



Production results of free range broiler chickens

D. ¹Terčič, J. ²Puhar, R. ¹Vadnjak, A. ¹Holcman, L. ³Gašperlin,
A. ³Rajar, B. ³Žlender

¹University of Ljubljana, Biotechnical Faculty, Zootechnical Department, Domžale, SI-1230 Groblje 3. Slovenia

²Ljubljana, SI-1107 Celovška 108. Slovenia

³University of Ljubljana, Biotechnical Faculty, Food Technology Department,
Ljubljana, SI-1000 Jamnikarjeva 101. Slovenia

ABSTRACT

The aim of this study was to compare growth performance and carcass characteristics from broilers raised in a free range system with those of broilers raised in a deep litter house. In the experiment 100 chickens of two commercial provenances were used. All the birds were raised in a deep litter house for the first four weeks. From then on they were divided into two groups, of which the free range group had free access to pasture ground. The chickens raised on pasture and the chickens raised in the deep litter house were slaughtered on the 56th day of age, after which certain carcass measurements were taken. The results obtained showed that the effects of genotype and sex on growth performance and carcass characteristics are much more important than the effects of the keeping system itself.

(Keywords: broilers, free range, fattening, carcass characteristics)

ZUSAMMENFASSUNG

Produktionsleistung von Broilern in Freilandhaltung

D. ¹Terčič, J. ²Puhar, R. ¹Vadnjak, A. ¹Holcman, L. ³Gašperlin, A. ³Rajar, B. ³Žlender

¹Universität Ljubljana, Biotechnische Fakultät, Abteilung für Zootechnik, Domžale, SI-1230 Groblje 3. Slowenien

²Ljubljana, SI-1107 Celovška 108. Slowenien

³Universität Ljubljana, Biotechnische Fakultät, Abteilung für Lebensmitteltechnologie
Ljubljana, SI-1000 Jamnikarjeva 101. Slowenien

In der vorliegenden Untersuchung wurden Wachstum und Schlachtkörperqualität von Broilern in Freilandhaltung und Bodenhaltung verglichen. In den Versuch wurden 100 Broiler von zwei Genotypen einbezogen. Alle Broilerküken wurden bis zum 28. Tag im Hühnerstall aufgezogen und dann in zwei Gruppen aufgeteilt. Die Broiler aus der Bodenhaltung blieben weiterhin im Hühnerstall, während diejenigen für Freilandhaltung einen freien Zugang zur Weide hatten. Alle Broiler wurden am 56. Tag geschlachtet und einige Schlachtkörpermerkmale verglichen. Die Ergebnisse der Untersuchung zeigen, daß Genotyp und Geschlecht einen größeren Einfluß auf Wachstum und Schlachtkörperqualität hatten als die Haltungsart.

(Schlüsselwörter: Broiler, Freilandhaltung, Mast, Schlachtkörperqualität)

INTRODUCTION

Free range chickens are thought to have a better taste and texture, mostly because they use their muscles (Remignon and Culioli, 1995). Standards and state regulations for free range chicken keeping are becoming very important as a guarantee for consumers. The *European Union (EU) Commission Regulation No 1538/91 of 5 June 1991* regulates stocking density for 'free range', 'traditional free range' and 'free range – total freedom' meat birds. In the United States loose federal guidelines do exist. Birds raised in the United States for meat – mainly chickens and turkeys – may be sold as 'free range' if they have USDA certified access to the outdoors and do not consume antibiotics or growth enhancers. No other criteria, such as vegetation, size of area, number of birds, or space per bird, are included in this term as defined by the Food Labelling Division of the Food Safety and Inspection Service (FSIS) of the US Department of Agriculture, which reviews and approves labels for federally inspected meat products (Morgan, 1999). In this study the effect of keeping system on the production results of broiler chickens was studied.

