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Preliminary results

Comparative analysis of environmental enrichment preferences in poultry

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ABSTRACT – The study, conducted at the Hungarian University of Agriculture and Life Sciences, involved five poultry species across 25 genotypes (N = 174). Environmental enrichment elements such as pumpkins, apples, corncobs, and hay were tested in pens designed to simulate real farm conditions. We monitored the consumption and weight change of these elements over a week, aiming to identify preferences and practical benefits for different poultry genotypes, contributing to improved animal welfare and potential economic efficiencies in production. TETRA SUPER HARCO consumed pumpkin and hay at rates over twice those of other layer hybrids (20 g/hen/day vs. 10 g/hen/day). The preference for red apples was markedly higher in TETRA-L SUPERB and TETRA-SL LL, with up to tenfold greater consumption compared to green apples (5 g/day/hen vs. 0.5 g/day/hen). Meat hybrid genotypes like TETRA-HB COLOR and ROSS 308 showed significant hay consumption (25 g/day/hen), surpassing layer hybrids. Native dual-purpose breeds preferred pumpkin (10 g/day/hen) and had lower consumption of hay, especially the Transylvanian bald-necked hens (3 g/day/hen). All hen genotypes showed reduced interest in enrichment elements over time. Ducks, particularly the Hungarian white, showed high consumption rates for pumpkin (up to 15 g/day/duck) and meadow hay (up to 51 g/day/duck), significantly more than other genotypes. Geese exhibited the highest consumption across all elements, with up to 74.8 g/day/goose of hay, reflecting their grazing nature. Turkeys consumed the most apples, averaging 28.3 g of red apples per individual, while guinea fowls showed lower consumption rates. Generally, softer elements like pumpkin were preferred, with the consumption of harder items such as corn being minimal. These results highlight differences in enrichment use based on genotype behavior and size, suggesting practical implications for enrichment strategies in avian management. Environmental enrichment enhanced the behavioral repertoire of all poultry species, benefiting their welfare. Laying hens preferred red apples over green, likely due to color attraction. Meat-type hens favored hay, reflecting their larger appetite and calmer behavior. Indigenous dual-purpose genotypes used enrichment elements more than intensively reared hybrids. Corn cob was minimally consumed, suggesting it's less effective as an enrichment material. Geese utilized enrichment the most, while Hungarian guinea fowl showed minimal interest, possibly due to their wilder nature. Turkey genotypes varied in their enrichment use, with a tendency towards hay. Further research with larger sample sizes and diverse enrichment forms is recommended.

Keywords: environmental enrichment, poultry behaviour, genotype preferences, animal welfare, consumption patterns

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INTRODUCTION

The development and study of various environmental enrichment processes is currently in its heyday across Europe. One of the main reasons for this is that the European Council banned the keeping of laying hens in traditional cages from January 1, 2012. In addition, the fact that a significant part of the population of the developed world has increased concern for the welfare of animals also plays a big role. This is perfectly demonstrated by a 2019 survey, which clearly shows that the majority of customers (regardless of their financial situation) prefer products that state that they come from appropriate animal welfare practices (*Cornish et al.,* 2020).

Compared to other poultry raised for meat use (broiler chicken, broiler duck, broiler goose), laying hens spend much more time, up to 1-1.5 years, in production compared to 5-9 weeks. It is important that this long period of time is spent under the conditions of the husbandry technology. That is why laying hens receive the greatest professional and scientific attention among poultry species and utilization directions in terms of husbandry technology and environmental enrichment issues.

It is known that physical constraints, especially housing, significantly influence animal behavior (*Black and Hughes* 1974). Comfortable behavior can be associated with a positive emotional state in domestic hens (*Zimmerman et al.,* 2011).

According to *Jacobs et al.* (2023), the activity level of animals can be improved by modifying the environment. Enrichment, which increases the complexity and diversity of the environment, can have great benefits for poultry welfare. Playful behavior leads to a positive feeling of well-being and, although we do not yet know how much play would be optimal, it has been proven that their deprivation reduces the well-being of animals. One of the goals of environmental enrichment is to reduce or even prevent the occurrence of harmful behaviors. Overall, environmental enrichment serves to preserve the mental and physical health of poultry, thereby improving commodity production.

Continuing to highlight the importance of environmental enrichment, it can be said that visual environmental enrichment can enhance neural development. Enrichments that test the left/right hemisphere of the brain and target behavioral characteristics can prepare the birds for the specific type of adult housing environment (e.g. cage, indoor, outdoor). In addition, the use of structural enrichment elements is also necessary for the optimal development of the skeleton. Enrichment elements can improve the function of the immune system by applying mild stress factors that promote adaptability. Housing systems with a rich stimulus environment can have many benefits, including reducing fear, which facilitate later transitions to multilevel technology. Overall, it can be said that environmental enrichment is necessary for the birds' physical and "mental" health, since the final product, be it meat or eggs, largely depends on these factors. Of course, breeders must adapt to different herd preferences in order to provide each group with the most suitable environmental enrichment according to age and genotype (*Campbell et al.,* 2019).

