EFFECTS OF DIFFERENT INDUCED MOULTING METHODS ON PLASMA THYROID HORMONES OF LAYING HENS

Farklı Tüy Dökümü Metotlarının, Yumurta Tavukların Plazma Tiroid Hormonları Üzerine Etkileri

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Özet

Bu çalışmada iki farklı tüy dökümü metodunun, yumurta tavukların plazma thyroxine (T4) ve triiodothyroxine (T3) konsantrasyonlarına olan etkisinin araştırılması amaçlanmıştır. Çalışmada, 72 haftalık, 96 adet Isabrown tavuğu seçilerek iki odaya ayrıldı. İlk odada 24 tavuk içeren iki kontrol grubu açlık (Açlık Kontrol grubu ve Düşük sodyumlu yem verilen Kontrol grubu) diğer odada ise 24 tavuk içeren iki deneme grubu (Açlık grubu ve Düşük sodyumlu yem verilen grup) kafeslere yerleştirildi. Tüy dökümünün programının başlamasıyla ilk 10 gün, Açlık grubunun yem verilmedi. Tavuklar 11.günden 41 .güne kadar yarka büyütme yemi ile beslendiler, 41. günden sonra yumurta tavuğu yemine geçildi. Düşük Na grubu 41. güne kadar % 0.08 sodyum içeren yumurta tavuğu yemi ile beslendi ve 41. günden sonra yumurta tavuğu yemine geçildi. Kontrol grubundaki tavuklar deney periyodu süresince yumurta tavuk yemiyle beslendi. Her iki deney grubunda tüy dökümü öncesi periyotta plazma T3 konsantrasyonu, tüy dökümü periyodundakinden daha düşük bulundu ($p<0.05$). Tüy dökümü öncesi periyotta plazma T4 konsantrasyonu da tüy dökümü dönemi ve tüy dökümü sonrası periyotlarından daha düşük ölçüldü ($p<0.05$). Her iki tüy dökümü metodu birbiriyle karşılaştırıldığında Düşük Na grubunun T4 konsantrasyonu Açlık grubundan daha

yüksek bulundu. Her iki deneme grubunun T3 konsantrasyonu, tüy dökümü sonrası periyot dışında birbirine benzer bulundu. Çalışma sonucunda daha çok tercih edilen bir metot olan düşük sodyum içeren diyetle beslenme metodunun, tiroit metabolizması üzerine üzerine açlık metodu kadar etkili olduğu görülmüştür..

Anahtar kelimeler: Aç bırakma metodu, yumurtacı tavuk, düşük sudyum diyeti, tüy dökümü, tiroid hormonları.

Summary

The objective of the study is to assess the effect of two different induced moulting methods on plasma thyroxine (T_4) and triiodothyronine (T_3) concentrations of laying hens. In this study, 96 Isabrown hens, 72-weeks of age were used. The hens were randomly divided into two rooms. Two control groups (FAST CON and Lo Na CON) were caged in the first room, each containing 24 hens, and two treatment groups (FAST and Lo Na) were caged in the second room, each containing 24 hens. Feed was withdrawn from the hens in the first treatment group (FAST) for 10 days and water were provided *ad libitum*. The photoperiod was reduced to 7h/day. On day 11, hens consumed the standard pullet grower ration *ad libitum* until day 41 and hens were returned the standard full feed layer ration and received. Lo Na group was fed layer ration containing 0.08 % sodium until 41 days. The hens in the control groups were fed the standard layer ration during experimental periods. In both experimental groups, plasma T_3 concentrations in the premoult period were lower than moulting periods ($p<0.05$). The plasma T_4 concentrations in premoult period were also measured lower than moult and postmoult periods ($p<0.05$). When two moulting procedures compared with each other, T_4 concentrations of Lo Na group were higher than FAST group. But, T_3 concentrations of both experimental groups were nearly similar with each other, except postmoult period. As

conclusion, results of this study indicated that low sodium diet as effective as fasting method, when T_3 and T_4 concentrations were taken into consideration.

Key words: Fasting method, Laying hence, Low sodium diet, Moulting, Thyroid hormones

Introduction

Chickens normally go through periodic moults and do not produce egg during moult. If they were allowed to moult naturally, it is alleged that this would be problematical for the producer because it would be erratic. Therefore, after one year of production, the hens are forced to moult (North and Bell 1990, Wolford 1984). Induced moult occurs when the bird's organism is stressed by some source that alters their environment. The most common ones are: lack of food and water, decrease of light, and change in diet. Food withdrawal can be done up to 10 days. The changes in diet usually are low calcium, low sodium and high zinc diet. All of these methods can be done separately or in any combination with each other (Alodan and Mashaly 1999). The regression of the reproductive tract is very pronounced during the cessation of egg laying and ovarian regression precedes the regression of the oviduct and shell gland (Decuypere and Verheyen 1986, Berry and Brake 1987). The induction of moult is more or less linked with feather rejuvenation and this criteria is suggested to be an indication of subsequent production level (Brake et al. 1979).

