

EFFECT OF FREE-RANGE AREA AND FEED RESTRICTION ON GROWTH PERFORMANCE OF HUNGARIAN LANDRACE GUINEA FOWL

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Abstract – *Hungarian Landrace Guinea Fowls are famous for their excellent meat quality produced by traditional free-range farming. The study aimed to identify the optimal size of a free-range area for keeping Hungarian Landrace Guinea Fowl, and to examine its effect in combination with quantitative feed restriction on growth performance, 486 birds were randomly distributed into 18 cages. Free-range areas of different sizes (either 50 m² or 15 m² per bird, or without a running area) were provided from 6 weeks of age, and from 9 to 14 weeks, feed restriction at varying levels of 90%, 80%, 70% or ad libitum feeding was also applied. Body weight, body weight gain and feed conversion ratios were recorded every two weeks. Results showed that differing free-range area sizes and feed restriction had a substantial effect on the body weight of Hungarian Landrace Guinea Fowl, which was evident by the age of 10 weeks and continued until 14 weeks, where feed restriction negatively affected guinea fowl growth in free-range keeping. Guinea fowl provided with 15 m² of free-range area per bird and fed ad libitum had the highest body weight*

(1378.52 ± 43.68 g) with relatively low feed conversion ratio (3.82 ± 0.14 kg feed per kg body weight gain) when compared with other experimental groups at the age of 14 weeks. The lowest body weight and feed conversion ratio was observed in groups with 15 m² free-range area per bird and 70% feed restriction (1245.93 ± 38.64 g and 3.52 ± 0.12 kg feed per kg body weight gain), while the highest feed conversion ratio was detected in groups fed ad libitum and kept closed, without a free range area (4.34 ± 0.06 kg feed per kg body weight gain).

Keywords: *conservation, free-range, and local guinea fowl.*

I. INTRODUCTION

There is evidence that guinea fowl had been introduced into the Carpathian Basin several centuries earlier than the first reports of the breeding of this animal appeared, and was kept as a pet around manor houses or monasteries from the Middle Ages [1], [2], thereafter a long adaptation process resulted in local landrace varieties. However, with the expansion of the poultry industry, local landraces have begun to disappear gradually from rural areas. The collection of local guinea fowl individuals from various rural regions in Hungary for conservation purposes was initiated in the early 1990's. The breed was officially registered under the name of Hungarian Landrace Guinea Fowl (HLGF) in 2004 by the Association of Hungarian Small Animal Breeders for Gene Conservation (MGE). Since then, unselected stocks of HLGF have been kept as part of in vivo gene bank at the Research Centre for Farm Animal Gene Conservation (HÁGK) and Hortobágy

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National Park (HNP) [3]. Several studies emphasize that local guinea fowl would be one of the promising genetic resources for evolving in low input systems which can be seen from the popularity of keeping guinea fowl in underprivileged regions of Africa [4], [5], Central Europe and countries [6]–[8] as well as in Southeast Asia [9]. Scientists consider guinea fowl as a reliable contributor to the livelihood of rural people [10], [11], and therefore, has the potential for reducing poverty [12]. Because of this, studies on the improvement of guinea fowl productivity, as well as investigation into the effects of genetic potential on productive and reproductive traits of local varieties for future use in various regions, are essential.

II. BACKGROUND

Hungarian poultry experts in the 20th century, Zoltan Csukas (1935) and Balint Baldy (1940), mentioned that excellent meat quality, good adaptability, disease resistance, and low keeping costs made guinea fowl an excellent poultry species - not only for local consumption but also for foreign markets. To ensure these superior traits are kept during farming practices, there is emphasis placed on the fact that guinea fowl should be kept using traditional methods as a scavenging bird around houses or large free-range farms [13], [14]. These traditional methods were characteristic for local guinea fowl raising in Hungary before the expansion of the poultry industry and can be considered as ‘traditional free-range farming’. Regarding nutritional regimes, Molapo and Webb [15] found that quantitative restriction of feeding applied as part of the rearing system could be advantageous in body weight gain of local chickens, which can be applicable seeing that guinea fowl chicks at growing stages have the same nutritional behaviour as chickens, thus restricted feeding may be useful for improving their growth performance [16]. However the effect of restricted feeding on production in guinea fowl remains uncertain. This study aims to identify an optimal size

of a free-range area for keeping HLGf using traditional methods and examines the effect of qualitative feed restriction on the growth performance of HLGf.