Researchers have already tried a wide variety of environmental enrichment elements, primarily in hen keeping, such as litter materials (*Huber,* 2001; *De Haas* (2014), beak abrasive blocks (*Farkas et al.*, 2021), special beak-wearing feeders (*Runion,* 1993), brightly colored bottles, balls , rattles (*Reed,* 1993), perching bars (*Gunnarsson*, 1999; *Huber*, 1999) and we could list more. In this research, we are looking for an answer to whether a the extent to which the environmental enrichment elements (hay, apples, corncobs, pumpkins) placed in different poultry were used and consumed by the different poultry species and genotypes. Which one they like the most, and which one may be justified to use for poultry species. With the results and conclusions of our study, we hope to be able to help practitioners in creating a more stimulating and well-being environment for animals, as well as in achieving the most economical production possible.

MATERIALS AND METHODS

The study was conducted at the Kaposvár Campus of the Hungarian University of Agriculture and Life Sciences with five different poultry species, with a total of 25 genotypes (N = 174).

Transdanubia's largest animal breeding exhibition, the "KÁN University Days" is the defining high-ranking professional event of the Hungarian University of Agriculture and Life Sciences in the autumn, at the economic poultry exhibition, the dominant breeders and breeding organizations of our country present the genotypes of various species and utilization types. We conducted our study at this location, where we created environmental conditions and conditions suitable for keeping poultry species.

After the exhibition, we carried out the tests for one test week.

The conditions of our study and the number of elements per genotype were given, and an increase in the number of elements may be justified in a further study.

At the same time, the uniqueness and specialness of our research is that we examined the preferences and practical experiences of different environmental enrichment elements used in both large and small farms in the same conditions in several genotypes of hens, turkeys, guinea fowls, ducks and geese.

The tested genotypes were

Commercially available laying hybrid hen genotypes
1. TETRA SUPER HARCO parent stock (17 weeks of life) (n = 14) 2 roosters, 12 hens (Bábolna TETRA Kft.)
2. TETRA-L SUPERB parent stock (21st week of life) (n = 13) 1 rooster, 12 hens (Bábolna TETRA Kft.)
3. TETRA-SL LL parent stock (20 weeks of life) (n = 14) 2 roosters, 12 hens (Bábolna TETRA Kft.)
4. TETRA-SL LL commercial hybrid (21st week of life) (n = 15) 15 hens (Bábolna TETRA Kft.)

Commercially available meat-type hen genotypes:
1. TETRA-HB COLOR parent stock (17th week of life) (n = 17) 3 roosters, 14 hens (Bábolna TETRA Kft.)
2. ROSS 308 parent stock (19 weeks of life) (n = 15) 1 rooster, 14 hens (Poultry-Tím Kft.)
3. ROSS 308 commercial hybrid (5th week of life) (n = 11) 5 roosters, 6 hens (Agro-Ciko Kft.)

Native dual purpose hen genotypes:
1. Hemp-seeded Hungarian hen (19 weeks of life) (n = 4) 1 rooster, 3 hens (NBGK, MGE*)
2. White Hungarian hen (19 weeks of life) (n = 3) 1 rooster, 3 hens (NBGK, MGE)
3. Yellow Hungarian hen (19 weeks of life) (n = 3) 1 rooster, 3 hens (NBGK, MGE)
4. Captive colored Hungarian hen (19 weeks of life) (n = 3) 1 rooster, 3 hens (NBGK, MGE)
5. Hemp-seeded Transylvanian bald-necked hen (19 weeks of life) (n = 3) 1 rooster, 3 hens. (NBGK, MGE)
6. Black and white Transylvanian bald-necked hen (19 weeks of life) (n = 8) 2 rooster., 6 hens. (NBGK, MGE)

(*Breeder: National Center for Biodiversity and Gene Preservation; Breeding Organization: Hungarian Livestock Gene Preservation Association)

Turkey indigenous genotypes:
1. Bronze turkey (1 year old) (n = 3) 1 gobbler, 2 hens (NBGK, MGE)
2. Copper turkey (1 year old) (n = 3) 1 gobbler, 2 hens (NBGK, MGE)

Guinea fowl:
1. Hungarian guinea fowl (1 year old) (n = 6) (NBGK, MGE)

Duck genotypes:
1. STIMUL-MG AS (mulard) parent stock (28 weeks of life) (n = 4; 1 drake, 3 hens) (ORVIA Magyarország Kft.)
2. White Hungarian duck (2 years) (n = 4; 1 drake, 3 hens) (NBGK, MGE)
3. Variegated (wild-colored) Hungarian duck (2 years old) (n = 4 pcs; 1 drake, 3 hens) (NBGK, MGE)
4. ST5 LOURD parent stock (65th week of life) (n = 4; 1 drake, 3 hens) (ORVIA Magyarország Kft.)

Goose genotypes:
1. Gray goose SI 14 parent stock (1 year) (n = 4; 1 gander, 3 geese) (ORVIA Magyarország Kft.)
2. Hungarian goose (18 weeks of life) (n = 4; 1 gander, 3 geese) (NBGK, MGE)
3. INTEGRÁL-MB 09 geese (5.5 years) (n = 4; 1 gander, 3 geese) (Integrál-Group Kft.)
4. Dunai Magyar Lúd Egyes (9th week of life) (n = 6; 1 gander, 3 geese) (ANABEST Kft.)
5. White goose SI 4 parent stock (1 year) (n = 4; 1 gander, 3 geese (ORVIA Magyarország Kft.)

