Corn bran	15.00	15.00	15.00	15.00	15.00
Blood meal	2.00	2.00	2.00	2.00	2.00
Oyster shell	4.00	4.00	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00	3.00	3.00
NaCl	0.05	0.05	0.05	0.05	0.05
Methionine	0.05	0.05	0.05	0.05	0.05
Lysine	0.05	0.05	0.05	0.05	0.05
*Premix	0.05	0.05	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00

Calculate: Crude protein = 17.08%; WWLM = Westwood larva meal; Metabolizable energy = 2560 Kcal/kg

*Premix composition: Vitamin A, 200,000,00 IU, Vit. D_3, 40,000,00 IU, Vitamin E (Mg) 460, Vitamin K_3 (Kg) 40, Vitamin B_1 (Mg) 60, Vitamin B_2 (Mg) 120, Niacin (Mg) 1,000, Calcium pantothenate (Mg) 200, Vitamin B_6 (Mg) 100, Vitamin B_{12} (Mg) 05, Folic acid (Mg), 20, Biotin (Mg) 1, Chlorine chloride (Mg) 8,000, Manganese (Mg) 2,400, Iron (Mg) 2,000, Zinc (Mg) 1,600 Copper (Mg) 170, Iodine (Mg) 30, Cobalt (Mg) 6, Selenium (Mg) 24, Anti-oxidant (Mg) 2,400

The insects were thereafter milled using hammer-mill to obtain what is known as Westwood Larva Meal (WWLM).

Experimental animals and management: Two hundred and fifty (250) 30 weeks old Isa-Brown laying birds weighing between 1.35 and 2.00 kg were randomly allocated to five dietary treatments, replicated into five with ten (10) birds per replicate. Birds were housed in pairs in a set of 2-tier conventional battery cages of which each unit measured 45.6 x 40.6 x 35.6 cm. The cages were disinfected two days to the allocation of birds into the units.

In the five diets, Westwood Larva Meal (WWLM) was used to substitute fish meal at 25, 50, 75 and 100% levels (weight: weight in the control diet). The five diets were A (0% WWLM), B (25% WWLM), C (50% WWLM), D (75% WWLM) and E (100% WWLM). The gross composition of the experimental diets is presented in Table 1. The birds were fed *ad-libitum* with daily feed allowance of 130 g/bird/day. Water was also provided *ad-libitum*. Routine management practices, medication and vaccination were carried out prior to the commencement of the experiment according to the standard practices in poultry production. Birds were maintained on standard growers mash containing 18% crude protein until first drop egg was recorded when the diet was changed to commercial layers mash. This was maintained until egg production attained 50% hen-day when the birds were introduced to the experimental diets. An adjustment period of one week was allowed before data collection, which lasted for 12 weeks. The birds were weighed before the commencement and at the end of the experiment. Mortality was recorded throughout the period of the experiment and expressed as percentage of the birds at the commencement of the experiment.

Data collection: Data were collected on feed intake, body weight gain egg production and egg qualities. Feed intake was determined by weighing and subtracting the left over from feed offered daily. Body weight was determined by weighing the birds at the commencement and at the terminal stage of the experiment using weighing scale. Weight change was therefore obtained as the difference between the two. Eggs were collected twice a day at 12:00 and 14:00 h daily and recorded. The percentage hen-day production was determined by expressing the eggs collected as a percentage of eggs expected. Egg weight was measured by weighing all eggs laid in the last days of each week individually using electronic weighing scale and the average determined. Efficiency of feed utilization was determined from feed intake and egg production. This was expressed as kilogram of feed consumed per kilogram egg laid.

Five eggs were randomly picked per treatment every week and broken for egg quality assessment. Egg quality characteristics measured were albumen height, yolk length, yolk weight, shell thickness and Haugh unit. The content of the eggs was emptied on a flat glass plate to determine the internal qualities. Albumen height was measured with the aid of a tripod spherometer and Haugh unit determined from the formula. $Hu = 100\log(H+7.57-1.7 W^{0.37})$ as outlined by Oluyemi and Roberts (1979) where Hu = Haugh units; H = albumen height and W = egg weight. Height of the yolk was measured using tripod spherometer.

