EFFECT OF THE LYSINE/ENERGY RATIO OF THE DIET ON THE ILEAL DIGESTIBILITY OF CRUDE PROTEIN IN GROWING PIGS WITH DIFFERENT GENETIC POTENTIAL

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SUMMARY

The aim of the study was to evaluate how the different lysine/digestible energy (DE) ratio of the diets effect on the apparent ileal digestibility (AID) of crude protein (CP) in growing pigs (40-60 kg) with different genetic potential. The trials were conducted a total of 90 animals (30 animals/genotype) with different genotypes ([Danish Yorkshire × Danish Landrace] × Danish Duroc; [Yorkshire × Landrace] × [Hampshire × Pietrain]; [Hungarian Yorkshire × Hungarian Landrace] × Duroc) in two replicates (n=10/treatment/genotype). Before the experiment series each of the barrows (avarage initial body weight = 40.9 ± 8.5 kg) were surgically fitted with post valve T-cannula (PVTC). The experimental diets were based on corn, barley and soybean meal, and formulated with 6 different total lysine/digetible energy (DE) ratios (A: 0.55; B: 0.61; C: 0.68; D: 0.74 E: 0.80; F: 0.82). For the digestibility trials, as an indigestible marker, titanium dioxide (TiO_2) was added to the diets (5 g/kg). The AID of the CP content of the diets were evaluated independently of the genotype (Genotype Indepedent Ileal Digestibility-GIID) and in genotype-specific aspect (Genotype Specific Ileal Digetibility-GSID). Based on our results, it can be concluded that the lysine/DE ratio of the diets affected the AID of the CP in a different ways by each genotype. Therefore the GIID assessment method occasionally over-evaluates, and in some cases under-estimates the CP digestibility in the different genotypes.

ÖSSZEFOGLALÁS

Tenke, J. – Sudár, G. – Vida, O. – Tossenberger, J.: A TAKARMÁNYOK LIZIN/ENERGIA ARÁNYÁNAK HATÁSA A NYERSFEHÉRJE ILEÁLIS EMÉSZTHETŐSÉGÉRE KÜLÖNBÖZŐ GENETIKAI POTENCIÁLLAL RENDELKEZŐ NÖVENDÉK SERTÉSEKBEN

A vizsgálat célja annak megállapítása volt, hogy a takarmányok eltérő lizin/emészthető energia (DE) aránya miként befolyásolja a nyersfehérje látszólagos ileális emészthetőségét, különböző genetikai potenciállal rendelkező növendék sertésekben (40-60 kg). A vizsgálatokat összesen 90 (30 állat/genotípus), különböző genotípusú állattal ([Dán Nagyfehér x Dán Lapály] x Dán Duroc; [Nagyfehér x Lapály] x [Hampshire x Pietrain]; [Magyar Nagyfehér x Magyar Lapály] x Duroc) két ismétlésben (10 állat/kezelés/genotípus) végeztük el. Az ártányokat (átlagos induló súly = 40,9 ± 8,5 kg) a vizsgálatok megkezdését megelőzően PVTC-kanüllel láttuk el. A kísérleti takarmányokat kukorica, árpa és szója alapon állítottuk össze 6 különböző lizin/DE-aránnyal (A: 0,55; B: 0,61; C: 0,68; D: 0,74; E: 0,80; F: 0,82). A takarmányokban titán dioxidot (TiO_2) használtunk markerként (5 g/kg). A takarmányok nyersfehérje-tartalmának ileális emészthetőségét genotípustól függetlenül (Genotípustól Független Ileális Emészthetőség-GFIE) és genotípus specifikusan (Genotípus Specifikus Ileális Emészthetőség-GSIE) is értékeltük. Eredményeink alapján megállapítható, hogy a takarmányok lizin/DE aránya genotípusonként eltérően befolyásolja a nyersfehérje látszólagos ileális emészthetőségét. Ebből adódóan a GFIE esetenként túl-, bizonyos esetekben pedig alulértékeli a nyersfehérje ileális emészthetőségét a különböző genotípusok vonatkozásában.

INTRODUCTION

The adequate nutrient supply of pigs is decisive for growth because their genetically determined growth rate can achieved only by meeting their nutrient requirements.

Feeding costs represent more than two thirds of the total cost of fattening, so the easiest way of decreasing feed costs is the optimization of the crude protein (CP) content and amino acid (AA) profile of the diets. In addition to the cost efficiency, the diets formulated on the basis of ideal protein concept can also decrease the environmental impact by the reduction of the excreted nitrogen. In swine nutriton, lysine is the first liming AA and it determines the growth performance primarly, for this reason in ideal protein concepts the quantity of digestible amino acids is given in percentage relative to the lysine (100%).