All hen genotypes were of almost the same age (17-21 weeks of life).

The observation of the flock and the collection of data started after a 5-day adaptation period.

The pens with a floor area of 4 m^2 (2 x 2 m) were littered with dust-free softwood shavings (10 cm thick) (picture 2, picture 3). A suspended hand-filled self-feeder was placed in the scratching area littered with wood shavings, from which the animals could consume the commercially available feed ad libitum, drinking water from a manually filled open surfaced self-drinker (picture 3).

The temperature in the barn during the test was usually 15-18ºC. We used LED (Dilaco Lighting Agro Star LED Spot) lighting for 16 hours a day (sunrise: start: 3:45, duration: 30 minutes, light: 4:15; sunset: start: 19:45, duration: 30 minutes, total darkness: 20:15).

Picture 1. Placement of the pens, part of the stock

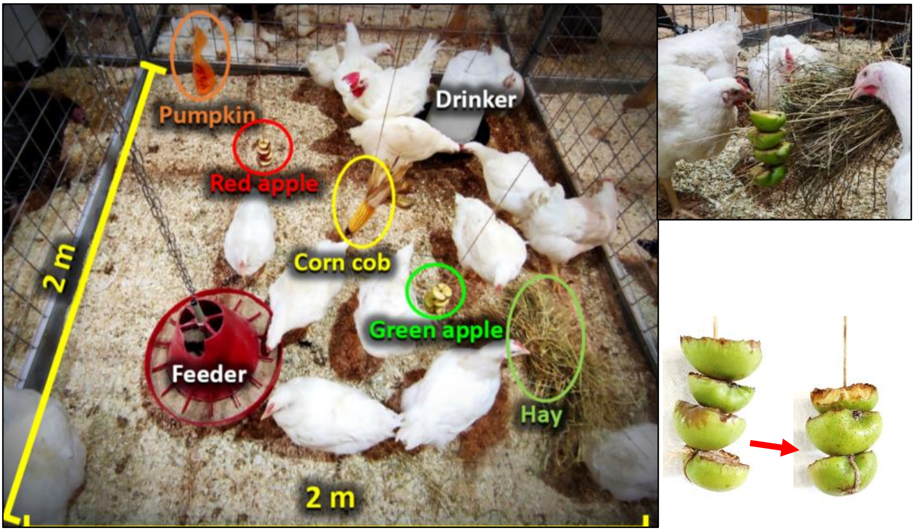
Five different environmental enrichment elements were suspended in the pens, the center of which reached the height of the animals' backs (picture 3). The tested environmental enrichment elements were the following:

1. Pumpkin (Canadian pumpkin, 'Orange' variety) quartered along the longitudinal axis
2. Red 'Jonathan' apple (4 half apples strung on top of each other, small juice apple category, more acidic, sour taste)
3. Corn cob
4. Green 'Mutsu' apple (4 half apples strung on top of each other, small juice apple category, sweet taste)
5. Meadow mixed hay

The environmental enrichment elements were suspended in the same order and distance from each other and other technological elements in all pens for all genotypes (picture 3).

If there were more replicates per genotype, we would have suspended them randomly.

If an environmental enrichment element was completely used up, it was immediately replaced.



Picture 2. The layout of the test pen and the environmental enrichment elements, consumption and weight loss

The observation of the flock, the installation of environmental enrichment elements and the collection of data started after a 5-day adaptation period and took place over the course of a test week.

Picture 3. The layout of the test pens and the placement of the inserted environmental enrichment elements, with the turkey genotypes in front

During the observations, we remeasured the weight change of the various environmental enriching elements daily, thus the extent of their weight loss. We also monitored the feed consumption of the animals.

In our research, we deliberately used environmental enrichment elements that could also function as food. After all, the wild ancestor of the domestic fowl, the red jungle fowl, spends most of its active time almost constantly searching for and eating food (*Dawkins*, 1989; *Deemling and Bubier*, 1999) and even caged laying hens spend around 40% of their time feeding filled (*Horn,* 1981). Stimulus enrichment related to nutrition is the one that is most suitable for arousing and binding the animal's interest compared to other diverse but less used stimulus enrichment elements (e.g. chain, ball, mirror, shelf, perch, etc.). In case of a larger consumption, it may be necessary for economical production to calculate the amount and content of the expected consumption of stimulus-enriching elements during feeding and production. Examining production indicators was not the aim of the research.

RESULTS

Use of environmental enrichment elements in the case of different genotypes of laying hens

Among the layer hybrid genotypes, we had the opportunity to observe three groups of parent stock and the TETRA-SL LL commercial hybrid.

The consumption of pumpkin and hay by TETRA SUPER HARCO, shown in the first half of the diagram, proved to be exceptionally high, more than twice that of the other three test groups, even the red apple was preferred by the light-bodied TETRA-L SUPERB parent stock with a lively temperament and the medium-heavy TETRA-SL LL hybrid (Figure 1). The green apple consumption was almost exactly the same for TETRA SUPER HARCO and the TETRA-SL LL hybrid, while the other two genotypes only consumed half of it during the study period. In the case of all genotypes, it is clear that the attention of the layer hybrids was captured by the corncob the least during the observation, they only consumed a few grams of it in a week. Due to its physical properties, this environmental enrichment element was less able to be consumed by the hen.

