

CHANGES IN BASIC NUTRITIONAL COMPOSITION OF THE PRODUCT (KERNEL) AFTER DEHULLING LUPIN SEEDS



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INTRODUCTION

It is the advantage of white lupin that it is well-suited for cultivation in the geo-climatic conditions of the Czech Republic. In addition, from an ecological point of view, the cultivation of lupins improves soil fertility as their root nodule bacteria enrich the soil with nitrogen.

The object of our evaluation was to focus on white lupin varieties which can be grown under the conditions of the Czech Republic and which have comparable or higher content of crude protein (CP) in their seeds than soybean meal. From this perspective, the optimum varieties used in the present study were white lupin varieties Dieta, Amiga and Zulika. In the present study, we assessed the content of basic nutrients in the seeds from these lupin varieties after dehulling.

MATERIALS AND METHODS

All the white lupin varieties were grown on the farm of the University of Veterinary and Pharmaceutical Sciences Brno in the land registry of Bartošovice village in the district Nový Jičín, under the identical soil and climate conditions (region where cereals are grown, 276 m above sea level, annual rainfall of 776 mm). Each variety was grown on the area of 10 ha. The sowing occurred at the beginning of April 2017 in the amount of 200 kg/ha. The crop was harvested at the end of August 2017. On a day before the harvest, 10 samples were taken from each variety (0.5 kg) from various parts of the field stand. In a laboratory, seeds were manually dehulled to produce a kernel in order to increase the content of CP and the total nutritional value. Hulls were the secondary product of this process.

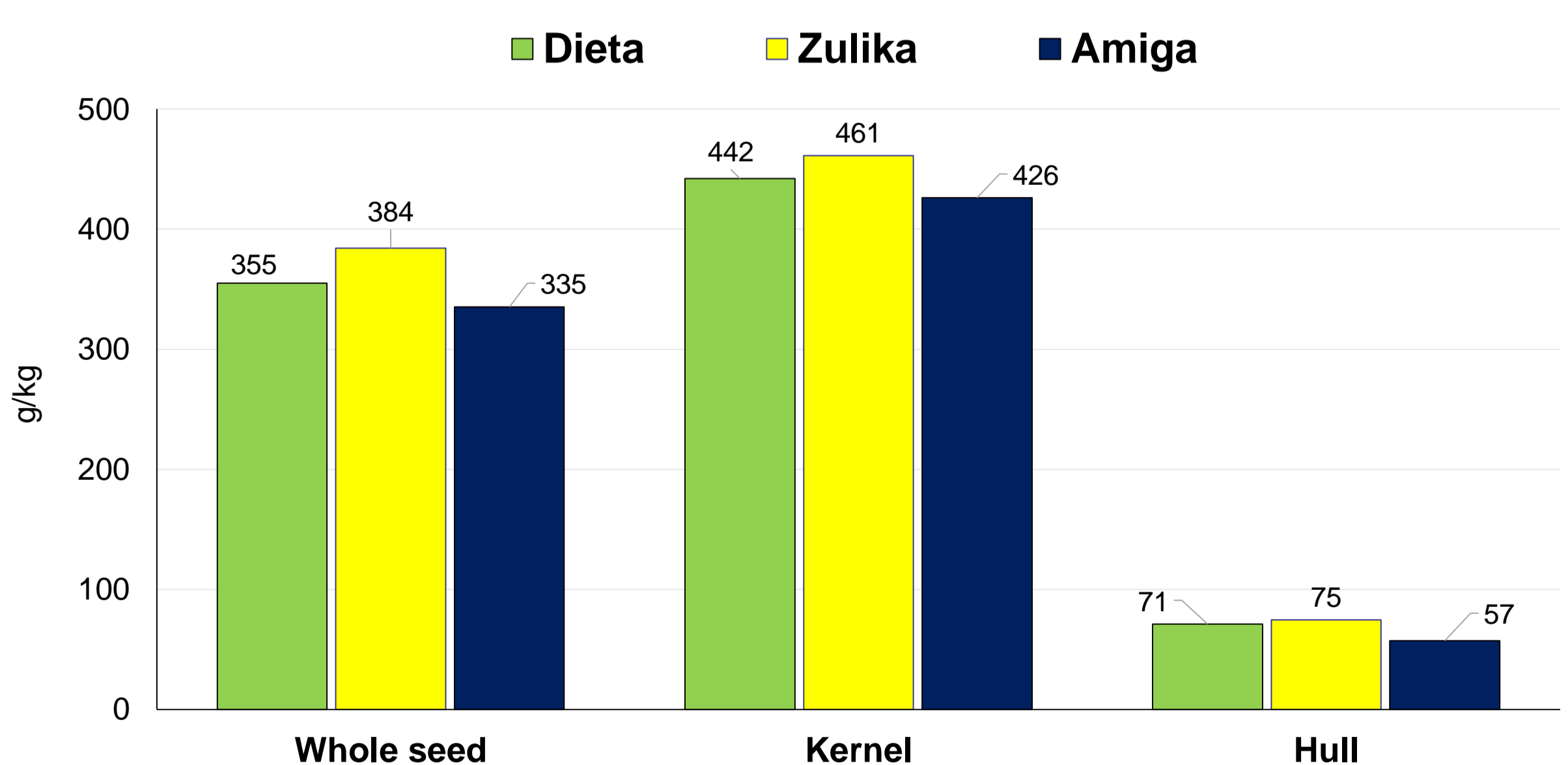
We determined the content of the following basic nutrients in the whole seed, kernel and hull: CP, crude fat, crude starch, crude fibre, acid-detergent fibre (ADF), neutral-detergent fibre (NDF), acid-detergent lignin (ADL), nitrogen-free extract (NFE), organic matter, crude ash, and gross energy (GE). The content of CP was determined by Kjeldahl method (nitrogen content x 6.25) using Buchi analyzer (CENTEC AUTOMATIKA, Czech Republic). Crude fat was determined by ANKOM^{MT10} Fat Analyzer (O.K. SERVIS BioPro, Czech Republic). Crude fibre, ADF, NDF and ADL were determined by ANKOM²²⁰ Fibre Analyzer (O.K. SERVIS BioPro, Czech Republic). Crude starch content was determined using the Automatic Digital Polarimeter P3002RS (KRÜSS, Germany). Crude ash was determined by weighting after the sample incineration at 550 °C under prescribed conditions. Gross energy was determined using the Kalorimetr AC500 (LECO, s.r.o., Czech Republic).