In addition to optimizing the AA profile of the diets, efforts should also be made to provide the energy requirements of animals of different genotypes to achieve adequate performance. According to *Campbell and Taverner* (1988) the energy consumption and energy requirements for maintanance of animals with high genetic value have increased as their growth potential and muscle growth rates have improved. The increased energy and AA needs are due to the higher protein deposition rate. Therefore the quality of the nutrient supply is a keyfactor, especially in the case of high performing modern genotypes. The estimated energy requirement of these animals could be above the voluntary feed intake mainly during the early stage of growth so the genetically determined lean meat production capacity can not be fully exploited at this age (*Close,* 2004a). The energy requirements of growth may not be provided due to physical limitations, which could inhibit the manifestation of the genetically determined performance (body weight gain). Therefore, the lysine/energy ratio of the diet plays an important role in the nutrition of modern genotypes.

Taking into consideration the lysine/energy ratio in swine nutrition is general. However, the variation in the performance of different genotypes used in industrial pork production under the same housing conditions may reach up to 30% (*Schnickel and De Lange,* 1996)*,* which leads to differences in the nutritional requirements of the animals, especially in the lysine/energy ratio of the diet. According to *Kim et al.* (2000) pigs with different growth intensity show differences in the performance and protein deposition rate when they were fed with the same diet. *Kim et al.* (2000) categorized the fatteners according to high, medium and low protein deposition rate (growth intensity) and found significant differences in the performance parameters and in the ileal digestible lysine requirements regarding to these categories. *Close* (2004b) also suggests that pigs should be categorized, but the differences in their average daily weight gain and the protein content of the empty body should be taken also into consideration, however these parameters could be different depending on the genetic potential. For this reason, the genotypes used in pork production could be categorized into three groups in terms of their genetic potential (*Table 1.)*.

Furthermore, the topic of the CP and AA supply of pigs can be influenced by the latest research results which show that there are differences also in the CP and AA digestibility in the different populations in intensive production (*Barea et* *al.,* 2011). This is of very high importance because it is well known that only AAs that are absorbed up to the terminal section of the small intestine are involved in protein synthesis (*Zebroswska,* 1973). The efficiency of the absorption of AAs is a key factor in formulating diets for digestible AA content, however, there are differences in the potential regarding digestion physiology between the different genotypes. These factors are still less taken into consideration. Therefore the aim of our study was to determine the effect of the different lysine/DE ratios of the diets on the apparent ileal digestibility (AID) of CP in growing pigs (40.0-60.0 kg) with different genetic potential.

Table 1.

Pig categories based on average daily weight gain and carcass protein content of empty body (*Close,* 2004b)

Genetic potential (1)	P A R A M E T E R S (2)	
	Average daily weight gain (g/day) (3)	Protein content of empty body (g/kg) (4)
High (5)	1000-1200	180
Medium (6)	800-1000	170
Traditional (7)	<800	160

1. táblázat A sertések kategorizálása az átlagos napi súlygyarapodás és az üres test fehérjetartalma alapján (Close, 2004b)

genetikai potenciál (1); paraméterek (2); átlagos napi súlygyarapodás (g/nap) (3); az üres test fehérjetartalma (g/kg) (4); nagy (5); közepes (6); hagyományos (7)

MATERIALS AND METHODS

Animals and facilities

The digestibility trials were conducted in 40.0-60.0 kg live-weight interval with crossbred growing pigs with 3 different genotype and genetic potential ([Danish Yorkshire × Danish Landrace] × Danish Duroc; [Yorkshire × Landrace] × [Hampshire × Pietrain]; [Hungarian Yorkshire × Hungarian Landrace] × Duroc). The effect of 6 different total lysine/DE ratio were evaluated (n=10/treatment/genotype). The genotypes investigated during the trial are shown in *Table 2*.

Before the trials, when the barrows reached approxymately 25.0 kg liveweight, all of the animals (30 animals/genotype) were surgically fitted with PVTC-cannula made of medical silicone, according the method described by *Van Leeuwen et al.* (1991). The trials were conducted at the Department of Animal Nutrition of Kaposvár University, in Hungary. The ethics approval for this study was issued by the National Scientific Ethical Committee on Animal Experimentation, Hungary, prior to the initiation of the experiment (approval number: SOI/31/446-7/2014.). The average initial bodyweight of the animals was 40.9 ± 8.5 kg. Before the surgeries, during the regeneration and adaptation period and under the collecting period the pigs were housed individually in floor pens in a climate-controlled room (19-22°C). To each pen a trough feeder and a stainless steel nipple drinker were installed.