Inhibition or induction of ovulation during the cessation of egg laying or at the beginning of the second production year, together with interactions of the same hormones upon the hypothalamo-hypophyseal-ovarian axis. Upon this axis, interaction of other hormones are grafted, and especially thyroid hormones are known to have antigonodotropic effects (Decuypere and Verheyen 1986, Brake et al. 1979, Herremans et al. 1988, Hoshino et al. 1988, Sekimoto et al. 1986). 3,5,3 *-triiodothyronine (T_3), and Thyroxine (T_4), plays major

metabolic roles in growth, egg production, and moulting progress of poltry (Herremans et al. 1988, Hoshino et al. 1988, Dicerman and Bahr 1988, Peebles et al. 1994, Renden et al. 1994). The forced moult induced by starvation, partial water and light restriction effect on thyroxine (T_4), triiodothyronine (T_3) concentrations of hens (Brake et al. 1979, Sekimoto et al. 1986, Davis et al. 2000, Dickerman 1989, Verheyen et al. 1986, Rodrigues et al. 1991). Lien and Siopes (1993) suggested that thyroid hormones were involved in termination of egg production and initiation of moult. Therefore, this study was designed to investigate the effects of different induced two moulting programs on T_3 and T_4 concentrations in laying hens.

Materials and Methods

In this study, 96 Isabrown hens, 72 weeks of age were used. The hens were randomly placed into two rooms (experimental groups and control groups). Two hens were housed in one cage (24x41x45) and received 17h light and 7h darkness/day. The hens in the first room were randomly divided into two treatment groups (FAST and Lo Na), each containing 24 hens. In the premoult period, the hens of both experimental groups were fed the standard full feed layer ration until the moulting periods. Feed was withdrawn from the hens in the first treatment group (FAST) for 10 days and water were provided *ad libitum*. The photoperiod was reduced to 7h/day. On day 11, hens consumed the standard pullet grower ration *ad libitum* until day 41 and hens were returned the standard full feed layer ration and received 17h of light/day on day 42. In the second group (Lo Na) was fed the layer ration containing 0.08 % sodium for 41 days and water was provided *ad libitum*. The photoperiod was reduced to 7h/day. Hens were returned to the standart full feed layer ration and received 17h of light/day on day 42. The contents of the standard full feed layer ration, the pullet grower ration and layer ration containing 0.08 % sodium were given table 1, 2 and 3, respectively.

The hens in the second room were divided into two control groups (Lo Na CON and FAST CON) and were fed the standard full feed layer ration during the study. Water was provided *ad libitum*. Blood samples were taken in premoult, on days 5 and 10 of the moulting period, and on days 20 and 60 of the post moulting period of FAST and FAST CON groups. The blood samples of Lo Na and Lo Na CON groups were taken in premoult, on days 21 and 42 of the moulting period, and on days 20 and 60 of the post moulting period. Blood samples were collected from brachial vein to obtain plasma samples. Plasma samples were collected at –20 ^{0}C until analysis. Plasma samples were thawed at room temperature and T_3, and T_4 concentrations were determined using commercially available radioimmunoassay kits (CT RIA T_3 DLS-3100 and T_4 DLS-3200, Diagnostics Systems Laboratories, Inc.USA)

Statistical Analysis All statistical analyses were carried out using the SPSS statistical analysis software (SPSS, Version 11.5). Duncan's multiple comparisons test was used to determine differences of T_3 and T_4 concentration among the moulting periods and independent-samples t test was used to determine differences between two experimental groups. All data were expressed as the mean ± SD.

Results

Plasma T_3 and T_4 concentrations in the experimental and control groups are presented in Table 4. Plasma T_3 concentrations of Lo Na and FAST groups in the premoult and postmoult periods were lower than the moulting periods ($p<0.05$). Plasma T_3 concentrations of these groups reached the lowest concentration at the end of the postmoult period. Plasma T_4 concentrations in both experimental groups were the lowest concentrations in premoult period ($p<0.05$) and then increased during the moult and postmoult periods ($p<0.05$). When Two moulting procedures were compared with each other, especially, plasma T_4 concentrations of Lo Na group were significantly higher than FAST group ($p<0.05$) in the moulting periods and

postmoult 2. T_3 concentrations of Lo Na group were nearly similar with those of FAST group during the experimental periods. T_3 and T_4 concentrations of both experimental groups were higher than control groups during the study, except T_3 concentrations in the postmoult period.

