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The effects of different moulting diets on bone characteristics and reproductive tracts in commercial brown egg laying hens

Hüseyin Yıldız[1]*, and Fazlı Alpay[2]

[1]*Anatomy Department, Faculty of Veterinary Medicine, Uludag University, Bursa, Turkey*
[2]*Zootechnics Department, Faculty of Veterinary Medicine, Uludag University, Bursa, Turkey*

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ABSTRACT

Feeding with barley and alfalfa in hens during induced moulting diets and their effects on the bone characteristics and the reproductive tracts were investigated. For this purpose, 88 week old 36 Lohmann Brown laying hens were divided into three homogenous groups and each group was fed: i) normal commercial feed ii) barley and iii) alfalfa over the ten day moulting period. The recorded body mass loss of each group over this period was around 18-19%. Although a relative increase in body mass was observed for all groups at the end of the second production cycle, only the value obtained for the normal commercial feeding group had statistical significance ($P<0.001$). Moulting diets had no influence on the length and mass of bones. Meanwhile, cortical thickness of the femur and tibiotarsus was higher in the alfalfa fed group compared to the other groups ($P<0.05$). Furthermore, the oviduct mass of the barley group was significantly heavier compared to the others ($P<0.05$).

Key words: chicken, moulting, bone strength, oviduct

Introduction

In modern egg production, in order to reduce operating costs, at the end of their productive live commercial layers are subjected either to a new laying cycle or moulting programme to extend their laying cycle. Traditional moulting programmes implying feed and water withdrawal result in induced stress conditions and are criticized by Animal Welfare Protection Associations. To overcome this problem, some new techniques, such as feeding layers with grain composed of barley or alfalfa have been developed (NORTH and BELL, 1990; HURWITZ et al., 1998; IBRAHIM, 1998).

For egg producers, egg prices play an important role in making the decision to implement an induced moulting programme and generally a positive correlation exists between feed prices and execution of the programme (McDANIEL and ASKE, 2000).

*Contact address:
Assoc. Prof. Dr. Hüseyin Yıldız, Anatomy Department, Faculty of Veterinary Medicine, Uludag University, 16059 Bursa, Turkey, Phone: +90 224 442 92 00; Fax: +90 224 442 80 25; E-mail: yildiz@uludag.edu.tr

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Although the quality and yield of eggs, as well the laying period of hens are increased by the moulting programme, some health problems, such as bone fractures, may occur, especially in older animals (HUGHES et al., 1993; NEWMAN and LEESON, 1997; KOCH et al., 2004). Over the moulting period slight body mass loss may occur nevertheless, and the ovaries may be influenced greatly. By the onset of egg production after the moulting period the mass and the mass of ovaries and oviducts could be lower than those measured prior to induced moulting (YOSEFI et al., 2003; BIGGS et al., 2004).

In the present survey the use of barley and alfalfa as a moulting diet over a 10 day period was investigated to determine their influence on ovary, oviduct and bone characteristics in commercial layer hens.

Materials and methods

Eighty-eight week old 36 laying hens (Lohmann Brown) used as material were obtained from the Applied Research Centre for Veterinary Faculty of Uludag University, Turkey.

As the second production cycle performance may be dependent on the pre-moulting body mass of animals (AKŞIT et al., 2003), the hens were first weighed (1991.60 ± 377.55 g) and divided into three homogeneous groups: control and two experimental. They were kept individually in cages and the moulting program described in Table 1 was applied for the groups.

Table 1. Feeding, water and lighting programme for control and experiment groups

Groups	Feed	Water	Lighting
Non moult control	Normal commercial feed	*Ad libitum*	Total 16 h lighting (day + night)
Barley	0-10th day *ad libitum* barley 10th day to end of experiment: normal commercial feed	*Ad libitum*	Total 16 h lighting (day + night)
Alfalfa	0-10th day *ad libitum* alfalfa 10th day to end of experiment: normal commercial feed	*Ad libitum*	Total 16 h lighting (day + night)

On the 10th day, which is the end of the moulting period, six animals from each group were weighed and sacrificed humanely by decapitation (ANONYMOUS, 2003). The experimental procedures were carried out according to the guidelines of the Uludag University Experimental Animals Ethical Committee, Turkey. The tibiotarsus and femur were immediately dissected from the surrounding tissues. The mass (Precisa XB 4200C, Switzerland), and length (Digital Calipers, Mitutoyo Corporation, Japan) of the bones

were measured. To assess the frontal cortical thickness of the bones a horizontal cut was performed from the centre of the longitudinal length (KESTIN et al., 1999; REITER and KUTRITZ, 2001). The body cavity was opened and the mass of the ovary and oviduct weighed with digital balances (Densi DS-20 Turkey and Sartorius H110, USA, respectively).