Table 2.

The genotype and the genetic potential of the experimental animals

Genotype (1)	PARAMETERS (2)	
	Genetic potential (3)	Average daily weight gain (g/day) (4)
[Danish Yorkshire × Danish Landrace] × Danish Duroc (5)	High (6)	1000-1200
[Yorkshire × Landrace] × [Hampshire × Pietrain] (7)	Medium (8)	800-1000
[Hungarian Yorkshire × Hungarian Landrace] × Duroc (9)	Traditional (10)	<800

2. táblázat A kísérleti állatok genotípusa és genetikai potenciálja

genotípus (1); paraméterek (2); genetikai potenciál (3); átlagos napi súlygyarapodás (g/nap) (4); (Dán nagy fehér x Dán lapály) x Dán duroc (5); nagy (6); (Nagyfehér x Lapály) x (Hampshire x Pietrain) (7); közepes (8); (Magyar nagyfehér x Magyar lapály) x Duroc (9); hagyományos (10)

Dietary treatments

The experimental diets were formulated on corn, barley and soybean meal (SBM) based, according to the recommendation of *NRC* (2012), taking into consideration the ideal protein concept. The experimental diets were formulated with constant CP and crude fiber content but with 6 different total lysine/DE ratio (A: 0.55; B: 0.61; C: 0.68; D: 0.74; E: 0.80; F: 0.82; *Table 3.* and *Table 4.*).

The DE value of each diet was calculated using the equation described by *NRC* (2012) as follows: DE (kcal/kg) = 4.168 - (91 x %Ash) + (19 x %Crude Protein) + (39 x %Ether Extract) – (36 x %Neutral Detergent Fiber). Vitamins and minerals were also included in all diets to meet the requirements (*NRC,* 2012). Titanium dioxide (TiO_2/Tioxide® A-HR) was added on top (5 g/kg) to the diets as an indigestible marker. Pigs were fed two times daily (at 8:30 am and at 4:30 pm) in two equal portions at a level of 2.8 times the maintenance energy requirement (450 kJ ME/kg $BW^{0.75}$*).* The physical form of the experimental diets were finely grounded meal. Animals had free access to water during the experiment.

Data and sample collection

The digestibility studies consisted of 5 days surgery, a minimum of 10 days regeneration, 5 days adaptation and 3 days collection period*.* At the beginning and at the end of each period, the bodyweight of the pigs was individually recorded, and the feed allowance for each animal was adjusted. Between the collection days (Monday, Wednesday and Friday) were implemented (Tuesday and Thursday). Ileal digesta samples were collected continuously, between 8:30 am and 4:30 pm on collection days.

During sample collections cannulas were opened and a polyethylene plastic bag was attached to the cannula and the digesta was able to flow into the bag. When bags were filled with digesta they were removed, and it was replaced with a new bag. After the removing the bags, the digesta samples were weighed and immediately frozen. Chymus samples were stored at -18 °C to prevent bacterial degradation of amino acids.

Table 3.

Composition and nutrient content of the experimental diets (g/kg as feed)