Discussion

The forced moult is an economically beneficial of laying hens to extend their productive life (Alodan and Mashaly 1999, Berry and Brake 1987, Herremans et al. 1988, Kaygısız, 2006) Several hormones have been suggested as candidates to control the process of moulting (Decuypere and Verheyen 1986, Brake et al. 1979, Hoshino et al. 1988, Davis et al. 2000). The fact that old feathers are gradually expelled by newly developing ones during moulting, suggestion that the hormonal control of moulting is associated with a stimulation of the feather papillae. Throoxine treatment has been shown to increase acid phosphatase activity in the feather papillae (Brake et al. 1979). Thyroid hormones seem to be crucial importance to the control of feather renewal accompanying an induced cessation of egg-laying. (Davis et al. 2000). There are different observations about thyroid hormones concentrations during moulting process (Wolford 1984, Hoshino et al. 1988, Dickerman 1989, Rodrigues et al. 1991)

Davis et al. (2000) reported that plasma T_3 and T_4 concentration varied regarding the age and egg production cycle of the hens. Plasma T_3 concentration decreased to its lowest concentration during the peak egg production, increased to its highest concentration during mid-egg production, and then decreased until the moult. Plasma T_4 concentration was at its lowest concentration subsequence the mid-egg production period and then increased during the moult and postmoult period. Linien and Siopes (1993) observed a similar response in turkeys. Plasma T_3 concentrations of turkeys peaked during the early onset of lay and then steadily declined during the remainder of the egg production cycle. Brake et al. (1979) found

a subsequent increase in plasma T_4 concentration of hens during and after moulting period. Hoshino et al. (1988) assumed that plasma T_4 and T_3 concentrations increased during moulting. Whereas, Rodrigues et al. (1991) suggested that plasma T_4 and T_3 concentrations in hens were decreased by starvation. The results relating to FAST group in the study are parallel with the results obtained by Davis et al. (2000), Brake et al. (1979) and Linien and Siopes (1993). Verheyen et al. (1986) reported that the time courses of T_3 and T_4 concentrations in the group fed low sodium diet were nearly similar with fast group. In this study, the time courses of T_3 and T_4 concentrations of both experimental groups were also observed to be similar with each other. The decreases in T_3 circulation appear to be related to peak egg production, whereas the increases in plasma T_4 concentration appear to be associated with the moult. The postmoult period is a time of regrowth and regeneration of the reproductive tract and feathers. Thus, elevated T_4 may be related to the metabolic effects required for regrowth and regeneration (Brake et al. 1979, Hoshino et al. 1988, Davis et al. 2000, Dickerman 1989). Some authors obtained results with low Na nearly as efficient as the fasting methods (Brake et al. 1979, Davis et al. 2000, Verheyen et al. 1986) In the present study, when the Lo Na group were compared with FAST group, plasma T_4 and T_3 concentrations were higher than FAST group in Moulting 1, 2 and Postmoult periods. As conclusion, results of this study indicated that low sodium diet as effective as fasting method, when T_3 and T_4 concentrations were taken into consideration.

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Table 1- The content of the standard pullet grower ration.

Ingredients	%	Nutrient Content and Energy levels	%
Corn	42.00	Dry matter	88.00
Extracted soybean meal (45 %)	26.00	Crude protein	21.70
Wheat	11.00	Crude fibre	4.30
Full fatt soybean	10.00	Ash	4.00
Sunflower meal	5.00	Crude fat	6.00
Fat	2.00	Ca	1.00
Dicalcium fhosphate	2.00	P	0.80
DL-Methionine	0.30	Metabolisable energy (ME Kcal/kg)	3000
Limestone	1.00		
Vitamin+mineral premix*	1.00		
Salt	0.30		

*Composition of vitamin premix per kilogram of premix: Vitamin E. 20 mg/kg; Vitamin A. 10.000.000IU; vitamin D3. 1.500.000 IU; vitamin K3. 3 mg /kg; vitamin B1. 2mg; vitamin B2. 5 mg: vitamin B6. 3 mg; vitamin B12. 15 mg; Ca pantothenate. 6 mg; Niacin 25 mg; Folic acid. 750 mg.