III. MATERIALS AND METHODS

A. Experimental design

This study took place at the HÁGK in vivo poultry gene bank farm in Gödöllő, Hungary. A base population of 486 birds were hatched from the nucleus stock of the HLGf gene bank. All chicks were marked with individual wing bands, then at birth, males and females were pooled together for investigation. In the first 5 weeks, the birds were kept in an enclosed area with a density of 40 birds per m² and fed *ad libitum*. From 6 weeks of age, all 486 birds were moved to a house for growers with free-range areas of different sizes (either 50 m² or 15 m² per bird) or without a running area, and were randomly distributed into 18 cages (27 birds per cage, 9 birds per m²). From 9 to 14 weeks of age, different feeding regimes (feed restriction at the levels of 90%, 80%, 70% and *ad libitum* feeding) were applied. The experimental design of the HLGf rearing system, and the labels of treatments are shown in Table 1.

Quantitative feed restrictions were applied through the control of the daily feed supply. From 9 to 14 weeks of age, the amount of feed given (FG) in the restricted feeding regimes was calculated based on measured feed intake (FI) of the *ad libitum* group from the previous week.

Equations used for the calculation of FG at 9 weeks of age were:

$$\begin{aligned} \text{FG of 15R90 in } i^{\text{th}} \text{ week} &= 90\% \times \text{FI of 15Adl in } j^{\text{th}} \text{ week} \\ \text{FG of 15R80 in } i^{\text{th}} \text{ week} &= 80\% \times \text{FI of 15Adl in } j^{\text{th}} \text{ week} \\ \text{FG of 15R70 in } i^{\text{th}} \text{ week} &= 70\% \times \text{FI of 15Adl in } j^{\text{th}} \text{ week} \end{aligned}$$

Where: j = a previous week ($j = 8, 9, 10, 11, 12$ and 13); and $i = j + 1$ week ($i = 9, 10, 11, 12, 13$ and 14)

The feed that was supplied was the feed prescribed by Szalay et al. [6] was given to all groups. The survival rate, body weight (BW),

Table 1: Experimental arrangement of Hungarian Landrace Guinea Fowl rearing systems from 6 to 8 and from 9 to 14 weeks of age

Label	Birds x cages	6-8 weeks of age	9-14 weeks of age
50Adl	27 × 3	50 m ² free-range area per bird ad libitum feeding	50 m ² free-range area per bird ad libitum feeding
00Adl	27 × 3	No free-range area per bird ad libitum feeding	No free-range area per bird ad libitum feeding
15Adl	27 × 3	15 m ² free-range area per bird ad libitum feeding	15 m ² free-range area per bird ad libitum feeding
15R90	27 × 3	15 m ² free-range area per bird ad libitum feeding	15 m ² free-range area per bird restricted feeding at 90%
15R80	27 × 3	15 m ² free-ranging area per bird ad libitum feeding	15 m ² free-range area per bird restricted feeding at 80%
15R70	27 × 3	15 m ² free-ranging area per bird ad libitum feeding	15 m ² free-range area per bird restricted feeding at 70%

body weight gain (BWG) and feed conversion ratio (FCR, kg feed per kg body weight gain) of HLGf was recorded at birth, 5 weeks of age and every two weeks from the 6th week. Experimental birds were tested in compliance with the national laws and regulations of HÁGK.

B. Data analysis

All statistical tests were performed by SPSS software version 20 [17], mean and standard deviation was estimated. Data was subjected first to Levene's test for homogeneity, then one-way ANOVA (for the 6th and 8th week) and two-way ANOVA test (weeks 10, 12 and 14). Following ANOVA, a pairwise comparison was conducted by Tukey test.