Components (1)	T R E A T M E N T S (2)					
	A	B	C	D	E	F
Corn (3)	503.0	494.7	505.0	531.0	536.0	549.0
Barley (4)	251.0	274.0	265.0	240.0	237.0	225.0
Extr. soybean meal (5)	191.8	187.0	183.6	179.6	175.0	171.5
Arbocel[1] (6)	11.0	8.0	8.0	8.0	8.0	8.0
Sunflower oil (7)	15.0	7.0	7.4	7.5	7.5	7.6
MCP (8)	7.5	7.5	7.5	7.6	7.6	7.7
Limestone (9)	10.0	10.0	10.0	10.0	9.9	9.9
NaCl (10)	4.1	4.1	4.2	4.2	4.2	4.2
Premix (0.5%)[2] (11)	5.0	5.0	5.0	5.0	5.0	5.0
Lysine-HCl 78%[3] (12)	1.0	1.8	2.9	4.0	5.1	6.2
DL-methionine 99%[3] (13)	0.0	0.1	0.6	0.9	1.2	1.5
L-cystine-HCl 98%[3] (14)	0.0	0.0	0.0	0.3	0.6	0.9
L-threonine 98%[3] (15)	0.0	0.0	0.5	1.1	1.7	2.2
L-tryptophan 98%[3] (16)	0.0	0.0	0.0	0.2	0.4	0.6
TOTAL (17)	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0
Energy and nutrient content (18)						
DE[4] (MJ/kg) (19)	14.0	13.8	13.8	13.8	13.8	13.8
Dry matter[5] (20)	904.0	900.3	903.0	900.0	902.7	902.3
Crude protein[5] (21)	153.7	153.7	155.0	155.0	155.0	155.3
Crude fat[5] (22)	37.7	30.0	30.3	30.3	30.3	30.3
Crude fiber[5] (23)	46.7	45.0	45.0	45.0	45.7	44.0
$Lysine_{total}$[5] (24)	7.7	8.4	9.4	10.2	11.0	11.3
Ca[5] (25)	5.6	5.2	5.4	5.3	5.3	5.4
P[5] (26)	5.0	4.9	5.1	5.0	5.1	5.1
Total lys/DE ratio[4] (27)	0.55	0.61	0.68	0.74	0.80	0.82

[1] Produced by J. Rettenmaier & Söhne GmbH (28)
[2] Provided the following per kilogram of premix: Vitamin A: 1,750,000 IU, Vitamin D3: 350,000 IU, Vitamin E: 8,750 mg, Vitamin K3: 350 mg, Vitamin B1: 262.5 mg, Vitamin B2: 875 mg, Vitamin B3: 2,100 mg, Vitamin B6: 700 mg, Vitamin B12: 4,375 mg, Biotin: 21 mg, Folic acid: 105.07 mg, Cholin: 24,000 mg, Fe: 19,175 mg, Zn: 20,001 mg, Mn: 6,488.3 mg, Cu: 2,225 mg, Co: 6.5 mg, I: 65 mg, Se: 67.75 mg (29)
[3] Produced by Ajinomoto (30)
[4] Calculated value (31)
[5] Analysed value (32)

3. táblázat A kísérleti takarmányok összetétele és táplálóanyag-tartalma (g/kg)

takarmánykomponensek (1); kezelések (2); kukorica (3); árpa (4); extrahált szójadara (5); Arbocel (6); napraforgó olaj (7); monokalcium-foszfát (8); takarmánymész (9); takarmánysó (10); 0,5%-os premix (11); Lizin-HCl (12); DL-metionin (13); L-cisztin-HCl (14); L-treonin (15); L-triptofán (16); összesen (17); energia- és táplálóanyag-tartalom (18); emészthető energia (19); szárazanyag (20); nyersfehérje (21); nyerszsír (22); nyersrost (23); összes lizin (24); kalcium (25); összes foszfor (26); összes lizin/emészthető energia arány (27); az Arbocel gyártója (28); 1 kg premix összetétele (29); az aminosavak gyártója (30); számított érték (31); mért érték (32)

Table 4.

Analysed amino acid composition of the experimental diets (g/kg as feed)

Amino acids (1)	T R E A T M E N T S (2)					
	A	**B**	**C**	**D**	**E**	**F**
Essential amino acids (3)						
Lysine (4)	7.7	8.4	9.4	10.2	11.0	11.3
Methionine (5)	2.4	2.5	2.8	3.0	3.6	3.9
Cystine (6)	2.3	2.3	2.2	2.3	2.2	2.2
Met + Cys (7)	4.7	4.8	5.0	5.3	5.8	6.1
Threonine (8)	5.8	5.8	6.4	6.7	7.0	7.5
Valine (9)	7.3	7.1	7.2	7.1	6.9	7.0
Leucine (10)	13.2	13.3	13.3	13.3	13.1	13.0
Izoleucine (11)	6.1	6.0	6.0	6.0	5.8	5.8
Histidine (12)	4.2	4.1	4.3	4.2	4.3	4.3
Phenilalanine (13)	7.7	7.9	7.8	7.7	7.5	7.6
Tyrosine (14)	4.2	4.4	4.4	4.3	4.3	4.2
Phe + Tyr (15)	11.9	12.3	12.2	12.0	11.8	11.8
Non essential amino acids (16)						
Arginine (17)	8.7	8.5	8.5	8.3	8.3	8.0
Aspartic acid (18)	3.4	14.2	14.2	13.9	13.7	13.7
Glutamic acid (19)	31.0	30.5	29.8	29.4	29.7	29.0
Alanine (20)	8.3	8.3	8.3	8.3	8.1	8.1
Serine (21)	7.7	7.8	7.7	7.7	7.6	7.5
Glycine (22)	6.5	6.4	6.4	6.3	6.1	6.1
Proline (23)	11.5	11.5	11.5	11.5	11.2	11.4