MATERIALS AND METHODS

Fifty broiler chickens of Ross commercial provenance and fifty broiler chickens of Prelux-bro commercial provenance were included in this research. The chickens of each provenance were divided in two groups according to sex (25 birds each) and housed from the time of hatching until 28 days of age in a deep litter house. At 28 days of age the chickens were allocated into two groups. The first group, which consisted of 12 Ross females, 13 Ross males, 12 Prelux-bro females and 13 Prelux-bro males, was reared indoors without access to pasture. The second group, which consisted of 13 Ross females, 12 Ross males, 12 Prelux-bro females and 12 Prelux-bro males, had free access to pasture all day. The ground to which the chickens had access was mainly covered with various types of grasses. The stocking density indoors was 0.17 birds per square metre up to 28 days of age and 0.34 birds per square metre from 28 days of age onward. Pasture available amounted to 2 m² per chicken. For the first 28 days the broilers were fed a starter diet which contained 3100 kcal/kg and 23.44% crude protein. From the 28th day until the end of the fattening period the broilers were given a feed mixture with 2700 kcal/kg and 14.5% crude protein. The latter feed mixture was composed of 70% grain (barley and maize). The chickens were fed ad libitum. Body weight and feed consumption were recorded in all groups and sub-groups once a week throughout the experiment. All the birds included in the experiment were slaughtered at 8 weeks of age. The chickens were dressed traditionally; that is, into the eviscerated carcass with the head and feet were inserted the gizzard, heart, spleen, liver and abdominal fat. An hour after slaughter the warm carcasses together with the innards (i.e. heart, liver, gizzard, spleen and abdominal fat) and the feet and head were weighed. During the night the carcasses were chilled in a cold store thermostatically maintained at +4°C. The next day the chilled carcasses together with the innards, abdominal fat, feet and head were weighed again. The edible innards (i.e. heart, liver and gizzard), abdominal fat, head, neck and feet belonging to each particular carcass were weighed separately. The data collected were used for statistical analysis. Statistical analysis was performed by means of the GLM procedure of the SAS/STAT programme package (*SAS/STAT User's Guide*, 1990). The statistical model used was as follows:

$$y_{ijk} = \mu + P_i + R_j + S_k + PR_{ij} + PS_{ik} + RS_{jk} + PRS_{ijk} + e_{ijk}$$

y_{ijk} = observed value of the trait studied

μ = mean value

P_i = effect of provenance i

R_j = effect of keeping system j

S_k = effect of sex k

PR_{ij} = interaction effect of provenance i and keeping system j

PS_{ik} = interaction effect of provenance i and sex k

RS_{jk} = interaction effect of keeping system j and sex k

PRS_{ijk} = interaction effect of provenance i, keeping system j and sex k

e_{ijk} = random error

RESULTS AND DISCUSSION

Basic statistical parameters for the growth performance and the carcass characteristics of the experimental groups are summarised in *Table 1*.

Free range chickens had lower weights at the time of slaughter, but the average weights showed no significant difference; the same was true of the eviscerated carcasses with innards after slaughter and chilling. These results are not in agreement with the work of *Muriel and Pascual (1995)* in which higher weights were recorded in free range chickens. More movement on the pasture in comparison with deep litter housing might explain these results. The free range chickens had less abdominal fat than the chickens raised indoors, but all the other carcass characteristics were modified only slightly. This result is consistent with the findings of *Ricard et al. (1986)* cited by *Muriel and Pascual (1995)*, who wrote that intensive management techniques led to fatter birds. Comparison of feet weight showed that the chickens raised indoors had slightly heavier feet than the chickens raised on pasture. This result does not support the findings of *Garcia et al. (1995)*, who asserted that a free range system assures higher development of shanks. The innards were heavier in the chickens reared on pasture, but no statistical differences were detected. These findings could be related to the well known effect of rearing on pasture, which promotes the development of the gizzard.

Although the differences were not statistically significant the males had more abdominal fat, in absolute terms, than the females. These results could be attributed to the fact that at the time of slaughter the males were significantly ($P \leq 0.001$) heavier than the females, since in terms of % of live weight at eight weeks of age the males had less abdominal fat than the females. Number of animals and feed conversion are shown in *Table 2*.

