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The effect of early nutrient supply on growth, development and body composition of pullets

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ABSTRACT

From the nutritionist's point of view it seems that egg production cannot be increased during the laying period alone by satisfying exclusively the nutrient needs of the laying hen during the actual production period. An experiment was conducted to evaluate the effects of the different nutrient supply in the early stages of pullet rearing and will this early nutrition influence the development of certain organs or organ systems that are involved in determining the success of the resulting egg production cycle. An experiment was conducted with two genotypes (Hy-Line variety White 98 and Hy-Line variety Brown) at the University of Kaposvár. The experiment was designed in a 2x2 factorial with 7 replicates of floor pens with 175 pullets in each. One group received a special pre-starter feed while the other group was fed a regular commercial starter feed from day-old to 4 weeks of age. The results showed that layer genotypes responded differently to the test feeding regimens. Furthermore, body weight differed between the test and control feed at 4 weeks of age (body weight: 288 gram vs. 243 gram, difference of 15.6%) and 18 weeks (body weight: 1452 gram vs. 1411 gram, difference of 2.9%) also. Brown type pullets diverted nutrients to develop their skeleton system (keel bone length 116 mm vs. 107 mm and weight of the tibia 11.46 gram vs. 10.2 gram), the liver and their reproductive organs. Conversely, white leghorns diverted their nutrient intake mainly towards the development of their reproductive tract ($P<0.05$).
(Keywords: feeding of pullets, pre-starter feed, growth, development of organs)

ÖSSZEFOGLALÁS

A jércék korai táplálóanyag-ellátottságának hatása a növekedésre, fejlődésre és a testösszetételre
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Hat évtizeddel az első tojóhibridek megjelenése után takarmányozási szempontból úgy tűnik, hogy a tojástermelési időszakban a tojótyúkok táplálóanyag szükségletének „jobb" kielégítésével már nem lehet érdemben fokozni a tojástermelést. A nevelési és a tojástermelési időszak kapcsolatának ismeretében joggal merül fel az a kérdés, hogy a jércenevelés időszakában – és annak is különösen a korai szakaszában – a fejlődés szempontjából kritikus időszak táplálóanyag-ellátottsága hogyan befolyásolja a jércék növekedését, az egyes szervek, szervrendszerek fejlődését, ezen keresztül pedig a későbbi tojástermelést. A Kaposvári Egyetemen két eltérő típusú tojóhibridet (Hy-Line variety White 98 és Hy-Line variety Brown) vizsgáltunk. A kezelések között csak a nevelés első négy hetében etetett takarmány összetételében – speciális prestarter indító (kísérleti), ill. kereskedelmi indító

(kontroll) táp – volt különbség. A Leghorn típusú és a középnehéz testű tojóhibridek a nevelés ideje alatt eltérő módon reagáltak a kezelésre. A kísérleti és a kontroll takarmányt fogyasztó csoportok között négyhetes korban mért testtömeg-különbség (testtömeg: 288 g, illetve 243 g, a különbség 15,7%) relatíve csökkent, de a nevelési periódus végéig (18 hetes kor) megmaradt (testtömeg: 1452 g és 1411 g, a különbség 2,9%). Az eltérő testtömegből adódó különbséget a középnehéz hibrid a csontos váz (mellcsonti taréj 116 mm és 107 mm, a combcsont tömege 11,46 g és 10,2 g), a szív- és érrendszer, illetve az ivarszervek fejlődésére fordította, míg a speciális prestarter indítót fogyasztó Leghorn hibrid esetében sokkal inkább az ivarszervek intenzívebb fejlődése(P<0,05) volt megfigyelhető.
(Kulcsszavak: jércekori takarmányozás; prestarter táp; növekedés, szervfejlődés)

INTRODUCTION

Total and average egg production of the world is increasing year by year. During the past 40 years, production increased by almost 4.4-fold. This quantitative increase can be attributed to a general increase in number of laying hens world-wide, strong genetic improvements and due to improvement in environment and management. A key element of environmental factors influencing egg production is feeding and nutrition. While breeding companies have emphasized the importance of correctly feeding pullets it is only until very recently that they have recognized the importance of early feeding. This may be due to the highlighted attention that broiler companies have given to the day-old chick. Modern fast-growing broilers and pullets, for example, are undergoing an enormous morphological and metabolic transformation during their first couple of days after hatching.