Yolk length was measured at the equatorial region using vernier calipers and yolk index obtained as the ratio of yolk height to yolk length. Yolk and albumen weights were measured with sensitive weighing scale after the yolk had been carefully separated from the albumen. Yolk colour was visually determined on a scale of one to five using Roche yolk colour fan. Shell thickness was taken as the average value of all the measurements taken at three sections (top, middle and bottom) using micrometer screw gauge. Shell weight was measured using sensitive weighing scale after the shell membrane had been carefully removed from the shell.

Proximate analysis: The proximate analysis of the compounded feeds and the westwood larva meal was carried out using the methods of A.O.A.C. (1990)

Statistical analysis: Data collected were subjected to one-way Analysis of Variance (ANOVA) using SAS package (SAS, 1988) and significance determined at $p<0.05$. Where significance was indicated, Duncan's option of the same package was used to separate the means.

RESULTS

The results of this investigation are presented in Table 2-4. The proximate composition of the experimental diets, Westwood Larva Meal (WWLM) and fish meal is presented in Table 2. The crude protein content of WWLM (66.74%) was higher than that of the fish meal (63.11%). Fish meal did not show any crude fibre content but fibre content of WWLM was high (7.55%). Dietary crude protein and crude fibre increased with increase in WWLM level in the diet. Ether extract did not show a definite trend. Ash content recorded in this study increased with increasing level of WWLM in the diets.

The effect of WWLM on the production performance of Isa-Brown laying hens is presented in Table 3. No significant ($p>0.05$) difference was observed in feed intake of the birds as a result of WWLM substitution for fish meal in the diet even though value observed for diet B (25% WWLM) was slightly higher than that of other diets.

Table 2: Proximate composition of the experimental diets

	A	B	C	D	E		
Parameters (%)	(0% WWLM)	(25% WWLM)	(50% WWLM)	(75% WWLM)	(100% WWLM)	Fish meal	WWLM
Crude protein	16.76	17.11	17.28	17.54	16.93	63.11	66.74
Crude fibre	5.81	6.18	6.76	7.12	7.28	-	7.55
Ether extract	3.25	3.41	3.39	3.49	3.45	7.63	9.50
Dry matter	92.83	92.88	92.93	92.96	92.91	80.00	91.88
Ash	6.25	6.37	6.46	6.87	6.91	6.45	7.03
Nitrogen free extract	64.01	62.72	62.40	61.43	61.79	10.44	10.61

Table 3: Effect of Westwood larva meal on production performance of Isa-Brown

	Level of WWLM in the diet (%)				
	0	25	50	75	100
Parameters	A	B	C	D	E
Feed intake (g/bird/day)	114.71±2.77^{ab}	118.30±3.44^{c}	115.21±3.66^{ab}	1.65±0.03^{ab}	1.55±0.04^{a}
Weight gain (g/bird)	-0.02±0.05	0.04±0.07	-0.11±0.04	-0.02±0.05	-0.09±0.05
Egg weight (g)	57.58±3.42^{a}	57.42±0.47^{a}	57.51±0.46^{a}	56.99±0.53^{ab}	55.50±0.6^{b}
Hen-day production (%)	77.86±3.42^{a}	78.32±2.47^{a}	77.82±2.16^{a}	77.37±1.69^{a}	73.39±2.7^{b}
Kg Feed/Kg eggs (Kg)	2.53±0.09^{b}	2.72±0.07^{ab}	2.73±0.06^{ab}	2.78±0.07^{ab}	3.00±0.09^{a}

^{a,b,c}Means along the same row with different superscripts differ significantly ($p<0.05$)

Table 4: Effect of Westwood larva meal on egg characteristics of Isa-Brown laying birds

	Level of WWLM in the diets (%)				
	0	25	50	75	100
Parameters	A	B	C	D	E
Yolk height (cm)	1.46±0.0.04^{c}	1.47±0.03^{bc}	1.57±0.04^{ab}	1.58±0.04^{ab}	1.65±0.03^{a}
Yolk weight (g)	15.10±0.17	15.15±0.37	15.41±0.45	15.43±0.39	14.89±0.38
Yolk length (cm)	4.30±0.04	4.04±0.12	4.16±0.07	4.17±0.05	4.16±0.05
Yolk colour	1.00±0.00	1.04±0.11	1.16±0.13	1.16±0.13	1.16±0.11
Yolk index	0.34±0.01^{c}	0.36±0.02^{bc}	0.38±0.01^{ab}	0.39±0.01^{ab}	0.40±0.11^{a}
Albumen height (cm)	6.67±0.0.12^{a}	5.60±0.24^{b}	6.43±0.33^{ab}	6.42±0.47^{ab}	6.39±0.18^{ab}
Albumen weight (g)	34.67±0.41^{a}	31.43±0.46^{ab}	30.95±0.51^{b}	33.26±0.53^{ab}	33.35±0.33^{ab}
Egg shell thickness (mm)	0.37±0.01	0.38±0.01	0.37±0.01	0.37±0.01	0.38±0.01
Egg shell weight (g)	7.12±0.10^{a}	6.80±0.12^{ab}	6.80±0.08^{ab}	6.83±0.09^{ab}	6.20±0.12^{b}
Haugh unit	94.36±0.97	89.23±1.47	93.38±1.53	93.38±2.50	93.29±0.97

