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Effect of cultivar and harvest year on the composition of yellow lupin seeds

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ABSTRACT

The seeds of 6 cultivars of yellow lupin from 7 consecutive harvest years, 1992-1998, were subjected to chemical analysis. The obtained results demonstrate significant differences ($P \leq 0.01$ or $P \leq 0.05$) between the evaluated cultivars in terms of ether extract, ash and alkaloids. Significant ($P \leq 0.01$ or $P \leq 0.05$) differences were also found among harvest years in crude fibre and pentosan contents. The highest content of crude protein characterized cultivars Amulet (445 $g \cdot kg^{-1}$) and Teo (441 $g \cdot kg^{-1}$) and, depending on harvest year, seeds from 1994 (443 $g \cdot kg^{-1}$), 1992 (440 $g \cdot kg^{-1}$) and 1995 (438 $g \cdot kg^{-1}$). Differences in the crude protein content were insignificant.

KEY WORDS: yellow lupin, seeds, cultivar, chemical composition, alkaloids

INTRODUCTION

Among legumes, yellow lupin seeds have a high protein content and a large share of structural carbohydrates and other antinutrients that limit their use in the feeding of monogastric animals (Saini et al., 1989; Wasilewko et al., 1999). Aside from genetic aspects, climatic factors have a major influence on the accumulation of components in plants. Under draught conditions, crops contain relatively more protein and secondary metabolites - in the case of lupins, alkaloids.

The objective of this study was to determine if the variability of nutrients and alkaloid contents in yellow lupin among cultivars and harvest years is significant.

MATERIAL AND METHODS

The study was conducted on 6 cultivars of fodder lupin from 7 consecutive harvest years, 1992-1998, with the exception of one cultivar, Manru, which was

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harvested in 1992-1995. The tested seeds were provided by the plant breeding stations of the cultivars Amulet, Manru, Radames and Teo in Wiatrowo (Poland), whereas the cultivars Parys and Popiel, in Radzików (Poland). The proximate analysis of the seeds was performed by standard methods (AOAC, 1990), cellulose and lignin were determined according to Jacyno et al. (1983), pentosans by the orcinol method of Mejbaum-Katzenellenbogen (1969), and total alkaloids, according to Skolik and Wiewiórowski (1959). Main effect analysis of variance was used to statistically analyse the data for cultivars and harvest years.

RESULTS

The data given in Table 1 show that there were significant differences between some cultivars ($P \leq 0.01$ or $P \leq 0.05$) in ether extract, nitrogen-free extractives, crude ash, pentosan and alkaloid contents. Year of harvest had a significant effect on the share of ether extract, crude ash, cellulose and pentosans ($P \leq 0.01$ or $P \leq 0.05$). Unfavourable essential higher total alkaloid contents characterized the cultivars Popiel and Parys in comparison with Amulet, Manru, and Teo ($P \leq 0.01$) and Radames ($P \leq 0.05$), and cv. Radames in comparison with Amulet and Manru ($P \leq 0.05$).

DISCUSSION

Gdala and Buraczewska (1996) and Wasilewko and Buraczewska (1999) report similar values to ours for crude protein, ether extract, crude ash, crude fibre, lignin, cellulose and hemicellulose contents in the seeds of cultivars Amulet, Popiel, Radames and Manru in the harvest years of 1991-1994. The differences in the alkaloid contents both among cultivars and harvest years are corroborated by the results of the COBORU study (Wiatr, 1995, 1997, 1999). Although the alkaloid content in lupins is genetically determined (Aniszewski, 1993), climatic and soil factors also influence alkaloid biosynthesis directly or indirectly (Waller and Nowacki, 1978). This opinion seems to be supported not only by the large differences in the alkaloid contents among cultivars, but also by the high standard deviations within the same cultivars.

Table 1. Average proximate analysis, fibre fractions and alkaloids ($g \cdot kg^{-1}$) in the dry matter of yellow lupine seeds harvested in 1992-1998 depending on the cultivar or harvest year

Specification	Cultivars[1]							Harvest year 19..								RS
	At	Ps	Pl	To	Rs	Mu	P	92	93	94	95	96	97	98	P	ME
Crude protein	445	419	428	441	426	430	0.1737	440	418	443	438	426	431	421	0.2692	1.9
Ether extract	50.1	58.7	53.7	57.0	54.8	52.3	0.0033	52.6	56.4	53.6	56.6	53.7	55.1	54.4	0.4540	0.9
Crude fibre	154	148	161	153	157	158	0.2436	139	161	149	154	161	166	159	0.0040	1.5
N-free extractives	298	319	306	299	307	310	0.1295	315	308	303	300	306	296	316	0.2795	1.6
Crude ash	52.2	55.2	51.6	49.5	55.8	50.0	0.0182	53.0	56.6	52.4	50.6	54.0	52.0	49.2	0.0580	0.9
Cellulose	173	174	176	169	174	169	0.8731	163	175	170	171	186	178	169	0.0826	1.4
Lignin	16.5	14.9	15.4	14.7	14.8	14.8	0.4964	14.2	15.5	14.3	15.9	15.4	15.1	16.7	0.3495	0.6
Pentosans	56.7	59.6	63.5	63.7	60.9	51.2	0.4177	54.5	51.2	46.9	61.0	59.0	74.1	78.0	0.0001	1.4
Alkaloids	0.72	1.71	1.76	0.95	1.25	0.70	0.0003	1.27	1.07	1.25	1.10	1.12	1.25	1.48	0.5949	0.3

[1] At (Amulet); Ps (Parys); Pl (Popiel); To (Teo); Rs (Radames); Mu (Manru)

CONCLUSIONS

The results of this study show significant differences in the proximate composition and alkaloid content of yellow lupin seeds not only among cultivars, but also among harvest years. They also point to the need to chemically analyse every lot of seed, since using the average values given in feeding requirements for animals may be insufficient.

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STRESZCZENIE

Ocena wpływu odmiany i roku zbioru na skład chemiczny nasion łubinu żółtego

Ocenie chemicznej poddano nasiona 6 odmian łubinu żółtego z 7 kolejnych lat zbioru 1992-1998. Wyniki badań wskazują na istotne różnice ($P \leq 0,01$ lub $P \leq 0,05$) pomiędzy ocenianymi odmianami w zawartości ekstraktu eterowego, związków bezazotowych wyciągowych, pentozanów, popiołu oraz alkaloidów. Wykazano również istotne różnice ($P \leq 0,01$ lub $P \leq 0,05$) w zawartości ekstraktu eterowego, celulozy, pentozanów i popiołu surowego pomiędzy latami zbioru. Najwięcej białka zawierały odmiany Amulet (445 $g \cdot kg^{-1}$) i Teo (441 $g \cdot kg^{-1}$), uwzględniając lata zbioru - nasiona z lat 1994 (443 $g \cdot kg^{-1}$), 1992 (440 $g \cdot kg^{-1}$) i 1995 (438 $g \cdot kg^{-1}$), lecz różnice były nieistotne.