The period immediately post hatching is especially critical from a feeding point of view. Already a short duration of more than 36 hours after hatch without nutrient ingestion can significantly decrease the differentiation of micro satellite cells in muscle fibres (*Halevy et al.,* 2000). These morphological changes, once incurred, will continue to influence the entire remaining growing period. The effect will be a significantly reduced muscle weight (*Cardiasis and Cooper*, 1975). The process of muscle cell differentiation is controlled by genetically determined growth factors including, for example, growth hormones. Growth hormone receptors have been identified in muscle and the satellite cells (*Halevy et al.*, 1996). The metabolic adaptations have to take place very rapidly because feed deprivation of more than 48 hours can have profound long-term effects on the outcome of the total growing period (*Noy and Sklan*, 1997).

Commercially, the practice of pullets rearing is governed by least cost production. This is true all over the world and partly a result of tradition but also occurs because of economical constraints. Pullet replacement flocks are often only considered as cost and not profit since no revenue is generated. Thus, the economic approach can well be understood. Aside from that, the other characteristic fact of rearing pullets is that feeding instructions are fully depends on the growth curve as suggested by the primary breeding company. This assumes that it is therefore the “obligation” of the breeding company to do their best in order to establish a feeding program with which the pullets can get closest to the suggested growth curve target (*NRC*, 1994). According to the practice, a pullet producer is successful when the replacement pullets have reached a specific body weight at a certain time (transfer to the laying house).

Considering the afore mentioned discussion, it seems nowadays that the major limiting factor to further improve egg production efficiency may very well rest with trying to direct development, conformation and growth of replacement hens into a favourable, productive way and this at the very early stages of pullet rearing. Clearly, correct feeding during the egg producing period alone cannot overcome mistakes made during the pullet rearing and conditioning phase. High biological performance can only be achieved when both growth phases have been properly managed and synchronized to achieve this common critical goal.

The aim of this study was to examine the effect of two different nutrient supply strategies at the very critical first few weeks of the pullet rearing phase of two different genotypes on performance during rearing.

MATERIALS AND METHODS

Animals

The experiment was conducted at the poultry farm of the Agricultural University of Kaposvár. The trial began with the placement of day-old chicks to the experimental farm. In order to maintain separation between the genotypes at the research farm all chicks were individually and permanently marked with a thermo-device cutting the phalangeal. *Table 1* shows the genotypes and origin of chicks which were used in the experiment.

Table 1

Genotype, type and place of origin of the stocks

Code of treatment (1)	Genotype (2)	Type of layer (3)	Place of origin (4)
a_1	Hy-Line W-98 n=2450	Leghorn	Imported (Spain)
a_2	Hy-Line Brown n=2450	Brown	Bábolna Agrária Ltd. (Hungary)

1. táblázat: A kísérleti állományok genotípusa, típusa és származása

A kezelés kódja(1), Genotípus(2), Fajta(3), Származás(4)

Housing

All pullets were brooded from day-old age in the same house until 18 weeks of age. A genotype × diet (2×2) factorial multireplication (7) experiment was carried out, with 175 day-old chicks per group. Thus the number of the experimental units altogether during the rearing was 28. Birds were placed to pens on litter, and within those to randomised pens during the growing period. All birds were de-beaked by the experts of Poultry Beak Cutting Service and Trading Co. The applied preventive immunisation programme for the pullets used in this test was based on the recommendation of breeding company as follows. All chicks received a vaccination against Salmonellas prior to arrival, than on day one Marek's Disease, day 20 and 30 Infectius Bursal Disease, day 25, 50 and 100 Newcastle and bronchitis, day 70 Pox and Avian Encephalomalacie.

The lighting programme was implemented as suggested by the breeding company during the growing period. The rearing was started with two days of continuous light at 10 lux intensity, than it was reduced from the third day till three weeks to 15 hours per day at 5 lux intensity. From the 4th week to 18 weeks the lighting programme was maintained a constant day-length of 10 hours at 5 lux intensity controlled by a RO-1330 type digital lux-meter to keep the correct interval of illumination light intensity. The temperature was reduced by 2 ^{o}C per week from 32 ^{o}C until 21 ^{o}C was reached.

