AMINO ACID COMPOSITION IN THE ACORNS OF THE CZECH QUERCUS ROBUR AND THE POSSIBILITY OF THEIR USE AS A FEED SOURCE IN A MIXTURE FOR FINISHING PIGS OF THE PŘEŠTICE BLACK-PIED BREED

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Abstract

Acorns are a very important animal feed that has been used for thousands of years. Finishing pigs with acorns has recently become very popular due to the positive influence on the composition of meat. Improving the meat quality of pigs can be achieved, among other things, through the addition of appropriate amino acids, therefore we decided to determine amino acids composition of acorns Quercus robur commonly occurring in the Czech landscape and evaluate nutritive value of the acorns as a potential source of some amino acids. We designed a feed mixture containing 10 % dried acorns and verified its effect on fattening parameters in finishing pigs of the Přeštice Black-Pied breed. Q. robur acorns have a relatively low proportion of essential amino acids, but their addition to the mixture did not affect the fattening parameters in the experiment. It can be used as a good source of energy for fattening pigs, but it is necessary to monitor a sufficient proportion of essential amino acids in feed mixture.

Key words: acorns; amino acids; pig; fattening

The acorns are very important wildlife food, and are the primary overwintering food for a great many species of birds and mammals. They have been used for feeding livestock for many thousands of years (Özcan, 2004). To this day, the production of pigs based on grazing and harvesting these fruits, especially in the Iberian Peninsula and the Mediterranean, has been partially preserved. It is used for producing of specific and very popular products produced in line with consumer concerns regarding ethics of production, animal welfare, and environmental impact (Rodriguez-Estevez et al., 2012). Finishing pigs with acorns has recently become very popular, even in countries where forest grazing is not maintained because the acorn feed ration positively affects the properties of the meat.

The content and composition of amino acids in meat is an important index for the evaluation of the nutritional value of pork and also affects the meat quality (Chen and Liu, 2004). Amino acids are not only essential components of proteins but also affect the synthesis of other components in the muscle. Improving the meat quality of pigs can be achieved via addition of appropriate amino acids and their derivatives (Ma et al., 2020). In addition, to being used as nutrients to satisfy animal growth needs, amino acids also increase pork flavor or regulate metabolic pathways to improve pork quality as regulatory additive (Ma et al., 2020). Quercus acorns include many essential amino acids and the quality of proteins as measured by the essential amino acid composition vary considerably among species (Boren et al. 1995). We decided to determine amino acids composition of acorns Quercus robur commonly occurring in the Czech landscape and evaluate nutritive value of the acorns as a potential source of some amino acids.

The aim of the experiment was to evaluate the amino acid content in the acorns of Quercus robur and to verify the effect of the addition of the acorns to the mixture for fattened pigs of the Přeštice black-pied (PBP) breed on fattening performance.

Material and Methods

In experiment it was used air dried, unpeeled acorns from English oaks (Quercus robur). Based on the previously performed analysis of nutrients in acorns, a mixture containing 10 % acorns suitable for the finishing pigs and composed of common components was designed. Composition of the mixture:

- wheat 25 %
- barley 52 %
- soybean meal (43 %) 8 %
- dried acorns 10 %
- wheat bran 2 %
- supplement of amino acids, vitamins and minerals 3 %

The proposed mixture was balanced by the program Optimization of feed mixtures for pigs (Agrokonzulta Žamberk) to the level of nutrients contained in the feed mixture commonly used for fattening pigs of this breed. The nutrient composition of the diets is shown in Table 1.

The designed acorn diet was practically verified in a feeding experiment with 20 pigs of the PBP breed. The pigs were divided into two groups of 10 with a balanced sex ratio (males were castrated at 5 days of age). The control group (C) was fed the basic mixture.

The experimental group A was fed the acorn mixture containing dried shredded acorns. The experiment was started at an average pig weight of 74 kg. Animals were weighed at weekly intervals and feed consumption for each group was monitored. The pigs were slaughtered at an average weight of 117 kg. Samples of muscle (musculus longissimus lumborum et thoracis - MLLT) from loin were collected 24 h after slaughter, between the second and the third last rib.

