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QUALITY EVALUATION OF RAPESEED OILS USED AS ENGINE FUELS

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Abstract

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Samples from six reference decentralised facilities and one industrial production unit of rapeseed oils were taken for the evaluation of the influence of production processes to the properties specified in the technical standard; in the laboratories, the properties limited by the standard for rapeseed oils were determined. In addition, long-term monitoring of changes in the oxidation stability in the storage test of rapeseed oils additived in the quantities of 200, 400 and 600 $mg.kg^{-1}$ of the Baynox antioxidant was started. The results confirmed that the critical points in the rapeseed oil production process consist in the contamination with ash-forming elements, such as phosphorus, magnesium, calcium and overall impurities. Not only in the case of hot pressing, but also in two-step cold pressing of rapeseed it is necessary to reduce the content of ash-forming elements using additional processes, such as degumming, neutralisation and whitening. The safety step consisting of filtration down to maximum particle size of 1 µm must be always in place before the oil distribution. A positive effect of the Baynox antioxidant was clearly proved. As 200 $mg.kg^{-1}$ of Baynox was added, the oxidation stability value increased from 8 to 9.05 hrs immediately after the pressing with a consequent decrease to 6 hrs after 270 days. With using of addition 400 ppm Baynox decreased oxidation stability under 6 hours not until after 390 days of storage. With addition 600 ppm Baynox the oxidation stability of rapeseed oil even after 510 days of storage makes 6.5 hours. The quality monitoring brought about necessary findings and knowledge for the optimisation of the rapeseed oil production and distribution as engine fuels. In addition, it serves as an initial supporting document for the creation of the necessary quality control system.

rapseed oil, oxidation stability, biofuels, engine fuels

In compliance with the principle of using the biomass as efficiently as possible in the place of its origin and minimise thus negative influences of its transport, oil seeds are processed, apart from the industrial oil-extracting plants, also in decentralised facilities. The processing of oil seed in the decentralised facilities includes treatment of an oleipherous plant, such as crushing, peeling and pre-heating, pressing by a screw press and, in addition, purification of the raw oil obtained in this way, mostly by a filtration process. The oils obtained in this way and purported for alimentary and industrial purposes must meet the current quality standards limiting their physico-chemical properties and, as the case may be, other associated requirements.

In the local and regional view, the standard rapeseed oil represents a prospective fuel for not only modified combustion engines in mobile means of transport but also for similar, power-generating engines working in a stationary mode and suitably coupled with the decentralised rapeseed processing facilities. A basic prerequisite for the application of such fuels on the market is to set up successfully a necessary quality control system. To survey the rapeseed oil quality, available on the market, oil samples were periodically taken from several oil mills and analyzed (*REMMELE, 2007; REMMELE, GASSNER, STOTZ, 2008*). Further more, experiments on a small scale pilot oil mill were accomplished to investigate the effect of seed variety and quality on rapeseed oil fuel properties.

Additionally, the influences of different storage conditions on the fuel quality were investigated. Finally the performance of safety filters was tested. Results are, that initially the rapeseed oil quality varied a lot, whereas with ongoing product control, fuel quality improved significantly. There is no obvious influence of the seed variety on oil quality, however seed ripeness appears as an important factor. Storage is best at a temperature of 5 °C, to prevent quick oil ageing. The testing of safety filters showed that the best efficiency was achieved with multi-layer filters.

If any rapeseed oil manufacturer intends to place its product on the engine fuel market, then it will be necessary to prove the conformity with the requirements of the relevant technical standard – ČSN 65 6516 (*2007*).

According to *ŠEDIVÁ, SVĚTLÍK et al.* (*2009*) the conducted evaluations of oil quality have been focused, to the quality testing of rapeseed oil samples taken from decentralised facilities in order to include their diversity in view of the output, pressing method, rapeseed heat treatment and final treatment of obtained oils. The parameters of seven rapeseed-oil samples taken from six decentralised facilities plus three samples from an industrial plant have been evaluated. Any vegetable oil is classified as "cold pressed" if pressed without the application of external heat and the outgoing product temperature being less than 50 °C.

After treatment with added substances, such as bleaching earth, silica gel and citric acid during the cleaning process can reduce deposit and ash-forming elements such as phosphorus (P), calcium (Ca) and magnesia (Mg) in cold-pressed rapeseed oil fuel, produced at small-scaled oil mills (*WITZELSPERGER, REMMELE, 2010*). In trials at laboratory scale, rapeseed oil with untypically high contents of phosphorus, calcium and magnesia was treated with ten different added substances available on the market and citric acid (20 %) at different oil temperatures. Afterwards, it was cleaned by means of centrifugation and filtration and then analysed for relevant parameters according to DIN V 51605 (2006). In trials at pilot plant scale, rapeseed oil of two different qualities concerning the contents of phosphorus, calcium and magnesia was treated with chosen added substances from the laboratory trials, citric acid (20 % and 40 %) and cellulose as a filter aid. The cleaning process was organized like it is typical for small-scaled oil mills, using a chamber filter press. The gained oil was then analysed for relevant parameters according to DIN V 51605 (2006).

The development of decentralised facilities for rapeseed pressing in the Czech Republic started in 1992 in the connection with the implementation of the governmentally approved programme, the 'Oleoprogram', which is the program of utilisation of rapeseed for the production of fatty acid methyl esters of rapeseed oil (MEŘO) (*JEVIČ et al., 2007*). Service units for rapeseed pressing are usually a part of decentralised MEŘO production plants. At present, there are several tens of small and decentralised units in the Czech Republic for rapeseed pressing. These facilities extensively varied – practically, there no two identical processes as regards their technology and service equipment. Their nominal capacities fluctuate from 8 to 500 tons of rapeseed processed a day. The capacities of pressing machines in service vary in the range from 20 to 8,000 kg of rapeseed per hour.

