EFFECTS OF DIETARY CALCIUM LEVEL ON PERFOR- MANCE AND EGG QUALITY OF COMMERCIAL LAYERS REARED UNDER TROPICAL ENVIRONMENT

T. A. MOHAMMED and S. A. MOHAMMED.

Institute of Animal Production, University of Khartoum, P. 0. Box 32, Khartoum North. Sudan.

SUMMARY

A randomized block design experiment was conducted with the Objective of estimating the Calcium (Ca) requirements of commercial layer hens reared under tropical conditions. Five experimental diets containing 2.5, 2.8, 3.1, 3.5 and 3.9% (DM)' Ca were formulated from local feed- stuff ingredients and offered ad-lib. to 7-month old Brown Highsex layers for a period of 10 weeks. The results indicated that increasing Ca content of diets significantly ($P < 0.05$) depressed feed consumption but improved ($P < 0.05$) egg production and feed utilization. It was observed that dietary Ca level had no effect on egg size but significantly ($P < 0.05$) improved egg shell weight and percent content of egg shell ash and Ca. It was concluded that increasing the Ca contents of the diets beyond 3.5% significantly ($P < 0.05$) depressed layers performance and had no effect on egg quality.

INTRODUCTION

The increasing demand for table eggs in tropical areas deemed the in- troduction of high producing poultry stocks bred for temperate environ- ments. This necessitated the need for research to investigate the extent to which the genetic potential of such exotic stocks would be expressed un- der tropical environments. An important factor in this respect is nutrition as such stocks have exacting demands for nutrients. It is generally accepted that birds subjected to warm temperatures re- quire higher levels of minerals than their likes in moderate climates (NRC, 1977). Calcium (Ca) is one of the

major elements that are essen- tial for the process of shell formation and egg production. Hence the quantity and quality of the eggs produced are highly affected by the level of Ca in the laying fowl diet. Neshiem (1974) observed that egg production could be maintained with diets containing low levels of"Ca but with unsatisfactory egg shells. Damron and Harms (1980) and Mongin and Sauver (_ 1974) reported that excess Ca depressed palatability of the diet and reduced egg production. The objective of this study was to estimate the optimum dietary Ca level for laying birds kept under tropical environments.

MATERIALS AND METHODS

Ninety 7 - month old commercial Brown Highsex laying hens were divided at random into 30 experimental units of 3 hens each. Each of the experimental units was accomodated in a one meter square pen construct- ed inside an open sided deep litter layer house exposed to the prevailing natural conditions. The experiment was conducted during the warm dry season of the year (March - June). The mean minimum and maximum temperatures recorded during that period were 26 degree C and 38 degree C respectively. The 30 experimental units were alloted randomly to 5 iso-caloric and iso-nitrogenous diets formulated from local feed ingredients to contain 2.5, 2.8, 3.1, 3.5 and 3.9% (DM) Ca. Ingredients and nutrient composi- tion of the experimental diets are shown in table 1. They were compound- ed using sorghum grain, protein mixture, com starch and oyster shell. The protein mixture consisted (W/ W) of 32% groundnut cake, 30% se- same cake, 17% fish meal, 11% cottonseed cake and 10% blood meal. The different levels of Ca were obtained by varying the proportions of corn starch and oyster shell in the diets. Nutrient composition of the experimental diets (table 1) was based on actual analysis of composite samples of the feed ingredients using AOAC (1980) methods. Total Ca and phosphorus (P) in the diets and egg shell were determined by atomic absorption spectroscopy following acid diges-tion of samples (Zasoski and Burau, 1977). , The laying hens were maintained on the experimental diets for a period of 10 weeks and had free access to the feed and water. Light was provid- ed all day throughout the experimental period. Weekly records were kept for feed consumption, egg production and egg size. Composite samples of egg shells were collected weekly and their

weight, ash and Ca contents were determined. Feed consumption, egg production, feed conversion ratio (FCR), egg shell weight and egg shell ash and Ca contents data 'were subjected to analysis of variance using a randomized block model. Means were com- pared by Duncan's New Multiple Range Test (Snedecor and Cochran, 1967) when F- values were significant ($P < 0.05$).

Table 1: Ingredients and nutrient composition of the experimental diets.

