Initial Results of Hungarian Blonde d'Aquitaine Breeding Bull Candidates in the Vytelle System

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Received/Érkezett: 25.02.2025 Revised/Átdolgozva: 26.03.2025
Accepted/Elfogadva: 25.04.2025 Published/Megjelent: 27.06.2025

ABSTRACT

Nowadays, public opinion is determined by economic and environmental considerations, so when selecting beef cattle for breeding, the aim is to achieve the largest possible body size while reducing feed costs and methane emissions. Computer-controlled automatic feeding systems can measure the exact amount of feed consumed by animals, enabling the RFI value to be determined. This value expresses the difference between the amount of feed actually consumed by the animal and the amount expected based on its live weight and body weight gain.

In 2024, we studied 29 Blonde d'Aquitaine breeding bulls that were fed using the Vytille system and housed in two pens in Taliándörögd. The animals were divided into four groups based on their RFI values and average daily weight gain, and their production data were analysed using a multivariate generalised linear model (GLM) method.

Based on our results, it was not necessary to take pen effect into account, as the husbandry technology was perfectly suited to the purpose. The four groups were sufficient for selection based on feed conversion and daily weight gain. Taking all the measured values into account, the young bulls in the group with favourable RFI and above-average daily weight gain are the most promising.

Keywords: Vytille system, comparative feed conversion, daily weight gain, Blonde d'Aquitaine, breeding bull candidates

DOI: 10.17108/ActAgrOvar.2025.66.1.5

1. INTRODUCTION

Methods to select animals with lower feed intake and higher feed conversion ratio without compromising product quality are at the forefront of beef cattle breeding today. In addition to improving profitability - while feeding costs are increasing - the importance of this for methane emissions and thus for the climate is obvious (Bormann & Rolf, 2022).

Therefore, in recent decades, the focus of beef cattle selection has shifted from increased weight gain to improved feed efficiency without compromising other important traits. Animals that are feed efficient have lower production costs and a lower environmental impact, thereby reducing greenhouse gas emissions (Arthur & Herd, 2008; Bezzera et al., 2013).

While the cost of providing feed to grazing livestock is more difficult to quantify than in pig or poultry production, it still represents a significant production cost in extensive grazing systems. Consequently, enhancing the efficiency of feed utilisation is crucial for reducing production expenses. According to McKenna et al. (2018), feed accounts for up to 75 % of costs in beef production systems. Arthur and Herd (2008) stated that feed costs for maintenance are estimated to be at least 60-65 % of the total feed requirement for a cowherd, with considerable variation between individual animals regardless of body size. Recent advances in computing and electronics and the availability of reliable automatic feed intake recorders have made it easier to measure feed intake in cattle (Arthur & Herd, 2008).

Methane production is strongly positively related to dry matter intake, live weight, and average daily gain. Additionally, methane production exhibits low to moderate positive correlations with carcass composition traits, including rib fat, rump fat, intramuscular fat, and rib eye area (Lakamp et al., 2022). The performance of Blonde d'Aquitaine (BLO) bulls was analysed using the Vytelle system to determine the effect of pen environment and RFI-ADG performance level on the studied parameters.

2. LITERATURE REVIEW

The concept of residual feed intake (RFI) in cattle was first introduced by Koch (1963) and has since been referenced in numerous publications, including those by Sainz and Paulino (2004), Kerley (2010) and Bezzera (2013). However, its significance was not fully recognised until the 1990s. RFI is calculated as the difference between an animal's actual feed intake and the amount it is expected to consume based on its average live weight and weight gain rate (Alende et al., 2016; Bezzera et al., 2013). RFI represents the variation in feed intake remaining after maintenance and growth requirements have been met. Efficient animals have a negative or low RFI because they eat less than expected, while inefficient animals have a positive or high RFI because they eat more than expected (Basarab et al., 2006). Therefore, cattle with a lower RFI are considered more efficient (Arthur & Herd, 2008; Alende et al., 2016).

RFI is calculated by regressing the animals in a test group against their body weight and daily gain. The regression coefficients for body weight and daily gain are then used to calculate an expected feed intake for each animal. The difference between the actual feed intake and the expected feed intake is reported as the RFI. Gain was regressed on intake and body weight, and the resulting regression coefficients were used to calculate the expected gain for each animal based on the group's mean performance (Kerley, 2010). By definition, within a contemporary group, the mean RFI derived from linear regression should result in a value of 0.0. Variation above and below the group mean depends on the individual contemporary groups (Minton, 2010).

