Protein quality assessment from unconventional feed plants for feeding laying hens

Iulia Varzaru[1†], Tatiana Panaite[2], Gabriela Cornescu[1], Margareta Olteanu[2], I. Van[1]

[1] University of Agronomic Science and Veterinary Medicine – 59 Marasti Blv., 011464, Bucharest, Romania; [2] National Research Development Institute for Animal Biology and Nutrition (IBNA)- 1 Calea Bucuresti, 077015 Balotesti, Ilfov, Romania

SUMMARY

Unconventional feed plants as protein sources for laying hens diet have been considered, aiming to minimize the production costs. Knowing the amino acid composition of feed plants is of great importance for achieving the nutritional requirements of laying hens. The aim of this study was to assess the amino acid profile of some unconventional feed plants for laying hens: camelina seeds and meal (rich in n-3 fatty acids), fenugreek seeds (antioxidant properties), linseed and linseed meal (natural source of n-3 fatty acids), mulberry leaves (valorisation of the large amounts of leaves not used because of the decreasing silkworm production). These feed plants were previously studied in laying hens trials for their n-3 fatty acids content (camelina seed and meal; linseed, linseed meal) and to lower the egg cholesterol content (fenugreek seed and mulberry leaves). The studied feed plants had a protein concentration between 19% (mulberry leaves) and 28.41% (camelina meal). The analysis of the essential amino acids (lysine, methionine, cystine) showed that fenugreek had the highest concentration of lysine (1.79%), followed by camelina meal (1.49%), mulberry leaves (1.37%), camelina seeds (1.26%), linseed (0.95%), linseed meal (0.8%). Camelina meal had the highest concentration of sulphur amino acids: 1.08 % methionine and 0.72 % cystine.

Amino acid assessment in unconventional feedstuffs is important for the formulation of layer diets.

Key words: unconventional feed plants, amino acid, laying hens.

INTRODUCTION

The increasing prices of the high quality conventional forage sources challenged the scientists to identify low-economic value plants that can be

† Corresponding author e-mail: iulia_maros@yahoo.com

used as sources of plant protein and not only (sources of antioxidants, of PUFA, etc.). The unconventional feed resources refer to all those feeds that have not been traditionally used in animal feeding and are not normally used in commercially produced rations for livestock.

Camelina meal is the by-product that remains after oil extraction from *Camelina sativa* seeds, for biodiesel production. Camelina meal and seeds have been used in animal feeding trials for the high content of n-3 fatty acids (Aziza et al., 2013, Vasilachi et al., 2012).

Fenugreek (*Trigonella foenum-gracecum*. L), is an annual herb of *Leguminosea* family, cultivated all over the world. It has a long history as both a culinary and medicinal herb in the ancient world, being also a good source of dietary protein for consumption by human and animals (Mamoun et al., 2014). The previous studies reported that fenugreek seed has hypocholesterolemic and antioxidant effect (Kenny et al., 2013).

Linseeds were previously studied in laying hens trials in order to enrich eggs in n-3 fatty acids (Criste et al., 2009).

Mulberry trees are grown extensively for its leaves, which are used for raising silkworms in the sericulture industry. Mulberry leaves were investigated for their digestibility (Olteanu et al., 2010) and for the effect of lowering cholesterol and triglyceride content of laying hens (Panja, 2013).

Amino acid requirement is an ongoing topic with overwhelming importance for poultry. It is well known that imbalance in amino acid profile will result in reduced growth rate and feed utilization efficiency. Quality protein and amino acids are some of the most expensive nutrients in feeds formulation; thus selecting the correct level of amino acids needed in feed formulation has economical impact. Within the current context of the challenges to animal feeding, knowing the quality of the protein/the amino acid profile from unconventional feed plants is of great help in the attempt to develop optimized poultry diets formulation. Using optimal amino acids for diets formulation reduce the feed costs and improve the production's efficiency, and also have environmental benefits (Dersjant-Li and Peisker, 2011).

MATERIAL AND METHODS

Amino acids from unconventional feed plants, were determined by high performance liquid chromatography (HPLC) using a method according to the UE Regulation 152/2009, which was optimized and the validated by Varzaru et al. (2013).

Equipment

HPLC Finningan Surveyor Plus (Thermo-Electron Corporation, Waltham, MA); HyperSil BDS C18 column, with silica gel, dimensions 250 × 4.6 mm, particle size 5µm (Thermo-Electron Corporation, Waltham, MA); rotary evaporator Buchi (Zurich, Switzerland).

Chemicals

Reference materials*:* lysine, aspartic acid, alanine, leucine (Merck, Darmstadt, Germany), cysteic acid and methionine sulfone (Sigma, Deisenhofer, Germany). Reagents: hydrogen peroxide (30%), disodium phosphate, sodium citrate, phenol, hydrochloric acid (37%, d = 1.19 kg·L-1), sodium hydroxide, boric acid, sodium disulphite (all analytical reagent grade), methanol and acetonitrile (HPLC grade) (Sigma, Deisenhofer, Germany).

Plants origin

Fenugreek and camelina seed were grown on the experimental plots of the National Agricultural Research Development Institute INCDA-Fundulea, in the South East region of Romania. Mulberry leaves were purchased from SC SERICAROM SA (the former Institute for Sericulture); linseed meal was imported from Agrosom GmbH (Germany); camelina meal, as by-product from aircraft fuel production, was bought from Romanian Research & Development Institute for Gas Turbines – INCDT COMOTI; linseed was purchased from AUGER PETRUS SRL (Romania). All the unconventional feed plants were used in the formulation of layer diets.