As expected, feed conversion for weight gain was higher in the chickens reared in the free range keeping system, although no great differences were observed between the two rearing systems. Overall mortality was 12%. This high mortality rate could be related to high ambient temperatures, which at the peak of mortality exceeded 30°C. The effects of provenance, keeping system and sex and their interactions on growth performance are shown in *Table 3*.

Table 4 reveals the effects of provenance, keeping system and sex and their interactions on carcass characteristics.

Table 1

Production results of broiler chickens included in the experiment (basic statistics)

Characteristics (1)	A	Provenance (3)		Keeping system (4)		Sex (5)	
Live weight in grammes at the age of: (6)		Ross (7)	Prelux (8)	Free range (9)	Indoors (10)	Females (11)	Males (12)
1 day (13)	<i>X</i> (22)	45.32	43.56	44.89	44.01	44.72	44.16
	<i>SD</i> (23)	3.87	4.23	4.20	4.06	4.15	4.13
1 week (14)	<i>X</i>	161.36	129.02	149.08	141.21	142.12	148.00
	<i>SD</i>	18.48	17.30	24.38	23.44	26.94	20.68
2 weeks	<i>X</i>	381.00	311.76	351.77	340.62	335.04	357.24
	<i>SD</i>	46.60	41.76	56.92	55.31	63.01	46.00
3 weeks	<i>X</i>	706.93	582.30	652.50	635.98	615.70	672.85
	<i>SD</i>	86.79	79.26	106.20	101.69	115.48	81.59
4 weeks	<i>X</i>	1094.08	891.12	997.44	988.13	924.40	1063.64
	<i>SD</i>	146.96	131.88	176.62	169.92	178.10	134.61
5 weeks	<i>X</i>	1483.97	1173.22	1317.23	1342.40	1233.70	1432.87
	<i>SD</i>	215.46	180.84	253.27	253.18	252.98	209.03
6 weeks	<i>X</i>	1910.20	1522.55	1703.40	1733.12	1573.22	1866.70
	<i>SD</i>	296.63	214.85	326.83	322.65	295.41	282.87
7 weeks	<i>X</i>	2435.72	1911.59	2142.02	2210.10	1974.16	2382.97
	<i>SD</i>	402.95	304.86	431.61	455.49	396.77	391.83
8 weeks	<i>X</i>	2889.09	2304.31	2560.46	2631.33	2384.65	2808.75
	<i>SD</i>	418.77	367.88	481.14	501.13	386.53	494.20
Eviscerated carcass with innards an hour after slaughter (g) (15)	<i>X</i>	2404.31	1940.90	2136.62	2207.00	1982.84	2362.38
	<i>SD</i>	369.52	307.04	384.89	434.82	309.28	413.93
Eviscerated carcass with intestines after chilling (g) (16)	<i>X</i>	2361.81	1909.20	2104.76	2164.88	1947.04	2323.97
	<i>SD</i>	360.61	304.32	381.57	423.35	304.74	402.37
Intestines weight (g) (17)	<i>X</i>	113.70	97.38	105.88	105.22	99.45	111.63
	(<i>SD</i>)	(15.43)	(12.76)	(15.49)	(17.19)	(13.97)	(16.31)
	<i>B</i>	3.93	4.22	4.13	3.99	4.17	3.97
Weight of abdominal fat (g) (18)	<i>X</i>	91.06	69.63	76.39	84.13	78.47	82.22
	(<i>SD</i>)	(24.59)	(16.89)	(21.25)	(25.27)	(22.70)	(24.54)
	<i>B</i>	3.15	3.02	2.98	3.19	3.29	2.92
Neck weight (g) (19)	<i>X</i>	103.13	92.65	94.16	101.46	78.93	116.86
	(<i>SD</i>)	(29.39)	(31.60)	(28.19)	(33.01)	(20.40)	(27.68)
	<i>B</i>	3.56	4.02	3.67	3.85	3.30	4.16
Feet weight (g) (20)	<i>X</i>	102.75	88.79	95.46	96.06	79.95	111.59
	(<i>SD</i>)	(21.14)	(19.56)	(21.75)	(21.36)	(11.89)	(16.61)
	<i>B</i>	3.55	3.85	3.72	3.65	3.35	3.97
Head weight (g) (21)	<i>X</i>	60.46	55.70	56.93	59.15	48.27	67.61
	(<i>SD</i>)	(14.57)	(19.00)	(19.23)	(14.71)	(15.43)	(12.59)
		2.09	2.41	2.22	2.24	2.02	2.40