 DOI: 10.17108/ActAgrOvar.2025.66.1.5

Thus, RFI is a measure of metabolic efficiency. It describes an animal's feed efficiency independently of its gain or growth performance (Kerley, 2010; Elolimy et al., 2018). Therefore, it allows individuals with lower feed intake at similar performance levels to be identified, i.e. those with high feed efficiency (Cantalapiedra-Hijar et al., 2024). Feed efficiency is associated with variation in feed intake, digestion and metabolism (including anabolism and catabolism, and variation in body composition), as well as activity and thermoregulation. According to Herd et al. (2004), the percentage contribution of these mechanisms to variation in residual feed intake is as follows: 9 % for differences in the thermal increment of feed, 14 % for differences in digestion, 5 % for differences in body composition, and 5 % for differences in activity. Together, these mechanisms may account for approximately one-third of the variation in RFI.

While most beef cattle systems worldwide are pasture-based, RFI evaluation and research are typically conducted under confinement conditions using automated feeding systems (Marín et al., 2024). Marín et al. (2024) used residual heat production to determine the energy efficiency of Hereford cattle under grazing conditions, i.e. without measuring actual feed intake, and to calculate breeding values in sires based on their daughters' performance.

The results obtained by selecting for RFI can, of course, be used to make beef production predominantly pasture-based (Kerley, 2010) because, unlike feed conversion, selection based on RFI appears to select for lower consumption rates and lower maintenance requirements for animals without altering their adult weight or weight gain (Bezzera et al., 2013).

RFI is an individual record obtained in long-term feeding trials (lasting at least 70-84 days), in which animals are housed either individually or in groups, and accurate measurements are taken of the feed offered and refused daily, as well as the average daily gain.

Newer techniques using electronic devices that identify each animal individually, open specific feed bunks, and measure the feed intake of individual animals in groups can also be employed (Sainz & Paulino, 2004).

The primary biological mechanisms driving RFI appear to be intrinsically linked to animal metabolism. Previous studies have suggested that branched-chain amino acids, which play a signalling role in key metabolic pathways such as protein and lipid synthesis, could serve as potential RFI biomarkers. However, the plasma concentration of branched-chain amino acids in ruminants is significantly influenced by feed protein intake and nutrient flow to the duodenum, as with other nutrients (Cantalapiedra-Hijar et al., 2024). In a study of young Charolais bulls, two metabolites — α-aminoadipic acid and 5-aminovaleric acid — were found to be associated with RFI, independently of feed intake. Both metabolites belong to the same metabolic pathway: lysine catabolism.

Richardson and Herd (2004) measured different factors influencing the RFI phenotype: body protein and lipid difference (5 %), feeding behaviour (2 %), activity level (10 %), digestion (10 %), and metabolic functions (73 %).

McKenna et al. (2018) investigated gene expression in adipose tissue in relation to feed efficiency, given that adipose cell size is known to be involved in regulating feed intake.

Mitochondrial respiration and RFI differ in magnitude between efficient and inefficient animals (Golden et al., 2008).

Of the 34 genes analysed in the rumen epithelium, the most efficient cattle according to RFI exhibited a higher abundance of genes involved in absorption, metabolism, ketogenesis, and the immune and inflammatory responses (Elolimy et al., 2018).