The objective of this paper is to publish the results of the evaluation of quality of rapeseed oils in view of ČSN 65 6516 (*2007*), where these oils are obtained by pressing of rapeseed without external heat supply (i.e. the so-called "cold pressing") on a pilot plant scale as well as rapeseed oils samples taken within the monitoring scheme in typical production conditions in the Czech Republic applying single- and two stage cold pressing processes, hot pressing, industrial pressing processes, extraction processes and those using various additional oil purification methods starting with filtration over deacidification and degumming, whitening and ending with complete refining of oils. In parallel with this, a long-term test of selected cold-pressed rapeseed oil containing various portions of the Baynox stabiliser has been conducted and evaluated.

MATERIALS AND METHODS

The first step consisted of pressing oil portions of various rapeseed types without direct heating in a pilot plant at VÚZT, v. v. i. Prague. The rapeseed oils obtained this way were tested for their neutralisation numbers, oxidation stability, phosphorus content and iodine value. Pressed and filtered portions of rapeseed oils were tested for the content of decisive fatty acids: palmitic, stearic, oleic, linoleic and linolenic acids and iodine value. Necessary portions of rapeseed oils were taken in a standard method in the decentralised facilities and quality analyses performed according to selected parameters as shown in Table I.

In the next stage, three portions of rapeseed oil were prepared from the storage tanks additived with the Baynox antioxidant in the quantities of 200, 400 and 600 mg.kg^{-1}. The samples prepared in this way were stored in three five-litre PVC vessels with the access of air. The vessels were placed into an unheated room lighted with the daylight coming through a window only. Every 30 days the test analysis was conducted with the taken samples. For these oils, the oxidation stability testing was performed during the whole 2008 year. Sampling was carried out according to ČSN 58 8752 (1994) "Sampling" in the following sequence: portion, partial sample, compound sample and test sample. The sample preparation for the analysis was carried out according to ČSN ISO 661 ("Animal and vegetable fats and oils – Preparation of test sample"). The evaluated properties were determined according to the test methods set out in ČSN 65 6516. The analyses were carried out in the

I: *Sampling characteristics of rapeseed oil test samples and scope of performed analyses*

Facility identification and its rapeseed oil its production capacity	Characteristics of oil pressing and treatment processes		Sample No.	Laboratory analysis	Analyses conducted in the authorised laboratory
ZS Kratonohy 190 $kg.h^{-1}$	cold pressing, single-step, filtration with manual cleaning and filtration cloth		1	density (15 ^{o}C) water content neutralisation number total impurities phosphorus content Mg+Ca content iodine number oxidation stability	all parameters according to ČSN 65 6516, without ignition tendency
RPN Chrudim 340 $kg.h^{-1}$	cold pressing, single-step, automatic leaf filter		2		like Sample 1
Agrochem Lanškroun 310 $kg.h^{-1}$	cold pressing, two-step, automatic leaf filter		3		-
A.B.C. Bransouze 410 $kg.h^{-1}$	cold pressing, two-step, automatic leaf filter		4		-
FABIO Holín 530 $kg.h^{-1}$	cold pressing, two-step, automatic leaf filter		5		-
FABIO Holín 530 $kg.h^{-1}$	cold pressing, two-step, whitening, automatic leaf filters		6		like Sample 1
Primagra Milín 930 $kg.h^{-1}$	hot pressing, degumming and neutralisation, automatic leaf filter		7		-
Setuza Olomouc 11 700 $kg.h^{-1}$	pressing and extraction	degumming	8	water content neutralisation number phosphorus content oxidation stability	-
		whitening	9		-
		refining	10		-

1: *DD 85G Comet pressing equipment with the pressing mechanism of Farmet with variable screw speed, press head temperature and nozzle size (press cake removal)*

laboratory of VÚZT, v.v.i. Prague and the Institute of Fuels and Lubricants.

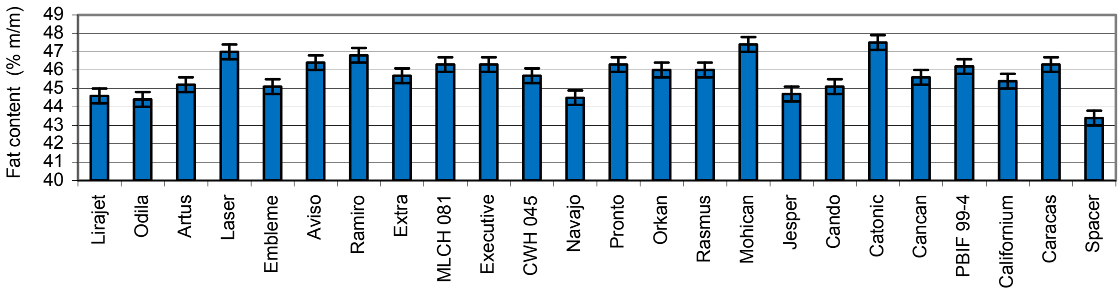
The pressing equipment, type DD 85G Comet with the pressing mechanism of Farmet Česká Skalice used in VÚZT, v.v.i., is shown in Fig. 1; twenty four rapeseed types (four kg each) were processed in this equipment. Optimum screw-speed parameters were set to guarantee the highest yield and press efficiency possible at a satisfactory output level. An 8mm nozzle diameter used for the press cake removal was selected and press head temperature at the pressing operation was detected (the head can be heated up to 250 ÷ 300 ^{0}C). This heating is necessary at the beginning of pressing as well as in cases some oily seed types, where the oil from oil cells might be released insufficiently.

The obtained results have been statistically evaluated and variance values were demonstrated in related graphical functionalities.