Ingredient/ Nutrient	Calcium content of diets (% DM)				
	2.5	2.8	3.1	3.5	3.9
Ingredient composition (w/w)					
Sorghum grain	54.0	54.0	54.0	54.0	54.0
Wheat bran	16.0	16.0	16.0	16.0	16.0
Protein mixture	18.5	18.5	18.5	18.5	18.5
Oyster shell	6.0	7.0	8.0	9.0	10.0
Corn starch	5.0	4.0	3.0	2.0	1.0
Salt	0.5	0.5	0.5	0.5	0.5
Nutrient composition (% DM)					
Crude protein (N X 6.25)	15.9	15.8	15.8	15.6	15.7
Metabolizable energy (MJ/ Kg)	11.46	11.38	11.31	11.13	11.27
Lysine	0.66	0.62	0.60	0.58	0.55
Methionine + Cystine	0.63	0.61	0.60	0.59	0.59
Phosphorus	0.77	0.73	0.71	0.68	0.65

RESULTS

The effect of the level of dietary Ca on the performance of laying hens are presented in table 2. Results indicated that the level of Ca in a layer diet had a significant ($P < 0.05$) effect on feed consumption, egg production and feed utilization. Feed consumption was depressed significantly ($P < 0.05$) as the level of Ca in the diet increased from 2.5 to 3.9%. Egg production and feed

utilization were significantly ($P < 0.05$) improved as the level of dietary Ca was increased but were reduced significantly ($P < 0.05$) when the dietary Ca contents were in excess of 3.5%. The effects of dietary Ca level on egg size, egg shell weight, and egg shell ash and Ca contents are shown in table 3. It was noticed that egg shell weight andgegg shell ash and Ca content increased significantly ($P < 0.05$) with the increase in dietary Ca level. However increasing the dietary Ca level beyond 3.5% had no effect.

Table 2: Effect of dietary Calcium level on performance of commercial layer hens reared under tropical conditions.

Parameter	Dietary Calcium level (% DM)					
	2.5	2.8	3.1	3.5	3.9	SE
No. of observations	6	6	6	6	6	-
Feed consumption (g/ bird/ day)	120.3 ^{a}	117.3 ^{ab}	116.0 ^{b}	114.3 ^{c}	110.0 ^{d}	0.86
Egg production (egg/ day)	0.47 ^{d}	0.53 ^{c}	0.56 ^{b}	0.62 ^{a}	0.47 ^{d}	0.01
FCR (Kg feed/ dozen egg)	3.2 ^{a}	2.9 ^{b}	2.6 ^{c}	2.4 ^{d}	2.9 ^{b}	0.06

SE : Standard error.
a, b, c & d : Means on the same row with different superscripts differ significantly ($P < 0.05$).

Table 3: Effect of dietary Calcium level on quality attributes of eggs produced by commercial layer hens reared under tropical conditions.

Quality attribute	Dietary Calcium level (%DM)					
	2.5	2.8	3.1	3.5	3.9	SE
No. of observations	6	6	6	6	6	-
Egg weight (g)	57.3 ^{d}	57.2 ^{bc}	56.7 ^{abc}	56.4 ^{ab}	56.9 ^{abc}	0.07
Egg shell weight (g)	4.4 ^{d}	4.9 ^{bc}	5.1 ^{abc}	5.2 ^{ab}	5.1 ^{abc}	0.03
Egg shell ash weight (g)	4.2 ^{d}	4.6 ^{bc}	4.8 ^{abc}	4.9 ^{ab}	4.8 ^{abc}	0.08
Egg shell Ca (g)	1.47 ^{d}	1.60 ^{c}	1.64 ^{bc}	1.71 ^{a}	1.69 ^{ab}	0.002

SE : Standard error.
a, b, c, & d: Means on the same row with different superscripts differ significantly ($P < 0.05$).

DISCUSSION

The ratio of Ca : P in the experimental diets ranged between 3.6 : 1 5.6 : 1. This range is well within the recommendations of NRC (1977) for laying hens. It is therefore, unlikely that such variation would have effect on the reported results. The observation that increasing Ca contents in layer diets from 2.5 to 3.9 reduced palatability and feed consumption is in agreement with the re- sults of Huttwiz and Bronstein (1966), Mongin and Sauver (1974), Ro- land et al (1978) and Damron and Harms (1980). However, it is contra- dictory to the observations of Gleaves et al (1977) and Reichmann and Connor (1977) who reported no adverse effects on feed consumption with high levels of dietary Ca. The noted improvement in egg production despite the depression in feed consumption is in accord with the results of Duddley and Pickering (1966), Scott et al (1971) and Damron and Harms (1980), who found no economic advantage of increasing the Ca content beyond 3.1 - 3.5% in layer diets. Petersen et al (1960) introduced egg quality as one of the criteria for estimation of dietary Ca adequacy in layers diets. In this study the egg quality attributes measured were egg size, egg shell weight and egg shell ash and Ca contents. Except for egg size it was observed that these attrib- utes improved with increasing the level of dietary Ca and were highest with diets containing 3.5% Ca. This is in agreement with the results of Chandramoni et al (1986) and Roush et al (1986). The results of this study confirm the recommendations of the sub~ committee on poultry nutrition (NRC, 1977) which suggested that the dietary Ca level for layers kept under warm conditions is higher than that for layers kept under moderate temperatures (3.25% Ca). It is evident that 3.5% Ca in the diet is adequate for supporting maximum egg production and quality under tropical environment.