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According to Silva et al. (2023), nutrient utilisation, energy metabolism, protein metabolism, vitamin metabolism, gut development and hindgut bacterial populations may be involved in RFI divergence in pre-weaning dairy calf offspring.
Even within the same breed, there is a significant difference in feed efficiency between individual animals raised under identical conditions. Beef cattle intake will vary by +/- 20 % from the predicted amount. This 40 % range describes the maximum and minimum efficiencies within the population. Research by Kerley (2010) measured an RFI range of approximately 5.89 kg (-2.9 to +2.9). Arthur et al. (2001) observed differences in RFI values of 0.69 and 0.66 for dry matter intake and feed conversion in Charolais cattle, respectively. This demonstrates that genetic selection for low RFI may result in lower dry matter intake and feed conversion. In a Simmental study group, high RFI heifers and bulls consumed 10 % and 15 % more feed, respectively, than their low RFI counterparts. The heifers also exhibited higher expression of lipogenesis-related genes than genetically similar bulls (McKenna et al., 2018). Meyer et al. (2008) compared RFI groups of grazing beef cows after classification had become widespread. Low RFI cows had a numerically lower dry matter intake of 21 %, but this difference was not significant.
RFI is estimated to have moderate heritability (h^2 of around 0.4, as cited by Basarab et al., 2006), providing a basis for genetic selection. Furthermore, predicting variance in feed efficiency can inform precision feeding approaches, which can improve resource efficiency and reduce environmental impact (Kerley, 2010; Cantalapiedra-Hijar et al., 2024).
The high genetic correlation between RFI and post-weaning adult RFI (rg = 0.98) suggests that RFI selection could be used to improve feed efficiency in both growing and adult animals simultaneously (Bezzera et al., 2013). Silva et al. (2023) also found that selecting high-efficiency calves during the pre-weaning period could accelerate genetic selection in dairy cattle.
According to Basarab et al. (2006), who compared the selection of bulls and cows based on RFI phenotype, 80-90 % of genetic improvement in a herd comes from sires. They concluded that efficient bulls pass on superior feed efficiency genetics to their progeny, resulting in feed savings for calves in the feedlot and replacement heifers in the cow herd.
Kerley (2010) demonstrated that, in dairy cattle, pitting the most efficient one-third of calves against the least efficient one-third can reduce feed costs by 20 % or more. Selecting heifers with negative RFI rather than positive RFI improved the feed conversion ratio of their progeny by 11 %. Selecting efficient sires over inefficient ones improved progeny feed conversion by 14 %. The most efficient cows consumed 20 % less feed during the non-lactating period and 12 % less during the milking period than the least efficient cows.
In a pilot study in North America led by Basarab et al. (2006), selection for low RFI reduced cow herd maintenance requirements by 9-10 %, reduced feed intake by 10-12 %, and had no effect on average daily gain or mature size. It also reduced manure nitrogen, phosphorus, and potassium production by 15-17%. However, lower methane emissions per unit of dry matter intake have not yet been demonstrated in cattle with a more favourable RFI (Alende et al., 2016).
According to the literature, the correlation between RFI and other production traits, especially those related to growth performance, is somewhat controversial, as is the question of whether it would be sufficient to select only for RFI or whether it would be better to combine it with other traits and include it in a selection index. Sainz and Paulino (2004) claimed that genetic selection to reduce RFI could result in progeny that consume less feed without compromising growth performance. Arthur and Herd (2008) also demonstrated that, under ad libitum feeding conditions, RFI is phenotypically independent of growth traits and that the genetic relationship between RFI and fatness is weak,
 DOI: 10.17108/ActAgrOvar.2025.66.1.5

requiring further investigation. Elolimy et al. (2018) found no differences in initial or final body weight or average daily gain between the two RFI classes established in finishing Red Angus bulls. There were no significant RFI × sex effects on growth performance or carcass traits. In the study by Hafla et al. (2012), bulls with low RFI phenotypes consumed 20 % less dry matter and had 10 % less backfat; however, they had similar average daily gain, scrotal circumference, and semen quality traits to those of high RFI bulls. The authors concluded that RFI should be incorporated into selection indices as it enables the selection of feed efficiency with minimal impact on growth and other performance traits. However, Kerley (2010) warned that, although RFI is independent of growth, care should be taken when using RFI as a selection criterion in unbalanced or single-trait selection approaches, as this could result in the selection of feed-efficient cattle with poor growth potential. Although RFI is not a production trait, Alende et al. (2016) found that activity and feeding behaviour differ in cattle with contrasting RFI: more efficient cattle are less active and have fewer daily feeding events.

3. MATERIALS AND METHODS

3.1 Farm conditions

The experiment was carried out at a progressive Blonde d'Aquitaine stud farm in Taliándörögd, a picturesque village in western Hungary. The farm was founded in 1993, with the first Blonde d'Aquitaine cattle being purchased in 2001. This breed was chosen for its excellent carcass weight, meat yield, and feed efficiency. The farm has a feedlot with a capacity of 220 cows and 200 bulls. Next to the feedlot is a barn designed for the Vytelle Sense system, which identifies the most efficient animals and collects phenotypic data (see *Figures 1a* and *1b*, and *Figure 2*). The company began using the system in 2022 and has opened its doors to other breeders, creating a unique opportunity for the beef industry to produce beef efficiently.