After the rearing period they were transferred to the layer house. Experimental data and results obtained regarding the laying house performance will be presented in another paper.

Treatments

During the rearing period two feeding programmes were implemented. The diets differed only in the composition and nutrient level of the starter feed. Both treatments (*Table 2*), control and experimental diets were provided to the birds from day-old to 4 weeks of age *ad libitum*.

The nutrient levels of the two feed types are shown in *Table 3.*

Measurements

Body weight of the day-old chicks was measured individually and later at 4, 12 and 18 weeks of age, pen means were determined each time. Feed intake was measured continuously on a pen basis, and feed conversion was calculated each time birds were weighed. Mortality was recorded daily and the causes were determined by the Veterinary Institute, Kaposvár. Growth of the birds were checked according to the schedule shown in *Table 4* whole body analyses and organ (ovary weight and liver weight and cubic capacity) and bone (length of tibia and sternum edge) preparation were done per occasion with the examination of 20 layers (5–5 per genotype and per feed treatment). The effect of diet and genotype on the reproductive organs development, was also examined by the gonado-somatic index (ovary weight per body weight × 100).

For total body chemical composition analysis birds were chosen randomly and after then they were killed by cervical dislocation without blood loss and immediately delivered to the laboratory to be frozen until chemical analysis was performed. For the pullets the dry matter, crude protein, crude fat and crude ash was determined for the whole body.

After thawing, the total body including feathers, breast meat etc. were weighed and transferred to a special plastic bag (Biohazard disposable autoclave bag, Cat No.#.13162). 200 cm^3 water was added before closing the plastic bag which was than autoclave treated at 2.0 Atm and 120 °C for 2 hours (Type: MA 5403, Labor MIM, Hungary). After being cooled down to 40–50 °C, the contents of the plastic bag was transferred to a household blender of sufficient size, and after 2 minutes blending bones and feather were almost decomposed. Finally a laboratory homogeniser with high speed of rotation (10.000 rpm) was used for a few seconds to emulsify the fat into the mass. The homogenous mass of the sample was used for chemical analysis.

Table 2

Feeding programme of the experiment

Age (weeks) (4)	**Treatments* (1)**	
	b_1 = experimental feed line (2)	b_2 = control feed line(3)
0–4	Special chicken starter (crumbled)(5)	Chicken starter (mash)(6)
5–6	Chicken starter (mash)	
7–16	Pullet grower (mash)(7)	
17–18	Pre-layer (mash)(8)	

**ad libitum* feeding, all compound feed were produced by the AGROKOMPLEX C.S.

2. táblázat: A kísérlet takarmányozási programja

Kezelések(1), Kísérleti takarmány(2), Kontroll takarmány(3), Életkor (hetek)(4), Speciális prestarter takarmány, morzsázott(5), Csibe indító táp, dercés(6), Jérce nevelő táp(7), Előtojó táp, dercés(8)

Table 3

Calculated nutrient contents of the experimental feeds

Nutrients (1)	Special chicken pre-starter feed (2)	Chicken starter feed (3)
ME poultry (MJ/kg) (5)	12.55	12.20
Crude protein (%) (6)	22.2	19.90
Ca (%)	1.00	1.00
P (%)	0.76	0.63
Na (%)	0.20	0.15
Lysine (%) (7)	1.35	1.10
Meth. + Cys. (%) (8)	0.95	0.77
Vitamin A (NE/mg)	*13.5*	10
Vitamin D (NE/mg)	30	2.5
Vitamin E (mg/kg)	100	15
	Pullet grower feed (4)	**Pre-layer feed (9)**
ME poultry (MJ/kg) (5)	11.90	11.85
Crude protein (%) (6)	15.50	16.40
Ca (%)	1.00	2.00
P (%)	0.62	0.62
Na (%)	0.15	0.15
Lysine (%) (7)	0.77	0.81
Meth. + Cys. (%) (8)	0.64	0.64
Vitamin A (NE/mg)	10	10
Vitamin D (NE/mg)	2.5	2.5
Vitamin E (mg/kg)	15	20

3 táblázat: A takarmányok számított táplálóanyag-tartalma

Táplálóanyag-tartalom(1), Speciális prestarter takarmány(2), Csibe indító táp(3), Jérce nevelő táp(4), ME baromfi(5), Nyersfehérje(6), Lizin(7), Metionin+cisztin(8), Előtojó táp(9)

Dry matter of the samples was determined by Hungarian Standard No. 6830/3-77 by drying to constant weigh at 105 °C.