The remained six hens from each group were fed normal commercial feed until the end of the 2nd month (second production cycle). Normal commercial feed contained 14.5% protein, 0.35% methionine, 0.72% Lysine, 1.10% linoleic acid, 0.50% sodium, 3.50% calcium, 0.50% phosphorus and 2.85% kcal ME/kg. They were also sacrificed humanely by decapitation and tested for the same parameters.

Body mass, bone properties and the mass of reproductive tracts of hens in the groups were analysed using ANOVA with the general linear model procedure of the SPSS statistics package programme (ANONYMOUS, 1999). When differences among the groups were significant, means were separated using the Paired Samples T Test.

Results

Non-significant changes were observed in body mass among the groups throughout the moulting period (Table 2). The body mass increased during the second production cycle in all groups, where a statistical significance was observed only in the non-moult control group ($P<0.001$).

Table 2. Mean (± SE) body mass (g) of hens at the end of the moulting period and second production cycle

Groups	End of the moulting period	End of the second production cycle
Non-moult control	1958.00 ± 196.90[a]	2428.00 ± 237.75[b]
Barley	1624.80 ± 347.76	2240.33 ± 205.84
Alfalfa	1638.00 ± 204.05	2483.00 ± 303.81

[a,b]- Means with different superscripts differ in rows ($P<0.001$)

Moulting diet had no influence on the mass and length of bones (Table 3, Fig. 1). For the control and alfalfa groups, a significant difference was observed for the cortical thickness of the femur ($P<0.05$). The measured cortical thickness of the tibiotarsus was considerably higher for the alfalfa group compared to the other groups ($P<0.05$).

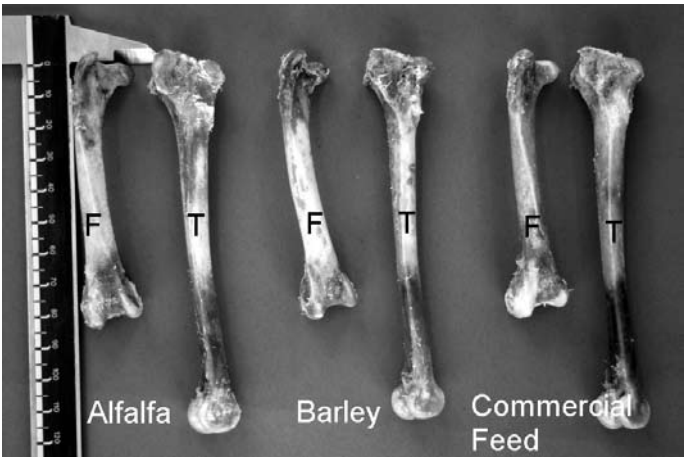

Fig. 1. The length of Femur (F) and Tibiotarsus (T) of hens

For all groups, normal commercial feeding given in the second production cycle had no influence on the morphometric characteristics of bones (Table 4).

In all the groups, the moulting programme had no remarkable effect on the mass of the ovaries and oviducts. At the end of the second production cycle, statistical differences were observed in oviduct mass between the barley and control groups and also the barley and alfalfa groups ($P<0.05$) (Table 5).

Table 3. Mean (± SE) for the morphometric characteristics of femur and tibiotarsus at end of the moulting period.

		Femur			Tibiotarsus		
Groups	n	Mass g	Length mm	Cortical thickness mm	Mass g	Length mm	Cortical thickness mm
Non-moult control	6	84.85 ± 1.13	5.75 ± 0.24	0.89 ± 0.01^{b}	113.19 ± 1.30	8.26 ± 0.36	0.88 ± 0.01^{b}
Barley	6	86.51 ± 0.77	5.95 ± 0.55	0.91 ± 0.01^{ab}	114.79 ± 1.34	8.04 ± 0.75	1.03 ± 0.02^{b}
Alfalfa	6	85.86 ± 1.21	6.28 ± 0.36	1.10 ± 0.03^{a}	114.48 ± 2.07	8.28 ± 0.55	1.32 ± 0.03^{a}

^{a,b}- Means with different superscripts differ in columns ($P<0.05$)

Table 4. Mean (± SE) for the morphometric characteristics of femur and tibiotarsus at the end of the second production cycle

		Femur			Tibiotarsus		
Groups	n	Mass g	Length mm	Cortical thickness mm	Mass g	Length mm	Cortical thickness mm
Non-moult control	6	6.82 ± 0.38	81.38 ± 1.00	1.19 ± 0.01	9.15 ± 0.79	116.83 ± 1.39	1.15 ± 0.01
Barley	6	7.81 ± 0.55	85.22 ± 1.63	1.23 ± 0.01	9.73 ± 0.56	118.14 ± 2.51	1.14 ± 0.01
Alfalfa	6	7.70 ± 0.68	83.97 ± 1.30	1.18 ± 0.02	9.64 ± 0.75	120.14 ± 1.97	1.07 ± 0.01