Figure 1a, 1b: Stable and pen

DOI: 10.17108/ActAgrOvar.2025.66.1.5

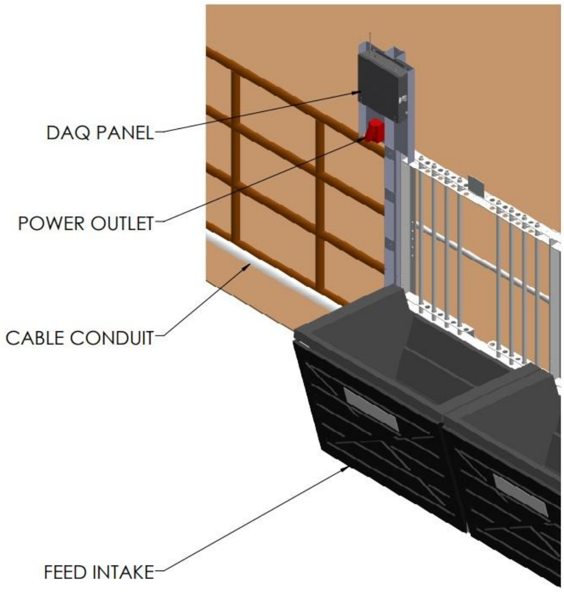

Figure 2: Parts of the feeding containers

The young bulls involved in the study were placed in two pens (pen 1, pen 2). Individuals were categorized into four groups, based on their RFI and ADG performances as shown in *Table 1*.

Table 1: Between-subjects factors

Subjects factor	Groups	Number of bulls
Pen	pen 1	14
	pen 2	15
RFI_ADG groups	Favorable RFI – Above Average ADG 1	8
	Unfavorable RFI – Above Average ADG 2	6
	Unfavorable RFI – Below Average ADG 3	9
	Favorable RFI – Below Average ADG 4	6

3.2 List of abbreviations and terms

The abbreviations used in this study are listed below.
DMI (Dry Matter Intake): The average daily dry matter intake of an animal during the test. DMI depends on the dry matter content of the feed provided during the trial period.
Start Wt.: Live weight at the start of the trial, on the start date.
End Wt.: Live weight at the end of the trial, with the end date.
ADG: Average Daily Gain.
Raw F:G: Feed to gain (F:G) ratio. Also referred to as feed conversion ratio (FCR). The F:G ratio refers to the amount of feed consumed per unit of weight gained on a dry matter basis. A lower ratio is considered more favourable. While selection for F:G (FCR) results in faster-growing animals, it is also associated with larger mature size.
Adj. F:G: Adjusted feed-to-gain ratio. It accounts for differences in animal age and size during the test. It is currently the standard for feed conversion efficiency used by the Beef Improvement Federation. The adjusted F:G ratio is calculated by multiplying the base F:G ratio by the trial group's

 DOI: 10.17108/ActAgrOvar.2025.66.1.5

metabolic mid-weight, then dividing it by the individual's metabolic mid-weight. A lower adjusted F:G ratio is favourable.

Residual Feed Intake (RFI): RFI stands for residual feed intake. It is a measure of feed efficiency, calculated as the difference between an animal's actual and predicted feed intake at a given production level. When RFI is used as a genetic selection tool, the resulting progeny consumes less feed at the same production level. RFI is independent of growth, body size, and other performance traits. Selecting animals with low RFI leads to reduced feed intake and improved feed conversion efficiency without compromising body size, carcass quality or growth. Lower RFI values are favourable. Cattle with low RFI values are more efficient than those with high RFI values.

RADG (Residual Average Daily Gain) is the difference between an animal's actual weight gain and its predicted gain based on dry matter intake, body weight maintenance and fat cover. Although RADG and RFI appear similar in that they both contain the same or similar components, the two concepts work in very different ways. RADG puts each animal's feed intake on the same level and looks at differences in average daily gain, whereas RFI puts each animal's growth and body size on the same level and looks at differences in feed intake. When selecting for RADG, cattle with higher values are more desirable than those with lower values, meaning that they achieved a greater average daily gain for the same amount of feed. However, this measure is not independent of body size, so caution should be exercised if mature cow size is important to your herd.

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3.3 Data of the pens

Table 2 shows the weight gain and RFI values of the young bulls included in the study per study group.

The average age of the bulls at the start and end of the trial was 318 days and 388 days, respectively. The age did not follow a normal distribution (Shapiro-Wilk test: 0.835, df: 29, P ≤ 0.001), thus non-parametric tests were used (Mann-Whitney U-Test and Kruskal-Wallis Test).