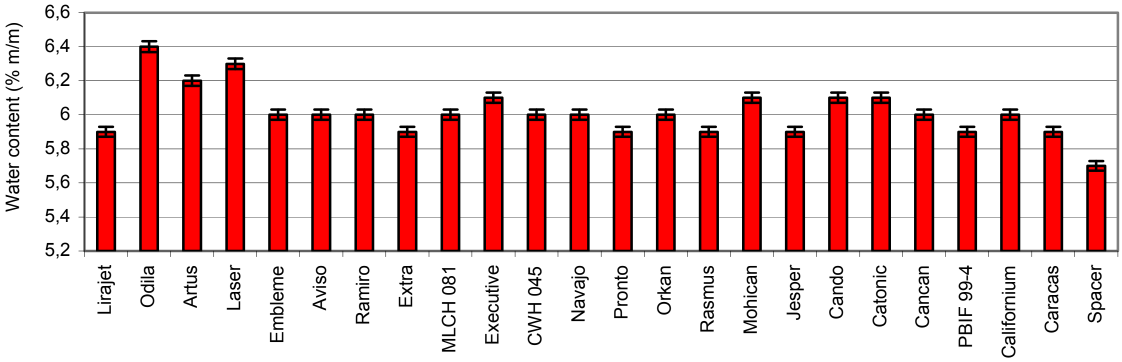
RESULTS AND DISCUSSION

Seed oiliness and water content

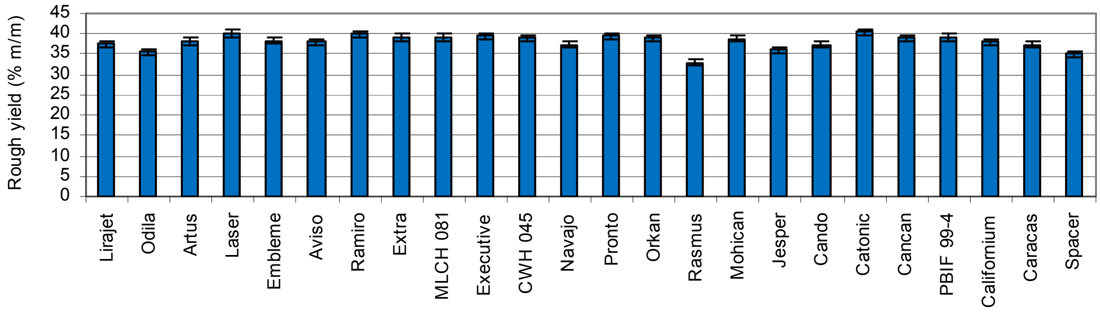
The oiliness of rapeseed samples is indicated in Fig. 2, while their water contents in Fig. 3. The maximum moisture level was well under the limit (8% m/m according to ČSN 46 2300-2 "Oilseeds",



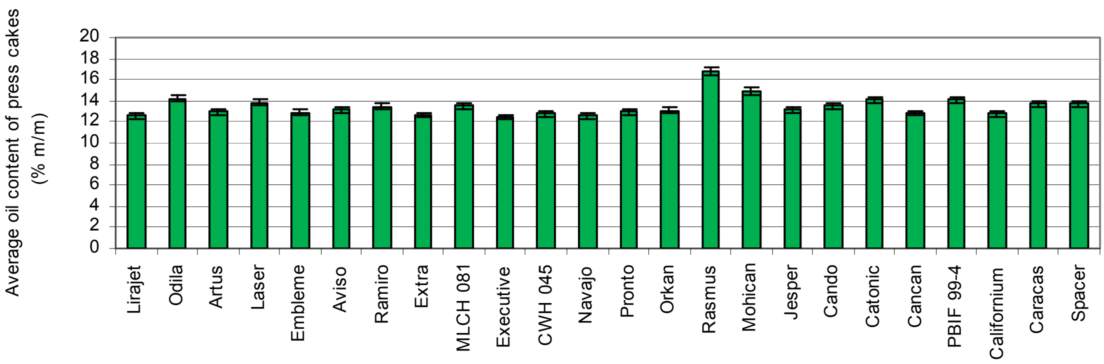
2: *Seed oiliness in samples of various rapeseed types*