Table 5. Mean (± SE for the mass of ovary and oviduct at the end of the moulting and second production cycle

		Ovary mass		Oviduct mass	
Groups	n	End of the moulting period	End of the second production cycle	End of the moulting period	End of the second production cycle
Non-moult control	12	0.37 ± 0.02	0.46 ± 0.01	2.78 ± 0.44	3.40 ± 0.23 [a]
Barley	12	0.38 ± 0.01	0.41 ± 0.02	1.69 ± 0.35	1.75 ± 0.15 [b]
Alfalfa	12	0.28 ± 0.01	0.36 ± 0.01	2.85 ± 0.93	3.11 ± 0.17 [a]

[a,b]- Means with different superscripts differ in columns ($P<0.05$)

Discussion

By the present study, the moulting programs composed of barley and alfalfa grains were investigated for their possible effects on body mass, leg bone characteristics and the reproductive tracks of commercial laying hens.

During the moulting programme, measured body mass loss in the barley and alfalfa groups was around 18-19%. This value is below those of reported by several authors (HUSSEIN, 1996; HURWITZ et al., 1998; ZUMBADO et al., 1998; ALODAN and MASHALY, 1999; OCAK et al., 2004) which varied between 25-30%. We thought that, compared to stressful traditional moulting techniques based on feed and water deprivation, the present technique was efficient particularly in the reduction of starvation linked stress factors, hence it is based on more humane grounds. In control group birds, measured body mass loss was around 2%, this could be normal and attributed to the aging of the birds.

The skeletal integrity of the birds at the end of laying and genetic selection of poultry towards maximum intensive production has created a predisposition to disorders of the skeletal system (LEACH and LILBURN, 1992; NEWMAN and LEESON, 1997; TOLON and YALÇIN, 1997; CRESPO et al., 2000; TATARA et al., 2004; TATARA, 2006). In hens, to evaluate the strength of bones, structural and strength characteristics of the tibiotarsus and femur are accepted as important criteria and the breaking strength of a bone is closely related to its morphometric properties (FLEMING et al., 1994). The force applied to the bone is spread by the cortical area and endosteum (NEWMAN and LEESON, 1998). In the present study the highest cortical thickness was measured in the alfalfa fed group. As described in the literature, this could be explained by the higher Ca and P content of alfalfa (SAUVANT et al., 2004). At the end of the second production period, statistically there was no difference between the groups regarding the cortical thickness, suggesting that normal commercial feeding repaired deficiencies occurring during moulting.

There are conflicting reports on the influence of moulting on ovary and oviduct masses. OGUIKE et al. (2005) reported a certain extend of regression in ovary mass, while some others observed no influence on ovary and oviduct masses (LEE, 1982; AKŞIT et al., 2003; BIGGS et al., 2004). Statistically, we could not detect any difference either between the periods or groups regarding the ovary mass. Similarly, for the oviduct mass, the difference was not significant between the periods, while it was statistically important between the groups in the second production cycle. This could also be explained by taking into account that moulting resulted in the rejuvenation of the reproductive tracts of old laying hens, preparing them for a second production cycle.

Alfalfa feeding during the induced moulting programme resulted in a relatively lower level of body mass loss and higher cortical thickness, thus provided not only reduced stress factors but also improved bone strength. Finally, the results obtained by the present study would also be important to assure higher animal welfare quality and to diminish the criticisms of Animal Welfare Protection Associations.

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SAŽETAK

Istraženi su učinci hranidbe nesilica ječmom i lucernom na svojstva kostiju i spolnih organa u tijeku mitarenja izazvanoga hranom. U tu je svrhu 36 nesilica, Lohmann Brown, u dobi od 88 tjedana, bilo podijeljeno u tri skupine od kojih je jedna skupina dobivala normalnu komercijalnu hranu, druga skupina ječam, a treća skupina lucernu tijekom deset dana u razdoblju mitarenja. Gubitak tjelesne mase u svakoj skupini u tom je razdoblju iznosio od 18 do 19%. Iako je relativno povećanje tjelesne mase zabilježeno u svim skupinama na kraju drugoga ciklusa proizvodnje, statistički značajne vrijednosti ($P<0,001$) dobivene su samo za skupinu hranjenu normalnom komercijalnom smjesom. Hrana za mitarenje nije imala utjecaj na dužinu i masu kostiju. Međutim, kortikalno zadebljanje femura i tibiotarzusa bilo je veće u skupini koja je dobivala lucernu nego u ostalim skupinama ($P<0,05$). Nadalje, masa jajovoda skupine hranjene ječmom bila je značajno veća u usporedbi s drugim dvjema skupinama ($P<0,05$).

Ključne riječi: kokoš, mitarenje, čvrstoća kostiju, jajovod