As regards the composition of the meat, the content of dry matter, protein and lipids was determined according to standard methodology. The amino acid content in acorns, feed mixtures and the meat samples were determined by an analyzer AAA 400 (INGOS s.r.o. Praha) after hydrolysis with 6 M HCl according to standard method.

The experimental data were statistically processed by QC expert (TriloByte Statistical Software Ltd.). The data in the Tables are presented as the arithmetic mean and the standard deviation (SD). Student's t-test was used for analysis of the data. The differences between the assessed groups were considered significant at $P < 0.05$.

Table 1. *Nutrient composition of feed mixtures*

%	Control mixture	Acorn mixture
Dry matter	87,705	87,849
Crude protein	14,886	14,206
Fat	2,023	2,749
Fiber	5,495	5,935
Ash	5,359	4,946
ME (MJ/kg)	12,40	12,30

Results and Discussion

The analysis of nutrients in acorns revealed the content of dry matter 90.76 %, crude protein 4.37 %, starch 40.85 %, lipids 4.20 %, fiber 9.82 % and ash 2.18 %. The predominant nutrient is starch and therefore acorns can be classified as a carbohydrate feed providing an energy source. The protein content, on the other hand, is low. Nieto et al. (2002) state that the acorn is an excellent source of available energy, but supplies low quantities of a protein with a poor biological quality. Özcan (2004) in his study reported that due to the very low crude protein content of

acorns, the total quantity of amino acids was very low, approximately half that of corn. In a study to evaluate the usefulness of Quercus acorns as an alternative energy source for growing lambs, the low cost of acorns compared with barley suggest that substitution of acorns for barley at maximum level of 24% would be economically advantageous (Al Jassim et al. 1988).

The content of 17 amino acids in the dried acorns was determined and compared with data in the literature. The values are given in Table 2. The most abundant amino acid in the analyzed acorns was glutamic acid (0.680 g/100g) and then aspartic acid (0.456 g/100g). The amino acid cysteine was the least represented (0.076 g/100g). The values obtained in the current study were consistent with the amino acid content found in a study published by Özcan (2004). He analyzed the acorns of 20 species of oak, including Q.robur, the protein content and 14 amino acids were determined. The values matched for example for amino acids Glu, Ile, Leu, Tyr from our analysis. We recorded higher values for Thr, Ser, Gly, Ala, His, Met, which is an increase in 3 essential amino acids for pigs (Thr, His, Met). At the same time, lower levels were found for the amino acids Val, Phe, Lys, which are also essential amino acids, and in addition, lysin is the first limiting amino acid for pigs. Nieto et al. (2002) state that acorns have low quantities of a protein and lysine is the first limiting amino acid there. They proposed dietary supplementation with lysine to achieve a higher efficiency of protein accretion in the Iberian pig when fed on acorn.

The amino acid content was further determined in experimental feed mixtures. The addition of acorns to the mixture resulted in an increase in content of the amino acid Asp, Pro, Glu, Val, Arg. To ensure normal bodily functions, 10 essential amino acids are needed for pigs, as well as a certain amount of non-essential amino acids (Šimeček et al., 2000). Thus, the content of two essential amino acids (Val, Arg) in the experimental acorn mixture increased compared to the control mixture. On the contrary, the decrease occurred in the amino acids ser, ala, ile, leu, tyr, phe. Thus, with the addition of acorns, the level of four essential amino acids decreased. Some amino acids remained at approximately the same level. A very slight change to 0.006 g / 100 g occurred in the essential amino acids Lys, Thr, Cys, Met, which level in the mixture is the most important for pigs.

During the experiment, the weight of each animal was determined at weekly intervals and the average daily gain was calculated. The difference between the groups was not statistically significant and it can therefore be stated that the addition of acorns to the feed mixture in amount 10 % did not affect the intensity of growth. There was also no statistically significant difference in feed consumption.

