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Supplementation of Magnesium Oxide to a Laying Hen Diet. B. Effect on Egg Quality and Carcass Quality

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NINE-MONTHS old Dandarawi x Rhode Island Red crossbred hens were used to determine what effects magnesium had on egg and carcass qualities. The birds were randomly assigned to 4 treatments of Mg levels, (340; 456; 590 and 840 mg/kg diet). The experiment lasted for three months.

Shell percentage and shell thickness were improved by magnesium supplementation, specially at the level of 465 p.p.m., while Haugh units decreased significantly at 840 p.p.m. However, egg weight was slighily improved by Mg supplementation, and no response was obtained on yolk and albumen percentages, yolk index, yolk colour, blood and meat spots and egg shape index.

The pectoralis major percentage decreased at 590 p.p.m. Mg, and the thigh muscle percentage decreased at 840 p.p.m. Mg. However, the drumstick muscle percentage increased at 465 p.p.m. The highest percentages of breast muscle, thigh muscle and eviscerated carcass was obtained at 340 p.p.m. of Mg.

The level of 465 p.p.m. of Mg was best for egg quality, while the level of 340 p.p.m. of Mg was best for carcass quality.

The role of magnesium in poultry nutrition has been in frequently studied. In the literature there are some reports dealing with the effect of magnesium on growth (Rogerson and Singsen, 1967), egg production (Edwards and Nugara, 1968), egg weight (Adams, 1976), fertility (Bajpai and Brown, 1964), hatchability (Hajj and Sell, 1968) and mortality (Harland *et al.*, 1974). However, no information exists on the relationship between magnesium and egg quality or carcass quality.

Therefore, it was decided to conduct a further study on the effect of dietary magnesium level on both egg quality and carcass quality of the laying hen.

Material and Methods

The experimental material, the diets and the design of the experiment were previously described in detail in part (A) of this report (Makled *et al.*, 1977). According to the experimental design, four groups of laying hens (I, II, III and IV) were fed four levels of magnesium 340, 465, 590 and 840 p.p.m. respectively.

Egg quality was measured at the end of the 90-day experimental period. All eggs laid in each group during 2 consecutive days were collected, weighed, measured, broken and separated into shells, yolks and albumens. The height of the thick albumen was immediately measured and the values obtained were converted to Haugh units (Haugh, 1937). The yolk index was obtained according of the method of Funk (1945), while the yolk colour was evaluated subjectively using a Roche colour fan. The blood and meat spots were visually classified. After albumen was separated, the yolk was weighed. The shell (with its membranes) was carefully emptied, dried and weighed, then albumen weight was calculated by difference. The shell thickness was measured to the nearest micron as described by Brant and Shrader (1952). The egg shape index was also determined.

At the end of the experiment, a random sample of 20 hens (5 birds from each group) were starved for about 12 hr, weighed, slaughtered, allowed to bleed freely and then weighed to obtain the weight of blood lost by bleeding. The birds were dry-plucked to obtain the weight of feather. The head and shanks were separated, then the carcass was eviscerated. The weights of the head, shanks (with feet), liver (without gall bladder), giblets, inedible viscera and eviscerated carcass were recorded. Then the breast muscles (pectoralis major and pectoralis minor) and leg muscles (thigh and drumstick) were carefully separated and weighed. All the recorded weights were calculated as percentages of live body weight.

The data were subjected to analysis of variance (Snedecor and Cochran, 1967) and to the multiple range test of Duncan (1955).

Results and Discussion

A —*Egg quality*

The traits of egg quality of the different groups are listed in Table 1. The analysis of variance showed that from all traits studied, the treatment had a significant effect only on shell percentage, shell thickness and Haugh units ($P < 0.05$). Shell percentage and shell thickness were improved with Mg supplementation at 465 p.p.m. While Haugh units decreased with Mg supplementation especially at the level of 840 p.p.m., the values were similar in the groups receiving the three lower levels of magnesium. However, the multiple range test of Duncan showed a slight increase in egg weight in the supplemented groups. No response to Mg supplementations was obtained in yolk and albumen percentages, yolk index, yolk colour ,blood and meat spots, and egg shape index.

TABLE 1. Different traits of egg quality as affected by dietary magnesium levels.

Traits	Groups			
	I	II	III	IV
Egg weight, g	44.2^{b}	46.3^{a}	45.2^{ab}	46.0^{a}
Shell,%*	8.8^{c}	9.7^{a}	9.5^{b}	9.6^{ab}
Yolk, %	33.7^{a}	34.8^{a}	32.9^{a}	33.7^{a}
Albumen, %	57.5^{a}	55.5^{a}	57.6^{a}	56.7^{a}
Shell thickness,* micron	329^{c}	347^{a}	337^{b}	343^{ab}
Yolk index, %	51.9^{a}	49.0^{a}	50.0^{a}	50.3^{a}
Yolk color	4.8^{a}	4.7^{a}	5.1^{a}	4.9^{a}
Haugh units*	84.6^{a}	81.9^{ab}	82.5^{ab}	80.6^{b}
Blood and meat spots	0.15^{a}	0.5^{a}	0.15^{a}	0.10^{a}
Egg shape index, %	75^{a}	77.4^{a}	76.9^{a}	75.5^{a}

* Effect of treatment was significant according to the analysis of variance and at 5% level. (a, b,c) Any two means not having the same letter are significantly different at 5% level.

The increase in shell percentage in groups II, III and IV was reasonable since shell thickness showed the same trend. Edwards and Nugara (1968) found a definite trend towards thinner shelled eggs with a greater variation in thickness from the hens fed mag-

nesium deficient diets. These findings are not surprising in view of the work of Iton and Hatans (1964) who reported that the total shell content of Mg was five times as much as that of phosphorus. According to Cox and Sell (1967), when rations of low Mg content were fed average egg weight was decreased as was the Mg concentration of egg shell and yolk.

