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Effect of Force Resting Induced Conventionally or by High Dietary Aluminum on Subsequent Laying Performance

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Abstract. A total of 416 Saudi Arabian Baladi hens were divided into four experimental groups and subjected to the following treatments: Commercial laying ration (17.48% CP, 2585 ME kcal/kg, 3.6% Ca and 0.343% available P) fed ad libitum as a control (C); Conventional force molting, feed removal for 10 days followed by 18 days full feed of cracked corn (F); 15 days ad libitum intake of the control ration supplemented with 0.35% Al as the sulfate (ALS) or chloride (ALC).

Treatments and production periods had highly significant ($P<.01$) effects upon post-rest egg production (HD), feed intake/bird/day(F/B/D), feed consumed per dozen (F/DE) and per Kg eggs (F/KgE). Similar effects were observed for their interaction but only on HD and F/B/D. ALC had significantly ($P<.05$) the lowest and the control the highest HD. F had significantly ($P<.05$) the highest F/B/D while ALS consumed similar amount as ALC but significantly ($P<.05$) lower than the control. F and ALS had similar F/DE and F/KgE whereas ALC had significantly ($P<.05$) the highest F/DE and F/KgE compared with the control and other groups. The control had significantly ($P<.05$) the lowest F/KgE but had similar F/DE as ALS group.

Introduction

Force molting has been studied for many years as a possible way of rejuvenating hens to improve subsequent laying performance. The results on the effects of force molting on egg production are controversial. Many investigators reported an increase in post-rest egg production of molted hens compared with the control or pre-molt indices [1-8], whereas some others did not detect any significant differences [9-12]. However force molting seems to have no or little influence on subsequent feed intake as reported by several investigators [9, 10, 13 and 14]. On the contrary, feed conversion appears to be improved by force molting as stated by Lee [6]; len *et al.* [15] and Noles [16]. With regard to mortality, many investigators reported no significant differences between molted and nonmolted birds [1, 3, 12 and 16].

Excessive dietary aluminum has been recently viewed as a possible means of force resting by Hussein *et al.* [17] and Alkhateeb [18]. However, the informations on its effects upon subsequent laying performance are very limited. The present study was undertaken to investigate in Saudi Arabian Baladi laying hens the following:

1) The effect of high dietary Al (as the sulfate or chloride) as a force resting agent on subsequent laying performance.

2) To compare the post-rest laying performance of Al treated hens with that of the control and hens subjected to conventional fasting procedure.

Materials and Methods

A total of 416 leg-banded Baladi laying hens were used in this study. The hens were obtained from Saudi Arabian Baladi flock which has been randomly bred for several years in the Experimental Poultry and Live-stock Farm of the Animal Production Department, King Saud University. The experimental birds were randomly alloted to 16 floor pens, 26 birds in each pen and divided into four experimental groups of four floor pens in an environmentally controlled house. Hens were in production for 52 weeks and 17 months of age at the beginning of the experimental period. The different experimental groups were randomly assigned to each of the following dietary treatments:

1- Commercial laying ration (17.48% CP, 2585 ME kcal/kg, 3.6% Ca and 0.343% available P) described in details by Alsobayel and Alkhateeb [19] as a control (C).

2- Conventional force molting: feed removal for 10 days followed by 18 days full feed of cracked yellow corn (F).

3- 15 days *ad libitum* intake of the control laying ration supplemented, to initiate forced-rest, with 0.35% aluminum as the sulfate "$Al_2(SO_4)_3$ $18H_2O$"(ALS) or the chloride "$AlCl_3$" (ALC).

The level of Al (0.35%) was approximately equal to the calculated level of available phosphorus (0.343%). Light was maintained constantly at 15h light : 9h dark. After the termination of the treatments, experimental birds received the commercial laying ration and the trial lasted nine 28 days periods. Maximum and minimum House temperature were also recorded daily during the whole experimental period and weekly averages were reported by the same authors [19].