^{a,b,c}Means along the same row with different superscripts differ significantly ($p<0.05$)

Also no significant difference was observed in the weight of the birds. Birds fed diets A, C, D and E however showed slight loss of weight while hens fed diet B gained slight weight over the experimental period.

Egg weight was significantly ($p<0.05$) affected by diets. Birds that were fed the control diet (A), 25% WWLM (B), 50% WWLM (C) and 75% WWLM (D) were comparable in terms of egg weight. Those that were fed 100%WWLM (E) however had smaller ($p<0.05$) egg weight than others.

Diets had significant ($p<0.05$) effect on hen-day production. Birds that were fed diet E (100% WWLM) had lower ($p<0.05$) hen-day production than others. Those that were fed diets A, B, C and D were however similar in terms of hen-day production.

Significant ($p<0.05$) difference in feed efficiency (kg feed consumed per kg eggs) was observed across the treatment means. Hen on diet E which had the least hen-day production was also inferior to others in terms of efficiency of feed utilization

Effects of WWLM on egg characteristics of Isa-Brown laying birds are presented in Table 4. Yolk height, yolk index, albumen height, albumen weight and egg shell weight were significantly ($p<0.05$) influenced by dietary treatments, while yolk weight, yolk length, shell thickness, Haugh unit and yolk colour were not. Yolk index tends to increase with WWLM level in the diets. Diet E exhibited the highest value (0.40). The trend observed for yolk height was similar to that of yolk index. The control diet proved to be superior to other diets in terms of albumen height, albumen weight and egg shell weight. Other diets containing WWLM were however comparable regarding these parameters.

DISCUSSION

The high protein content of the WWLM showed that it could be a substitute for fish meal in poultry diet. The protein value obtained for WWLM in this study falls within the range reported by earlier workers (Malaisse and Parent, 1980). The higher crude fiber content of WWLM compared to fish meal could be attributed to chitin, a carbohydrate polymer that is present in invertebrate exoskeleton, protozoa, fungi and algae (Goodman, 1989). Chitin is not digestible by enzymes in mammalian intestines and as a result, it is regarded as a dietary fibre (De Foliart, 1992). The progressive increase observed in the crude protein and crude fibre content of the diet as WWLM increased was as a result of higher content of these components in WWLM. Also the progressive increase observed in the ash of the diets can be attributed to higher contents of the mineral nutrients in the WWLM over fish meal (Ande, 2003).

The slight weight gain observed for the birds fed diet B could be due to the fact that these birds consumed slightly more feed than birds on other diets. Consumption and utilization of diet B was probably adequate to satisfy both the maintenance and production requirements of the birds. This was not so in the birds fed diets A, C, D and E so nutrients were mobilized for egg production purpose from their body reserve which led to weight loss. The average egg weight observed from this study was in line with those reported by Obida and Sanford (1988). The need for average sized eggs to achieve good hatchability in poultry birds have long been demonstrated (Brah *et al*., 1999; Ganzalez *et al*., 1999).

The fact that birds that were fed diets A, B, C and D were comparable in terms of egg weight and egg production indicates that up to 75% fish meal can be replaced by WWLM in broiler diet. This agreed with the work of Oyegoke *et al*. (2006) who also observed no difference in the growth of broilers fed up to 100% WWLM. The decrease observed in hen-day production and efficiency of feed utilization of birds fed diet E over those fed other diet was an indication of poor feed utilization which could be due to effect of chitin which probably reached threshold level at this inclusion level. The fact that birds that were fed diets A, B, C and D were similar with respect to these parameters indicates that up to 75% WWLM could be substituted for fish meal in laying chicken diet.