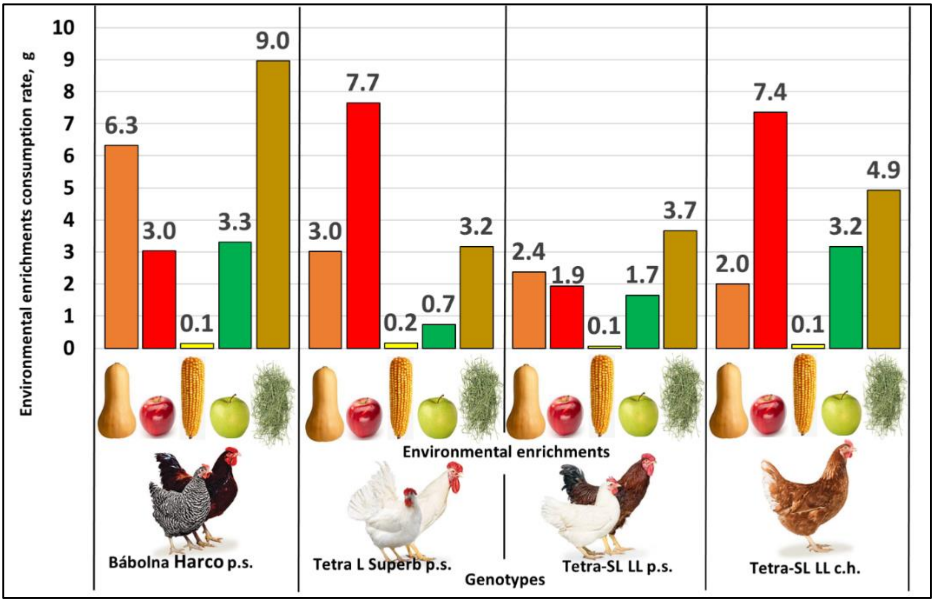


Figure 1. Average daily weight loss of different environmental enrichment elements during the test week for the different genotypes of laying hens (g/bird)

By inserting the two different apples, we searched for the answer to which one the hen would prefer if she chose the apple. It is worth using red or green apples in practice, if it comes down to it.

Overall, it can be said that we experienced a higher consumption of red apples, since all genotypes, except for TETRA SUPER HARCO, consumed red apples to a greater extent, which difference in the evening of the TETRA-SL LL hybrid is double, and in the case of the light-bodied TETRA-L SUPERB parent stock, more than it was tenfold.

Use of environmental enrichment elements in the case of different meat hybrid genotypes

Among the environmental enrichment elements, the hay consumption of the TETRA-HB COLOR and ROSS 308 parent stock was outstanding. It is interesting that the parent stock TETRA-HB COLOR, which gives premium meat quality, and which grows more slowly, and ROSS 308, which is used for the production of typical large-scale chickens, consumed hay in a similar proportion (picture 4), which surpassed the hay consumption of the previously presented layer hybrids (TETRA SUPER HARCO except).

One of the reasons for this high consumption rate may be that these genotypes have a high appetite and feed consumption. It is also characteristic that these calmer, more phlegmatic genotypes ate more of the easier-to-consume environmental enrichment element.

By the way, it is a well-known fact from practical application that straw, which is somewhat similar to hay, attracts the attention of broiler chickens to a large extent and also has a positive effect in reducing foot diseases (*Baxter et al.,* 2018).

The consumption of pumpkin and apples was similar for these two genotypes, showing a value of about one third of the hay, while the meat-type hens paid almost no attention to corn, and used roughly the same amount as the layer hybrids.

The evaluation of the ROSS 308-a broiler final product was left to the end because this genotype was a rather special case. There was hardly any measurable consumption of environmental enrichment elements by these birds. On the other hand, their consumption of mixed feed was exceptionally high compared to the other genotypes, well representing the meat type's high appetite serving its outstanding growth potential.

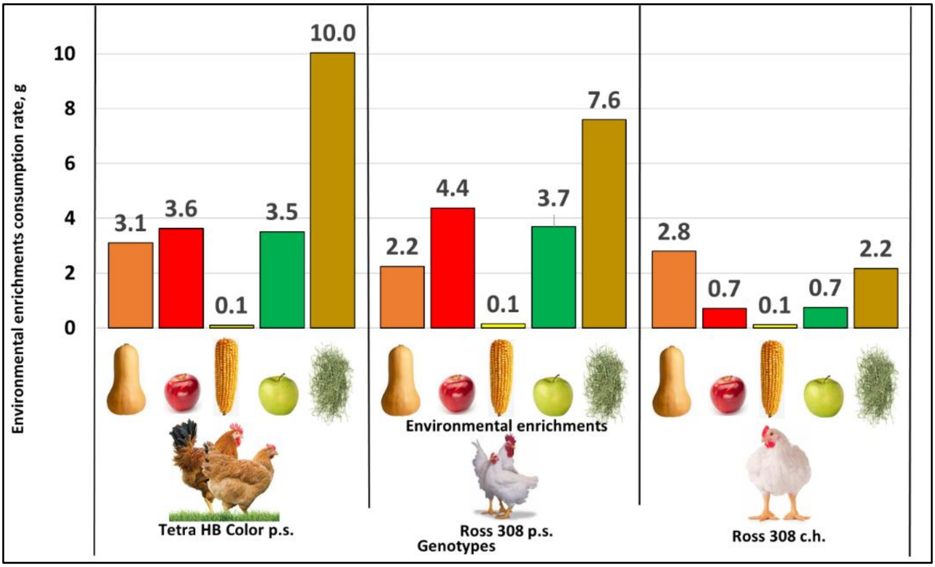


Figure 2. Average daily weight loss of different environmental enrichment elements during the test week for different meat type hen genotypes (g/bird)

There was no meaningful, significant difference between the consumption of red and green apples, they were consumed to approximately the same extent.