IV. RESULTS AND DISCUSSION

This study showed that the survival rate of guinea fowl kept in all investigated systems was relatively high. From six to fourteen weeks of age, the lowest recorded survival rate was 96.3% with no significant difference amongst groups. The average BW and FCR of HLGf were comparable to the results observed in studies of Blum et al. [18] and Adjetey et al. [19]. HLGf seemed to become more sensitive to the sizes of the free-range

area and feeding regimes as they aged. Average BW measured on the hatching day and at the end of the 5th week was 29 g and 287 g respectively. Following the application of different sizes of free-range areas and feeding regimes, the average BW and FCR recorded at the ages of weeks 6, 8 and weeks 10, 12, 14 are shown in Tables 2 and 3. Figure 1 illustrates BWG of HLGf in the period between 8 to 14 weeks of age. The results of Levene's test indicated that equality of variances could be assumed. The size of the free-range area did not affect BW, FCR of HLGf between the 6th and 8th week. The significant impact of free-range area size on BW was found at the age of 10 weeks and on FCR at the age of 10, 12 and 14 weeks and it had a substantial effect on the BWG of HLGf at all ages. While the effect of feed restriction on BW and BWG was apparent, it was hardly seen to affect FCR.

The results showed that BW and BWG of birds with feed restriction were significantly lower than birds fed *ad libitum*. The higher rate of feed restriction was applied, the lower BWG was recorded. From 8 to 14 weeks of age, the 15Adl experimental group gained 634.07 ± 41.95 g and grew $1.47 \pm 0.09\%$ per day. This result was comparable to that of 15R90 but significantly higher than

Table 2: Average body weight (BW, g) and feed conversion ratio (FCR, kg feed per kg body weight gain) of Hungarian Landrace Guinea Fowl, kept with different free-range area sizes, and recorded on weeks 6 and 8.

	50m ² per bird		15m ² per bird			No free-range area	Sig.
	50Adl	15Adl	15R90	15R80	15R70	00Adl	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
BW6	570.37 ± 7.14	554.07 ± 31.77	556.30 ± 7.80	568.15 ± 34.02	551.85 ± 13.39	576.30 ± 26.04	ns
BW8	778.52 ± 11.18	744.44 ± 23.09	765.19 ± 7.80	751.85 ± 39.90	746.67 ± 21.43	740.74 ± 24.48	ns
FCR6	2.60 ± 0.03	2.55 ± 0.17	2.58 ± 0.02	2.46 ± 0.15	2.50 ± 0.09	2.45 ± 0.12	
FCR8	3.02 ± 0.04	3.04 ± 0.11	3.06 ± 0.02	2.98 ± 0.16	2.96 ± 0.10	3.09 ± 0.11	

SD: standard deviation; Sig.: significance detected by ANOVA test, ns: not significant; 50Adl: free-range area of 50m² per bird and ad libitum feeding from 8th to 14 weeks; 15Adl: free-range area of 15m² per bird and ad libitum feeding from 8th to 14 weeks; 00Adl: no free-range area and ad libitum feeding from 8th to 14 weeks; 15R90: free-range area of 15m² per bird and 90% feed restriction from 8th to 14 weeks; 15R80: free-range area of 15m² per bird and 80% feed restriction from 8th to 14 weeks; 15R70: free-range area of 15m² per bird and 70% feed restriction from 8th to 14 weeks

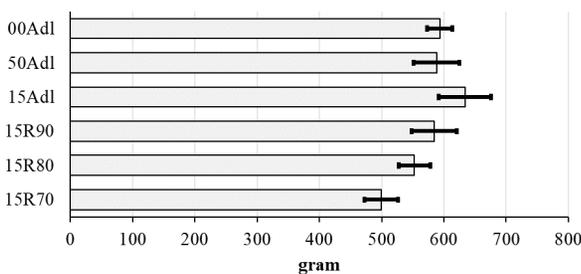


Fig. 1: Bodyweight gain of Hungarian Landrace Guinea Fowl in the period between 8 weeks to 14 weeks of age (50Adl: free-range area of 50 m²/bird and *ad libitum* feeding; 15Adl: free-range area of 15 m²/bird and *ad libitum* feeding; 00Adl: no free-range area and *ad libitum* feeding; 15R90: free-range area of 15 m²/bird and 90% feed restriction; 15R80: free-range area of 15 m²/bird and 80% feed restriction; 15R70: free-range area of 15 m²/bird and 70% feed restriction)

recorded in both 15R80 and 15R70 groups. Additionally, at the age of 14 weeks, 15Adl had the highest BW and relatively low FCR in comparison with others. The lowest BW and FCR were obtained by 15R70, while the highest FCR was detected in 00Adl. The

results demonstrate that if feed quantity was restricted, guinea fowl would grow slower, even though there is access to large running areas (up to 50 m²/bird).