3: *Water content in samples of various rapeseed types*

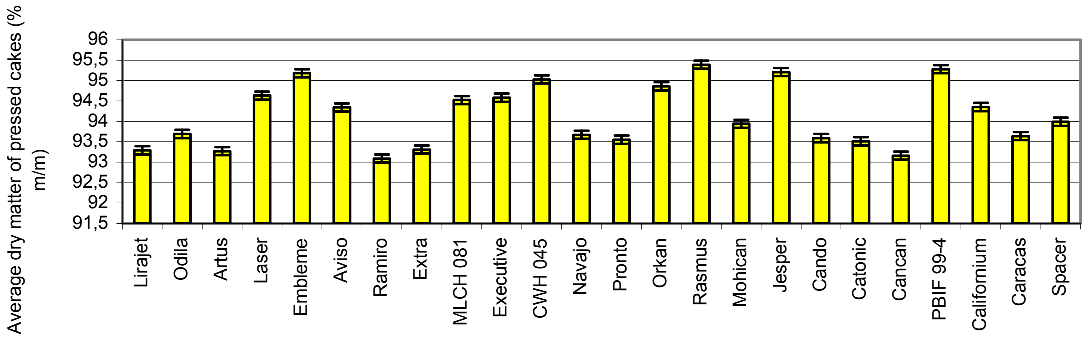


4: *Rough yield of the „cold" pressing of variety samples of rapeseed*

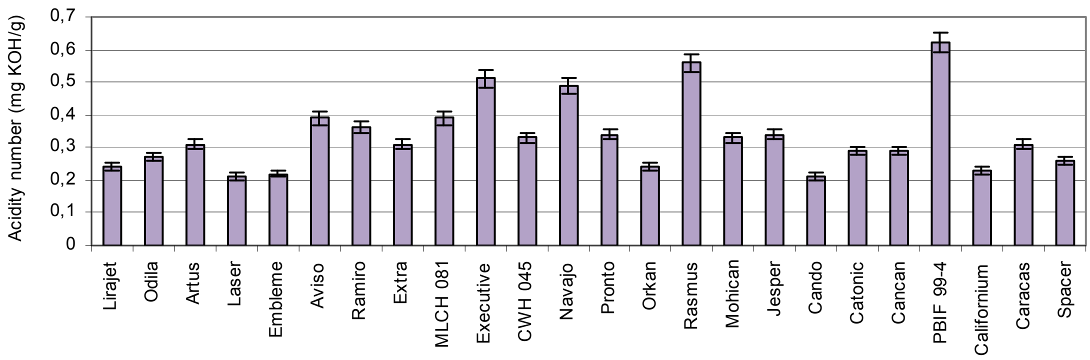


5: *Fat contents in press cakes pressed out of samples of various rapeseed types*

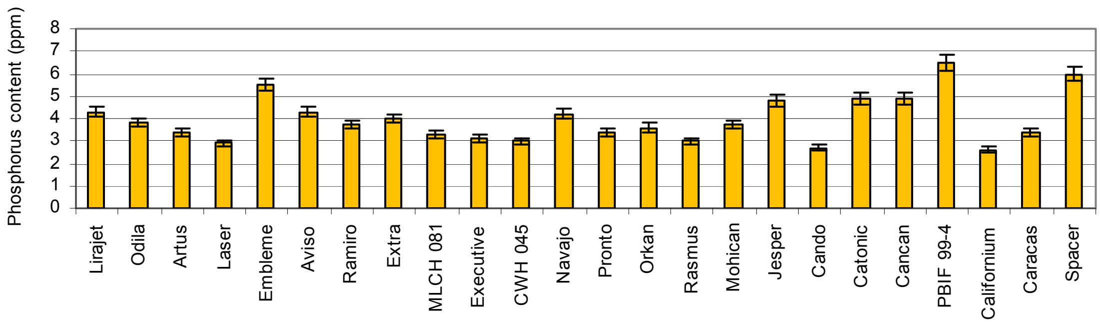
Part 2: "Rape seed"). All varieties showed the fat content over 43% m/m, where the sample of Catonic was the highest (47.5% m/m) and the sample of Spacer on the opposite end of the range (43.3% m/m).



6: *Dry matter contents in press cakes pressed out of samples of various rapeseed types*



7: *Neutralisation numbers of rapeseed oils*



8: *Phosphorus content in rapeseed oils*

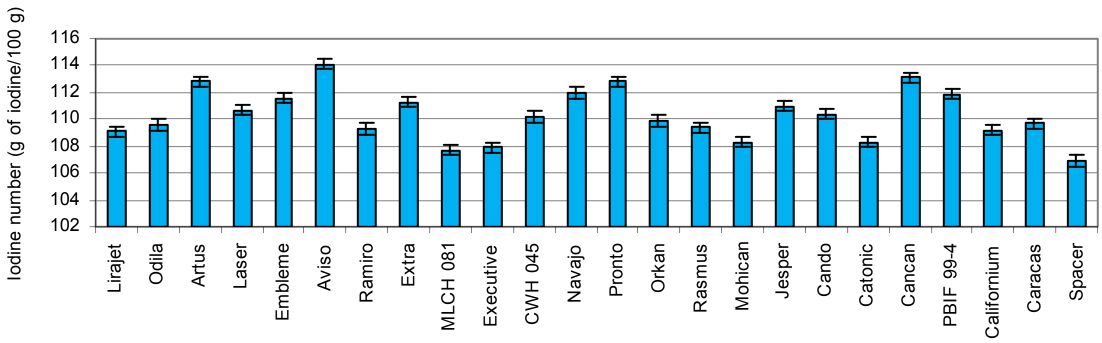
Influence of cold pressing to technical parameters and fat content in press cakes

The pressed oil temperature did not exceed 48 °C, which indicated the virgin oil. The output figures confirm that the operating mode of the Farmet press has been optimally chosen, i.e. 10.5% kg of rapeseed per hour. The yield and process efficiency values correspond to this pressing procedure. The gross yield (Fig. 4) represents the percentage share of weight of the rapeseed oil obtained out of the total rapeseed weight processed. The press-cake fat content is shown in Fig. 5, while the dry matter content in Fig. 6, presenting thus the potential of this simple procedure of the rapeseed oil production.

Rapeseed oil quality

With respect to the maximum acidity level of 2 mg KOH.g^{-1} required by the standard, very low neutralisation numbers (Fig. 7) have been observed here, which indicates good quality of rapeseed, its proper treatment and storage. Similarly, phosphorus content values (Fig. 8) are significantly lower than the limit at 12 ppm required by the standard. According to the standard, iodine values (Fig. 9) should vary within the range from 95 to 125 g of iodine (100 g)$^{-1}$. The composition of fatty acids determines the iodine value. The targeted conditions consist of high-oily rapeseed, high yield per hectare and high shares of oleic acid, low content of saturated fatty acids (palmitic, stearic) and linolenic acid.