Table 2: Data of ADG and RFI values according to the groups of RFI_ADG and groups of pens

Parameter	RFI_ADG group	Pen group	Mean	STD deviation	Number of bulls
ADG, kg/day	1	pen 1	1.72	0.148	5
		pen 2	1.63	0.085	3
		Total	1.69	0.131	8
	2	pen 1	1.64	0.090	4
		pen 2	1.64	0.141	2
		Total	1.64	0.094	6
	3	pen 1	1.40	0.104	3
		pen 2	1.46	0.066	6
		Total	1.44	0.079	9
	4	pen 1	1.28	0.085	2
		pen 2	1.37	0.083	4
		Total	1.34	0.088	6
	Total	pen 1	1.57	0.203	14
		pen 2	1.49	0.132	15
		Total	1.53	0.171	29
RFI, kg	1	pen 1	-0.73	0.395	5
		pen 2	-0.45	0.611	3
		Total	-0.63	0.467	8
	2	pen 1	0.85	0.511	4
		pen 2	0.78	0.028	2
		Total	0.83	0.397	6
	3	pen 1	0.75	0.799	3
		pen 2	0.74	0.745	6
		Total	0.74	0.712	9
	4	pen 1	-1.37	0.233	2
		pen 2	-0.97	0.297	4
		Total	-1.10	0.324	6
	Total	pen 1	-0.05	1.026	14
		pen 2	0.05	0.948	15
		Total	0.00	0.970	29

DOI: 10.17108/ActAgrOvar.2025.66.1.5

Table 3 shows that the individuals in pen 1 were 21 days older than those in pen 2 (MW: 29, P ≤ 0.001).

Table 3: Age at the start and at the end of test, according to the pen code (pen 1: n = 14, pen 2: n = 15)

Parameter	Pen group	Mean	Std. Error of Mean
Start Age, day	1	328	4.306
	2	307	4.215
End Age, day	1	398	4.306
	2	377	4.215

Table 4 summarizes the ages at the beginning of the study and at the end of the study according to the RFI_ADG codes. The Kruskal-Wallis Test confirmed that the average age of the bulls in each group did not differ at the beginning or at the end of the study (KW: 1.980, df: 3, P = 0.577).

Table 4: Age at the start and at the end of experience according to the RFI_ADG_pen code (1: n = 8, 2: n = 6, 3: n = 9, 4: n = 6)

Parameter	RFI_ADG_group	Mean	Std. Error
Start Age, day	1	319	5.597
	2	312	6.483
	3	315	5.326
	4	323	6.483
End Age, day	1	389	5.597
	2	382	6.483
	3	385	5.326
	4	393	6.483

3.4 Statistical analysis

We used the SPSS (version 24) program packages in our study.
We checked the normal distribution of the examined data using the Shapiro-Wilk test (see *Table 5*). The results show that all our data met the conditions for a normal distribution. Therefore, variance analysis can be used in the study. Multivariate GLM (generalised linear model) is an extension of GLM that deals with more than one dependent variable and one or more independent variables. The structure of the multivariate GLM was as follows: intercept + pen code (1.2) + RFI_ADG groups (1-4). The dependent variables (y) were: Start Wt., End Wt., Avg. DMI, RADG, Raw F and Adj F.
In this study, the independent variables were pen group (1.2) and the RFI_ADG groups (1-4). The model generated the main averages and determined the estimated average values according to the independent variables. The Bonferroni method (α = 0.05) was used to calculate differences between the average values of the groups.

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Table 5: Results of the test of normality (Shapiro-wilk) (n = 29)

Parameter	Statistic	df	Sig.
Start Wt., kg	0.983	29	0.898
End Wt., kg	0.986	29	0.956
Avg DMI, kg	0.952	29	0.209
RADG, kg/day	0.956	29	0.268
Raw F:G	0.971	29	0.597
Adj F:G	0.943	29	0.121

4. RESULTS AND DISCUSSION

Table 6 shows the main average values for the examined parameters.
The initial live weight of the examined individuals was 422.6 kg in average. At the end of the test, the live weight of the bulls was 106.7 kg more. In the case of both data, the relative deviation value was medium at 11-13 %. Regarding the Avg. DMI, the relative deviation value was similar (16 %) to the previous ones.

Table 6: Grand means on all parameters (n = 29)

Dependent Variable	Mean	Std. Error of Mean
Start Wt., kg	422.6	5.641
End Wt., kg	529.4	6.279
Avg DMI, kg	7.629	0.122
RADG, kg/day	-0.005	0.018
Raw F:G	5.046	0.107
Adj F:G	5.056	0.115

Table 7: Results of multivariate tests (n = 29)

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	1.000	32273.5	6.0	19.0	0.0001
Pen code	Pillai's Trace	0.407	2.2	6.0	19.0	0.0910
RFI_ADG_code	Pillai's Trace	1.783	5.1	18.0	63.0	0.0001

The relative deviation values for the raw F:G and Adj F:G results are 21 % and 23 % respectively, which can represent a suitable variance for selecting excellent bulls.
The results of the multivariate tests are summarized in *Table 7*. Among the two factors studied, the effect of the pen was not significant ($P > 0.05$), while the RFI_ADG group effect was significant ($P \leq 0.0001$).