Statistical analysis

All determinations were performed in triplicate. Analysis of variance (ANOVA) and Fisher's least square difference (LSD) tests were applied to compare means at 5% significance level using the statistical data analysis software StatView for MS Windows (Statistical Analysis System, Version 6.0). Results were expressed as the mean of replications ± SD for all measurements.

RESULTS AND DISCUSSION

The unconventional feed plants were analysed for the crude protein content and the results ranged between 19 % dry matter basis (DM) in mulberry leaves and 28.41 % DM in camelina meal (Fig. 1).

Amino acids were traditionally classified as nutritionally essential, semi-essential or nonessential for animals and humans. Amino acid determination from the proposed unconventional feedstuffs has led us to the results presented in Table 1. The higher content of the essential amino acids has been

registered for camelina meal with 8.977 % DM, and the smaller content by linseed meal with 6.479 % DM.

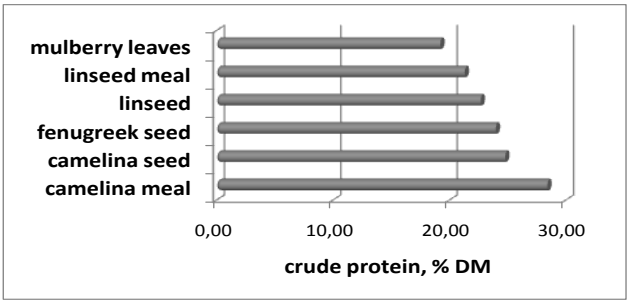

Fig. 1- Crude protein content from the selected feedstuffs

Table 1 - The content of the amino acid classes of the selected plants, %/kg DM

Unconventional feedstuffs	Essential amino acid	Semi-essential amino acid	Non-essential amino acid
Camelina meal	8.977 ± 0.63	5.671 ± 0.52	10.553 ± 0.64
Camelina seed	7.380 ± 0.02	4.196 ± 0.29	9.352 ± 0.22
Mulberry leaves	7.564 ± 0.65	3.008 ± 0.21	8.043 ± 0.58
Linseed	6.627 ± 0.98	3.94 ± 0.404	9.337 ± 0.09
Linseed meal	6.479 ± 0.65	3.561 ± 0.3	8.651 ± 0.9
Fenugreek seed	7.767 ± 0.55	4.799 ± 0.08	8.845 ± 0.5

Among the essential amino acids, methionine, cystine, lysine and threonine are limiting amino acids for poultry (Dersjant-Li and Peisker, 2011). The amino acid analysis of the unconventional feedstuffs revealed that fenugreek had the highest concentration of lysine (1.79%), followed by camelina meal (1.49%), mulberry leaves (1.37%), camelina seeds (1.26%), linseed (0.95%), linseed meal (0.8%) (Fig. 2).

Mulberry leaves had the highest threonine content from the analysed plants (1.383 % DM), and in agreement with those reported by Yao et al., 2000 and which can vary with the stage of maturity . Camelina meal had the highest concentration of sulphur amino acids: 1.08 % methionine and 0.72 % cystine, being the most balanced in essential amino acids from the proposed plants. These results are in agreement with the values that other researcher (Cherian, 2012) obtained in analysing amino acids from camelina meal: 0.92 % methionine and 0.95 % cystine.

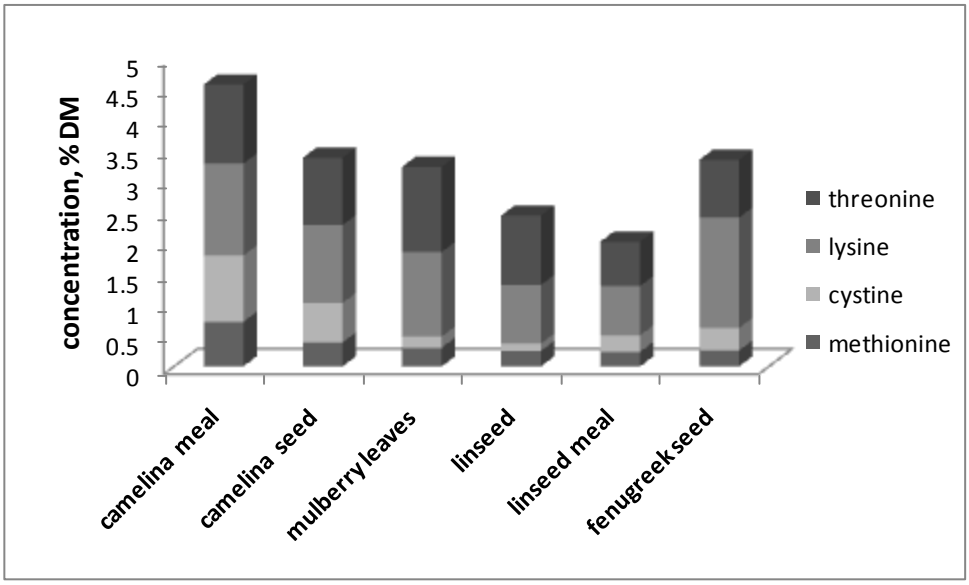

Fig. 2 - Limiting amino acids content of the unconventional feedstuffs

CONCLUSIONS

The unconventional feed plants proved to have high quality protein, due to their content in essential amino acids. Among the proposed feed plants, camelina meal had the higher content of crude protein, with the most balanced profile of limiting essential amino acids.

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