With their phlegmatic and calm temperament, we can explain that they "concentrated" only on eating the food placed in front of them, and then on resting afterwards.

Picture 4. Hay consumption of the meat-type TETRA-HB COLOR and ROSS 308 parent stock

We also found that the interest in environmental enrichment elements decreased somewhat during the study period, even in the study by *Ohara et al.* (2015), where it was established that the use of environmental enrichment elements gradually decreased as the age of the birds increased.

Use of environmental enrichment elements in the case of native dual-use hen genotypes

The native dual-purpose breeds shown in the diagram represented a completely different category than the genotypes discussed so far.

On the other hand, they paid at least as much, if not more, attention to the environmental enrichment elements placed in the voliere than their egg and meat hybrid counterparts (Figure 3). In the pens of almost all indigenous poultry breeds, pumpkin consumption was the highest with values of around 10 g/hen, followed by red apples and hay, not far behind. Green apple was consumed moderately in the pens of most genotypes, except for Hemp seed color Hungarian hens, where the amount used by the animals was a slightly higher

6.8 g/hen. These birds also ate about as much of the corn cob as the previously mentioned genotypes.

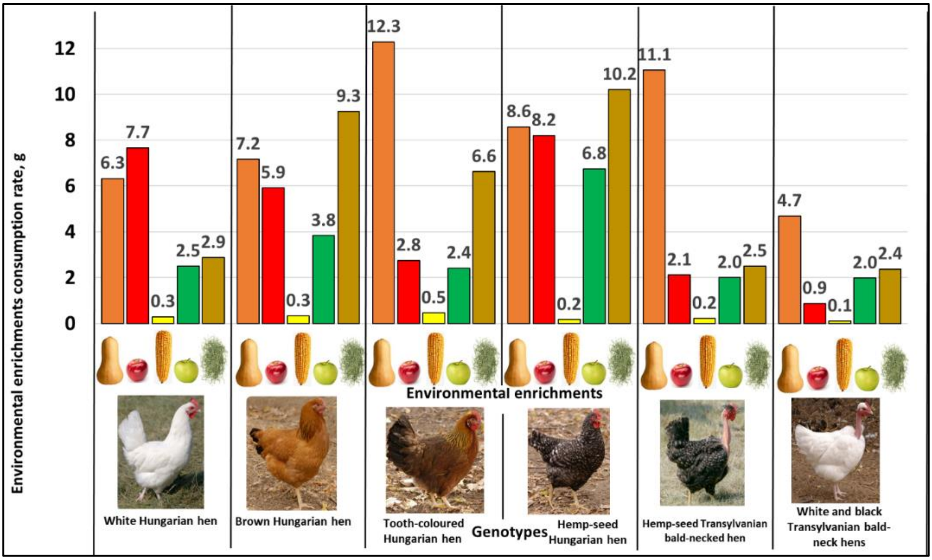


Figure 3. Average daily weight loss of different environmental enrichment elements during the test week for the different native dual purpose hen genotypes (g/bird)

Overall, it can be said that among the six indigenous breeds, the black and white Transylvanian bald-necked hens had the lowest weight loss from all environmental enrichment elements. The bald-necked ones consumed less hay specifically, one of the reasons for which may be that the protruding harder, sharper straw fibers could have irritated or poked the bald neck area, which could have disturbed them in eating hay.

These dual-use breeds, suitable for indoor or outdoor conditions, made extensive use of all environmental enrichment elements, one of the reasons for which is the wilder, more natural life instinct that can be traced back to the wilder genotype.

In addition, it may be worth mentioning that the genotypes of TETRA and ROSS were kept in intensive housing conditions before the test, so they did not encounter hay and other environmental elements and factors occurring in semi-intensive conditions.

On the other hand, the indigenous dual-use Hungarian genotypes were raised in semi-intensive conditions. That is why we prefer to compare them with each other, which is also why they are included in a diagram.

Use of environmental enrichment elements in the case of the studied duck genotypes

The consumption of environmental enrichment elements of the studied duck genotypes is in some cases much higher compared to the hen-shaped ones discussed so far (Figure 4).