The results were evaluated by mathematical and statistical methods using the software UNISTAT for Excel version 56, applying Tukey's HSD multiple comparison test. Differences between mean values were tested at significance level $P \leq 0.05$. In the figures and table, average values (on dry matter basis) found within the respective groups are presented.

RESULTS

After dehulling, the content of CP in the product (kernel) after dehulling of lupin seeds was higher compared to the whole seed ($P \leq 0.05$), from 19.9 (Zulika) to 27.1 % (Amiga). A similar increase in the CP content in the kernel compared to the whole seed was also found by Laudadio and Tufarelli (2011) in micronized-dehulled white lupin variety Multitalia (20.8 %). A considerable increase in the CP content in the kernel compared to the whole seed (33.7 %) was achieved by Saez et al. (2015) in white lupin seeds of Hamburg variety which were manually dehulled under laboratory conditions after foregoing prior rough grinding of the seed.

Figure 1: The average content of crude protein in the whole seed, kernel and hull of the respective lupin varieties (g/kg of dry matter basis)

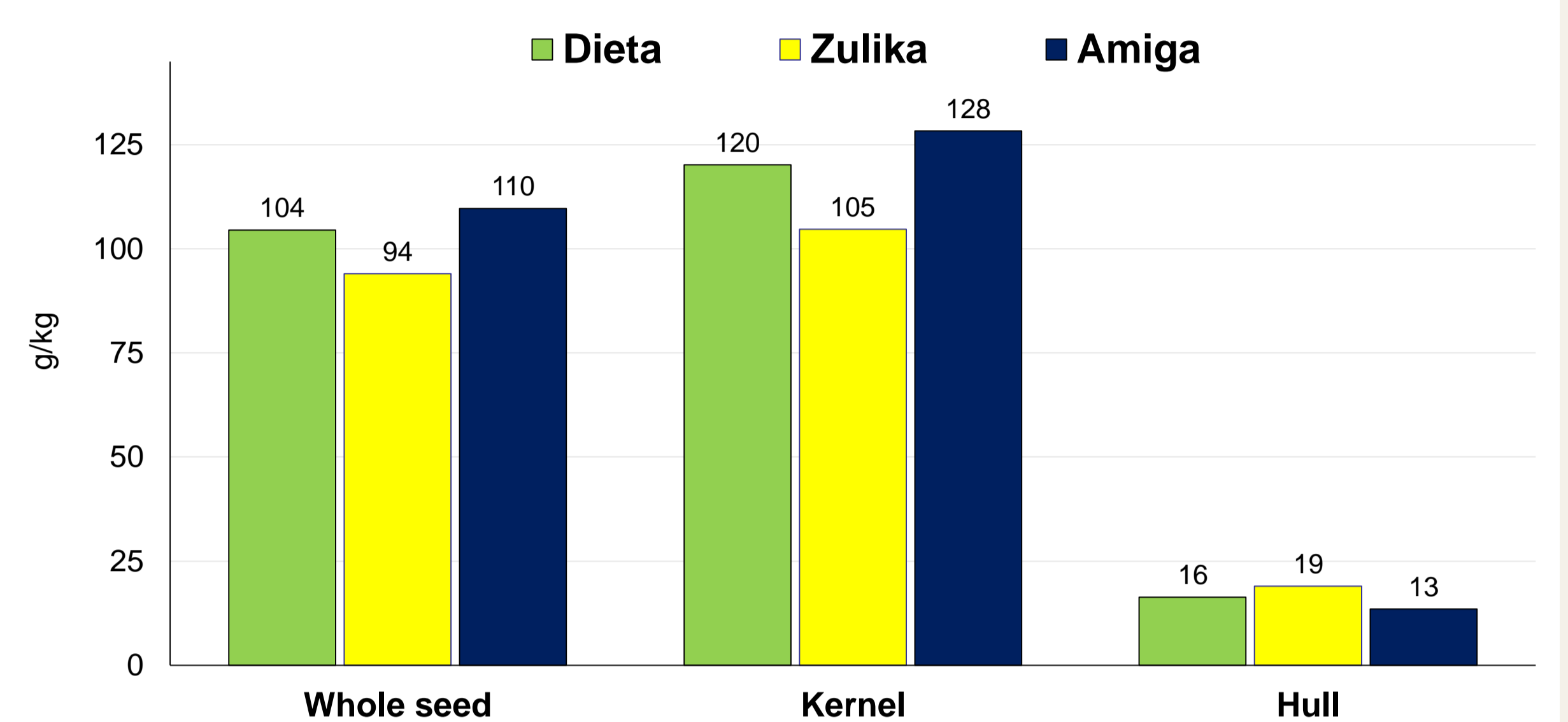


The lupin kernel in the present study contained from 426.2 (Amiga) to 461.1 g/kg (Zulika) crude protein (Figure 1), which is comparable to standard extracted soybean meals. As for the CP content of the whole seed in the respective lupin varieties, its lower content was generally confirmed in the present study as compared to our earlier assessment of the nutritional value of these varieties (Zapletal et al., 2015).

Crude fat content in the kernel was significantly higher as compared to the whole seed (Figure 2), by 11.4 (Zulika) to 16.9 % (Amiga). A slightly lower increase in the kernel fat content (5.5 %) was observed by Laudadio and Tufarelli (2011) when used the micronisation process. By contrast, a considerably higher increase in the kernel fat content (157.5 %) was achieved by Saez et al. (2015).

The increased crude fat content in the kernel of the respective lupin varieties in the present study was related to the higher GE value (Table) that increased by 3.4 (Zulika) to 4.1 % (Amiga).

Figure 2: The average content of crude fat in the whole seed, kernel and hull of the respective lupin varieties (g/kg of dry matter basis)



From the perspective of diet, the content of crude fibre in the present study decreased by 83.4 (Zulika) to 85.2 % (Amiga), while the ADF decreased by 72.7 (Zulika) to 78.6 % (Dieta), the NDF decreased by 70.9 (Amiga) to 77.3 % (Zulika) and the ADL decreased by 87.8 to 100 % (Zulika) in the kernel compared to the whole seed. The fibre and the mentioned fibre fractions sometimes can act as antinutrients, mainly in poultry diets. As compared to the standard soybean meals, the lupin kernel had the higher content of crude starch and NFE and the lower content of crude ash.