Composition of trace elements premix per kilogram of premix: Mn.80 mg; Fe. 60 mg; Zn. 60 mg; Cu. 5 mg: Co 500 mg; Se. 150 mg.

Table 2- The content of the standart full feed layer ration.

Ingredients	%	Nutrient Content and energy levels	%
Corn	30.00	Dry matter	89.00
Wheat	25.00	Crude protein	17.50
Full fatt soybean	11.00	Crude fibre	5.00
Sunflower meal	15.00	Ash	12.00
Fat	0.80	Crude fat	5.20
Dicalcium phosphate	2.00	Ca	3.90
DL-Methionine	0.10	P	0.85
Limestone	9.50	Metabolisable energy (ME Kcal/kg)	2750
Vitamin+mineral premix*	1.00		
Salt	0.30		
Meat and bone meal	3.00		
Gluten	2.00		
L-Lysine	0.20		
Antioxdant	10mg/kg		

*Composition of vitamin premix per kilogram of premix: Vitamin E. 20 mg/kg; Vitamin A. 10.000.000IU; vitamin D3. 2.000.000 IU; vitamin K3. 3 mg /kg; vitamin B1. 3 mg; vitamin B2. 6 mg: vitamin B6. 4 mg; vitamin B1. 2; 15 mg; Ca pantothenate. 10 mg; Niacin 25 mg; Folic acid. 1mg; D Biotin; 25 mg .

Composition of trace elements premix per kilogram of premix: Mn. 80 mg; Fe .60 mg; Zn. 60 mg; Cu. 5 mg: Co 500 mg; Se. 150 mg.

Table 3- The content of the full feed layer ration containing 0.08 % sodium.

Ingredients	%	Nutrient Content and energy levels	%
Corn	42.00	Dry matter	88.00
Extracted soybean meal (45 %)	26.00	Crude protein	21.70
Wheat	11.00	Crude fibre	4.30
Full fatt soybean	10.00	Ash	4.00
Sunflower meal	5.00	Crude fat	6.00
Fat	2.00	Ca	1.00
Dicalcium fhosphate	2.00	P	0.80
DL-Methionine	0.30	Metabolisable energy (ME Kcal/kg)	3000
Limestone	1.00		
Vitamin+mineral premix*	1.30		
Antioxdant	10mg/kg		

*Composition of vitamin premix per kilogram of premix: Vitamin E. 20 mg/kg; Vitamin A. 10.000.000IU; vitamin D3. 2.000.000 IU; vitamin K3. 3 mg /kg; vitamin B1.3 mg; vitamin B2. 6 mg: vitamin B6. 4 mg; vitamin B12; 15 mg; Ca pantothenate. 10 mg; Niacin 25 mg; Folic acid. 1mg; D Biotin; 25 mg .

Composition of trace elements premix per kilogram of premix: Mn. 80 mg; Fe .60 mg; Zn. 60 mg; Cu. 5 mg: Co 500 mg; Se. 150 mg.

Table 4. Plasma T_4 and T_3 concentrations of two different induced moulting methods during premoult, moulting, postmoult periods (n=24)

	Group	Premoult	Moulting 1	Moulting 2	Postmoult 1	Postmoult 2
T_4 (µg/ml)	Lo Na	58.75±30.79^{b}	154.38±36.98^{a*}	162.50±42.00^{a*}	152.50±52.58^{a}	171.25±51.39^{a*}
	Lo Na CON	55.00±24.49	51.25±35.65	67.50±19.09	68.75±31.37	77.50±13.89
	FAST	61.25±24.75^{b}	103.75±31.14^{a}	121.25±11.26^{a}	103.75±46.27^{a}	117.50±30.12^{a}
	FAST CON	55.00±24.49	77.50±32.40	80.00±27.26	72.50±14.88	81.25±25.32
T_3 (µg/ml)	Lo Na	0.64±0.22^{b}	0.87±0.18^{a}	0.92±0.18^{a}	0.57±0.16^{b}	0.41±0.10^{b*}
	Lo Na CON	0.63±0.07	0.65±0.14	0.68±0.08	0.68±0.11	0.58±0.12
	FAST	0.66±0.20^{b}	0.92±0.32^{a}	0.90±0.09^{a}	0.63±0.12^{b}	0.24±0.15^{c}
	FAST CON	0.57±0.05	0.56±0.10	0.56±0.11	0.58±0.07	0.59±0.11

^{a,b,c}: Means within the same line with different letters differ ($p< 0.05$)

*: $p< 0.05$ (Lo Na group vs FAST group)

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