The voluntary quality check of 39 oil mills showed a various quality on the market with partially enormous deviation from limiting values of pre-standard DIN V 51605. Only four oil mills could achieve a standard conform quality in every of the six samplings. 12 oil mills failed only for one



9: *Iodine values of rapeseed oils*

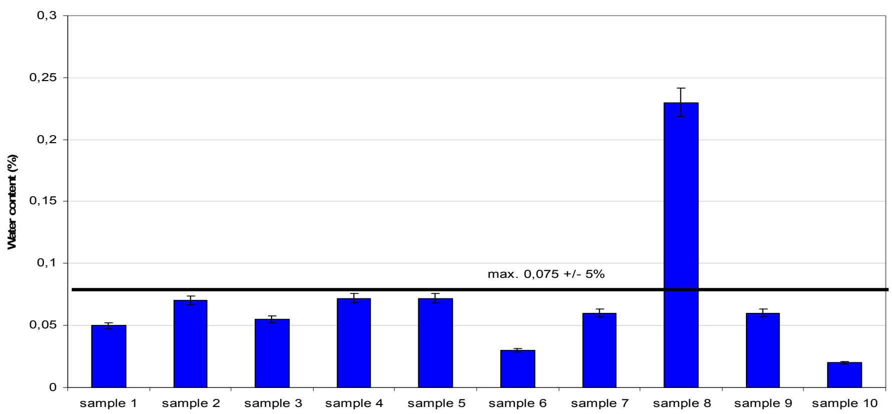
parameter once. Fuel quality improved significantly with raising awareness of the importance of quality assurance measures and increasing skills of the oil miller. The systematic investigations on the small scale pilot oil press showed no obvious influence of the seed variety on oil quality. Solely high oleic varieties have advantages in regards of oxidation stability. Both acid number and oxidation stability are negatively influenced by contamination of the seed with weeds. The ripeness of seed appears as an important factor: With increasing ripeness of the rapeseed, acid number, oxidation stability and the content of P, Ca and Mg in the oil are positively influenced. Germinated seed has an unfavourable influence on acid number, oxidation stability and P-, Ca- and Mg-content. Peeling of the seed might improve the acid number and element content in the oil but has no influence on oxidation stability. Neither acid number nor oxidation stability and element content in the oil were influenced negatively, when seed was dried at different temperatures of up to 80 °C. The trials in two practice plants, regarding the variation of screw rotation speed could confirm results of previous research works (*ATTENBERGER et al., 2005*), that an optimized adjustment of screw presses for low P-, Ca- and Mg-content in the oil is possible.

Quality monitoring of rapeseed oils from reference production plants

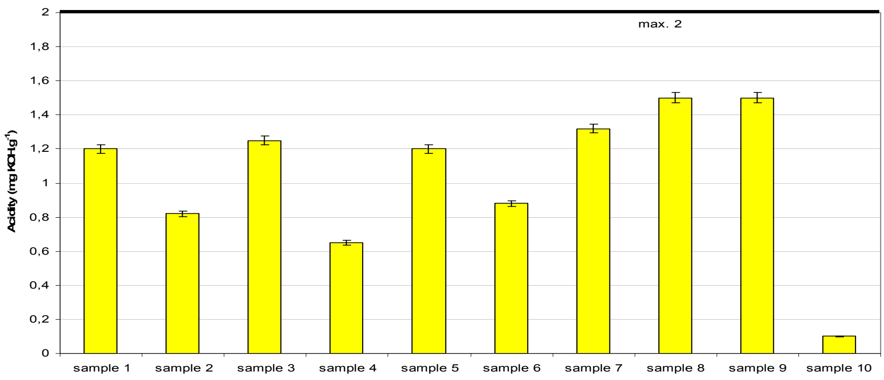
The results of the parameters found for water content, neutralisation number, total impurities, phosphorus content, Mg+Ca content, oxidation stability and iodine number for rapeseed oils, sampled as shown in Table I, are shown in Figs. 10 to 16. In Table II and III, the results for all these parameters are shown (apart from the ignition tendency) and compared with the limits set out in ČSN 65 6516.

There are no doubts about the importance of the ignition tendency parameter. At present, there are in place standardised methods for the cetane number determination in test engines, e.g. for FAME – ČSN EN 14214; however, they are suitable only for an orientation determination of ignition tendency of rapeseed oils. The sphere of application of these test methods are not intended for rapeseed oils used as the fuel for the compression ignition engines. For these reasons, the limiting value (No. 39) found in this way should be considered of reference value only. In spite of the fact that the request for the ignition tendency determination is still in the place, it is possible to leave out the testing of this property until a test method suitable for the cetane number determination for rapeseed oils in test engines is available.

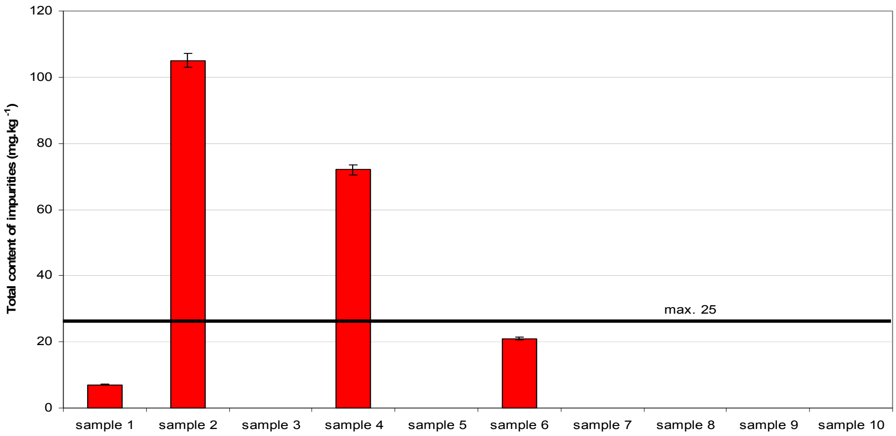
Changes in the course of oxidation stability of these oils after 180-day storage are shown in Fig. 18.