Fat content was determined by the Stoldt method (Hungarian Standard No. 6830/6-78). The short description of the method is the following: 2.5 g of the sample to the nearest 1 mg was weighed into a 400 cm^3 beaker and 100 cm^3 3M hydrochloric acid was added to it. The beaker was covered with a watch glass, and the mixture was boiled gently over a hot plate for one hour. The product was not allowed to stick to the sides of the container. After cooling the material was filtrated to prevent any loss of fat during filtration. The residue was washed in cold water until a neutral filtrate was obtained. The residue was placed on a watch glass and dried for one and the half hours in an oven at 100±3 °C. The filter paper containing the dry residue was placed in an extraction thimble and covered with a fatfree cotton wool. The thimble was placed in an extractor and the fat content was determined by the Soxhlet method.

Total protein contents of the samples were measured by Kjel-Foss 16200 type nitrogen analyser (protein content=N%x6.25). The sample was digested by sulphuric acid in the presence of potassium-sulphate, mercury-oxide and hydrogen-peroxide. The acid solution was made alkaline with sodium-hydroxide solution. The ammonia was distilled and collected in a measured quantity, and was titrated with a standard solution of sulphuric acid (Hungarian Standard: 6830/4-77).

Ash content of the samples was determined by the Hungarian Standard (6830/8-85) after combustion at 550 °C for 3 hours.

Table 4

The schedule of the examinations during the experiment

Age (week) (1)	Examination (2)		
	Live weight (3)	Whole body analyses (5)	Organ and bone preparation (6)
Day-old age (7)	x	x	-
3 weeks	-	x	-
4 weeks	x	x	x
6 weeks	-	x	-
8 weeks	-	x	x
10 weeks	-	x	-
12 weeks	x	x	x
14 weeks	-	x	-
18 weeks	x	x	x

4. táblázat: A kísérlet alatt végzett vizsgálatok

Életkor (hét)(1), Vizsgálati jellemző(2), Élősúly(3), Teljestest analízis(5), Szerv és csontpreparálás(6), Naposkor(7)

Statistical analysis

All obtained data were analyzed using SPSS 10.0 for Windows (1999), and significance was measured at $P<0.05$ using ANOVA to determine differences between treatments means. Diet and types of layers were regarded as fixed effects in ANOVA.

RESULTS AND DISCUSSION

Data in *Table 5* shows that feeding the two different diets had a significant effect on body weight of the pullets. Birds fed the special pre-starter diet had a significantly higher body weight than the birds fed the control diet. In this experiment the difference in body weight was first observed at 4 weeks of age. However, the significant differences persisted also throughout the remainder of the pullet rearing period until 18 weeks of age. This difference was noted in both genotypes. Genotypes in body weight started to differ at the age of 12 weeks, while the effect of the diets were continuous. The effect of experimental feeding treatment was much higher on body weight of brown pullets than Leghorn type at 12 weeks of age. This significant interaction between genotype and diet was confirmed statistically by ANOVA. This type of observed situation, the interaction between genotype and environment was reported as one of the basic principles by *Brandsch* (1976).

There were no differences between genotypes and diets neither body weight uniformity (CV%) nor in mortality. It is important to mention that all treatments achieved a very good uniformity level, the CV% ranged between 6.0 and 8.8%. Generally, mortality was also very low, (0.4 and 0.7%), which level is below the rearing technology standard.