Our findings are not in line with those of Adams (1976) who showed that Mg SO_4 significantly affected egg weight but not shell quality as measured by specific gravity or egg quality as measured by Haugh units. This disagreement may be due to the large difference between magnesium levels and the method of administration of the Mg supplement in the two experiments.

From our data, it may be concluded that 465 p.p.m. of dietary magnesium is adequate for egg quality. This seems to be in accordance with the results of Hajj and Sell (1968), which indicate that the minimum Mg requirement of the laying hen is 375 p.p.m. to maintain egg production, hatchability and egg weight.

B — *Carcass quality*

The percentages of different carcass parts of the different experimental groups are presented in Table 2. The differences due to treatment in shank, head, giblets, breast muscles (pectoralis major), thigh and drumstick muscles were significant. It can be seen that the least percentages of shank, head, liver, giblets and inedible viscera were obtained at the highest level of dietary magnesium (840 p.p.m.). However, feather percentage was significantly lower at 465 p.p.m. Mg.

The breast muscle (pectoralis minor) was not affected by dietary Mg level, while pectoralis major percentage was lowered at 590 p.p.m. Mg in comparison with the control group.

The thigh muscle percentage significantly decreased at 840 p.p.m. Mg, while the drumstick muscle increased at 465 p.p.m.

The low percentages of shank, head and inedible viscera in group IV did not improve greatly the eviscerated carcass percentage.

TABLE 2. Carcass parts of laying hens as affected by treatments.

Variables	Groups			
	I	II	III	IV
Live body weight, g.	1360.8[a]	1412.0[a]	1346.6[a]	1321.0[a]
Blood, %	4.8[a]	4.7[a]	4.8[a]	4.6[a]
Feather, %	4.5[b]	3.5[b]	5.6[a]	5.3[a]
Shank *, %	3.1[a]	3.3[a]	2.9[a]	2.1[b]
Head *, %	3.1[a]	3.3[a]	2.6[b]	1.9[c]
Liver, %	2.4[ab]	2.6[ab]	2.7[a]	2.3[b]
Giblets, * %	4.9[bc]	5.1[ab]	5.6[a]	4.5[c]
Inedible viscera, %	17.0[ab]	18.5[a]	16.2[ab]	15.9[b]
Eviscerated carcass, %	63.6[a]	61.0[b]	61.3[b]	61.1[b]
Breast muscles:				
Pectoralis major*, %	9.2[a]	8.5[ab]	8.1[b]	8.4[ab]
" minor, %	3.8[a]	3.7[a]	3.6[a]	3.5[a]
Leg muscles:				
Thigh muscles*, %	8.7[a]	8.5[a]	8.3[a]	7.4[b]
Drumstick muscles,*%	6.9[b]	7.7[a]	6.8[b]	6.8[b]

* Effect of treatment was significant according to the analysis of variance and at 5% level.

(a, b, c) Any two means not having the same letter are significantly different at 5% level.

The highest breast muscle, thigh muscle and eviscerated carcass percentages were obtained at 340 p.p.m. of Mg. Thus, it appeared that the magnesium supplementation caused a decrease in the relative proportions of most edible parts with the exception of drumstick muscle percentage which was increased.

Although no constant relationship between carcass quality and Mg supplementation could be detected from this experiment, the level of 340 p.p.m. may be recommended to obtain better eviscerated carcass percentage.

From these results we may conclude that the level of 465 p.p.m. of dietary Mg was most suitable for egg quality, while the level of 340 p.p.m. of dietary Mg was best for carcass quality. However, further studies on this problem may be undertaken.

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اضافة اكسيد الماغنسيوم الى علائق الدجاج البياض

ب ـ تأثيره على جودة بيض وذبائح الدجاج

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استخدمت ١٦٠ دجاجة خليطة (دندراوى x رود ايلاند احمد) عمر حوالى تسعة شهور لدراسة تأثير مستوى الماغنسيوم فى الغذاء على كل من نوعية البيضة ونوعية الذبيحة . وقد قسمت الطيور عشوائيا وبالتساوى على اربعة معاملات ذات مستويات مختلفة من الماغنسيوم (٣٤٠ « كونترول » ـ ٤٦٥ ، ٥٩٠ ، ٨٤٠ ملليجرام / كجم عليقة) واستمرت المعاملات لفترة ثلاثة شهور .

وقد تحسن كل من سمك القشرة ونسبة القشرة باضافة الماغنسيوم خصوصا عند مستوى ٤٦٥ جزءا فى المليون . وقد لوحظت زيادة طفيفة فى وزن البيضة باضافة الماغنسيوم للعليقة ولكن لم توجد اية استجابة لذلك بالنسبة لدليل الصفار ولون الصفار ونسبة الصفار ونسبة البياض ونسبة البيض الذى يحتوى على بقع دم او لحم .

وبالنسبة للذبيحة فقد وجد ان نسبة العضلة الصدرية الكبرى انخفضت عند مستوى ٥٩٠ جزءا فى المليون ماغنيسيوم بينما انخفضت نسبة عضلة الفخذ عند مستوى ٨٤٠ جزءا فى المليون .

وقد لوحظ ان اعلى نسبة لكل من الذبيحة المجهزة وعضلات الصدر وعضلات الفخذ هى عند مستوى ٣٤٠ جزءا فى المليون ماغنيسيوم .

وعلى ذلك فقد توصل البحث الى ان مستوى ٤٦٥ جزء فى المليون كان انسب المستويات المدروسة لنوعية البيضة بينما كان مستوى ٣٤٠ جزءا فى المليون هو انسبها لنوعية الذبيحة .