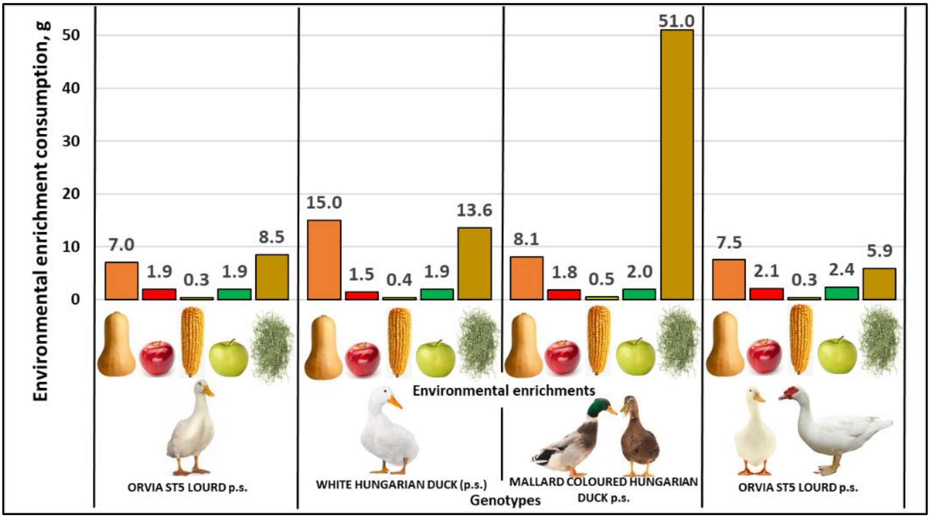


Figure 4. Average daily weight loss of different environmental enrichment elements during the test week for different duck genotypes (g/duck)

This can be explained by their visibly larger larger body size and the fact that ducks especially like to peck and search with their beaks. With the exception of the white Hungarian duck, we measured approximately the same pumpkin weight loss in the pens of the other three genotypes, 7-8.1 grams per duck. The Hungarian white duck consumed 15 grams/duck of this environmental enrichment element, which is twice that of the other breeds. The consumption of the two types of apple and the corn was similar for the four genotypes, even the inserted meadow hay was used quite differently, because in the pen of the variegated (wild-colored) Hungarian ducks, we measured a weight loss of 51g/duck during the test period, one of the reasons for which is the genetic background, i.e. it is also to be found in the wilder, more natural temperament. In the case of the other genotypes, this was only between 5.9 and 13.6 g/individual.

Overall, we observed that the duck breeds, like the other genotypes participating in the study, first consumed the soft, easier-to-eat inside of the pumpkin, and then switched to its harder flesh. In relation to their consumption of hay, we noted that they did consume part of the ducks as an element that enriches the environment, but they just "played" with the other part.

Use of environmental enrichment elements in the case of the investigated goose genotypes

It can be confidently stated that for the five environmental enrichment elements, the highest weight loss was measured in the pens of the goose genotypes (Figure 5).

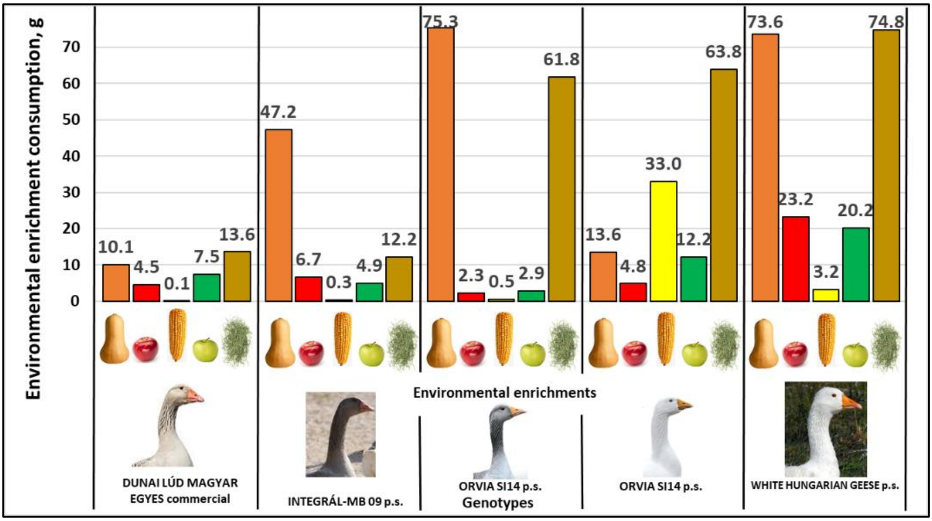


Figure 5. Average daily weight loss of different environmental enrichment elements during the test week for different goose genotypes (g/goose)

Geese are known to be excellent grazers, they really like to peck and use their strong beaks to dig into harder materials. Wild specimens and their domesticated but free-range relatives both graze a lot and are very curious, which is why they taste almost everything (*Vickery and Gill,* 1999). For this reason, we fixed the environmental enrichment elements in the pens of the geese participating in the study with a material that they cannot catch. Regardless of this, there was an example of some environmentally enriching element being pinched to such an extent that it ended up in the litter. In such a case, the inserted food was completely consumed within a short time, pointing out that the spatial location of the potential food intended as an environmental enrichment element can also affect the level of consumption. If an experimental item ran out, we naturally replaced it as soon as possible.

We can cite the INTEGRÁL-MB 09 breeding animals, the two parent stock of geese, and the bar chart of the Hungarian goose as a perfect example of this, as it perfectly illustrates how much higher weight loss could be measured in the event that the environmental enrichment element was added to the litter. It can therefore be said that the geese were most interested in the five environmental enrichment elements when they were below the litter level.