Table 5

Body weight (g) of pullets at 4, 12 and 18 weeks of age

Age weeks (1)		Leghorn (2)		Brown (3)		Genotypes (4) G		Diets (5) D		Effects (6)		
		Experi-mental (7)	Control (8)	Experi-mental	Control	Leg-horn	Brown	Experi-mental	Control	G	D	GxD
4	Means (9) sd	289 ±21.3[a]	243 ±4.2[b]	288 ±24.2[a]	242 ±18.2[b]	266 ±32.5[A]	264 ±32.5[A]	288 ±0.7[A]	243 ±0.7[B]	NS	***	NS
12	Means sd	998 ±56.9[c]	958 ±59[d]	1107 ±73[a]	1039 ±69.5[b]	978 28.3[B]	1073 ±48.1[A]	1052 ±77.1[A]	998 ±57.3[B]	***	***	***
18	Means sd	1394 ±96.3[c]	1359 ±100.9[d]	1509 ±116.4[a]	1462 ±108.1[b]	1376 ±24.7[B]	1486 ±33.2[A]	1452 ±81.3[A]	1411 ±72.8[B]	***	***	NS

Effects: G=genotype, D=feed, G×D=interaction of two effects. (*Tényezők: G=genotípus, D=takarmány, G×D=a két tényező interakciója.*); Significant level: *=P<0.05; **=P<0.01; ***=P<0.001; NS=P>0.05; Different small letters mean significant differences (P<0.05) among treatments. (*Az eltérő kisbetűk szignifikáns különbséget jelentenek a kezelések között.*); Different block letters mean significant differences (P<0.05) between averages in feed or genotype. (*Az eltérő nagybetűk szignifikáns különbséget jelentenek a takarmány vagy genotípus átlagok között.*)

5 táblázat: Az élősúly alakulása 4, 12 és18 hetes korban

Életkor hetekben(1), Leghorn típus(2), Középnehéz típus(3), Genotípusok(4), Takarmányok(5), Tényezők(6), Kísérleti(7), Kontroll(8), Átlag(9)

In *Table 6* the data of feed consumption are summarised. The effect of diets (P<0.001) and that of genotypes (P<0.05) were significant during the first 4 weeks and during the whole rearing period until 18 weeks of age. The relative differences caused by diets were the strongest at 4 weeks of age (16–19%). The statistical differences remained until the end of rearing period (2–3%), favoring the pre-starter diet. The Leghorns consumed more feed in the first 4 weeks, but during the whole rearing period the brown pullets consumed significantly more feed, because of the higher inherent body weight gain typical for brown egg type hens.

Table 6

Cumulative feed consumption of pullets in the rearing periode (g/pullet)

Age weeks		Leghorn		Brown		Genotypes G		Diets D		Effects		
		Experi-mental	Control	Experi-mental	Control	Leg-horn	Brown	Experi-mental	Control	G	D	GxD
0-4	Means sd	610 ±18[a]	510 ±8[c]	590 ±12[b]	480 ±13[d]	560 ±70.7[A]	530 ±77.8[B]	600 ±14.1[A]	495 ±21.2[B]	*	***	NS
0-18	Means sd	5982 ±7.5[a]	5814 ±74[b]	6022 ±13.5[a]	5877 ±2.6[b]	5898 ±118.8[B]	5950 ±102.5[A]	6002 ±28.3[A]	5845 ±44.5[B]	*	***	NS

See Table 5 (*Lásd 5. táblázat*)

6. táblázat: Halmozott takarmányfelvétel a nevelés során

Lásd 5. táblázat

Data of the length of the keel bone (sternum) and the weight of the tibia are summarised in *Table 7* and *8*. Brown pullets did react to the dietary pre-starter regimen with a significantly increased keel bone length (115.8 mm vs. 106.8 mm, 8,4%) and a significantly heavier tibia (11.46 g vs. 10.20 g, 12,4%) leading to a significant effect on interaction between diet and genotype. Conversely at 18 weeks of age, the Leghorn pullets did not show any significant differences due to diet for keel bone length (109.0 mm vs. 108.8 mm) or weight of the tibia (9.60 g vs. 9.46 g).

