

## ROLE OF LIGHT INTENSITY ON REPRODUCTIVE PERFORMANCE IN FEMALE TURKEYS

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**ABSTRACT:** *Light exerts a major influence on the reproductive function of turkeys. The objectives of this study are: 1) light intensity manipulation during the starting growing and holding periods on subsequent reproductive performance of turkey hens. 2) Effect of vasoactive intestinal peptide (VIP) immunoneutralization on reproductive performance of breeder hens. 3) Effect of light intensity manipulation and VIP immunoneutralization on reproductive hormone (prolactin). A total of 576 Nicolas Large White strain female turkeys were used in this study. The females were subjected to 3 different light intensities (18-20 F.C., 3 F.C. and 0.2-0.3 F.C.). Within each light treatment, hens were divided into two subgroups: 1) Control received, gave adjuvant-KLH. 2) Treated birds were vaccinated against VIP. The results show that mean plasma levels of the prolactin in the KLH-cVIP immunized turkeys was significantly ( $P \leq 0.01$ ) lower ( $57.20 \pm 2.86$  ng/ml) than that in the of KLH-immunized, control group ( $77.52 \pm 6.45$  ng/ml). Light intensity affects egg production, light treatment 1 (3 F.C.) exhibited the greatest egg production ( $2.81 \pm 0.54$  egg/hen/week). The difference between vaccinated and non-vaccinated groups under light treatments was significant ( $P \leq 0.05$ ) and average egg production of all vaccinated groups was greater than that of control ones.*

**Short running title:** Light & reproductive traits in turkeys

### INTRODUCTION

Turkey egg laying seasons are considerably shorter than those of chickens. One major explanation for this is that turkeys undergo an intensive incubation period that is induced by increased plasma prolactin (Youngren et al., 1991). Prolactin (PRL) is a hormone, its secretion is seasonally or photoperiodically dependant in many avian and mammalian species. This hormone in conjunction with ovarian steroid hormones, induces incubation behavior, cessation of ovulation, and subsequent ovarian regression (El Halawani and Rozenboin, 1993). It is worthy to mention that hens showed an increase in prolactin levels following photostimulation. When day and night prolactin levels for each hen were compared over the

entire reproductive cycle, more than 50% of those studied had significantly higher prolactin levels at the end of the scotophase than at the end of the photophase (Proudman, 1998).

Vasoactive intestinal peptide (VIP) has proven to be a potent hypothalamus releaser of prolactin in the turkey (El-Halawani et al., 1990 b) and it consequently elevates prolactin mRNA concentration of pituitary cell. Passive immunization of incubating chickens with anti-VIP serum induces a reduction in plasma PRL and pituitary PRL mRNA resulting in termination of incubation behavior (Talbot et al., 1991). Active immunization against chicken VIP (cVIP) prevents the secretion of PRL induced by electrical stimulation of turkey hypothalamus (Youngern et al., 1994). This mean that active immunization of turkeys with VIP would neutralize endogenous VIP, decrease circulating PRL, and consequently prevent the expression of incubation behavior (El-Halawani et al., 1995). Plasma prolactin (PRL) levels rise following long daily photostimulation and increase dramatically at the onset of incubation behavior. A daily rhythm in PRL secretion may occur, with the lowest PRL levels found prior to lights out and the highest levels found prior to lights on (Proudman, 1998). The same author obtained results showed that daytime PRL measurement accurately reflecting reproductive state, and moderate PRL levels seemed to be consistent with optimum egg production.

## MATERIALS AND METHODS

These experiments were conducted at the Agriculture Experimental Station, Rose-mount, Department of Animal Science, University of Minnesota, USA. A total of 576 Nicolas Large White strain female turkeys were used in this study. The birds were housed in floor pens with trap nests, eight birds per pen. The females were raised in three separate environmental rooms (each containing 16 pens) and reared under three different lighting programs until 29 weeks of age as follows:

- (1) 14 hours of light, daily, to 17 weeks of age. Then, day length was reduced to 6 hours of light and 18 hours of darkness from 17 to 29 weeks of age. Light intensity 3 foot candles (18 F.C.).
- (2) Similar to (1), except the light intensity was at 3 F.C.
- (3) Similar to (1), except the light intensity was at 0.2-0.3 F.C.

At 29 weeks of age, all birds were placed in the same breeder barn and subjected daily to a gonadal stimulatory photoperiod of 15 hours of light and 9 hours of darkness at level of 8-10 F.C.