Daily egg production was recorded to calculate hen-day egg production (HD) following the treatment period. Eggs produced per pen were collected on three consecutive days on the 14th, 15th and 16th day of each 28 days period and individually weighed to the nearest 0.01 gram. Feed intake per pen basis was biweekly recorded to calculate feed intake / hen / day (F/B/D) and feed conversion, Kg feed/dozen and/ Kg eggs, (F/DE and F/KgE). Mortality was also recorded during the whole experimental period.

Data collected were subjected to statistical analysis using SAS general linear model procedure, KSU computer center, according to the following model:

$$Y_{ijk} = U + P_i + T_j + (PT)_{ij} + e_{ijk}$$

where the Y_{ijk} is the k^{th} observation of the i^{th} production period (P) j^{th} treatment (T).

$(PT)_{ij}$ is the interaction between production period and treatment. U is the general mean and e_{ijk} is the random error associated with the Y_{ijk} observation [20].

Results

Hen-day egg production (HD). Post-rest hen-day was significantly ($P < .01$) affected by treatment, production period and their interaction (Table 1). ALC had significantly ($P < .05$) the lowest and the control the highest HD, whereas F and ALS groups had similar HD. Figure 1 showed that ALC had the lowest, while the control the highest HD during most of the production periods. ALS and the control had also absolutely the highest values during the third production period which were higher than their pre-rest level. On the other hand, F had higher HD than ALS during periods 2, 5, 6 and 8.

Body weight. Initial body weight averages were similar for the different experimental groups. The same trend was observed at the end of the post-rest period. However the weight means of the different groups tended to be lower than their initial weights. Weight means at the start and end of the expeimental period were 1452, 1419, 1432, 1418 and 1410, 1391, 1384, 1386 g for F, ALS, ALC and the control groups, respectively. On the other hand, feed restricted group had significantly ($P < .05$) lower weight (1232 g) than the control (1320g) and the other experimental groups (ALS, 1311; ALC, 1329g) up to week 4 following the treatment period.

Feed intake (g F/B/D). Treatment, production periods and their interaction had a highly significant ($P < .01$) effect upon post-rest feed intake (Table 1). F had significantly ($P < .05$) the highest feed intake whereas ALS consumed feed similar to ALC but was significnatly ($P < .05$) lower than that of the control. However, ALC,

Table 1. Effect of force resting induced conventionally (F) or by high dietary aluminum as the sulfate (ALS) or cholride (ALC) on subsequent hen day egg production (HD), feed intake per bird per day (F/B/D), feed/dozen eggs (F/DE) and feed/kilogram eggs (F/KgE).

	Parameter			
	HD %	F/B/D gm	F/DE Kg	F/KgE Kg
Treatment (T)	**	**	**	**
F	34.87 ± 0.35^{b}	78.01 ± 0.33^{b}	2.81 ± 0.09^{b}	4.82 ± 0.17^{b}
ALS	35.60 ± 0.35^{b}	75.86 ± 0.33^{a}	2.69 ± 0.09^{ab}	4.62 ± 0.17^{b}
ALC	31.10 ± 0.35^{a}	76.63 ± 0.33^{ac}	3.14 ± 0.09^{c}	5.35 ± 0.17^{c}
C	38.74 ± 0.35^{c}	77.07 ± 0.33^{c}	2.43 ± 0.09^{a}	4.15 ± 0.17^{a}
Period (P)	**	**	**	
TxP	**	**	N.S.	N.S.
Overall mean	35.08 ± 0.18	76.89 ± 0.16	2.77 ± 0.05	4.73 ± 0.08

** $P < 0.01$
a,b,c Means within the same column with different superscript letters differ significantly ($P < 0.05$).
N.S. Nonsignificant

ALS and the control had on the average comparable feed intake (Table 1). Figure 2 shows that group F consumed more feed during produciton periods 1, 2, 3 and 4 compared with other experimental groups, whereas ALS ate the lowest amount during periods 3, 4 and 7 and the control ate the least and highest amounts during the 1st and 5th production periods, respectively. However, feed intake of all groups was generally increased during the last three production periods and surpassed that of the control during the rest period.