Based on the observations, approximately 15 m² of free-range area and *ad libitum* feeding are recommended to keep local landrace guinea fowl for meat production, up to 14 weeks of age. This sizeable running area is in accordance with the traditional free-range farming mentioned by Baldy (1940), being almost 4 times higher than present organic farming regulation for guinea fowl.

V. CONCLUSION

The size of the free-range area coupled with feed restriction techniques had a significant effect on the body weight of Hungarian Landrace Guinea Fowl only after 8 weeks, and predominantly from the age of 10 to 14 weeks. Feed restriction was found to negatively affect guinea fowl growth, therefore a free-range area of 15 m² per bird with *ad libitum* feeding is recommended for optimal meat production of Hungarian Landrace Guinea Fowl.

Table 3: Average body weight (BW, g) and feed conversion ratio (FCR, kg feed per kg body weight gain) of Hungarian Landrace Guinea Fowl, kept with different free-range area sizes and feed restriction regimes, and recorded on weeks 10, 12 and 14.

	50Adl	15Adl	00Adl	Sig.	15Adl	15R90	15R80	15R70	Sig.
	Mean ± SD	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
BW10	1009.63 ^a ± 5.13	998.52 ^{ab} ± 4.63	983.70 ^b ± 13.02	*	998.52 ^a ± 4.63	942.96 ^a ± 7.14	926.67 ^b ± 31.11	888.15 ^c ± 14.80	**
BW12	1203.70 ± 33.55	1224.44 ± 50.88	1181.48 ± 43.11	ns	1224.44 ^a ± 50.88	1161.48 ^a ± 21.00	1088.89 ^{ab} ± 30.55	1048.89 ^b ± 40.06	**
BW14	1366.67 ± 40.00	1378.52 ± 43.68	1334.07 ± 40.04	ns	1378.52 ^a ± 43.68	1349.63 ^a ± 38.25	1304.44 ^b ± 38.55	1245.93 ^c ± 38.64	*
FCR10	3.11 ^b ± 0.01	3.15 ^b ± 0.02	3.36 ^a ± 0.05	**	3.15 ± 0.02	3.34 ± 0.01	3.20 ± 0.11	3.19 ± 0.06	ns
FCR12	3.35 ^b ± 0.07	3.41 ^b ± 0.02	3.76 ^a ± 0.12	**	3.41 ± 0.02	3.50 ± 0.06	3.46 ± 0.11	3.38 ± 0.14	ns
FCR14	3.76 ^b ± 0.12	3.82 ^b ± 0.14	4.34 ^a ± 0.06	**	3.82 ^a ± 0.14	3.83 ^a ± 0.11	3.63 ^b ± 0.12	3.52 ^c ± 0.12	**

^a, ^b, ^c: different superscript letters in a column show significant differences ($P < 0.05$) between groups, analysed by Tukey HSD test; SD: standard deviation; Sig.: significance detected by ANOVA test, ns: not significant, *: $P < 0.05$; **: $P < 0.01$; 50Adl: free-range area of 50m² per bird and ad libitum feeding from 8th to 14 weeks; 15Adl: free-range area of 15m² per bird and ad libitum feeding from 8th to 14 weeks; 00Adl: no free-range area and ad libitum feeding from 8th to 14 weeks; 15R90: free-range area of 15m² per bird and 90% feed restriction from 8th to 14 weeks; 15R80: free-range area of 15m² per bird and 80% feed restriction from 8th to 14 weeks; 15R70: free-range area of 15m² per bird and 70% feed restriction from 8th to 14 weeks

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