## Turkey, light intensity, VIP immunization, reproductive performance.

Birds from each pre-breeder light treatment (3 treatments) were distributed among 16 pens at a rate of 12 birds per pen. Within each group of 16 pens per light treatment, hens in 8 pens used were as non-treated controls, meanwhile the hens in the other 8 pens were vaccinated against VIP and the treatments were as follows:-

- Total of 288 hens were vaccinated against VIP.
- Control birds (288) were given adjuvant KLH.
- Primary vaccination was given at 24 weeks of age (125 mg/bird)
- Boosters (25 mg/bird) were given on the day of photostimulation. Thereafter, with a total of 6 boosters were given at 0, 4, 8, 12, 16 and 20 weeks following photostimulation (i.e. at 4 wk intervals).
- Blood samples (~ 2 ml) were collected from 8 hens of each replicate pen (48 pens) and they were analyzed for antibody titer and prolactin hormone. Plasma was assayed in duplicate. Antibody titers were determined by incubating plasma at 1:1000 dilution with <sup>125</sup>I-mono iodinated VIP (Mauro et al., 1992). Titers were expressed as percentages of total counts that were specifically bound by plasma.
- During the egg production season, records were kept of the egg production by pen number and treatment, and 3 complete breeder seasons of 20 or more weeks will be observed.

**Statistical analysis:** Statistical analysis were performed using the general linear models procedure of the Statistical Analysis System (SAS) Institute, Cary, NC, 1989).

**Immunization:** Chicken VIP was conjugated by the glutaraldehyde method to Keyhole Limpet Homocyanin (KLH; A chemically synthesized peptides predicted from the nucleotide sequence of the hepatitis B virus genome elicit antibodies reactive with the native envelope protein of Dane particles, Peninsula Laboratories, Belmont, CA, (Lerner et al, 1981). The first dose of the immunogen contained 125 mg cVIP and was given as KLH-cVIP conjugate in 1.0 ml Freund's complete adjuvant made up to 2.0 ml with distilled water. The mixture was emulsified and intradermally injected into the lateral thoracic wall under the wings.

## RESULTS

**Plasma prolactin levels:** Plasma PRL level was lower ( $P \leq 0.05$ ) in the KLH-cVIP immunized group ( $36.8 \pm 3.7$  ng/ml) when compared with KLH-immunized group, which was considered as control ( $40.9 \pm 5.8$  ng/ml)

during the first week before photostimulation (Fig. 1). The PRL level of KLH-immunized control group increased to a peak level of  $129.2 \pm 16.5$  ng/ml by week 6 of photostimulation. There was a decline in plasma PRL by week 14, with levels remaining almost stable thereafter. There were significant differences in the plasma levels of PRL between KLH and KLH-cVIP-immunized turkeys during weeks 6 ( $P \leq 0.01$ ), 14 and 18 ( $P \leq 0.05$ ). The overall mean of the plasma levels of the KLH-cVIP-immunized turkeys was significantly lower ( $57.20 \pm 6.45$  ng/ml),

**Egg production:** Peak of egg production was compared under the 3 light intensities throughout 3 successive breeding seasons of 20 weeks (Fig. 2). In the first egg production period, all vaccinated groups proved superiority of the egg production under the 3 light treatments. Light treatment two (3 F.C.) exhibited the greater egg production ( $2.81 \pm 0.54$  egg/hen/week), the difference between vaccinated and non-vaccinated groups under light treatments in this concept was significant ( $P \leq 0.05$ ). Represent the peak of egg production among the three periods ( $3.09 \pm 0.41$  egg/hen/week).

The second production period: Vaccinated group under light treatment one (18-20 F.C.) exhibited the greatest egg production ( $3.26 \pm 0.60$  egg/hen/week) among all treatments, but the difference was not significant. All vaccinated groups throughout this period still superior than KLH-immunized controls.

In the third production period the light treatment (18-20 F.C.) had achieved the greatest egg production among the other treatments ( $3.02 \pm 0.35$  egg/hen/week). Average egg production of all vaccinated groups was greater than that of controls (Table, 2) and the differences between vaccinated groups were significant ( $P \leq 0.05$ ).

## DISCUSSION

The results of the present study clearly revealed that active immunization of female turkeys with KLH-cVIP prevents the rise of circulating PRL. The effect of VIP immunization on lowering PRL, is consistent with the role of hypothalamic VIP as a PRL-releasing neuropeptide in the turkey (El Halawani et al., 1990a). This concept may be supported by the reduction in plasma PRL and PRL mRNA content after passive and active immunization with VIP antibodies in vivo (Sharp et al., 1989 and Talbot et al., 1991). El Halawani et al. (1995) reported that successful immunization of female turkeys with cVIP would neutralized the effects of endogenous VIP, consequently decreasing circulating PRL levels as well as increasing egg production by preventing the expression of incubation behavior. Thus,

Turkey, light intensity, VIP immunization, reproductive performance.

active immunization against cVIP seems to have promising potential effects for increasing the egg-laying performance of turkey females.