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MILK COAGULATINGPROPERTIES OF Solanum incanum

Y. R. SULIEMAN, Y. M. A. EL IMAM‘ and HUSNA I. ALLAGABO.

K uku Research Station, P. 0. Box 89 Industrial Area Khartoum North, Sudan.

SUMMARY

The aqueous extracts of the whole fruit, fruit coat and seed of Solanum incanum Lim. were studied, separately, for their milk coagulat- ing properties. Phytochemical examination indicated that the active princi- ple is a glycoside and the whole extract is necessary for coagulation. The shortest coagulation time was recorded using the seed extract.

INTRODUCTION

Milk produced in the country is normally consumed fresh, sometime as soured milk (roub) for cooking or beverage. However when surplus is available, particularly during the rainy season (kharif) excess milk is curdled and preserved as salted soft cheese. Fresh or dried young pre- ruminant stomach (abornasum) was mostly used for this purpose in trans- humant and far-reached rural areas in the kharif. Some herb seeds of the family Soianaceae widly distributed in the country are known to be used in milk clotting particularly Solarium incanum Lim. (Arabic Vernacular name; Gibbein), (Broun, Massey and Hutchinson, 1929; Andrews, 1956). In this study however the curdling properties of S. incanum were studied.

MATERIALS AND METHODS

Materials:

Dessicating plants were collected during January 1988 from a stand growing on a clay cracking soil at Kuku area on the eastern bank of Blue Nile, Khartoum North district. The berries were harvested then separated into whole fruit, fruit coat and seed; then dried in forced air oven at 100 °C for 24 h. The dried material was then ground in a laboratory hammer mill. Extraction and characterization: Ten grammes of ground material from each fruit part was dissolved for 24 h at room temperature in glass distilled water

and filtered. The fil- trate was then transferred into a 100 ml volumetric flask, mixed and dilut- ed to final volume with distilled water. The chemically active extracted constituents were identified by means of some specific reactions and thin layer Chromatography, both for the aqueous or hydrolysed extracts. Hydrolysis was affected by refluxing with 10% hydrochloric acid and heating for 30 minutes. Milk coagulation test: Volumes of the extract from each fruit part were pipetted into glass centrifuge tubes containing 100 ml pasteurised milk, to obtain fruit part extract concentrations 1, 2, 3, 4, 5, 8, 12, 16 and 20 g/l milk. The tubes; 4 from each concentration, were incubated in a water bath at 37 °C. The tubes were examined regularly every 5 minutes for fust onset of coagula- tion, starting from the highest to the lowest concentrations of the extract. When it occurred, the period was recorded.

RESULTS AND DISCUSSION

The relationship between concentration of fruit part and coagulation time of milk is given in Table 1. The seed extract coagulated milk faster than the extracts of the other fruit parts. Hydrolysis, boiling or removal of the colouring material by charcoal caused loss of the extract milk-coagulating properties and the intact ex- tract was responsible for these properties. It can not be an enzyme that would certainly be destroyed by the high temperature (100 °C), at which the fruit was intially dried. Thin layer chromatography (Systems; Silica gel-benzene : ethanol (65 : 35); Silica gel - Ethyl acetate : isopropanol : Water (65 : 23 : 12) sprayed with a mixture of chloramine solution 1% and trichloroacetic 25% gave a single spot corresponding to a glycoside with Rf values 0.67 and 0.93 re- sportively.

Table 1: The relationship between concentration of fruit part extract of *Solanum incanum* and coagulation time of milk.

concentration g/l	Coagulation time in minutes Whole berry	Seed	Coat
1	92	87	115
2	47	43	105
3	35	32	97
4	30	25	89
5	27	20	80
8	46	-	-
12	40	-	-
16	35	-	-
20	32	-	-

The glycoside was shown to contain steroidal aglycone, and the ex- tract contained no tannins or saponins, table 2. The current investigation of the milk coagulating properties of S. incanum has not been preceded by a similar attempt. Note should be made however of report by Bo-Dansky 1924 on a milk coagulating en- zyme from S. eleagnifolium. At the present time our knwledge of the milkcoagulating compounds of the Solanum species, is still rudimentary. How far the distribution of such compounds, within the genus can only be ascertained and quantified by further investigation of many more species. Moreover any potential toxicity of Solanum - clotted milk has yet to be examined before any wide scale utilization of the Solanum in cheese mak- ing could be developed in the foreseeable future.

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