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The Levene’s test showed that the error variances of the dependent variables were homogeneous ($P > 0.05$) for all parameters (*Table 8*).

Table 8: Levene's test for equality of error variances (n = 29)

Parameter	F	df1	df2	Sig.
Start Wt., kg	0.556	7	21	0.782
End Wt., kg	0.722	7	21	0.655
Avg DMI, kg	0.856	7	21	0.556
RADG, kg/day	1.585	7	21	0.195
Raw F:G	2.278	7	21	0.068
Adj F:G	1.689	7	21	0.166

Table 9 shows the different sources of variance in the adjusted model, regarding the constants, as well as regarding the two influencing factors. It can be seen, that in the case of the pen code, the empirical significance level (P) for all traits was greater than 0.05, so statistically verifiable differences were not detectable at this level of error. Accordingly, the average values of each group must be considered to be the same.

Table 9: Tests for between-subjects effects on all parameters (n = 29)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Pen group	Start Wt.	3728.186	1	3728.186	4.171	0.052
	End Wt.	3526.286	1	3526.286	3.185	0.087
	Avg DMI	0.150	1	0.150	0.358	0.555
	RADG	0.039	1	0.039	4.146	0.053
	Raw F:G	0.284	1	0.284	0.877	0.358
	Adj F:G	0.001	1	0.001	0.002	0.962
RFI_ADG_group	Start Wt.	1539.062	3	513.021	0.574	0.638
	End Wt.	7723.619	3	2574.540	2.325	0.100
	Avg DMI	20.000	3	6.667	15.910	0.000
	RADG	0.309	3	0.103	10.973	0.000
	Raw F:G	10.889	3	3.630	11.208	0.000
	Adj F:G	12.994	3	4.331	11.645	0.000

On the other hand, the RFI_ADG groups showed statistically guaranteed differences in all other parameters ($P \leq 0.0001$), with the exception of the initial and final weight data.

DOI: 10.17108/ActAgrOvar.2025.66.1.5

Table 10 shows the estimated means and standard deviations, grouped by the two pens. As the results in *Table 11* show, there is no difference in performance between the two pens for any of the parameters (P > 0.05), so we can disregard the effect of the pens on performance.

Table 10: Estimated values of the dependent variables according to the pens (pen 1: n = 14, pen 2: n = 15)

Dependent Variable	Pen group	Mean	Std. Error of Mean
Start Wt., kg	Pen 1	434.5	8.210
	Pen 2	410.7	8.035
End Wt., kg	Pen 1	540.9	9.138
	Pen 2	517.7	8.943
Avg DMI, kg	Pen 1	7.705	0.178
	Pen 2	7.554	0.174
RADG, kg/day	Pen 1	-0.043	0.027
	Pen 2	0.034	0.026
Raw F:G	Pen 1	5.150	0.156
	Pen 2	4.942	0.153
Adj F:G	Pen 1	5.062	0.167
	Pen 2	5.050	0.164

Table 11: Results of the pairwise comparisons on dependent variables (pen 1 = 14, pen 2 = 15)

Dependent Variable	Pen group (i)	Pen group (j)	Mean Difference (I-J)	Std. Error	Sig.
Start Wt., kg	Pen 1	Pen 2	23.873	11.689	0.052
End Wt., kg	Pen 1	Pen 2	23.217	13.009	0.087
Avg DMI, kg	Pen 1	Pen 2	0.152	0.253	0.555
RADG, kg/day	Pen 1	Pen 2	-0.077	0.038	0.053
Raw F:G	Pen 1	Pen 2	0.208	0.222	0.358
Adj F:G	Pen 1	Pen 2	0.011	0.238	0.962

The results of the four groups according to the RFI_ADG are *Tables 12-13*.
The average initial and final weights of the bulls are not different (P > 0.05) and are the same for the four groups. If better feed conversion or weight gain had been observed among the individuals studied, bulls with identical starting weights would have achieved these results.
The fact that the bulls in the second pen were 21 days younger yet performed similarly to those in the first pen suggests that the rearing conditions (housing and feeding) were favourable.