On the other hand, prolactin plays an important role in the inhibition of the ovarian function and subsequently, egg laying. All known management procedures to discourage incubation behavior and improve egg production are based on lowering Prolactin levels. The present study demonstrated a positive effect of VIP immunoneutralization on egg production. These results agreed with those obtained by El Halawani et al., (1995, 1996), who concluded that the increased egg production observed in KLH-cVIP-immunized turkeys is the result of failure to express incubation behavior due to lower PRL levels.

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**Table (1): Prolactin levels ng/ml. (Mean  $\pm$  S.D.)**

<b>Photostimulation</b>	<b>N</b>	<b>Treatment</b>	<b>Mean <math>\pm</math> S.D.</b>
-1 wk	48	VIP	36.833 $\pm$ 3.7877
-1 wk	48	Control	40.929 $\pm$ 5.8057
6 wk	48	VIP	68.814 $\pm$ 11.0103
6 wk	48	Control	129.208 $\pm$ 16.5341
14 wk	29	VIP	49.078 $\pm$ 8.0177
14 wk	40	Control	69.462 $\pm$ 8.9005
18 wk	48	VIP	60.02 $\pm$ 5.9316
18 wk	47	Control	79.815 $\pm$ 8.1667
27 wk	47	VIP	71.313 $\pm$ 9.8639
27 wk	48	Control	68.22 $\pm$ 5.9655
	2	Pool	117.354 $\pm$ 17.7705

**Table (2): Effect of vaccination and light intensity on egg production at different periods of age (Mean/wk ± S.D.).**

Variable	N	Production period (1)		Production period (2)		Production period (3)	
		Sum.	Mean/wk ± S.D.	Sum.	Mean/wk ± S.D.	Sum.	Mean/wk ± S.D.
VAC-1	8	443	2.76 ± 0.58	522	3.26 ± 0.60	500	3.12 ± 0.44
VAC-2	8	436	2.72 ± 0.25	489	3.05 ± 0.21	468	2.92 ± 0.22
Light-1	16	879	2.74 ± 0.42	1011	3.15 ± 0.44	968	3.02 ± 0.35
VAC-1	8	477	2.98 ± 0.34	519	3.24 ± 0.43	508	3.17 ± 0.36
VAC-2	8	423	2.64 ± 0.09	484	3.02 ± 0.47	443	2.67 ± 0.54
Light-2	16	900	2.81 ± 0.54	1003	3.13 ± 0.45	951	2.97 ± 0.49
VAC-1	8	467	2.91 ± 0.36	489	3.05 ± 0.33	479	2.99 ± 0.30
VAC-2	8	419	2.61 ± 0.29	465	2.90 ± 0.31	444	2.77 ± 0.42
Light-3	16	887	2.76 ± 0.33	954	2.98 ± 0.32	923	2.88 ± 0.37
Overall	48	2667	2.77 ± 0.32	2968	3.09 ± 0.41	2843	2.96 ± 0.38

Production period 1, 2 and 3 = 20 wk

VAC-1 = VIP, VAC-2 = Control, Light-1 = 18-20 F.C., Light-2 = 3 F.C., Light-3 = 0.2-0.3 F.C.