After the animals were slaughtered, meat samples were taken in which the proportion of dry matter, fat and protein was determined. Again, there was no statistically significant difference between the groups. The protein content was 24.5% in the control group, while in the group with acorn supplement in the mixture it decreased to 22.7%. However, the decrease was not statistically significant ($P>0.05$). The amino acid profile of these samples was further analyzed. A total of 17 amino acids were determined and the difference in their content between the groups was evaluated. The values are given in Tab.3. There were 11 amino acids without a statistically significant difference. For four amino acids (Ser, Ile, Leu, Tyr) a difference was found between the groups at the level of significance $P <0.05$ and it was always a decrease in the content in experimental group A. Similarly, the content also decreased for the amino acid proline at the level of significance $P <0.01$. The only amino acid whose content increased in muscle of experimental group A is the amino acid cysteine. The value has increased from 0.44 ± 0.06 to 0.73 ±0.04 g / 100g ($P <0.01$). Cysteine is a well-known precursor of sulfur-containing flavors in meat (Cerny and Davidek 2003). The meat flavor components consist of many

substances as free amino acids (such as threonine, alanine, serine, lysine, proline, hydroxyproline, glutamic acid, aspartic acid, and arginine), which account for a high proportion (Ma et al., 2020). To better evaluate these parameters, the free amino acid content of the meat should be determined.

Table 2. Amino acids profile in acorns and experimental mixtures (g/100g)

Aminoacid (g/100g)	Acorns (results of analysis)	Quercus robur (Özcan, 2006)	Control mixture	Acorn mixture
ASP	0.456	0.524	0.685	0.702
THR	0.190	0.154	0.440	0.442
SER	0.216	0.173	0.446	0.438
GLU	0.680	0.686	2.073	2.130
PRO	0.272		0.533	0.667
GLY	0.225	0.122	0.461	0.466
ALA	0.260	0.227	0.463	0.458
VAL	0.216	0.234	0.467	0.473
ILE	0.177	0.187	0.373	0.360
LEU	0.321	0.327	0.675	0.666
TYR	0.103	0.095	0.278	0.268
PHE	0.178	0.208	0.418	0.411
HIS	0.207	0.140	0.358	0.354
LYS	0.156	0.207	0.601	0.607
ARG	0.312		0.641	0.671
CYS	0.076		0.178	0.175
MET	0.064	0.036	0.165	0.160

Table 3. Amino acid profile of muscle (Musculus longissimus lumborum et thoracis)

Aminoacid (g/100g)	Group C		Group A		Significance
	Mean	SD	Mean	SD	
ASP	7.64	0.17	5.60	0.99	ns
THR	3.78	0.07	2.73	0.55	ns
SER	3.26	0.07	2.24	0.41	*
GLU	12.75	0.16	9.05	1.65	ns
PRO	4.22	0.42	2.08	0.80	**
GLY	3.40	0.14	2.42	0.50	ns
ALA	4.30	0.12	3.06	0.57	ns
VAL	3.87	0.15	2.84	0.52	ns
ILE	3.56	0.12	2.48	0.41	*
LEU	6.13	0.08	4.29	0.69	*
TYR	2.78	0.04	1.86	0.35	*
PHE	3.03	0.08	2.70	0.46	ns
HIS	3.52	0.20	2.64	0.48	ns
LYS	5.41	0.22	4.43	0.76	ns
ARG	4.70	0.76	3.54	0.67	ns
CYS	0.44	0.06	0.73	0.04	**
MET	2.41	0.43	2.14	0.20	ns

Significance level: ns - not significant, * P<0.05, ** P<0.01

Conclusion

Chemical analysis of Quercus robur acorns revealed that the dominant nutrient in these fruits is starch and it is therefore possible to classify them as carbohydrate feeds. The protein content, on the other hand, is low. The proportion of essential amino acids important for pigs is also poor. The particularly low amino acid content of lysine can have a negative effect on pig growth. The proposed experimental mixture containing 10% acorns was balanced to the required level of protein and amino acids and its use for finishing pigs of the PBP breed had no negative effect on the fattening parameters. Q.robur acorns commonly found in the Czech Republic can therefore be used as a good source of energy in the feed mixture, but it is necessary to monitor a sufficient proportion of essential amino acids in the feed ration.

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