Table 7

Length of the keel bone (sternum) in mm at the age of 8, 12 and 18 weeks

Age weeks		Leghorn		Brown		Genotypes G		Diets D		Effects		
		Experi-mental	Control	Experi-mental	Control	Leghorn	Brown	Experi-mental	Control	G	D	GxD
8	Means sd	79.0 ±2.12[a]	74.4 ±4.16[b]	79.2 ±1.3[a]	78.0 ±3.53[ab]	76.7 ±3.25[A]	78.6 ±0.86[A]	79.1 ±0.14[A]	76.2 ±2.55[B]	NS	*	NS
12	Means sd	98.8 ±2.38[ab]	93.2 ±2.77[c]	102 ±4.3[a]	95.4 ±2.79[bc]	96.0 ±3.96[A]	98.7 ±4.67[A]	100.4 ±2.26[A]	94.3 ±1.56[B]	NS	***	NS
18	Means sd	109.0 ±5.83[b]	108.8 ±3.03[b]	115.8 ±3.11[a]	106.8 ±2.16[b]	108.9 ±0.14[A]	111.3 ±6.36[A]	112.4 ±4.81[A]	107.8 ±1.41[B]	NS	*	*

See Table 5 (*Lásd 5. táblázat*)

7. táblázat: A mellcsonti taréj hosszának változása 8, 12 és 18 hetes korban

Lásd 5. táblázat

Table 8

Weight of the left tibia (g) at the age of 8, 12 and 18 weeks

Age weeks		Leghorn		Brown		Genotypes G		Diets D		Effects		
		Experi-mental	Control	Experi-mental	Control	Leghorn	Brown	Experi-mental	Control	G	D	GxD
8	Means sd	5.48 ±0.17[b]	5.6 ±0.75[ab]	6.18 ±0.23[a]	5.86 ±0.32[ab]	5.54 ±0.08[B]	6.02 ±0.23[A]	5.83 ±0.49[A]	5.73 ±0.18[A]	*	NS	NS
12	Means sd	8.64 ±0.44[b]	7.66 ±0.47[c]	9.58 ±0.64[a]	9.1 ±0.56[ab]	8.15 ±0.69[B]	9.34 ±0.34[A]	9.11 ±0.66[A]	8.38 ±1.02[B]	***	**	NS
18	Means sd	9.6 ±1.19[b]	9.46 ±0.88[b]	11.46 ±0.58[a]	10.2 ±0.18[b]	9.53 ±0.1[B]	10.83 ±0.89[A]	10.53 ±1.32[A]	9.83 ±0.52[B]	**	NS	NS

See Table 5 (*Lásd 5. táblázat*)

8. táblázat: A bal combcsont súlyának változása 8, 12 és 18 hetes korban

Lásd 5. táblázat

Significant difference was found between diets on liver weight ($P<0.05$) at 4 weeks of age (*Table 9*): the pullets were fed the experimental pre-starter had a significantly higher liver weight than the control birds. A genotype and diet interaction was noted at 12 weeks of age between the experimental groups. At 18 weeks of age the brown layer again responded to the pre-starter diet by significantly increasing liver weight (27.1g vs. 21.8 g) and cubic liver content, 26.4 cm^3 vs. 20.2 cm^3 (*Table 10*) while no response was observed in the Leghorn group. Concerning the proportion of liver weight expressed as percentage of pullets body weight similar results were presented in broilers by *Leeson and Summers* (1980). It was complicated to compare and discuss the organ and bone preparation, because there are only a few publications in connection with this topic.

Table 9

Weight of the liver (g) at the age of 4, 12 and 18 weeks

Age weeks		Leghorn		Brown		Genotypes G		Diets D		Effects		
		Experi-mental	Control	Experi-mental	Control	Leghorn	Brown	Experi-mental	Control	G	D	GxD
4	Means sd	8.56 ±0.80^{a}	7.44 ±0.67^{b}	8.22 ±0.98^{ab}	7.52 ±1.64^{b}	8.00 ±0.79^{A}	7.87 ±0.49^{A}	8.39 ±0.24^{A}	8.56 ±0.06^{B}	NS	*	NS
12	Means sd	19.16 ±2.63^{ab}	20.72 ±1.03^{a}	19.44 ±0.99^{ab}	17.76 ±0.7^{b}	19.94 ±1.1^{A}	18.6 ±1.19^{A}	19.3 ±0.20^{A}	19.24 ±2.09^{A}	NS	NS	*
18	Means sd	26.08 ±3.23^{ab}	27.1 ±2.78^{a}	27.08 ±4.86^{a}	21.84 ±2.68^{b}	26.59 ±0.72^{A}	24.46 ±3.71^{A}	26.58 ±0.71^{A}	24.47 ±3.72^{A}	NS	NS	NS