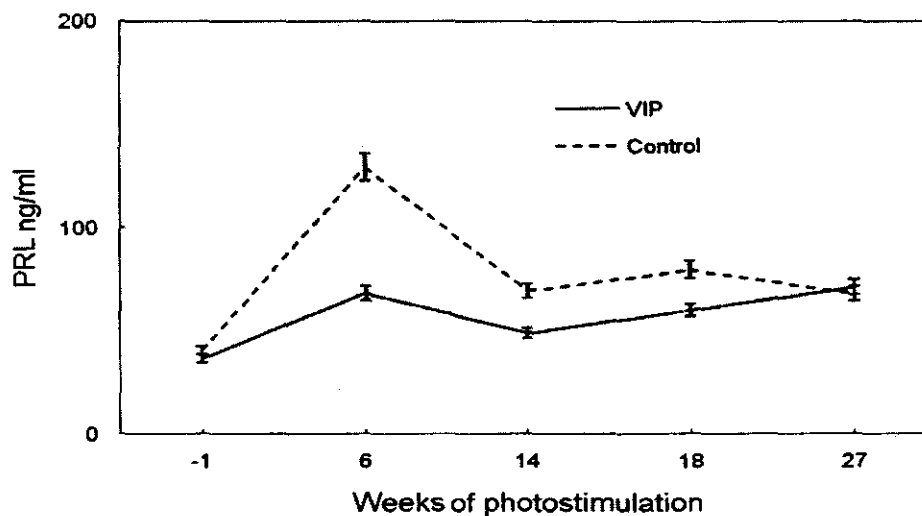
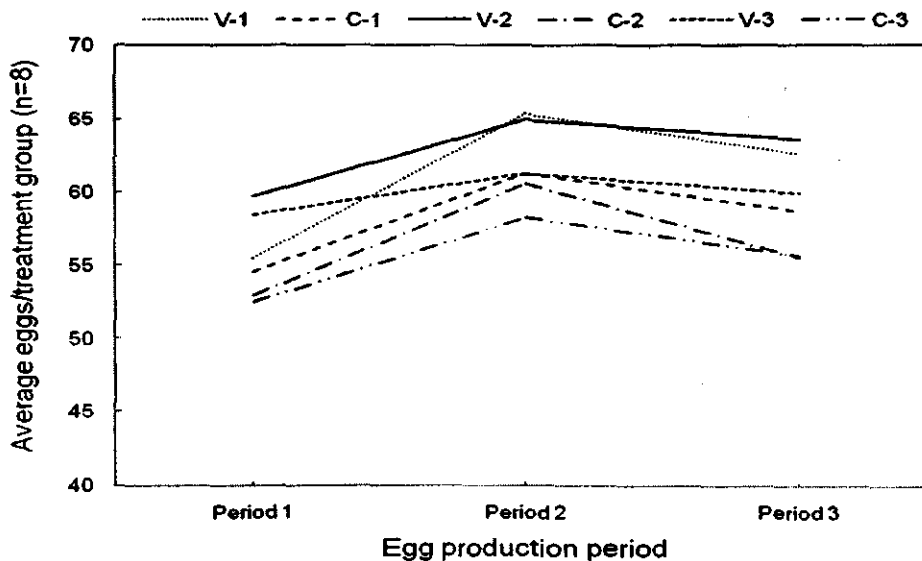


Fig. (1): Prolactin levels by photostimulation period.



V-1=VIP under 18-20 F.C.      C-1= Control under 18-20 F.C.  
 V-2=VIP under 3 F.C.  
 C-2= Control under 3 F.C.      V-3= VIP under 0.2-0.3 F.C.  
 C-3= Control under 0.2-0.3 F.C.

Fig. (2): Egg production by period for different groups.

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### الملخص العربي

### دور كثافة الضوء علي الكفاءة الانتاجية لدجاجات الرومي

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للضوء تأثير رئيسي علي الوظيفة التناسلية للرومي و الغرض من هذا البحث هو:-

(١) دراسة تأثير كثافة الضوء اثناء فترات البداية و النمو علي الكفاءة التناسلية لدجاجات الرومي،  
(٢) تأثير VIP (Vasoactive intestinal peptide) علي معادلة المناعة وبالتالي علي الكفاءة التناسلية لدجاجات الرومي،

(٣) تأثير استخدام كلاً من كثافة الضوء و VIP علي مستوى هرمون البرولاكتين في بلازما الدم .  
استخدم في هذا البحث عدد ٥٧٦ دجاجة رومية من نوع النيكولاس الابيض الكبير. تم تعريض الاناس الي ثلاث كثافات اضاءة مختلفة هي من ١٨-٢٠ FC و ٢ FC و من ٠.٢-٠.٣ FC. و تحت كل معاملة ضوئية تم تقسيم اناث الدجاج الرومي الي تحت مجموعتين:

(١) مجموعة كنترول و تحقن بال (Keyhole Limpet Homocyanin) KLH

(٢) المجموعة المعاملة و تحصن ضد ال VIP.

و اوضحت نتائج هذا البحث انه في الطيور المحصنة بـ KLH-cVIP كان متوسط مستوي البلازما من KLH-cVIP اقل بصورة معنوية جداً (٠.٢٠±٥٧.٢٠ نانوجرام/مل) من تلك المحصنة فقط بال KLH الكنترول (٠.٥٢±٧٧.٤٥ نانوجرام/مل).

تؤثر شدة الاضاءة علي انتاج البيض فالمعاملة الأولى اظهرت انتاج بيض اكثر من المجموعات الباقية من شدة الاضاءة (٠.٨١±٠.٥٤ بيضة /دجاجة/اسبوع).

كانت الاختلافات بين المجموعة المحصنة و الغير محصنة معنوية وكان متوسط انتاج البيض لكل المجموعات المحصنة اكثر من تلك الكنترول.