4. táblázat A kísérleti takarmányok analizált aminosavtartalma (g/kg)

aminosavak (1); kezelések (2); esszenciális aminosavak (3); lizin (4); metionin (5); cisztin (6); metionin+cisztin (7); treonin (8); valin (9); leucin (10); izoleucin (11); hisztidin (12); fenilalanin (13); tirozin (14); fenilalanin+tirozin (15); nem esszenciális aminosavak (16); arginin (17); aszparaginsav (18); glutaminsav (19); alanin (20); szerin (21); glicin (22); prolin (23)

Laboratory analysis

The DM, CP ether extract, crude fiber, ash, calcium, and phosphorus content of the ingredients and experimental diets were analyzed according to the procedures of the *AOAC* (2006). Amino acid concentration of the ingredients, experimental diets and chymus samples were measured according the method described by *Bech-Andersen et al.* (1990), using AAA 400 Ingos automatic amino acid analyzer. The concentration of AAs were calculated as g AA/100 g protein, except tryptophan. Titanium dioxide (TiO_2) of the ingredients, experimental diets and the digesta samples were anayzed by the description of *AOAC* (2006) with Secomam Anthelie UV/Visible light spectrophotometer.

Statistical Analyses

Trial data were analyzed by two-way variance analysis (ANOVA). In case of statistical reliability the differences were verified by Tukey's test. For statistical procedures, SAS® University Edition (2019) statistics program was used. The relationship between the lysine content of the diet and the ileal digestibility of the crude protein was tested by nonlinear regression analysis (SPSS for Windows 11.5.0, 2002).

RESULTS AND DISCUSSION

Based on our results, the genotype-specific ileal digestibility (GSID) of CP in the experimental animals *(Table 5.)* with different genetic potential was influenced by the total lysine/DE ratio of the diet in a different way in each genotype *(Figure 1.)*.

Table 5.

Genotype specific ileal digestibility of crude protein in growig pigs with different genetic potential (%)

Genetic potential (1)	Genotype specific ileal digestibility (%) (2)						RMSE (3)
	A	**B**	**C**	**D**	**E**	**F**	
High (4)	75.0^{ab}	75.8^{abd}	76.6^{d}	76.2^{cd}	75.2^{bc}	74.1^{a}	1.1
Medium (5)	72.2^{a}	73.6^{ab}	74.5^{b}	74.1^{b}	73.9^{b}	73.5^{ab}	1.4
Traditional (6)	73.3^{a}	74.5^{ab}	74.7^{ab}	74.4^{ab}	74.5^{ab}	74.8^{b}	1.5

Lysine content (g/kg) (7) : A: 7.7; B: 8.4; C: 9.4; D: 10.2; E: 11.0; F: 11.3
Lys/DE ratio (8): A: 0.55; B: 0.61; C: 0.68; D: 0.74; E: 0.80; F: 0.82
a, b, c, d : $p<0.05$

5. táblázat A nyersfehérje genotípus specifikus ileális emészthetősége különböző genetikai potenciállal rendelkező növendék sertésekben (%)

genetikai potenciál (1); genotípus specifikus ileális emészthetőség (2); átlagos négyzetes hiba gyöke (3); nagy (4); közepes (5); hagyományos (6); lizintartalom (g/kg) (7); lizin/emészthető energia arány (8)

Comparing our data with the results of other authors it can be concluded that the AID of the CP is affected not only by the protein sources and the total lysine content of the diet, but also the genotype and the BW of the growing pigs. *Adebiyi et al.* (2015) declared 74.0% AID of the CP in Yorkshire x Landrace animals, when the CP content of the corn-soybean based diet was 155.0 g/kg and the total lysine content was 9.0 g/kg. The CP content in our trial was similair to reported by *Adebiyi et al.* (2015), however the total lysine content was higher in Treatment-C (CP:155.0 g/kg, total lysine: 9.4 g/kg). In our study, by the animals with medium genetic potential the 74.5% AID of CP was determined and in case of pigs with traditional genetic potential fed corn-barley-SBM based diet 74.7% AID of CP was measured.