The highest hen-day production (78.32% for birds on diet B) in this study was lower than the recommended target value of 88% hen-day at 30 weeks (Odunsi *et al*., 1996). This could be due to difference in climatic condition and the strain of birds used. The similarity in feed efficiency of bird fed diets A, B, C and D indicates that up to 75% fish meal could be replaced with WWLM in the diet of laying chicken.

The non-significant effect of WWLM on yolk colour could be attributed to the fact that WWLM is not a plant product that could contain carotene or xanthophyllous pigments needed for egg colouration development. The values obtained for egg shell thickness in this study were similar to the values reported by Odunsi *et al*. (1996) for birds fed wild sunflower leaf meal and maize based diet. The implication of this is that diets containing WWLM would offer similar protection against mechanical damage to egg as fish meal would do.

The role of eggshell thickness has been well emphasized in hatchable eggs (Narushin and Romanov, 2002). Increase in shell thickness of one micrometer in the range of 0.29-0.35 mm was reported to result in about 2% increase in hatchability (Sergeyeva, 1986), while hatchability of thick shelled eggs was 30% higher than thin-shelled eggs (Tsarenko, 1988). The fact that no mortality was recorded throughout the period of the experiment was an indication that WWLM does not contain toxic substances.

Conclusion: It was concluded from this trial that up to 75% fish meal can be replaced with WWLM in the diet of laying birds without any adverse effects on egg quality parameters.

REFERENCES

A.O.A.C., 1990. Official Methods of Analysis. 15th Edn. Association of Official Analytical Chemists, Washington, D.C.U.S.A.

Ande, A.T., 2003. Comparative studies of the mineral composition of processed larvae and prepupae of *Cirina forda* West wood (Lepidoptera: Saturnidae) Science Focus, 4: 11-13.

Brah, G.S., M.L. Chaudhary and J.S. Sandhu, 1999. Analysis of relation of egg weight with embryonic mortality, hatching time, chick weight and embryonic efficiency in chickens. Indian J. Poult. Sci., 34: 308-312.

De Foliart, G.R., 1992. Insect as human food. Crop Prot., 11: 395-399.

Fasoranti, J.O. and D.O. Ajiboye, 1993. Some edible insects of Kwara State, Nigeria. American Entomologist, 39: 113-116.

Ganzalez, A., D.G. Satterlee, F. Moharer and G.G. Cadd, 1999. Factors affecting ostrich egg hatchability. Poult. Sci., 78: 1257.

Goodman, W.G., 1989. Chitin a magic bullet. The food insect Newsletter, 3: 6-7.

Malaisse, F. and G. Parent, 1980. *Les Chenillis comestibles dushabas meridionaire (zaire)*. Les Nathal Belges, 61: 2-24.

Narushin, V.G. and M.N. Romanov, 2002. Egg physical characteristics and hatchability World's Poult. Sci. J., 58: 297-303.

Obida, J.Y. and P.E. Sanford, 1988. A comparison of the cage layers fed sorghum grain or pearl millet. Nig. J. Anim. Prod., 15: 127-133.

Odunsi, A.A., G.O. Farinu and J.O. Akinola, 1996. Influence of dietary wild, sun-flower (*Tithonia diversifolia Hemsi*, A.Gray) leaf meal on layers performance and egg quality. Nig. J. Anim. Prod., 23: 28-32.

Oluyemi, J.A. and F.A. Roberts, 1979. Poultry Production in warm wet climate *London*. Macmillan press Ltd.

Oyegoke, O.O., A.J. Akintola and J.O. Fasoranti, 2006. Dietary potentials of the edible larvae of Cirina forda (westwood) as a poultry feed. Afr. J. Biotechnol., 5: 1799-1802.

SAS, 1988. SAS or STAT users guide (Release 6.08) SAS Institute inc. Cary, North Carolina, USA.

Sergeyeva, A., 1986. Egg quality and egg hatchability. Ptitsevodstvo. Moscow, Russia, 3: 24-25.

Swaminathan, M., 1986. Principles of nutrition and dietetics. Bangalore Printing and publishing Co.Ltd., Bangalore, pp: 528.

Tsarenko, P.P., 1988. Increasing the quality of poultry products: Table and Hatching eggs. Russia Agropromizdat, Leningrad, Russia.