See Table 5 (*Lásd 5. táblázat*)

9. táblázat: A máj súlyának változása 4, 12 és 18 hetes korban

Lásd 5. táblázat

Table 10

Volume of the liver (cm^3) at the age of 4 and 18 weeks

Age weeks		Leghorn		Brown		Genotypes G		Diets D		Effects		
		Experi-mental	Control	Experi-mental	Control	Leghorn	Brown	Experi-mental	Control	G	D	GxD
4	Means sd	7.8 ±1.48^{a}	6.8 ±0.45^{b}	8.4 ±1.14^{a}	7.2 ±0.45^{ab}	7.3 ±0.71^{A}	7.8 ±0.85^{A}	8.1 ±0.42^{A}	7.0 ±0.28^{A}	NS	*	NS
18	Means sd	24.0 ±3.80^{ab}	24.2 ±2.49^{ab}	26.4 ±4.83^{a}	20.2 ±2.77^{b}	24.1 ±0.14^{A}	23.3 ±4.38^{A}	25.2 ±1.70^{A}	22.2 ±2.83^{A}	NS	NS	NS

See Table 5 (*Lásd 5. táblázat*)

10. táblázat: A máj térfogatának alakulása 4 és 18 hetes korban

Lásd 5. táblázat

The results of gonado-somatic index are shown in the *Table 11*. Feeding the pre-starter diet was associated with a significantly higher ($P<0.05$) gonado-somatic index than the control diet at the age of 18 weeks. At the same time it became obvious that the Leghorn hybrid is reproductively maturing at a much faster rate than the brown type pullet based on the time of the onset of egg production as well as the gonado-somatic index at the age of 12 and 18 weeks.

Table 11

Changing of gonado-somatic index at the age of 12 and 18 weeks

Age weeks		Leghorn		Brown		Genotypes G		Diets D		Effects		
		Experi-mental	Control	Experi-mental	Control	Leghorn	Brown	Experi-mental	Control	G	D	GxD
12	Means sd	0.055 ±0.010[a]	0.054 ±0.015[a]	0.039 ±0.004[b]	0.044 ±0,008[ab]	0.054 ±0.001[A]	0.041 ±0.004[B]	0.047 ±0.011[A]	0.049 ±0.007[A]	*	NS	NS
18	Means sd	1.73 ±1.59[a]	0.86 ±0.63[ab]	0.38 ±0.63[b]	0.10 ±0.07[b]	1.30 ±0.62[A]	0.24 ±0.20[B]	1.06 ±0.95[A]	0.48 ±0.54[B]	*	*	NS

See Table 5 (*Lásd 5. táblázat*)

11. táblázat: A gonado-szomatikus index alakulása 12 és 18 hetes korban

Lásd 5. táblázat

Whole body chemical analysis was performed eight times during the growing period. The data of chemical analysis show that as pullets getting older the dry matter content of the whole body increased from 30.9–31.9% to 41.3–41.5%, the crude fat content from 5.4–7.2% to 11.4–13.2%, the crude protein content from 20.3–21.4%, to 24.1–25.4% and the ash content from 3.3%–3.5% to 3.9–4.1%. *Leeson and Summers* (1984) observed similar results in commercial pullets at 16 weeks of age (crude protein 24,4%, crude fat 13,7%). The data of the chemical whole body composition analyses showed no differences attributable to nutritional treatments.

The effect of the genotypes was also analysed (*Figure 1*). The dry matter, crude protein, crude fat and crude ash content of the whole pullets are represented for Leghorn and brown genotypes from 3 to 18 weeks of age. Dry matter and crude fat content increases with age for the entire period in both genotypes. The differences between genotypes in dry matter content and its changes with age were influenced for the most by crude fat and crude protein content of the body. Crude ash content did not show marked differences due to diet or genotype. Brown pullets are tended to have higher ash and crude fat content in most periods of measurement compared to Leghorns, the differences between means however were usually smaller as one standard deviation.