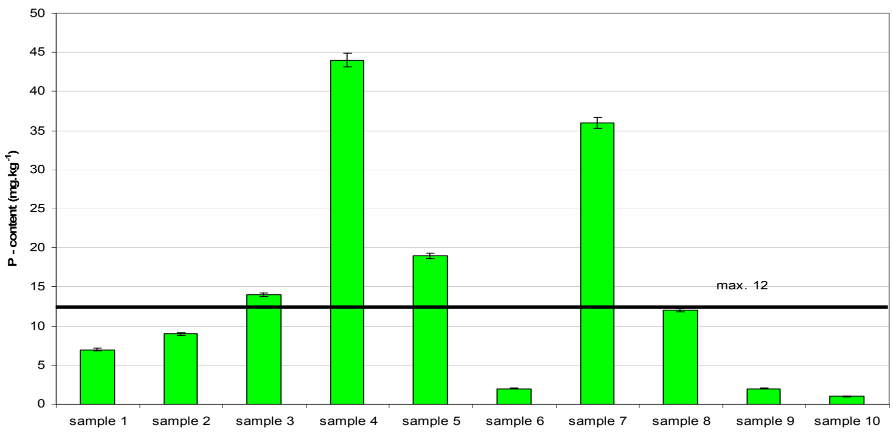
10: *Water content in test samples of rapeseed oils*



11: *Neutralisation numbers in test samples of rapeseed oils*



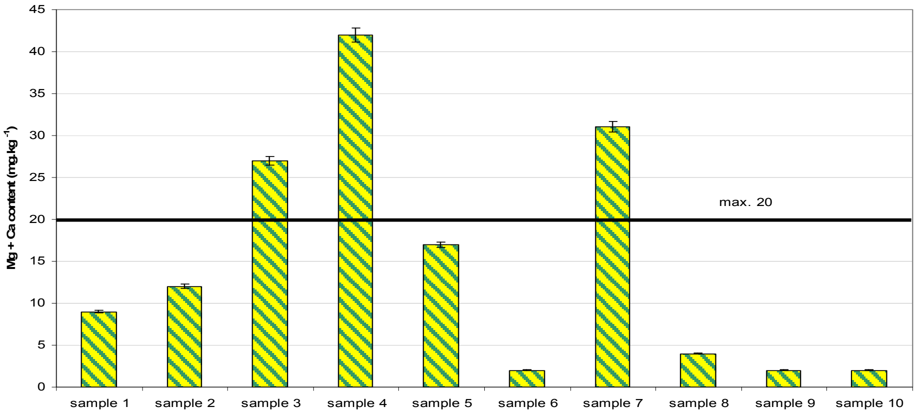
12: *Total content impurities in test samples of rapeseed oils*



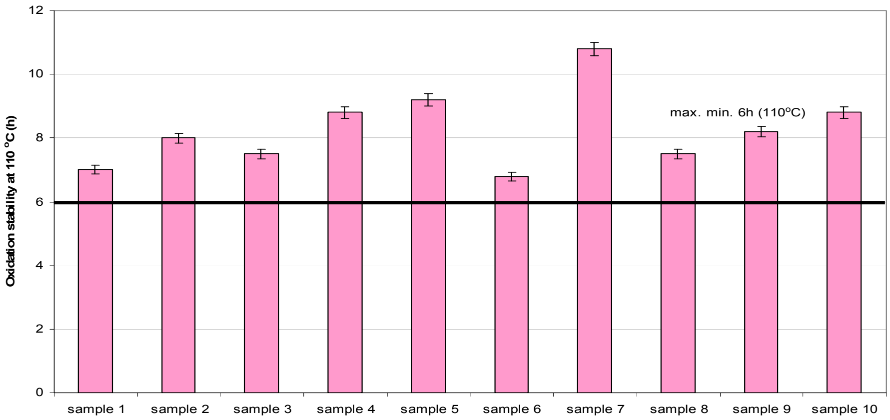
13: *Phosphorus content in test samples of rapeseed oils*

No. 2 rapeseed oil (see Tab I) of the initial value of oxidation stability after eight hours was selected as the test sample. The additive from Baynox has a very positive effect to the storage stability. After 180 days, the rapeseed oil sample with the lowest content of this additive (200 ppm) still offered the oxidation stability value of 7.77 hrs, which significantly exceeded the induction period of min. 6 hrs stipulated by ČSN 65 6516.

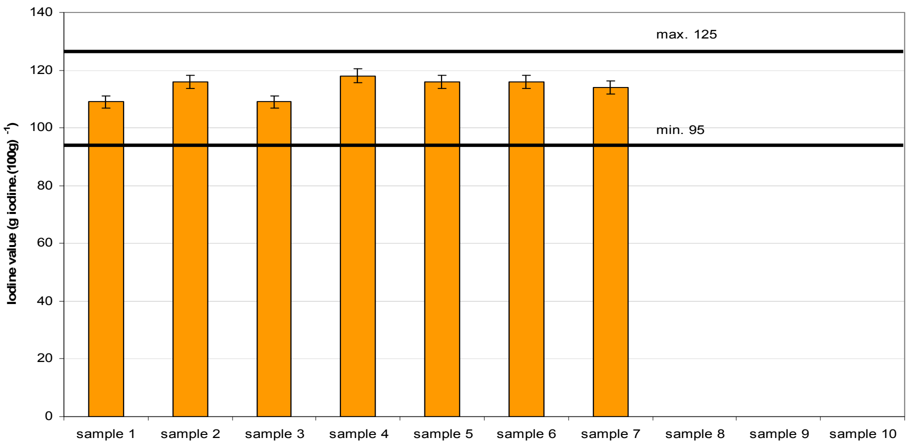
The quality monitoring results confirmed large differences in the quality of produced rapeseed oils. It was no problem for any oil extracting plant to meet the requirements for water content, neutralisation number and oxidation stability. However, the monitoring showed that the contamination of rapeseed oils presented a limiting factor. Out of seven test samples, four did not meet the requirements for the phosphorus content (Nos. 3, 4, 5 and 7). Samples Nos. 3, 4 and 5 were taken from