However, striking differences in the consumption of individual environmental enrichment elements can also be observed between the investigated goose genotypes. We measured weight loss of 10.1-13.6 g/goose even in the pen of the parent stock of the Dunai lúd goose and the white goose, while the other three genotypes consumed almost five times and seven times this amount during the test period.

The same division can be said about the hay consumption of goose breeds. Individuals of the two genotypes shown in the first half of the table consumed only 12.2-13.6 grams, and in the pens of the other three groups of geese, We measured a weight loss of 61.8-74.8 g/goose during the week.

Use of environmental enrichment elements for the examined turkey genotypes and guinea fowls

The consumption of the environmental enrichment element developed very differently for these three genotypes. These breeds were not overly interested in corn either, the consumption of the individuals was between 0.2 and 0.7 grams. Pumpkin was consumed by turkeys to about the same extent, guinea fowls were somewhat less interested in it (Figure 6).

The two types of apples were consumed prominently by the turkey compared to the other two genotypes. In this booth, an individual consumed an average of 28.3 grams of red apples in one week, and 18.4 grams of green apples. The apple consumption of the other two genotypes was only a fraction of these values. The two genotypes of turkeys used at least twice as much hay as the Hungarian guinea fowl.

We would like to note that for these breeds (bronze turkey, copper turkey, Hungarian guinea fowl), I measured the greatest weight loss on environmental enrichment elements in the last two days.

It may be that even according to our experience, these wilder genotypes had the hardest time getting used to their new place, perhaps the five-day adaptation period before the test proved to be too little for them and they only start to show their natural behavior after that.

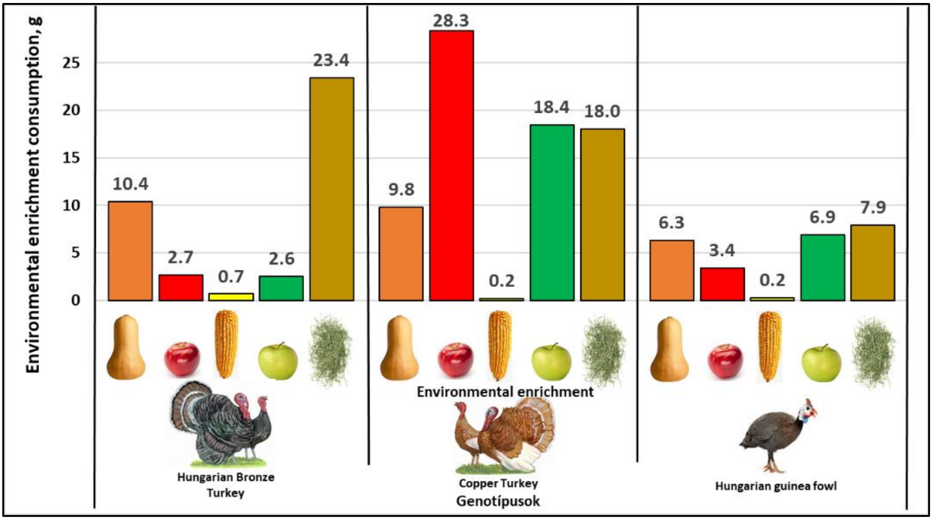


Figure 6. Average daily weight loss of different environmental enrichment elements during the test week for turkey and guinea fowl genotypes (g/bird)

Other observations and comments

In summary, we found that based on our observations, the hen genotypes used in the production of hybrids and their end products proved to be the most suitable for rapid adaptation, their rhythm of life and behavior were least affected by the new, never-before-seen environment. In the case of native genotypes, it is conceivable that during semi-intensive education, they could have encountered more diverse environmental factors and been familiar with them.

Focusing on the corncob as the environmental enrichment factor used in our study, our view is that the majority of the animals were not so interested in this element because it proved to be difficult to obtain.

Because if the corn had been placed in front of the animals not in the form of a tube, but crumbled, so that we could have measured a higher weight loss, it would have functioned more as feed than as an environmental enrichment element.

Most of the examined genotypes usually only consumed the softer, seedier, fibrous, easier-to-squeeze part of the pumpkin placed in the booth, which, in turn, helped the longer-term use of this element.

Hay was one of the first to attract the attention of birds everywhere, but mostly this element was not consumed for nutritional purposes, rather they pulled the fibers out of the bundle out of curiosity and then threw them into the litter.

In practice, for large farms, other, simpler forms of placement of these environmental enrichment elements are recommended, which are less labor-intensive, such as distribution in a feeding basket, net or trough system, depending on the material and species.

During the test week, we did not experience any injuries or deaths, in which the use of environmental enrichment elements could have played a role, because according to *Reed et al.* (1993), environmental enrichment during production can be an important factor that affects the level of fear of adult birds and can reduce the risk of injuries.

In addition, according to *Son et al.* (2022), alfalfa hay effectively alleviates the stress that occurs in animals during keeping, and is also able to improve the production of laying hens in flocks kept in aviaries.

The aim of the thesis was not to examine the production and feeding of animals. However, we considered it important to record the amount of daily feed consumption of the different genotypes, which has an informative nature.

Table 1 only describes the feed consumption of those hen genotypes that are in domestic and international trade, have high production potential and economic weight. In addition, the daily feed consumption data corresponding to the given age were presented from the public product brochures of the breeding companies.