Feed conversion (Kg F/DE, Kg F/KgE). Treatments and periods effects were highly significant ($P < .01$) while their interactions were nonsignificant (Table 1). F and ALS groups had similar F/DE and F/KgE values, whereas ALC groups had significantly ($P < .05$) the highest F/DE and F/KgE values compared with other groups. The control group consumed significantly ($P < .05$) the least F/KgE but had F/DE values similar to that of ALS (Table 1). Figure 3 shows that F/DE and F/KgE decreased from the first production period and reached their lowest values during the

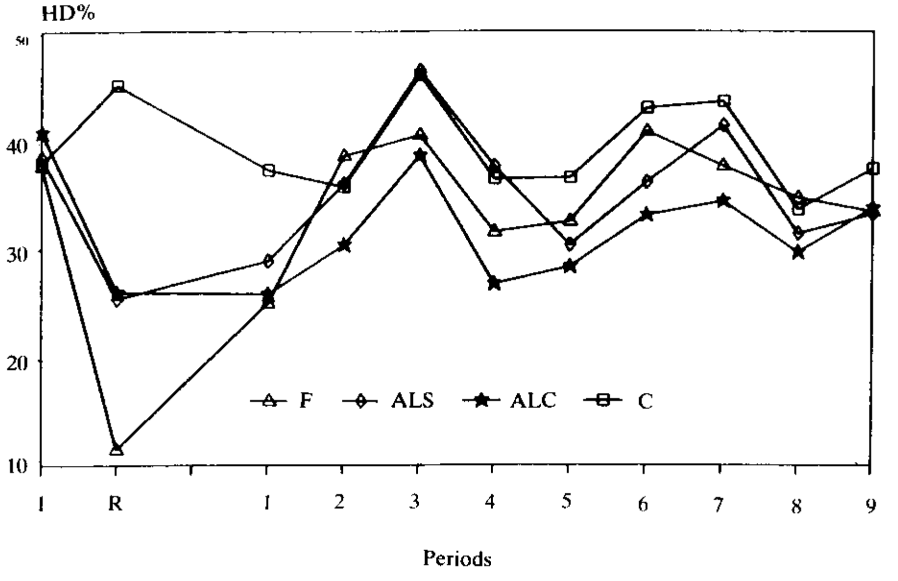

Fig. 1. Effect of force resting on hen-day egg production during the rest (R) and post-rest periods.

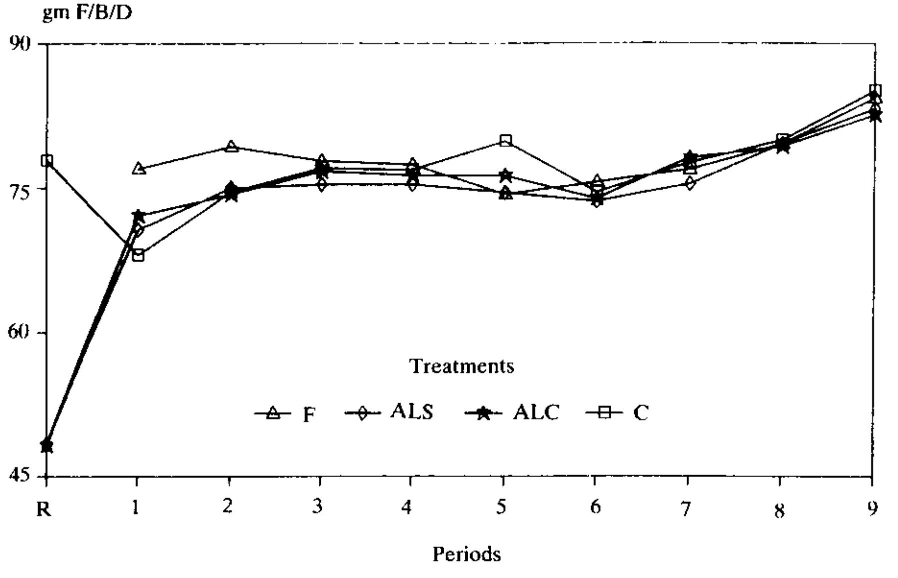

Fig. 2 Effect of force resting on feed intake/bird/day (gm/B/D) during the rest (R) and post-rest periods.