14: *Mg+Ca content in test samples of rapeseed oils*



15: *Oxidation stability of test samples of rapeseed oils*



16: *Iodine values of test samples of rapeseed oils*

the plants using the double-step pressing process, while Sample No. 7 from the production using the hot pressing process, even though with degumming and neutralisation steps. Three samples failed to meet the limit for the total Mg+Ca content (Nos. 3, 4 and 7). From the comparison of Samples Nos. 5 and 6 taken in different phases of processing, the influence of whitening to the reduction of the total Mg+Ca content can be unambiguously confirmed. Out of four samples evaluated for the total impurities (Nos. 1, 2, 4 and 5), Samples Nos. 2 and 4, taken from the plants equipped with the single-stage automatic filtration only, failed to meet the limit. Out of the samples from the decentralised facilities, only Samples Nos. 1 and 6 met all requirements of ČSN 65 6516. On the other hand, no doubts about meeting all the parameters were raised in the case of Samples Nos. 9 and 10 coming from the industrial

II: *Quality parameters of No. 1 test sample of rapeseed oil and comparison of achieved results with the limits according to ČSN 65 6516*

Parameter	Unit	Result	Limit min.	Limit max.
Flash Point (closed up, Pensky-Martens method)	°C	**262.0**	220	-
Water content Karl Fischer method (m)	% (*m/m*)	**0.0478**	-	0.075
Kinematic viscosity at 40 °C	mm²/s	**34.65**	-	36.0
Ash content (ash oxide)	% (*m/m*)	**0.001**	-	0.01
Neutralisation number	mg KOH/g	**1.199**	-	2.0
Calorific value	kJ/kg	**37 710**	36 000	-
Total impurities of low-viscosity fuels by filtration	mg/kg	**8**	-	24
Conradson carbon residue	% (*m/m*)	**0.24**	-	0.40
Oxidation stability at 110 °C	h	**7.6**	6.0	-
Density at 15 °C	kg/m³	**918.5**	900.0	930.0
Sulphur content	mg/kg	**<3**	-	10
Iodine value	g iodine/100 g	**109**	95	125
Phosphorus content	mg/kg	**7**	-	12
II. Group Metals: Mg+Ca	mg/kg	**9.44**	-	20

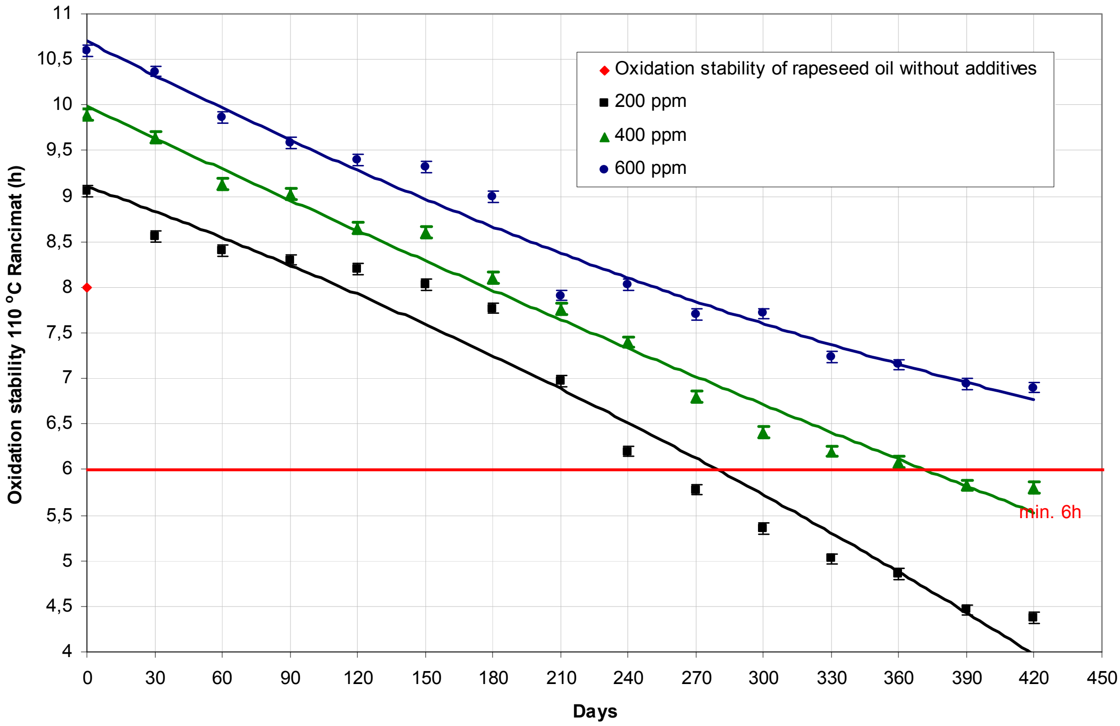
III: *Quality parameters of No. 2 test sample of rapeseed oil and comparison of achieved results with the limits according to ČSN 65 6516*

Parameter	Unit	Result	Limit min.	Limit max.
Flash Point (closed up, Pensky-Martens method)	°C	**275.0**	220	-
Water content Karl Fischer method (m)	% (m/m)	**0.0659**	-	0.075
Kinematic viscosity at 40 °C	mm²/s	**34.85**	-	36.0
Ash content (ash oxide)	% (m/m)	**0.002**	-	0.01
Neutralisation number	mg KOH/g	**0.82**	-	2.0
Calorific value	kJ/kg	**37 690**	36 000	-
Total impurities of low-viscosity fuels by filtration	mg/kg	**106**	-	24
Conradson carbon residue	% (m/m)	**0.22**	-	0.40
Oxidation stability at 110 °C	h	**8.0**	6.0	-
Density at 15 °C	kg/m³	**919.9**	900.0	930.0
Sulphur content	mg/kg	**<3**	-	10
Iodine value	g iodine/100 g	**112**	95	125
Phosphorus content	mg/kg	**9.33**	-	12
II. Group Metals: Mg+Ca	mg/kg	**12.53**	-	20

oil-extracting plants, where both whitening and refining processes are in place. For Sample No. 1, the single-step pressing was characteristic with the output of 250 $kg.h^{-1}$ of processed rapeseed with the raw oil fine filtration, while the two-step pressing with the consequent filtration of raw oil and further treatment by whitening and connected filtration (automatic filter).