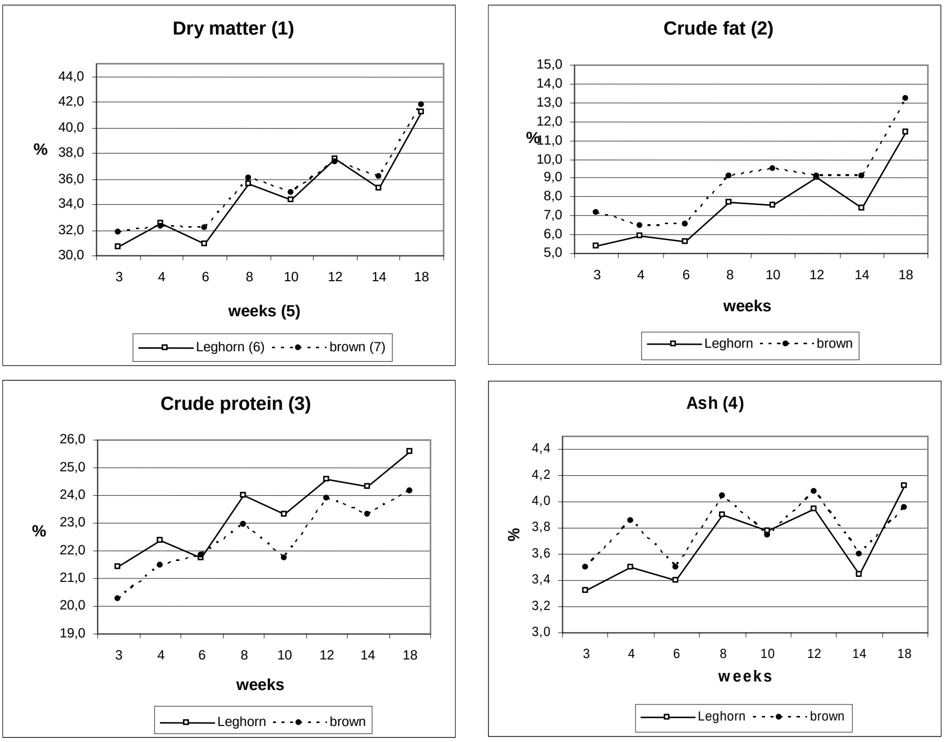
In commercial practice the growth of the layer hybrid pullets are predominantly controlled by frequent measurements of body weight at specific time intervals. It is obvious from the experimental results of this trial that there are many more physiological and metabolic alterations that cannot be immediately identified and recognized by simply measuring the weight of the birds alone.

1. Based on the results of the trial it can be concluded that today's modern layer hybrids - both the Leghorn type and brown type commercial hybrids - react very strongly to increased nutrient density (pre-starter) during the early stages of the growing period from 0–4 weeks of age. These nutritional effects altering the development of the pullet are maintained till the end of the pullet rearing period at 18 weeks of age, although the differences diminish as the birds got older.
2. At the end of the growing period only the brown hybrid showed measurable differences in the development of the skeleton as the result of feeding two different diets from 0–4 weeks of age. The Leghorn type pullet did not show this response.

3. The situation was similar regarding the liver weight. Feeding the special pre-starter feed from 0–4 weeks of age was associated with significantly greater organ weight at 18 weeks of age only in the brown type hybrid.
4. The weight of the ovary and the gonado-somatic index were statistically increased (P<0.01) when the pullets received the pre-starter feed.

Figure 1

Changes in the chemical composition of whole body of Leghorn and brown type pullets during the rearing period



1 ábra: A Leghorn és a középnehéz genotípus testösszetételének változása a nevelés során

Szárazanyag(1), Nyerszsír(2), Nyersfehérje(3), Hamu(4), Hetek(5), Leghorn(6), Középnehéz típus(7)

The obtained results let us conclude that feeding either a standard starter feed or a special pre-starter diet from 0–4 weeks of age in two different genotypes of commercial pullets can lead to a differential growth response. Brown hybrids turn differences measured in body weight into a more intensive development of the skeleton, heart, the vascular system and the sexual organs while the Leghorn type hybrid converts this higher body weight only into a greater weight and development of the sexual organs. This observation was further supported by the data obtained for body composition.

Those results showed that despite the differences in body weight, the chemical composition of the body was not significantly different.

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