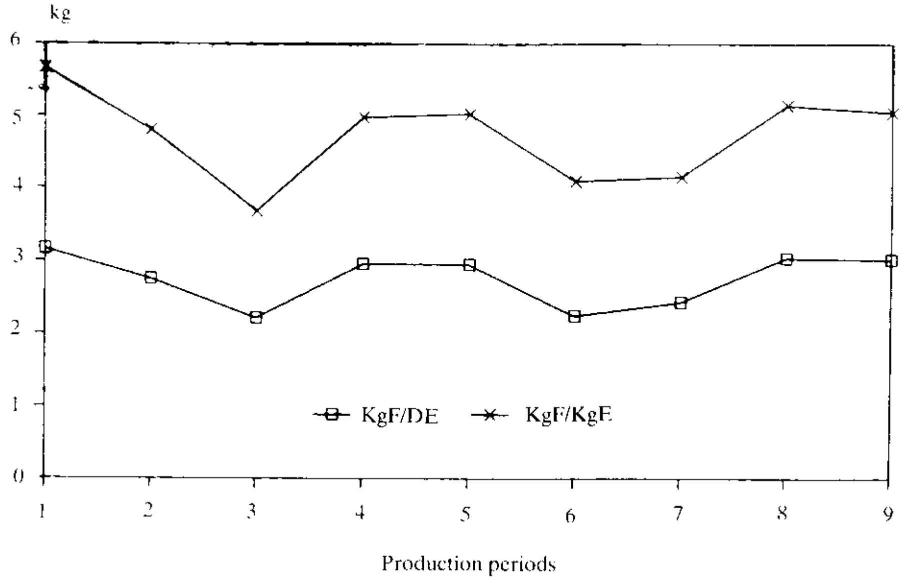

Fig. 3 Effect of production period on feed intake per dozen eggs (KgF/DE) and per kilogram eggs (KgF/KgE).

third production period. However, during periods 4, 5, 8 and 9 values are high but still lower than that of the first production period.

Livability. During the post-rest period livability was generally high for the different experimental groups. Although, there were no significant differences in livability, F group tended to have numerically the highest (96.04) while ALC and the control groups the lowest (94.23) livability percent during the post-rest period.

Discussion

Feed-restricted hens had significantly lower post-rest egg production than their pre-rest level or the control. These results disagree with those of many investigators [5-8] who reported higher post-molt egg production for feed-restricted group compared with the control or their pre-molt level. However, Shippee *et al.* [10] and McCormick and Cunningham [12] did not detect any significant differences between pre- and post-molt production level.

Feed-restricted hens had significantly ($P < .05$) lower weight than the control and other groups by week 4 following the treatment period. However, the control and other experimental groups had comparable weights at the end of the experimental period but tended to be lower than their initial weights. This might be due to the high house temperature prevailed during most of the post-rest periods [19]. Feed-restricted group had significantly higher feed intake than the control. Similar results were reported by Hurwitz *et al.* [1]; Hembree *et al.* [3]; Wilson *et al.* [21] and Roland and Brake [22]. The same group also consumed more feed per dozen and kilogram eggs compared with the control. Contradictory to these results, Hurwitz *et al.* [1], Lee [6], Len *et al.* [15] and Noles [16] reported better feed conversion for molted compared with nonmolted hens. Livability rates were similar for both, which is in agreement with the findings of many investigators [1, 16, and 23]. However, Lee [6] reported lower livability for the control group.