By (Yorksire x Landrace) x Duroc animals, *Yoo et al.* (2019) reported higher AID of CP at the same CP level (155.0 g/kg) and with 9.8 g/kg total lysine content in the diet. The authors declared 85.0% AID of CP but the experimental animals were fed with corn-fishmeal based diet and the initial BW of the animals were more than

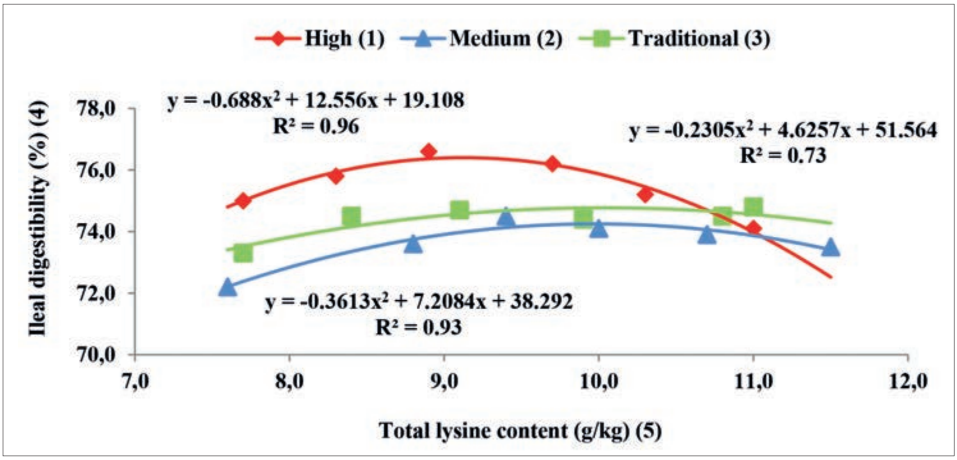
10.0 kg lower (24.1±0.7 kg vs. 35.0±2.6 kg) compared to the study conducted by *Adebiyi et al.* (2015).

She et al. (2018) fed the experimental animals with corn-SBM based diet which was formulated with 179.0 g/kg CP and 11.0 g/kg total lysine. The authors measured 77.4% CP digestibility. In our trials the AID of CP was 75.2% in the animals with high genetic potential fed the Threatment-E diet which was formulated with 155.0 g/kg CP and 11.0 g/kg total lysine. Besides, our results were similar to those reported by *Wang et al.* (2018) and *Jerez-Bogota et al.* (2020).

In general it can be determined that the digestibility of CP in the animals with traditional genetic potential increased significantly ($p<0.05$) only in the case of feeding the diet with the highest total lysine/DE ratio (Treatment F). In contrast, by the genotype with medium genetic potential, the total lysine/DE ratio of Treatment C has already improved the digestibility of the CP ($p<0.05$). By this genotype, further treatments (Treatment D, E, and F) did not have any significant effect on the digestibility of CP.

In pigs with high genetic potential, the digestibility of CP increased also significantly as a result of Treatment C ($p<0.05$), but the highest total lysine/DE ratio (Treatment F) decreased the digesgibility of CP compared to Treatment C ($p<0.05$). According to this results, it can be concluded that all three genotypes had a different response in growing tendency to the diets with different total lysine/DE ratios. Despite the variation in the digestibility of CP by the different genotypes, a

Figure 1. *The GSID of crude protein in growig pigs with different genetic potential (%)*



TREATMENT (6)	A	B	C	D	E	F
Total lysine content (g/kg) (5)	7.7	8.4	9.4	10.2	11.0	11.3
Total lysine/DE ratio (7)	0.55	0.61	0.68	0.74	0.80	0.82

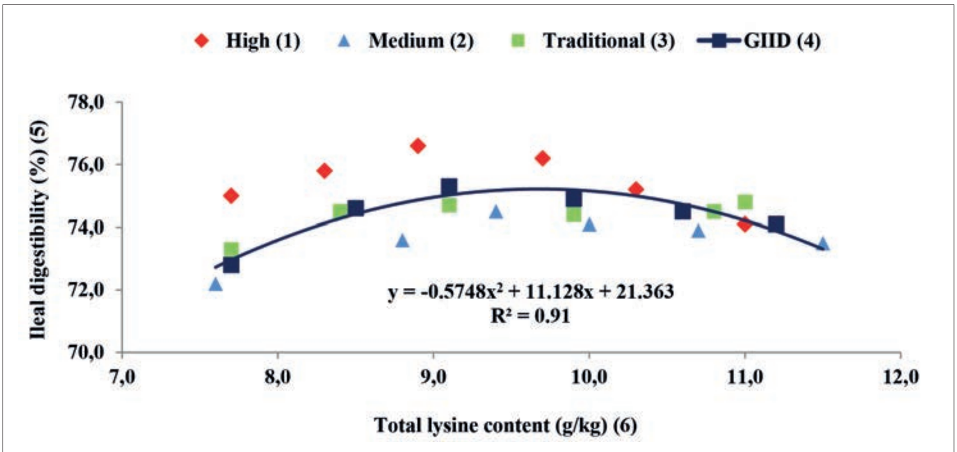
1. ábra A nyersfehérje genotípus specifikus ileális emészthetősége különböző genetikai potenciállal rendelkező növendék sertésekben (%)