In relation to almost all parent pairs, it can be clearly seen that the laying hens in our study consumed more feed than the daily feed consumption amounts given by the breeding company, even with the consumption of stimulus-enriching elements that can function as feed. The simple reason for this is that, in this life stage, the parent pair is kept with naturally dosed feeding based on the recommendation of the breeding company, while in my study we fed ad libitum. It is also known that laying hens consume more in addition to ad libitum feeding.

From the point of view of production and feed consumption, we obtain truly relevant and usable data regarding the bottom line, in the case of the final product ROSS 308. Commercially available feed was available to them ad libitum both in colony conditions and in the study. In our study, they consumed 25% less feed than the daily feed consumption data provided by the breeding company. From this, I conclude that the consumption of stimulus-enriching elements could also reduce the amount of feed intake. Although, according to our measurements, 6.5 g/day/individual was lost, which does not necessarily explain the 46 g lower feed consumption. There is probably another reason for this. For example, the feed we feed is not exactly the same as described in the ROSS 308 final product brochure, and in our study there was 16 hours of lighting, while the ROSS 308 final product brochure states 18 hours of lighting at this age, which of course affects feed consumption.

Table 1

Development of daily feed consumption of different hen genotypes

Genotype	Feed consumption g/day/bird	Literature data (g)	Difference (g)
TETRA SUPER HARCO p.s. (12 h., 1 r.) ***17th week of life***	133	87[1]	+46
TETRA-L SUPERB p.s. (12 h., 1 r.) ***21st week of life***	83	95[2]	-12
TETRA-HB COLOR p.s. (14 h., 3 r.) ***17th week of life***	203	115[3] (21. week of life)	+88
TETRA-SL LL p.s. (12 h., 2 r.) ***20th week of life***	102	90[4]	+12
TETRA-SL LL c.h. (15 h.) ***21st week of life***	104	97[5]	+7
ROSS 308 p.s. (14 h., 1 r.) ***19th week of life***	223	99[6]	+124
ROSS 308 c.h. (11) ***5th week of life***	**134**	**180[7]**	**-46**

[1]: BÁBOLNA HARCO LAYER Parent Stock Chart and Graphs (*URL1*); [2]: TETRA L SUPERB Parent Stock Management Guide (*URL2*); [3]: TETRA HB COLOR Parent Stock (*URL3*); [4]: TETRA-SL LL Parent Stock Management Guide (*URL4*); [5]: TETRA-SL LL tojóhibrid Táblázatok és grafikonok (*URL5*); [6]: ROSS 308 Performance Objectives 2016 (*URL6*); [7]: ROSS 308 ROSS 308 FF Performance Objectives 2022 (*URL7*)

CONCLUSIONS

Based on the results of our study, we concluded that the presence of environmental enrichment elements may have increased the behavioral repertoire of all poultry species, since they dealt with these different diverse environmental enrichment elements, which is particularly beneficial from an animal welfare point of view. The enrichment elements, to varying degrees, attracted the animals' interest as they consumed and utilized them. Since laying hybrid genotypes generally consumed more red apples than green ones, we conclude that laying hens prefer red apples over green ones as an enrichment element.

We hypothesize that this preference may be due to a greater attraction to the color red rather than green, with taste likely playing a secondary role.

The meat-type parent stock hens predominantly consumed hay, which we attribute to their larger appetite and calmer temperament, leading to a feeding behavior that prioritizes easily, quickly, and abundantly available enrichment elements.

Indigenous dual-purpose genotypes, reared semi-intensively, made greater use of the enrichment elements compared to intensively reared modern laying and meat hybrid parent stock and commercial genotypes.

Only a few grams of corn cob, used as a environmental enrichment, were consumed by the various poultry species over a week. From this, we infer that among the tested enrichment elements (pumpkin, red apple, green apple, hay, corn), corn is the least effective as a stimulant. We believe this may be due to its physical properties, making it difficult to consume in this form. It may be beneficial to fix it in place, such as on a wall, to make it easier to consume.

Despite this, they may have dealt with it relatively much, tweaked it, it may have achieved its goal of enriching the environment, but they could not consume it.

Since the ROSS 308 mixed-sex final product consumed the least amount of all the enrichment elements, it can be concluded that among all the studied poultry species and utilization directions, the use of these elements is least justified in broiler chicken farming.

Geese, compared to other commercial poultry species, utilized the enrichment elements the most, especially hay, which is due to their species-specific characteristics. As they are highly inclined to use enrichment elements, their application is recommended, particularly in housing conditions and age groups where reducing stress and aggressive interactions is necessary.

The Hungarian guinea fowl consumed relatively small amounts of all the enrichment elements placed in their enclosure. This could be due to their wilder nature, as they are at a lower level of domestication and are more cautious. Further research is recommended to study the use of enrichment elements in larger housing systems and under calmer conditions.

The two turkey genotypes showed different usage patterns of the enrichment elements. However, like the geese, they consumed relatively more hay, likely due to their lower level of domestication, large body size, and strong beaks.

For more comprehensive and in-depth conclusions, further studies with larger sample sizes and more repetitions are recommended. Standardizing rearing conditions for the same poultry genotypes is also important. Additionally, it is crucial to examine the effects of different enrichment materials on production and aggression. It is also recommended to explore offering the enrichment elements we studied in different, fixed forms, as well as testing other enrichment materials across all poultry species.

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