From the literature, it is known that bleaching earths (*EBERT et al., 1997; PRYOR et al., 1994; WELSH et al., 1991; ZSCHAU, 1993*) and other substances, such as diatomaceous earths (*SCHEUERMANN, 1980*), cellulose (*SCHEUERMANN, 1980; ZSCHAU, 1998*) and synthetic silica gels (*FLESSENR et al., 2004; PRYOR et al., 1994; WELSH et al., 1991; ZSCHAU, 1993*) are suitable for the elimination of phosphorus, calcium and magnesia from vegetable oils. The addition of acid (citric acid or phosphoric acid) and water to vegetable oil allows phospholipids and the metal ions associated with them, such as calcium, magnesia, iron and copper to be removed from the oil (*WIDMANN et al., 2001*).

The beneficial effects of filter aids to the filtration process (higher oil volume flow rate during filtration, more favourable structure of the filter cake, chamber filter press easier to clean) should be used by adding a combination of added substances and citric acid to the oil (*WITZELSPERGER, REMMELE, 2010*). Diatomaceous earths are said to be unhealthy when breathing them in, because of the contained crystalline silicates. Celluloses are not harmful to the user's health and can be used as a filter aid as shown. The effect of the added substance concentration with regard to the reduction of the element contents of phosphorus, calcium and magnesia is often not linear if interaction with other quality-determining



17: *Relationship of oxidation stability of rapeseed oil with the content of the Baynox antioxidant at the levels of 200, 400 and 600 mg.kg*$^{-1}$

characteristics is considered. Therefore, the concentration of added substances, oil temperature while conditioning and period of conditioning must be optimized specifically for each oil to be treated. If citric acid also should be used, the added concentration must be optimized, too.

The positive influence of the Baynox antioxidant was confirmed. With this additive, Sample No. 2 was evaluated as non-standard because of the content of total impurities. They amounted to 106 mg.kg^{-1} against the limited value of 24 mg.kg^{-1}.

CONCLUSIONS

It is possible, based on the results and other parameters obtained, to identify the factors influencing the quality indicators for rapeseed oils specified in ČSN 65 6516 and describe the measures guaranteeing that rapeseed oils meet the specifications of ČSN 65 6516. For the determination and comparison of the quality of rapeseed oils, test samples were taken from seven decentralised facilities and one industrial oil-extracting plant. The consequent analyses of test samples were carried out in a way enabling the comparison with the specifications of limiting values of the relevant technical standard – ČSN 65 6516 "Rapeseed oil for combustion engines using vegetable oils". The measured characteristics showed large differences in the quality of test samples. All production facilities processed rapeseed types meeting the qualitative purchase conditions, which largely helped to meet the requirements for water content, neutralisation number and oxidation stability for all facilities without any problem. However, the contamination with phosphorus, magnesium, calcium as well as total impurities with the solid residue from rapeseed, belongs among the critical points in the production of rapeseed oils. A consequent detailed investigation of causes enabled to identify the factors influencing this contamination. The following recommendations can be made from the above findings:

- It is necessary to engage the second safety step of filtration with the particle filtration efficiency of max. 1 μm for the single-stage process of rapeseed cold pressing in order to keep the contamination level of phosphorus, magnesium and calcium under the limits specified by the relevant technical standard – ČSN 65 6516.
- The two-step cold pressing process, as well as its "hot" option, or the industrial processing with the extraction are always connected with an excessive phosphorus and, very often, calcium and magnesium content in rapeseed oils. For this reason, the degumming and/or neutralisation operation, as applicable, or even other steps, such as whitening, filtration through water-repellent membranes, must always follow. On the other hand, such steps increase the costs and therefore their careful selection is necessary. As regards the degumming, the "superdegumming" process can be recommended along with the conventional processes. A combined process of acid and water adding-up before the operation leads, apart from the highly effective separation of phospholipides, to a substantial lower water occurrence.

Oxidation stability is another important element determining the rapeseed oil suitability as the fuel in view of its storage and degradation connected therewith. The continuous evaluations of the storage test of rapeseed oils additived with the Baynox antioxidant and kept in PVC vessels with the access of air and placed into an unheated room lighted with the daylight coming through a window only, proved that in case of application of doses of 400 and 600 mg.kg^{-1} of this preparation, no decrease in the oxidation stability under the initial level found in the oil directly after its pressing and filtration was observed even after 180 days. As 200 mg.kg^{-1} of Baynox was added, the oxidation stability value increased from 8 to 9.05 hrs immediately after the pressing with a consequent decrease to 7.8 hrs after 180 days. Not until after 270 days decreased under limit value 6 hours.

The quality monitoring brought about necessary findings and knowledge for the optimisation of the rapeseed oil production and distribution as engine fuels. In addition, it serves as an initial supporting document for the creation of the necessary quality control system. Its implementation into practice is the prerequisite for ensuring the stable and high quality of engine fuels based on rapeseed oils.

SUMMARY

To evaluate effect of production processes on standardized properties the samples from typical small-capacity oil mills and one industrial production plants of rapeseed oils were took-off. At the same time the storage experiment for rapeseed oils with additive of 200, 400 and 600 ppm of antioxidant was established including evaluation of oxidation stability. The results have proved that critical points of the process of rapeseed oils acquisition are contamination caused with ash-generating elements as phosphorus, magnesium, calcium and total contamination. The monitoring has brought necessary knowledge for optimization of rapeseed oils acquisition process, their distribution and importance of antioxidants utilization. The monitoring also is a basis for establishing of necessary quality control in rapeseed oils production.

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