nagy (1); közepes (2); hagyományos (3); ileális emészthetőség (%) (4); összes lizintartalom (g/kg) (5); kezelés (6); összes lizin/DE arány (7) close polynomial relationship (R^2 = 0.72-0.96) can be found between GSID and the total lysine/DE ratio of the diet. In case of genotype-independent ileal digestibility (GIID) assesment method, we found also a close polynomial relationship between the total lysine/DE ratio of the diet and the digestibility of the CP (R^2 = 0.92).

However, it is also important to note that GIID does not highlight differences in genetic potential, thereforein some cases it over-evaluates, and in others it underestimates the efficiency of CP digestion *(Figure 2.).* It is also considerable that the digestibility of CP in hybrids with high genetic potential is clearly higher between 0.55-0.80 Lys/DE ratio compared to animals with medium and traditional genetic potential. Based on the data, it can be established, that the protein digestion of young pigs with high genetic potential is the most effective when they are fed diets with higher proportion of crystalline than protein-bound amino acids (Treatment A, B, C, D and E). In this range, regarding to the digestion of CP, pigs with high genetic potencial have an advantage compared to the two other genotypes.

This shows that the use of a feeding strategy based on a higher proportion of „native" proteins and amino acids taken in by the feed ingredients may be less disadvantageous when fattening animals with high genetic potential. It is well known that diets with a lower crystalline AA content are poorer and slower digestible than feeds with higher crystalline amino acids levels (*Buraczewska and Swiech*, 2000*; Han and Lee,* 2000)*.* This also confirms that protein digestion is more efficient in pigs with high genetic potential than genotypes with traditional and medium genetic potential. The ileal digestibility of CP in animals with high genetic

Figure 2. *The GIID of crude protein in growing pigs (%)*



TREATMENT (7)	A	B	C	D	E	F
Total lysine content (g/kg) (6)	7.7	8.4	9.4	10.2	11.0	11.3
Total lysine/DE ratio (8)	0.55	0.61	0.68	0.74	0.80	0.82

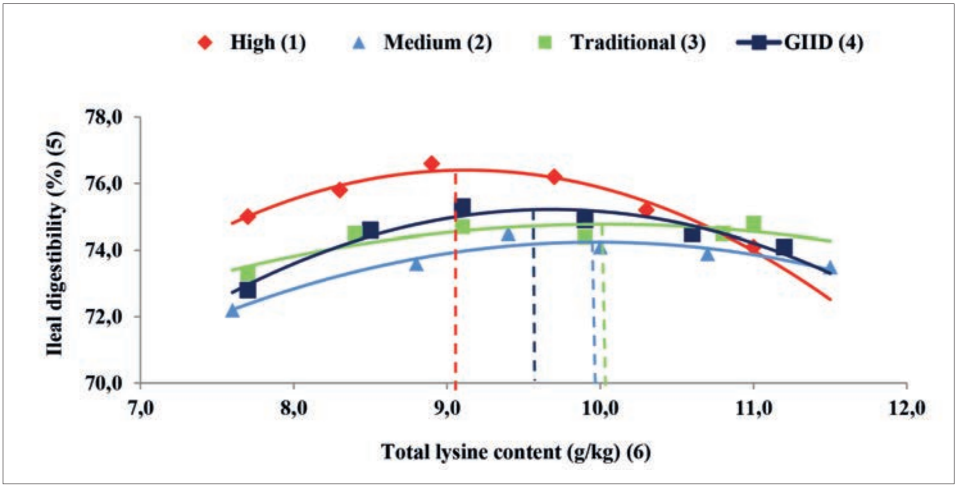
2. ábra A nyersfehérje genotípustól független ileális emészthetősége növendék sertésekben (%)