 DOI: 10.17108/ActAgrOvar.2025.66.1.5

Table 12: Estimated values of the dependent variables according to the RFI_ADG codes (1: n = 8, 2: n = 6, 3: n = 9, 4: n = 6)

Dependent Variable	RFI_ADG_group	Mean	Std. Error of Mean
Start Wt., kg	1	428.141	10.670
	2	432.395	12.359
	3	414.732	10.154
	4	415.200	12.359
End Wt., kg	1	546.260	11.876
	2	547.187	13.756
	3	515.112	11.301
	4	508.891	13.756
Avg DMI, kg	1	7.105	0.231
	2	8.621	0.268
	3	8.306	0.220
	4	6.485	0.268
RADG, kg/day	1	0.117	0.035
	2	0.081	0.040
	3	-0.055	0.033
	4	-0.163	0.040
Raw F:G	1	4.233	0.203
	2	5.240	0.235
	3	5.834	0.193
	4	4.878	0.235
Adj F:G	1	4.164	0.218
	2	5.131	0.252
	3	5.949	0.207
	4	4.980	0.252

As shown in *Table 13*, the performance of Group 1 (Favourable RFI – Above Average ADG 1) was statistically more favourable than that of Groups 2 and 3 in AV_DMI (1 vs 2 Group: -1.517 kg, P ≤ 0.001; 1 vs 3 Group: -1.202 kg, P ≤ 0.006).

Regarding the RADG parameter, Group 1's average performance did not differ from Group 2's, but differed significantly from Groups 3 and 4's results, favouring Group 1 (Group 1 vs Group 3: 0.172 g/day, P ≤ 0.009; Group 1 vs Group 4: 0.280 g/day, P ≤ 0.0001).

The same situation applies to Raw F:G and Adj F:G: Group 1 showed statistically significant better performance compared to Groups 2 and 3 (Raw F:G: 1 vs 2 Group: -1.008, P ≤ 0.019; 1 vs 3 Group: -1.601, P ≤ 0.0001. For Adj F:G, the values were: 1 vs 2 Group: -0.968, P ≤ 0.043; 1 vs 3 Group: -1.785, P ≤ 0.0001.

The AV_DMI value of bulls belonging to Group 4 was more favourable than that of Groups 2 and 3 (Group 4 vs Group 2: -2.136 kg, P ≤ 0.0001; Group 4 vs Group 3: -1.821 kg, P ≤ 0.0001). Conversely, their RADG values were less favourable (Group 4 vs Group 1: -0.280 g/day, P ≤ 0.0001; Group 4 vs

 DOI: 10.17108/ActAgrOvar.2025.66.1.5

Group 2: -0.244 g/day, P ≤ 0.002). Therefore, these individuals produced lower weight gains from smaller feed intakes than the bulls in Group 1 on average.

Table 13: Results of the pairwise comparisons on dependent variables (1: n = 8, 2: n = 6, 3: n = 9, 4: n = 6)

Dependent Variable	RFI_ADG_group (I)	RFI_ADG_group (J)	Mean Difference (I-J)	Std. Error of Mean	Sig.
Avg DMI, kg	1	2	-1.517*	0.350	0.001
		3	-1.202*	0.323	0.006
		4	0.620	0.357	0.574
	2	3	0.315	0.351	1.000
		4	2.136*	0.383	0.000
	3	4	1.821*	0.341	0.000
RADG kg/day	1	2	0.036	0.052	1.000
		3	0.172*	0.048	0.009
		4	0.280*	0.053	0.000
	2	3	0.136	0.053	0.096
		4	0.244*	0.057	0.002
	3	4	0.108	0.051	0.272
Raw F:G	1	2	-1.008*	0.307	0.019
		3	-1.601*	0.284	0.000
		4	-0.645	0.314	0.306
	2	3	-0.593	0.309	0.401
		4	0.362	0.337	1.000
	3	4	0.956*	0.300	0.024
Adj F:G	1	2	-0.968*	0.330	0.043
		3	-1.785*	0.304	0.000
		4	-0.817	0.337	0.139
	2	3	-0.817	0.331	0.127
		4	0.151	0.361	1.000
	3	4	0.968*	0.321	0.036

* The mean difference is significant at the 0.05 level.