Table: The average content of selected nutrients in the whole seed, kernel and hull of the respective lupin varieties

Nutrient (g/kg of DM)	White lupin variety								
	Dieta			Zulika			Amiga		
	Whole seed	Kernel	Hull	Whole seed	Kernel	Hull	Whole seed	Kernel	Hull
Crude protein	355.0 ^b	442.2 ^a	71.0 ^c	384.4 ^b	461.1 ^a	74.7 ^c	335.2 ^b	426.2 ^a	57.2 ^c
Crude fat	104.5 ^b	120.2 ^a	16.4 ^c	94.0 ^b	104.7 ^a	19.0 ^c	109.7 ^b	128.3 ^a	13.5 ^c
Crude starch	95.8 ^a	95.7 ^a	53.4 ^b	83.4 ^a	88.1 ^a	55.9 ^b	95.4 ^a	94.1 ^a	50.6 ^b
Crude fiber	110.5 ^b	17.6 ^c	530.8 ^a	107.7 ^b	17.8 ^c	522.2 ^a	116.8 ^b	17.3 ^c	536.3 ^a
ADF	155.0 ^b	33.2 ^c	649.3 ^a	140.6 ^b	38.4 ^c	644.7 ^a	152.0 ^b	33.2 ^c	699.8 ^a
NDF	184.5 ^b	48.3 ^c	752.5 ^a	198.1 ^b	45.0 ^c	740.7 ^a	182.3 ^b	53.1 ^c	772.6 ^a
ADL	3.8 ^b	0.06 ^c	25.2 ^a	3.4 ^b	0.42 ^c	23.8 ^a	4.7 ^b	0.0 ^c	28.0 ^a
NFE	389.5 ^a	377.3 ^a	351.3 ^b	374.1 ^a	367.2 ^{a,b}	352.3 ^b	395.9 ^a	385.7 ^a	361.2 ^b
Organic matter	959.5 ^b	957.3 ^b	967.3 ^a	960.2 ^b	958.9 ^b	968.2 ^a	958.8 ^b	957.4 ^b	968.1 ^a
Crude ash	40.6 ^b	42.7 ^a	32.7 ^c	39.8 ^b	41.1 ^a	31.9 ^c	41.2 ^b	42.6 ^a	31.9 ^c
GE (MJ/kg)	20.9 ^b	21.7 ^a	17.7 ^c	20.8 ^b	21.5 ^a	17.7 ^c	20.9 ^b	21.8 ^a	17.5 ^c

DM = dry matter; ADF = Acid detergent fiber; NDF = Neutral detergent fibre; ADL = Acid detergent lignin; NFE = Nitrogen-free extractives; GE = Gross energy.

^{a,b,c}: means within the variety and row with different superscripts differ ($P \leq 0.05$)

The analysis further showed that the hulls of all lupin varieties contained the higher content of crude fiber, ADF, NDF, ADL, organic matter and the lower content of CP, crude fat, crude starch, crude ash, GE as compared to its whole seed ($P \leq 0.05$).

CONCLUSIONS

The analysis showed that the kernel of all lupin varieties contained the higher content of CP, crude fat, crude ash, GE and the lower content of crude fibre, ADF, NDF, ADL compared to its whole seed. There were no significant differences between the whole seed and the kernel in the values of NFE, crude starch and organic matter in all white lupin varieties assessed. It can be concluded that the kernel is a high-quality concentrated protein feed that can be used in the diet for monogastric animals and it can be an important component of feed mixtures, especially in poultry nutrition.

When compared to the whole seeds, hulls from the seed of all studied varieties show the high content of crude fiber, individual fiber fractions and organic matter, and on the other hand, the lower content of CP, crude fat, crude starch, crude ash and GE. With regards to the nutrient composition of lupin seed hulls it can be stated that this component could be used in feed rations for horses, rabbits and especially ruminants.

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