nagy (1); közepes (2); hagyományos (3); genotípustól független ileális emészthetőség (4); ileális emészthetőség (%) (5); összes lizintartalom (g/kg) (6); kezelés (7); összes lizin/DE arány (8) potential was 2.1% higher compared to animals with medium genetic potential. The digestibility of CP did not reach its maximum value in any of the investigated genotypes by Treatment F, despite the fact that the ratio of crystalline AA was the highest in this experimental diet and therefore the best digestibility was expected in this case. This could be explained by the fact that the different absorption rates of crystalline and protein-bound amino acids decrease the intensity of tissue protein synthesis and through the nitrogen metabolism regulator mechanism of the animals this slows down the further absorption of peptides and amino acids from the gastrointestinal tract (*Trottier,* 2004). Due to the differences in the absorption phases, this phenomenon may have been more pronounced when feeding diets supplemented at higher levels of crystalline amino acids.

With increasing the total lysine/DE ratio of the feed, the digestibility of CP had an increasing in all genotypes. The absorption maximum is represented by the highest points on the curves on *Figure 3.*

The absorption maximum was calculated by genotype ($GSID_{max}$) and also independently from the genotype ($GIID_{max}$). Calculating the absorption maximum point has high importance because on this point is the digestibility of CP the biggest. The location of these points on the curves and the efficiency of the digestibility of CP varies by genotype, which further confirm the need for the development

Figure 3. *Comparison of maximal crude protein digestibility in GSID and GIID assessment methods in growing pigs (%)*



TREATMENT (7)	A	B	C	D	E	F
Total lysine content (g/kg) (6)	7.7	8.4	9.4	10.2	11.0	11.3
Total lysine/DE ratio (8)	0.55	0.61	0.68	0.74	0.80	0.82

3. ábra A nyersfehérje maximális emészthetőségének összehasonlítása genotípus specifikusan és genotípustól függetlenül (%)

nagy (1); közepes (2); hagyományos (3); genotípustól független ileális emészthetőség (4); ileális emészthetőség (%) (5); összes lizintartalom (g/kg) (6); kezelés (7); összes lizin/DE arány (8) and practical application of genetic specific feeding technologies. In pigs with high genetic potential, the ileal digestibility of CP reached its maximum when the diet lysine content was 9.1 g/kg. In contrast, in the genotypes with traditional and medium genetic potential, absorption maximum appeared at a lysine level of 10.0 g/kg. The genetic independent ileal digestibility (GIID) of CP reached its maximum when the diet had a lysine content of 9.7 g/kg. Based on the data presented in *Figure 3.*, it can be concluded that the most effective CP digestion can be achieved by feeding animals with different lysine/DE ratios per genotype. In addition, it should be emphasized that the genotype-independent assessment method does not give real information about the maximum value of CP digestibility nor the total lysine/DE ratio which required to achieve this maximum in the examined genotypes. For this reason, the importance of developing and applying genotype-specific nutritional technologies, even at the level of the amino acids, is considered to be essential.

CONCLUSIONS

Based on our results, it can be concluded that the genotype-specific ileal digestibility of CP (GSID) in growing pigs shows significant differences depending on the genetic potential. The genotype-independent assessment method (GIID) are not able to take these differences into account and in some cases it over-evaluates and in others underestimates the ileal digestibility of CP. The genotype-specific assessment method (GSID) is more accurate, so it is essential to take this into account by developing feeding technologies based on the genetic profile. Besides, with using this assessment method a close (R2=0.72-0.96) polynomial relationship can be found between GSID and total lysine/DE ratio of the diet, despite the differences in the digestibility of CP between genotypes. The results of our study confirm, that the ileal digestibility of CP reaches its maximum ($GSID_{max}$) at different total lysine/DE ratios of the diet in growing pigs with different genetic potentials, and the efficiency of absorption is also genotype-specific. At the same time, it should be emphasized that the digestibility of CP in growing pigs with high genetic potential is significantly higher compared to the genotypes with medium and traditional genetic potential.

Based on our results, for growing pigs (40-60 kg) with traditional and medium genetic potential diet with 10.0 g/kg total lysine, for pigs with high genetic potential diet with 9.1 g/kg total lysine content are recommended.

ACKNOWLEDGEMENT

The release of the paper was supported by the Recovery and Resilience Facility (RRF) project, which was financed under the National Recovery Fund budget, RRF-2.3.1-21 funding scheme. Project no. RRF-2.3.1-21-00001.

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Érkezett: 2020. január

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