A: Statistical parameter (2), X: mean (22), SD: standard deviation (23), B: weight at 8 weeks (24)

1. Tabelle: Die Produktionsergebnisse von Broilern im Versuch

Bezeichnung(1), Statistische Parameter(2), Genotyp(3), Haltungsmethode(4), Geschlecht(5), Lebendgewicht in Gramm im Alter von(6), Genotyp Ross (7) Genotyp Prelux(8), Freilandhaltung(9), Stallhaltung(10), weiblich(11), männlich(12), 1 Tag(13), 1 Woche(14), Schlachtkörper mit Innereien eine Stunde nach dem Schlachten(15), Schlachtkörper mit Innereien nach der Kühlung(16), Gewicht der Innereien(17) Gewicht des Bauchhöhlenfettes(18), Gewicht des Halses(19), Gewicht der Füße(20), Gewicht des Kopfes(21), Mittelwert(22), Standardabweichung(23), prozentuales Lebendgewicht im Alter von 8 Wochen(24)

Table 2**Effect of keeping system on feed conversion**

Weeks (1)	1 st	2 nd	3 rd	4 th	5 th	6 th		7 th		8 th	
						Free range(4)	Indoors(5)	Free range	Indoors	Free range	Indoors
Number of animals (2)	99	99	99	98	97	47	48	47	48	43	45
Feed conversion (3)	1.188	1.442	1.708	2.561	2.793	2.793	2.731	2.823	2.636	3.325	3.030

2. Tabelle: Einfluss der Haltungsmethode auf die Futterverwertung

Wochen(1), Bestandszahl(2), Futterverwertung(3), Freilandhaltung(4), Stallhaltung(5)

Table 3**Influence of provenance, keeping system and sex and their interactions on chicken growth performance**

CHARACTERISTICS(1)	EFFECT(2)						
Live weight at the age of: (3)	P _i	R _j	S _k	PR _{ij}	PS _{ik}	RS _{jk}	PRS _{ijk}
1 day (4)	0.0166	n.s.	n.s.	n.s.	n.s.	n.s.	0.0236
1 week (5)	0.0001	0.0257	n.s.	n.s.	n.s.	n.s.	0.0312
2 weeks	0.0001	n.s.	0.0088	n.s.	n.s.	n.s.	n.s.
3 weeks	0.0001	n.s.	0.0003	n.s.	n.s.	n.s.	n.s.
4 weeks	0.0001	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.
5 weeks	0.0001	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.
6 weeks	0.0001	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.
7 weeks	0.0001	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.
9 weeks	0.0001	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.

P≤0.05 = Statistically significant (*Statistisch signifikant*), P_i = Effect of provenance i (*Einfluss des Genotyps*), PS_{ik} = Interaction effect of provenance i and sex k (*Interaktion zwischen Genotyp und Geschlecht*), P≤0.01 = Statistically significant (*Statistisch signifikant*), R_j = Effect of keeping system j (*Einfluss der Haltungsmethode*), RS_{jk} = Interaction effect of keeping system j and sex k (*Interaktion zwischen Haltungssystem und Geschlecht*), P≤0.001 = Highly statistically significant (*Hoch statistisch signifikant*) S_k = Effect of sex k (*Einfluss des Geschlechts*), n.s. = Non significant (P≥0.05) (*Nicht signifikant*), PR_{ij} = Interaction effect of provenance i and keeping system j (*Interaktion zwischen Genotyp und Haltungsmethode*), PRS_{ijk} = Interaction effect of provenance i, keeping system j and sex k (*Interaktion zwischen Genotyp, Haltungsmethode und Geschlecht*)

