Rapeseed qualities of Thuringian harvests from 1992 to 2002

Horst Hartung[1], Jürgen Bargholz[1], Günter Müller[1], Lothar Herold[1], Gerhard Jahreis[2], Wolfgang Schumann[3] and Friedrich Schöne[1]

[1]Agricultural Institution of Thuringia, D-07743 Jena, Naumburger Straße 98, Germany, E-Mail: postmaster@jena.tll.de

[2] Friedrich-Schiller-University (Jena), Institute of Nutrition, D-07743 Jena, Dornburger Straße 25, Germany, E-Mail: b6jage@uni-jena.de

[3] Research Institute of Agriculture and Fishery of Mecklenburg-Vorpommern, Dorfplatz 1, D-18276 Gülzow, Germany, E-mail: schumann@lfa-mv.de

ABSTRACT

In the last decade the area under cultivation with rapeseed (RS) increased from almost 10% to 16 % of the total arable area in Thuringia. Farmers only sowed certified seeds from *00*-varieties. However, the crops of different seed batches apparently reproduced unidentical levels of GSL and therefore had to be investigated in terms of their GSL contents. Since 1992 the yearly monitoring comprises a representative number of RS batches which are harvested on different soils. From a total of 658 samples, about 60 are analysed each year in terms of moisture, oil, protein and GSL contents. There was some variation in moisture, oil and protein content between the years. The higher GSL concentration in 1992 was obviously caused by plants germinated from seeds of earlier cultivars with higher contents of GSL. A differing GSL concentration in the following years may result from changes in the preference for certain varieties and from weather effects. Furthermore, there is some variation in the distribution of GSL in descendent plants often resulting in a higher GSL content in the harvested RS crop compared to the parental seed. Evaluating the seed GSL content with regard to the quality of derived feedstuffs such as RS press cake or solvent extracted meal, the high variation seems problematic. Several samples of the analysed seeds did not achieve 00-quality, neither in terms of the Canadian rules with a maximum threshold value of 18 µmol·g^{-1} nor by the EU rules with a maximum threshold value of 25 µmol·g^{-1}. Negative effects of too high GSL contents could be demonstrated in farm animals and only RS batches with proven low 00 quality guarantee a constantly low feeding risk.

Key words: Rapeseed – glucosinolates – threshold values – protein – oil

INTRODUCTION

In the last decade the area under cultivation with rapeseed (RS) increased from almost 10% to 16 % of the total arable area in Thuringia. Farmers only sowed certified seeds from 00-varieties with an upper limit of 18 µmol glucosinolates (GSL)/g seed (91 % dry matter basis) set by German Plant Breeders´ Association. However, the crops of different seed batches apparently reproduced unidentical levels of glucosinolates (GSL) and therefore had to be investigated in terms of their GSL contents. Further criteria were the contents of moisture, oil and protein, the percentage of admixtures of foreign material in seed batches and the seed weight.

MATERIALS AND METHODS

Since 1992 the yearly monitoring comprises a representative number of RS batches which are harvested on different soils. There was a total of 658 samples, about 60 were analysed each year. From 1992 to 2000 the moisture (1000 g sample minus g dry matter (DM)/ kg), was determined by drying the seed samples at 105 °C. Also the fat and the protein (N x 6.25) were analyzed according to VDLUFA-Methodenbuch III (1994). In seed batches admixtures of foreign material and the mean seed weight were determined according to the international seed testing rules (ISTA 2003). The GSL were analysed with the official method of the European Commission (1990) by HPLC over the whole time. From the harvest 2000 up to the harvest 2002 moisture, oil, protein and GSL were detected by the near infrared spectrophotometry

(NIRS) method. Therefore GSL seed contents of the last three harvests resulted from two analysis methods.