According to our analysis, Group 1 was the most valuable, as these individuals – despite having the same starting weight – had better feed consumption, greater weight gain and higher feed efficiency than individuals in Groups 2 and 3.
Despite the favourable feed intake of Group 4, the data shows that this resulted in lower weight gain and feed sales compared to the other groups.
According to Kerley (2010), selection for RFI has not been associated with any other phenotypic traits. However, he points out that there is a consensus that selecting for RFI alone would be a mistake. In their experiment, they used calves in the top 10 % for efficiency and bottom 10 % for growth to calculate the benefits of selecting for feed efficiency in terms of feed cost and feed conversion ratio.

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Bezzera et al. (2013) also concluded in their review that studies evaluating the genetic and phenotypic correlations between RFI and growth traits have shown that RFI variation is independent of body weight and weight gain, both phenotypically and genotypically.
Elolimy et al. (2018) found no differences in initial body weight, final body weight or average daily gain between the two RFI groups they defined in Red Angus cattle in the fattening phase.

5. CONCLUSION

- The domestic adaptation of the Vytelle system was successful. The performance of the bulls in the second pen, which were 21 days younger, matched that of the bulls in the first pen in the studied parameters. This indicates that the rearing conditions were favourable for the actual performance.
- It is an important finding that the "pen effect" does not influence performance, so no correction is needed in this direction (Sig.: 0.091, $P > 0.05$).
- The performance of Group 1 (Favourable RFI – Above Average ADG) in AV_DMI compared to Group 2 (Unfavourable RFI – Above Average ADG) and Group 3 (Unfavourable RFI – Below Average ADG) was statistically more favourable (1 vs 2 group: -1.517 kg, $P \leq 0.001$; 1 vs 3 group: -1.202 kg, $P \leq 0.006$). This suggests that there is a significant relationship between RFI and DMI, which is also confirmed by the studies of Holló et al. (2022).
- Regarding the RADG parameter, the average performance of group 1 (Favourable RFI – Above Average ADG) differed significantly from the results of Groups 3 and 4 both with values below average ADG (1 vs 3 group: 0.172 g/day, $P \leq 0.009$; 1 vs 4 group: 0.280 g/day, $P \leq 0.0001$). This may indicate that there is a close relationship between RADG and ADG values.
- The results suggest that categorizing young bulls into four groups based on RFI and ADG is sufficiently differentiated for selection purposes. Considering all the examined parameters, the average performance of the bulls in the first group was the most favourable.
- Selection to improve the F:G ratio (feed conversion ratio) could be important in Hungary to produce bulls with larger mature size, provided there is a market demand for such traits.

 DOI: 10.17108/ActAgrOvar.2025.66.1.5

Acta Agronomica Óváriensis

M., Demény et al./ActAgrOvar, Vol.66.1. (2025)

A magyar blonde d'Aquitaine tenyészbika jelöltek első eredményei a Vytelle rendszerben

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ÖSSZEFOGLALÁS

Napjainkban a gazdasági és környezettudatossági szempontok határozzák meg a közgondolkodást, így a húsmarhák tenyész kiválasztásában sem csak a minél nagyobb testméret elérésére törekszenek, hanem fontos szemponttá vált takarmányozási költségek és a metánkibocsátás csökkentése. A számítógép vezérelt automatikus takarmányozási rendszerek segítségével mérhető az állatok pontos takarmányfelvétele, így meghatározható az RFI értékmérő, ami azt az állat által valóban elfogyasztott és az élősúlya, valamint a testtömeggyarapodásának mértéke által elvárt takarmányfelvétel különbségét fejezi ki.

A Vytelle rendszer alkalmazásával takarmányozott, két karámban elhelyezett 29 blonde d'Aquitaine tenyészbika jelöltet vizsgáltunk 2024-ben, Taliándörögdön. Az állatokat az RFI értékük és az átlagos napi testtömeggyarapodásuk alapján négy csoportba soroltuk és a termelési adataikat többváltozós GLM módszerrel elemeztük.

Karámhatással az eredményeink alapján nem kell számolni, a tartástechnológia elemei tökéletesen megfeleltek a célnak. A négy csoport meghatározása takarmányértékesítés és napi tömeggyarapodás alapján elégségesnek bizonyult a szelekcióhoz. Az összes vizsgált értékmérő alapján az előnyös RFI – átlagon felüli napi testtömeggyarapodás csoport növendék bikái értékelhetők a legkedvezőbbnek.

Kulcsszavak: Vytelle rendszer, összehasonlító takarmányértékesítés, napi testtömeggyarapodás, blonde d'Aquitaine, tenyészbika jelöltek

 DOI: 10.17108/ActAgrOvar.2025.66.1.5

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