3. Tabelle: Einfluss des Genotyps, der Haltungsmethode, des Geschlechts und deren Interaktionen auf das Wachstum von Broilern

Bezeichnung(1), Einfluss(2), Lebendgewicht im Alter von (3), Tag(4), Wochen(5)

Table 4

Influence of provenance, keeping system and sex and their interactions on chicken carcass characteristics

CHARACTERISTIC (1)	EFFECT (2)						
	P _i	R _j	S _k	PR _{ij}	PS _{ik}	RS _{jk}	PRS _{ijk}
Eviscerated carcass with intestines (gizzard, heart, liver, spleen, abdominal fat) an hour after slaughter (3)	0.0001	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.
Eviscerated carcass with intestines (gizzard, heart, liver, spleen, abdominal fat) after chilling (4)	0.0001	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.
Weight of innards (5)	0.0001	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.
Weight of abdominal fat (6)	0.0001	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Neck weight (7)	0.0187	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.
Feet weight (8)	0.0001	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.
Head weight (9)	n.s.	n.s.	0.0001	n.s.	n.s.	n.s.	n.s.

P≤0.05 = Statistically significant (*Statistisch signifikant*), P_i = Effect of provenance i (*Einfluss des Genotyps*), PS_{ik} = Interaction effect of provenance i and sex k (*Interaktion zwischen Genotyp und Geschlecht*), P≤0.01 = Statistically significant (*Statistisch signifikant*), R_j = Effect of keeping system j (*Einfluss der Haltungsmethode*), RS_{jk} = Interaction effect of keeping system j and sex k (*Interaktion zwischen Haltungssystem und Geschlecht*), P≤0.001 = Highly statistically significant (*Stark statistisch signifikant*) S_k = Effect of sex k (*Einfluss des Geschlechts*), n.s. = Non significant (P≥0.05) (*Nicht signifikant*), PR_{ij} = Interaction effect of provenance i and keeping system j (*Interaktion zwischen Genotyp und Haltungsmethode*), PRS_{ijk} = Interaction effect of provenance i, keeping system j and sex k (*Interaktion zwischen Genotyp, Haltungsmethode und Geschlecht*)

4. Tabelle: Einfluss des Genotyps, der Haltungsmethode, des Geschlechts und deren Interaktionen auf den Schlachtkörper von Broilern

Bezeichnung(1), Einfluss (2), Ausgenommener Schlachtkörper mit Innereien (Magen, Herz, Leber, Milz, Bauchhöhlenfett) eine Stunde nach dem Schlachten(3), Ausgenommener Schlachtkörper mit Innereien (Magen, Herz, Leber, Milz, Bauchhöhlenfett) nach der Kühlung(4), Gewicht der Innereien(5), Gewicht des Bauchhöhlenfettes(6), Gewicht des Halses(7), Gewicht der Füße(8), Gewicht des Kopfes(9)

For live weight at the same age no significant differences were detected according to keeping system for eviscerated carcass weight and cut weight. These results are in agreement with the study performed by Garcia et al. (1995). The differences in the above characteristics were, with the exception of head weight, very significant between provenance and, as expected, between sexes.

CONCLUSIONS

The study of the influence of keeping system (indoor versus free range) on chicken growth performance and carcass characteristics was the subject of this study. The results of the experiment show no statistically significant differences between the chickens from the deep litter house and the free range chickens. Regarding growth and carcass characteristics, the effects of provenance and sex were much more important than the effect of keeping system.

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Corresponding author (*Adresse*):

Dušan Terčič

University of Ljubljana, Biotechnical Faculty

SI-1230 Domžale, Groblje 3. Slovenia

Universität Ljubljana, Biotechnische Fakultät

SI-1230 Domžale, Groblje 3. Slowenien

Tel.: +386-61-717-800, Fax: +386-61-721-005