RESULTS AND DISCUSSION

There was some variation in moisture, oil and protein content between the harvests (Tab 1) and in the GSL content, too (Tab 2) . The higher GSL concentration in 1992 was obviously caused by plants germinated from seeds of earlier cultivars with higher contents of GSL. A differing GSL concentration in the following years may result from changes in the preference for certain varieties and from weather effects. Furthermore, there is some variation in the distribution of GSL in descendent plants often resulting in a higher GSL content in the harvested RS crop compared to the parental seed (ROTHE et al. in these Proceedings.)

A computation of correlation coefficients (r) of linear regressions in the harvest 2000 data resulted in the well-known negative relationship between seed oil and protein content ($r=-0.76$, $P<0.001$) and in a weak, however, significant relationship between the GSL and protein seed content ($r=0.26$, $P<0.05$). There seem to be some links between GSL and protein seed status which may be reasoned by utilization of the amino acids both for the synthesis of GSL and protein (UNDERHILL et al., 1973).

Table 1: Winter rapeseed harvested in Thuringia – mean ± SD of moisture, protein, fat, admixtures of foreign material and mean seed-weight[1)]. From 1992 – 1999 the content of moisture, protein and fat was determined by the VDLUFA-Methodenbuch, from 2000 - 2002 by the NIRS method.

Year	Moisture g/kg	Protein g/kg DM	Fat g/kg DM	Admixtures of foreign material g/kg	Mean seed-weight mg
1992	92±36	233±20	441±37	64±44	4.1±0.6
1993	115±32	226±16	475±21	n.d.[2)]	4.8±0.4
1994	55± 4	235±14	473±16	n.d.[2)]	4.2±0.5
1995	60± 2	211±13	462±20	41±33	5.1±0.5
1996	122±39	228±17	464±21	67±40	5.1±1.3
1997	91±22	237±15	478±19.	52±36	4.6±0.4
1998	83±16	221±12	451±16	32±15	4.7±0.6
1999	80±22	207±11	476±15	30±31	4.7±0.4
2000	91±21	230±14	456±18	33±23	4.7±0.6
2001	78±16	219±10	476±15.	31±19	4.8±0.5
2002	78±20	227±14	457±17	67±51	4.4±0.5

[1)] No. of samples in Table 2
[2)] not determined

Results of detection of glucosinolates with NIRS (not shown) were quite similar to the results by HPLC method. The correlation coefficients of linear regressions between the GSL contents according to the HPLC and the NIRS analysis were in a magnitude of 0.7 ($P<0.001$).

Table 2: Winter rapeseed harvested in Thuringia – glucosinolate concentration (mmol/kg seed, 9 % moisture, glucosinolate determination by HPLC)

Year	No. of samples	Mean ± SD	Range (min – max)
1992	45	18.8 ± 3.4	13.3 – 28.5
1993	65	15.6 ± 3.5	8.1 – 26.3
1994	70	13.4 ± 4.9	6.7 – 35.2
1995	60	13.5 ± 3.0	6.6 – 22.9
1996	60	18.2 ± 7.1	8.1 – 33.4
1997	60	13.2 ± 7.1	9.5 – 18.2
1998	60	15.2 ± 2.3	8.1 – 23.1
1999	60	11.9 ± 2.9	4.9 – 19. 2
2000	59	16.2 ± 3.8	6.7 – 24.0
2001	60	17.2 ± 5.8	10.0 – 53.1
2002	59	15.5 ± 3.1	8.01 – 23.8

Evaluating the seed GSL content with regard to the quality of derived feedstuffs such as RS press cake or solvent extracted meal, the high variation seems to be problematic. Several samples of the analysed seeds did not achieve 00-quality, neither in terms of the Canadian rules (Canola Council of Canada, 1994) with a maximum threshold value of 30 µmol GSL/g of air dry, oil free meal = 18 µmol/g seed (91 % DM basis) nor by the EU rules with a maximum threshold value of 25 µmol/g (European Community, 1999). Negative effects of too high GSL contents could be demonstrated in farm animals and only RS batches with proven low 00 quality guarantee a constantly low feeding risk.

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