Inclusion of 0.35% Al as the sulfate or choloride to the diet containing 0.343% available phosphorus depressed feed intake to 62% of that of the control [18]. With regard to post-rest egg production and feed intake, Hussein *et al.* [17] observed no significant differences between feed-restricted and Al fed groups up to 11 and 14 weeks, respectively. However, the results of the present study show that feed-restricted hens ate significantly ($P<.05$) more feed than the Al fed hens, but had significantly ($P<.05$) higher production than the aluminum chloride fed group. However, feed intake of all groups was generally increased during the last three production periods and surpassed that of the control during the rest period (Fig. 2). This might be due to the decreased house temperature which ranged between 14.65 and 27.53°C during those periods. Hens fed aluminum sulfate had higher egg production than feed-restricted and aluminum chloride fed hens. However, all of the experimental groups significantly lagged behind the control with respect to egg production. During the 4th and 5th periods, egg production was low for all the groups (Fig. 2). This might be due to the high house temperature (26.65–31.78°C) prevailed at that time. In the present work, force resting by means of feeding high dietary Al seems to have no positive effect upon feed conversion compared with the control. However, compared with previous results [24] the same birds had on the average higher first year egg production (47.95%), feed intake (85.75 g/B/D) and better feed conversion (2.15 Kg/DE; 3.98 Kg/KgE).

From the results of this study it is concluded that feed-restricted and Al treated hens had comparable performance but lagged behind the control with respect to egg production and feed conversion.

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تقويم إضافة مستويات عالية من الألمنيوم للعليقة كمرغم للتوقف المؤقت عن الإنتاج في الدجاج البلدي

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ملخص البحث. أجريت هذه الدراسة على عدد ٤١٦ طائرًا من إناث الدجاج البلدي عمر ١٧ شهرًا، وقد قسمت إلى أربع مجاميع تجريبية من أربعة مكررات وأخضعت للمعاملات التالية:

١ ـ التغذية على عليقة بياض تجارية (١٧٪ بروتين خام ٣,٦٪ كالسيوم، ٠,٣٤٣٪ فوسفور متاح) كمجموعة مشاهدة (C).

٢ ـ نظام قلش تقليدي عن طريق التصويم لمدة ١٠ أيام، ومن ثم قدم للطيور ذرة صفراء مجروشة لمدة ١٨ يومًا (F).

٣ ـ ١٥ يومًا تغذية على عليقة مجموعة المشاهدة مضافًا إليها ٠,٣٥٪ ألمنيوم كبريتات (ALS) أو كلورايد (ALC).

دلت النتائج على أن المعاملة وفترة الإنتاج لهما تأثير معنوي (P<.01) على إنتاج البيض، استهلاك العلف، كمية العلف المستهلك لإنتاج دستة من البيض، وكذلك استهلاك العلف لإنتاج كيلوجرام من البيض. كذلك كان تأثير التفاعل بين المعاملة وفترة الإنتاج فيما يخص إنتاج البيض، واستهلاك العلف اليومي. كانت مجموعة كلوريد الألمنيوم (ALC) الأقل معنويًا (P<05) بينما كانت المشاهدة الأعلى فيما يخص إنتاج البيض. أما بالنسبة لاستهلاك العلف فإن مجموعة التصويم (F) كانت الأعلى (P<.05) بينما استهلكت مجموعتا الألمنيوم (ALC, ALS) كمية متقاربة، لكنها كانت أقل (P<0.5) من مجموعة المشاهدة (C). أما مجموعة التصويم وكبريتات الألمنيوم (F, ALS) فقد استهلكت كمية متقاربة من العلف لإنتاج دستة أو كيلوجرام من البيض. وكانت مجموعة كلوريد الألمنيوم (ALC) الأعلى (P<.05) فيما يخص استهلاك العلف لإنتاج كيلوجرام من البيض، لكنها متقاربة مع مجموعة كبريتات الألمنيوم (ALC) بالنسبة لاستهلاك العلف لإنتاج دستة من البيض.